STANAG 4568
(Edition 1)

NORTH ATLANTIC TREATY ORGANIZATION
(NATO)

NATO STANDARDIZATION AGENCY
(NSA)

STANDARDIZATION AGREEMENT
(STANAG)

SUBJECT: STANDARD INTERFACES OF UAV CONTROL SYSTEM (UCS) FOR NATO UAV INTEROPERABILITY

Promulgated on 20 April 2004

J. MAJ
Brigadier General, POLAR
Director, NSA

RECORD OF AMENDMENTS

N°	Reference/date of amendment	Date entered	Signature

EXPLANATORY NOTES

AGREEMENT

1. This NATO Standardization Agreement (STANAG) is promulgated by the Director NATO Standardization Agency under the authority vested in him by the NATO Standardization Organisation Charter.

2. No departure may be made from the agreement without informing the tasking authority in the form of a reservation. Nations may propose changes at any time to the tasking authority where they will be processed in the same manner as the original agreement.

3. Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

RATIFICATION, IMPLEMENTATION AND RESERVATIONS

4. Ratification, implementation and reservation details are available on request or through the NSA websites (internet ***http://nsa.nato.int;*** NATO Secure WAN ***http://nsa.hq.nato.int***).

FEEDBACK

5. Any comments concerning this publication should be directed to NATO/NSA – Bvd Leopold III - 1110 Brussels - BE.

STANAG 4586
(Edition 1)

NATO STANDARDISATION AGREEMENT (STANAG)

STANDARD INTERFACES OF UAV CONTROL SYSTEM (UCS) FOR NATO UAV INTEROPERABILITY

Annexes: A. TERMS AND DEFINITIONS
B. STANDARD INTERFACES OF UAV CONTROL SYSTEM (UCS) FOR NATO UAV INTEROPERABILITY

The following Standardisation Agreements (STANAGs), Military Standards (MIL-STDs), International Telecommunication Union (ITU) Recommendations and International Standards (ISs) contain provisions which, through references in this text, constitute provisions of this STANAG. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this STANAG are encouraged to investigate the possibility of applying the most recent editions of the STANAGs, MIL-STDs, ITU Recommendations and ISs listed below. NATO maintains registers of currently valid STANAGs.

REFERENCE DOCUMENTS:

AAP-6 (V) modified version 02 – NATO Terms and Definitions
AC/224(AG/4)D/104, NATO Imagery Interoperability Architecture
APP-11 – NATO Message Catalogue (NMC)
ANEP 51 Standard Message Catalogue
CRD – Common Route Definitions
ICAO document - Rules of the Air and Air Traffic Services, Doc 4444-RAC/501
ISO/DIS 9241-3 - Visual Display Requirements
ISO/DIS 9241-8 - Requirements for Displayed Colours
ISO/Work Doc 9241-9 - Non-Keyboard Input Devices
ISO/DIS 9241-10 - Dialogue Principles
ISO/Work Doc 9241-12 - Presentation of Information
ISO/CD 9241-13 - User Guidance
ISO/DIS 9241-14 - Menu Dialogues
ISO/CD 9241-16 - Direct Manipulation Dialogues
ISO/CD 13406-2 - Flat Panel Displays
MIL-STD-2525B – Common Warfighting Symbology
MIL-STD-2401 - World Geodetic System – 84 (WGS – 84)
NATO C3 Technical Architecture (NC3TA) / Version 2.0 – 15 Dec 2000 (All 5 volumes)
NATO Data Policy 2000 – 12.20-00
STANAG 2019 Military Symbols For Land Based Systems

STANAG 3150 Uniform System of Supply Classification
STANAG 3151 Uniform System of Item Identification
STANAG 3377 ADP Format
STANAG 3809 Digital Terrain Elevation Data (DTED) Geographic Information Exchange Standard
STANAG 4250 NATO Reference Module for Open Systems Interconnection - Part 1 General Description
STANAG 4545 NATO Secondary Imagery Format
STANAG 4575 NATO Advanced Data Storage Interface (NADSI)
STANAG 4559 NATO Standard Image Library Interface (NSILI)
STANAG 4607, NATO Ground Moving Target Indicator Format (NGMTIF) (pending ratification)
STANAG 4609, NATO Motion Imagery Format (NMIF) (pending ratification)
STANAG 5500 NATO Message Text Formatting System (FORMETS) ADatP-3
STANAG 7023 Air Reconnaissance Imagery Data Architecture
STANAG 7024 Imagery Air Reconnaissance Tape Recorder Standards
STANAG 7044 Functional Aspects of Mission Planning Station Interface Design
STANAG 7074 Digital Geographic Information Exchange Standard (DIGEST Version 2.1)
STANAG 7085 Interoperable Data Links for Imaging Systems
STDI-0002, National Imagery and Mapping Agency, "The Compendium of Controlled Extensions (CE) for the National Imagery Transmission Format (NITF)", CMETAA Support Data Extension.

AIM

1. The aim of this agreement is to promote interoperability of present and future UAV systems in a NATO Combined/Joint Service Environment. Interoperability is required because it will significantly enhance the warfighting capability of the forces. Interoperability will increase flexibility and efficiency to meet mission objectives through sharing of assets and common utilization of information generated from UAV systems. The objective is to achieve interoperability between the Ground Segments (e.g., UCSs), the Air Segments (e.g., UAVs), and the Command, Control, Communication, Computer and Intelligence (C4I) segments of UAV Systems operating in a NATO Combined/Joint environment. The implementation of the specified standard UCS interfaces will also facilitate the integration of different types of UAV Systems into a NATO Combined/Joint Service battlefield environment. The herein specified Standardisation will support interoperability of legacy as well as future UAV Systems. This version of the STANAG supports the Electro-Optical/Infra-Red (EO/IR), Synthetic Aperture Radar (SAR), Communications Relay, and Stores (e.g., weapons,) payloads across the Data Link Interface (DLI). As additional payloads are defined the STANAG will be updated accordingly to incorporate those payloads. The Command and Control Interface (CCI) utilizes applicable messages from the NATO Message Text Formatting System (FORMETS), ADatP-3. As this system is replaced with bit oriented message formats, (e.g., Generic Relational Data Base such as ADatP-32), this STANAG will be updated accordingly. In addition this STANAG supports the NATO Air Force Armaments Group (NAFAG) NATO Imagery Interoperability Architecture (NIIA) in that it invokes compliance with the NIIA specified standards.

AGREEMENT

2. This NATO Standardisation Agreement (STANAG) is promulgated by the Director NSA under the authority vested in him by the Charter of the NSO. No departure shall be made from the agreement without consultation with the tasking authority where they will be processed in the same manner as the original agreement. Participating nations agree to implement the standards presented herein in whole or in part within their respective UAV systems to achieve the desired level of interoperability (LOI). Ratifying nations have agreed that national orders, manuals and instructions implementing this STANAG will include a reference to the STANAG number for purposes of identification.

DEFINITIONS

3. The terms and definitions used in this document are listed in Annex A.

GENERAL

4. The outline of this STANAG follows the following format:

- **Annex A** contains the Terms and Definitions used in the STANAG.
- **Annex B** provides a top level description of the objectives and the approach taken to achieve UAV Systems Interoperability through standardising the interfaces between the Core UCS (CUCS) and the air vehicle, the CUCS and the external C4I Systems, and the CUCS to the UAV system operator. It describes the requirement for a standard functional UCS architecture to accommodate those interfaces and refers to the Appendices B1 – B3 that contain the details of the Standards required by STANAG 4586. It also lists other STANAGs, standards and protocols that are required for achieving UAV Systems interoperability and offers some considerations for their implementation.

DETAILS OF AGREEMENT

5. STANAG 4586 defines the architectures, interfaces, communication protocols, data elements, message formats and identifies related STANAGs that compliance with is required to operate and manage multiple legacy and future UAVs in a complex NATO Combined/Joint Services Operational Environment. The UCS Architecture encompasses the Core UCS to handle UAV Common/Core processes, the Data Link Interface to enable operations with legacy as well as future UAV systems, the Command Control Interface for UAV and UAV payload data dissemination to support legacy and evolving NATO C4I Systems and Architectures, and the Human Computer Interface to address the interface to the UAV system operators. This version of the STANAG contains the messages that support the Electro-Optical/Infra-Red (EO/IR), Synthetic Aperture Radar (SAR), Communications Relay, and Stores (e.g., weapons, payloads, etc.) across the Data Link Interface (DLI). As additional payloads are defined the STANAG will be updated accordingly to incorporate those payloads. The Command and Control Interface (CCI) utilizes applicable messages from the NATO FORMETS, ADatP-3. As this system is replaced with bit oriented message formats, (e.g. Generic Relational Data Base such as ADatP-32), this STANAG will be updated accordingly.

IMPLEMENTATION OF THE AGREEMENT

7. This STANAG is implemented by a nation when it has issued instructions that all such equipment procured for its forces will be manufactured in accordance with the characteristics detailed in this agreement.

ANNEX A

TERMS AND DEFINITIONS

1 **Acronyms and Abbreviations.** The following acronyms are used for the purpose of this agreement.

3D	3 Dimensional
4GL	4th Generation Language
A	
A/A	Air-to-Air
A/G	Air-to-Ground
AAL	Asynchronous Transfer Mode (ATM) Adaptation Layer
AC	Allied Committee/Alternate Current
ACATS	Advisory Committee on Advanced Television Service
ACCS	Army Command and Control System (US)/Air Command and Control System (NATO)
Accel	Acceleration
ACK	Acknowledge
ACM	Airspace Control Means
ACO	Airspace Control Order
ACS IPF	Aerial Common Sensor Integrated Processing Facility
AD	Additional Data
ADatP-3	Allied Data Publication - 3
ADOCS	Automated Deep Operations Coordination System
ADR	Airborne Data Relay
ADS	Automatic Dependent Surveillance
ADT	Air Data Terminal
ADU	Air Defense Unit
AFATDS	Advanced Field Artillery Tactical Data System
AFCS	Automatic Flight Control System
AFMSS	Air Force Mission Support System
AGL	Above Ground Level
AIIM	Automated Image Import Module
AIS	Automated Information System
AJ	Anti Jamming
ALAR	Automated Launch and Recovery
AMHS	Automated Message Handling Service
AMPS	Aviation Mission Planning System
ANSI	American National Standards Institute
AOA	Angle Of Attack
AOC	Air Operations Centre
AOI	Area Of Interest
AOR	Area Of Responsibility
AP	Allied Publication/Alliance Publication

API	Application Program(ming) Interface
ASARS	Advanced Synthetic Aperture Radar System
ASAS	All Source Analysis System
ASCII	American Standard Code for Information Interchange
ASM	Air Space Management
ASW	Anti-Submarine Warfare
ATC	Air Traffic Control
ATCCIS	Army Tactical Command and Control Information System
ATHS	Automated Target Hand-Off System
ATM	Asynchronous Transfer Mode/Air Traffic Management/Air Tasking Message
ATO	Air Tasking Order
ATP	Allied Technical Procedure
ATR	Automatic Target Recognition
ATS	Air Traffic Services
ATSC	Advanced Television Systems Committee
ATWCS	Advanced Tomahawk Weapons Control System (US)/ Allied Tactical Weapons Control Station (NATO)
AV	Air Vehicle
AVC	Air Vehicle Control
AVO	Air Vehicle Operator
B	
BDA	Battle Damage Assessment
BE	Basic Encyclopaedia
BER	Bit Error Rate
BGP	Border Gateway Protocol
BHA	Bomb Hit Assessment
BICES	Battlefield Information Collection and Exploitation System
BIIF	Basic Image Interchange Format - See ISO/IEC 12087-5.
BIT	Built-in-Test
BITE	Built-in-Test Equipment
BLOS	Beyond Line of Sight
BOM	Bit-Oriented Message
BMS	Battle Management System
BS	British Standard
C	
C2	Command and Control
C3	Command, Control, and Communications
C3I	Command Control Communication, and Intelligence
C4I	Command, Control, Communications, Computers and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
C&S	Control & Status
CAOC	Combined Air Operation Centre
CARS	Contingency Airborne Reconnaissance System

CASE	Computer Aided Software Engineering
CBIT	Continuous Built-in-Test
CCD	Camouflage, Concealment, and Deception/Charged Coupled Device
CCI	Command & Control Interface
CCISM	Command and Control Interface Specific Module
CCTV	Closed Circuit Television
CDBS	Central Data Base System
CDL	Common Data Link
CDL-N	Common Data Link - Navy
CDMA	Code Division Multiple Access
CDR	Commander
CEN	European Standardisation Organisation
CEP	Circular Error Probable
CFOV	Centre Field of View
CG	Centre of Gravity
CGCS	Common Ground Control Station
CGS	Common Ground Segment/Common Ground Station/Common Ground System
CIC	Combat Information Centre
CID	Combat Identification
CIDCAS	Combat Identification Close Air Support
CIDDS	Combat Identification Dismounted Soldier
CIGSS	Common Imagery Ground/Surface System
CIRC	Circular
CJTF	Combined Joint Task Force
CL	Connectionless
cm	Centimetres
CM	Configuration Management
CMF	Combat Mission Folder
CMISE	Combat Management Integration Support Environment
CMP	Common Message Processor
CNS/ATM	Communication, Navigation, Surveillance/Air Traffic Management
CO	Connection Oriented
COE	Common Operating Environment
COM	Character-Oriented Message/Communications
COMCAT	Character-Oriented Message Catalogue
COMINT	Communication Intelligence
COMPASS	Common Operational Modelling, Planning and Simulation System
COMPLAN	Communication Plan
COMSEC	Communication Security
CONOPS	Concept of Operations
COP	Common Operational Picture
CORBA	Common Object Request Broker Architecture
CORCEN	Correlation Centre

COSIP	Computer Open Systems Interface Processor
COTS	Commercial-Off-The-Shelf
CR	Communications Relay
CRC	Cyclic Redundancy Check
CRD	Common Route Definition
CRT	Cathode Ray Tube
CSAR	Combat Search And Rescue
CSDF	Collected Signal Data Format
CSMA/CD	Carrier Select Multiple Access/Collision Detection
CTOL	Conventional Take-off and Landing
CUCS	Core UAV Control System
D	
DAMA	Decremented Assigned Multiple Access
DB	Data Base
DBDD	Data Base Design Description
DBMS	Data Base Management System
DC	Direct Current
DCE	Distributed Computing Environment
DCGS	Distributed Common Ground Station
DCM	Data Link Control Module
DDL	Direct Downlinks
DDS	Defense Dissemination System
DEA	Data Exchange Agreements
DFAD	Digital Feature Analysis Data
DFS	Distributed File System
DGPS	Differential Global Positioning System
DID	Data Item Description
DIE	Defense Interoperability Environment
DIGEST	Digital Geographic Information Exchange Standard
DII	Defense Information Infrastructure
DII/COE	Defense Information Infrastructure/Common Operating Environment
DIN	Deutsche Institut fur Normung
DISA	Defense Information Systems Agency
DISN	Defense Information System Network/Defense Integrated Secure Network
DL	Data Link
DLI	Data Link Interface
DMS	Defense Message Service
DNS	Domain Name Service
DoD	Department of Defence
DS	Direct Sequence
DTE	Data Termination Equipment
DTED	Digital Terrain Elevation Data
DVB	Digital Video Broadcast

E	
EB	Engineering Build
EC	European Community
ECM	Electronic Counter Measures
EEI	External Environment Interface/Essential Elements of Information/External Entity Interfaces
EFTA	European Free Trade Association
EIA	Electronic Industries Association
EIA/IS	EIA Interim Standard
EIRP	Effective Isotropic Radiated Power
ELINT	Electronic Intelligence
EM	Electro Magnetic
EMC	Electro Magnetic Compatibility
EMCON	Emission Control
EMI	Electro Magnetic Interference
EO	Electro-Optical
EO/IR	Electro Optical/Infrared
EOB	Electronic Order of Battle
EP	External pilot
EPM	Electronic Protection Measures (now replacing ECCM acronym)
ERF	Ego-Referenced Frame
ERS	Emergency Recovery System
ESD ICD	Exploitation Support Data Interface Control Document
ESM	Electronic Support Measures
ETA	Estimated Time of Arrival
ETRACS	Enhanced Tactical Radar Correlating System
ETSI	European Telecommunications Standards Institute
EW	Electronic Warfare
F	
FAADS	Forward Area Air Defense System
FANS	Future Area Navigation Systems
FATDS	Field Artillery Tactical Data Systems
FDDI	Fibre-Distributed Data Interface
FEBA	Forward Edge of the Battle Area
FH	Frequency Hopping
FLIR	Forward Looking Infrared
FLOT	Forward Line of Own Troops
FOB	Forward Operations Base
FOO	Forward Observation Officer
FOL	Forward Operating Location
FOV	Field of View
FMS	Foreign Military Sales
FSK	Frequency Shift Keying
FSPL	Free Space Path Loss

FT	Flight Termination
FTP	File Transfer Protocol
G	
Gb	Gigabyte
GBS	Global Broadcast Service
GCCS	Global Command and Command System
GCE	Ground Combat Element
GCS	Ground Control Station/Ground Control System
GCU	Ground Control Unit
GDT	Ground Data Terminal
GENSER	General Service
G/G	Ground-to-Ground
GIAS	Geospatial & Imagery Access Services
GMT	Greenwich Mean Time
GMTI	Ground Moving Target Indicator
GOTS	Government Off-The-Shelf
GPS	Global Positioning System
GPS/AN	Global Positioning System Auto Navigation
GSE	Ground Support Equipment/Government Supplied Equipment
GSM/CGS	Ground Station Module/Common Ground Station
GUI	Graphical User Interface
H	
HALE	High Altitude, Long Endurance
HAZMAT	Hazardous Material
HCI	Human Computer Interface
HCISM	Human Computer Interface Specific Module
HDBK	Handbook
HLA	High Level Architecture
HF	High Frequency
HIDL	High Integrity Data Link
HL	Hand Launched
HMI	Human Machine Interface
HMMWV	High Mobility Multi-purpose Wheeled Vehicle
HSI	Hyperspectral Information
HTML	Hyper Text Mark-up Language
HTTP	Hypertext Transfer Protocol
HZ	Hertz, cycles per second
I	
I/O	Input/Output
IA	International Agreement
IACP	International Armaments Cooperation Programs
IAM	Image Acquisition Module
IAS	Intelligence Analysis System /Imagery Analysis System
ICAO	International Civil Aviation Organization

ICD	Interface Control Document
ICS	Image Communication Service/Intercommunications System
ID	Identification
IDB	Integrated Data Base
IDD	Interface Design Description/Interface Definition Document
IDL	Interface Definition Language
IDT	Integrated Data Terminal
IEA	Information Exchange Agreements
IEC	International Enterprise Committee/International Electro technical Commission
IEEE	Institute of Electrical and Electronics Engineers
IER	Information Exchange Requirements
IES	Imagery Exploitation System
IETF	Internet Engineering Task Force
IEW	Intelligence and Electronic Warfare
IFF	Identification Friend or Foe
IIR	Image Interpretation Report
ILS	Integrated Logistic Support
IMGR	Image Manager
IMINT	Imagery Intelligence
Impl	Implementation
INS	Inertial Navigation System
IP	Internet Protocol/Internal Pilot
IPA	Imagery Product Archive
IPB	Intelligence Preparation of the Battlefield
IPF	Integrated Processing Facility
IPL	Image Product Library
IPS	Image Print Services
IPX	NetWare Transport Protocol
IR	Infrared
IRLS	Infrared Line Scanner
IRS	Interface Requirements Specifications
IRST	Infrared Search and Tracking
ISAR	Inverse Synthetic Aperture Radar
ISDN	Integrated Services Digital Network
ISG	Industry Support Group
ISO	International Organisation for Standardisation
ISO/CD	Committee Draft of ISO
ISO/DIS	Draft International Standard of ISO
ISR	Intelligence, Surveillance, Reconnaissance
ISTAR	Intelligence, Surveillance, Target Acquisition and Reconnaissance
ITDP	International Technology Demonstration Program
ITU	International Telecommunication Union
ITU-T(SB)	International Telecommunications Union – Telecommunications

	(Standardisation Bureau)
IUAV	Interoperable UAV
IVWR	Image Viewer
J	
JAA	Joint Aviation Authority
JASA	Joint Airborne SIGINT Architecture
JDISS	Joint Deployable Intelligence Support System
JFACC	Joint Force Air Component Commander
JFC	Joint Force Commander
JHQ	Joint Headquarters
JII	Joint Interoperability Interface
JMCIS	Joint Maritime Command Information System
JMF	Joint Message Format
JMPS	Joint Mission Planning System
JMUS	Joint Multiple UAV Systems
JOTS	Joint Operational Tactical System
JPEG	Joint Photographic Experts Group
JSH	JASA Standards Handbook
JSIPS	Joint Service Imagery Processing System
JSTARS	Joint Stand-off Target Attack Radar
JSWG	JASA Standards Working Group
JTA	Joint Technical Architecture
JTF	Joint Task Force
JTFC	Joint Task Force Commander
JTIDS	Joint Tactical Information Distribution System
JWICS	Joint Worldwide Intelligence Communications System
JWIDs	Joint Warrior Interoperability Demonstrations
K	
Kb	Kilobyte
Kbs	Kilobytes per second
Kilo	1,000
km	Kilometres
L	
L&R	Launch and Recovery
L-16	Link-16 (TADIL-J message standard)
LIDAR	Light Detection And Ranging
LAN	Local Area Network
LAS	Local Access Subsystem
LB	Land-Based
LCD	Liquid Crystal Display
LDIU	Legacy Data Link Interface Unit
LEO	Low Earth Orbiting
LIU	Legacy Interface Unit
LO	Low Observable

LOI	Level of Interoperability
LOCE	Linked Ops-Intel Centre Europe
LNA	Low Noise Amplifier
LOS	Line of Sight
LPI	Low Probability of Intercept
LRE	Launch and Recovery Equipment
LRF	Laser Range Finder
LRIP	Low Rate Initial Production
LRS	Launch & Recovery System
LRU	Line Replacement Unit
LTD	Laser Target Designator
LVT	Low Volume Terminal
M	
MALE	Medium Altitude, Long Endurance
MAS	Military Agency for Standardization
MAV	Micro Air Vehicle
MAW	Missile Approach Warning
MAX	Maximum
Mb	Megabyte
Mbs	Megabytes per second
MCCIS	Maritime Command & Control Information System
MDV	Minimum Detectable Velocity
Met	Meteorological
MFTP	Multi-Cast FTP
MGRS	Military Grid Reference System
MIB	Management Information Base
MIDB	Modern Intelligence Data Base
MIDS	Multifunction Information Distribution System
MIES	Modernized Imagery Exploitation System
MIJI	Meaconing, Intrusion, Jamming, and Interference
MIL	Military
MIL-STD	Military Standard
MIME	Multipurpose Internet Mail Extension
MIN	Minimum
MIS	Management Information System
MMP	Modular Mission Payload
MMS	Manufacturing Messaging Specification
MO	Mission Order
MOA	Memorandum of Agreement
MOOTW	Military Operations Other Than War
MOTS	Military Off-The-Shelf
MOU	Memorandum of Understanding
MP	Mission Planning/Mission Planner
MPEG	Motion Pictures Experts Group

MPO	Mission Planning Operator/Mission /Payload Operator
MPS	Mission Planning Station
MS	Mobile Subsystem
MSE	Mobile Subscriber Equipment
Msg	Message
MSI	Multi-Spectral Information
MSK	Minimum Shift Keying
MSL	Mean Sea Level
MTBCF	Mean Time Between Critical Failures
MTBF	Mean Time Between Failures
MTDG	Multichannel Tactical Digital Gateway
MTF	Message Text Formats
MTI	Moving Target Indicator
MTTR	Mean Time To Repair
MUAV	Maritime UAV
MUSE	Multiple Unified Simulation Environment
N	
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NAVMAC	Navy Modular Automated Communication System
NB	Narrow Band
NBC	Nuclear, Biological and Chemical
NC3TA	NATO C3 Technical Architecture
NCIS	NATO Common Interoperability Standards
NCOE	NATO Common Operating Environment
NCSP	NC3 Common Standards Profile
NCTR	Non Co-operative Target Recognition
NDI	Non-Developmental Item
Near RT	Near Real Time
NED	NATO Effective Date
NEO	Non-combatant Evacuation Operation
NFS	Network File System
NIIA	NATO Imagery Interoperability Architecture
NIMP	NATO Interoperability Management Plan
NIIRS	National Imagery Interpretation Rating Scale
NIPD	NATO Interoperability Planning Document
NIPS CDB	Naval Intelligence Processing Services Common Date Base
NITF	National Imagery Transmission Format
NITFS	National Imagery Transmission Format Standard
nm	Nanometer
NNAG	NATO Naval Armaments Group
NNTP	Network News Transfer Protocol
NOSIP	NATO Open System Interconnection Profile

NOTS	NATO Off-The-Shelf
NRT	Non-Real Time
NSE	Non Standard Equipment
NSIF	NATO Secondary Imagery Format
NSIL	NATO Standard Image Library
NSILI	NATO Standard Image Library Interface
NSR	NATO Staff Requirements
NSSE	Non Standard Support Equipment
NTF	Network File Server
NTIS	NATO Technical Interoperability Standards
NTS	Naval Telecommunications System
NTSC	National Transmission Standards Committee
O	
OB	Order of Battle/Observer
OBP	On Board Processing
OBREP	Order of Battle Report
ODB	Operational Data Base
OGC	Open GIS Consortium
OOK	On Off Keying
OOSE	Object-Oriented Simulation Environment
OOTW	Operations Other Than War
OPFOR	Opposing Force
OPS	Operations
OQPSK	Offset – Quadrature Phase Shift Keying
OSE	Open System Environment
OSI	Open System Interconnection (model)
OTCIXS	Officer In Tactical Command Information Exchange System
OTH	Over The Horizon
OTH-T	Over The Horizon – Targeting
P	
PAL	Phase Alternating Line
PC	Personal Computer
PDF	Portable Document Format
PDU	Power Distribution Unit
PG/35	Project Group 35
PM	Preventive Maintenance/Presentation Manager
PO	Payload Operator
POSIX	Portable Operating System Interface
PPE	Personal Protective Equipment
PPP	Point-to-Point Protocol
PRF	Pulse Repetition Frequency
PROFSV	Profile Server
PRS	Passive Receiver Station/Parachute Recovery System
Pyld	Payload

Q	
QoS	Quality of Service
R	
R&D	Research and Development
RAD	Radians
RAID	Redundant Array of Inexpensive Disks
RATO	Rocket Assisted Take-Off
RCS	Radar Cross Section/Remote Communication Servers
RD&A	Research, Development, and Acquisition
RDT	Remote Data Terminal
RDT&E	Research, Development, Test and Evaluation
RECCEXRE	Reconnaissance Exploitation Report
RF	Radio Frequency
RFC	Request for Comment
RFI	Request For Information
RGB	Red-Green-Blue
RISTA	Reconnaissance, Intelligence, Surveillance and Target Acquisition
ROE	Rules of Engagement
ROS	Relief on Station/Rules of Safety
RP	Route Plan
RPC	Remote Procedure Call
Rpt	Report
RSTA	Reconnaissance Surveillance and Target Acquisition
RSVP	Reservation Protocol
RT	Real Time
RTB	Return To Base
RTOS	Real Time Operating System
RTP	Real Time Protocol/ Real Time Processor
RVT	Remote Video Terminal
RWR	Radar Warning Receivers
Rx	Receive
S	
SA	Situational Awareness
SALUTE	Size, Activity, Location, Unit, Time, Equipment
SAR	Synthetic Aperture Radar/Search And Rescue
SATCOM	Satellite Communications
SB	Sea-based
SDD	Software Design Description
SDE	Support Data Extension
SDP	Software Development Plan
SE	Support Equipment
SEC	Seconds
SECAM	Sequential Colour And Memory (US). Systeme En Couleur Avec Memoire (French) (Translation: Colour (TV) system with memory)

SED	Signal External Descriptor
SIGINT	Signal Intelligence
SINCGARS	Single Channel Ground and Airborne Radio System
SIP	Software Installation Plan
SIPRNET	Secret Internet Protocol Router Network
SMAP	Security Management Application Program
SMPS	Standard Mission Preparation System
SMPTE	Society of Motion Picture and Television Engineers
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
SNR	Signal to Noise Ratio
SPIRIT	Special Purpose Integrated Remote Intelligence Terminal II (As in Trojan SPIRIT II)
SPS	Software Product Specifications
SR	Stimulus-Response
SRD	Systems Requirements Document
SRS	Software Requirement Specification
SRU	Standard Replaceable Unit
SSDD	System / Subsystem Segment Design Description
SSG	Special Study Group
SSMP	Service Specific Mission Planner
SSS	System / Subsystem Segment Specification
ST	Specialist Team
STANAG	(NATO) Standardization Agreement
STAR	Surveillance Target Acquisition Reconnaissance
STE	Special Test Equipment
SVD	Software Version Description
SWP	Size Weight and Power
T	
T&E	Test & Evaluation
TAC	Tactical Advanced Computer
TACCOM	Tactical Communications
TACNOTE	Tactical Note
TACREP	Tactical Report
TADIXS	Tactical Data Information Exchange System
TAMPS	Tactical Aircraft Mission Planning System
TBA	To Be Addressed
TBD	To Be Defined
TBMCS	Theatre Battle Management Core System
TC	Tele Command
TCAS II	Technical Collision Avoidance System
TCDL	Tactical Common Data Link
TCP/IP	Transfer Control Protocol/Internet Protocol
TCS	Tactical Control System

TDMA	Time Division Multiple Access
TDP	Tactical Data Processor
TE	Test Equipment
TEG	Tactical Exploitation Group
TES	Tactical Exploitation System
Tgt	Target
Tlm	Telemetry
TMDE	Test, Measurement, and Diagnostic Equipment
TOA	Time Of Arrival
Trojan SPIRIT II	Trojan Special Purpose Integrated Remote Intelligence Terminal II
TUAV	Tactical UAV
TV	Television
TX	Transmit
U	
UAV	Unmanned Aerial Vehicle/Uninhabited Aerial Vehicle
UB	Unified Build
UCARS	UAV Common Automated Recovery System
UCAV	Unmanned/ Uninhabited Combat Aerial Vehicle
UCO	Universal Common Object
UCP	Universal Communications Processor
UCS	UAV Control System
UCT	Universal Coordinated Time
UDIE	Universal Data Import and Export
UDP	User Datagram Protocol
UES	UAV Exploitation System
UHF	Ultra High Frequency
UI	User Interface
UJTL	Universal Joint Task List
UPS	Uninterruptible Power Supply
URL	Uniform Resource Locator
US	United States
USIS	United States Imagery Standards
USMTF	United States Message Text Formatting
UTM	Universal Transverse Mercator
UV	Ultra Violet
V	
VBI	Vertical Blanking Interval
VCR	Video Cassette Recorder
VDL	VHF Data Link
VDU	Visual Display Unit
VHF	Very High Frequency
VISP	Video Imagery Standards Profile
VMAP	Vector Map

VMF	Variable Message Format
VMF TIDP	Variable Message Format Technical Interface Design Plan
VSM	Vehicle Specific Module
VTOL	Vertical Take-off and Landing
VTUAV	Vertical Take-off and Landing UAV
W	
WAN	Wide Area Network
WAS	Wide Area Subsystem
WB	Wide Band
WBDL	Wide Band Data Link
WBS	Work Breakdown Structure
WGS-84	World Geodetic System - 84
WIMP	Windows, Icons, Mouse and Pull-down/pop-up (menus)
WP	Waypoint
WRF	World-Referenced Frame
X	
XDR	External Data Representation Standard
XML	Extended Mark-up Language
Y	
Z	

2. **Terms and Definitions.** The following terms and definitions are used for the purpose of this agreement.

Agent	An agent provides a service to a client on behalf of some other entity; often an agent is called a "proxy agent" to emphasise that it is acting on behalf of something else rather than on its own.
Air Data Terminal (ADT)	The data link element consists of the air data terminal in the air vehicle and the ground data terminal (GDT) on the ground. Connectivity between the GDT and ADT is prerequisite for Level 2+ interoperability.
Air Reconnaissance	The collection of information of intelligence interest either by visual observation from the air or through the use of airborne sensors.
Air Surveillance	The systematic observation of air space by electronic, visual or other means, primarily for the purpose of identifying and determining the movements of aircraft and missiles, friendly and enemy, in the air space under observation.
Air Traffic Control (ATC)	A service provided for the purposes of: a) preventing collisions between aircraft and in the manoeuvring area between aircraft and obstructions; and b) expediting and maintaining an orderly flow of air traffic.
Air Vehicle (AV)	The AV is the core platform consisting of all flight relevant subsystems but without payload and data link.
Aircraft Handover	The process of transferring control of aircraft from one controlling authority to another.
Allied Data Publication – 3 (ADatP-3)	ADatP-3 is the NATO standard for formatted messages and can be considered as the military version of Electronic Data Interchange, EDI. The standard consists of an 'abstract' and a 'specific' part. The abstract part describes the form these formatting rules can take. The specific part, the actual formatting rules, is periodically delivered by NATO in a database. ADatP-3 messages are the NATO equivalent to USMTF.
Allied Joint Operation	An operation carried out by forces of two or more NATO nations, in which elements of more than one service participate.
Altitude	The vertical distance of a level, a point or an object considered as a point, measured from mean sea level. The terms most relevant to UAV operations are: Absolute Altitude: The height of an aircraft directly above the surface or terrain over which it is flying. Critical Altitude: The altitude beyond which an aircraft or air-breathing guided missile ceases to perform satisfactory. True Altitude: The height of an aircraft as measured from mean sea level.
Analysis	In intelligence usage, a step in the processing phase of the intelligence cycle in which information is subjected to review in order to identify significant facts for subsequent interpretation.
Area Search	Reconnaissance or search of a specific area to provide new or updated information on general or specific situations and/or activities.
Automated Take-off and Landing	Automated take-off is the ability of the AV to be launched with a single command once planning and pre-flight has been conducted and permission to launch has been granted. Automated take-off includes releasing the AV from a securing device and flight of the AV to the first waypoint. Automated landing is the ability to land and secure the AV with a single command once the air vehicle has been stationed at a gate position no closer than 100 meters to the landing spot.

Battle Damage Assessment (BDA)	The determination of the affect of all air attacks on targets (e.g., bombs, rockets, strafing, etc.).
Battlefield Surveillance	Systematic observation of the battle area for the purpose of providing timely information and combat intelligence.
Bearer System	A system which carries electronic communication; a data link.
Byte	Eight bits.
Cassette	In photography, a reloadable container for either unexposed or exposed sensitised materials which may be removed from the camera or darkroom equipment under lighted conditions.
Cautions	Warnings, cautions and advisories inform the operator about any unusual or critical conditions.
Chemical Monitoring	The continued or periodic process of determining whether or not a chemical agent is present.
Classification	Classification is the ability to determine unique characteristics about a contact, which allow the differentiation of military and commercial contacts and determination of contact class and type.
Combat Mission Folder (CMF)	The CMF provides the operators, for pre mission briefing and during mission execution, with reference material for the planned mission.
Combat Surveillance	A continuous, all-weather, day-and-night, systematic watch over the battle area to provide timely information for tactical combat operations.
Combined Joint Operation	An operation carried out by forces of two or more nations, in which elements of at least two services participate.
Command and Control	The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of a mission.
Command Control Interface (CCI)	The CCI is an interface between the UCS Core and the external C4I systems. It specifies the data requirements that shall be adopted for communication between the UCS Core and all C4I end users through a common, standard interface.
Command and Control Interface Specific Module (CCISM)	Conversion software and/or hardware between the CCI and incompatible C4I systems. The CCISM may form part of a particular UCS implementation to establish a connection between the UCS and specific "customers" of the UAV system (i.e. one or more C4I systems). The CCISM can range in complexity from a simple format or protocol translator to a user-specific application to adapt the type of information to C4I requirements.
Command and Control Information System	An integrated system comprised of doctrine, procedures, organizational structure, personnel, equipment, facilities and communications which provides authorities at all levels with timely and adequate data to plan, direct and control their activities.
Commonality	An item of an interchangeable nature which is in common use by two or more nations or services of a nation.
Communication Intelligence	Intelligence derived from electromagnetic communications and communications systems by other than intended recipients or users. Also called COMINT.
Communications Plan	The overarching plan which covers all communication aspects. The Communication Plan includes the Data Link Plan.
Communications Satellite	An orbiting vehicle that relays signals between communications stations.

Communications Security	The protection resulting from the application of cryptographic, transmission, emission and physical security measures to deny unauthorized persons any information of value which might be derived from the study of all communications means.
Compatibility	The suitability of products, processes or services for use together under specific conditions to fulfil relevant requirements without causing unacceptable interactions.
Component	In logistics, a part or combination of parts having a specific function, which can be installed or replaced only as an entity.
Compression	The ability to transmit the same amount of data in fewer bits. There are a variety of data compression techniques, but only a few have been standardized. The CCITT has defined a standard data compression technique for transmitting faxes (Group 3 standard) and a compression standard for data communications through modems (CCITT V.42*bis*). In addition, there are file compression formats, such as ARC and ZIP. Data compression is also widely used in backup utilities, spreadsheet applications, and database management systems. Certain types of data, such as bit-mapped graphics, can be compressed to a small fraction of their normal size.
Concept of Operations	A clear and concise statement of the line of action chosen by a commander in order to accomplish his mission.
Continuous Strip Imagery	Imagery of a strip of terrain in which the image remains unbroken throughout its length, along the line of flight.
Controlled Airspace	An airspace of defined dimensions within which air traffic control service is provided to controlled flights (e.g., flights within controlled airspace require approval by/coordination with the controlling authority, and certain manoeuvres may be prohibited or restricted, or require supervision).
Core UCS (CUCS)	The CUCS provides the UAV operator with the functionality to conduct all phases of a UAV mission. It must support the requirements of the DLI, CCI, and HCI. The CUCS provides a high resolution, computer generated, graphical user capability that enables the UAV operator to control different types of UAVs and payloads with minimal additional training.
Countermeasures	That form of military science that, by the employment of devices and/or techniques, has as its objective the impairment of the operational effectiveness of enemy activity.
Damage Assessment	The determination of the effect of attacks on targets.
Data Communication	The transfer of information between functional units by means of data transmission according to a protocol.
Data Link	The means of connecting one location to another for the purpose of transmitting and receiving data.
Data Link Interface (DLI)	The interface between the Vehicle Specific Module (VSM) and the UCS core element. It provides for standard messages and formats to enable communication between a variety of air vehicles and NATO standardised ground control stations. Data between the UCS and the air vehicle shall conform to the DLI requirements detailed in Appendix B -1.
Data Link Plan	The details of the available link including the band and frequencies to be used. The Data Link Plan has to be associated with waypoints within the route and the details of required actions made available for cueing the operator.

Direct Maintenance Man-hours	Man-hours spent on the repair or preservation of the system. Direct maintenance man-hours do not include administrative or supervisory time for maintenance personnel.
Dispensing Payloads	Payloads that are released from the UAV as part of the UAV mission objectives. This can include the release of weapons or deployment of remote sensors, etc.
Dormant system	A system, which is stored in a full up condition. A dormant system may be transported in packing containers. However, the system is not operated during the dormant period.
Drone	An unmanned vehicle which conducts its mission without guidance from an external source.
Electromagnetic Compatibility	The ability of equipment or a system to function in its electromagnetic environment without causing intolerable electromagnetic disturbances to anything in that environment.
Electromagnetic Interference	Any electromagnetic disturbance, whether intentional or not, which interrupts, obstructs, or otherwise degrades or limits the effective performance of electronic or electrical equipment.
Electromagnetic Spectrum	The range of frequencies of electromagnetic radiation from zero to infinity.
Electronic Intelligence (ELINT)	Intelligence derived from electromagnetic non-communications transmissions by other than intended recipients or users.
Electronic Warfare (EW)	Military action to exploit the electromagnetic spectrum encompassing: the search for, interception and identification of electromagnetic emissions, the employment of electromagnetic energy, including directed energy, to reduce or prevent hostile use of the electromagnetic spectrum, and actions to ensure its effective use by friendly forces.
Emergency Recovery Plan	In case of failures such as data link loss, UAVs need to automatically carry out recovery actions referred to as Rules of Safety (ROS). The ROS are selected at the mission planning stage. The ROS differ according to the priority given to emergency action relative to that given to mission execution. Using the mission planning application the UCS operator selects the appropriate safety scenario (e.g., to define a pre-programmed recovery route).
Environment Control System	All equipment necessary to maintain a desired temperature, humidity, etc. within a shelter.
Encoding	Converting information or data from a system, format or signal to another.
Exercise	A military manoeuvre or simulated wartime operation involving planning, preparation, and execution. It is carried out for the purpose of training and evaluation. It may be a combined, joint, or single Service exercise, depending on participating organizations.
Fail soft	A system capability which allows contained system operations in a degraded mode rather than catastrophic failure in the event of any single malfunction.
Field of View	In photography, the angle between two rays passing through the perspective Centre (rear nodal point)) of a camera lens to the two opposite sides of the format. Not to be confused with angle of view.

Flight Route Plan	A flight route plan will comprise a set of waypoints for the UAV to follow, as well as general air vehicle commands for auxiliary systems (e.g., lights, IFF, de-icing, etc.) and emergency operation commands. Flight patterns may be incorporated into the route either as a series of sequenced waypoints or as 'seed' waypoints with range and bearing information, which, will depend on the sophistication of the UCS and UAV systems.
Formatted Message Text	A message text composed of several sets ordered in a specified sequence, each set characterized by an identifier and containing information of a specified type, coded and arranged in an ordered sequence of character fields in accordance with the NATO message text formatting rules. It is designed to permit both manual and automated handling and processing.
Forward Line of Own Troops (FLOT)	A line which indicates the most forward positions of friendly forces in any kind of military operation at a specific time.
Frame	In photography, any single exposure contained within a continuous sequence of photographs.
Free Form Message Text	A message text without prescribed format arrangements. It is intended for fast drafting as well as manual handling and processing.
Frequency bands	Specified segments of the electromagnetic spectrum which are grouped and identified together by their common properties.
Functional Architecture	The UCS Functional Architecture establishes the following functional elements and interfaces: • Core UCS (CUCS) • Data Link Interface (DLI) • Command and Control Interface (CCI) • Human Computer Interface (HCI) • Vehicle Specific Module (VSM) • Command and Control Interface Specific Module (CCISM) • Human Computer Interface Specific Module (HCISM
Fusion	The blending of intelligence and/or information from multiple sources or agencies into a coherent picture. The origin of the initial individual items should then no longer be apparent.
Geopositional Accuracy	The accuracy in terms of latitude and longitude, which the UAV system can report the position of tracks reported by AV payloads to a C4I system.
Ground Data Terminal	The data link element consists of the air data terminal in the air vehicle and the ground data terminal (GDT) which can be located either on the ground or in the air (e.g., Command and Control aircraft). Connectivity between the GDT and ADT is prerequisite for Level 2+ interoperability.
Handover	The act of passing control of a UAV in flight from one Ground Control Station to another Ground Control Station.
Human Computer Interface (HCI)	Definitions of the requirements of the functions and interactions that the UCS should allow the operator to perform. The HCI interface will support any HCI requirements that are imposed on the CUCS by the Command and Control Interface (CCI) and Data Link Interface (DLI). The HCI will also support any specific or unique CCI Specific Module (CCISM) or Vehicle Specific Module (VSM) display requirements.

Human Computer Interface Specific Module (HCISM)	Definition of the functionality for the UCS operator(s) to interact with the CUCS via the HCI. The HCISM translates the HCI data parameters from the CUCS to a form that can be understood by the operators(s), it also allows the operator to interact with the CUCS by translating operator actions. This translation could be in the form of a visual display, auditory warning, or physical interaction. The HCISM can also be considered the physical realisation of the HCI (e.g., the set of controls and displays available to the operator(s)).
Hyperspectral Imagery (HSI)	The image of an object obtained simultaneously using hundreds or thousands of discrete spectral bands.
Image	A two-dimensional rectangular array of pixels indexed by row and column.
Image Associated Data	Data which is needed to properly interpret and render pixels; data which is used to annotate imagery such as text, graphics, etc.; data which describes the imagery such as textual reports; and data which support the exploitation of imagery.
Imagery	Collectively, the representations of objects reproduced electronically or by optical means on film, electronic display devices, or other media.
Imagery Exploitation	The cycle of processing and displaying, assembly into imagery packs, identification, interpretation, mensuration, information extraction, the preparation of reports (including annotated images) and the dissemination of information.
Imagery Intelligence (IMINT)	Intelligence information derived from the exploitation of collection by visual photography, infrared sensors, lasers, electro-optics, and radar sensors such as synthetic aperture radar wherein images of objects are reproduced optically or electronically on film, electronic devices, or other media.
Integrated Logistical Support (ILS)	The management and technical process through which supportability and logistic support considerations are integrated into the design and taken into account throughout the life cycle of systems/equipment and by which all elements of logistic support are planned, acquired, tested and provided in a timely and cost-effective manner.
Integration	Refers to combining segments – not systems – and ensuring that the segments work correctly within the environment; do not adversely impact one another; and conform to standards. Integration does not imply interoperability. It only provides a level of assurance that the system will work as designed.
Intelligence	The product resulting from the processing of information concerning foreign nations, hostile or potentially hostile forces or elements, or areas of actual or potential operations. The term is also applied to the activity which results in the product and to the organizations engaged in such activity.
Interaction	A one or two-way exchange of data among two or more systems/sub-systems.

Interface	(1) A concept involving the definition of the interconnection between two equipment items or systems. The definition includes the type, quantity, and function of the interconnecting circuits and the type, form, and content of signals to be interchanged via those circuits. Mechanical details of plugs, sockets, and pin numbers, etc., may be included within the context of the definition. (2) A shared boundary, (e.g., the boundary between two subsystems or two devices). (3) A boundary or point common to two or more similar or dissimilar command and control systems, subsystems, or other entities against which or at which necessary information flow takes place. (4) A boundary or point common to two or more systems or other entities across which useful information flow takes place. (It is implied that useful information flow requires the definition of the interconnection of the systems which enables them to interoperate.) (5) The process of interrelating two or more dissimilar circuits or systems. (6) The point of interconnection between user terminal equipment and commercial communication-service facilities.
Interoperability	The ability of Alliance forces and, when appropriate, forces of Partner and other nations to train, exercise and operate effectively together in the execution of assigned missions and tasks.
Joint	Adjective used to describe activities, operations and organizations in which elements of at least two services participate.
Landing area	A specially prepared or selected surface of land, water, or deck designated or used for take-off and landing of aircraft.
Laser Designator	A device that emits a beam of laser energy which is used to mark a specific place or object.
Laser Range-Finder	A device which uses laser energy for determining the distance from the device to a place or object.
Level of Interoperability (LOI)	Multiple levels of interoperability are feasible among different UAV systems. Maximum operational flexibility can be achieved if the UAV systems support the following levels of UAV system interoperability: • **Level 1**: Indirect receipt of secondary imagery and/or data. • **Level 2**: Direct receipt of payload data by a UCS; where "direct" covers reception of the UAV payload data by the UCS when it has direct line-of-sight with the UAV or a relay device which has direct line-of-sight with the UAV. • **Level 3**: Level 2 interoperability plus control of the UAV payload by a UCS. • **Level 4**: Level 3 interoperability plus UAV flight control by a UCS. • **Level 5**: Level 4 interoperability plus the ability of the UCS to launch and recover the UAV.
LIDAR	An acronym of Light Detection And Ranging, describing systems that use a light beam in place of conventional microwave beams for atmospheric monitoring, tracking and detection functions.
Legacy Interface Unit (LIU)	Any "non standard" hardware or software.
Meaconing	A system of receiving radio beacon signals and rebroadcasting them on the same frequency to confuse navigation. The meaconing stations cause inaccurate bearings to be obtained by aircraft or ground stations.

Metadata	Data about data. The term is normally understood to mean structured data about resources that can be used to help support resource description and discovery, the management of information resources (e.g., to record information about their location and acquisition), long-term preservation management of digital resources, and for help to preserve the context and authenticity of resources. Other metadata might be technical in nature, documenting how resources relate to particular software and hardware environments or for recording digitisation parameters. In short, any kind of standardised descriptive information about resources, including non-digital ones.
Mission Change Time	Includes all of the functions in Turn Around Time and the time required to change the AV payload.
Modularity	Use of sub-systems or components from one system to function properly as part of another system. The interface at the sub-system level is sufficiently defined.
Motion Imagery	A sequence of images, with metadata, which are managed as a discrete object in standard motion imagery format and displayed as a time sequence of images.
Moving Map Display	A display in which a symbol, representing the vehicle, remains stationary while the map or chart image moves beneath the symbol so that the display simulates the horizontal movement of the vehicle in which it is installed.
Moving Target Indicator (MTI)	A radar presentation which shows only targets which are in motion. Signals from stationary targets are subtracted out of the return signal by the output of a suitable memory circuit.
Multispectral Imagery (MSI)	The image of an object obtained simultaneously in a number of discrete spectral bands.
Narrow band link	A link which has a bandwidth associated with radio transmissions.
National Transmission Standards Committee (NTSC)	The first colour TV broadcast system was implemented in the United States in 1953. This was based on the NTSC standard. NTSC is used by many countries on the North American continent and in Asia including Japan. This U.S. video standard uses EIA RS-170 and SMPTE 170 M – 1994 formats. The standard applies to imagery with metadata in either closed caption overlays or encoded via closed caption. NTSC runs on 525 lines/frame and 30 frames/second with 2:1 interlace.
NATO Imagery Interoperability Architecture (NIIA)	The architecture that defines the STANAGs used for ISR sensor system interoperability. This architecture is defined in document AC/224(AG/4)D/104.
NATO OSI Profile Strategy (NOSIP)	Interoperability strategy now merged into the NC3TA.
NATO Standardization Agreement (NATO STANAG)	The record of an agreement among several or all the member nations to adopt like or similar military equipment, ammunition, supplies, and stores; and operational, logistic, and administrative procedures. National acceptance of a NATO Allied publication issued by the Military Agency of Standardization may be recorded as a Standardization Agreement.
Navigation accuracy	The accuracy with which the AV can be located on the surface of the earth in terms of latitude and longitude and the altitude of the AV above the surface of the earth measured in feet.
NC3 Common Standards Profile (NCSP)	The minimum set of communication and information technology standards to be mandated for the acquisition of all NATO C3 systems.

NC3 Technical Architecture (NC3TA)	The technical, standards-related view of an overarching NC3 Architectural Framework.
Near Real Time	Pertaining to the timeliness of data or information which has been delayed by the time required for electronic communication and automatic data processing. This implies that there are no significant delays.
Network	(1) An interconnection of three or more communicating entities and (usually) one or more nodes. (2) A combination of passive or active electronic components that serves a given purpose.
Non-Real Time Processing	Non-flight critical processing accomplished within the host system software including interface to C4I system(s). Pertaining to the timeliness of data or information that has been delayed by the time required for electronic communication and automatic/manual data processing. There can be significant delays.
On condition maintenance	Maintenance performed as a result of an indication of a component failure or a change in status of a system component (such as wear indications) which requires repair or replacement.
On task time	The amount of time that the AV can spend in the objective area during a single flight. The AV is in the objective area if the AV payload can accomplish the mission within the geographic parameters, which the AV controller is assigned as an objective.
Open Systems Interconnect Model	This model is defined in ISO/IEC 7498-1.
Operator aids	Display presentations providing information such as payload data and air vehicle status, which allow the operator to easily exploit data and control the AV.
Operational Architecture	A description of the operational elements, assigned tasks, and information flows required to support the warfighter. It defines the type of information, the frequency of exchange, and what tasks are supported by these information exchanges. The operational architecture is often graphical and describes missions, functions, tasks, and information requirements.
Order of Battle	The identification, strength, command structure, and disposition of the personnel, units, and equipment of any military force.
Phase Alternating Line (PAL)	Standard introduced in the early 1960's and implemented in most European countries except for France. The PAL standard utilises a wider channel bandwidth than NTSC which allows for better picture quality. PAL runs on 625 lines/frame and 25 frames/second with 2:1 interlace.
Passive	In surveillance, an adjective applied to actions or equipment which emit no energy capable of being detected.
Passive receiver station	A UCS capable of receipt only of the UAV downlink, enabling a level two interoperability.
Payload	UAV sensor(s), weapons, chaff, pamphlets, onboard systems, etc. carried onboard which are used to accomplish a specified mission.

Payload Plan	A Plan with details of the sensor to be used, or which sensors are to be loaded if multiple payloads are within the UAV capability. At specific points along a route there may be pre-planned sensor operations and the details of these have to be incorporated into the payload plan and associated with waypoints in the route. The resulting payload plan has to be available as hard copy for UAV payload loading and for display with or along side the route plan, action cueing has to be incorporated either for the operator or the UAV depending on system sophistication. Planning includes payload configuration (e.g., payload type and lens size), payload imagery extraction (e.g., desired resolution), and operator commands for controlling both EO/IR and SAR payloads (e.g., zoom settings, depression angle, and focus).
Photographic Intelligence	The collected products of photographic interpretation, classified and evaluated for intelligence use.
Primary Data	Data directly received from the sensor.
Primary Imagery	Unexploited, original imagery data that has been derived directly from a sensor. Elementary processing may have been applied at the sensor, and the data stream may include auxiliary data.
Processed Imagery	Imagery that has been formatted into image pixel format, enhanced to remove detected anomalies and converted to a format appropriate for subsequent disposition.
Protocol	(1) [In general], A set of semantic and syntactic rules that determine the behaviour of functional units in achieving communication. For example, a data link protocol is the specification of methods whereby data communication over a data link is performed in terms of the particular transmission mode, control procedures, and recovery procedures. (2) In layered communication system architecture, a formal set of procedures that are adopted to facilitate functional interoperation within the layered hierarchy. Note: Protocols may govern portions of a network, types of service, or administrative procedures.
Radius of action	The maximum distance a ship, aircraft, or vehicle can travel away from its base along a given course with normal combat load and return without refuelling, allowing for all safety and operating factors. For a UAV system the radius of action is defined as the maximum range at which the AV can achieve the on-task times stated.
Real Time Processing	AV command and control info including antenna positioning and AV video receipt and processing. Pertaining to the timeliness of data or information that has been delayed only by the time required for electronic communication. This implies that there are no noticeable delays.
Reconnaissance	A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or potential enemy; or to secure data concerning the meteorological, hydrographic characteristics of a particular area.
Recovery	The term "recovery" or "recovery phase" in air operations is the phase of a mission which involves the return of an aircraft to base and includes the approach to the landing platform, & landing. If the Air Vehicle is to be stowed after flight, securing on deck and handling of the Air Vehicle (AV) is also included.
Remotely Piloted Vehicle (RPV)	An unmanned vehicle capable of being controlled from a distant location through a communication link. It is normally designed to be recoverable.
Resolution	A measurement of the smallest detail which can be distinguished by a sensor system under specific conditions.

Scalability	The characteristic that enables system size and capability to be tailored dependent on the user needs.
Search and Rescue	The use of aircraft, surface craft, submarines, specialized rescue teams and equipment to search for and rescue personnel in distress on land or at sea.
Secondary data	The output of processing primary data.
Secondary Imagery	Imagery and/or imagery products derived from primary imagery or from the further processing of secondary imagery.
Secondary Imagery Dissemination	The process of dispersing or distributing secondary imagery.
Secondary Imagery Dissemination System	The equipment and procedures used in secondary imagery dissemination.
Sensor	Equipment which detects, and may indicate, and/or record objects and activities by means of energy or particles emitted, reflected, or modified by objects.
SECAM (Sequential Colour And Memory - US) (Systeme En Couleur Avec Memoire – French).	Standard introduced in the early 1960's and implemented in France. SECAM uses the same bandwidth as PAL but transmits the colour information sequentially. SECAM runs on 625 lines/frame and 25 frames/second with 2:1 interlace.
Shall	Mandatory compliance.
Should	Recommended compliance.
Signal Intelligence	The generic term used to describe communications intelligence and electronic intelligence when there is no requirement to differentiate between these two types of intelligence, or to represent fusion of the two.
Software	A set of computer programs, procedures and associated documentation concerned with the operation of a data processing system, (e.g., compilers, library routines, manuals, and circuit diagrams).
STANAG	The NATO term derived from standardization agreement. See NATO Standardization Agreement.
Standardization	The development and implementation of concepts, doctrines, procedures and designs to achieve and maintain the required levels of compatibility, interchangeability or commonality in the operational, procedural, material, technical and administrative fields to attain interoperability.
Station keeping	The ability of the AV to maintain a position or station in terms of range, bearing and altitude from the controlling station for an extended period of time.
Storage	a) The retention of data in any form, usually for the purpose of orderly retrieval and documentation. b) A device consisting of electronic, electrostatic or electrical hardware or other elements into which data may be entered, and from which data may be obtained.
Surveillance	The systematic observation of aerospace, surface or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means.

Synthetic Aperture Radar (SAR)	A system that uses the frequency shifts associated with the motion of the sensor (Doppler shift) to produce an image with higher resolution then would be available with only the radar system's beam width and pulse length. It requires complex data processing after collection of the radar data. Synthetic aperture radar complements photographic and other optical imaging capabilities because of the minimum constraints on time-of-day and atmospheric conditions and because of the unique responses of terrain and cultural targets to radar frequencies.
System specification (a spec)	The document which accurately describes the essential equipment requirements for items, materials or services, including the procedures by which it will be determined that the requirements have been met.
Systems Architecture	Defines the physical connection, location and identification of the key nodes, circuits, networks, warfighting platforms, etc., associated with information exchange and specifies systems performance parameters. The systems architecture is constructed to satisfy operational architecture requirements per the standards defined in the technical architecture.
Tactical UAV (TUAV)	An unmanned aerial vehicle designed, equipped and operated to support tactical units (normally division and below, and combatant ships) with local area and battlefield intelligence that will support their operations
Target	a) A geographical area, complex, or installation planned for capture or destruction by military forces. b) In intelligence usage, a country, area, installation, agency, or person against which intelligence operations are directed.
Target Acquisition	The detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons. Increasingly applied to reconnaissance as the object(s) of search and location activity, whether to provide intelligence data or to cue weapon systems directly.
Target Signature	The characteristics pattern of a target displayed by detection and identification equipment.
Targeting	The ability to report the position (may include speed and direction) of a target detected with an AV payload. Target position is reported in terms of latitude and longitude (may include altitude) or in terms relative to a point. Target position information is sufficiently accurate to support weapon system fire control requirements.
Technical Architecture	A minimal set of rules governing the arrangement, interaction, and interdependence of the parts or elements whose purpose is to ensure that a conformant system satisfies a specific set of requirements. It identifies system services, interfaces, standards, and their relationships. It provides the framework, upon which engineering specifications can be derived, guiding the implementation of systems. Simply put, it is the "building codes and zoning laws" defining interface and interoperability standards, information technology, security, etc.
Television Imagery	Imagery acquired by a television camera (EO/IR) and recorded or transmitted electronically. Can also include SAR, MTI, ESM, and other synthetic imagery delivered via computer in TV format.
Theatre UAV	A UAV intended to provide information on a theatre wide basis for operations, planning/execution, intelligence assessments and command oversight. In general, these UAVs have extended endurance and loiter and are capable of autonomous or semiautonomous operations.

Tracking	Accurate location and updating of target positions (in terms of geographic co-ordinates) by radar, optical or other means.
Turn-Around-Time (TAT)	The time required to ready an AV for flight following recovery. TAT includes refuelling, loading or reloading the mission plan and positioning of the AV for launch.
Uninhabited Aerial Vehicle /Unmanned Aerial Vehicle (UAV)	A powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload.
UAV system	Includes the air vehicles, modular mission payloads, data links, launch and recovery equipment, mission planning and control stations, data exploitation stations and logistic support.
UAV Control System (UCS)	The functional set charged with control of the AV and interfacing with C4I, the UAV payload and UAV System operator(s). UCS includes all the UAV control systems and encompasses launch and recovery system.
United States Message Text Format (USMTF)	Fixed format, character-oriented messages which are man-readable and machine processable.
Variable Message Format (VMF)	Used between systems requiring variable bit-oriented messages.
Vehicle Specific Module (VSM)	A function that resides between the DLI and the air vehicle subsystem. The VSM facilitates compliance with this STANAG by acting as a bridge between standard DLI data formats, and protocols, and a specific air vehicle.
Video Imagery	A sequence of images, with metadata, which is collected as a timed sequence of images in standard motion imagery format, managed as a discrete object in standard motion imagery format, and displayed as a sequence of images. Video imagery is a subset of the class of motion imagery.
Warnings	Warnings, cautions and advisories inform the operator about any unusual or critical conditions.
Waypoint	A point on a UAV route which is defined by latitude/longitude. Altitude is usually defined.
Waypoint Control	Semi-autonomous or man-in-the-loop method of air vehicle control involving the use of defined points (latitude/longitude/altitude) to cause the UAV (air vehicle, sensor(s), weapons, dispensable payloads, onboard systems, etc.) to accomplish certain actions.
Wide band link	A link which has a bandwidth associated with imagery transmissions.

ANNEX B

TABLE OF CONTENTS

LIST OF FIGURES

1 Introduction.

1.1 STANAG 4586 Objectives.

Unmanned aerial vehicles (UAVs) have become valuable assets in helping Joint Force Commanders (JFC) to meet a variety of theatre, operational and tactical objectives. The optimum synergy among the various national UAVs deployed requires close co-ordination and the ability to quickly task available UAV assets, the ability to mutually control, both, the air vehicles and their payloads, as well as rapid dissemination of the resultant information at different command echelons. This requires the employed UAV systems to be interoperable.

Current or "legacy" UAV systems have been designed and procured nationally and contain system elements that are generally unique and system specific. They do not have standard interfaces between the system elements.. This results in a variety of non-interoperable "stovepipe" systems. Although commonality of hardware and software would be a solution to this problem and may be desirable from an economic standpoint, it is not mandatory to achieve interoperability.

In order to establish interoperability for UAV systems the implementation of standards for key system interfaces and functions is required. These standards are laid down in a number of existing or emerging NATO STANAGs and generally applied commercial standards documents. They are referred to and listed in this STANAG, where they are applicable. The selection and application of these Standards will determine the Level of Interoperability (LOI) (see section 2.3 for definition) that the specific UAV System will achieve.

The objective of STANAG 4586 is to specify the interfaces that must be implemented in order to achieve the operationally required and feasible LOI according to the respective UAV system's Concept of Operations (CONOPS) as applicable to the specific theatre of operations. This will be accomplished through implementing standard interfaces in the UAV Control System (UCS) to communicate with different UAVs and their payloads, as well as with different C4I Systems. The implementation of standard interfaces will also facilitate the integration of components from different sources as well as the interoperability of legacy systems.

The standards in STANAG 4586, which are identified as mandatory, must be implemented as a whole in order to achieve the required LOI. Conformance to STANAG 4586 will allow an operator trained for operating a specific system to operate and exploit similar functions of other UAV systems with minimal additional training. This should significantly reduce the training and the required operator certification effort. It is also assumed that air safety regulations will require the certification of new combinations of UAV systems, which result from combining the operation of assets from different UAV systems. Compliance with STANAG 4586 will ease this process and likely UAV System combinations can be certified in advance.

On this basis UAV systems that are compliant with STANAG 4586 will increase NATO Combined/Joint Service flexibility and efficiency to meet mission objectives through the sharing of assets and common utilisation of information generated from UAV systems.

1.2 Assumptions and Constraints.

This STANAG was developed using the following assumptions and constraints:

- Elements of the system (e.g., Core UAV Control System (CUCS), Data Link Interface (DLI) Vehicle Specific Module (VSM), Command and Control Interface (CCI), Command and Control Interface Specific Module (CCISM), Human Computer Interface (HCI) and Human Computer Interface Specific Module (HCISM)) are not required to be co-located.
- The STANAG requirements have been developed independent of national CONOPS. Thus it is not the intent to define or imply in this STANAG specific CONOPS.
- This STANAG addresses the interface with Airspace Management Authority required to coordinate the operation of UAVs in a controlled air space. It does not address or imply the overall requirements and required certifications that may be necessary to operate UAVs in controlled air space.
- Critical real/near real time requirements of UAV and payload control should be allocated to the VSM function.
- The UAV system scalability is independent of the contents of the STANAG.

1.3 Annex B Structure.

Annex B provides a top level description of interoperability objectives and the approach taken to achieve UAV systems interoperability through standardising the interfaces between the CUCS and the air vehicle, the CUCS and external C4I systems, and the CUCS to the UAV system operator. It describes the requirement for a standard functional UCS architecture to accommodate those interfaces and refers to the Appendices B1 – B3 that contain the details of the Standards required by STANAG 4586. It also lists other STANAGs, standards and protocols that are required for achieving UAV systems interoperability and offers some considerations for their implementation. The following Appendices are elements of Annex B.

- **Appendix B1** explains the approach to standardising the Data Link Interface (DLI) and the functionality of the VSM. It contains the standard messages and protocols required at the DLI that enable the CUCS to communicate with and exploit different UAVs and payloads and to support the required UAV System operator(s) interface as specified in the Human Computer Interface (HCI), Appendix B3.
- **Appendix B2** shows the approach selected to standardise the Command and Control Interface (CCI) and the application of the Command and Control Interface Specific Module (CCISM). The appendix contains the Information Exchange Requirements (IER), Attachment B2 - 1 and lists the UCS ADatP-3 Message Implementation Requirements, Attachment B2 - 2, to satisfy the IER requirements and to support the required UAV System operator(s) interface as specified in the Human Computer Interface (HCI), Appendix B3.
- **Appendix B3** describes the Human Computer Interface (HCI) to the UAV System Operator and defines a standard set of parameters that need to be provided to the UAV System operator(s).

2 Interoperability Concepts.

2.1 Overview.

A UAV System can be divided into five distinct elements as shown in Figure B -1. The air vehicle element consists of the airframe, propulsion and the avionics required for air vehicle and flight management. The payload element is comprised of payload packages. These can be sensor systems and associated recording devices that are installed on the air vehicle (AV), or they can consist of stores, e.g. weapon systems, and associated control/feedback mechanisms, or both. As illustrated, the data link element consists of the air data terminal in the air vehicle and the ground data terminal. Control of the UAV System is achieved through the UCS and data link elements. Although shown as part of the UAV Surface Component, the UCS and the associated data link terminal can be located in any platform, (e.g., air platform). The UCS element incorporates the functionality to generate, load and execute the UAV mission and to disseminate useable information data products to various C4I systems. It should be noted that while Figure B-1 shows a common path for both UAV command and control, and the payload control and products, these functions may be accomplished on separate, independent data links. The launch and recovery element incorporates the functionality required to launch and recover the air vehicle(s).

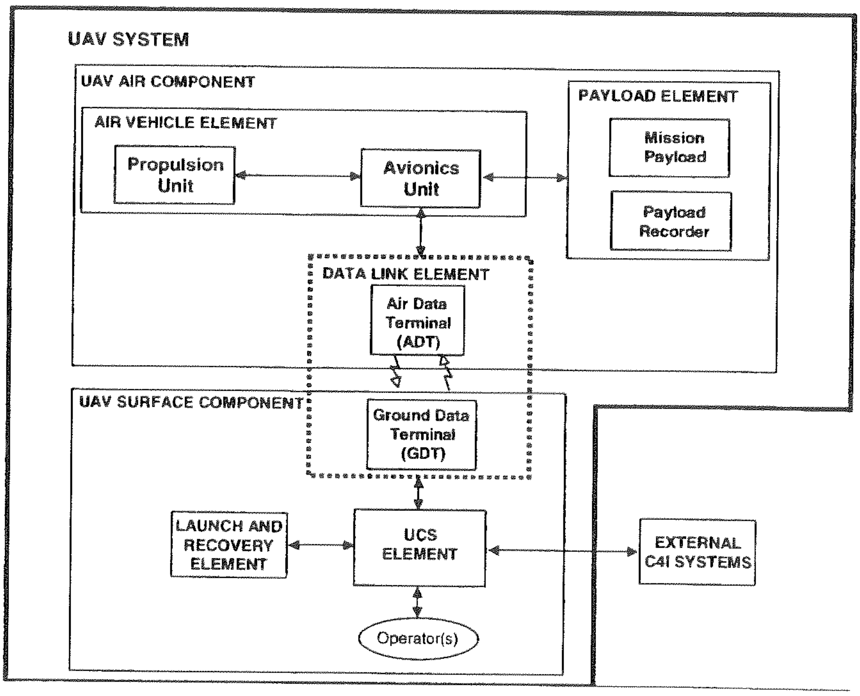


Figure B - 1. UAV System Elements.

2.2 Current Status of UAV Systems Interoperability.

Current UAV systems are mostly "stove pipe" systems. They utilize unique data links, communication protocols and message formats for communication between UCS and Air Vehicle and the UCS and external C4I Systems. As a result, the dissemination of sensor data is mostly via indirect means, (e.g., from UCS to an exploitation system to the user). Likewise, UAV systems mission tasking from external C4I Systems is also via indirect means and generally slow. Current UAV System Operations in Joint NATO Operations are illustrated in Figure B - 2.

The illustrated UAV systems all utilize unique data links and UCS as well as unique data/message formats for communication between the Air Vehicle and the UCS and also the UCS and the C4I Nodes. The only way to provide data from any of the UAV systems to the users is from the respective National C4I Nodes via the established NATO Command and Control (C2) Links. This process is generally slow and does not support dynamic joint cooperative operations. These types of operations require near real time tasking/re-tasking and dissemination of reconnaissance data to support the Tactical Commander.

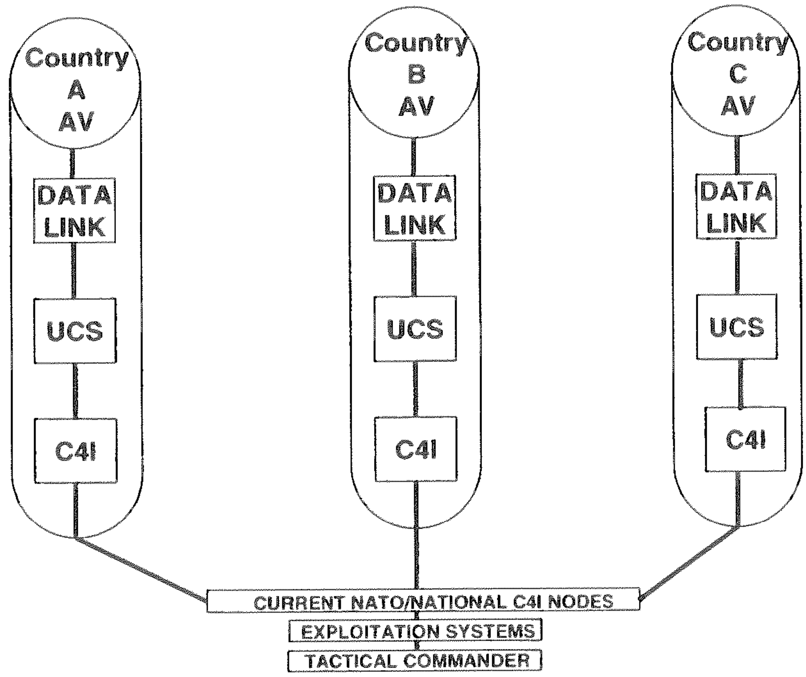


Figure B - 2. Current UAV System Operations.

2.3 Future UAV Systems Interoperability.

Multiple levels of interoperability are feasible among different UAV systems. Based on studies performed by AC/141 (PG/35) and NATO Industrial Advisory Group (NIAG), Sub Group (SG) 53, maximum operational flexibility can be achieved if the UAV systems support the following levels of UAV system interoperability:

- **Level 1**: Indirect receipt of secondary imagery and/or data.
- **Level 2**: Direct receipt of payload data by a UCS; where "direct" covers reception of the UAV payload data by the UCS when it has direct line-of-sight with the UAV or a relay device which has direct line-of-sight with the UAV.
- **Level 3**: Level 2 interoperability and control of the UAV payload by a UCS.
- **Level 4**: Level 3 interoperability and UAV flight control by a UCS.
- **Level 5**: Level 4 interoperability and the ability of the UCS to launch and recover the UAV.

The interoperability levels defined above can be achieved through the standardization of interfaces between the UAV system elements and between the

UCS and external C4I Systems. This can be accomplished if the overall System Architecture is also standardised to the extent that it accommodates the implementation of these standard interfaces. In order to achieve interoperability the UCS Architecture and interfaces must support the appropriate communication protocols and message formats for legacy as well as new UAV systems. In addition, level 2 and above (level 2+) interoperability requires the use of a Ground Data Terminal (GDT) that is interoperable with the Air Data Terminal (ADT), (e.g., connectivity between the GDT and ADT is prerequisite for level 2+ interoperability).

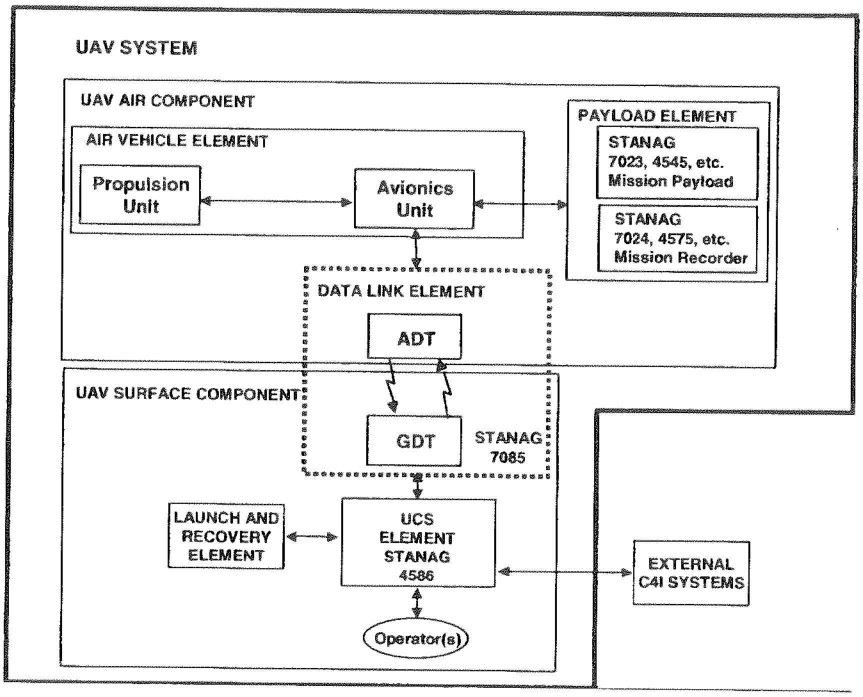


Figure B - 3. UAV System Interoperability Architecture.

As illustrated in Figure B - 3, there are already a number of existing or emerging Standardization Agreements (STANAGs) that are applicable to UAV systems. They provide standards for interoperable data link (STANAG 7085), digital sensor data between the payload and the AV element of the data link (STANAG 7023, 4545), and for on board recording device(s) (STANAG 7024, 4575).

Currently, there is no standard that defines the interfaces between the UCS and the AV (including launch and recovery functions) via the GDT, the UCS and External C4I Systems, and the UCS and the UAV System Operator(s).

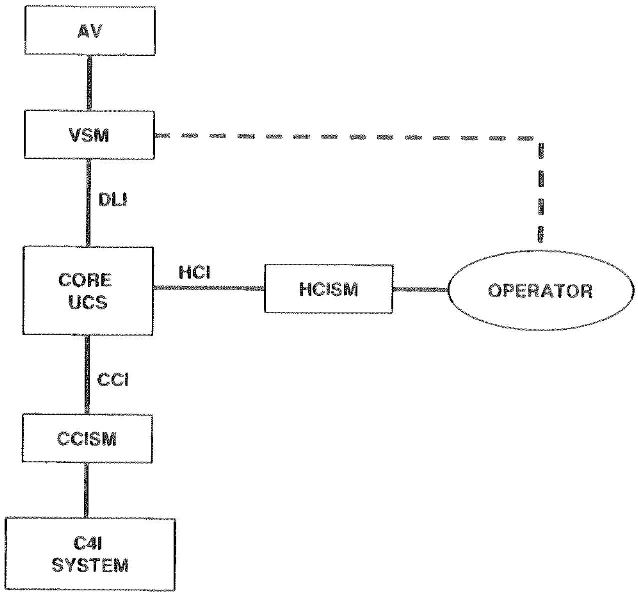
STANAG 4586 provides the standardization of these interfaces. UAV systems, which are compliant with STANAG 4586, including the referenced STANAGs and standards, will achieve interoperability at one of the levels defined above. Within STANAG 4586 the interface requirements (messages or display parameters) to achieve a given interoperability level are identified. To be interoperable to a particular level, the UCS shall be compliant with all the requirements stated for all the levels up to that which is desired; (e.g., for level 4 interoperability, the UCS must incorporate requirements for levels 1,2, 3 and 4).

Thus the approach to achieving the desired level of UAV interoperability is based on compliance with existing standards or establishing new standards for:

- A data link system(s) that provides connectivity and interoperability between the UCS and the AV(s). The data link system(s) must accommodate legacy as well as future systems. STANAG 7085, Interoperable Data Links for Imaging Systems, specifies a data link system that would provide the required connectivity and interoperability. Users that require encryption should reference work being done for data links by NAFAG Air Group IV and NATO International Military Staff (IMS) for interoperable encryption standards.
- Format for payload/sensor data for transmission to the UCS via the data link and/or for recording on the on-board recording device. STANAG 7023, Air Reconnaissance Imagery Data Architecture, with addition for non-imagery sensors, (e.g., Electronic Support Measures (ESM)), and STANAG 4545, NATO Secondary Imagery Format, STANAG 4607, NATO GMTI Format, and STANAG 4609, NATO Digital Motion Imagery Format provide standard formats for transmitting payload data to the UCS or storage on the on-board recording device.
- Recording device for on board recording of sensor data, if required, STANAG 7024, Imagery Air Reconnaissance Tape Recorder Standard, and STANAG 4575, NATO Advanced Data Storage Interface (NADSI), specify standard recording devices and formats for wideband tape and other advanced media (e.g. solid state, RAID) recorders, respectively.
- UCS interfaces with the data link system (e.g., DLI); UCS interface with the operators (e.g., HCI); and UCS interface with command and control systems (e.g., CCI).

3 UCS Functional Architecture.

The UCS Functional Architecture required to support interoperability among UAV systems, legacy as well as future, is illustrated in Figure B - 4, UCS Functional



Architecture.

Figure B - 4. UCS Functional Architecture.

This architecture establishes the following functional elements and interfaces:

- Core UCS (CUCS)
- Data Link Interface (DLI)
- Command and Control Interface (CCI)
- Human Computer Interface (HCI)
- Vehicle Specific Module (VSM)
- Command and Control Interface Specific Module (CCISM)
- Human Computer Interface Specific Module (HCISM)

This STANAG is not an attempt to define a detailed design or implementation for the CUCS other than specifying that the functional architecture accommodate the integration of the DLI, CCI and HCI and recommending that it follow applicable NATO STANAGS and guidelines for software. Lastly, because of changing technology, this STANAG does not define a specific Common Operating Environment (COE) but only specifies that the Operating Environment supports/integrates the specified network/transport protocols and supports the specified user applications.

Future, as well as legacy UAV systems, will achieve interoperability through compliance with this architecture and the relevant STANAGs. The DLI must support legacy as well as future UAVs and all air vehicle technologies (e.g., fixed wing, rotary wing, etc.), and all UAV concepts (surveillance, reconnaissance, and combat). Future UAV systems shall utilize a STANAG 7085 compliant data link system. For those that do not (future as well as legacy systems), an ADT compatible GDT must be provided in order to achieve Level 2 and above interoperability.

In similar fashion, the CCI interface must support legacy as well as future C4I systems (e.g., Allied Command and Control System (ACCS)). Thus, the interface between the Core UCS and the External C4I nodes must be compatible with the communication system infrastructure utilized to support the external tasking and sensor data dissemination. This will be accomplished by using the communication standards identified by the NATO C3 Technical Architecture's (NC3TA's) NC3 Common Standards Profile (NCSP) as specified in Section 4. The NC3TA is intended to provide an overall framework for NATO communications. All future communications and information systems used in NATO are to conform to these standards.

The concept of a Vehicle Specific Module (VSM) function is introduced which provides the unique/proprietary communication protocols, interface timing, and data formats that the respective air vehicles require. The VSM shall also provide any necessary "translation" of the DLI protocols and message formats to the unique air vehicle requirements. Since the VSM is unique to each air vehicle, the air vehicle manufacturer would generally provide it. If the data links utilized in the UAV system are not STANAG 7085 compliant, then the GDT associated with the non-compliant data link must be provided and interfaced with the UCS via the VSM function. The VSM function can be hosted on the air vehicle or on the ground. A ground based VSM function can reside on the same, different, or even remote hardware with respect to the core UCS, as long as sufficient bandwidth is provided for the message interface. If required, the critical real/near real time functions and interfaces shall be implemented via the VSM function to assure meeting the system latency requirements as illustrated by the dashed line in Figure B - 4 above.

When a new UAV is introduced into a pool of interoperable UAV systems, it may be necessary to introduce and validate a new corresponding VSM function into each existing UCS. This would be necessary only if the newly introduced vehicle requires VSM functionality in the ground portion of the system. If, however, the existing UCS includes a 7085 compliant GDT and incorporates the data link management functions defined by STANAG 4586, and if the newly introduced air vehicle implements DLI messages directly and includes a 7085 compliant ADT, then a separate ground based VSM is not required.

The CCISM provides a function similar to the VSM, that is, the encapsulation of the CCI data and any translation required to be compatible/interoperable with the physical communication links between the UCS and the C4I systems. The CCISM can be hosted on and collocated with the UCS or by and with the connecting C4I node. The UCS architecture shall make provision for the integration of a CCISM.

The HCI to the UAV system operator must provide for the display of a standard set of parameters that the operator can use to operate/monitor the UAVs that have been assigned to him. This includes his interface with the Controlling Air Management Authority. Although it is not necessary for different STANAG 4586 compliant UCSs to have identical displays, it is mandatory that the parameters specified by the HCI, Appendix B3, as well as the Guidelines for the HCI Interface be followed.

The HCISM provides the functionality for the UCS operator(s) to interact with the CUCS via the HCI.

The DLI and CCI shall be implemented using messages. This specifically excludes the use of, for example, function calls which requires the CUCS to be recompiled when a function in the CCI or DLI changes, and vice versa. For display of Vehicle and C4I specific data the UCS shall support a Web browser like "remote display" capability utilizing the following: Java, HTML, X-Windows or similar remote display methodology.

For UAV system tasking and status reporting the CCI interface shall utilize STANAG 5500, NATO Message text Formatting System (FORMETS) – Allied Data Publication – 3 (ADatP-3). As the data exchange standards evolve from Text Formats of ADatP-3 to a Generic Data Base and Replication Models according to NATO Data Policy 2000-2.20-00, STANAG 4586 will be updated accordingly.

3.1 Core UCS Requirements.

The CUCS provides the UAV operator with the functionality to conduct all phases of a UAV mission. It must support the requirements of the DLI, CCI, and HCI. The CUCS shall provide a high resolution, computer generated, graphical user interface that enables the UAV operator to control different types of UAVs and payloads with minimal additional training.

Depending on the appropriate level of interoperability, the CUCS should provide:

- The functionality and capability to receive, process, and disseminate payload data from the AV and payload; perform mission planning; monitor and control the payload; monitor and control the AV; and monitor and control the data links
- An open software architecture to support additional future air vehicles and payload capabilities
- The UAV operator with the necessary tools for computer related communications, mission tasking, mission planning, mission execution and monitoring, data receipt, data processing, and data dissemination
- The capability to host the VSM, HCISM and CCISM functions

3.2 Data Link interface (DLI).

The DLI interface between the CUCS and the GDT of the UAV system data link element is defined in Appendix B1. It will enable the CUCS to generate and understand specific messages, detailed in Appendix B1, for control and status of air vehicles and payloads. This standard message set and accompanying protocols have been developed to be air vehicle and payload class, e.g., EO/IR, independent. In addition the DLI specifies the mechanism for the processing and display of vehicle specific messages.

3.3 Command and Control Interface (CCI).

The CCI interface between C4I Systems/nodes and the CUCS is defined in Appendix B2.

The standard message set and accompanying protocols have been selected to be C4I System/node independent and to avoid placing additional requirements on the C4I System. The UCS provider and respective C4I user of the UAV system shall jointly identify the CCISM functionality required to provide UCS compatibility with the specific C4I system. Appendix B2 specifies the protocols down to the message content and format level. The networks and communications used to support the CCI

Interface shall be NC3TA compliant. The NC3TA is intended to provide an overall framework for NATO communications that provides for interoperability among military command, control and communications systems. The NC3TA strategy has been developed to achieve interoperability, maximize the exploitation of commercial of-the shelf (COTS), and reduce the proliferation of non-standard systems. All future communication and information systems used in NATO will conform to these standards.

3.4 Human Computer Interface (HCI).

The HCI Appendix B3 establishes the detailed requirements that the UCS should allow the operator to perform. Appendix B3 specifies the requirements levied upon the UCS, and does not impose any design requirements on human factors (HF) and ergonomics, (e.g., number of displays, manual controls, switches etc.). Appendix B3, while not specifically defining the format of the data to be displayed, provides a style guide, which aims to provide guidance on display techniques and standards, and acts as a source of reference and best practice in HCI design.

The HCI interface supports the HCI requirements that are imposed on the CUCS by the CCI and DLI. The HCI also supports specific or unique CCISM or VSM function display requirements.

The HCISM translates the HCI data parameters from the CUCS to a form that can be understood by the operators(s), and also allows the operator to interact with the CUCS by translating operator actions. This translation could be in the form of a visual display, auditory warning, or physical interaction. The HCISM can also be considered the physical realisation of the HCI (e.g., the set of controls and displays available to the operator(s)).

4 UCS Communication and Information Technology Protocols and Standards.

UAV and C4I Systems should be capable of interoperating across a routed network of multiple sub-networks, in which the UAV vehicle is seen as a terminal element (or terminal sub-network) of the whole network. This will allow the physical components of the UAV and C4I Systems to be anywhere on that network. The electronic exchange of information between UCS and the C4I systems shall be in accordance with the NATO Command, Control, Communication (NC3) Technical Architecture (TA), Volume 4, NC3 Common Standards Profile (NCSP), Annex 4 of AC/322(SC/5)WP/31(rev).

The NCSP is a single profile containing the emerging and mandatory standards and profiles of standards for these systems, their communications and computers, and their interfaces with other (NATO or National or other relevant Civilian) systems to support critical combined/joint interoperability in NATO missions, including the Combined Joint Task Force (CJTF) concept. The NCSP applies to all NATO command and control information system (CCIS) and management information system (MIS) systems, including their internal and external interfaces, which produce, use, or exchange information electronically.

The NCSP specifies the minimum set of communication and information technology standards to be mandated for the acquisition of all NATO command, control and communication (C3) systems. In order to assist planners and developers of future C3 systems and major upgrades to existing C3 systems, it also contains a set of emerging standards. Future NATO C3 systems are expected to support both combined and joint operations, and thus national commitments to the appropriate mandatory standards specified in this document will also significantly contribute to the achievement of the degree of interoperability required between NATO and national C3 systems for such objectives. The degree of interoperability needed to achieve the desired goal will be determined by operational requirements. In this scenario, it is important to note that different interoperability levels may be required to achieve internal interoperability between NATO systems than those required for external interoperability between NATO systems and national systems. The standards selection focuses on mandating only those standards critical to interoperability, and is based primarily on commercial open system technology, which has strong support in the commercial marketplace. Where a system is to be implemented utilizing certain services, it is essential that it adopts the relevant standards mandated in the NCSP; (e.g., if a service/interface is required, it should be implemented in accordance with the associated mandated standard(s)). Specification and usage of other standards, if required beyond those identified in the NCSP, must be additive, complementary, and non-conflicting with NCSP mandated standards. Legacy standards, when necessary, can be implemented as necessary on a case-by-case basis, in addition to the mandated NCSP standards. Emerging standards are standards required to capitalize on new technologies. It is expected that emerging standards will be elevated to mandatory status when implementations of the standards mature, and national consensus is reached.

The NCSP document organizes these standards into the eleven service areas defined by NC3TA, NATO Technical Reference Model, Volume 2:

- User Interface
- Data Management
- Data Interchange
- Graphics
- Communications
- Operating Systems

- Internationalisation
- System Management
- Security
- Distributed Computing
- Software Engineering

4.1 Data Interchange/Communications Protocols and Standards.

For Data Interchange services, at a minimum, the following NCSP mandated standards should be implemented in the UCS to achieve interoperability:

- Geographical
  - Digital Geographic Information Exchange Standard (DIGEST Version 1.2a), STANAG 7074:1998.
  - Digital Terrain Elevation Data (DTED) Geographic Information Exchange Standard, STANAG 3809.
  - Digital Feature Analysis Data (DFAD).
  - World Geodetic System - 84 (WGS-84), Mil-STD-2401.

For Communications service area, at a minimum, the following NCSP mandated standards shall be implemented in the UCS to achieve interoperability:

- Internet Protocol (IP) (IPv4 (RFC 791, 792, 919,922, 1112)/ IPv6 (RFC 2460-4, 2375, 2236).

The UCS architecture will adhere to the IP version selected by the wider defence community within which they are integrated. In the near-term, systems will need to support the current version of IP [IPv4, RFC 791]. In the longer term, as digitisation progresses, it is possible that the new version of IP [IPv6, RFC 1883] will be adopted by the military to overcome perceived weaknesses in IPv4. IPv6 increases the available address space, reorganizes the protocol headers and improves support for security, throughput, latency, error rate and cost.

- Transport Control Protocol (TCP) (IETF STD 7) RFC 793 (TCP).

The Transport Control Protocol (TCP) [RFC 761] provides a connection oriented reliable byte stream service. TCP is a bi-directional protocol, which has no concept of messages. Any framing has to be added at the application level. TCP contains an acknowledgement scheme which makes it reliable (bytes are delivered correctly and in order) and which implements flow control.

The TCP/IP protocols were selected since they can provide consistent end-to-end network and transport communications compliant with NATO-wide digitisation initiatives.

The use of a single end-to-end network and transport communications protocol allows an entire system to be managed and administered as if it were a single entity, even if it is sub-divided into individual communities for local management and administration.

- Hypertext Transfer Protocol (HTTP) Version 1.1, IETF RFC 2616.

Hypertext Transfer Protocol (HTTP) should be the main protocol used for web browsing. Web browsing provides a common and powerful mechanism for sharing information. HTTP and applications associated with the use of HTTP are used to index, access and transfer processed information. The ability to search the web server can be provided using COTS applications. A C4I user needs a Web browser (e.g., Netscape or Internet Explorer), the Uniform Resource Locator (URL) of the page and communications connectivity to access the information.

- File Transfer Protocol (FTP), IETF, RFC 959.

File Transfer Protocol (FTP) should be used to transfer processed information. It can be used in support of HTTP to transfer files, but needs additional support for providing an index to the information stored on the file server. Once the file has been transferred to the C4I system it is then the responsibility of the C4I to provide applications to process the file.

- Network Time Protocol (V3), April 9, 1992, NTP (RFC-1305)

NTP shall be used to provide the mechanisms to synchronize time and coordinate time distribution in large, diverse Internets. It uses a returnable-time design in which a distributed subnet of time servers operating in a self-organizing, hierarchical-master-slave configuration synchronizes local clocks within the subnet and to national time standards via wire or radio. The servers can also redistribute reference time via local routing algorithms.

4.2 Standards For Optional Functionality

If it is desired to implement additional service areas (e.g., data interchange), and classes within these service areas (e.g., video and audio interchange) into the UCS, the NCSP mandated standards should be used in implementing these services.

4.3 Compliance With Other STANAGS.

In addition to STANAG 4586, adoption of the following STANAGS, to the extent required to support the desired LOI, is mandatory for the success of UAV system interoperability:

- 3809 - Digital Terrain Elevation Data (DTED) Geographic Information Exchange Standard
- 4575 - NATO Advanced Data Storage Interface (NADSI) (If advanced storage is required)
- 4545 - NATO Secondary Imagery Format
- 4559 - NATO Standard Image Library Interface (NSILI) (If interface with Image library is desired)
- 4607 – NATO GMTI Data Format (Emerging Standard)
- 4609 – NATO Digital Motion Imagery Format (Emerging Standard)
- 5500 - NATO Message Text Formatting System (FORMETS) ADatP-3
- 7023 - Air Reconnaissance Imagery Data architecture
- 7024 - Imagery Air Reconnaissance (Digital Tape Storage) (If tape storage is required)
- 7085 - Interoperable Data Links For Imaging Systems
    - Digital Point to Point Annex of STANAG 7085 (compatible with Common Data Link (CDL)/Tactical Common Data Link (TCDL) specification)
- 7074 - Digital Geographic Information Exchange Standard (DIGEST Version 2.1)

To enhance UAV interoperability and flexibility, it is recommended that the UCS should also be compliant with the following STANAGs:

- 3377 - Automated Data processing (ADP) Format
- 4250 - NATO Reference Module for Open Systems Interconnection

APPENDIX B1 – DATA LINK INTERFACE

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 Introduction.

1.1 Scope.

NATO Standardization Agreement (STANAG 4586) Annex B Appendix B1 specifies the detailed requirements for interfacing the CUCS to a Vehicle Specific Module (VSM). This interface is designated as the Data Link Interface (DLI) throughout this document.

STANAG 4586 Annex B Appendix B1 is intended to allow NATO nations to achieve UAV interoperability between any compliant CUCS and any compliant Air Vehicle system (through its VSM) by specifying a standard set of messages and data formats for the interface while at the same time providing support for handling vehicle-specific data needs.

1.2 Appendix B1 Overview.

This Appendix defines the Data Link Interface (DLI) element of the UCS. The DLI provides a common set of messages and mechanisms for handling vehicle and payload specific messages. Appendix B1 is divided into the following sections:

- Section 1 Scope - Provides a general introduction of the DLI architecture and gives a brief system overview.
- Section 2 System Functional Requirements (by Mission Phase) - Identifies functions for the DLI interface to address by the phases of a UAV mission (pre-flight through post mission).
- Section 3 DLI Requirements - Identifies items such as Quality of Service, the Physical & Electrical Interface, Structure for Packing VSM Messages.
- Section 4 Message Distribution Standard - Identifies the common and generic data structures for Air Vehicle and Payload data (status & command).
- Section 5 Miscellaneous Interfaces

1.3 DLI General Overview.

A wide range of air vehicles and control system requirements must be considered in establishing the DLI message set. The DLI shall be the interface between the VSM and the CUCS element. It provides standard messages and formats to enable communication between a variety of air vehicles and STANAG 4586 compliant control systems. This relationship, or architecture, is presented in Figure B1 - 1.

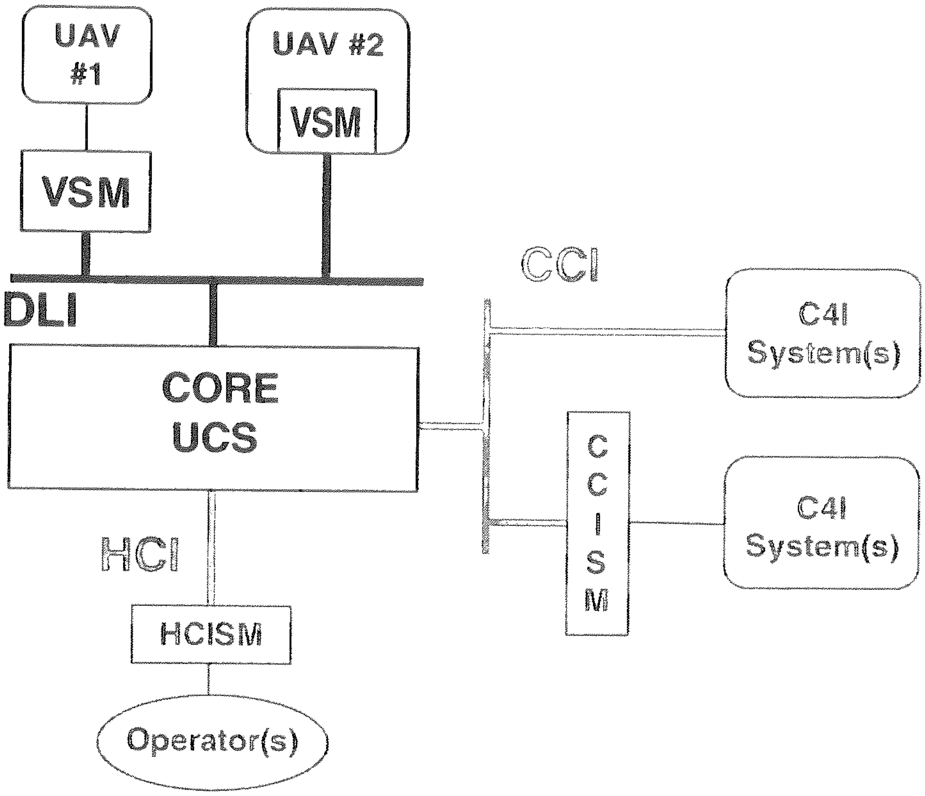


Figure B1 - 1: DLI Role in the UCS Concept

In Figure B1 - 1 there are two (possibly different) air vehicles. Each VSM shall perform the function of translating or converting air vehicle specific data formats into DLI-compliant messages. Each air vehicle type has a potentially unique VSM (generally provided by the air vehicle manufacturer). The location of the VSM function may be incorporated in the air vehicle and/or with the UAV control system. Annex B places a requirement that the VSM shall manage the real-time, low-latency interfaces with the air vehicle. Sufficient control logic on the aircraft and within the VSM shall be provided such that real-time interaction between the CUCS and the VSM is not required. In the case of legacy systems using a data link that is not compliant with STANAG 7085, the VSM shall serve as an isolating interface that allows the UAV system to become STANAG 4586 compliant without requiring modifications to the air vehicle or the data link.

The DLI shall enable the CUCS to both generate and understand specific messages for air vehicles and payloads. The development of a standard message set and protocol for communication between the VSM and the CUCS function is key to establishing an interoperable CUCS architecture. These messages as defined in this document are air vehicle and payload independent.

VSM functions and CUCS functions communicate with each other via messages as opposed to 'function calls'. The messaging structure at this interface has two objectives. First, the message structure shall pass UAV control and status information between the CUCS and VSM. This is similar to accessing a database, in that the data is known and can be acted upon by the local host machine. Second, the message structure shall allow the DLI to affect the HCI on the CUCS, much like a web browser accesses web pages for locally displaying data residing on a remote host. This VSM-driven HCI not only includes display of data which is not part of any standard "data" message sets, but also allows the operator to interact with the air vehicle through the VSM to select options, modes of operation, and other vehicle-specific actions.

Defining the DLI message structure for VSM/CUCS communication is the purpose of this Appendix. Existing message protocols and standards are used wherever possible to facilitate the process of defining this standard interface. Message standards for "remote display of data" can include Java, HTML, X Windows, etc.

The message set defined in this Appendix includes control and status messages for the following:

- Air Vehicle
- Payloads
- Data links
- Cautions and Warnings

The message set contains UAV data that is vehicle and payload independent, such that the interface standard is not required to change to accommodate a particular air vehicle or payload. In addition the message set includes a capability to have the DLI generate system specific displays through the UCS HCI.

The DLI has two major components. The first is a set of messages designed to be vehicle and payload independent that supports CUCS functionality and common air vehicle data needs. The second is a mechanism for communicating vehicle specific information to allow the CUCS to flexibly create vehicle-specific displays or generate vehicle specific commands without modification or updates as new vehicle types enter service.

The VSM function can reside on the same, different, or even remote hardware with respect to the CUCS, as long as sufficient bandwidth for the message interface (including sensor data) can be provided. The intent of this appendix is not to specify hardware, but to specify in detail the DLI such that interoperability can be achieved.

Figure B1 - 2 provides another view of the relationship among the CUCS, the VSM, and the DLI. In this figure, note that real time processing has been allocated to the VSM, and it maintains closed loop control with the air vehicle. In addition, it provides a command and status interface with the data link subsystem. The CUCS, in contrast, performs its function in "non-real time". This is to say that the system is not bound to a particular latency specification. This is a critical distinction that presumes a reasonable level of automation in the system. For those functions requiring real time interaction with a human operator, the interfaces to the system will be directly through the VSM.

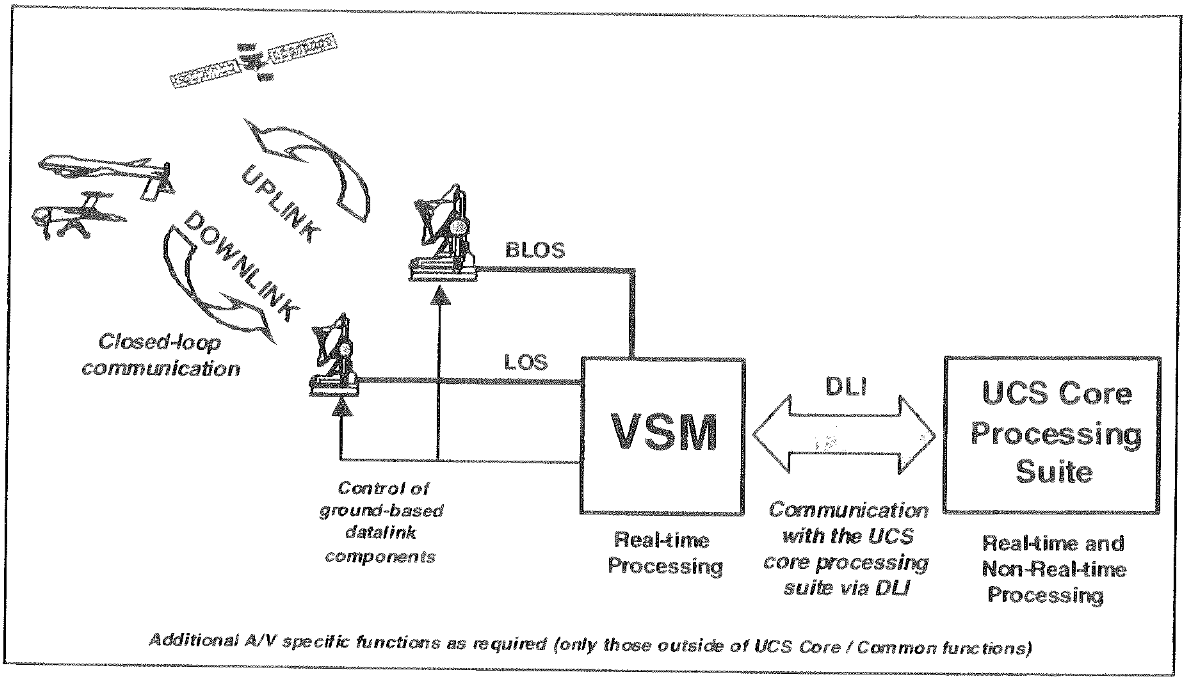


Figure B1 - 2: Role of the VSM

1.4 Vehicle Specific Module Functions.

In the CUCS system architecture, the Vehicle Specific Module (VSM) is responsible for the following functions:

- Managing real-time control interactions with the air vehicle(s).
- Translating data from the representation used by the core (DLI) to vehicle specific representations and vice versa.
- Acting as a repository and server for vehicle-specific data (such as vehicle configuration and performance limitations) and methods (such as routines for updating vehicle-specific operator displays).
- Packing and unpacking data link data to optimise transmission bandwidth when necessary.
- Managing interfaces required to control and monitor data link(s) operation.

A VSM is an air vehicle specific function(s) that services the DLI interface between the CUCS elements and the air vehicle system. The VSM shall insulate the CUCS from air vehicle specific interface peculiarities by maintaining closed-loop control and communication with the air vehicle and its payload(s) following the air vehicle's specific protocols, timing and encoding methods. The VSM shall also provide direct control of the data link(s), if any, associated with the air vehicle.

To accomplish these functions, in most cases, the VSM will reside as a component of the CUCS system. It is envisaged that the VSM will be an embedded processing element that interprets data link control/status messages, interfaces with the Ground Data Terminal (GDT) to initialise and operate the data link, packs data for transmission to/from the air vehicle, and performs ground-based real time control functions (such as loop closures for controlling landing of a UAV onto a moving landing platform, emergency recovery, etc.). The VSM is also envisioned as the element of the CUCS system architecture that provides a migration path for legacy

UAV systems to achieve STANAG 4586 compliance with minimal impact to the air vehicle design.

However, the possibility exists for the VSM to become an airborne component, particularly in new system designs. Under such a configuration, the GDT must support a DLI-compliant interconnection directly with the CUCS. In such cases this approach requires that the GDT shall have the following functionality:

- A hardware interface necessary to support the network connection to the CUCS over which DLI messages are exchanged.
- Sufficient processing capability to format outgoing messages and to parse incoming messages to/from DLI formats.
- Capability of distinguishing data link command and status messages from those that are intended for the airborne VSM component and provides a pass-through mechanism for the VSM messages.
- Capability of interpreting data link control commands and status without assistance from the CUCS other than the data contained in data link related DLI messages.
- When the GDT cannot support such a direct interface, another possible configuration is to split the VSM function into two parts. A small ground-based component could serve as the GDT interface, with the remainder of the functionality residing in the UAV.

1.5 Interfaces.

1.5.1 Physical Interfaces

The DLI (notionally depicted in Figure B1 - 3) can actually consist of multiple physical interfaces. At least one full duplex bi-directional digital data interface shall provide a communication pathway for the following:

- Commands to the UAV, payload, data link and VSM
- Environmental data to the UAV system elements
- Status from the UAV, payload, data link and VSM
- Digital payload data from the UAV -depending on data rate requirements and available bandwidth, digital payload data may require a separate physical interface to be included in a specific DLI implementation
- Digital voice data to and from the UAV (e.g. Air Traffic Control communications)

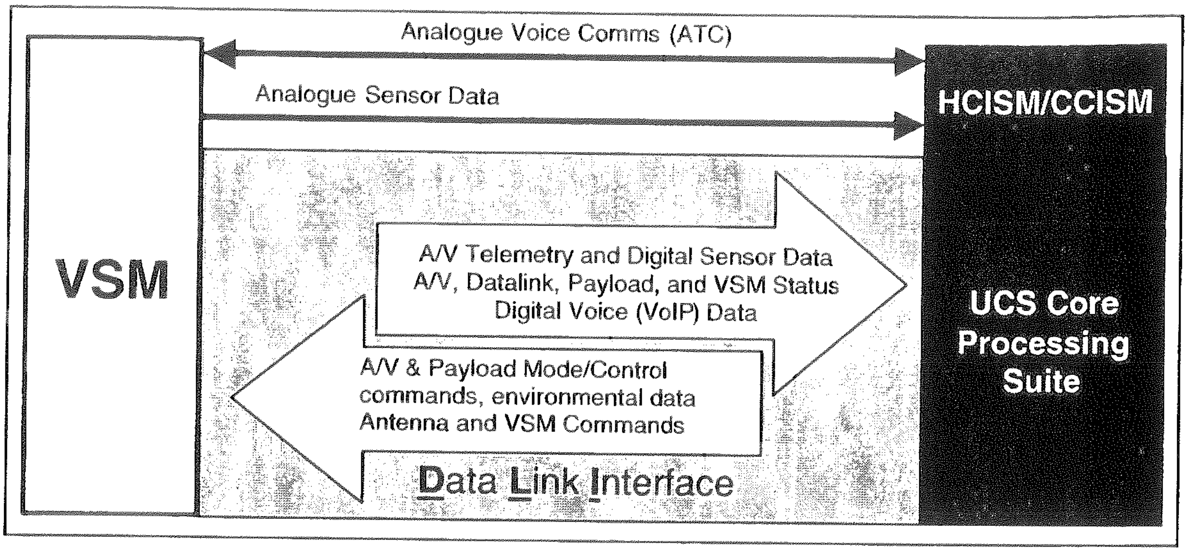


Figure B1 - 3: High-Level Depiction of DLI Interface Content

This STANAG envisions an all-digital medium for data; analogue data interfaces are not within the scope of the DLI. The VSM shall provide analogue to digital conversion ("frame grabbing") services when imagery or other sensor data is transmitted from the air vehicle in analogue format. To avoid unnecessary translation from analogue to digital and back to analogue, the VSM may provide a dedicated physical interface for displays (through the HCISM) or for external feeds (through the CCISM). Similarly, analogue voice communications, as might be used to support Air Traffic Control communications, may be supported on a dedicated bi-directional interface.

The physical interface between the CUCS and the VSM can differ depending upon where the VSM is physically located. The VSM can either reside on the ground as part of the CUCS or as a subsystem in the air vehicle. When the VSM interfaces with the CUCS, the physical interface shall support TCP/IP (e.g., Ethernet (IEEE 802) – 10Base2, 10BaseT, 100BaseT, 1000BaseT, fibre, etc.). The VSM then interfaces to the data link and shall incorporate the standards as documented in STANAG 7085. When the VSM resides in the air vehicle, the interface to the ADT portion of the Data Link is defined in STANAG 7085 and the GDT must support a DLI-compliant interface to the CUCS.

1.5.2 System Latency and Real-time Interface Considerations.

In vehicle control systems, designers typically must consider all sources of latency to ensure satisfactory handling qualities and system stability. This is particularly true in a UAV system employing manual control of the aircraft. In such systems, a critical area of concern is the total latency between the air vehicle and the operator controls and displays, as this attribute will strongly influence system performance under manual control.

In the UCS architecture, real-time UAV and data link control functions (when required) are managed by the VSM. The CUCS performs non-real-time processing, and the DLI specifies neither fixed nor maximum latency in exchanges between the VSM and the CUCS. Though message delivery is guaranteed, latency is not, and consequently real time performance is not guaranteed for signals passing through the DLI. In general, the DLI physical medium will have sufficiently high data rates to support control and display data needs at reasonable rates for human interaction. However, because the DLI medium may potentially be shared among a number of VSMs simultaneously, messaging rates and overall bandwidth may tend to be variable and must not be relied upon.

Several approaches are possible in constituting a UCS-compliant system:

- The VSM performs all real-time functionality autonomously, and data interchange needed to support controls and displays are designed to be of a non-real-time nature. In this approach, controls and displays presented to the user are not dependent upon any particular latency. Changes in latency are managed such that they do not affect readability of displays or performance of controls. For instance, integrators in a control stick filter may use dynamic integration time to avoid changes in the timing of data delivery across the DLI.
- The system is designed to take advantage of measured throughput available through the DLI and in the CUCS using "soft" real time techniques, but special provisions are incorporated to sense and accommodate excessive latency. This approach is somewhat risky in that the CUCS hardware configuration is variable and some configurations may not support a given function or approach.
- Certain manual controls and displays are critical and must be serviced in a "hard real-time" (isochronous) process. In this case, processing is performed in the VSM and device interfaces are managed directly by the VSM without passing through the DLI logically or physically. This approach might be used by legacy systems that do not have the sophistication to perform autonomous operations.
- In the case where the VSM is housed in the aircraft, the GDT must have a DLI-compliant interface and autonomously perform real time control of the data link.

1.6 Tailoring by Interoperability Level.

The applicability of various message sets varies with the interoperability level. For example, vehicle steering commands are inappropriate at Levels of Interoperability (LOI) 1-3 (as defined in Annex B). The CUCS shall filter messages and respond to, as well as issue, only those messages that are applicable at the currently active LOI. A correspondence table is provided in Table B1 - 5, Message Summary and Properties, defining applicability of each message.

1.7 Philosophy of Interface Data Representation.

The approach adopted for creating the Interface Data Representation for a message is outlined in the following sub-sections. The general requirements for the generation of a message are identified and each message is defined in detail in Section 4. It is recommended that these requirements be complied with whenever possible in the specification of new messages.

1.7.1 Byte and Bit Ordering.

RFC 1832 (XDR: External Data Representation Standard) shall be used for bit ordering, byte ordering, and byte grouping (the basic unit being four bytes). XDR is actually a data representation description language. If further canonical data typing is required, the Extensible Mark-up Language (XML) data standards shall be used.

Bit ordering within a byte shall be least significant bit first, whereas byte ordering shall be most significant byte first. In addition, the smallest data "word" shall be four bytes long. Shorter words shall be padded with trailing zero bytes as required. (Reference: IEEE Standard for Binary Floating-Point Arithmetic, ANSI/IEEE Standard 754-1985, Institute of Electrical and Electronics Engineers, August 1985)

1.7.2 Units.

Due to the variety of possible UAV systems envisioned in the future, and the international nature of the interoperability planned for the UCS, the philosophy for developing the message types in the DLI shall be to use metric (SI, ISO 1000:1992) units wherever possible. The DLI is a system-internal representation only between the CUCS and the VSM, and therefore any conversions required for human readability or familiarity (e.g., metres/sec to knots) can be performed at the appropriate user interface.

All earth-fixed position references shall be expressed in the latitude-longitude system with respect to the WGS-84 ellipsoid in units of degrees using double precision floating-point numbers. Representations in other systems, such as Universal Transverse Mercator (UTM), shall be converted at the point of use. All times shall be represented in Universal Coordinated Time (UCT) in seconds since Jan 1, 1970 using IEEE double precision floating point numbers.

Most angles shall be referenced in radians. However, for convenience, control surface deflections that are typically measured in degrees shall be expressed in that way. Bearings shall be measured clockwise from true north. Elevation shall be referenced from local horizontal, positive toward the zenith.

Data quantities, where specified in megabits (or megabytes), shall be specified as 1,000,000 bytes (or bits) instead of 2^{20} (1024x1024). (Reference: Amendment 2 to International Standard IEC 60027-2: Letter symbols to be used in electrical technology - Part 2: Telecommunications and electronics (Jan 1999).)

1.7.3 Approach to Packaging Command Data.

The general intent for packaging data was to strike a balance between minimizing the overhead associated with message headers while maximizing the modularity of the message set. In addition, the further intent was to categorize data into logical messages combinations, such as inertial data vs. body-relative data vs. wind-relative data when referring to vehicle state. Command and status data are kept in separate message groups to separate uplink messages from downlink messages. Data for which some sort of acknowledgement receipt is generally required are separated from status information requiring no acknowledgement. Finally, an attempt is made to keep data from appearing in multiple messages to avoid the possibility of inconsistencies.

1.7.4 Concept for Display of Vehicle Specific Data.

A critical need is the ability to display data and present display formats that are tailored to a given vehicle. The CUCS shall contain the facilities for generating such displays according to display formats and procedures determined by the VSM. Figure B1 – 4 below provides a scenario of how such a display is generated.

In this scenario, the system detects a need to place a vehicle-specific display on the screen such as a detailed warning message on the state on engine #2. Generic system status information messages (such as contained in message 10 below) provide abstract information used to create generic displays on the CUCS. Under the present scenario, an annunciator flashes to indicate to the user that an engine warning state exists requiring a more detailed display. The user indicates his desire to see the display by clicking on the annunciator, which generates a message, requesting engine 2 status, which is sent to the VSM. The vehicle-specific engine display format and data is developed and communicated back to the CUCS, which provides a generic display pane of a prearranged size. The CUCS then uses the format and content data provided by the VSM and paints the appropriate image on the screen.

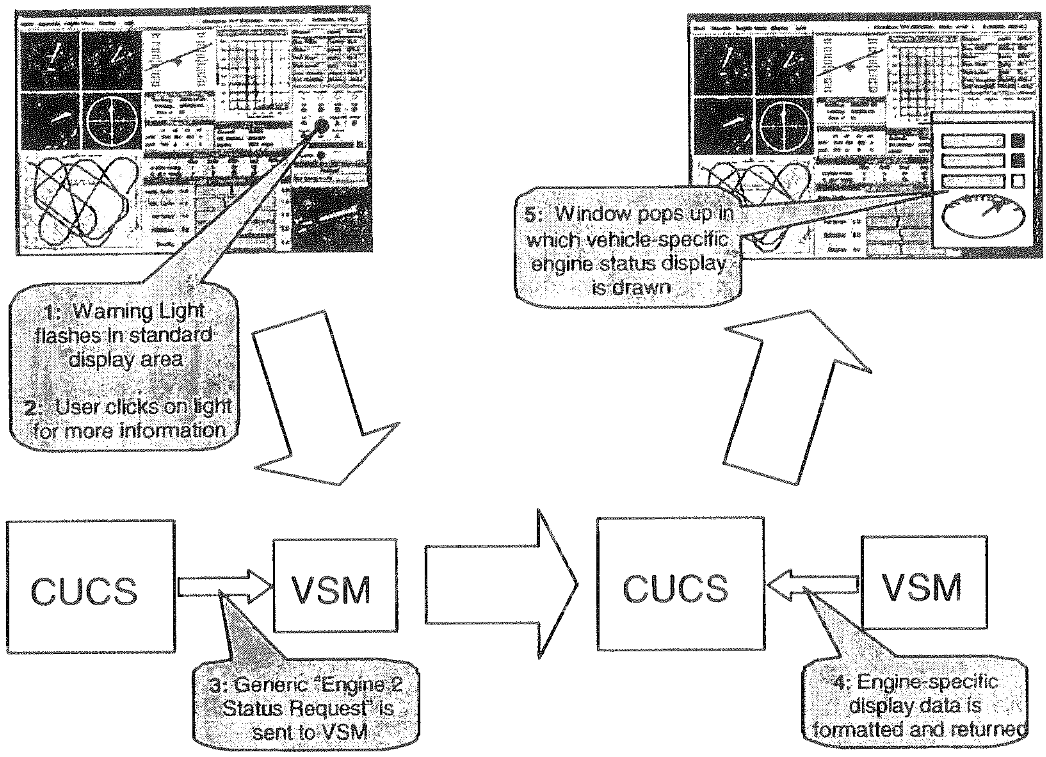


Figure B1 - 4: Typical Scenario for Generating Vehicle-Specific Displays

This structure provides the means for creating a CUCS display that is applicable to a wide variety of vehicle types, without cluttering the display with particulars of many different types or creating the need for the CUCS to carry around large libraries of display functions that would be difficult to keep current. In this concept, the VSM is responsible for providing the information necessary for detailed system management functions, but that information lies hidden until needed.

1.7.5 Vehicle and CUCS Identification (ID) Numbers.

Each message shall contain fields that identify the Identification (ID) numbers for the air vehicle and CUCS that are communicating with one another. These numbers shall be formed as 4-byte numbers that may be expressed for human-readable purposes in a format identical to IP addresses (e.g., 109.15.206.9). The first (most significant) byte shall be the standard NATO country code of the country of origin for that CUCS or air vehicle. The remaining three bytes shall be assigned statically at the time of commissioning according to procedures and protocols identified and maintained by the respective member countries. Valid country codes shall range from 0 to 99 (as of date of publication of this document). NATO may assign additional country codes in the range of 100 to 254 at its discretion. Country code 255 shall be reserved. ID number 255.255.255.255 shall be reserved as a null ID. Each member country shall be responsible for establishing a system to assure unique ID numbers for each in-service air vehicle or CUCS. Since they are employed in separate fields, a vehicle ID may in some cases be identical to a CUCS ID without causing confusion. ID numbers for systems that have been taken out of service may be reused if necessary.

2 System Functional Requirements By Mission Phase.

The DLI data content is determined by the functional requirements of the CUCS and VSM needs to communicate with one another. The set of common functions and vehicle/payload specific functions from which data elements of the DLI are described can be found in detail in Section 4. Functionality is categorised by the phase of a UAV mission. Within each mission phase, functionality is identified as either common (meaning consistent across all vehicle and payload types) or vehicle-specific. In most cases, vehicle specific functions are those that vary either in procedure or in data content and will require interaction between the CUCS and the VSM to how those functions are to be performed. The functions within each of the phases of the UAV mission are described in the table below:

Mission Phase	Common Functions	Vehicle-Specific Functions
Pre-flight	Interoperable Mission Planning Mission Plan / Verify Upload Process. Common Built-In-Testing (BIT). Mission Go / No-go	Vehicle Availability. Flight Plan Validation. Lost Link Strategy. Vehicle Specific BIT. Payload Configuration Validation & BIT checks. Pre-flight Checkout and Initialisation. Downloaded Mission Plan Validation. UCS/Vehicle Communications. Clocks Synchronization (Air Vehicle & UCS).
Takeoff	Local ATC Communications. Checklists Complete Validation. UCS/UAV Communications Validation. Takeoff Clearance Acquisition.	Ground Traffic Pattern/Plan Execution. Ground Operations Safety Constraints Monitoring. Launch. Abort Sequence Management.
Ingress / Egress	Mission Execution Monitoring. Active Emitters (e.g., radar) Activation.	UAV Vehicle-Specific Handoff Data Management.
Prime Mission Area (Target Area)	Generic Payload Control. Payload Data Handling. Mission Execution Monitoring. System Status Summary Information.	Detailed System Status Monitoring. Payload Specific Control & Monitoring. Payload Specific Data Handling
Approach / Landing	ATC Coordination. Recovery Procedures Execution.	Approach Flight path Acquisition and Maintenance. Landing Sequences Execution. Taxi Sequence Execution. Shutdown / Safing Checklists & Procedure Execution.
Post-Mission Reporting	Mission Execution Summary Report.	Vehicle Maintenance Status Report.
Phase-independent In-flight	UAV handoff among UCSs Management. Mission Execution Monitoring. Mission Phase Monitoring. General Health & Status Monitoring (H&SM) and Warning. Dynamic Flight Path Replanning. Multiple (Possibly Different) Aircraft Control. Data Recording / Buffering. GDT Control, Status, & Initialisation. Differential GPS Corrections.	Detailed Health & Status Monitoring. Lost Link Strategy Execution and Monitoring. Operator Control Modes Management. CBIT (Continuous Built-In-Tests) Across Subsystems.

Table B1 - 1: Common vs. Vehicle Specific Functions by Mission Phase

3 Message Distribution Standard.

3.1 Introduction.

A primary goal of the Core UAV Control System (CUCS) is to provide a set of functions that are common among many different vehicle platforms and different C4I systems. Some of the functions of the CUCS include providing connectivity with various national C4I systems, providing standard controls and displays for users with a common training background to operate differing air vehicle platforms, providing standard operations and maintenance displays, and providing a common basis for battle space awareness and mission management. However, to perform the full range of its functions in a manner that is truly interoperable among different vehicle platforms and varying external ground-based systems, the CUCS must have a consistent, common way of obtaining input from and providing output to external systems. A common "language" for expressing key information has to be established that is both robust enough to support a full range of functions as well as flexible enough to adapt to a rapidly changing technology environment. The Data Link Interface (DLI) in particular must address this problem, as it must serve as the point of contact between vehicle specific systems and the CUCS.

A common approach to providing inter-process (and inter-processor) communications is a technique known as "message passing." In a message passing system, data serving a common purpose is aggregated into structured packages that are commonly understood by both sender and receiver. A system for transporting messages, assuring proper delivery, and managing allocation of resources, as well as a standard definition for how data is packaged and formatted, is all that is required. If a commonly available library of functions is provided for these services, robust integration can be achieved at relatively little extra cost and with very little interaction among disparate development teams. Properly defined, this technique of formatting, packing, transmitting, parsing, and interpreting information can be as flexible, detailed, and robust in application as needed. If defined as an open standard, it can assure interoperability among independently developed systems.

This section provides a definition for message content and handling methods within the CUCS. In general, inter-process communications shall be implemented as message transactions in which data is sent in half-duplex mode from one process to another. Messages requiring an explicit receipt acknowledgment shall use a separate message type. While the scope of this document is to provide a schema for inter-process communications across the DLI, it's intent is to define a standard general enough to be used by all interfaces touching the CUCS.

Data communications within a given process may be managed by whatever means the developer chooses, consistent with sound software engineering practices. Interoperability between tasks within a process is entirely within control of the developer because performance constraints may not always permit messaging system overhead.

3.2 Requirements.

A message handling structure must, as a minimum, consist of the following elements:

- Definition of structured data format and content for standard information.
    - For information supporting common functions within the CUCS that is supportable across multiple system types, a set of messages must be developed that define in detail the variables,

values, data formats, and locations within the message to permit efficient handling of the information according to a consistent scheme. This structure must not be burdened by vehicle or system specific "baggage", and must encompass only that which serves a common purpose.

- A means for transmitting unstructured data.
    - Some information will have to be exchanged between air vehicle and ground processing elements that support platform-specific functionality. A generalized messaging scheme must be capable of passing data for which the format and content of the message are unknown to the CUCS but through which the data must pass.
- A means of managing transport of messages of any type.
    - A variety of message types will have to be supported, and a means for distinguishing among types for proper processing must be defined. Furthermore, UAV systems will have multiple channels for transporting information among system components, and the messaging system has to be capable of managing messages passing among multiple source-destination pairs across multiple communications channels.
- A means for managing multiple (possibly redundant) channels of communications among multiple processes.
    - This requirement has several different "flavours." Data may need to be replicated across multiple channels for the sake of redundancy. Data may need to be passed from one process to a sole recipient (private communication) or from one process to many (broadcast communication). To assure interoperability and portability among environments, the means of transporting and routing messages must be independent of the physical transport mechanism used (e.g., Ethernet, dedicated serial port, Unix sockets) and transport protocol (either TCP/IP or UDP, depending on the port used).
- A means of cataloguing an expanding set of message types and tracking changes needed to support evolving technology.
    - UAV technology is rapidly evolving, and a static system definition will soon become obsolete. Therefore, provision must be made for supporting a continually evolving set of message types. This catalogue must not only support the definition of the message types, but to be maximally useful it must also support an open source library of methods for handling new and evolving message types.

3.3 Message Handling Approach.

3.3.1 Message Wrapper Information.

Each message has a wrapper around the message body consisting of a header and a trailer, as depicted in Figure B1 - 5. The header contains information that enables the message handling software to manage transmission and distribution of the messages to the appropriate entities. The footer contains the checksum information that assists identifying transmission errors. The following sections provide a description of each of the data items in the wrapper and its role in the message handling system.

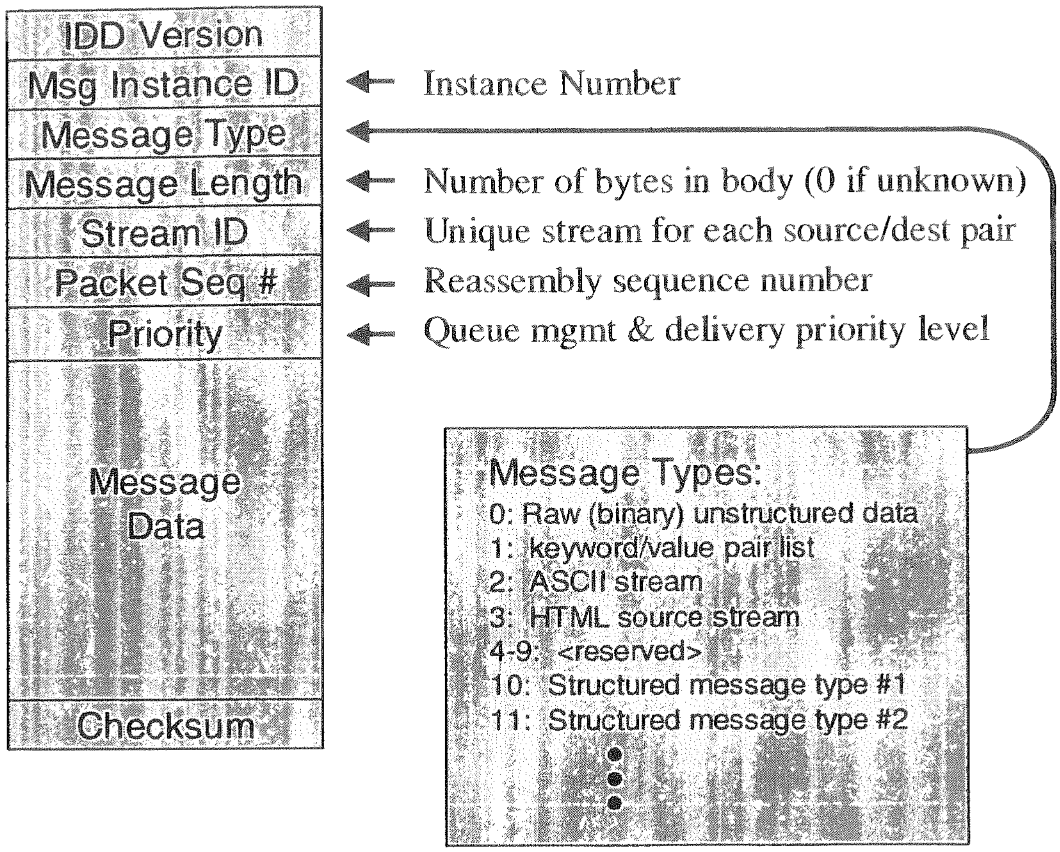


Figure B1 - 5: Message Wrapper Structure

Special Note: Unless otherwise noted, all header entries described below are 32-bit unsigned integers generated sequentially by an application call to a core library function. The intent is that ID and sequence numbers shall not be reused within a given mission. However, because ID utilization rates and mission duration's can vary without bound, the burden is left on the application developer to ensure that any reuse of ID numbers shall not result in ambiguity of meaning for the receiving process. (This may be managed, for example, by tagging messages for which reuse MAY occur with date-time groups).

3.3.1.1 Interface Definition Document (IDD) Version.

Each message shall contain the version number of the Interface Definition Document (IDD) from which its structure was defined. This version number shall be a null-terminated string of no more than 32 ASCII characters. Version number management shall be used by error checking functions to validate format consistency.

3.3.1.2 Message Instance Identifier.

The instance identifier uniquely identifies every instance of a message of a given type with a given stream ID. Instance identifiers are used by the system to keep streaming data coordinated, and to identify dropped messages of a given type at the application level. Instance identifier numbers may be reused by different source/destination pairs if desired, but for a given message type within a given stream, instance identifiers shall not be used unless other provisions for avoiding identifier ambiguity are provided in the message body.

3.3.1.3 Message Format.

The format identifier shall be a 1-byte integer indicating the message data format. There are three fundamental classes of messages: messages in a format peculiar to the vehicle specific application for which no standard can be written (type 0), standard unstructured or semi-structured formats for open transfer of generic data (types 1-99), and structured messages for particular data in a standard format (types 101 and up). For structured messages, the message type ID also inherently identifies the kind of data contained in the message in that merely by knowing the type tells the recipient how to unpack the data and how to interpret the contents.

Table B1 - 2 provides a list of the available types described below:

Type	Description
0	Unknown Format
1	Keyword-Value Pair List
2	Text Stream
3	XML Stream
4	HTML Stream
5	Structured Binary Data Set
6	Unstructured Binary Data Set

Table B1 - 2: Message Format Definitions

3.3.1.3.1 Unknown Format.

This type allows the transmission of data for which the structure or formats are completely unknown to the standard message handling functions. These types may be used by system developers to package data peculiar to their own applications and for which there is no requirement for interoperability. These messages shall be treated as binary data streams for which only the length and routing information is known.

3.3.1.3.2 Keyword-Value Format.

A convenient means for open exchange of data among processes is using keyword, value pairs. This approach makes it possible for user applications to quickly scan for particular data while eliminating the configuration management difficulties of keeping ordered lists intact.

Keywords shall be null-terminated ASCII strings of up to 32 bytes in length. The first character of the keyword shall indicate the value type according to the following:

Type	Description
A	Null-terminated character string
I	32-bit two's-complement integer
F	IEEE single-precision floating point number
D	IEEE double-precision floating point number
X	Hexadecimal

Table B1 - 3: Message Type Definitions

Each keyword shall be separated from the previous value by a carriage return/line feed pair to facilitate parsing and display of data sequences. A message may contain any number of pairs. Every keyword occurring in the message must have an associated value entry (void data fields are prohibited). The first keyword-value pair shall convey message type information for use by the recipient, using a scheme determined by the application.

The purpose of this message type is to define a flexible means for which a library of manipulation routines can be developed and distributed for rapid prototyping purposes.

3.3.1.3.3 ASCII Text Format.

Data in an open text message shall be characters represented using the Universal Multiple Octet Coded Character Set (UCS) Transformation Format 8 (UTF-8). UTF-8 is a subset of the Universal Multiple Octet Coded Character Set (UCS) composed of 1-byte and 2-byte UTF-8 encoded characters (Basic Latin and Latin Supplement 1). The 1-byte encoded characters of the UTF-8 Subset (U8S) are the BCS characters. The Universal Multiple Octet Coded Character Set (UCS) is used for expressing text that must be human readable, potentially in any language of the world and is defined in ISO/IEC 10646-1.

3.3.1.3.4 XML Format.

Extensible Mark-up Language, abbreviated XML, describes a class of data objects called XML documents and partially describes the behaviour of computer programs which process them. XML is an application profile or restricted form of SGML, the Standard Generalized Mark-up Language [ISO 8879]. By construction, XML documents are conforming SGML documents. XML documents are made up of storage units called entities, which contain either parsed or unparsed data. Parsed data is made up of characters, some of which form character data, and some of which form mark-up. Mark-up encodes a description of the document's storage layout and logical structure. XML provides a mechanism to impose constraints on the storage layout and logical structure. A software module called an XML processor is used to read XML documents and provide access to their content and structure. It is assumed that an XML processor is doing its work on behalf of another module, called the application.

3.3.1.3.5 HTML Format.

HTML (Hypertext Mark-up Language) is rapidly becoming a universally accepted means for transmitting graphical and textual data such that it can be readily displayed by client applications and provides a means for user interactive functions. This format is well defined, well understood, and provides a medium for graphical and textual display information, such as operations checklists or maintenance data, to be readily processed.

3.3.1.3.6 Structured Binary Data.

Structured binary data is data represented as binary numbers or symbols that are aligned in a prespecified way to permit parsing algorithms to be defined and developed. The message is divided into a number of fields, each of which has a fixed length representation of some variable. Parsing software knows how to find a certain data element because it always appears in the same location in the message. Data labels and typing information are unnecessary since they are implicit in the organization of the binary data. The structure is generally defined using a tabular format identifying fields, lengths per field, and variable type. All of the defined message types in section 4 are structured binary data.

3.3.1.3.7 Unstructured Binary Data.

Unstructured binary data is data that is not differentiated by its position in the stream, and is segregated from other data only by predefined delimiters or byte count. Unstructured data is generally "flat" in its organization, meaning that the bytes are all of the same type and unvarying in their symbolic value. Examples of unstructured data might include streaming audio or video.

3.3.1.4 Message Type.

The message type is the integer value associated with the defined messages types below. Message types shall be numbered sequentially from 1 to n, where n is any integer less than 1000 and represents the highest approved message type. It is anticipated that the number of standard message types may grow and that NATO will establish a commission to maintain configuration control on changes to the standard message list. For vehicle specific messages, type "0" may be used, or enumerated types may be used, in which cases the type numbers must be greater than 1000.

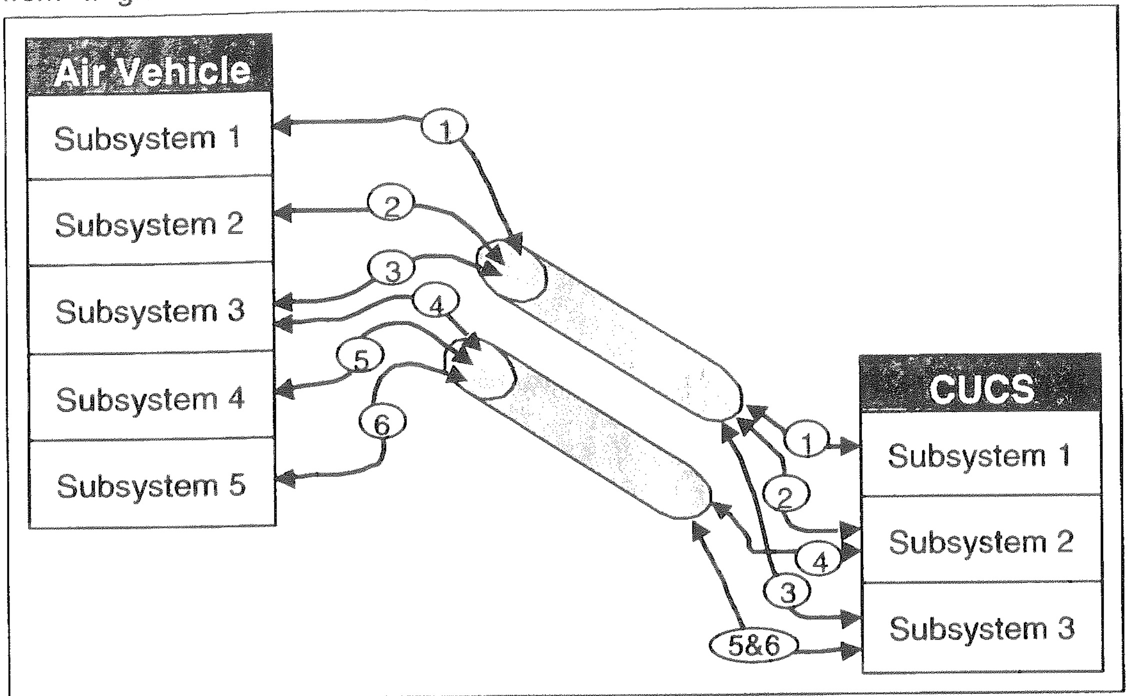
3.3.1.5 Message Length.

The length shall be a 32-bit unsigned integer of the number of bytes in the message body, exclusive of the header. The length may be any number between 1 and 0xFFFFFFFF (hexadecimal representation). A zero value in the length field shall denote unknown message length. The length shall be the length of that message only; length of multiple-packet messages shall be determined incrementally from the pieces.

3.3.1.6 Stream ID.

A stream is a half-duplex communications channel between two processes. These processes may reside on the same or different processors or platforms. Stream ID shall be independent of the mode of communications (e.g., network, dedicated serial port, sockets, shared memory). The communications system shall provide to requesting processes a unique stream ID for each source/destination pair for each communication session requested. A source destination pair may have multiple stream IDs assigned if it is establishing different communication ports for different purposes.

The purpose of Stream IDs is to provide a means for separating flows of data among various processes sharing a single communications channel, and among messages from a given source to multiple destinations. Consider the various scenarios



depicted in Figure B1 - 6. Two independent messages from/to different processes may have to share the same communication channel (messages 1 & 2). A given process may send a given message type to two different recipients via different channels (messages 3 & 4) for purposes of redundancy. Multiple processes may need to communicate with the same recipient (messages 5 & 6). Not depicted is the case of broadcast, where a process transmits a single message intended for any listening recipient. Another case not depicted is the corresponding functions on two different vehicles sending to the same function on the same ground station. When they emerge at the receiving end, messages in each of these cases must be properly routed. Explicit identification of message streams that identify source/destination pairs provides a mechanism for managing and routing the flow of information in a given channel.

Figure B1 - 6: Data Stream Scenarios Depicting Stream ID Requirement

3.3.1.7 Packet Sequence Number.

Some types of messages may require segmenting the data into sequences of blocks of a maximum length. For instance, raw text messages could conceivably be unbounded in their length. If a retransmission due to checksum error has to be forced, it can be highly inefficient to retransmit an entire long file due to a single bit error. Segmenting long messages and reassembling them at the destination is an efficient means of overcoming errors.

For a given message identifier, if the message content has been segmented into a series of messages of contiguous data, the Packet Sequence Number shall begin at 1 and increase sequentially until the end of the message is reached. The message instance ID shall remain constant to indicate continuation of a particular message. The receiving process shall reassemble the data using the sequence number. If a given sequence number is lost in transmission, the system shall either attempt to retransmit or purge the entire message. A negative Packet Sequence Number, whether in the first or nth packet for a given instance ID, always indicates that the current packet is the last, with the absolute value of the number representing the final packet's sequence number. This scheme allows up to 231-1 packets in a sequence;

applications requiring more than this amount will be required to apply an application-specific data segmentation scheme.

3.3.1.8 Delivery Service Priority.

Delivery service priority is a way of indicating relative importance of messages and provides a means for managing resource allocation among communication needs. Messages come in various priority types, as shown in Table B1 - 4:

Priority	Description
0	Emergency override message (bypasses priority scheme)
1-10	Real-time data requiring guaranteed delivery and latency. (Different priorities on different latency levels defined by application)
11-20	Real-time data; requires guaranteed latency only (dropped messages will not be recovered)
21-30	Requires guaranteed delivery only. Recovery (retransmit) on error is mandatory
31-40	Requires sequential delivery with other messages of the same type
41-99	Application-specified relative priority levels
100	No priority; deliver as resources permit

Table B1 - 4: Priority Type Definitions

In general, messages will be sorted by priority, with lower numbered priorities taking precedence over higher numbered ones whenever resources are in contention.

3.3.1.9 Checksum.

Checksum shall be employed to determine the presence of errors during transmission or handling of messages. Checksums shall be 4-byte results achieved by simple binary additions truncated to four bytes.

4 Message Formats.

4.1 Common Message Formats.

The Message Summary and Properties Table (Table B1-5) and the individual data element descriptions in this section define the required superset of messages that shall be implemented in order to achieve UAV NATO interoperability via the DLI. Regardless of vehicle type, there are certain pieces of information that must be passed regularly from the vehicle to the control system, such as position, attitude, general vehicle health, operating state, etc. Control systems will also have a set of common commands and requests for the air vehicle, such as air vehicle or payload operating commands. A primary purpose of this section is to define the set of common message structures for communicating across the DLI between vehicle specific functions and the display and control functions common to STANAG 4586 compliant CUCS implementations. The intent of this Appendix is to provide an expandable structure and preliminary set of message definitions that can grow with UAV technology.

The goal of the common message set is to provide a standard information group required by the CUCS for displays that are common to compliant implementations. Provisions are also made for vehicle-specific message types. Manufacturers may provide any amount of information, whether or not redundant with the common message types, as required by their particular design. However, the common message types shall be supported to guarantee interoperability with CUCS functionality, though not every data element is needed in every application. To assure consistency, unneeded data elements, whether not applicable or unknown, shall be filled in either as "not reported" values specified in the message formats or as out-of-range values. Receiving processes shall perform range checking and properly handle out-of-range values. Out of range values, invalid data and non-supported messages shall not cause the CUCS/VSM to be adversely affected.

In Table B1 - 5, each message type is identified with several properties, indicated in the rightmost six columns. The first property is labelled "Criticality Level" and refers to how the message affects system performance. In general, messages that are flight critical could, if lost, result in a chain of events that might result in loss of control. Mission critical messages are those that, if lost, would affect mission performance but not necessarily result in loss of control. Non-critical message types do not directly or immediately affect system performance. These criticality levels are enumerated to help establish priority and latency requirements.

The second property is captured in the column labelled "Type". This column classifies messages as "push" and "pull" types. Pull messages are messages that are generated in response to a request. This mechanism is used to assure that data link bandwidth is not unnecessarily consumed by unneeded data. Push messages are broadcast either periodically or based on some event, but do not require a request to result in sending a message.

The third property ("Source") identifies the entity from which the message is issued (CUCS or VSM).

The fourth property defines whether the receiving function must acknowledge receipt of the message type. Acknowledgements are only required for "Push" type messages, since "Pull" type messages are themselves a response to a request. If the request is not granted in a timely fashion, the requestor must generate a fresh request. Acknowledgement is accomplished by sending message #40.

The fifth property ("Guaranteed Delivery") identifies whether the given message requires guaranteed delivery. In general, guaranteed delivery is required in the case of pull type messages (response to a specific request) or push type messages that are commands. Messages requiring guaranteed delivery must be communicated through a port using TCP/IP protocols. Messages not requiring guaranteed delivery (such as periodic state information broadcasts for which failure to receive and process the data is not a critical event) may be transmitted using UDP data grams.

The sixth property is captured in the column labelled "LOI" that lists the minimum level of UAV interoperability applicable to each of the common message types. The levels of control refer to the authority level with which the user may provide commands that alter air vehicle state and are defined in Annex B, Section 2.3. The LOI specifies the lowest level and all levels above (e.g., level 2 means that the message is required to support level 2, 3, 4 and 5).

Msg Type	Description	Criticality Level	Type	Source	Ack. Req'd	Guar. Delivery-	LOI
1	Vehicle ID	Mission	Pull	VSM	-	Yes	2
2	User ID	Mission	Pull	CUCS	-	Yes	2
3	Vehicle Configuration	Mission	Pull	VSM	-	Yes	2
4	Payload Configuration and Status	Mission	Pull	VSM	-	Yes	2
5	Inertial States (Lat/Lon Format)	Flight	Push	VSM	No	No	2
6	Air and Ground Relative States	Flight	Push	VSM	No	No	2
7	Body-Relative Sensed States	Flight	Push	VSM	No	No	2
8	Vehicle Operating States	Flight	Pull	VSM	-	Yes	3
9	Engine Operating States	Mission	Pull	VSM	-	Yes	4
10	Vehicle Operating Mode Command	Mission	Push	CUCS	Yes	Yes	4
11	Vehicle Steering Command	Flight	Push	CUCS	Yes	Yes	4
12	Vehicle Control Transition Coord.	Flight	Push	Either	Yes	Yes	4
13	Control Assumption Acknowledgement	Flight	Push	Either	Yes	Yes	3
14	Handoff Status Report	None	Pull	CUCS	-	Yes	2
15	Mission Plan Upload Command	Mission	Push	CUCS	Yes	Yes	4
16	Flight Termination Command	Flight	Push	CUCS	Yes	Yes	4
17	System Health Status Summary	Mission	Push / Pull	VSM	No	No / Yes	2
18	Generic Information Request	None	Push	CUCS	No	Yes	2
19	Subsystem Status Alert	Flight	Push	VSM	No	Yes	1
20	Subsystem Status Report	None	Pull	VSM	-	Yes	2
21	Subsystem Status Request	None	Push	CUCS	No	Yes	2
22	Subsystem Status Detail Request	None	Push	CUCS	No	Yes	2
23	EO/IR Payload Operating State	Mission	Pull	VSM	-	Yes	2
24	SAR Payload Operating State	Mission	Pull	VSM	-	Yes	2
25	Staring (Body Fixed) Camera Status	Mission	Pull	VSM	-	Yes	2
26	Steerable Payload Command	Mission	Push	CUCS	No	Yes	3
27	Stores Release System Status	Mission	Push	CUCS	-	Yes	3
28	Stores Release System Command	Mission	Pull	VSM	-	Yes	3
29	Payload Data Recorder Status	Mission	Pull	VSM	-	Yes	2
30	Payload Data Recorder Control Command	Mission	Push	CUCS	No	Yes	3
31	STAR EO & Laser Payload Command	Mission	Push	CUCS	Yes	Yes	3
32	STAR Radar Payload Commands	Mission	Push	CUCS	Yes	Yes	3
33	Communications Relay Command	Mission	Push	CUCS	Yes	Yes	3
34	Communications Relay Status	None	Pull	VSM	-	Yes	2
35	IFF Code Command	None	Push	CUCS	No	Yes	4
36	IFF ID Command	None	Push	CUCS	No	Yes	4
37	IFF Status Report	None	Pull	VSM	-	Yes	2
38	Data link Control Command	Flight	Push	CUCS	Yes	Yes	3
39	Data link Status Report	None	Pull	VSM	-	Yes	2
40	Message Acknowledgement	None	Pull	Any	-	Yes	2
41	CUCS Resource Request	None	Push	VSM	No	Yes	2
42	CUCS Resource Response	None	Pull	CUCS	No	Yes	2

Table B1 - 5: Message Summary and Properties

Common message formats covering command and status of other payloads (e.g., electronic countermeasures, weapons delivery, electronic warfare, self-defence payloads) are not currently defined. UAVs carrying such payloads shall use vehicle specific message mechanisms described above. Future revisions of this STANAG will incorporate standard control and status messages for such payloads as they become commonly employed across a variety of UAV platforms.

Note: In the tables that follow, data types shall conform to the following meanings:

- Character (n) – ASCII character data of "n" bytes in length
- Integer (n) – signed integers, where n is either 1, 2, or 4 bytes
- Float – IEEE format floating point numbers (4 bytes in length)
- Double – IEEE double precision floating point numbers (8 bytes in length).

4.1.1 System ID Messages.

4.1.1.1 Message #1: Vehicle ID.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	(See section 1.7.2)
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Vehicle Type** Identifies the type name of vehicle (e.g. Predator, Pioneer, SEAMOS, Vigilante); numbers to be assigned by NATO	Integer 2	None	0 = not identified $1 \leq x \leq 2^{15}$
5	**Vehicle Subtype** Identifies the design block number as designated by the manufacturer.	Integer 2	None	$1 \leq x \leq 2^{31}$
6	**Owning Country ID** Identifies the owning country, using NATO-assigned numerical identifiers.	Integer 1	None	$0 = \leq x \leq 99$ 255 = not identified
7	**Tail Number** Null terminated string with the tail number designated by the owning country's certifying agency.	Character, 16 bytes	None	Null-terminated Printable ASCII
8	**Mission ID** Identifies mission and (by reference) flight plan currently executing on this platform.	Integer 4	None	0 = None $1 \leq x \leq n$
9	**ATC Call Sign**	Character, 32 bytes	None	Printable ASCII, null terminated
10	**ATC Transponder Code**	Integer 2	None	Octal 0000 to 7777, transmitted as decimal

4.1.1.2 Message #2: User ID.

This message shall be used to identify the entity currently in command of the vehicle's flight path. It is possible that multiple sources of commands could direct the path of the vehicle (such as a payload operator steering the vehicle to achieve a certain view angle). However, there is one and only one authority, identified by this message, who is responsible for the flight safety of the vehicle and surrounding air space.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	(See section 1.7.2)
2	**Vehicle ID** See message #1, field #1 declaration.	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Operating Country ID** Identifies the country of origin of the operator, using NATO-assigned numerical identifiers.	Integer 1	None	0 = not identified $1 \le x \le 255$
5	**Operator Certification Level** Identifies the operations level at which the current operator is certified to control the vehicle.	Integer 1	None	$3 \le x \le 5$

4.1.2 Flight Vehicle Command and Status Messages.

4.1.2.1 Message #3: Vehicle Configuration.

This message shall be used to specify the configuration of the vehicle, primarily for flight planning purposes. It indicates the current configuration of the vehicle either as specified by type by the manufacturer, or based on current loading. For instance, "Optimum Cruise Speed" is likely only to be available as the manufacturer-specified performance index, even though presence of extra load or external stores may cause the number to vary in an unknown manner.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	(See section 1.7.2)
2	**Vehicle ID** See message #1 declaration.	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Configuration ID** Identifies particular configuration of the air vehicle as specified by the manufacturer. (This manufacturer-specified identifier is used by the VSM to provide vehicle specific data, such as current weight and c.g. given current stores status.)	Integer 4	None	$1 \le x \le n$
5	**Fuel Capacity** Amount of weight in fuel that can be carried for this configuration.	Float	kg	Configuration dependent
6	**Maximum Indicated Airspeed** Not to exceed dash speed	Float	Metres/sec	Configuration dependent
7	**Optimum Cruise Speed**	Float	Metres/sec	Configuration dependent
8	**Optimum Endurance Speed**	Float	Metres/sec	Configuration dependent
9	**Maximum Load Factor** Not-to-exceed G-load tolerance	Float	Metres/sec^2	Configuration dependent
10	**Number of Stations** Number of stores or payload stations available on the vehicle.	Integer 2	None	$1 \le x \le 65535$
11	**Gross Weight** Calculated gross weight of current configuration, including effects of fuel load changes.	Float	kg	Determined by vehicle configuration
12	**Fuel Remaining**	Float	kg	Determined by vehicle configuration
13	**Battery Capacity Remaining**	Float	%	Determined by vehicle configuration
14	**X_CG** Calculated centre of gravity of current configuration rearward from the nose.	Float	Metre	Determined by vehicle configuration

4.1.2.2 Message #4: Payload Configuration and Status.

This message shall be used to identify payload configuration by vehicle station. Configuration data is used by mission planning, dynamic re-planning, and mission execution monitoring applications to determine flight performance characteristics, manoeuvring limits, and to ascertain flight safety issues, particularly during takeoff and landing. In-flight configuration changes may also need to be tracked by the UCS in terms of their effect on vehicle performance as the mission progresses. Need to highlight the possibility of expendable payloads.

The intent of this message is to provide the CUCS with payload status primarily on a change basis. One instance of this message shall be sent for each employed payload station during initialisation for mission planning purposes. An instance of the message shall be sent each time the configuration changes. If the payload station status is “empty”, mass and centre of gravity values shall be ignored.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Station Number**	Integer 1	None	$1 \le x \le n$ (Determined by veh. config.)
5	**Payload Type** Type ID associated with deployable or dispensable payloads (e.g., chaff, weapons) Payload types will be identified per an enumerated list of types that will be published and maintained by NATO	Integer 2	None	0 = not specified 1 = EO/IR 2 = SAR 3 = Fixed Camera 4 = Comms Relay 5 = Dispensable Munition 6 = Jammer Pod 7 = Targeting Pod 8 – $(2^{31}-1)$ = Reserved
6	Number of Payload Recording Devices	Integer 1	None	$0 \le x \le 255$
7	**Payload State** State of the station or the payload currently mounted on it	Integer 1	None	0 = empty 1 = standby 2 = initialising 3 = operating 4 = emitting 5 = armed 6 = release error 7 = operating error 8-255 = Reserved

4.1.2.3 Message #5: Inertial States.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Sample Time Stamp** Date-time group at which the data in the table was sampled	Double	Seconds	See Section 1.7.2
5	**Latitude**	Double	Deg	$-90 \leq x \leq 90$
6	**Longitude**	Double	Deg	$-180 \leq x \leq 180$
7	**Altitude** Distance above (+) or below (-) the WGS-84 reference spheroid.	Float	Metres	$-1000 \leq x \leq 100000$
8	**U_North** Speed component along true north vector	Float	Metres/sec	$-10000 \leq x \leq 10000$
9	**V_East** Speed component perpendicular to true north vector	Float	Metres/sec	$-10000 \leq x \leq 10000$
10	**W_Down** Inertial vertical speed component	Float	Metres/sec	$-10000 \leq x \leq 10000$
11	**X_Accel** Acceleration component along true north vector	Float	Metres/sec^2	$-100 \leq x \leq 100$
12	**Y_Accel** Acceleration component perpendicular to true east vector	Float	Metres/sec^2	$-100 \leq x \leq 100$
13	**Z_Accel** Inertial vertical acceleration component	Float	Metres/sec^2	$-100 \leq x \leq 100$
14	**Phi** Roll angle (Euler convention)	Float	radians	$-\pi \leq x \leq \pi$
15	**Theta** Pitch angle (Euler convention)	Float	radians	$-\pi/2 \leq x \leq \pi/2$
16	**Psi** Yaw angle (Euler convention)	Float	radians	$-\pi \leq x \leq \pi$
17	**Phi_dot** Roll rate (Euler convention)	Float	rad/sec	$-1000 \leq x \leq 1000$
18	**Theta_dot** Pitch rate (Euler convention)	Float	rad/sec	$-1000 \leq x \leq 1000$
19	**Psi_dot** Yaw rate (Euler convention)	Float	rad/sec	$-1000 \leq x \leq 1000$

4.1.2.4 Message #6: Air and Ground Relative States.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Sample Time Stamp** Date-time group at which the data in the table was sampled	Double	Seconds	See section 1.7.2
5	**Angle of Attack**	Float	radians	$-\pi \le x \le \pi$
6	**Angle of Sideslip**	Float	radians	$-\pi \le x \le \pi$
7	**True Airspeed**	Float	Metres/sec	$0 \le x \le 10000$
8	**Indicated Airspeed**	Float	Metres/sec	$0 \le x \le 10000$
9	**Outside Air Temp**	Float	°C	$-100 \le x \le 100$
10	**U_Wind** Estimated wind component along true north vector	Float	Metres/sec	$-10000 \le x \le 10000$
11	**V_Wind** Estimated wind component perpendicular to true north vector	Float	Metres/sec	$-10000 \le x \le 10000$
12	**Barometric Pressure** Local reading (sea level adjusted)	Float	kilopascals	$0 \le x \le 1075$
13	**Barometric Altitude** Estimated MSL altitude based on local static pressure	Float	Metres	$-1000 \le x \le 100000$
14	**Barometric Altitude Rate** Estimated vertical velocity (+ up) based on pressure rate from air data system	Float	Metres/sec	$-1000 \le x \le 1000$
15	**U_Ground** Ground Speed component along true north vector	Float	Metres/sec	$-10000 \le x \le 10000$
16	**V_Ground** Ground Speed component perpendicular to true north vector	Float	Metres/sec	$-10000 \le x \le 10000$

4.1.2.5 Message #7: Body-Relative Sensed States.

Directly sensed body-relative states are packaged as a separate message type from other vehicle states because these terms may need to be known at substantially higher rates for various control-related functions.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Sample Time Stamp** Date-time group at which the data in the table was sampled	Double	Seconds	See section 1.7.2
5	**X_Body_Accel** Longitudinal acceleration, + forward	Float	Metres/sec^2	$-100 \le x \le 100$
6	**Y_Body_Accel** Lateral acceleration, + right	Float	Metres/sec^2	$-100 \le x \le 100$
7	**Z_Body_Accel** Vertical acceleration, + down	Float	Metres/sec^2	$-100 \le x \le 100$
8	**Roll_Rate**	Float	rad/sec	$-100 \le x \le 100$
9	**Pitch_Rate**	Float	rad/sec	$-100 \le x \le 100$
10	**Yaw_Rate**	Float	rad/sec	$-100 \le x \le 100$

4.1.2.6 Message #8: Vehicle Operating States.

This message shall be used to report the vehicle operating state while in flight.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Commanded Altitude**	Float	Metres	$-1000 \le x \le 100000$
5	**Commanded Heading**	Float	Rad	$-\pi \le x \le \pi$
6	**Commanded Airspeed**	Float	Mps	$0 \le x \le 10000$
7	**Power Lever Angle** Average throttle setting of all engines	Integer 2	Percent	Specified by configuration (Nominally 0-110%)
8	**Flap Deployment Angle**	Float	Deg	$0 \le x \le 90$
9	**Speed Brake Deployment Angle**	Float	Deg	$0 \le x \le 90$
10	**Landing Gear State**	Integer 1	N/A	0 = No Value 1 = Stowed 2 = Cycling 3 = Down 4 = Inoperative
11	**Payload Bay Doors**	Integer 1	N/A	0 = No value 1 = Closed 2 = Cycling 3 = Open 4 = Inoperative
12	**Current Fuel level** *(Reported as a percentage for interoperable gauge displays.)*	Integer 1	%	0-100%
13	**Current Fuel Flow Rate** Total consumption	Integer 2	kg/hr	Specified by configuration
14	**From Waypoint – Latitude**	Double	Deg	$-90 \le x \le 90$
15	**From Waypoint – Longitude**	Double	Deg	$-180 \le x \le 180$
16	**From Waypoint Altitude**	Float	Metres	$-1000 \le x \le 100000$
17	**From Waypoint Time**	Double	Seconds	See sect. 1.7.2
18	**To Waypoint – Latitude**	Double	Deg	$-90 \le x \le 90$
19	**To Waypoint – Longitude**	Double	Deg	$-180 \le x \le 180$
20	**To Waypoint Altitude**	Float	Metres	$-1000 \le x \le 100000$
21	**To Waypoint Time**	Double	Seconds	See sect. 1.7.2
22	**Next Waypoint – Latitude**	Double	Deg	$-90 \le x \le 90$
23	**Next Waypoint – Longitude**	Double	Deg	$-180 \le x \le 180$
24	**Next Waypoint Altitude**	Float	Metres	$-1000 \le x \le 100000$
25	**Next Waypoint Time**	Double	Seconds	See sect. 1.7.2

4.1.2.7 Message #9: Engine Operating States.

This message shall be used to report the operating state of a given engine. For vehicles with multiple engines, full operating state shall require one such message for each engine. The intent of this message is to provide data for a generic set of indicators for the operator. (Detailed information about engine operating state and health is left as a vehicle-specific function.)

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Engine Number** ID of engine currently being reported	Integer 4	None	Specified by configuration
5	**Engine Power Setting**	Float	Percent	0 <= x <= 110
6	**Engine Speed**	Float	RPM	0 <= x <= 100000
7	**Engine Speed Status**	Integer 1	None	<status>
8	**Output Power (Shaft Torque) Status**	Integer 1	None	<status>
9	**Engine Body Temperature Status** (for reciprocating engines, this state is nominally reported as cylinder head temp)	Integer 1	None	<status>
10	**Exhaust Gas Temperature Status**	Integer 1	None	<status>
11	**Coolant Temperature Status**	Integer 1	None	<status>
12	**Lubricant Pressure Status**	Integer 1	None	<status>
13	**Lubricant Temperature Status**	Integer 1	None	<status>
14	**Fire Detection Sensor Status**	Integer 1	None	<status>

Note: <Status> enumerated values are:

0 = No Status
1 = Low – Red
2 = Low – Yellow
2 = Low – Green
4 = Normal – Green
5 = High – Green
6 = High – Yellow
7 = High – Red

4.1.2.8 Message #10: Vehicle Operating Mode Command.

This message shall be used to control the vehicle operating mode. The vehicle operating mode defines the system behaviour and establishes how commands shall be interpreted. The behaviours established include vehicle flight path response and payload response. The intent of these behaviours is to provide a standard way of expressing common operating modes and tactics the specific implementation of which is left up to the vehicle manufacturer.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See Section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Select Flight Path Control Mode** Specifies the method for controlling the vehicle's flight path. Manual control modes lie in the range 1-10, automatic control modes lie in the range 11-20 Mode numbers above 127 may be used in a vehicle-specific fashion, but shall not be supported in the generic user displays with other than a mode number indication	Integer 1	None	0 = No Mode 1 = Attitude Rate 2 = Flight Director 3-10 = Reserved 11 = Waypoint 12 = Loiter (circular) 13 = Loiter (racetrack) 14 = Loiter (figure 8) 15 = Autopilot (general) 16 = Autopilot (terrain avoidance) 17 = Autopilot (NavAid slaved) 18 = Ground controlled steering 19 = Autoland engage 20 = Autoland wave-off 21-255 Reserved
5	**Select Sensor Payload Control Mode**	Integer 1	None	0 = No Mode 1 = Manual Pointing 2 = Slaved to Ground Location 3 = Slaved to Moving Target 4 = Target Search 5 = Area Sweep

4.1.2.9 Message #11: Vehicle Steering Command.

This message shall be used to provide the ability to command a new flight vector to the air vehicle. Such commands could be generated either by an automatic plan executive or by manual input. Upon receipt, the vehicle's response shall be to immediately enter into a manoeuvre to achieve the new desired flight state. The vehicle's responsibility shall be to avoid unsafe flight states during the manoeuvre to answer the new command.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See Section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Altitude Command Type**	Integer 1	None	0 = No valid altitude command 1 = Altitude 2 = Altitude Rate 3 = Rate-limited altitude
5	**Commanded Altitude** Altitude hold value to be achieved (ignored in type 2 command mode)	Float	metres	$-1000 \le x \le 100000$
6	**Commanded Altitude Rate** Altitude rate value to be achieved (ignored in type 1 command mode, used as rate limit in type 3)	Float	metres/sec	$-1000 \le x \le 1000$
7	**Heading Command Type**	Integer 1	None	0 = No valid heading command 1 = Heading 2 = Heading Rate 3 = Rate-limited Heading
8	**Commanded Heading** Heading hold value to be achieved (ignored in type 2 command mode)	Float	Rad	$-\pi \le x \le \pi$
9	**Commanded Heading Rate** Heading rate value to be achieved (ignored in type 1 command mode, used as rate limit in type 3)	Float	rad/sec	Configuration dependent
10	**Commanded Airspeed**	Float	Metres/sec	$0 \le x \le 10000$

4.1.2.10 Message #12: Vehicle Control Transition Coordination Message.

This message shall be used to commence a handover of control from one UCS to another. The controlling UCS shall initiate this message to the air vehicle and the acquiring UCS. To effect a control transition, the vehicle shall receive from the acquiring UCS a control assumption acknowledgement command (message #13) within the specified transition interval if authorised control level is Level 3 or above.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See Section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID** (controlling)	Integer 4	None	See Section 1.7.5
4	**Assigned Data Link ID** (controlling UCS)	Integer 2	None	$1 \le x \le 65535$
5	**Acquiring CUCS ID**	Integer 4	None	See Section 1.7.5
6	**Assigned Data Link ID** (acquiring UCS)	Integer 2	None	$1 \le x \le 65535$
7	**Authorized Control Level** (acquiring UCS)	Integer 1	None	$3 \le x \le 5$
8	**Controlled Subsystem Station Number**	Integer 1	None	$1 \le x \le n$ (Determined by vehicle configuration)
9	**Control Transition N Latitude Boundary**	Double	Deg	±90
10	**Control Transition S Latitude Boundary**	Double	Deg	±90
11	**Control Transition E Long. Boundary**	Double	Deg	±180
12	**Control Transition W Long. Boundary**	Double	Deg	±180
13	**Control Transition Lower Alt. Boundary**	Float	Metres	$-1000 \le x \le 100000$
14	**Control Transition Upper Alt. Boundary**	Float	Metres	$-1000 \le x \le 100000$
15	**Control Transition Interval Start Time**	Double	Sec	(See Sect. 1.7.2)
16	**Control Transition Interval End Time**	Double	Sec	(See Sect. 1.7.2)
17	**Acknowledgement Message Required**	Integer 1	None	0 = No 1 = Yes

4.1.2.11 Message #13: Control Assumption Acknowledgement.

This message shall be used to establish the capability of the acquiring UCS to control the air vehicle during and after the handover procedure. The acquiring UCS shall send this message after determining that it has adequate link coverage. There may be some vehicle specific activity that takes place in order to confirm whether the acquiring UCS is authorised to take control, and/or capable of taking control. The data for fields 5 through 7 are derived from receipt of a message #12 that is transmitted either through the air vehicle or via ground communications networks.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See Section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID** (acquiring)	Integer 4	None	See Section 1.7.5
4	**CUCS ID** (relinquishing control)	Integer 4	None	See Section 1.7.5
5	**Assigned Data Link ID** (acquiring UCS)	Integer 2	None	$1 \leq x \leq 65535$
6	**Authorised Control Level** (acquiring UCS)	Integer 1	None	$3 \leq x \leq 5$
7	**Controlled Subsystem Station Number**	Integer 1	None	$1 \leq x \leq n$ (Determined by vehicle config.)

4.1.2.12 Message #14: Handover Status Report.

This message shall be used to report the status of the handover procedure. The air vehicle and acquiring UCS shall send this message to report status.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See Section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID** (acquiring)	Integer 4	None	See Section 1.7.5
4	**CUCS ID** (relinquishing control)	Integer 4	None	See Section 1.7.5
5	**Sender ID**	Integer 4	None	See Section 1.7.5
6	**Status**	Integer 1	None	1 – handoff in progress 2 – handoff successful 3 – handoff failed

Note: The execution of the handover sequence (message sequence of Messages 12, 13 and 14) shall be in accordance with the following process:

- The controlling UCS shall initiate the transfer of Vehicle Control Transition Coordination Message (DLI message #12) to the acquiring UCS via the DLI and/or the CCI.
- In response to message #12, the acquiring UCS shall respond, via the DLI and/or the CCI, with the Control Assumption Acknowledgement Message (DLI message #13).
- The air vehicle, at transition of control to the acquiring UCS as per the "plan" defined in the Vehicle Control Transition Coordination Message (DLI message #12), shall transmit the Handoff Status Report (DLI message #14) to the acquiring UCS (if possible also to the UCS relinquishing control).

- The acquiring UCS, now in control of the air vehicle and/or its payloads as per the Vehicle Control Transition Coordination Message (DLI message #12), shall transmit, via the DLI and CCI, the Handoff Status Report (DLI message #14) to the UCS relinquishing control.
- In Message 14 the SENDER ID shall enable receivers of this message to determine whether the message was sent by the air vehicle or acquiring UCS. The SENDER ID will duplicate either the Vehicle ID or acquiring CUCS ID.

4.1.2.13 Message #15: Mission Upload Command.

The flight mission shall be uploaded to the vehicle as a series of linked waypoints. The start of the message shall indicate the number of points to follow, hence the message is a variable length message. Each waypoint shall indicate its successor to assure proper sequencing. Each point shall be represented as a point in space with a series of states to be matched on or approaching that point. Activities, such as payload manipulation plans, communications plans, weapons delivery plans shall be separately managed and linked to the flight plan by referencing route point numbers in their respective files.

Route point numbers do not need to be sequential or contiguous, but use of sequential and contiguous integers are recommended. Each point shall also specify the manner of propagating from the current state to the goal point. A route point is reached once the vehicle passes within the circle about the goal point formed by the tolerance radius. The route point label is merely a screen display name and shall not be used for indexing or referencing.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See Section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Mission Plan**	Character Var Length	None	Valid ASCII set Null terminated

Mission plans are represented as formatted text. A sample UAV mission plan conforming to the Common Route Definition (CRD) format can be found in the STANAG 4586 Implementation Guide. This sample uses the XML formatting per the most recent version of the "Common Route Definition Interface Control Document". As of this writing, the latest document is version 1.1.2 dated 22 March 2000. The VSM shall contain the functionality required to translate CRD-formatted mission plans into the appropriate vehicle-specific format.

4.1.2.14 Message #16: Flight Termination Command.

This message shall be used to provide a secure means for the CUCS to issue a flight termination command to the VSM. Authentication codes shall be negotiated between the VSM and the CUCS when network connectivity is established between them using a process to be defined. To accomplish flight termination, this message shall be sent twice with two different values in field 4 (once to arm, and a second time to execute).

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Commanded Flight Termination State**	Integer 1	Enumerated	0=Reset FT System 1=Arm FT System 2=Execute FT Seq.
5	**Flight Termination Mode**	Integer 1	Enumerated	0=Not Specified 1-255=Vehicle-specified flight termination mode
6	**Termination Authentication Code** Code used to authenticate that the current user has the authority to issue a flight termination command.	Integer 4	None	0 = null ID $1 \leq x \leq 2^{31}-1$

4.1.3 Vehicle Subsystems Health and Status Messages

The common message set includes summary health and status information for use by CUCS status displays. This information need not convey detailed, configuration-specific health and status information, but must provide the CUCS with overall health summary data suitable for annunciation on the console using conventional colour codes (Green=Nominal, Yellow=Caution, Red= Warning, Black=Failed or Out-of-service). In the event of a system caution or warning, vehicle or configuration-specific status messages can provide detailed diagnostic information peculiar to that configuration.

Support is provided for up to four engines and primary and auxiliary support systems. This message shall provide health and status overview information only in an interoperable context; detailed status information about particular subsystems shall be a vehicle-specific message type.

4.1.3.1 Message #17: System Health Status Summary.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Engine #1 Health**	Integer 1	None	<Status Byte>
5	**Engine #2 Health**	Integer 1	None	<Status Byte>
6	**Engine #3 Health**	Integer 1	None	<Status Byte>
7	**Engine #4 Health**	Integer 1	None	<Status Byte>
8	**Primary Electrical Power**	Integer 1	None	<Status Byte>
9	**Auxiliary Electrical Power**	Integer 1	None	<Status Byte>
10	**Primary Hydraulic Power**	Integer 1	None	<Status Byte>
11	**Auxiliary Hydraulic Power**	Integer 1	None	<Status Byte>
12	**Fuel System Status**	Integer 1	None	<Status Byte>
13	**Navigation System Status**	Integer 1	None	<Status Byte>
14	**Transponder System Status**	Integer 1	None	<Status Byte>
15	**Recovery System Status** (Includes recovery parachutes, drag devices, landing gear, arresting hooks, and any avionics strictly associated with recovery operations.)	Integer 1	None	<Status Byte>
16	**Environmental Control System Status** (Includes cooling, pressurization, etc.)	Integer 1	None	<Status Byte>
17	**Air Data link Terminal Status**	Integer 1	None	<Status Byte>
18	**Ground Data link Terminal Status**	Integer 1	None	<Status Byte>
19	**Payload Deployment System** (Includes control of doors and panels, extension and retraction mechanisms, dispensing mechanisms, antenna apertures, etc.)	Integer 1	None	<Status Byte>
20	**VSM Status**	Integer 1	None	<Status Byte>

Note: <Status byte> enumerated values are: 0 = No Status, 1 = Nominal, 2 = Caution, 3 = Warning, 4 = Emergency, 5 = Failed

4.1.3.2 Message #18: Generic Information Request Message.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Pull Message ID** Type number of the message being requested	Integer 2	None	$1 \le x \le 43$

4.1.3.3 Message #19: Subsystem Status Alert Message.

This message shall be used by the VSM to create a Subsystem Status Alert. Examples are:

- "Engine #3 Failure"
- "Engine #3 Cylinder Head Temp > 280C, currently 295 C"

Note: Subsystem State Report Reference shall be assigned by the VSM however it chooses. The purpose of this field is to provide a reference number for subsequent requests for more information. The CUCS shall respond with a request for additional information using Messages #21 and 22.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Priority**	Integer 1	None	0 = No status 1 = Nominal 2 = Caution 3 = Warning 4 = Emergency 5 = Failed
5	**Subsystem State Report Reference** Identifier associated with a particular report associated with the specified subsystem. Used to request particular status information from the VSM.	Integer 4	None	-1 = no more info available 1 to 2^{31} if more info is available upon demand
6	**Subsystem ID**	Integer 1	None	1 Engine 2 Mechanical 3 Electrical 4 Comms 5 Fuel 6 Navigation 7 Payload 8-20 Reserved
7	**Type**	Integer 1	None	1 = not clearable by operator 2 = clearable by operator 3 = display for fixed time then automatically clear
8	**Text**	Character 80	None	ASCII string

4.1.3.4 Message #20: Subsystem Status Report.

This message shall be used by the VSM to produce a Subsystem Status Report.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See Section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Subsystem ID** Identifier associated with the subsystem for which status information is being reported. Seven generic standard subsystems are identified, IDs above 7 are used for vehicle and payload specific subsystems.	Integer 1	None	1 Engine 2 Mechanical 3 Electrical 4 Comms 5 Fuel 6 Navigation 7 Payload 8-20 Reserved
5	**Subsystem State**	Integer 1	None	0 = No status 1 = Nominal 2 = Caution 3 = Warning 4 = Emergency 5 = Failed
6	**Subsystem State Report Reference** Identifier associated with a particular alert or error state for the specified subsystem. Used to request particular status information from the VSM.	Integer 4	None	-1 = no more info available $1\text{-}2^{31}$ if more info is available upon demand

4.1.3.5 Message #21: Subsystem Status Request.

This message shall be used by the CUCS to request Subsystem information from the VSM.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Subsystem ID** Identifier associated with the subsystem for which status information is being requested. Seven generic standard subsystems are identified, IDs above 7 are used for vehicle and payload specific subsystems.	Integer 1	None	0 All 1 Engine 2 Mechanical 3 Electrical 4 Comms 5 Fuel 6 Navigation 7 Payload 8-20 Reserved

4.1.3.6 Message #22: Subsystem Status Detail Request.

This message shall be used by the CUCS to request more information from the VSM about a specific message. The VSM shall respond using a message in one of the formats specified in Table B1 - 2.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Subsystem State Report Reference** Identifier associated with a particular alert or error state for the specified subsystem. Used to request particular status information from the VSM.	Integer 4	None	-1 = no more info available $1\text{-}2^{31}$ if more info is available upon demand

4.1.4 Payload Command and Status Messages.

Since UAVs are commonly used as carriers for imaging payload sensor systems, the messages in this group are specified to provide a means for the UCS to command sensor operating state in an interoperable fashion. Vehicles not carrying such payloads need not support the messages in this group.

4.1.4.1 Message #23: EO/IR Operating State.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Station Number**	Integer 2	None	1 <= x <= 65535
5	**EO/IR Type** Type is identified using NATO stock numbers, which are 13-digit numerical values conforming with the NATO Codification System as defined in STANAGs 3150 and 3151 define the structure for these values.	Character 13	None	ASCII string
6	**EO/IR Type Revision Level** Number identifying modification level of the type specified in field 4.	Integer 1	None	0 <= x <= 255
7	**System Operating Mode**	Integer 1	None	0 = stowed 1 = off/ 2 = caged 3 = initialising 4 = standby 5 = active 6 = calibrating
8	**EO Camera Status**	Integer 1	None	0 = off 1 = On; B/W mode 2 = On; mode
9	**EO Vertical Image Dimension** Number of pixel rows	Integer 2	None	0 = Off $1 \le x \le 2^{15}$
10	**EO Horizontal Pixel Dimension** Number of pixel columns	Integer 2	None	0 = Off $1 \le x \le 2^{15}$
11	**IR Camera Status**	Integer 1	None	0 = Off 1 = On,uncooled 2 = On, cooled
12	**IR Vertical Image Dimension** Number of pixel rows	Integer 2	None	0 = Off $1 \le x \le 2^{15}$
13	**IR Horizontal Pixel Dimension** Number of pixel columns	Integer 2	None	0 = Off $1 \le x \le 2^{15}$
14	**Current Field of View – Elevation Min** (relative to body x axis)	Float	Radians	$-\pi \le x \le \pi$
15	**Current Field of View – Elevation Max** (relative to body x axis)	Float	Radians	$-\pi \le x \le \pi$
16	**Current Field of View – Azimuth Min** (relative to body x axis)	Float	Radians	$-\pi \le x \le \pi$
17	**Current Field of View – Azimuth Max** (relative to body x axis)	Float	Radians	$-\pi \le x \le \pi$
18	**Field of Regard – Elevation Min**	Float	Radians	$-\pi \le x \le \pi$
19	**Field of Regard – Elevation Max**	Float	Radians	$-\pi \le x \le \pi$
20	**Field of Regard – Azimuth Min**	Float	Radians	$-\pi \le x \le \pi$
21	**Field of Regard – Azimuth Max**	Float	Radians	$-\pi \le x \le \pi$
22	**Pointing Mode**	Integer 1	None	0 = No Value 1 = Body fixed 2 = Fixed rate slewing 3 = Lat-Lon Slaved 4 = Target-slaved 5=Operator Directed

4.1.4.2 Message #24: SAR Operating State. (Continued on Page B1-45)

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Station Number**	Integer 2	None	1 <= x <= 65535
5	**SAR Type** Type is identified using NATO stock numbers, which are 13-digit numerical values as of date of publication.	Character 13	None	ASCII string
6	**SAR Type Revision Level** Number identifying modification level of the type specified in field 4.	Integer 1	None	0 <= x <= 255
7	**Radar Operating Mode** (Reference: STDI-0002, National Imagery and Mapping Agency, "The Compendium of Controlled Extensions (CE) for the National Imagery Transmission Format (NITF)", CMETAA Support Data Extension, Index 300- 600.)	Character 5	None	Collection Mode : OFF – Unpowered INIT - Initializing STDBY – Standby 0FR - Mode 0, slant plane 0FG - Mode 0, ground plane 1FR - Mode 1, slant plane 1FG - Mode 1, ground plane 2FR - Mode 2, slant plane 2FG - Mode 2, ground plane 22FR - Mode 5, slant plane 22FG - Mode 5, ground plane 07A - Mode 3 area, slant plan 07L - Mode 3 LOC, slant plan 14A - Mode 4 area, slant plane 14L - Mode 4 LOC, slant plane 1SP - ETP, spotlight 1, slant 3SP - ETP, spotlight 3, slant 10S - ETP, scan, slant GSP - Tier 2+ spot mode GSH - Tier 2+ search mode AIP13 - Monopulse Calibration AIP14 - Wide Area MTI (WAMTI) AIP15 - Coarse Resolution Search AIP16 -Medium Resolution Search AIP17 - High Resolution Search AIP18 - Point Imaging AIP19 - Swath MTI (SMTI) AIP20 - Repetitive Point Imaging AS201 - Search AS202 - Spot 3 AS204 - Spot 1 AS207 - Continuous Spot 3 AS208 - Continuous Spot 1 AS209 - EMTI Wide Frame Search AS210 - EMTI Narrow Frame Search AS211 - EMTI Augmented Spot AS212 - EMTI Wide Area MTI AS213 - Monopulse Calibration

Position	Data Element Name & Description	Type	Units	Range
8	**Resolution** - Current pixel resolution of SAR product	Integer 2	cm	0 = unknown 1<= x <= 10000
9	**Current Field of View – Elevation Min** (above body x axis)	Float	rad	$-\pi \leq x \leq \pi$
10	**Current Field of View – Elevation Max** (above body x axis)	Float	rad	$-\pi \leq x \leq \pi$
11	**Current Field of View – Azimuth Min** (right of body x axis)	Float	rad	$-\pi \leq x \leq \pi$
12	**Current Field of View – Azimuth Max** (right of body x axis)	Float	rad	$-\pi \leq x \leq \pi$

4.1.4.3 Message #25: Staring (Body Fixed) Camera Status.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Station Number**	Integer 2	None	1 <= x <= 65535
5	**Staring Camera Type** Type is identified using NATO stock numbers, which are 13-digit numerical values as of date of publication.	Integer 8	None	0 = unknown $1 \leq x \leq 2^{64}$
6	**System Operating Mode**	Integer 1	None	0 = off/stowed 1 = initialising 2 = standby 3 = active
7	**Camera Mode**	Integer 1	None	0 = off 1 = On; B/W mode 2 = On; mode
8	**Vertical Image Dimension** Number of pixel rows	Integer 2	None	0 = Off $1 \leq x \leq 2^{15}$
9	**Horizontal Pixel Dimension** Number of pixel columns	Integer 2	None	0 = Off $1 \leq x \leq 2^{15}$
10	**Current Field of View – Elevation Min** (relative to body x axis)	Float	radians	$-\pi \leq x \leq \pi$
11	**Current Field of View – Elevation Max** (relative to body x axis)	Float	radians	$-\pi \leq x \leq \pi$
12	**Current Field of View – Azimuth Min** (relative to body x axis)	Float	radians	$-\pi \leq x \leq \pi$
13	**Current Field of View – Azimuth Max** (relative to body x axis)	Float	radians	$-\pi \leq x \leq \pi$

4.1.4.4 Message #26: Payload Steering Command.

This message shall be used to steer the payload at station n to the pointing angle identified.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Station Number**	Integer 2	None	1 <= x <= 65535
5	**Set Centreline Azimuth Angle** (+ right of aircraft x axis)	Float	Rad	$-\pi \leq x \leq \pi$
6	**Set Centreline Elevation Angle** (+ above aircraft waterline)	Float	Rad	$-\pi \leq x \leq \pi$
7	**Set horizontal field of view**	Float	Rad	$0 \leq x \leq \pi$
8	**Set vertical field of view**	Float	Rad	$0 \leq x \leq \pi$

4.1.4.5 Message #27: Stores Release System Status.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Station Number	Integer 2	None	1 <= x <= 65535
5	Active weapon type	Integer 1	None	0 = no mode 1 = air to air weapon 2 = air to ground weapon 3 = air to surface
6	Active weapon sensors	Integer 1	None	0 = no mode 1 = EO 2 = Laser 3 = EM 4 = IR
7	Active weapon number	Integer 1	None	0 = none selected 1 = one weapon 2 = two weapons
8	Active target acquisition mode	Integer 1	None	0 = no mode 1 = coordinates 2 = sensor-based tracking
9	Active attack mode	Integer 1	None	0 = no mode 1 = time 2 = heading
10	Weapon initialising	Integer 1	None	0 = no mode 1 = sensors initial alignment 2 = seeker steering mode 3 = navigation data loading 4 = target data loading
11	Weapon release clearance	Integer 1	None	0 = not clear 1 = clear
12	Clearance validity	Integer 1	None	0 = not clear 1 = clear
13	Weapon Power State	Integer 1	None	0 = unpowered 1 = powered
14	Rack/Rail/Ejector Unlock	Integer 1	None	0 = Unlocked 1 = Locked
15	Safety Enable Discrete State	Integer 1	None	0 = N/A 1 = Enable 2 = Inhibit
16	Launch Acceptable Region (LAR) Status	Integer 1	None	0 = N/A 1 = Green (Acceptable) 2 = Yellow (Marginal) 3 = Red (Not Acceptable)
17	Safe Separation Status	Integer 1	None	0 = N/A 1 = Green (released) 2 = Red (hung store)

4.1.4.6 Message #28: Stores Release System Command.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	sec	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Station Number	Integer 2	None	1 <= x <= 65535
5	Power Command	Integer 1	None	0 = N/A 1 = power off 2 = power on
6	Active weapon mode command	Integer 1	None	0 = N/A 1 = disarm 2 = initialise 3 = arm 4 = jettison 5 = launch
7	Active target acquisition mode select	Integer 1	None	0 = N/A 1 = coordinates 2 = sensor-based tracking
8	Active attack mode	Integer 1	None	0 = N/A 1 = time 2 = heading
9	Rack/Rail Ejector Enable	Integer 1	None	0 = N/A 1 = Lock 2 = Unlock
10	Safety enable discrete command	Integer 1	None	0 = N/A 1 = enable 2 = inhibit
11	Set Target latitude	Double	Deg	$-90 \leq x \leq 90$
12	Set Target longitude	Double	Deg	$-180 \leq x \leq 180$
13	Set Target altitude	Float	Metres	$-1000 \leq x \leq 100000$
14	Set Target inertial speed (Vx)	Float	m/sec	$-1000 \leq x \leq 1000$
15	Set Target inertial speed (Vy)	Float	m/sec	$-1000 \leq x \leq 1000$
16	Set Target inertial speed (Vz)	Float	m/sec	$-1000 \leq x \leq 1000$

4.1.4.7 Message #29: Payload Data Recorder Status.

This message shall be used to report the status of the platform payload data storage device(s). It assumes that there is a potential for multiple recorders on board the platform and that each recorder has independent play/record states (e.g., is capable of simultaneous record and playback activity.) Recorder status messages shall be sent by request only.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Payload Recording Device Number**	Integer 1	None	0 - 255
5	**Active Index Type** – indicates the type of indexing currently in use on the given recorder.	Integer 1	None	0=Time 1=Block number 2=Event mark 3= Session number
6	**Recording Status**	Integer 1	None	0=Stop 1=Active, Not Ready 2=Ready/Pause 3=Recording
7	**Record Rate**	Float	Mbit/s	$.001 \le x \le 1000$
8	**Current Recording Index**	Integer 4	None	0 = no active index $1 \le x \le 2^{31}$
9	**Record Index Time Stamp** – for events, time of the event, for blocks or sessions, the time of block or session start.	Double	Seconds	See section 1.7.2
10	**Replay Status**	Integer 1	None	0=Stop 1=Active, Not Ready 2=Ready/Pause 3=Reading
11	**Replay Rate**	Float	Mbit/s	$.001 \le x \le 1000$
12	**Current Replay Index**	Integer	None	0 = no active index $1 \le x \le 2^{31}$
13	**Health Status Code**	Integer 2	None	Recorder specific

4.1.4.8 Message #30: Payload Data Recorder Control Command.

This message shall be used to change the state of the platform payload data storage device indicated in the "Station Number" field to the state as specified in the message.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Station Number	Integer 2	None	$1 \le x \le 65535$
5	Set Recording Index Type	Integer 1	None	0=Time 1=Block number 2=Event mark 3= Session number
6	Set Recording Status	Integer 1	None	0=Stop 1=Ready 2=Recording 3=Play 4=Seek
7	Set Recording Rate	Float	Mbit/s	$.001 \le x \le 1000$
8	Initial Recording Index	Integer	None	0 = no active index $1 \le x \le 2^{31}$
9	Set Replay Status	Integer 1	None	0=Stop 1=Ready 2=Reading
10	Replay clock rate	Float	Mbit/s	$.001 \le x \le 1000$
11	Seek replay index	Integer	None	0 = no active index $1 \le x \le 2^{31}$

4.1.4.9 Message #31: Surveillance Target Acquisition Reconnaissance (STAR) EO & Laser Payload Command.

This message shall be used to instruct the VSM to generate all commands for STAR EO/IR and Laser payloads except for payload pointing and FOV change (Zoom) commands which are covered in the Payload Steering Command Message #26.

Notes:

- Payloads with optics are assumed to either have fixed focus optics or to have automatic focus capability.
- The VSM is responsible for ensuring that only valid commands are sent to the AV.
- Slaved modes are assumed to lock on the centre of FOV at the time the command is received by the VSM.
- Target slaving implies that the FOV will track the target.
- Lat-Long slaving implies that the FOV will track a specific location on the ground.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Station Number**	Integer 2	None	$1 \leq x \leq 65535$
5	**Set EO Sensor State**	Integer 1	NA	0=Turn Off 1=Turn On
6	**Set IR Sensor State**	Integer 1	NA	0=Turn Off 1=Turn On 2=Go to Standby
7	**Set EO/IR Pointing Mode**	Integer 1	NA	0=Nil 1=Body Fixed 2=Constant Rate 3=Slewing 4=Lat-Long Slaved 5=Target Slaved 6=Stow
8	**Fire Laser Rangefinder**	Integer 1	NA	0=Turn Off 1=Turn On 2=Fire One Laser Pulse
9	**Select Laser Rangefinder First/Last Pulse**	Integer 1	NA	1=First 2=Last
10	**Set Laser Designator Code**	Integer 2	NA	Laser Illuminator Code per STANAG 5516 (Ed 2) (Link 16) Page E-3-527 DFI #1676 DUI 001
11	**Initiate Laser Designator**	Integer 1	NA	0=Turn Off 1=Turn On 2=Deactivate Laser 3=Activate Laser

4.1.4.10 Message #32: STAR Radar Payload Commands.

This message shall be used to instruct the VSM to generate all commands for Radar Payloads, except for pointing and FOV commands that are covered in the Payload Steering Command Message #26.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Station ID	Integer 2	None	1 ≤ x ≤ 65535
5	Set Radar State	Integer 1	NA	0=Turn Off 1=Turn On 2=Go to 3=Standby 4=Deploy 5=Activate 6=Deactivate 7=Stow
6	Set MTI Radar Mode	Integer 1	NA	1=Clutter Map 2=Moving Target
7	Set SAR Modes	Character 5	NA	Per STDI-0002, National Imagery and Mapping Agency, "The Compendium of Controlled Extensions (CE) for the National Imagery Transmission Format (NITF)", CMETAA Support Data Extension, Index 600. See message #24, field 7 for details)
8	Set Radar Resolution	Integer 2	cm	0=unknown 1 ≤ x ≤ 10,000

4.1.4.11 Message #33: Communications Relay Command Message.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Station ID	Integer 2	None	1 ≤ x ≤ 65535
5	Set Relay State	Integer 1	None	0=Turn Off 1=Turn On 2=Go to Standby 3=Deploy 4=Activate 5=Deactivate 6=Stow

4.1.4.12 Message #34: Communications Relay Status Message.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Station ID	Integer 2	None	$1 \leq x \leq 65535$
5	Set Relay State	Enumerated	NA	0=Turn Off 1=Turn On 2=Go to Standby 3=Deploy 4=Activate 5=Deactivate 6=Stow

4.1.5 IFF Command and Status Messages.

4.1.5.1 Message #35: IFF Code Command.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Mode 1 Code	Integer 1	Units	First digit 0..7 2nd digit 0..3, transmitted as decimal
5	Mode 1 Enable	Integer 1	N/A	0=Off 1=On
6	Mode 2 Code	Integer 2	Units	octal 0000 to 7777, transmitted as decimal
7	Mode 2 Enable	Integer 1	None	0=Off 1=On
8	Mode 3/A Code	Integer 2	None	Octal 0000 to 7777, transmitted as decimal
9	Mode 3/A Enable	Integer 1	None	0=Off 1=On
10	Mode C Enable	Integer 1	None	0=Off 1=On
11	Mode 4 Enable	Integer 1	None	0=Off 1=On
12	Mode 4 A/B	Integer 1	None	A=0/B=1
13	Mode 4 Hold	Integer 1	None	1=Hold, 0=Normal
14	Mode 4 Zeroize	Integer 1	None	1=Zeroize, 0=Normal
15	Mode	Integer 1	None	1=standby 2=normal 3=emergency

4.1.5.2 Message #36: IFF Ident (Squawk) Command.

This message shall be used to activate the transponder to begin sending out an IFF code. This "squawking" shall be maintained for the indicated duration, at which time the system returns to the "standby" state. The system shall use message #35 to cause the IFF subsystem to cease transponding.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Mode 3/A Ident	Integer 1	Units	0 = normal 1 = Ident
5	Ident Duration	Integer 2	Seconds	0 = indefinite $1 \le x \le 65535$

4.1.5.3 Message #37: IFF Status Report.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Mode 1 Code	Integer 1	Units	First digit 0..7 2nd digit 0..3, transmitted as decimal
5	Mode 1 Enabled	Integer 1	N/A	0=Off 1=On
6	Mode 2 Enabled	Integer 1	None	0=Off 1=On
7	Mode 3/A Code	Integer 2	None	Octal 0000 to 7777, transmitted as decimal
8	Mode 3/A Enabled	Integer 1	None	0=Off 1=On
9	Mode C Enabled	Integer 1	None	0=Off 1=On
10	Mode 4 Enable	Integer 1	None	0=Off 1=On
11	Mode 4 A/B	Integer 1	None	A=0/B=1
12	Mode 4 Hold	Integer 1	None	1=Hold, 0=Normal
13	Mode	Integer 1	None	1=standby 2=normal 3=emergency

4.1.6 Data Link Command and Status Messages.

4.1.6.1 Message #38: Data Link Control Command.

This message shall be used to send instructions to the VSM to command the components of the data link. When the VSM is in the AV the Ground Data Terminal (GDT) must be able to read and execute the message instructions.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Data link ID	Integer 2	None	$1 \leq x \leq 65535$
5	Set Data link State	Integer 1	NA	0=Turn Off 1=Turn On 2=Go to Standby 3=Deploy 4=Activate 5=Deactivate 6=Stow 7=Acquire 8=Track
6	Set Data link Type	Enumerate	NA	LOS BLOS
7	Set Data link Mode	Integer	NA	Link Dependent
8	Select Band	Integer 1	NA	Link Dependent
9	Select Channel	Integer 2	NA	Link Dependent
10	Set Channel Lower Frequency	Float	Hz	Link Dependent
11	Set Channel Upper Frequency	Float	Hz	Link Dependent
12	Set antenna azimuth	Float	radians	$0 < x \leq 2\pi$
13	Set antenna elevation	Float	radians	$-\pi \leq x \leq \pi$
14	Set GDT Latitude	Double	Deg	±90
15	Set GDT Longitude	Double	Deg	±180
16	Set GDT Altitude	Float	Metres	$-1000 < x \leq 100000$
17	Set ADT Latitude	Double	Deg	±90
18	Set ADT Longitude	Double	Deg	±180
19	Set ADT Altitude	Float	Metres	$-1000 < x \leq 100000$
20	Acquisition Start Time	Double	Sec	See Sect. 1.7.2
21	Acquisition Stop Time	Double	Sec	See Sect. 1.7.2
22	Idle Timeout Interval	Integer 2	Seconds	$0 \leq x \leq 2^{16}$

4.1.6.2 Message #39: Data Link Status Report.

This message shall be used by the VSM to send the CUCS information on the status of the data link. When the VSM is in the AV the Ground Data Terminal (GDT) must be able to generate this message in response to a request.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See Section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Data link ID**	Integer 2	None	$1 \leq x \leq 65535$
5	**Return Data link State**	Enumerated	NA	0 = Turn Off 1 = Turn On 2 = Go to Standby 3 = Deploy 4 = Activate 5 = Deactivate 6 = Stow 7 = Acquire 8 = Track
6	**Return Data link Type**	Enumerate	NA	LOS BLOS
7	**Return Data link Mode**	Integer	NA	Link Dependent
8	**Return Band**	Integer 1	NA	Link Dependent
9	**Return Channel**	Integer 2	NA	Link Dependent
10	**Return Channel Lower Frequency**	Float	Hz	Link Dependent
11	**Return Channel Upper Frequency**	Float	Hz	Link Dependent
12	**Return antenna azimuth** (relative to True North)	Float	radians	$0 < x \leq 2\pi$
13	**Return antenna elevation** (relative to local horizontal)	Float	radians	$-\pi \leq x \leq \pi$
14	**Return BIT Status**	Integer 1	NA	0 = Normal 1 = Non-Critical 2 = Fault 3 = Critical Fault
15	**Return BIT Code**	Integer 1	NA	0-255
16	**Return BIT Message**	Character 80	NA	Printable ASCII
17	**Return Bit Error Rate**	Float	NA	$10^{-10} \leq x \leq 1$

4.1.7 Miscellaneous Message Types.

4.1.7.1 Message #40: Message Acknowledgement.

This message shall be used to acknowledge standard message types that require acknowledgement per table B1-4 of this document. Vehicle specific message types may also elect to use this message if desired.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5
4	**Original Message Time Stamp**	Double	Seconds	See section 1.7.2
5	**Original Message Instance ID**	Integer 4	NA	0 to 2^{31}-1
6	**Original Message Type**	Integer 4	NA	0 to 2^{31}-1

4.1.7.2 Message #41: CUCS Resource Request.

This message is used to request information concerning services available on the CUCS. The VSM sends this message to the CUCS and receives a response via message #42. No data is associated with this message.

Position	Data Element Name & Description	Type	Units	Range
1	**Time Stamp**	Double	Seconds	See section 1.7.2
2	**Vehicle ID**	Integer 4	None	See Section 1.7.5
3	**CUCS ID**	Integer 4	None	See Section 1.7.5

4.1.7.3 Message #42: CUCS Resource Response.

This message shall be used to communicate to the VSM the resources available within the CUCS for managing operator input and output. It is sent in response to receipt of a message #41 from the VSM.

Position	Data Element Name & Description	Type	Units	Range
1	Time Stamp	Double	Seconds	See section 1.7.2
2	Vehicle ID	Integer 4	None	See Section 1.7.5
3	CUCS ID	Integer 4	None	See Section 1.7.5
4	Number of Pointing Devices Available	Integer 1	None	$0 \leq x \leq 4$
5	Number of Display Screens Available	Integer 1	None	$0 \leq x \leq 4$
6	Keyboard Available	Integer 1	None	0=No 1=Yes
7	HTML Server Available	Integer 1	None	0=No 1=Yes
8	XML Server Available	Integer 1	None	0=No 1=Yes
9	XWindow Server Available	Integer 1	None	0=No 1=Yes
10	JAVA Engine Available	Integer 1	None	0=No 1=Yes
11	PDF Reader Available	Integer 1	None	0=No 1=Yes
12	Display #1 Horizontal Pixels	Integer 2	None	$0 \leq x \leq 65536$
13	Display #1 Vertical Pixels	Integer 2	None	$0 \leq x \leq 65536$
14	Display #2 Horizontal Pixels	Integer 2	None	$0 \leq x \leq 65536$
15	Display #2 Vertical Pixels	Integer 2	None	$0 \leq x \leq 65536$
16	Display #3 Horizontal Pixels	Integer 2	None	$0 \leq x \leq 65536$
17	Display #3 Vertical Pixels	Integer 2	None	$0 \leq x \leq 65536$
18	Display #4 Horizontal Pixels	Integer 2	None	$0 \leq x \leq 65536$
19	Display #4 Vertical Pixels	Integer 2	None	$0 \leq x \leq 65536$

4.2 Vehicle- and Payload-Specific Message Formats.

Section 4.1 defines generic message types common to all compliant systems. Vehicle and payload specific messages may be formatted in a manner determined by the designers of the VSM using any of the methods defined in Section 3.3.1.3. Standard handlers shall be provided by the CUCS for displaying message formats 1 through 4 as shown in Figure B1 - 5.

The CUCS shall provide the services for displaying vehicle or payload specific data according to display formatting contained within the message. Generic displays may be created by sending information either as keyword/value pairs or ASCII text and shall be displayed in ordinary text windows. More richly formatted information may be sent using either XML or HTML formats, in which case the CUCS will provide services for interpreting and displaying information appropriately (such as in a browser window). Display instructions may also be sent as a Java applet, in which case the CUCS shall route the instructions to its Java engine and perform the display commands appropriately. In all cases, vehicle or payload specific displays created at the CUCS using such messaging shall be compliant with Appendix B3 (HCI).

5 Miscellaneous Interfaces.

5.1 Analogue Video Interface.

Interfaces for analogue video lie outside the scope of the DLI. In cases where video data is transmitted to the ground in analogue format, the VSM shall provide services to translate video into digital form consistent with STANAG 4609, 4545, or 7023 for transport across the DLI. Where desired, the VSM may provide an analogue output port for exporting analogue video (e.g., RS-170 format) to displays or other nodes. If displays at the operator station require analogue input, a separate channel may be established between the HCISM and VSM to transmit the data directly.

5.2 Digital Image Data Interface.

Digital Payload Data (still digital imagery, full motion digital imagery, SAR imagery, etc.) shall enter the CUCS via the DLI interface. Digital Payload Data shall be transferred to the CUCS using established NATO standards (STANAGs 7023, 4609, 4545, 4607, as specified in Annex B) for both communication protocol and physical medium.

If bandwidth constraints permit, a physical interface between the CUCS and the VSM can be shared for Digital Payload Data and Command and Status data. Where bandwidth requirements exceed capabilities of the Core-to-VSM physical interface, a separate physical interface (e.g., a second Ethernet port) shall be established for transfer of Digital Payload Data.

Where necessary to satisfy system requirements, the CUCS shall provide the functionality to annotate, display, and distribute Digital Payload Data. The UCS Core shall also provide any necessary functionality to store, retrieve, and display Digital Payload Data.

Any payload-specific metadata that is associated with the digital payload data shall be published on the same interface as the payload data in accordance with applicable NATO standards. The metadata and payload data must be time tagged, and share a common time reference. The resolution of the time tag must be sufficient to fully exploit the payload data. The contents of the metadata shall be sufficient to process the payload data in downstream processes.

If the payload is Motion Imagery in MPEG-2 format, it must be in accordance with STANAG 4609.

APPENDIX B2 - COMMAND AND CONTROL INTERFACE

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

1 Introduction.

1.1 Scope.

STANAG 4586, Annex B Appendix B2 specifies the Command and Control Interface (CCI) between the Unmanned Aerial Vehicle (UAV) Control System (UCS) and Command, Control, Communication, Computer, & Intelligence (C4I) systems.

Standardisation of the CCI is intended to enable NATO nations to achieve interoperability between UAV Systems and C4I users by the implementation of a common set of generic interface standards. A standard CCI should facilitate seamless integration of NATO UAV systems into joint combined C4I infrastructures across all levels of interaction.

The purpose of Appendix B2 is to specify standards covering command, control, and data transmission and receipt from all external systems that need to communicate with the UCS. These standards will lead to the achievement of interoperability between all present (legacy systems) and future UAV systems and designated C4I systems. This appendix specifies standards to be implemented in the UCS, and does not impose any requirements on C4I systems.

1.2 CCI General Overview.

The CCI is an interface between the UCS Core and the external C4I systems. It specifies the data requirements that shall be adopted for communication between the UCS Core and all C4I end users through a common, standard interface. All types of data or information that need to be formally exchanged between the UCS and the external C4I systems must be defined in accordance with the standards specified in this Appendix.

The CCI is intended to cover all types of messages and data that need to be exchanged in both directions between the UCS core and the C4I systems during all the phases of a UAV mission, including:

- Before the flight: tasking messages, tactical situation, environmental data, general mission constraints and mission plans.
- During the flight: status and service messages, payload data, progress reports
- After the flight: status and service messages, payload data, post-flight exploitation reports, mission reports

The format of all data passing across the CCI is defined in this appendix but a UCS implementation or connected C4I system may use other formats provided format translations take place in accordance with the CCI definitions:

- A UCS implementation may be CCI compliant with the UCS core retaining its own, possibly non-standard internal data representation, for example for processing efficiency. Appendix B2 allows UCS core developers to identify data that has to be generated or accepted by the UCS core software in order to be CCI compliant.
- Many C4I systems, particularly legacy systems, may not directly comply with the CCI standards specified in this appendix. To avoid both proliferation of the number of standards specified in the CCI and modifications to the large number of national or joint C4I systems to be connected to UCS, conversion software and/or hardware will be necessary between the CCI and incompatible C4I systems. This conversion software/hardware is shown in Figure B2 - 1 and is called the Command and Control Interface Specific Module (CCISM). The CCISM may form part of a particular UCS implementation to establish a connection between the UCS and specific "customers" of the UAV system (e.g., one or more C4I systems). The CCISM can range in complexity from a simple format or protocol translator to a user-specific application to adapt the type of information to particular C4I requirements.

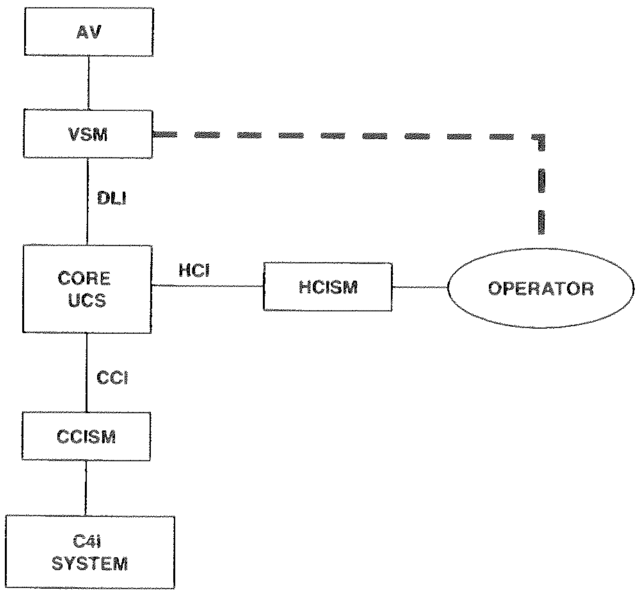


Figure B2 - 1: UCS Interface Functional Architecture

The CCISM is mainly intended for communication with legacy C4I systems that are not directly compatible with STANAG 4586 specified standards, protocols or physical layer. When future C4I systems are developed it is expected that they will be STANAG 4586 compliant in which case there will be a direct link without the need for an intermediate CCISM.

This appendix does not address either the hardware needed for information exchange between the CUCS and the CCISM or the architecture and design of the

CCISM itself. Design, development and fielding of specific CCISM functionality, when needed, will be the responsibility of either the UAV system or the applicable C4I program office.

Also, it is recognised that some communication will take place between the UCS and C4I systems via voice or email. As these methods are inherently unstructured, they fall outside the scope of this STANAG, apart from the need to conform to the requirements of the NATO C3 Technical Architecture (NC3TA), cited in Annex B, to ensure that such communications can take place.

1.3 Appendix B2 Overview.

Appendix B2 is divided into the following sections:

- Section 1: Introduction: Provides a general introduction of the CCI architecture and gives a brief system overview.
- Section 2: CCI Data Description: Identifies and describes the data exchanged between the UCS and the C4I systems. This section concentrates on the description of the information to be transferred across the CCI without specification of data formats.
- Section 3: CCI Data Representation: Defines the data formats that must be implemented in an implementation of the CCI. This chapter covers message formats, file formats, data exchange standards, applicable transfer media and protocols.
- Attachment B2-1: Information Exchange Requirements: Lists the information exchange requirements for communications between the CCI and external systems.
- Attachment B2-2: UCS Allied Data Publication-3 (ADatP-3) Message Implementation Requirements: Lists the set of ADatP-3 messages that are to be transferred across the CCI.
- Attachment B2-3: UAV Level of Interoperability (LOI) ADatP-3 Requirements: Lists the ADatP-3 messages required to achieve each LOI.

1.4 Information Exchange Requirements.

The information exchange requirements (IERs) define the generic data types, criticality of the data, receiving and transmitting nodes, and format of the data that need to be exchanged between the UCS and the various types of C4I systems, as well as other UCSs, to support the operational user mission needs. These IERs, provided in Attachment B2-1 of this appendix, identify the information exchange that needs to take place between the UCS and the external C4I systems to achieve the operationally required feasible LOI according to the UAV system's Concept of Operations (CONOPS). The identification and definition of messages to satisfy these requirements is provided in sections 2 and 3 of this appendix.

1.5 Types of CCI Data.

Figure B2 - 2 depicts the top level of the IERs exchanged between the UCS and the external C4I systems. Further breakdown of these top level IERs is presented in Attachment B2 -1.

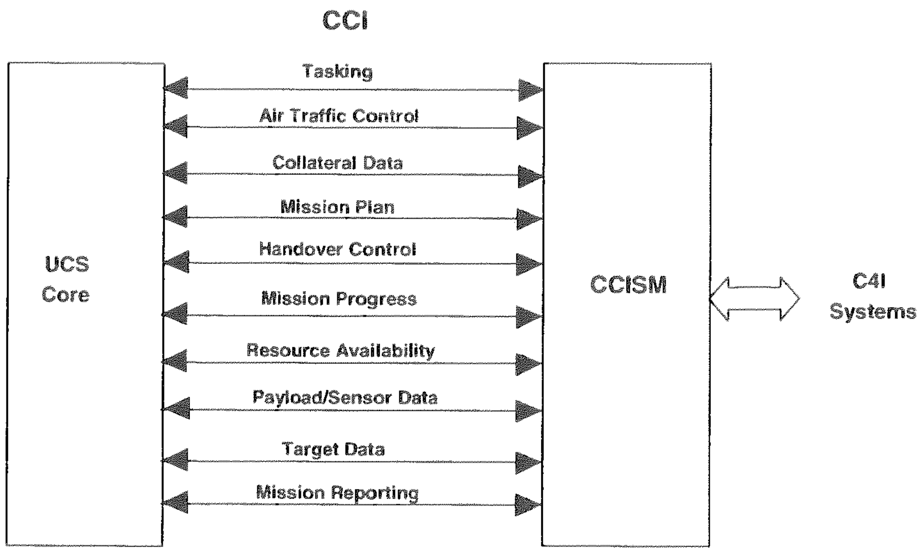


Figure B2 - 2: Types of CCI Data

These data types are described in section 2 of this appendix, and are summarised below:

- Tasking - UAV tasking messages as received from the appropriate tasking authority.
- Air Traffic Control (ATC) - Data that must be sent or received from civil or military aviation authorities if the UAV has to pass through controlled airspace.
- Collateral Data - Supporting information that is required for the planning and execution of UAV missions, and which is not defined in the other data areas. This includes the tactical situation, target database, previously exploited imagery and environmental data.
- Mission Plan - As generated for a tasked mission.
- Handover Control - For handing over control of the air vehicle and/or payload to another UCS.
- Mission Progress - Status as the UAV mission is in progress.
- Resource Availability - Status of the sub components of the UAV system.
- Payload/Sensor Data - Data received from the UAV payload(s), may be raw, processed or exploited.
- Target Data - Near real time target location data for targeting purposes.
- Mission Reporting – Information on the outcome of a mission.

1.6 Implementation of UAV LOI in the CCI.

For an implementation of the UCS to achieve a required LOI, levels 1 through 5, it is necessary for the CCI to specify which different data types are mandatory to achieve a given LOI and above. This is specified in section 3 and Attachments B2 - 1 and B2 - 2 of this appendix by the use of, for example, 3+ to express that inclusion of a data type is mandatory to achieve LOI 3 and above.

However, this does not cover the requirements of particular national and/or NATO concepts of operation for different types of UAV systems which may override the necessity to include particular types of data. For example, section 3.3 states that ATC messages are mandatory to achieve LOI 4+. This may not be appropriate for a UAV that will never use civil airspace, such as a short range tactical UAV, but which is nevertheless required to achieve LOI 4. Operating procedures will vary according to individual national and NATO requirements and are therefore outside the scope of this STANAG. Therefore use of the term mandatory in connection with LOI in this appendix must be interpreted to include the phrase "provided that operating procedures require the exchange of this type of data".

1.7 Strategy for Selection of CCI Standards.

The approach taken in the selection of standards for each type of data given in section 1.5 has been:

- To identify existing NATO standards as specified in various STANAGs and other NATO publications.
- Where such NATO standards do not exist, identify other military or commercial standards that are applicable to that data type.
- Analyse the candidate standards to ensure they meet the requirements of all types of UAV systems.
- Where choices may be made, for example in the selection of ADatP-3 messages, the selected items are given (e.g., the standard is profiled).

Priority has been given to existing NATO standards wherever possible. In some cases, there is a likely future standard that is applicable to some of the data types. Such future standards cannot be specified at this stage as they may change or never be adopted. In these cases, an existing standard has been used, (e.g. ADatP-3), with a switch to the future standard intended for the future.

2 CCI Data Description.

2.1 Introduction.

This section provides a description of each of the data types exchanged between the CUCS and the CCISM, and ultimately the C4I systems.

2.2 Tasking of the UCS.

The CUCS is expected to receive and respond to tasking orders, pre-planned mission plans and mission plan changes requiring dynamic retasking (change of a pre-planned mission after it has been uploaded to the UAV). The response to the tasking order will be a mission plan which may be passed across the CCI interface to higher levels of the command and control structure for deconfliction and approval. (See section 2.5 for a description of the mission plan.)

ADatP-3 tasking messages defined in STANAG 5500 Edition 4 are appropriate for tasking UAV missions within the UCS. It is assumed that the UCS mission planner will be designed to support multi-UAV operations (two or more UAVs flying simultaneously), therefore the CUCS shall be able to receive multi-mission tasking.

In a given UCS, particularly smaller systems, tasking may be received by voice or e-mail messages. These are outside the scope of this STANAG with the exception that e-mail message applications be in compliance with NC3TA's NC3 Common Standards Profile (NCSP) as specified in Annex B.

The CCI shall also provide the capability for dynamic re-tasking of the UAV (e.g., changes to either the flight route or the payload plan). These changes may be required during all phases of an operation.

2.2.1 Tasking.

The most prevalent method of tasking a UAV system is by the use of an Air Tasking Order (ATO) which is common to all air missions, manned and unmanned, across multi-national forces and multi-service operations.

The ATO is an ADatP-3 message that may be very large and complex, possibly several hundred pages in size, not all of which will be applicable to UAV systems. There are other ADatP-3 messages that do not form part of an ATO and that may be used to task individual UAV systems or payloads. Examples include a Road, Bridge or Tunnel Reconnaissance Order (RBTRECCEORD) or an Electronic Warfare Requesting/Tasking Message (EWRTM). The complete list of these tasking messages is given in section 3.2.1.

2.2.2 Airspace Control.

Airspace Management (ASM) is the activity of structuring the airspace and scheduling its use. In the military airspace management system the airspace is structured through the specification of Airspace Control Means (ACM) which define airspace volumes, surfaces and lines, and specific rules for the use of the resulting airspace partitions. The ACMs approved for a given period of time are promulgated in the ADatP-3 Airspace Control Order (ACO). The ACO is based upon the air operations and airspace usage requirements of other Air Command and Control Systems (ACCS), non-ACCS tri-service entities, civil requirements and airspace requests, together with constraints imposed on the use of that airspace.

The ACO allows the separation of all types of aircraft, manned and unmanned, fixed and rotary wing, by the definition of altitude layers and geographic zones. The ACO defines how a volume of airspace is to be structured for air missions over a given period. The ACO defines how this division of airspace will be used by different air operations throughout the 24-hour ACO cycle.

Therefore, for mission planning, a UCS requires the ACO to define the constraints on the route to be flown by the UAV.

2.3 Air Traffic Control (ATC).

When a UAV, particularly a long range strategic UAV, has to pass through controlled airspace, it is necessary to file a flight plan with civil aviation authorities.

The International Civil Aviation Organization (ICAO) publishes a document that specifies the content of all messages that have to be submitted to ATC authorities before, during and after flights. This document is the "Rules of the Air and Air Traffic Services", DOC 4444-RAC/501 currently at the thirteenth edition dated 1996.

The messages may be sent as appropriate and desired over voice channels, by completed paper forms or electronically. Voice messages and paper forms are outside the scope of the CCI, hence only electronic messages are considered below. There are two types of electronic messages specified by the ICAO, Air Traffic Services (ATS) and Automatic Dependent Surveillance (ADS) messages. ADS messages are sent from the air platform via a data link to an ATS unit covering the airspace in which the platform is flying, hence these are not applicable to the UCS and not considered further. However, in order to be compliant with ICAO regulations, the Air Vehicle (AV) must carry a compatible Identification Friend or Foe (IFF) device (e.g., Mode S IFF).

The content and formats of ATS messages are given in Appendix 3 of the above ICAO document. This STANAG does not mandate the use of these messages because they will not be required for some UAV systems (e.g., small UAVs), but does require that, if generated in a particular system, the ICAO format shall be used.

The ATS message types are listed in Table B2 –1:

Category	Message Type	Description
Emergency	Alerting	Contains a description of an emergency
	Radio communication failure	
Filed flight plan and associated update	Filed flight plan	
	Modification	Changes to a flight plan
	Cancellation	Cancellation of a flight plan
	Delay	If departure is delayed
	Departure	Actual departure time
	Arrival	Actual arrival time
Coordination (Note)	Current flight plan	Flight plan plus estimated time at a boundary point
	Estimate	Estimated time at a boundary point
	Coordination	Amendment to coordination data
	Acceptance	Acceptance of the current flight plan, estimate or coordination message
	Logical acknowledgment	Computer to computer acknowledgment
Supplementary	Request flight plan	
	Request supplementary flight plan	
	Supplementary flight plan	Fuel endurance, frequencies available, aircraft markings + others irrelevant to UAVs

Table B2 - 1: Air Traffic Control Messages

Note: Coordination messages are for handing over control from one ATC centre to the next during a flight.

2.4 Collateral Data.

2.4.1 General Battlefield Picture.

Both enemy and own tactical situation can be exchanged between C4I systems and the UCS. This information is carried by messages, which are both incoming and outgoing. Knowledge of the position of own and enemy forces is useful within the UCS to allow the operators to understand the context of the required mission and to optimise the flight plan. Reciprocally, the UCS may use the results of image exploitation to update the local tactical situation (by generating tactical symbols related to observed targets) and to export it through intelligence networks or to upper levels of command.

Information on the tactical situation shall be obtained and reported by use of relevant ADatP-3 messages, particularly the Enemy Situation Report (ENSITREP) and Own Situation Report (OWNSITREP).

2.4.2 Mission Dependent Data.

Some information on the tactical situation may be obtained via additional ADatP-3 messages that are specific to particular missions and/or payloads. An example of this is the Meaconing, Intrusion, Jamming, and Interference (MIJI) Warning Report which provides information on hazardous Electronic Warfare (EW) situations. A full list of this type of message is given in section 3.4.2.

2.4.3 Nuclear, Biological and Chemical (NBC).

The NBC situation is handled by a set of specific NBC reports that are received by all units on the battlefield (see section 3.4.3). These are required by a CUCS both as a hazard warning and to carry out mission planning for NBC payloads.

2.4.4 Artillery Targeting.

A UCS can support artillery operations such as target acquisition and firing support. Information has to be exchanged between the UCS and the artillery networks. There are specific ADatP-3 messages to cover this requirement, for example the Artillery Target Intelligence-Target Information Request (ATI.TIR) that is used to request target information either as a one-time query or as a standing request for target information. Another example is the Artillery Target Intelligence-Artillery Target Report (ATI.ATR) message, which provides a report in response to the ATI.TIR.

2.4.5 Meteorological Data.

Meteorological data is required for UAV mission planning. This includes information related to wind (direction and speed), visibility, significant current and forecasted weather, amount of turbulence, cloud cover, cloud base altitude, cloud top altitude, temperature, and barometric pressure. This is available via the ADatP-3 messages listed in 3.4.5 or via international meteorological data.

2.4.6 Image Products.

There will be a requirement for the operator to read imagery and image products, which are relevant to the area of operation, from external C4I systems. Such collateral material could be needed, for example, for detailed mission planning or image exploitation. It is expected that these image products will be accessed from one of a number of Image Product Libraries (IPLs) held by various NATO or coalition nations. STANAG 4559, the NATO Standard Image Library Interface (NSILI), exists to standardise access to such IPLs.

The UCS may be connected to a C4I Local Area Network (LAN) to allow network file transfers from the external IPLs to the UCS using the software interface specified in STANAG 4559.

Once the operator is logged on to the external IPLs (logging on is beyond the scope of STANAG 4559), NSILI specifies only query and read transactions with IPLs. Writing image products into an IPL is the responsibility of the IPL owner and is outside the scope of both STANAG 4559 and STANAG 4586. Therefore, there is no requirement for the UCS to deposit imagery or image products into external IPLs, merely to send such products to external C4I systems.

NSILI specifies that image products will be delivered in STANAG 4545 format. Delivery of image products will be via the LAN in the majority of cases, but NSILI also permits delivery via other media. If products are delivered on magnetic tape the media must conform to STANAG 7024 with the data stored in STANAG 4545 format. This will require magnetic tape readers conforming to STANAG 7024 to be provided in an implementation of the UCS.

2.5 Mission Plan.

2.5.1 General Considerations.

Mission planning for UAV systems consists of flight route planning, payload planning, data link planning (including frequency planning), and UAV emergency recovery planning (rules of safety). The combined result of these four items comprise the mission plan.

It should be noted that the data required to be able to generate a mission plan is normally far more than contained in these items. A detailed knowledge of current Phase and Boundary lines, Engagement Areas, Hazards, Air Defence Units (ADU) and Control Measures is also required. This information is already covered in the collateral data section.

Pre-planned missions may also be provided across the C4I interface in the form of a mission plan that has been developed by another UAV planning system.

The mission planner also requires vehicle performance models for UAVs controlled by the UCS to calculate fuel consumption, climb rates etc. These performance models will be included in the Vehicle Specific Module (VSM), described in Appendix B1, Data Link Interface.

Other functions that may be available in a mission planner are the ability to do radar shadowing and line of sight evaluations and to show confliction and inter visibility between points and routes. These calculations require a knowledge of ADU/Radar characteristics and the plans of other users.

Planning for designator operations will also require a means of catering for Laser Codes and Keywords.

The capability shall exist to provide the mission plan, or components of the mission plan, as hard or soft copy as required. The outputs from a mission planner may also include printouts of instructions for loading the UAV (e.g., fuel type and amount, sensor/designator settings, and communications frequencies).

2.5.2 Dissemination of the Mission Plan.

The mission plan needs to be sent to different recipients at various times, these include:

- The tasking authority, immediately after generation of the mission plan, for airspace deconfliction and approval
- The air vehicle via the Data Link Interface (DLI) for those UAVs that can autonomously fly a mission plan
- To another UCS for handover of UAV control whether via the DLI and air vehicle or direct via the CCI.

Ideally, the same data format will be used for each transfer of the mission plan data. However it is recognised that not all recipients will require the full mission plan. For those systems it will be possible to extract only the necessary parts. Note that UCS-to-UCS transfer requires the ability for a UCS to receive a mission plan.

ATC is excluded from the list of recipients as there are existing civil flight plan formats (see section 2.3) that are adequate for UCS mission plan formats.

2.5.3 Flight Route Planning.

Flight route planning may be done at the UCS or passed from an external agency. This agency may be Headquarters, another UCS, or come from an intermediate level. A route plan from Headquarters may require additional tactical information to be built into it at the squadron of the Forward Operations Base (FOB) to make it compatible with the current state of the battle space. The instructions might be very detailed, where information about a specific target is required or may be instructions for a Reconnaissance, Intelligence, Surveillance and Target Acquisition (RISTA) type operation and specify only an area of operations. When a route plan comes from another UCS this may be a UAV handover operation with detailed route and instructions or may be a plan generated at another UCS for use by other operators.

A route plan will comprise a set of waypoints. These waypoints may have different parameters, which drive the action to be taken when a waypoint is reached. Flight patterns may be incorporated into the route either as a series of sequenced waypoints or as 'seed' waypoints with range and bearing information, which will depend on the sophistication of the UCS and UAV systems.

2.5.4 Payload Planning.

Payload planning includes details of how a specific payload is to be used. The details of planned payload operations shall be incorporated into the payload plan, and associated to waypoints in the route.

2.5.5 Data Link Planning.

Data link planning includes the details of the links, bands, and frequencies to be used (e.g., see paragraph 3.2.1 Tasking, of this appendix). Data link planning requires initial assignment provided by C4I (e.g., through the OPTASK LINK message) and leads to a set of configuration data that is used by the mission planner. This is sent to the DLI for Data link configuration (see Appendix B1, Data Link Control Command).

2.5.6 Emergency Recovery Plan.

In case of failures such as data link loss, UAVs need to automatically carry out recovery actions referred to as Rules of Safety (ROS). The ROS are selected at the mission planning stage. The ROS differ according to the priority given to emergency action relative to that given to mission execution. Using the mission planning application, the UCS operator selects the appropriate safety scenario (e.g., to define a pre-programmed recovery route).

2.6 Handover Control.

When control of a UAV platform and/or payload is handed over from one UCS to another UCS, various data will need to be transferred between systems before, during, and after that handover procedure. The detailed operating procedure adopted for handover and the actual data to be transferred will vary according to national and NATO CONOPS and is outside the scope of this STANAG. If a common handover procedure were to be defined among several NATO nations, it would be described in an Allied Technical Procedure (ATP). The aim of the CCI and DLI handover-related chapters is to provide the exchange support messages, the sequence of these messages and data needed to allow implementation of different CONOPS.

The handover process is further complicated by the fact that data transfer and coordination may take place via the DLI, the CCI, by voice communications or some combination of all three. This will be specified by a particular UAV system design and accompanying operating procedures. Data transfer and coordination via the DLI and/or voice are outside the scope of the CCI and will not be considered further here.

To provide the flexibility that will be needed to accommodate any operating procedures and UAV system design the CCI shall provide the capability for:

- Exchange of all or any subset of necessary data and/or
- Exchange of coordination messages

A handover is roughly composed of two phases: preparation and execution. The set of data and messages that may be exchanged through C4I communication networks vary accordingly with these two phases:

- Preparation of the handover can take place before the flight (during mission planning) or during the flight (upon request of the non-controlling UCS). In both cases, there is a minimal set of data to be exchanged between the two UCSs in order to properly initiate and secure the procedure:
    - Definition of the location and schedule of the handover
    - Data link modes and frequencies
    - Various configuration parameters.

  A standard coordination message containing this data has been defined (see Appendix B1, DLI message #12), and can be used across the CCI either during mission planning or during the flight. This message would be limited to exchange of information between STANAG 4586 compliant UCSs. An alternative way to prepare the handover procedure is to exchange the whole or any part of the mission plan (see section 2.5).

- Execution of the handover operation will require various means of coordination synchronisation or handshake messages. During that phase, communication between the two UCSs is usually done by voice and/or by data and message exchanged via the air vehicle (see Appendix B1). However, it is possible that the whole set of handover coordination messages defined in Appendix B1 may be exchanged between the UCSs across the CCI. It is also possible to exchange a handover status report using the standard mission progress messages (see section 2.7).

2.7 Mission Progress.

This data is required primarily to inform higher levels of command about the progress of the mission. This includes information on the air vehicle position, status of on-board equipment, fuel levels and ongoing achievement of mission goals. The ADatP-3 message Mission Report (MISREP) amplified by accompanying text in an amplification (AMPN) set shall be used to report this information.

2.8 Resource Availability.

The CCI will have the capability to provide, as well as receive, the status and operational capability of the sub-components of the UAV system. This will include both the Air Segment and the Ground Segment of the UAV system as specified in the following paragraphs.

2.8.1 Air Segment Status.

The status and operational capability of the Air Segment of the UAV system will consist of data relevant to the Air Vehicle(s), the Payload(s), and the Air Data Link(s). The following types of data will be incorporated into the resource availability reporting process:

2.8.1.1 Air Vehicles (AV)

<table>
<tr><td colspan="3">Total number of AVs assigned</td></tr>
<tr><td rowspan="4">UAV type
(repeated for each UAV type)</td><td colspan="2">Number of UAVs of this type</td></tr>
<tr><td rowspan="3">Tail number
(repeated for each UAV of this type)</td><td>AV configuration</td></tr>
<tr><td>AV status (see 2.8.1.4)</td></tr>
<tr><td>AV operational state (see below)</td></tr>
</table>

Table B2 - 2: AV Availability

AV operational state is one of:

- Airborne - Executing a mission
- Ground alert - Ready to fly and execute a mission
- Airborne alert - In flight and awaiting a mission

2.8.1.2 Payloads.

<table>
<tr><td colspan="3">Total number of payloads</td></tr>
<tr><td rowspan="4">Payload type
(repeated for each payload type)</td><td colspan="2">Number of payloads of this type</td></tr>
<tr><td rowspan="3">Payload ID(repeated for each payload)</td><td>Payload Configuration</td></tr>
<tr><td>Payload Status (see 2.8.1.4)</td></tr>
<tr><td>UAV Tail number</td></tr>
</table>

Table B2 - 3: Payload Availability

2.8.1.3 Air Data Terminals (ADT).

Total number of ADTs		
ADT Type (repeated for each ADT type)	Number of ADTs of this type	
	Status (repeated for each type)	Primary link status (see 2.8.1.4)
		Secondary link status (see 2.8.1.4)

Table B2 - 4: ADT Availability

2.8.1.4 Status Table.

This table shows the status data that shall be used for status entries in the tables in sections 2.8.1 and 2.8.2.

Fully Operational	
Limited Operational	Reasons/Limitations
	Estimated Time of Return to Full Ops
Number Non-Operational	Reasons
	Estimated Time of Return to Full Ops

Table B2 - 5: Operational Status Data

2.8.2 Ground Segment Status.

The status and operational capability of the Ground Segment of the UAV system will consist of data relevant to the UCS(s), the Launch System(s), the Recovery System(s) the Ground Data Link(s), and the Maintenance and Refurbishing System(s). The following types of data will be incorporated into the resource availability reporting process:

2.8.2.1 UCSs.

Number of UCSs available to support UAV operations		
UCS ID (Repeated for each UCS)	UCS Configuration (including AV Types supported, and LOI)	
	UCS Status	(see 2.8.1.4)
	CCI Dissemination Capability	C4I Products Supported
		C4I Systems Supported

Table B2 - 6: UCS Availability Data

2.8.2.2 Launch Systems.

Number of launch systems available to support UAV operations		
Launch System ID (repeated for each launch system)	Launch System Configuration (including AV Types supported)	
	Launch System Configuration (including AV Types supported)	
	Status	(see 2.8.1.4)

Table B2 - 7: Launch System Availability

2.8.2.3 Recovery Systems.

Number of recovery systems available to support UAV operations		
Recovery system ID (repeated for each recovery system)	Recovery System Configuration (including AV Types supported)	
	Status	(see 2.8.1.4)

Table B2 - 8: Recovery System Availability

2.8.2.4 Ground Data Terminals (GDT).

Number of GDT's available		
GDT type (repeated for each GDT type)	Number of GDT type available	
	Link status (repeated for each GDT type)	Primary (see 2.8.1.4)
		Secondary (see 2.8.1.4)

Table B2 - 9: GDTs Availability

2.8.2.5 Maintenance and Refurbishing Systems.

Type of replaceable unit (repeated for each type)	Number of each type held
Fuel availability	
Personnel Availability to Perform Maintenance	

Table B2 - 10: Other Unit Resource Availability Data

2.9 Payload/Sensor Data.

2.9.1 Overview.

Sensor data may be received from the air platform in a variety of formats depending on the type of UAV and sensor. Where possible, the formats used to transmit data from the UCS to the C4I systems across the CCI shall use existing international standards (NATO or commercial) so as to minimise the number of formats used in the CCI and by the receiving C4I systems. It is impossible to cover all existing and future types of payloads because of the rate of change in sensor technology. Therefore, only the most common types of sensors have been considered to date; and specific UCS implementations may need to convert from a particular sensor data format to the CCI required data format if the two do not match.

The types of payloads, possible sensor outputs via the CCI, and corresponding applicable standards are summarised in Table B2 –11:

Payload Type	Sensor type	CCI Output	Recommended standards
Electro Optical Electro-Optical (EO)/Infrared (IR)	TV camera	Motion/Still image	STANAG 4545, 7023
	Line scanner	Continuous image/Still image	STANAG 4545, 7023
	Photo sensor	Still image	STANAG 4545, 7023
	Multi/Hyperspectral	still image	STANAG 4545
	Laser designator	None	Not Applicable (N/A)
Radar	Synthetic Aperture Radar (SAR)	Spot	STANAG 4545, 7023
		Swath (Area Search)	STANAG 4545, 7023
	Moving Target Indicator (MTI)	Vector data	STANAG 4607
Signals Intelligence (SIGINT)	Electronics Intelligence (ELINT)	Signal data	JASA Standards Handbook (JSH).
		Dissemination reports	JASA Standards Handbook (JSH).
	Communications Intelligence (COMINT)	Signal data	JASA Standards Handbook JSH).
		Dissemination reports	JASA Standards Handbook (JSH).
Electronic Warfare (EW)	Jammer	None	N/A
Nuclear, Biological, and Chemical (NBC)	Detectors	Dissemination reports	N/A
Communi-cations relay	N/A	None	N/A
Stores/Weapon	N/A	None	N/A

Table B2 - 11: Payload and Sensor Type with CCI Output.

It is recognised that there will be requirements to receive unprocessed (raw) sensor data from particular UAV payloads (for example unprocessed SAR) that may need to be transferred to an external system (for example for exploitation). Such data is likely to be in a proprietary non-standard format, therefore it is outside the scope of the CCI standard and not considered further in this appendix.

Those payloads that provide data to be disseminated via the CCI are described below.

2.9.2 Imagery.

2.9.2.1 Still Imagery.

2.9.2.1.1 Framed.

A framed image is a single rectangular image of a predefined size. The still image can be a standalone image or combined with annotations, symbology and descriptive text. The dimensions of the image are only limited by sensor characteristics.

2.9.2.1.2 Scanned.

Scanned images are typically produced by line scan sensors and the image forms a continuous strip. In this case, the complete image is of indefinite length and the image may cover an irregular path according to platform route, sensor viewing angle etc.

2.9.2.2 Motion Imagery.

2.9.2.2.1 Analogue Video.

Analogue video is a product that is provided by many legacy UAV systems, and also required as an input by some legacy C4I systems. If analogue video is required by a C4I system, it shall be obtained either directly from the VSM (if analogue video is a direct output from the air vehicle to the VSM), or via the CCISM, if format and/or protocol conversion is required. Note that as a function of CCISM design, analogue video can be output from the CCISM in any of the international standard formats desired, and can also include encoding of telemetry metadata within the analogue video stream in a closed caption format in accordance with Video Imagery Standard Profile (VISP) Standard 9709 and VISP recommended practice 971.

(Note: The Core UCS has a requirement to process digital video, but not a requirement to process analogue video. If analogue video is received from the air vehicle, it can be distributed directly to the C4I system from the VSM, and will also be transformed by the VSM into digital video in accordance with STANAG 4609 for processing within the CUCS. If digital video is received from the air vehicle, it can be processed within the UCS; and if a C4I system requires analogue video, the CCISM will need to take the digital video as processed inside the CUCS, and convert it into the analogue video product required)

2.9.2.2.2 Digital Video.

Where higher quality and increased resolution is required, digital imagery shall be output from the CCI in the formats specified in section 3.9.2, Table B2-23.

2.9.3 Radar.

2.9.3.1 Synthetic Aperture Radar (SAR).

SAR data that has been processed on the platform or in the UCS shall be transmitted across the CCI using the same standards as for EO/IR images.

There may be systems (possibly legacy systems) that require SAR processing to be carried out in an external ground station and therefore require the unprocessed data to be transmitted from the UCS. As stated above, this is considered to be non-standard data and is outside the scope of the CCI standard until such time as a standard for this data has been defined.

2.9.3.2 Ground Moving Target Indicator (GMTI).

Processed GMTI data gives the position and velocity of moving targets and hence consists of a set of target vectors.

GMTI also requires extensive processing of the sensor data to generate the target vectors. As with SAR data, this processing could occur in the air or on the ground (either the receiving UCS or another ground station). GMTI data shall be transmitted in accordance with STANAG 4607.

2.9.4 Signals Intelligence (SIGINT).

The UCS must handle SIGINT data and reports generated from processed SIGINT data. Cooperating airborne platforms require that data be fused to generate SIGINT information. This fusion may take place inside a UCS. Therefore, this data must be transmitted to and from the UCS. SIGINT reports may be generated in the UCS for transmission to a user via the CCI.

2.9.5 Nuclear, Biological, and Chemical (NBC).

UAVs can carry a large set of NBC detectors. Results of NBC detection will be transmitted across the CCI through standard NBC reports (see section 3.9.5). This assumes that information required within these reports are generated on board the platform or within the UCS. The CCI will not include unprocessed NBC measurements as there is no known standard format for this data.

2.9.6 Other Payload Types.

2.9.6.1 ESM.

ESM data is derived from analysis of enemy electronic signals and is not included in this issue of the CCI standard as there are no agreed standards to transmit the information. If suitable standards are defined in the future they will be included within the CCI.

2.9.6.2 Multi/Hyperspectral.

Multispectral and hyperspectral images consist of multiple images from different parts of the electromagnetic spectrum. STANAG 7023 and 4545, respectively, are the controlling standards for these type of payloads.

2.10 Target Data.

Near real time target data transmission across the CCI has not been included in this issue of the CCI for the following reason.

- Target reporting requires a commander to approve the target and issue authority to fire; it is unclear whether this should be a function carried out within a UCS or whether the CCI should provide the required data with the near real time performance needed for this type of decision. This issue may be resolved in a future issue of STANAG 4586.

2.11 Mission Reporting.

The UCS will provide the various C4I systems with payload dependent core UCS products; including, but not limited to, payload reports, mission status, mission progress and mission reports. This information may have to be provided on a routine basis during the flight of the UAV, on completion of the mission, on demand, or when specified threshold criteria are met.

Selected C4I systems may be supplied with one or more of the following types of reports:

- Reports derived from sensor processing and/or exploitation
- Mission status reports. In any kind of emergency or unexpected mission event, the ADatP-3 General Information Message (GENINFOMSG) may be used to provide information, which cannot be provided using existing ADatP-3 message text formats. This is a special message used for unusual circumstances that cannot be anticipated or planned, and should not be used on a routine basis. It is not intended to replace existing messages described in section 2.8.
- Mission Progress reports. The ADatP-3 message MISREP may be used to report mission results and items of intelligence interest in all tactical roles. It may also be used to retransmit and/or amplify in-flight reports.
- Final Mission Report. On completion of the mission.

A number of ADatP-3 message reports, as listed in section 3.11, will be used for these types of reports as appropriate.

2.12 General Messages.

There are numerous messages contained in STANAG 5500, NATO FORMETS ADatP-3. Several of these messages are germane to overall UCS C2 functionality and operational mission accomplishment (e.g., operational environments ranging from peacetime to Military Operations Other Than War to Wartime), but do not appropriately fit into the message categories previously discussed. Those messages that are deemed appropriate for UCS operations, but have not been identified in previous sections, are listed in section 3.12.

3 CCI Data Representation.

3.1 Introduction.

This section defines which standards are to be used for the data types described in section 2. Where an ADatP-3 message is mandated, a fuller description of that message and the applicable LOI is contained in Attachment B2-2. Some of these ADatP-3 messages are designated optional and may be included as required by a particular UCS; they are included below for completeness.

3.2 Tasking of the UCS.

3.2.1 Tasking.

The UCS shall be capable of processing the following ADatP-3 message types in order to accomplish the Tasking function:

Index	Identifier	Format Name
A033	FM.CFF	FIRE MISSION-CALL FOR FIRE
A034	FM.SUB	FIRE MISSION-SUBSEQUENT ADJUSTMENT
A035	FM.MTO	FIRE MISSION-MESSAGE TO OBSERVER
A036	FM.FMC	FIRE MISSION-FIRE MISSION COMMAND
A080	FRAGO	FRAGMENTARY ORDER
A087	RBTRECCEORD	ROAD, BRIDGE OR TUNNEL RECONNAISSANCE ORDER
A091	GAPRECCEORD	GAP RECONNAISSANCE ORDER
A099	OBSRECCEORD	OBSTACLE RECONNAISSANCE ORDER
F004	AIRTASK	AIR TASK
F015	AIRALLOC	AIR ALLOCATION MESSAGE
F043	RESPONSE	AIR SUPPORT RESPONSE
F058	ATO	AIR TASKING ORDER
J017	IFFPROD	IFF PROCEDURES
J045	COMMGATEWAYREQ	COMMUNICATIONS GATEWAY REQUEST
J047	COMMGATEWAYWNGO	COMMUNICATIONS GATEWAY WARNING ORDER
J048	COMMGATEWAYEXORD	COMMUNICATIONS GATEWAY EXECUTION ORDER
J050	ORBATTOA LAN-AIR	ORDER OF BATTLE TRANSFER OF AUTHORITY MESSAGE – LAND AND AIR
J051	ROEIMPL	RULES OF ENGAGEMENT IMPLEMENTATION
J060	ROEAUTH	RULES OF ENGAGEMENT AUTHORIZATION
J065	EWSTOPJAM	ELECTRONIC WARFARE STOP JAMMING MESSAGE
J066	EWRTM	ELECTRONIC WARFARE REQUESTING/TASKING MESSAGE

Index	Identifier	Format Name
J070	WCO	WEAPON CONTROL ORDER
J076	ACTWARN	ACTIVATION WARNING MESSAGE
J077	ACTREQ	ACTIVATION REQUEST MESSAGE
J078	ACTORD	ACTIVATION ORDER MESSAGE
J079	LASERWARN	LASER TARGET MARKING WARNING MESSAGE
N010	OPTASK.ASUW	OPERATIONAL TASKING OF ANTI-SURFACE WARFARE
N017	OPTASKLINK	OPERATIONAL TASKING DATA LINK
N023	GREEN	MARITIME UNIT EXECUTION ORDER
N028	OPTASK AIR	OPERATIONAL TASKING ORGANIC AIRCRAFT
N067	OPTASK COMMS	OPERATIONAL TASKING COMMUNICATIONS
N068	OPTASK EW	OPERATIONAL TASKING ELECTRONIC WARFARE

Table B2 - 12: ADatP-3 Tasking Messages

3.2.2 Airspace Control.

Where appropriate for the required LOI, the UCS shall be capable of processing the following ADatP-3 message types in order to accomplish the Airspace Control function:

Index	Identifier	Format Name
A069	SPRT.ACA	SUPPORT AIRSPACE COORDINATION ORDER
F011	ACO	AIRSPACE CONTROL ORDER
F012	ACMREQ	AIRSPACE CONTROL MEANS REQUEST

Table B2 - 13: ADatP-3 Airspace Control Messages

3.3 Air Traffic Control.

The ATS messages summarised in section 2.3 shall be formatted as described in Appendix 3 of the ICAO document, Rules of the Air and Air Traffic Services, Doc 4444-RAC/501. These are mandatory for UAVs that fly in controlled airspace and for LOI 4+.

3.4 Collateral Data.

3.4.1 General Battlefield Picture.

The UCS shall be capable of processing the following ADatP-3 message types in order to accomplish the General Battlefield Picture:

Index	Identifier	Format Name
A026	ENSITREP	ENEMY LAND FORCES SITUATION REPORT
A031	OWNSITREP	OWN LAND FORCES SITUATION REPORT
A032	ORBATLAND	ORDER OF BATTLE – LAND FORCES
A071	SYS.RFR	SYSTEM-REQUEST FOR REPORT
F001	AIRINTREP	AIR INTELLIGENCE REPORT
F006	FAM	FRIENDLY AIR MOVEMENTS
F032	ORBATAIR	ORDER OF BATTLE – AIR FORCES
J009	FIRSTHOSTILEACT	FIRST HOSTILE ACT REPORT
J015	MARINTSUM	MARITIME INTELLIGENCE SUMMARY
J016	MARINTREP	MARITIME INTELLIGENCE REPORT
J019	AIRATTACKWARN	AIR ATTACK WARNING
J038	GEOSITREP	GEOGRAPHIC SITUATION REPORT
J071	TRACKREP	TARGET TRACK REPORT
J111	INTSUM	INTELLIGENCE SUMMARY

Table B2 - 14: ADatP-3 General Battlefield Picture Messages

3.4.2 Mission Dependent Data.

The UCS shall be capable of processing the following ADatP-3 message types in order to provide Mission Dependent Data:

Index	Identifier	Format Name
A058	ATI.ATR	ARTILLERY TARGET INTELLIGENCE-ARTILLERY TARGET REPORT
A059	ATI.TIR	ARTILLERY TARGET INTELLIGENCE-TARGET INFORMATION REQUEST
A070	SPRT.GEOM	SUPPORT-BATTLEFIELD GEOMETRY
J005	COMSPOT	COMMUNICATIONS SPOT REPORT
J006	INCSPOTREP	INCIDENT SPOT REPORT
J018	MIJIWARNREP	MIJI WARNING REPORT
J072	COVREP	WEAPON COVERAGE REPORT
J073	SENSCOVREP	SENSOR COVERAGE REPORT
J110	INTREP	INTELLIGENCE REPORT
N003	JAMWARN	JAMMING WARNING
N025	LOCATOR	MARITIME FORCE LOCATOR

Table B2 - 15: ADatP-3 Mission Dependent Data Messages

3.4.3 NBC.

The UCS shall be capable of processing the following ADatP-3 message types in order to provide NBC Data:

Index	Identifier	Format Name
J022	NBC 6	NBC 6 MESSAGE
J024	NBCSITREP	NBC SITUATION REPORT
J026	NBC3	NBC 3 REPORT
J028	NBC BWR	NBC BASIC WIND REPORT
J033	NBC4	NBC 4 REPORT
J034	NBC5	NBC 5 REPORT
J061	NBC EDR	NBC EFFECTIVE DOWNWIND REPORT

Table B2 - 16: ADatP-3 NBC Data Messages

3.4.4 Artillery Targeting.

The UCS shall be capable of processing the following ADatP-3 message types in order to support Artillery Target Intelligence reporting:

Index	Identifier	Format Name
A058	ATI.ATR	ARTILLERY TARGET INTELLIGENCE – ARTILLERY TARGET REPORT
A059	ATI.TIR	ARTILLERY TARGET INTELLIGENCE – TARGET INFORMATION REQUEST

Table B2 - 17: ADatP-3 Artillery Target Intelligence Messages

3.4.5 Meteorological Data.

The UCS shall be capable of processing the following ADatP-3 message types in order to coordinate Meteorological Data:

Index	Identifier	Format Name
A062	MET.TA	METEOROLOGICAL-TARGET ACQUISITION
A060	MET.CM	METEOROLOGICAL-COMPUTER
A061	MET.RFM	METEOROLOGICAL-REQUEST FOR MET

Table B2 - 18: ADatP-3 Meteorological Data Messages

3.4.6 Image Products.

The UCS shall provide access to external Image Product Libraries via the CCI in accordance with the interface specified in STANAG 4559.

Image products received from an Image Product Library shall be received in STANAG 4545 format for both Local Area Network (LAN) and magnetic tape delivery. If magnetic tape is used for delivery, the tape reader must conform to STANAG 7024.

Inclusion of this capability is largely independent of LOI and therefore optional, but if there is a requirement for a system to access image product libraries for collateral information, then use of STANAG 4559 is mandatory.

3.5 Mission Plan.

A complete mission plan needs to include a flight route plan, payload plan, data link plan, and emergency recovery plan. There is currently no international standard agreed upon that fully defines these four elements of a mission plan. However, there is an ongoing US initiative to specify a Common Route Definition (CRD) that is applicable to a route plan and a limited payload plan. The CRD specification, for reference purpose, will be provided as an attachment to STANAG 4586 Implementation And Validation Guide. In the future it may also be available on a NATO Website. The website address will be provided when available.

To communicate with C4I systems or other UCSs, the UCS shall endeavour to use the CRD format (see DLI Mission Upload Command message as defined in Appendix B1) whenever possible to transmit or receive the flight route and the payload plan.

When not possible, a CCISM shall be provided to translate other C4I system messages. Figure B2-3 provides the notional representation of CRD utilization.

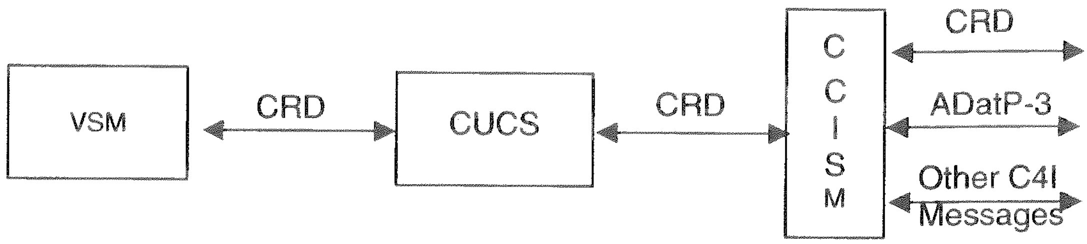


Figure B2 - 3: Notional Mission Plan Interfaces

The capability to transmit and receive mission plans is mandatory for achievement of LOI 2+.

The ROS are likely to be included in the VSM (Appendix B1) for two reasons:

- Scenarios are likely to be specific to particular types of air vehicles as they depend on air vehicle capability, etc.
- Not all existing air vehicles implement ROS.

Therefore a standard for ROS is not proposed in this document.

(NOTE: It is assumed that the emergency recovery plan is not exchanged with the C4I systems.)

3.6 Handover Control.

The capability to handover control of a UAV and payload is mandatory for achievement of UAV LOI 3+.

As discussed in section 2.6, handover execution is usually wholly or partly achieved via the DLI, but may also require the exchange of formatted messages through C4I networks. If operating procedures and/or system design require use of the CCI for this process:

- Transfer of the minimum set of configuration parameters required to prepare the handover procedure shall conform to the requirements of the Vehicle Control Transition Coordination Message (DLI message #12, see Appendix B1).
- Transfer of the whole or part of a mission plan shall conform to the requirements of section 3.5.
- Transfer of mission progress data, if required, shall conform to the requirements of section 3.7

The execution of the handover sequence shall be in accordance with the process described in Appendix B1 and summarized in the following:

- The controlling UCS will initiate the transfer of Vehicle Control Transition Coordination Message (DLI message #12, see Appendix B1) to the acquiring UCS via the DLI and/or the CCI.

- In response to message #12, the acquiring UCS will respond, via the DLI and/or the CCI, with the Control Assumption Acknowledgement Message (DLI message #13, see Appendix B1). The air vehicle, at transition of control to the acquiring UCS as per the "plan" defined in the Vehicle Control Transition Coordination Message (DLI message #12), will transmit the Handoff Status Report (DLI message #14) to the acquiring UCS (if possible also to the UCS relinquishing control).
- The acquiring UCS, now in control of the air vehicle and/or its payloads as per the Vehicle Control Transition Coordination Message (DLI message #12), will transmit, via the DLI and CCI, the Handoff Status Report (DLI message #14) to the UCS relinquishing control.

3.7 Mission Progress.

The UCS shall be capable of processing the ADatP-3 message F031, Mission Report (MISREP), to report mission progress. When appropriate, the MISREP shall include an AMPN message set to report data not included in the standard MISREP message sets.

The capability to transmit mission progress is mandatory for achievement of LOI 2+.

Index	Identifier	Format Name
F031	MISREP	MISSION REPORT

Table B2 - 19: ADatP-3 Mission Report Message

3.8 Resource Availability.

3.8.1 Air Segment Status.

The UCS shall be capable of processing the following ADatP-3 message types in order to provide status and operational capability of the Air Segment:

Index	Identifier	Format Name
J002	ASSESSREP	COMMANDER'S ASSESSMENT REPORT
J029	AIRSTAT	OFFENSIVE WEAPON SYSTEM AND AIR DEFENCE STATUS REPORT
J082	LOGASSESSREP	LOGISTIC ASSESSMENT REPORT
J083	LOGUPDATE	LOGISTIC UPDATE REPORT
J095	SITREP	SITUATION REPORT
J099	CISSITREP	CIS SITUATION REPORT

Table B2 - 20: ADatP-3 Air Segment Status and Operational Capability Messages

3.8.2 Ground Segment Status.

The UCS shall be capable of processing the following ADatP-3 message types in order to provide status and operational capability of the elements of the Ground Segment.

Index	Identifier	Format Name
A010	LOGSITLAND	LOGISTIC SITUATION REPORT LAND FORCES
J002	ASSESSREP	COMMANDER'S ASSESSMENT REPORT
J029	AIRSTAT	OFFENSIVE WEAPON SYSTEM AND AIR DEFENCE STATUS REPORT
J082	LOGASSESSREP	LOGISTIC ASSESSMENT REPORT
J083	LOGUPDATE	LOGISTIC UPDATE REPORT
J095	SITREP	SITUATION REPORT
J099	CISSITREP	CIS SITUATION REPORT

Table B2 - 21: ADatP-3 Ground Segment Status and Operational Capability Messages

3.9 Payload/Sensor Data.

3.9.1 Overview.

This section specifies the standards to be used for transmission of UAV ISR payload data via the CCI.

3.9.2 Imagery.

Standards that shall be used for transmission of imagery data are identified in Table B2-23. The capability to transmit payload data is mandatory for achievement of LOI 2+.

Standard	Imagery Type
STANAG 4545	Still EO/IR, MSI/ HSI, and SAR
STDI-0002	Controlled extensions for STANAG 4545 metadata
STANAG 7023	Still EO/IR, MSI/HSI, and SAR
STANAG 4607	Ground moving target indicator
STANAG 4609	Motion EO/IR, MSI/ HSI

Table B2 - 1: Imagery Standards

3.9.2.1 Still Imagery.

All digital still imagery shall be transmitted over the CCI using STANAG 4545 or 7023 as appropriate. For all still imagery types, STDI-0002 shall be used to record metadata describing the imagery when using STANAG 4545. However when STANAG 7023 is used, metadata describing the imagery shall be captured as specified within STANAG 7023.

3.9.2.2 Digital Motion Imagery

STANAG 4609 (estimated promulgation spring 2004) specifies a standard compression (MPEG-2) and means to capture metadata describing digital motion imagery. Motion imagery, whether collected as analogue or digital, shall be transmitted over the CCI using STANAG 4609 to those C4I systems requiring digital motion imagery.

For those instances where an external CCI node requires analogue imagery, the VSM or the CCISM will provide the necessary conversion (if any required) of the payload imagery to the format required by the respective CCI node, as discussed in section 2.9.2.2.1.

3.9.3 Radar.

3.9.3.1 Synthetic Aperture Radar (SAR).

SAR images shall be transmitted across the CCI in accordance with STANAG 4545 or STANAG 7023 specified formats.

SAR auxiliary text files shall contain support data as defined in STANAG 4545 and STDI-0002, National Imagery and Mapping Agency, "The Compendium of Controlled Extensions (CE) for the National Imagery Transmission Format (NITF)", CMETAA Support Data Extension.

3.9.3.2 Ground Moving Target Indicator (GMTI)

STANAG 4607 (estimated promulgation fall 2003) specifies a common standard format for GMTI data. GMTI data shall be transmitted over the CCI in accordance with STANAG 4607.

3.9.4 SIGINT.

SIGINT data and related reports shall conform to the requirements of the Joint Airborne SIGINT Architecture (JASA) developed by the JASA Standards Working Group (JSWG) and described in the JASA Standards Handbook (JSH).

The JSH specifies that the Collected Signal Data Format (CSDF) manual is followed for collected signals and associated Signal Related Information and metadata to allow sharing and exploitation of unprocessed or semi-processed data between systems.

For data sharing and signal fusion and analysis, the JSH stipulates use of the Signal External Descriptor (SED) Word format.

Dissemination reports shall conform to one of the ten reporting formats permitted by the JSH.

3.9.5 Nuclear, Biological, and Chemical (NBC).

The UCS shall be capable of processing the following ADatP-3 messages to report data from an NBC payload. Note that NBC SITREP is not included as it is envisioned that it will be generated outside the UCS following multi-source analysis. (The NBC SITREP is included in Section 3.4.3.)

Index	Identifier	Format Name
J007	NBC1	NBC 1 REPORT
J020	NBC CDR	NBC CHEMICAL DOWNWIND REPORT
J022	NBC6	NBC 6 REPORT
J023	NBC2	NBC 2 REPORT
J026	NBC3	NBC 3 REPORT
J028	NBC BWR	NBC BASIC WIND REPORT
J033	NBC4	NBC 4 REPORT
J034	NBC5	NBC 5 REPORT
J061	NBC EDR	NBC EFFECTIVE DOWNWIND REPORT

Table B2 - 2: ADatP-3 NBC Data Messages

3.9.6 Other Payload Types.

3.9.6.1 ESM.

ESM data is derived from analysis of enemy electronic signals and is not included in this issue of the CCI standard as there are no agreed standards to transmit the information. If suitable standards are defined in the future they will be included within the CCI.

3.9.6.2 Multi/Hyperspectral.

Multispectral and hyperspectral images consist of multiple images from different parts of the electromagnetic spectrum. STANAG 7023 and 4545, respectively, are the controlling standards for these type of payloads.

3.10 Target Data.

Formats for near real time target data may be included in a future issue of the CCI appendix.

3.11 Mission Reporting.

Where appropriate, the UCS shall be capable of processing the following ADatP-3 messages to report the results from a mission:

Index	Identifier	Format Name
A046	OBSREP	OBSTACLE REPORT
A088	RBTRECCEREP	ROAD, BRIDGE OR TUNNEL RECONNAISSANCE REPORT
A092	GAPRECCEREP	GAP RECONNAISSANCE REPORT
A100	OBSRECCEREP	OBSTACLE RECONNAISSANCE REPORT
F031	MISREP	MISSION REPORT
J046	COMMGATEWAYACC	COMMUNICATIONS GATEWAY ACCEPTANCE
J049	COMMGATEWAYSTATREP	COMMUNICATIONS GATEWAY STATUS REPORT
J064	EWMSNSUM	ELECTRONIC WARFARE MISSION SUMMARY
J101	COMPASSESSREP	COMPLIANCE ASSESSMENT REPORT
J103	RECCEXREP	RECONNAISSANCE EXPLOITATION REPORT
N024	PURPLE	MARITIME MISSION SUMMARY REPORT

Table B2 - 3: ADatP-3 Mission Results Messages

3.12 General Messages.

There are a number of messages that do not appropriately belong in any of the message categories discussed in the previous sections, but that are applicable to UCS functionality and may be necessary to support a given LOI. Attachment B2-2 defines whether they are mandated or optional for a given LOI. Where appropriate the UCS shall be capable of processing the following AdatP-3 messages.

Index	Identifier	Format Name
A009	PRESENCE	PRESENCE REPORT
A027	LOGASREQ	LOGISTIC ASSISTANCE REQUEST
A028	LOGASRESP	LOGISTIC ASSISTANCE RESPONSE
A057	MAPREQ	MAP REQUEST
A072	SYS.RRM	SYSTEM REPLY MESSAGE
F087	MOVEREQ	MOVEMENT REQUEST
F088	MWO	MOVEMENT WARNING ORDER
F089	MEO	MOVEMENT EXECUTION ORDER
F090	MCR	MOVEMENT COMPLETION REPORT
J001	MSGCORRCANX	MESSAGE CORRECTION OR CANCELLATION
J003	GENINFOMSG	GENERAL INFORMATION MESSAGE
J012	SARIR	SEARCH AND RESCUE INCIDENT REPORT
J013	SARREQ	SEARCH AND RESCUE REQUEST
J021	INTREQ	INTELLIGENCE REQUEST
J052	ROEREQ	RULES OF ENGAGEMENT REQUEST
J092	EVENTREP	EVENTS REPORT
J112	CIINTREP	COUNTER-INTELLIGENCE AND SECURITY REPORT
J113	CIINTSUM	COUNTER-INTELLIGENCE AND SECURITY SUMMARY
J114	SUPINTREP	SUPPLEMENTARY INTELLIGENCE REPORT
J115	CISUPINTREP	COUNTER-INTELLIGENCE AND SECURITY SUPPLEMENTARY REPORT
N033	SATVULREP	SATELLITE VULNERABILITY REPORT

Table B2 - 4: ADatP-3 General Messages

Attachment B2 - 1: Information Exchange Requirements

This section contains the Information Exchange Requirements imposed on the UCS and hence on the CCI which, excluding the DLI, represents the external interface to the UCS.

NOTES:

1 "Tx" indicates that this function/product is transmitted from the UCS. "Rx" indicates that this function/product is received by the UCS.

2 The following provides the descriptions of the various Universal Joint Task List (UJTL) numbers identified in this document.

ST 2.2.1	Collect Information on Theatre Strategic Situation
ST 2.4.2.2	Provide Theatre Current Intelligence
ST 2.4.2.4	Provide Target Intelligence for Theatre Planning and Execution
ST 5.1.4	Monitor Worldwide and Theatre Strategic Situation
OP 1.2.5	Conduct Offensive Operations in the Joint Operations Area
OP 1.3.2	Enhance Movement of Operational Forces
OP 2.1.3	Prepare Operational Collection Plan
OP 2.2	Collect and Share Operational Information
OP 2.2.1	Collect Information on Operational Situation
OP 2.2.3	Collect and Assess METOC Information
OP 2.2.5	Collect Target Information
OP 2.4	Produce Operational Intelligence and Prepare Intelligence Products
OP 2.4.2.1	Provide Indications and Warnings for the Joint Operations Area
OP 2.4.2.2	Provide Current Intelligence for the Joint Operations Area
OP 2.4.2.4	Provide Target Intelligence for the Joint Operations Area
OP 2.5	Disseminate and Integrate Operational Intelligence
OP 2.5.3	Provide Near Real Time Intelligence for the Joint Operations Area Planners and Decision Makers
OP 3.1.3	Develop Operational Targets
OP 3.1.6.1	Assess Battle Damage on Operational Targets
OP 5.1.4	Maintain Operational Information and Force Status
OP 5.1.5	Monitor Strategic Situation
OP 5.2	Assess Operational Situation
OP 5.2.1	Review Current Situation
TA 1.2.2	Conduct Joint Airborne Operations
TA 2.2	Obtain and Access Intelligence Information

NOTES:

TA 3.1	Process Targets
TA 5.1	Acquire and Communicate Information and Maintain Status and Force Reporting
TA 5.2.1	Establish, Operate, and Maintain Baseline Communications

3 This indicates the operating LOI of the UCS. The "+" indicates that level and all levels above.

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI) -INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-										
Product/ Action [1]	Rationale (UJTL#) [2]	LOI [3]	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
TASKING Identified in sections 2.2. and 3.2.										
Airspace Control Order (Rx)	ST 5.1.4, OP 2.2.5	4+	STANAG 5500 (ADatP-3) ACO	Tactical Msg		Restricted flight zones: 4-Dimension	JFACC; Any capable ATM node	UCS	Yes; may not always be required	Variable; Minutes to Hours
Tasking Orders (Rx)	ST 2.2.1, ST 2.4.2.2, ST 2.4.2.4, ST 5.1.4	2+	STANAG 5500 (ADatP-3)	Tactical Msg(s)	At min. mandatory fields: (e.g., ATO Msg.)	UAV Mission Tasking; Route, Pyld. Comm. Plan	JFACC or any properly equipped C2 Node	UAV Det or System	Yes	Variable; Minutes to Hours
E-Mail Messages (Rx)	OP 2.2.1 OP 2.2.5	2+	SMTP	Text Message		Min. Mission Plan, e.g. route/target area	Any authorized C2 Node	UAV Det or System	Yes	Variable; Minutes to Hours
Sensor Tasking/Re-tasking (Rx)	OP 2.2.5, OP 2.4.2.2, OP 2.5.3	2+	STANAG 5500 (ADatP-3) SMTP	Tactical Msg, Text Msg		New Plan for Sensor, e.g. AOI, dwell time, etc.	Any authorized C2 Node	UAV Det or System	No. Dependent on mission	Variable; Minutes to Hours
Voice Tasking (Rx)	OP 2.2.5, OP 2.4.2.2, OP 2.5.3	2+	N/A	Voice		Mission Tasking	Any authorized C2 Node	UAV Det or System	Yes	Variable; Minutes to Hours

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI)

-INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-

Product/ Action [(1)]	Rationale (UJTL#) [(2)]	LOI [(3)]	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
AIR TRAFFIC CONTROL Identified in sections 2.3 and 3.3.										
ATS Messages (Tx/Rx)	ST 5.1.4, OP 2.2.5	4+	DOC 4444-RAC/501	Tactical Msg(s)	For operations in civil airspace.	Corridors, Flight Routes, Plan Changes, etc.	JFACC; Any capable ATM node, UCS	JFACC; Any capable ATM node, UCS	Yes; may not always be required	Variable; Minutes to Hours
E-Mail Messages (Tx./Rx)	ST 5.1.4, OP 2.2.5	4+	SMTP	Text Message		Corridors, Flight Routes, etc.	JFACC; Any capable ATM node, UCS	JFACC; Any capable ATM node, UCS	No – unless Tactical Msgs not available	Variable; Minutes to Hours

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI) -INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-										
Product/ Action [(1)]	Rationale (UJTL#) [(2)]	LOI [(3)]	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
COLLATERAL DATA Identified in sections 2.4 and 3.4.										
Tactical Situation (Rx)	OP 2.2.1, OP 5.1.4, OP 5.1.5, TA 5.1	2+ (1+ for some msgs. See AdatP-3 Impl Table)	STANAG 5500 (AdatP-3)	Tactical Msg, Text Msg	Includes, but not limited to Enemy and Friendly Order of Battle and SitReps	Blue/Red Force Location, charact/OB Map Overlay data	Any C2 node having data	UCS	Yes	Variable; Minutes to Hours
Hostile Systems (Tx/Rx)	OP 3.1.3	2+	STANAG 5500 (AdatP-3)	Tactical Msg		Location & Charact. Of threat(s)	Any C2 node having data	UCS	Yes	Variable; Minutes to Hours
Target Database (Update) (Tx/Rx)	TA 3.1, OP 2.4.2.4	2+	STANAG 5500 (AdatP-3)	Tactical Msg, Data		Loc. & type Of all tgts.	UCS; Any C2 node having Tgt data	UCS; Any C2 node having Tgt data	Depends on mission	Variable; Minutes to Hours
Meteorolog-ical Data (Tx/Rx)	OP 2.2.3	2+	STANAG 5500 (AdatP-3)	Tactical Msg, Text Msg		Met. Data for specified location	UCS; Any C2 node having Met data	UCS; Any C2 node having Met data	Depends on mission	Variable; Minutes to Hours
NBC Data (Tx/Rx)	ST 2.2.1, OP 2.2	2+	STANAG 5500 (AdatP-3)	Tactical Msg, Text Msg		NBC Data for specified location	UCS; any C2 node having NBC data	UCS; any C2 node having NBC data	Depends on mission	Variable; Minutes to Hours

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI)
-INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-

Product/ Action (1)	Rationale (UJTL#) (2)	LOI (3)	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
COLLATERAL DATA – Continued Identified in sections 2.4 and 3.4.										
Image Products (Rx)	OP 2.5	1+	STANAG 4559	Digital Imagery		Digital	Any C2 Node having IPL	UCS	Depends on mission; yes for most RSTA	Variable; Minutes to Hours

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI)
-INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-

Product/ Action [1]	Rationale (UJTL#) [2]	LOI [3]	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
MISSION PLAN Identified in sections 2.5 and 3.5. **(For mission plan that is transmitted to C2 for Response to ATO or externally generated mission plan – same as DLI)**										
Flight Route (Tx/Rx)	OP 2.4.2.2, OP 2.5.3	3+	CRD (STANAG is TBD)	Tactical Msg, Text Msg	Internat'l Filing Format	Waypoints, recovery plan, etc. Loaded to AV	UCS, JFACC, or any capable C2 node	UCS, JFACC, or any capable C2 node	Yes; may not always be required	Variable; Minutes to Hours
Collection Data Plan (Tx/Rx)	OP 2.1.3	3+	CRD (STANAG is TBD)	Tactical Msg, Text Msg	To/from AMPS	Payload plan data; formatted message or e-mail	UCS, JFACC, or any capable C2 node	UCS, JFACC, or any capable C2 node	Yes; may not always be required	Variable; Minutes to Hours
Comm Plan (Tx/Rx)	OP 2.5.3	3+	CRD (STANAG is TBD)	Tactical Msg, Text Msg		Data Link plan data	UCS	UCS, JFACC, or any capable C2 node	Yes; may not always be required	Variable; Minutes to Hours
Emergency Recovery Plan		3+	CRD (STANAG is TBD)	Tactical Msg(s), Text Msgs		Emergency Recovery Plan	UCS	UCS, JFACC, or any capable C2 node	Yes; may not always be required	Variable; Minutes to Hours

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI)
-INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-

Product/ Action [1]	Rationale (UJTL#) [2]	LOI [3]	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
HANDOVER CONTROL Identified in sections 2.6 and 3.6. (Includes mission plan (as above) and mission progress (as below) to be transmitted from one UCS to another receiving UCS.)										
AV Handover (Tx/Rx)	OP 1.2.5, OP 2.2, TA 1.2.2, TA 2.2	4+	DLI Specified format	Tactical Msg, Data		Plan for handover of UAV from one UCS to another	UCS; any capable C2 node	UCS	Yes	Variable; Minutes to Hours
Payload Handover (Tx/Rx)	OP 1.2.5, OP 2.2, TA 1.2.2, TA 2.2	3+	DLI Specified format	Tactical Msg, Data		Plan for handover of Pyld from one UCS to another	UCS; any capable C2 node	UCS	Yes	Variable; Minutes to Hours
Handover Control Acknow-ledge	OP 1.2.5, OP 2.2, TA 1.2.2, TA 2.2	3+	DLI Specified format	Tactical Message	Handover alert/ACK		UCS	UCS	Yes	Variable; Seconds to minutes
MISSION PROGRESS Identified in sections 2.7 and 3.7.										
Tactical Messages (Tx/Rx)	OP 2.4.2.1, OP 5.1.4, OP 5.2.1	2+	STANAG 5500 (ADatP-3)	Tactical Msg		AV Position, Sys. Status, Pyld Status, etc.	UCS	UCS; any capable C2 node	Yes	Near real time

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI)
-INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-

Product/ Action (1)	Rationale (UJTL#) (2)	LOI (3)	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
RESOURCE AVAILABILITY Identified in sections 2.8 and 3.8. (Includes entire system availability, including both air segment and ground segment.)										
UAV Status (Tx/Rx)	OP 5.2.1, TA 5.1	1+	STANAG 5500 (ADatP-3)	Tactical Msg, Text Msg	Including payload status.	AV Status, Pyld availability	UAV, UCS	UCS; any capable C2 node	Yes	Variable; Minutes to Hours
Data Link Status (Tx/Rx)	OP 5.2.1, TA 5.1	1+	STANAG 5500 (ADatP-3)	Tactical Msg, Text Msg	Including Air and Ground Data Terminals	D/L type & availability	Data links, UCS	UCS; any capable C2 node	Yes	Variable; Minutes to Hours
UCS Status (Tx)	OP 5.2.1, TA 5.1	1+	STANAG 5500 (ADatP-3)	Tactical Msg, Text Msg		UCS capability & status	UCS	Any capable C2 node	Yes	Variable; Minutes to Hours
Launch and Recovery Sys (Tx/Rx)	OP 5.2.1, TA 5.1	1+	STANAG 5500 (ADatP-3)	Tactical Msg, Text Msg		Launch and Recovery Sys capability & status	Launch and Recovery Systems, UCS	UCS; any capable C2 node	Yes	Variable; Minutes to Hours
Maint. and Refurb Sys (Tx/Rx)	OP 5.2.1, TA 5.1	1+	STANAG 5500 (ADatP-3)	Tactical Msg, Text Msg			UCS	UCS; any capable C2 node	No	Variable; Minutes to Hours

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI) -INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-										
Product/ Action [(1)]	Rationale (UJTL#) [(2)]	LOI [(3)]	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
PAYLOAD/SENSOR DATA (Primary and Secondary) Identified in sections 2.9 and 3.9										
Digital Data (Tx/Rx)										
EO/IR Motion Imagery	OP 2.2.5, OP 2.4	1+	STANAG 4609; MPEG2 ISO/IEC 13818-1 to – 3	Encoded or Decoded imagery stream	EO/IR Framing Line Scan Sensor	Continuous video and telemetry as the AV transmits	UCS	UCS; any capable C4 node	Yes	Variable; Seconds to Hours
EO/IR Still Imagery	OP 2.2.5, OP 2.4	1+	STANAG 7023 STANAG 4545 STDI-0002	Still Imagery	NITF 2.0/2.1	UCS processed/annotated imagery	UCS	UCS; any capable C4 node	Yes	Variable; Seconds to Hours
SAR Processed	OP 2.2.5, OP 2.4	1+	STANAG 7023 STANAG 4545 STDI-0002	Encoded Imagery Stream Or Still Imagery	SAR Data formed into an image	Continuous video and telemetry as the AV transmits Or UCS processed/annotated imagery	UCS	UCS; any capable C4 node	No (If other imagery available)	Variable; Seconds to Hours

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI)
-INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-

Product/ Action [1]	Rationale (UJTL#) [2]	LOI [3]	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
GMTI Processed	OP 2.2.5, OP 2.4	1+	**STANAG 4607**	MTI Tracks & Vectors		Continuous data as the AV transmits	UCS	UCS; any capable C4 node	No (If other imagery available)	Variable; Seconds to Hours
MSI, HSI	OP 2.2.5, OP 2.4	1+	**STANAG 4545** **STANAG 7023**		Future Implement					
SIGINT Data (ELINT and COMINT)	OP 2.2.5, OP 2.4	1+	**JASA Handbook**			Continuous data as the AV transmits	UCS	UCS; any capable C4 node	Yes	Variable; Seconds to Hours
NBC Data	OP 2.2.5, OP 2.4	1+	**TBD**			Continuous data as the AV transmits	UCS	UCS; any capable C4 node	No (If other data available)	Variable; Seconds to Hours
ESM	OP 2.2.5, OP 2.4	1+	**TBD**		Future Implement					
Weapon Payloads - Unmanned Combat Aerial Vehicles (UCAV) Platforms					Future Implement					

TARGET DATA - Deferred until future update and implementation of STANAG 4586.

Identified in sections 2.10 and 3.10.

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI)
-INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-

Product/ Action (1)	Rationale (UJTL#) (2)	LOI (3)	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
MISSION REPORTING Identified in sections 2.11 and 3.11.										
Mission Status (Tx/Rx)	OP 2.2.1, OP 5.2, TA 5.1	2+ (1+ for some msgs. See ADatP-3 Impl Table)	STANAG 5500 (ADatP-3) SMTP	Tactical Msg, Text Msg		Tasked Mission Status, (pending, in progress, etc.)	UCS	UCS; any capable C2 node	Yes	Variable; Minutes to Hours
Target, Collection Coordinate (Tx/Rx)	OP 2.2.5, TA 3.1	2+	STANAG 5500 (ADatP-3)	Tactical Msg		UAV detected target data	UCS	UCS; any capable C2 node	Yes	Variable; Seconds to Hours
Battlefield Geometry (Tx/Rx)	OP 5.1.5	2+	STANAG 5500 (ADatP-3)	Tactical Msg		Order Of Battle	UCS	UCS; any capable C2 node	Yes	Variable; Minutes to Hours
Recon Rpts (Tx)	OP 2.4, OP 2.5	2+ (1+ for some msgs. See ADatP-3 Impl Table)	STANAG 5500 (ADatP-3)	Tactical Msg		Summary Reports (mission, communicai tions, EW, etc.)	UCS	UCS; any capable C2 node	Yes	Variable; Minutes to Hours
Battle Damage Reports (Tx)	OP 3.1.6.1	2+ (1+ for some msgs. See ADatP-3 Impl Table)	STANAG 5500 (ADatP-3)	Tactical Msg, Video, Imagery	Can be via tactical msg, or BDA imagery.	Damage assessment report	UCS	UCS; any capable C2 node	Yes	Variable; Minutes to Hours

UNMANNED AERIAL VEHICLE CONTROL SYSTEM (UCS) COMMAND AND CONTROL INTERFACE (CCI)
-INFORMATION EXCHANGE REQUIREMENTS (IER) MATRIX-

Product/ Action (1)	Rationale (UJTL#) (2)	LOI (3)	NATO or Internat'l Standard	Format	Remarks	Info/Char	Sending Node	Receiving Node	Critical	Timeliness
MISCELLANEOUS										
LAN Connection	TA 5.2.1	1+	ISO/IEC 8802-3, ANSI/IEEE Std 802.3 (DOD JTA, protocols)	Imagery, Text, Voice, Video, Data	Includes protocols (e.g., TCP, UDP, IP, SMTP, FTP, NFS, MIME, etc.) (Annex B)	N/A	N/A	N/A	Yes	N/A
IPL Interface (Tx)	OP 2.2	1+	STANAG 4559	Imagery	Inherent use of CORBA	NSIF imagery files to IPL	UCS	IPL	Yes	Variable; Seconds to Hours
Digital Voice (Tx/Rx)	TA 5.2.1	1+	H.232	Voice	Voice over IP		UCS; any capable C4 node	UCS; any capable C4 node	No	Real Time

Attachment B2 - 2: UCS ADatP-3 Message Implementation Requirements

The table provided in this attachment contains the list of ADatP-3 messages that are applicable to the UCS. Each message is identified, its function or purpose summarised, and its applicable LOI stated.

Index Ref. No – This column contains the Index Reference Number as listed in ADatP-3. This column also indicates the transmission (Tx) or receipt (Rx) requirements of the UCS.

MTF Identifier – This column contains the Message Text Format Identifier as listed in ADatP-3.

MTF Name – This column contains the Message Text Format Name as listed in ADatP-3.

Function or purpose – This column contains the Function or Purpose as listed in ADatP-3.

LOI – This column contains the applicable LOI associated with each message. This number refers to the lowest level at which the message is mandatory. Below this number, implementation is optional.

Comments – This column contains general comments and cross-references to paragraphs in Annex B and Appendix B2, where applicable.

Attachment B2-2: UCS ADatP-3 Message Implementation Requirements.

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
A009 (Tx)	PRESENCE	Presence Report	The PRESENCE report is used to inform a commander on the deployment of military organizations within his area of responsibility. The report addresses both organizations under his command and those that are not.	Optional	Para 3.12 General Msg
A010 (Tx)	LOGSITLAND	Logistic Situation Report Land Forces	The LOGSITLAND is used to provide a superior headquarters with an evaluation of a unit's or formation's logistical situation, capability, and deficiencies/surpluses.	Optional	Para 3.8.2 Resource Availability, Gnd Seg Status
A026 (Tx/Rx)	ENSITREP	Enemy Land Forces Situation Report	The ENSITREP is used to report and inform on the enemy forces situation, to include: locations, activities, boundaries, status, order of battle (ORBAT) and subordination of units/formations.	2+	Para 3.4.1 Collateral data, Gen Battlefield Pic
A027 (Tx)	LOGASREQ	Logistics Assistance Request	The LOGASREQ is used by land forces to request logistics assistance.	Optional	Para 3.12 General Msg
A028 (Rx)	LOGASRESP	Logistics Assistance Response	The LOGASRESP is used by land forces to respond to a request for logistics assistance.	Optional	Para 3.12 General Msg
A031 (Tx/Rx)	OWNSITREP	Own Land Forces Situation Report	The OWNSITREP is used to report factors affecting the situation, deployment, status and/or order of battle of own and subordinate units.	2+	Para 3.4.1 Collateral Data, Gen Battlefield Pic

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
A032 (Rx)	ORBATLAND	Order of Battle - Land Forces	The ORBATLAND is used to inform major NATO commanders (MNC's)/strategic commanders (SC's) and other NATO commanders in peacetime and in periods of crisis and war of changes in the order of battle land forces and thereby to assure that the most current information is available for operational planning.	4+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
A033 (Tx)	FM.CFF	Fire Mission-Call For Fire	The FM.CFF is used to transmit initial fire for effect requests and/or orders to fire.	3+	Para 3.2.1 Tasking
A034 (Tx)	FM.SUB	Fire Mission-Subsequent Adjustment	The FM.SUB is used to transmit updated grid locations, to repeat fire for effect and/or to terminate missions.	3+	Para 3.2.1 Tasking
A035 (Tx/Rx)	FM.MTO	Fire Mission-Message to Observer	The FM.MTO is used to transmit a message to observer in response to a call for fire on a target of opportunity.	3+	Para 3.2.1 Tasking
A036 (Tx)	FM.FMC	Fire Mission-Fire Mission Command	The FM.FMC is used to transmit a fire mission command to a fire unit or an observer.	3+	Para 3.2.1 Tasking
A046 (Tx/Rx)	OBSREP	Obstacle Report	The OBSREP is used to report obstacles up the chain of command	2+	Para 3.11 Mission Reporting
A057 (Tx/Rx)	MAPREQ	Map Request	The MAPREQ is used to submit requests for map coverage.	Optional	Para 3.12 General Msg

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
A058 (Tx/Rx)	ATI.ATR	Artillery Target Intelligence-Artillery Target Report	The ATI.ATR is used to transmit targets by target type based on a standing request for information or a one-time query for target information resulting from an ATI.ATR message. It will also be used to establish or delete target information.	2+	Para 3.4.2 Collateral Data, Mission Dependent
A059 (Rx)	ATI.TIR	Artillery Target Intelligence-Target Information Request	The ATI.TIR is used to request target information either as a one-time query or as a standing request for target information.	2+	Para 3.4.2 Collateral Data, Mission Dependent
A060 (Rx)	MET.CM	Meteorological-Computer	The MET.CM is used to transmit computer meteorological data.	2+	Para 3.4.4 Collateral Data, MET
A061 (Tx/Rx)	MET.RFM	Meteorological-Request For Met	The MET.RFM is used to request meteorological support.	2+	Para 3.4.4 Collateral Data, MET
A062 (Tx/Rx)	MET.TA	Meteorological-Target Acquisition	The MET.TA is used to transmit meteorological data for target acquisition purposes.	2+	Para 3.4.4 Collateral Data, MET
A069 (Tx/Rx)	SPRT.ACA	Support-Airspace Coordination Area	The SPRT.ACA is used to establish or delete airspace coordination areas (ACA).	4+	Para 3.2.2 Airspace Control
A070 (Tx/Rx)	SPRT.GEOM	Support-Battlefield Geometry	The SPRT.GEOM is used to establish or delete battlefield geometries (e.g., avenue of approach, axis of advance, target areas, zone of fire) in support of land combat operations for current operations or for a fire plan.	2+	Para 3.4.2 Collateral Data, Mission Dependent

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
A071 (Tx/Rx)	SYS.RFR	System-Request For Report	The SYS.RFR is used to establish or delete a request for ammunition status reports, fire unit status reports, firing sites, battlefield geometry, friendly unit locations, fire plan target lists, and other applicable reports.	2+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
A072 (Tx/Rx)	SYS.RRM	System Reply Message	The SYS.RRM is used to transmit a reply to a received message.	1+	Para 3.6 & 3.12 Handover Control & General Messages
A080 (Rx)	FRAGO	Fragmentary Order	The FRAGO is used to issue key sections of an operation order before the complete order has been produced; provide specific instructions to commanders who do not require the complete operation order; provide a summary of the complete order to serve as confirmatory notes; issue timely changes to existing operation orders or provide an outline operational directive (mission order) for use in fast moving mobile operations.	1+	Para 3.2.1 Tasking
A087 (Rx)	RBTRECCEORD	Road, Bridge or Tunnel Reconnaissance Order	The RBTRECCEORD is used to order the technical reconnaissance along a section of a route.	2+	Para 3.2.1 Tasking
A088 (Tx/Rx)	RBTRECCEREP	Road, Bridge or Tunnel Reconnaissance Report	The RBTRECCEREP is used to report the results of a technical reconnaissance of a road, bridge or tunnel along a section of a route.	2+	Para 3.11 Mission Reporting
A091 (Rx)	GAPRECCEORD	Reconnaissance Order	The GAPRECCEORD is used to order the reconnaissance of a gap-crossing site.	2+	Para 3.2.1 Tasking

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
A092 (Tx/Rx)	GAPRECCEREP	Gap Reconnaissance Report	The GAPRECCEREP is used to report the results of a gap crossing site reconnaissance.	2+	Para 3.11 Mission Reporting
A099 (Rx)	OBSRECCEORD	Obstacle Reconnaissance Order	The OBSRECCEORD is used to order friendly forces to conduct a reconnaissance of friendly or enemy obstacles, either existing or planned.	2+	Para 3.2.1 Tasking
A100 (Tx/Rx)	OBSRECCEREP	Obstacle Reconnaissance Report	The OBSRECCEREP is used to report the results of a reconnaissance of enemy or friendly obstacles, existing or planned.	2+	Para 3.11 Mission Reporting
F001 (Rx)	AIRINTREP	Air Intelligence Report	The AIRINTREP is used to inform SHAPE and ACE commanders of changes in the location, disposition, status and other essential elements of information concerning non-NATO air order of battle.	4+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
F004 (Rx)	AIR TASK	Air Task	The AIRTASK is used to task tactical air support including support for land or maritime operations.	2+	Para 3.2.1 Tasking
F006 (Rx)	FAM	Friendly Air Movements	The FAM is used to inform units of civil and military air movements in their area of interest which are not part of tactical air support for maritime operations (TASMO) or carrier operations.	Optional	Para 3.4.1 Collateral Data, Gen Battlefield Pic
F011 (Rx)	ACO	Airspace Control Order	The ACO is used to provide specific detailed orders for airspace management and control from a higher command to subordinate units	4+	Para 3.2.2 Airspace Control
F012 (Tx/Rx)	ACMREQ	Airspace Control Means Request	The ACMREQ is used to request that a specific airspace control means be specified in a future airspace control order.	4+	Para 3.2.2 Airspace Control

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
F015 (Rx)	AIRALLOC	Air Allocation Message	The AIRALLOC is used to inform subordinate units, formations and/or tasking agencies of the air effort allocated.	2+	Para 3.2.1 Tasking
F031 (Tx/Rx)	MISREP	Mission Report	The MISREP is used to report mission results and items of intelligence interest in all tactical roles and to retransmit and/or amplify in-flight reports.	3+	Para 3.7 & 3.11 Mission Progress & Mission Reporting
F032 (Rx)	ORBATAIR	Order of Battle - Air Forces	The ORBATAIR is used to inform major NATO commanders (MNC's)/strategic commanders (SC's) and other NATO commanders in peacetime and in periods of crisis and war of changes in the order of battle air forces and thereby to assure that the most current information is available for operational planning.	4+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
F043 (Tx)	RESPONSE	Air Support Response	The RESPONSE is used to accept, refuse, or veto an air support request. it may also endorse or state priorities for an air support request.	4+	Para 3.2.1 Tasking
F058 (Rx)	ATO	Air Tasking Order	The ATO is used to task air missions, assign cross-force tasking and may also be used for intraservice tasking.	2+	Para 3.2.1 Tasking
F087 (Tx/Rx)	MOVEREQ	Movement Request	The MOVREQ is used by a unit or higher level to request execution of a deployment of land-based unit(s).	Optional	Para 3.12 General Msg
F088 (Rx)	MWO	Movement Warning Order	The MWO is used by tasking agencies to warn of intended or expected deployments of land-based unit(s).	Optional	Para 3.12 General Msg
F089 (Rx)	MEO	Movement Execution Order	The MEO is used by tasking authorities to order the deployment of land-based unit(s).	Optional	Para 3.12 General Msg

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
F090 (Tx/Rx)	MCR	Movement Completion Report	The MCR is used by land-based units to report the completion of deployment.	Optional	Para 3.12 General Msg
J001 (Tx/Rx)	MSRCORRCANX	Message Correction or Cancellation	He MSGCORRCANX is used to cancel a message(s) and/or to correct the information in a previously transmitted message(s).	1+	Para 3.12 General Msg
J002 (Tx/Rx)	ASSESSREP	Commander's Assessment Report	The ASSESSREP is used to advise superior commanders of the situation/operations in the reporting commander's area of concern, his assessment of the overall situation, and his intended or recommended actions based on that assessment.	Optional	Para 3.8.1 & 3.8.2 Resource Availability, Air Segment Stat & Gnd Segment Stat
J003 (Tx/Rx)	GENINFOMSG	General Information Message	The GENINFOMSG may only be used to provide information which cannot be provided using existing MTFs. This is a special message used for unusual circumstances that cannot be anticipated or planned and should not be used on a routine basis nor is it intended to replace existing messages.	Optional	Para 3.12 General Msg
J005 (Tx/Rx)	COMSPOT	Communications Spot Report	The COMSPOT is used to report actual or forecast communications outages including relocation and EMCON.	2+	Para 3.4.2 Collateral Data, Mission Dependent
J006 (Tx/Rx)	INCSPOTREP	Incident Spot Report	The INCSPOTREP is used to provide time critical information on important events that have an immediate impact on operations.	2+	Para 3.4.2 Collateral Data, Mission Dependent
J007 (Tx/Rx)	NBC1	NBC 1 Report	The NBC1 is used to provide the observer's initial report giving basic data on a single nuclear, biological, or chemical attack.	2+	Para 3.9.5 & 3.9.11 Payload Data, NBC & Mission Reporting

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J009 (Rx)	FIRST HOSTILE ACT	First Hostile Act Report	The FIRST HOSTILE ACT is used to rapidly provide major NATO commands with information on initial enemy/opposition forces (OPFOR) hostile acts in order to enable major NATO commands to react as early as possible.	1+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
J012 (Tx)	SARIR	Search and Rescue Incident Report	The SARIR is used to report any situation which may require a search and rescue effort.	Optional	Para 3.12 General Msg
J013 (Rx)	SARREQ	Search and Rescue Request	The SARREQ is used to request forces to participate in a search and rescue mission.	4+	Para 3.12 General Msg
J015 (Rx)	MARINTSUM	Maritime Intelligence Summary	The MARINTSUM is used to provide periodic summary information pertaining to the movement of non-NATO forces in NATO maritime areas.	1+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
J016 (Rx)	MARINTREP	Maritime Intelligence Report	The MARINTREP is used to provide time sensitive advisory information pertaining to the movement of non-NATO forces in NATO maritime areas.	4+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
J017 (Rx)	IFFPROD	IFF Procedures	The IFFPROD is used to provide friendly forces with effective IFF modes and codes, and effective time periods.	4+	Para 3.2.1 Tasking
J018 (Tx/Rx)	MIJIWARNREP	MIJI Warning Report	The MIJIWARNREP is used in times of peace and crisis to warn NATO nations, commands and units of hazardous electronic warfare situations caused by MIJI incidents, which are of hostile, friendly (inadvertent) or unknown origin.	1+	Para 3.4.2 Collateral Data, Mission Dependent

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J019 (Rx)	AIRATTACKWARN	Air Attack Warning	The AIRATTACKWARN is used to warn of imminent enemy air attacks against friendly forces. It may be used in conjunction with either global early warning (GEW) or local early warning (LEW) messages generated by automated air defence (ad) systems.	1+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
J020 (Rx)	NBC CDR	NBC Chemical Downwind Report	The NBC CDR is used by appropriate agencies every six hours to disseminate a forecast of the meteorological data needed for the chemical hazard area prediction procedure for 3 consecutive 2 hour periods for either the nearest 6 hours or for a period more than 6 hours ahead.	1+	Para 3.9.5 & 3.11 Payload Data, NBC & Mission Reporting
J021 (Tx/Rx)	INTREQ	Intelligence Request	The INTREQ is used to standardise the method by which military authorities and forces of NATO nations and NATO commands request intelligence information.	2+	Para 3.12 General Msg
J022 (Tx/Rx)	NBC6	NBC 6 Message	The NBC6 is used to pass detailed information on chemical attack.	2+	Para 3.4.3 & 3.9.5 Collateral Data, NBC & Payload/Sensor Data, NBC
J023 (Rx)	NBC2	NBC 2 Report	NBC2 is used for disseminating evaluated data of a single nuclear, biological or chemical attack.	1+	Para 3.9.5 Payload/Sensor Data, NBC
J024 (Rx)	NBCSITREP	NBC Situation Report	The NBCSITREP is used for passing information on the NBC situation.	2+	Para 3.4.3 Collateral Data, NBC

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J026 (Tx/Rx)	NBC3	NBC 3 Report	The NBC3 is used for passing immediate warning of predicted contamination and hazard areas following NBC attack.	1+	Para 3.4.3 & 3.9.5 Collateral Data, NBC & Payload/Sensor Data, NBC
J028 (Tx/Rx)	NBC BWR	NBC Basic Wind Report	The NBC BWR is used to report wind direction and speed in 2,000m increments from the surface of the earth to 30,000m altitude for either the nearest 6 hours or for a period more than 6 hours ahead.	Optional	Para 3.4.3 & 3.9.5 Collateral Data, NBC & Payload/Sensor Data, NBC
J029 (Tx)	AIRSTAT	Offensive Weapon System and Air Defence Status Report	The AIRSTAT is used to keep Shape informed on availability of offensive air forces committed to Shape, maritime helicopter and patrol aircraft committed to Shape, and defensive weapon systems committed to the integrated air defence of ACE.	4+	Para 3.8.1 & 3.8.2 Resource Availability, Air Segment Stat & Gnd Segment Stat
J033 (Tx/Rx)	NBC4	NBC 4 Report	The NBC4 is used to report NBC monitoring and survey results.	2+	Para 3.4.3 & 3.9.5 Collateral Data, NBC & Payload/Sensor Data, NBC
J034 (Tx/Rx)	NBC5	NBC 5 Report	The NBC5 is used for passing information on areas of actual nuclear, biological, or chemical contamination.	2+	Para 3.4.3 & 3.9.5 Collateral Data, NBC & Payload/Sensor Data, NBC

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J038 (Rx)	GEOSITREP	Geographic Situation Report	The GEOSITREP is used to keep major subordinate commands informed during periods of tension and war on the geographical situation within ace. The first report is required to inform headquarters of serious shortages and most urgent requirements within the geographic services when military vigilance is declared. It also gives an overall picture of the map/chart reproduction potential immediately available. Continuation reports are required to keep the information up-to-date for evaluation, planning, and coordination by the headquarters.	Optional	Para 3.4.1 Collateral Data, Gen Battlefield Pic
J045 (Tx/Rx)	COMMGATEWAYREQ	Communications Gateway Request	The COMMGATEWAYREQ is used to request the establishment of a communications gateway with another unit/nation.	1+	Para 3.2.1 Tasking
J046 (Tx/Rx)	COMMGATEWAYACC	Communications Gateway Acceptance	The COMMGATEWAYACC is used to respond to a communications gateway request message and to accept the establishment of a gateway link.	1+	Para 3.11 Mission Reporting
J047 (Tx/Rx)	COMMGATEWAYWNGO	Communications Gateway Warning Order	The COMMGATEWAYWNGO is used to announce the operational characteristic of a communications gateway pending the use of a communications gateway executive order.	1+	Para 3.2.1 Tasking
J048 (Tx/Rx)	COMMGATEWAYEXORD	Communications Gateway Executive Order	The COMMGATEWAYEXORD is used to order the establishment of a communications gateway.	1+	Para 3.2.1 Tasking
J049 (Tx/Rx)	COMMGATEWAYSTATREP	Communications Gateway Status Report	The COMMGATEWAYSTATREP is used to report the status of a communications gateway.	1+	Para 3.11 Mission Reporting

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J050 (Rx)	ORBATTOA LAN-AIR	Order of Battle Transfer of Authority Message - Land and Air	The ORBATTOA LAND-AIR is used to report or direct the transfer of operational command (OPCOM) and/or control (OPCON) between nations and NATO or within the NATO chain of command. An ORBATTOA land-air message will normally confirm the delegation of authority requested in ACTWARN and ACTREQ messages.	Optional	Para 3.2.1 Tasking
J051 (Rx)	ROEIMPL	Rules of Engagement Implementation	The ROEIMPL is used to implement and/or cancel specific rules of engagement.	3+	Para 3.2.1 Tasking
J052 (Tx/Rx)	ROEREQ	Rules of Engagement Request	The ROEREQ is used to request authorization to implement specific rules of engagement (roe(s)).	Optional	Para 3.12 General Msg
J060 (Rx)	ROEAUTH	Rules of Engagement Authorization	The ROEAUTH is used by the North Atlantic Council (NAC)/Defence Planning Committee (DPC) to authorize implementation or cancellation of specific rules of engagement (roe(s)).	3+	Para 3.2.1 Tasking
J061 (Rx)	NBC EDR	NBC Effective Downwind Report	The NBC EDR is used to provide the effective downwind data needed for prediction of fallout areas following nuclear burst for either the nearest 6 hours or for a period more than 6 hours ahead, including specific downwind speeds and directions for up to seven selected weapon yields.	2+	Para 3.4.3 & 3.9.5 Collateral Data, NBC & Payload/Sensor Data, NBC
J064 (Tx/Rx)	EWMSNSUM	Electronic Warfare Mission Summary	The EWMSNSUM is used to summarize significant electronic warfare missions and the status of offensive electronic warfare assets.	3+	Para 3.11 Mission reporting

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J065 (Rx)	EWSTOPJAM	Electronic Warfare Stop Jamming Message	The EWSTOPJAM is used to terminate immediately a jamming mission being conducted by an electronic countermeasures asset.	3+	Para 3.2.1 Tasking
J066 (Rx)	EWRTM	Electronic Warfare Requesting/Tasking Message	The EWRTM is used to task component commanders to perform electronic warfare (EW) operations in support of the overall joint EW plan and to support component EW operations.	3+	Para 3.2.1 Tasking
J070 (Rx)	WCO	Weapon Control Order	The WCO is used to order a new weapon control order for SHORAD.	4+	Para 3.2.1 Tasking
J071 (Tx/Rx)	TRACKREP	Target Track Report	The TRACKREP is used to report aircraft movement by track number.	2+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
J072 (Rx)	COVREP	Weapon Coverage Report	The COVREP is used to inform other formations of SHORAD weapon coverage.	4+	Para 3.4.2 Collateral Data, Mission Dependent
J073 (Rx)	SENSCOVREP	Sensor Coverage Report	The SENSCOVREP is used to inform other formations of SHORAD sensor coverage.	4+	Para 3.4.2 Collateral Data, Mission Dependent
J076 (Rx)	ACTWARN	Activation Warning Message	The ACTWARN is used to inform nations, military headquarters, MNCS and other commands of a potential requirement to activate contingency plans, on call forces, special surveillance missions or other unique requirement to employ military forces.	1+	Para 3.2.1 Tasking

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J077 (Tx/Rx)	ACTREQ	Activation Request Message	The ACTREQ is used to request authority from the NATO military committee (NAMILCOM) to activate contingency plans, on call forces, special surveillance missions or other unique requirement to employ military forces.	Optional	Para 3.2.1 Tasking
J078 (Rx)	ACTORD	Activation Order Message	The ACTORD is used to activate contingency plans, on call forces, special surveillance missions or other unique requirement to employ military forces.	1+	Para 3.2.1 Tasking
J079 (Tx/Rx)	LASERWARN	Laser Target Marking Warning Message	The LASERWARN is used to confirm the activation arrangements for laser target markers.	3+	Para 3.2.1 Tasking
J082 (Tx/Rx)	LOGASSESSREP	Logistic Assessment Report	The LOGASSESSREP is used to standardise the method for informing superior headquarters of the command's logistics status and to provide an assessment of the overall logistics situation for forces, together with intended or recommended action.	Optional	Para 3.8.1 & 3.8.2 Resource Availability, Air Segment Status & Gnd Segment Status
J083 (Tx/Rx)	LOGUPDATE	Logistic Update Report	The LOGUPDATE is used to provide NATO commanders with a dynamic update of changes to core database information on stockpiles of specific equipment and consumable materiel held by national forces declared to NATO, as well as specified equipment and materiel held by nations in support of such forces.	Optional	Para 3.8.1 & 3.8.2 Resource Availability, Air Segment Status & Gnd Segment Status

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J092 (Tx/Rx)	EVENTREP	Events Report	The EVENTREP is used to provide NATO HQ and Nations, through the MNC chain of command, information about important events, trends and activities that do not have an element of extreme urgency, but do influence peace support operations force (PSOFOR) (e.g. IFOR, SFOR) operations.	1+	Para 3.12 General Msg
J095 (Tx/Rx)	SITREP	Situation Report	The SITREP is used to provide SACEUR with information of the committed forces capabilities with regard to current and release operations and the overall situation of the involved parties.	1+	Para 3.8.1 & 3.8.2 Resource Availability, Air Segment Status & Gnd Segment Status
J099 (Tx/Rx)	CISSITREP	CIS Situation Report	The CISSITREP is used to provide a periodic report of own communications and information systems (CIS) status in support of operations and exercises.	1+	Para 3.8.1 & 3.8.2 Resource Availability, Air Segment Status & Gnd Segment Status
J101 (Tx/Rx)	COMPASSESSREP	Compliance Assessment Report	The COMPASSESSREP is used to provide MNCS and NATO HQ information of the parties' compliance with accepted agreements concerning the designated 'safe' or other area(s)/exclusion zone(s)/separation zone(s). This report may include assessments.	1+	Para 3.11 Mission Reporting
J103 (Tx/Rx)	RECCEXREP	Reconnaissance Exploitation Report	The Reconnaissance Exploitation Report (RECEXREP) is used to report the results of an air reconnaissance mission by the interpretation of sensor data.	1+	Para 3.11 Mission Reporting

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J110 (Tx/Rx)	INTREP	Intelligence Report	The INTREP is used for the immediate dissemination of key intelligence that could have a significant impact on current and pending operations and planning.	1+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
J111 (Rx)	INTSUM	Intelligence Summary	The INTSUM is used to periodically inform addressees of military, associated political/economical or other related intelligence and the assessment of this. It gives an indication of change in potential OPFOR (opposing force) capabilities, preparedness or military posture, activities, intentions, objectives and/or courses of action in peace, operations other than war, and war.	1+	Para 3.4.1 Collateral Data, Gen Battlefield Pic
J112 (Tx/Rx)	CIINTREP	Counter-Intelligence and Security Report	The CIINTREP is used for the immediate dissemination of counter-intelligence and security information that could have a significant impact on current or pending operations and planning.	Optional	Para 3.12 General Msg
J113 (Tx/Rx)	CIINTSUM	Counter-Intelligence and Security Summary	The CIINTSUM is used to inform addressees periodically on current counter-intelligence and security and to provide estimate of threat posed by hostile intelligence services (his) or subversive groups.	Optional	Para 3.12 General Msg
J114 (Rx)	SUPINTREP	Supplementary Intelligence Report	The SUPINTREP is used for providing all addressees with comprehensive reviews of non-time-sensitive intelligence collected over an extended period of time, or detailed intelligence studies on specific subjects	Optional	Para 3.12 General Msg

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
J115 (Rx)	CISUPINREP	Counter-Intelligence and Security Supplementary Report	The CISUPINTREP is used to provide all addressees with a comprehensive review of all counter-intelligence (CI) data collected over an extended period of time including an assessment of trends in the development of the CI situation. The CISUPINTREP is also used to provide a comprehensive review of one or several specific CI projects.	Optional	Para 3.12 General Msg
N003 (Tx/Rx)	JAMWARN	Jamming Warning	The JAMWARN is used to issue a warning about own jamming operations.	1+	Para 3.4.2 Collateral Data, Mission Dependent
N010 (Rx)	OPTASK ASUW	Operational Tasking of Anti-Surface Warfare	The OPTASK ASUW is used to promulgate detailed tasking and instructions for the conduct of anti-surface warfare.	3+	Para 3.2.1 Tasking
N017 (Rx)	OPTASK LINK	Operational Tasking Data Links	The OPTASK link is used to provide detailed instructions regarding the operations of tactical data links.	2+	Para 3.2.1 Tasking
N023 (Rx)	GREEN	Maritime Unit Execution Order	The GREEN is used to task maritime patrol or surveillance and ASW units.	1+	Para 3.2.1 Tasking
N024 (Tx/Rx)	PURPLE	Maritime Mission Summary Report	The PURPLE is used to provide a comprehensive summary of the activities of a mission or event.	3+	Para 3.11 Mission Reporting
N025 (Tx/Rx)	LOCATOR	Maritime Force Locator	The LOCATOR is used to report surface, subsurface, air, or special interest units operating in the maritime environment.	2+	Para 3.4.2 Collateral Data, Mission Dependent

Index Ref No	MTF Identifier	MTF Name	Function or purpose	LOI	Comments
N028 (Rx)	OPTASK AIR	Operational Tasking Organic Aircraft	The OPTASK air is used for the OTC or delegated authority to promulgate detailed tasking and instructions for all organic aircraft. This message is normally promulgated by the OTC or the air coordinator.	3+	Para 3.2.1 Tasking
N033 (Rx)	SATVULREP	Satellite Vulnerability Report	The SATVULREP is used to promulgate periods of vulnerability to satellite reconnaissance and to prescribe countermeasures to satellite surveillance.	Optional	Para 3.12 General Msg
N067 (Rx)	OPTASK COMMS	Operational Tasking Communications	The OPTASK COMMS is used to promulgate the communications plan in force and provide communications related instructions.	2+	Para 3.2.1 Tasking
N068 (Rx)	OPTASK EW	Operational Tasking Electronic Warfare	The OPTASK EW is used to promulgate detailed tasking and instructions for the conduct of electronic warfare.	3+	Para 3.2.1 Tasking

Attachment B2 - 3: UAV System LOI ADatP-3 Requirements

The following tables provided in this attachment list the ADatP-3 messages that are required to support each UAV system LOI.

Level of Interoperability 1

Index Ref No	MTF Identifier	MTF Name
A072	SYS.RRM	SYSTEM REPLY MESSAGE
A080	FRAGO	FRAGMENTARY ORDER
J001	MSRCORRCANX	MESSAGE CORRECTION OR CANCELLATION
J009	FIRST HOSTILE ACT	FIRST HOSTILE ACT REPORT
J015	MARINTSUM	MARITIME INTELLIGENCE SUMMARY
J018	MIJIWARNREP	MIJI WARNING REPORT
J019	AIRATTACKWARN	AIR ATTACK WARNING
J020	NBC CDR	NBC CHEMICAL DOWNWIND REPORT
J023	NBC2	NBC 2 REPORT
J026	NBC3	NBC 3 REPORT
J045	COMMGATEWAYREQ	COMMUNICATIONS GATEWAY REQUEST
J046	COMMGATEWAYACC	COMMUNICATIONS GATEWAY ACCEPTANCE
J047	COMMGATEWAYWNGO	COMMUNICATIONS GATEWAY WARNING ORDER
J048	COMMGATEWAYEXORD	COMMUNICATIONS GATEWAY EXECUTIVE ORDER
J049	COMMGATEWAYSTATREP	COMMUNICATIONS GATEWAY STATUS REPORT
J076	ACTWARN	ACTIVATION WARNING MESSAGE
J078	ACTORD	ACTIVATION ORDER MESSAGE
J092	EVENTREP	EVENTS REPORT
J095	SITREP	SITUATION REPORT
J099	CISSITREP	CIS SITUATION REPORT
J101	COMPASSESSREP	COMPLIANCE ASSESSMENT REPORT
J103	RECCEXREP	RECONNAISSANCE EXPLOITATION REPORT
J110	INTREP	INTELLIGENCE REPORT
J111	INTSUM	INTELLIGENCE SUMMARY
N003	JAMWARN	JAMMING WARNING
N023	GREEN	MARITIME UNIT EXECUTION ORDER

Level of Interoperability 2

All lower LOI messages are required plus the following messages:

Index Ref No	MTF Identifier	MTF Name
A026	ENSITREP	ENEMY LAND FORCES SITUATION REPORT
A031	OWNSITREP	OWN LAND FORCES SITUATION REPORT
A046	OBSREP	OBSTACLE REPORT
A058	ATI.ATR	ARTILLERY TARGET INTELLIGENCE-ARTILLERY TARGET REPORT
A059	ATI.TIR	ARTILLERY TARGET INTELLIGENCE-TARGET INFORMATION REQUEST
A060	MET.CM	METEOROLOGICAL-COMPUTER
A061	MET.RFM	METEOROLOGICAL-REQUEST FOR MET
A062	MET.TA	METEOROLOGICAL-TARGET ACQUISITION
A070	SPRT.GEOM	SUPPORT-BATTLEFIELD GEOMETRY
A071	SYS.RFR	SYSTEM-REQUEST FOR REPORT
A087	RBTRECCEORD	ROAD, BRIDGE OR TUNNEL RECONNAISSANCE ORDER
A088	RBTRECCEREP	ROAD, BRIDGE OR TUNNEL RECONNAISSANCE REPORT
A091	GAPRECCEORD	RECONNAISSANCE ORDER
A092	GAPRECCEREP	GAP RECONNAISSANCE REPORT
A099	OBSRECCEORD	OBSTACLE RECONNAISSANCE ORDER
A100	OBSRECCEREP	OBSTACLE RECONNAISSANCE REPORT
F004	AIR TASK	AIR TASK
F015	AIRALLOC	AIR ALLOCATION MESSAGE
F058	ATO	AIR TASKING ORDER
J005	COMSPOT	COMMUNICATIONS SPOT REPORT
J006	INCSPOTREP	INCIDENT SPOT REPORT
J007	NBC1	NBC 1 REPORT
J021	INTREQ	INTELLIGENCE REQUEST
J022	NBC6	NBC 6 MESSAGE
J024	NBCSITREP	NBC SITUATION REPORT
J033	NBC4	NBC 4 REPORT
J034	NBC5	NBC 5 REPORT
J061	NBC EDR	NBC EFFECTIVE DOWNWIND REPORT
J071	TRACKREP	TARGET TRACK REPORT
N017	OPTASK LINK	OPERATIONAL TASKING DATA LINKS
N025	LOCATOR	MARITIME FORCE LOCATOR
N067	OPTASK COMMS	OPERATIONAL TASKING COMMUNICATIONS

Level of Interoperability 3

All lower LOI messages are required plus the following messages:

Index Ref No	MTF Identifier	MTF Name
A033	FM.CFF	FIRE MISSION-CALL FOR FIRE
A034	FM.SUB	FIRE MISSION-SUBSEQUENT ADJUSTMENT
A035	FM.MTO	FIRE MISSION-MESSAGE TO OBSERVER
A036	FM.FMC	FIRE MISSION-FIRE MISSION COMMAND
F031	MISREP	MISSION REPORT
J051	ROEIMPL	RULES OF ENGAGEMENT IMPLEMENTATION
J060	ROEAUTH	RULES OF ENGAGEMENT AUTHORIZATION
J064	EWMSNSUM	ELECTRONIC WARFARE MISSION SUMMARY
J065	EWSTOPJAM	ELECTRONIC WARFARE STOP JAMMING MESSAGE
J066	EWRTM	ELECTRONIC WARFARE REQUESTING/TASKING MESSAGE
J079	LASERWARN	LASER TARGET MARKING WARNING MESSAGE
N010	OPTASK ASUW	OPERATIONAL TASKING OF ANTI-SURFACE WARFARE
N024	PURPLE	MARITIME MISSION SUMMARY REPORT
N028	OPTASK AIR	OPERATIONAL TASKING ORGANIC AIRCRAFT
N068	OPTASK EW	OPERATIONAL TASKING ELECTRONIC WARFARE

Level of Interoperability 4 and 5

All lower LOI messages are required plus the following messages:

Index Ref No	MTF Identifier	MTF Name
A032	ORBATLAND	ORDER OF BATTLE - LAND FORCES
A069	SPRT.ACA	SUPPORT-AIRSPACE COORDINATION AREA
F001	AIRINTREP	AIR INTELLIGENCE REPORT
F011	ACO	AIRSPACE CONTROL ORDER
F012	ACMREQ	AIRSPACE CONTROL MEANS REQUEST
F032	ORBATAIR	ORDER OF BATTLE - AIR FORCES
F043	RESPONSE	AIR SUPPORT RESPONSE
J013	SARREQ	SEARCH AND RESCUE REQUEST
J016	MARINTREP	MARITIME INTELLIGENCE REPORT
J017	IFFPROD	IFF PROCEDURES
J029	AIRSTAT	OFFENSIVE WEAPON SYSTEM AND AIR DEFENCE STATUS REPORT
J051	ROEIMPL	RULES OF ENGAGEMENT IMPLEMENTATION
J070	WCO	WEAPON CONTROL ORDER
J072	COVREP	WEAPON COVERAGE REPORT
J073	SENSCOVREP	SENSOR COVERAGE REPORT

APPENDIX B3 – HUMAN COMPUTER INTERFACE

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

1 Introduction.

1.1 Scope.

NATO Standardisation Agreement (STANAG 4586) Annex B Appendix B3 specifies the interface between the Unmanned Aerial Vehicle (UAV) Control System (UCS) and the Operator. It will be referred throughout this document as the Human Computer Interface (HCI). STANAG 4586 Annex B Appendix B3 is intended to allow NATO nations to achieve UAV interoperability.

Standardisation of the HCI is intended to enable NATO nations to achieve interoperability between UAV Systems and UCS operators by the implementation of a common set of generic interface standards. A standard HCI should facilitate seamless integration of NATO UAV systems into joint combined NATO battlefield infrastructures across all levels of interaction.

The HCI Appendix B3 establishes the detailed requirements for information to be displayed by the UCS. The requirements detail the functions and interactions that the UCS should allow the operator to perform.

Annex B Appendix B3 specifies the requirements levied upon the UCS, and does not impose any requirements on Human Factors (HF) and ergonomics. However, Appendix B3 provides a Style Guide which aims to provide guidance on display techniques and standards, and acts as a source of reference and best practice in HCI design.

The HCI complies with the NATO C3 Technical Architecture's NC3 Common Standards Profile (NCSP).

1.2 General Overview.

The HCI defines the requirements for the functions and interactions that the UCS should allow the operator to perform. As illustrated in Figure B3 - 1, the HCI interface will support any HCI requirements that are imposed on the CUCS by the Command and Control Interface (CCI) and Data Link Interface (DLI). The HCI will also support any specific or unique CCI Specific Module (CCISM) or Vehicle Specific Module (VSM) display requirements.

The Human Computer Interface Specific Module (HCISM) provides the functionality for the UCS operator(s) to interact with the CUCS via the HCI. The HCISM translates the HCI data parameters from the CUCS to a form that can be understood by the operators(s). It also allows the operator to interact with the CUCS by translating operator actions. This translation could be in the form of a visual display, auditory warning, or physical interaction. The HCISM can also be considered the physical realisation of the HCI (e.g., the set of controls and displays available to the operator(s)).

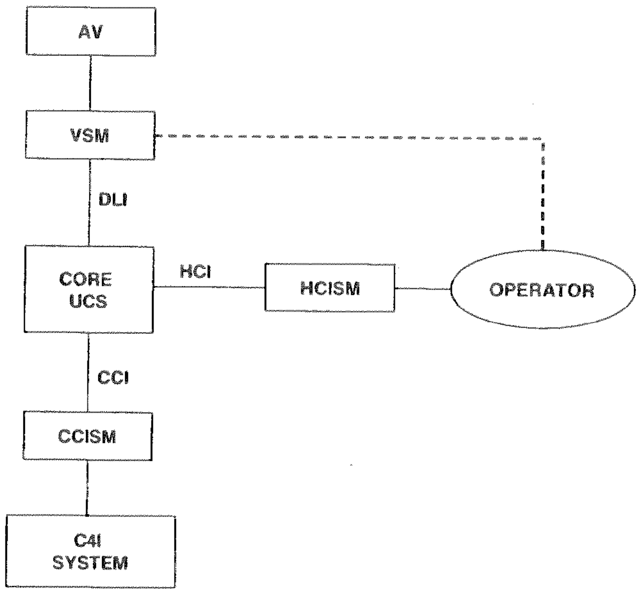


Figure B3 - 1. UCS Functional Architecture

A key point to note is that there is no limit to how many HCISMs can be connected to a single CUCS. As shown in Figure B3 - 2, multiple HCISMs can be connected to one CUCS, though the individual HCISMs may have differing functionality depending on the needs of the operator. A simple UCS may consist of a single HCISM/operator configuration. To accommodate operators with different functionality needs, the system could consist of multiple HCISMs, each offering the specific functionality for the operator. For example, control of the AV and the payload could be from a HCISM (dual-workstation in a shelter), although launch and control could be controlled from a portable unit by a physically separated operator. Typically, in larger UCSs, there may be multiple operators working from a single HCISM. For example, this could be a single HCISM allowing the AV operator, payload operator, and a mission planner to control and monitor the UAV.

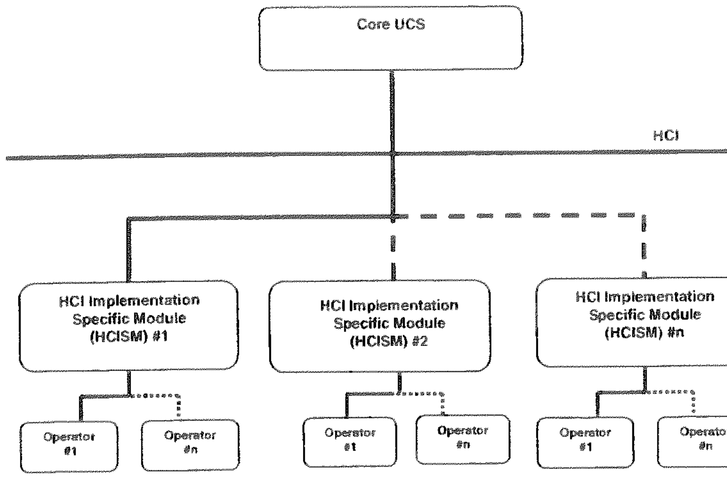


Figure B3 - 2. Physical Realisation of the HCI

Although a HCISM will have a physical implementation, Annex B Appendix B3 does not impose any design requirements, however it does provide User Interface (UI) design guidelines in the form of a Style Guide. This means that there are no restrictions to size, form or components used in a HCISM. Example 1: a HCISM may be a dual workstation in a shelter offering a high degree of functionality required by a High Altitude Long Endurance (HALE) UAV, whereas a small portable unit (hand-held computer) used to operate a Micro Air Vehicle (MAV) would also be considered a HCISM. Example 2: for a maritime UCS, there may be a HCISM providing level 5 functionality, whilst lower levels of functionality (level 1 or 2) could be required on other parts of the ship, which may require a different HCISM.

There may be a requirement for commonality in HCISMs across services and nations for separate UCSs. This may result in higher productivity, shorter training time and reduced development, operation and support costs.

Within this appendix, the applicable levels of interoperability (LOI) have been identified for all requirements (both mandatory 'shall' and recommended 'should' statements). This has the effect of clearly identifying what requirements the CUCS must be compliant with in order to ensure the required LOI. To be interoperable to a particular level, the CUCS shall be compliant with all the requirements stated for all the levels up to that which is required (e.g., for level 4 interoperability, the CUCS shall have to incorporate all requirements for levels 1, 2, 3 and 4).

1.3 Appendix B3 Overview.

Appendix B3 organization is illustrated by Figure B3 - 3.

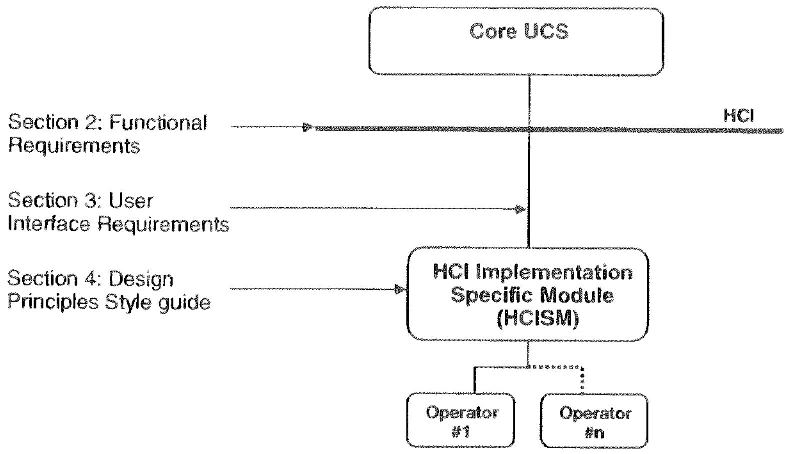


Figure B3 - 3 . Appendix B3 Overview

Section 2: Functional Requirements provides a set of mandatory requirements and recommendations for the HCI to allow user interoperability between NATO Nations' UAV assets. These are categorised under the following headings:

- 2.1 General Requirements
- 2.2 UCS Configuration
- 2.3 Mission Planning
- 2.4 Air Vehicle Control
- 2.5 Operator Control and Monitoring
- 2.6 Payload Control and Monitoring
- 2.7 Warnings, Cautions, and Advisories
- 2.8 Communications Management
- 2.9 Post Mission Reporting

Section 3: UI Requirements, provides standards for UI services to ensure a high degree of application portability and to provide a consistent "look and feel" across multiple implementations.

Section 4: Design Principles/Guidance, provides guidance material on the HF aspects of the HCI. This section is not designed to be a set of mandatory requirements, but acts as a style guide. This style guide defines the general design objectives for HF work, such as Compatibility, Consistency, Memory, Structure, Feedback, Mental Workload and Individualisation. It also provides a greater detail for these design objectives.

2 Functional Requirements.

2.1 General Requirements.

The operator shall be able to control, operate, and use the UCS and all the subsystems and components contained therein, to their required extent for all specified environmental conditions, and when the operator is clothed in the appropriate personal/protective equipment (PPE).

The HCI shall allow the setting of threshold levels for system indicators. These may include, but are not limited to:

- Air Vehicle altitude and altitude rate of change
- Fuel levels
- Speed
- Maximum G loading

When system indicator threshold levels are exceeded, the HCI shall indicate a Caution, Warning, or Advisory to the operator.

The operator shall have the ability to enter and synchronise a time with the UAV System and applicable C4I systems.

2.2 UCS Configuration.

The HCI should be able to accept and present VSM displays that are sent across the DLI.

The HCI should be able to accept and present CCISM displays that are sent across the CCI.

The HCI shall provide the operator with the ability to generate, receive, display, edit, and send any message types that can be exchanged over the CCI with applicable C4I systems. These message types are defined in CCI Appendix B2,

The HCI should provide the ability to automatically update tactical information displays from incoming messages via the CCI. This display could be visual (e.g., on the map), auditory, etc.

All operators should have access to CCI message/report generation applications.

The HCI should provide common templates that enable the operator to create messages to be sent across the CCI.

The HCI shall provide the operator with access to all peripheral systems that are present in the UCS (e.g., video recorders, printers, etc).

The UCS should provide redundancy in all operations, such that the loss of any one HCI input device does not prohibit operation of any UCS function.

The HCI should maximise data re-use and minimise data re-entry.

When a discrete list of options for a given task exists, that list should be presented to the operator to aid the appropriate response. It should be made obvious to the operator whether there is a range of options that can be selected.

Common HCI templates should allow "auto fill" of the message fields to reduce operator workload.

The HCI shall enable the operator to save default values and units that have been specified for various displays and templates.

The operator shall be able to globally change the measurement units (e.g., change from imperial units to metric, or Latitude/Longitude to Universal Transverse Mercator (UTM) or Military Grid Reference System (MGRS)).

The HCI shall enable the operator to enter parameter sets that will adapt the UCS for the vehicle type and the respective missions. It may include, but not be limited to, the following capabilities:

- Select the system functionality (e.g., operational/training/maintenance modes)
- Filter and combine information to improve situational awareness (e.g., knowledge of the state of the system and its environment)
- Import/translate the Mission Order (MO)/Air Tasking Order (ATO) and load the appropriate data sets into the CUCS
- Input the data/parameters for the number and types of AV and their payload configurations that are to be controlled from the UCS
- Provision of sufficient controls and displays to initiate all system Built-in-Tests (BIT) and display the status
- The capability to save/load the UCS set-up configuration information and revert to a default set-up configuration
- The ability to enable operator-initiated search for relevant procedures
- Provide context sensitive help to inform the operator what type or range of data is expected for a given display input
- The ability to select directional references, for example among true-, grid- and magnetic north, and relative to the UCS platform

The system should provide the operator with relevant feedback of information within an appropriate timeframe. The provision of feedback of information should not impede system operation. Consequently, the user does not need to know when and how to search for this information and does not need to invest in these actions.

Appropriate Priority Controls should be used for AV and Mission Payload functions that require either quick accessibility or constant availability. Priority control devices can include, but are not limited to:

- Touch panels
- Buttons
- Switches
- Joysticks
- Keyboard shortcuts

The HCI shall provide adequate identification of all information displayed to the operator.

The HCI should enable fast and easy access to the requested information with adequate orientation cues and state explanation. It should correspond to the optimal search strategy for the specific task and situation, (e.g., support several accurate information acquisition processes for operators).

While the UCS is performing an automated procedure, the HCI should provide appropriate information as to what it is doing and why, so that, for example, the user will remain in the loop of task execution.

The HCI should prevent multiple operators from operating the same application/procedures at any one time. However, the HCI should provide the ability to allow other operators to view applications/procedures that are being used. The status of these applications and procedures should be apparent.

The HCI should provide the operator with the ability to interact with a target database. An example of this interaction may be entering and referencing target data co-ordinates in conjunction with the map display.

2.3 Mission Planning.

Mission Planning includes all planning aspects of all phases of the mission contained in the MO/ATO (e.g., pre-flight and in-flight for AV, payload, data link and communications.)

The HCI shall enable the operator to create, edit, and save a mission plan(s).

The HCI shall enable the operator to plan and validate the mission and review the results of mission validation.

The HCI shall enable the operator to re-plan or update a current mission plan at any time before or during flight.

The HCI shall be able to access any DLI/vehicle specific data required for mission planning through the DLI and/or the CCI message interface.

The HCI shall provide the operator with the ability to upload mission plans to the AV.

The operator should have the ability to review selected mission plans prior to AV upload.

The operator should have the ability to download mission plans from the AV.

The operator should be able to import mission plans via the CCI.

The operator should be able to export mission plans via the CCI.

Launch, recovery, handover, action, and normal waypoints shall be specified and easily distinguishable from each other.

All contingency routes shall be easily distinguishable from operational and approved scheduled routes.

Mission Plans should include route, contingency route, payload, communications, Identify Friend or Foe (IFF), and navigation aid planning.

Constant altitude, infeasible, descending, ascending, and all other route segments should be easily distinguishable.

The operator should be able to display flight corridors, controlled airspace and any other relevant airspace co-ordination information.

The operator should be able to de-clutter the planning display to remove unnecessary items.

The HCI should be able to display Time-on-Station information.

The HCI should provide the operator with the ability to print (hard-copy) mission plans.

The HCI should allow mission planning to take into account meteorological and environmental conditions.

For imaging payloads, the HCI should be able to display payload search area information such as expected visual acuity range due to atmospheric conditions, diurnal transition periods for thermal imagery, lunar and solar terrain shadowing and basic flight weather conditions.

If the UAV is to be flown in civil airspace, the HCI shall enable the operator to generate specific messages for submittal to appropriate ATC authority in accordance with Table B2 - 1 Air Traffic Control Messages, Appendix B2 Command Control Interface.

2.4 Air Vehicle Control.

The operator shall have sufficient controls and displays to safely control and monitor all vehicle systems and subsystems that require user monitoring or input. At a minimum these shall include:

- Airspeed
- Altitude
- Track/Heading
- Current position

Additional systems that require monitoring may include, but are not limited to the following:

- Vehicle autopilot/stability augmentation system
- Vehicle fuel system
- Vehicle lights (e.g. strobe, hazard, anti-collision, navigation)
- Vehicle identification system (e.g., IFF)
- De-icing and anti-icing systems
- Flight termination system
- Sensor calibration
- Electrical power system
- Flight Control system
- Propulsion system
- Cooling system
- Lift devices
- Airborne and UCS data recorder
- Landing gear
- Automatic launch and recovery systems

The HCI shall provide the ability for the operator to perform pre-flight checks and to acknowledge and confirm each step as necessary. The HCI shall provide the ability to store the completed pre-flight checklist.

The HCI shall provide controls and displays for controlling/monitoring the air vehicle attitude in all supported flight modes. These modes may include the following:

- Flight vector command consisting of heading, altitude, and speed controls

- Manual control mode consisting of pitch, roll, yaw, throttle, and collective

The flight display should have the following controls (commanded) and status reports (reported) available:

- Commanded flight mode and reported flight mode
- Commanded AV position and reported AV position
- Commanded altitude and reported altitude
- Commanded heading and reported heading
- Commanded roll/bank angle and reported roll/bank angle
- Commanded airspeed and reported airspeed
- Commanded engine speed and reported engine speed
- Commanded pitch angle and reported pitch angle
- Reported Angle Of Attack (AOA)
- Reported yaw
- Reported vertical velocity
- Fuel remaining/Fuel flow rate/Bingo fuel
- Icing status

When automatic launch and recovery systems are employed, the HCI shall make provision for the operator to abort launch and recovery.

Flight critical control/monitor displays shall be visible at all times while an AV is under control.

The operator shall have the ability to pass AV control (handover) to another UCS and monitor the status of the handover as per the process defined in Appendices B1 (DLI) and B2 (CCI).

The operator should have the controls to implement contingency plans as necessary.

2.5 Operator Control and Monitoring.

The "Map" is considered a CUCS function. It provides the primary display for situational awareness of a UAV mission, and geographic information for the mission planning.

The map shall be able to support the following map types:

- Digital Terrain Elevation Data (DTED) Geographic Information Exchange Standard, STANAG 3809
- Digital Feature Analysis Data (DFAD)
- World Geodetic System - 84 (WGS-84), Mil-Std 2401
- Vector
- ARC Standard Raster Product
- Digital Geographic Information Exchange Standard (DIGEST Vers 2.1) STANAG 7074:1998

The presentation scale of the map shall be selectable. Continuous scaling is preferred to discrete.

The operator shall be able to derive the scale of the map from the display.

The operator shall be able to de-clutter the map display (excluding Raster maps) to remove unnecessary items.

Upon entering of ground data terminal (GDT) information, a GDT icon shall appear at the current location on the map.

Upon receipt of data from an AV, an icon representing the AV shall appear at its current location on the map

When an AV icon is present on the map, the user shall have the ability to change the AV icon's colour

A different icon shall be displayed for each type of air vehicle. MIL-STD 2525B is a recognised source of military symbology, though the variety of icons available to depict friendly, unfriendly, and unknown UAVs is limited.

The map may support, but is not limited to, the following functions/characteristics:

- The ability to create user-defined overlays
- Incorporation of meteorological data (at the operational altitude of the UAV) as an overlay on the map
- The ability to derive geographic co-ordinates of the position of a cursor and to be able to load this data into appropriate forms/templates
- The ability to display the GDT coverage at any given altitude(s)

The user shall have the ability to individually enable/disable the display of the following information to appear with the AV icon:

- AV tail number
- AV position
- AV heading
- AV speed
- AV altitude
- AV fuel level

The AV information and AV trail shall be identifiable as belonging to a specific AV (e.g., this may be as simple as being the same colour).

An AV trail shall be available to be displayed on the map for every AV from which the UCS is receiving data.

The user shall be able to control the following characteristics of the AV trail:

- Length of the AV trail
- Enable/Disable the AV trail

The HCI shall provide the ability to display valid AV flight route plans.

When several flight routes are displayed on the map simultaneously, the active flight route should be easily distinguishable from the other routes.

The operator should be able to select and deselect flight routes.

If a payload footprint is available, the operator should have the ability to enable/disable the display of the payload footprint.

The user shall have the ability to select the colour of the payload footprint.

When display of the payload footprint is enabled, the footprint of the imaging payload shall be displayed on the map.

All payload footprints displayed on the map shall be clearly associated with its AV. This can be facilitated by, for example, a line(s) from the AV icon to the payload field of view, use of same colour as the AV icon, etc.

When a stores (dispensing) payload is present, the map should be able to display the arming, release, and impact points. These points should be easily distinguishable from waypoints.

When a data link to the AV is lost, an indication on/near the AV icon shall be displayed.

The operator should have the ability to place target icons on the map. Primary and alternate targets should be easily distinguishable.

The HCI shall provide the ability to import digital and scanned hard-copy maps.

The operator should be able to display, but not be limited to, the following overlays on the map:

- Flight corridors
- Restricted airspace
- Threat areas
- Sensor/Payload coverage
- Restricted payload operating areas
- Data link coverage

The HCI shall provide a generic image display to allow the operator to edit, load, and save image files from image libraries and external C4I sources.

The HCI should provide the ability for the operator to print hard copy. This can include, but is not limited to:

- Mission plans
- The map
- Messages
- Imagery
- Screen-dumps

2.6 Payload Control and Monitoring.

The Payload Control HCI functions defined within the CUCS will be generic to types of payload, rather than specific payloads, where possible. The payload types are:

- Imaging Sensors (Passive) (including Ultra Violet (UV), visible and infrared wavebands, hyperspectral, and multispectral sensors)
- Radar Sensors (Active) (including Airborne Radar, Synthetic Aperture Radar (SAR) and Moving Target Indicator (MTI))

- Laser Based Payloads (e.g., Laser Range Finders, Laser Target Designators)
- Communications Relay
- Stores (Dispensing) payloads (to include weapons, humanitarian aid, unattended ground sensors, buoys)

HCI shall provide the capability to support additional payloads, e.g. Electronic Warfare (EW), Meteorological, Nuclear, Biological and Chemical (NBC) Detection and Monitoring payloads as they are incorporated in the respective UAV Systems.

2.6.1 General Requirements.

The HCI shall provide sufficient controls and displays to control all payloads and all associated functions.

The HCI shall provide sufficient controls and displays to monitor all payloads and all associated functions.

The operator shall have the ability to pass and receive control (handover) of the AV's payload to/from another control system and monitor the payload control passing, as per process defined in Appendices B1 (DLI) and B2 (CCI)

In the event of AV controller failure, the operator shall have the controls to implement contingency plans as necessary.

Operator controls and displays should support the following functions:

- Create, edit, and send tactical messages
- Create, edit, load, and save image files
- Dissemination of images and data to all UCS supported C4I Systems

If an image is stored, additional information to aid exploitation of the image shall also be saved.

The operator shall have the ability to monitor the status of certain AV and payload parameters. These parameters may include, but not be limited to:

- AV tail number indication
- AV speed indication
- AV heading indication
- AV altitude indication
- AV height above target indication
- Zoom factor indication
- Slant Range indication
- Payload azimuth indication
- Payload azimuth rate indication
- Payload depression angle indication
- Payload depression angle rate indication
- AV position
- Centre field of view crosshair position

- Centre field of view crosshair altitude
- Pointer (cursor) position
- Sensor mode
- Gain/Level states

2.6.2 Imaging Payloads.

The operator shall have an imagery display (e.g., motion imagery).

The imagery display shall have overlays that can be enabled/disabled by the operator. The overlay may include, but not be limited to, the following items:

- Graphical depression angle indication
- Numeric depression angle indication
- Centre Field of View (FOV) crosshairs
- Graphical zoom scale
- Polarity indication
- Selected sensor indication
- Image orientation indication
- Line of Sight (LOS) incidence angle indication
- Slant range to centre FOV indication
- Air Vehicle identification
- Date/Time
- Weapon to target vector information
- Designated target symbols/icons

The operator shall have the ability to enable/disable individual items in the overlay.

The operator shall have controls and displays necessary to correctly operate the imaging payload. Such operating functions may include, but not be limited to:

- Freeze/Unfreeze the imagery display
- Capture a single frame image
- Zoom
- Focus
- Iris
- Contrast
- Payload azimuth angle
- Payload depression angle

2.6.3 Radar Payloads.

The operator should have controls for the selection of the operating mode of the SAR and MTI payloads.

The operator should have controls for the selection of SAR/MTI operating resolution.

The operator shall have access to overlays that can be enabled and disabled.

Individual components of the overlay should be able to be enabled and disabled. The overlay may include, but is not limited to, graphical or textual depictions of:

- Operating mode
- Resolution
- Range
- Depression angle
- Location accuracy (Circular Error Probable (CEP))
- Spot size (Spotlight mode)
- Operating frequency/Band
- Minimum detectable velocity (MDV), (MTI only)
- Target velocity vectors (MTI only)
- Target history data (MTI only)
- Transmitting power
- Image orientation indication

2.6.4 Laser Based Payloads.

For Laser Range Finders (LRFs) that are used in conjunction with imaging systems, the area that is under illumination should be clearly identified on the image display.

The range to target area should be overlayed onto the image display.

The overlay of the target area and range should be able to be turned on and off at the command of the operator.

For Laser Target Designator (LTD) systems that are used in conjunction with imaging systems, the target of interest should be clearly identified on the image display.

The operator should be aware of a positive target lock through graphical or textual means.

The UCS Core shall facilitate upload and selection of Laser Key-Codes. Key Codes need to be selected when the UAV crosses national boundaries.

2.6.5 Communications Relay (CR) - General Requirements.

This section shall identify the key components of communication relay packages and describe their HCI requirements upon the UCS. CR payloads act as a routing service for communications from other airborne assets, ground troops, Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) assets, Special Forces etc, to wherever the message is intended (e.g., Brigade HQ).

The footprint of the CR payload should be displayed on the operator map display.

The footprint shall be easily distinguishable from other sensor footprints that may be present on the operator map display.

The status of each component of the CR payload (e.g., data link/bearer system, antennas, etc) should be displayed to the operator upon request.

Changes in the status of the CR components should be positively identified to the operator (see cautions and warnings).

The operator should be alerted to the potential loss of link due to coverage limitations.

The mission planning phase should indicate the following parameters:

- The ability to import mission plans from other systems
- Spectrum usage of other users in the operating area (Spectrum Management)
- Areas of poor connectivity (CR payload footprints)
- Any need for antennae swap-overs (if applicable)
- Potential communications and aircraft vulnerability
- Need for data link/bearer and gateway switching
- Viewing/Planning user dispersion

2.6.6 Encryption Unit.

The operator should have the ability to reconfigure an encryption unit (if one is utilized). It may not be possible to perform this task when the UAV is in flight.

Note: Users that require encryption should reference work being done for data links by NAFAG Air Group IV and NATO International Military Staff (IMS) for interoperable encryption standards.

The status of the encryption unit should be indicated to the operator.

2.6.7 Data Link/Bearer System.

The UCS Core shall provide sufficient controls and displays for the operator to operate any data link/bearer systems as is necessary. Due to the custom nature of data link/bearer system functionality, controls may include, but not be limited to:

- Health checking of system
- Changing of frequency channel currently in use
- Changing of frequency-hop sets
- The ability to reconfigure the data link/bearer system connections (e.g., which bearer system is connected to which connections (via the gateway and the encryption units if necessary))

2.6.8 Antenna Systems.

If the antennae are directional, then the operator should have the ability to redirect or align them to different locations or targets as and when required.

The status of the antennae (power output, azimuth and elevation angles) should be indicated to the operator.

2.6.9 Gateway Component.

The operator shall have the ability to upload and/or reconfigure the gateway as required.

The operator should have control over the translation templates on the Gateway component.

The current translation template operating should be displayed to the operator.

The currently active set of forwarding rules for the gateway system should be indicated to the operator.

The Forwarding rules for the gateway should be controllable by the operator.

2.6.10 Stores (Dispensing) Payloads.

Stores (dispensing) payloads are considered to be those that are released from the UAV as part of the UAV mission objectives. This can include the release of weapons or deployment of remote sensors, etc.

Where a stores (dispensing) payload is present the operator shall have the necessary controls and displays to operate the system.

The status of the stores (dispensing) payload should be indicated to the operator upon command. Any change in the status of the payload should be flagged to the operator.

The release mechanism for the payload shall be clearly identified and labelled to the operator.

A safety interlock shall operate such that the operator cannot inadvertently release the payload.

If multiple commands are required to release the payload, the order of operation should be clearly indicated to the operator.

An alert message should be displayed to the operator when the payload has been armed, prior to release.

An alert message should be displayed to the operator when the payload has been released.

For multiple-shot dispensing payloads, the number of uses remaining shall be indicated to the operator upon command.

When the multiple-shot payload has been exhausted, an alert message should be indicated to the operator.

Alert messages should be displayed in a pop up window to attract the attention of the operator. The message dialog box should not cover over any flight or safety critical information on the operator display.

If the payload sends live telemetry to the UCS after release, then a dialog box should indicate to the operator the status of the connection.

Any sensor information received from the released payload should follow the guidelines set out in the appropriate sections of this STANAG.

Failure to release the payload or failure of the payload to operate should be indicated to the operator. The operator should initiate, depending on the nature of the payload, the relevant safety procedures.

2.6.11 Future Payloads.

2.6.11.1 Nuclear, Biological and Chemical (NBC) Detection and Monitoring Payloads.

Where an NBC detection and monitoring system is present, the operator shall have the necessary controls and displays to operate the payload.

It is envisaged that the raw data from the sensor along with positional information may be relayed to the operator. Meteorological information may also need to be relayed.

2.6.11.2 Electronic Warfare (EW) Payloads.

Electronic Warfare can be subdivided into three categories: Electronic Support Measures (ESM), Electronic Counter Measures (ECM), and Electronic Protection Measures (EPM). ESM involves actions taken to search for, intercept, identify, and locate radiated energy for the purpose of immediate threat recognition. This includes warning of detection, target acquisition, and engagement as well as providing information required to conduct ECM and EPM. ESM systems can consist of Radar Warning Receivers (RWR), Missile Launch Detectors (usually UV based), and Missile Approach Warning (MAW). ECM involves actions taken to prevent or reduce an enemy's effective use of the EM spectrum. ECM systems can be mechanical (e.g., Chaff, Flare, and Decoys) or Electro Magnetic (EM) based (e.g., Laser Dazzlers, Jammers). EPM involves actions taken to ensure friendly effective use of the EM spectrum despite the enemy's use of Electronic Warfare. EPM can be Concept of Operations (CONOPS) based (e.g., manoeuvres to be performed when detected by a RWR) or design based (e.g., use of a faraday cage, directional antennas, or frequency hopping techniques for communications).

Where an electronic warfare system is present the operator shall have the necessary controls and displays to operate the terminal.

The HCI shall provide sufficient displays and controls for ESM systems outputs. This may include, but not be limited to:

- RWR indication of radar activity
- Bearing and range of UAV to detected radar activity (from RWR)
- Detection, location, and range of missile launch site
- Detection, location, and range of missiles

The HCI shall provide sufficient displays and controls to allow operation of ECM systems. These may include, but not be limited to:

- Dispensing of chaff, flare, or decoys
- Operation of jamming devices
- Operation of Laser Dazzle devices (including targeting, wavelength selection, etc)

The HCI shall provide sufficient displays and controls to allow operation of EPM systems. Control and display of EPM techniques may include such things as:

- Instigating frequency-hopping techniques for communications to and from the UAV and changing the frequency-hop set

2.6.11.3 Meteorological Payloads.

For meteorological payloads, the operator shall have sufficient controls and displays to control and monitor such payloads. At a minimum, the display should include the following:

- Temperature
- Relative Humidity
- Barometric Pressure
- Wind Speed and Direction
- Altitude

2.7 Warnings, Cautions, and Advisories.

Warnings, cautions, and advisories inform the operator about any unusual or critical condition. The HCI shall provide the capability to display, track, log, and otherwise manage warnings, cautions, and advisories. The HCISM shall provide all HCI functionality for the system while the content of individual warnings will be determined by messages from the DLI. In this way, the UCS provides a common look and feel to the operator no matter what UAV is being flown without having to understand the content of all warnings from all types of vehicles. Definitions of warnings, cautions, and advisories can be found in Annex A of this STANAG.

The operator shall be required to acknowledge all critical warnings.

The warning and caution indications shall be located in the operator's primary field of view.

Warnings and cautions shall not be obscured by other HCI elements.

The procedures provided should consist of context specific, procedural task knowledge. The advice should be minimal, not more than necessary. Each individual procedure should however describe a complete problem-solving path to accomplish the goal.

Warning and caution displays may include the following characteristics:

- Ability to provide the procedures (rules) for the alarm handling tasks that have to be accomplished
- Ability to toggle between only active cautions/warnings and a complete cautions/warnings history for the mission
- Ability to sort cautions and warnings by time
- Ability to sort cautions and warnings by severity
- Ability to sort cautions and warnings by system

The HCI should provide a separate means for alerting the operator of new warnings, depending on the severity of the warning. The HCI shall provide a rapid means for cancellation of such warnings.

Each alarm should trigger, as far as possible, one task for the human operator and the corresponding advice should directly accompany the alarm.

2.8 Communications Management.

Communications Management controls the communications links between the UCS and the UAV. This would include any additional antennas or data links required to support a specific payload (e.g., a CR payload). It provides the operator at the CUCS with the ability to configure the data links and to change a number of parameters of the Air Data Terminal (ADT) and the GDT. Whilst the majority of data link parameters will be controlled from the CUCS, some more specific data link functions will need to be controlled through the DLI. Reference should be made to Appendix B1: Data Link Interface.

The HCI shall provide the operator with the ability to open and control the communications links between the CUCS and other outside agencies such as:

- C4I systems via the CCI interface
- Air traffic control via both voice and data links
- ADT/GDT

The operator shall have an antenna/data link situational awareness display. This display does not necessarily have to be separate from the AV Control/Monitor display.

Antenna Situation awareness items may include, but are not limited to the following items:

- Graphical GDT and ADT antenna azimuth indication
- Graphical GDT and ADT antenna elevation indication
- Graphical indication of AV position relative to GDT antenna
- Graphical representation of antenna shadowing zones

Data link situational awareness/control display should include, but not be limited to the following items:

- Data link selection
- Command/active/inactive data link indication
- GDT type
- GDT tracking mode
- GDT azimuth
- GDT elevation
- Receiver mode
- Receiver status
- Transmitter power
- Transmitter status
- Up-link frequency
- Receive signal strength
- Down-link frequency
- Link quality

Upon loss of data link, an indication shall appear. These indications shall automatically disappear when data link is regained. This indication may contain the following items:

- AV Position at loss of link
- Predicted AV position
- Predicted AV heading
- Predicted AV altitude
- Predicted AV fuel level
- Loss of link timer (displays how long the link has been lost)

2.9 Post Mission Reports.

The HCI shall support the ability to create, edit and display post mission reports.

3 User Interface Standards.

Interface services are needed to ensure a high degree of application portability and to provide a consistent "look and feel" across multiple implementations. The user interface services provide a consistent means for developers, administrators and users of a system to gain access to application programs, operating system functions and system utilities. Information system architecture should not only address technical features of the user interface, but also the human engineering considerations.

The style of a UI may fall into one of three main categories:

- Character-Oriented interfaces (e.g., for DOS on a Personal Computer) are subject to few standards, except for the underlying character sets or common, but proprietary, terminal emulation standards (e.g., VT100).
- Graphical User Interfaces (GUIs) may be created for a variety of different computer systems (e.g., UNIX workstation, Macintosh or personal computer (PC), running their specific windowing environment). The choice of a GUI standard is largely driven by the choice of the underlying operating system. For instance, Microsoft operating systems uses the Microsoft Windows GUI, for UNIX it is X-Windows.
- Dedicated interfaces are typically purpose built, using dedicated displays and electronics (e.g., for weapon systems). They are subject to few standards; the main concerns are those of usability as opposed to those of design.

A modern GUI presents the programmer with a wide range of capabilities for displaying the output of a computer program on the screen. These comprise the appearance of screen entities such as windows, buttons and scroll bars, as well as the actions that users must perform to navigate the display and utilise the program's functions. While this breadth of capability is powerful, it can lead to systems in which different applications behave in different ways. Standardisation of GUIs is important to allow the transfer of a user's knowledge of one application to the operation of another, thus reducing the training costs. "User portability" makes the definition of a common HCI a desirable objective. Two areas of GUI standardisation can be distinguished:

- The first area of standardisation consists of a toolkit, which supports the developer to establish the overall style of an on-screen presentation
- The second area of standardisation involves the detailed design of appearance and behaviour

Unfortunately, it is possible to use a toolkit's capabilities in many different ways to yield different appearances and behaviours. The solution is the use of style guides, which are available for specific toolkits (e.g., defining functions of menus, push-buttons, or dialog boxes), as well as for overarching design decisions. Hence, applications can be designed to behave in a similar way under different GUIs. However, it is equally possible for two developers to follow the appropriate style guide and come up with two drastically different products.

Table B3-1 shows NATO mandatory and emerging standards for User Interface Requirements.

Service Area	Class	Mandatory Standards	Emerging Standards	Remarks
User Interface				
	Graphical User Interface	X Windows System 11R5	X Windows System 11R6.4	Although X11R6.4 is the current version, only services based on version X11R5 have enough product support. This situation should be monitored as a shift to X11R6.4 may be expected in the near future.
		Win 32 APIs		As part of MS NT (See OS)
	Look and Feel	CDE 1.0	CDE 2.1	
		Motif Style Guide Rev 1.2	Motif/CDE Style Guide Rev 2.1	Toolkit specific style guides
		MS Windows Interface Guidelines for Software Design (1995)		Toolkit specific style guides. As part of MS NT (See OS Svc)
		US DoD HCI Style Guide (TAFIM V3.0)		Domain specific style guide
			UK Army CIS Style guide V2.0	Domain specific style guide
	Toolkit	Motif 1.2	Motif 2.1	

Table B3 - 1. User Interface Requirements

4 Summary Table of Functional Requirements.

Req. ID	Description	Applicable LOI
	2.1 General	
HCI001	The operator shall be able to correctly operate the UCS under all specified environmental conditions	1+
HCI002	The operator shall be able to correctly operate the UCS when clothed in the necessary protective clothing	1+
HCI003	The HCI shall allow the setting of threshold levels for system indicators	2+
HCI004	When system indicator threshold levels are reached, the HCI shall indicate a Caution, Warning, or Advisory	2+
HCI005	The operator shall have the ability to enter and synchronize a time with the UAV system and applicable C4I systems	2+
	2.2 UCS Configuration	
HCI006	The HCI shall provide the operator with the ability to generate, receive, display, edit, and send any message types that can be exchanged over the CCI with applicable C4I systems	1+
HCI007	The HCI shall provide the operator with access to all peripheral systems that are present in the UCS (e.g., video recorders, printers, etc	1+
HCI008	The UCS shall provide redundancy in all operations, such that the loss of any one HCI input device does not prohibit operation of any UCS function	1+
HCI009	The HCI shall enable the operator to save default values and units that have been specified for various displays and templates	1+
HCI010	The operator shall be able to globally change the measurement units (e.g., change from imperial units to metric, or Latitude/Longitude to Universal Transverse Mercator (UTM) or Military Grid Reference System (MGRS)).	1+
HCI011	The HCI shall enable the operator to enter parameter sets that will adapt the UCS for the vehicle type and the respective missions	1+
HCI012	The HCI shall provide adequate identification of all information displayed to the operator	1+

Req. ID	Description	Applicable LOI
	2.3 Mission Planning	
HCI013	The HCI shall enable the operator to create, edit, and save a mission plan(s).	3+
HCI014	The HCI shall enable the operator to plan and validate the mission and review the results of mission validation.	3+
HCI015	The HCI shall enable the operator to re-plan or update a current mission plan at any time before or during flight.	3+
HCI016	The HCI shall be able to access any DLI/vehicle specific data required for mission planning through the DLI and/or the CCI message interface.	3+
HCI017	The HCI shall provide the operator with the ability to upload mission plans to the AV.	3+
HCI018	Launch, recovery, handover, action, and normal waypoints shall be specified and easily distinguishable from each other.	3+
HCI019	All contingency routes shall be easily distinguishable from operational and approved scheduled routes	4+
HCI020	If the UAV is to be flown in civil airspace, the HCI shall enable the operator to generate specific messages for submittal to appropriate ATC authority	4+
	2.4 Air Vehicle Control	
HCI021	The operator shall have sufficient controls and displays to safely control and monitor all vehicle systems and subsystems that require user monitoring or input. At a minimum these shall include: airspeed	4+
HCI022	The operator shall have sufficient controls and displays to safely control and monitor all vehicle systems and subsystems that require user monitoring or input. At a minimum these shall include: altitude	4+
HCI023	The operator shall have sufficient controls and displays to safely control and monitor all vehicle systems and subsystems that require user monitoring or input. At a minimum these shall include: Track/Heading	4+
HCI024	The operator shall have sufficient controls and displays to safely control and monitor all vehicle systems and subsystems that require user monitoring or input. At a minimum these shall include: Current position	4+

Req. ID	Description	Applicable LOI
HCI025	The HCI shall provide the ability for the operator to perform pre-flight checks and to acknowledge and confirm each step as necessary.	4+
HCI026	The HCI shall provide the ability to store the completed pre-flight checklist.	4+
HCI027	The HCI shall provide controls and displays for controlling/monitoring the air vehicle attitude in all supported flight modes	4+
HCI028	When automatic launch and recovery systems are employed, the HCI shall make provision for the operator to abort launch and recovery	5+
HCI029	Flight critical control/monitor displays shall be visible at all times while an AV is under control	4+
HCI030	The operator shall have the ability to pass AV control (handover) to another UCS and monitor the status of the handover as per the process defined in Appendices B1 (DLI) and B2 (CCI)	4+
	2.5 Operator Control and Monitoring	
HCI031	The map shall be able to support the following map types:(1)Digital Terrain Elevation Data (DTED) Geographic Information Exchange Standard, STANAG 3809; (2) Digital Feature Analysis Data (DFAD); (3) World Geodetic System 84 (WGS-84), MIL-STD-2401; (4) Vector; (5) ARC Standard Raster Product; (6) Digital Geographic Information Exchange Standard (DIGEST vers 2.1), STANAG 7074:1998	2+
HCI032	The presentation scale of the map shall be selectable	2+
HCI033	The operator shall be able to derive the scale of the map from the display	2+
HCI034	The operator shall be able to de-clutter the map display to remove unnecessary items	2+
HCI035	Upon entering of ground data terminal (GDT) information, a GDT icon shall appear at the current location on the map.	2+
HCI036	Upon receipt of data from an AV, an icon representing the AV shall appear at its current location on the map	2+
HCI037	When an AV icon is present on the map, the user shall have the ability to change the AV icon's colour	2+
HCI038	A different icon shall be displayed for each type of air vehicle	2+
HCI039	The user shall have the ability to individually enable/disable the display of the following information to appear with the AV icon: AV Tail Number	2+

Req. ID	Description	Applicable LOI
HCI040	The user shall have the ability to individually enable/disable the display of the following information to appear with the AV icon: AV Position	2+
HCI041	The user shall have the ability to individually enable/disable the display of the following information to appear with the AV icon: AV speed	2+
HCI042	The user shall have the ability to individually enable/disable the display of the following information to appear with the AV icon: AV Altitude	2+
HCI043	The user shall have the ability to individually enable/disable the display of the following information to appear with the AV icon: AV fuel level	2+
HCI044	The AV information and AV trail shall be identifiable as belonging to a specific AV	2+
HCI045	An AV trail shall be available to be displayed on the map for every AV from which the UCS is receiving data.	2+
HCI046	The user shall be able to control the following characteristics of the AV trail: Length of the AV Trail	2+
HCI047	The user shall be able to control the following characteristics of the AV trail: Enable/Disable AV Trail	2+
HCI048	The HCI shall provide the ability to display valid AV flight route plans	4+
HCI049	The user shall have the ability to select the colour of the payload footprint	2+
HCI050	When display of the payload footprint is enabled, the footprint of the imaging payload shall be displayed on the map	2+
HCI051	All payload footprints displayed on the map shall be clearly associated with its AV	2+
HCI052	When a data link to the AV is lost, an indication on/near the AV icon shall be displayed	2+
HCI053	The operator should have the ability to place The HCI shall provide the ability to import digital and scanned hard-copy maps.	2+
HCI054	The HCI shall provide a generic image display to allow the operator to edit, load, and save image files from image libraries and external C4I sources	2+

Req. ID	Description	Applicable LOI
	2.6 Payload Control and Monitoring	
	2.6.1 General	
HCI055	The HCI shall provide sufficient controls and displays to control all payloads and all associated functions	3+
HCI056	The HCI shall provide sufficient controls and displays to monitor all payloads and all associated functions.	3+
HCI057	The operator shall have the ability to pass and receive control (handover) of the AV's payload to/from another control system and monitor the payload control passing, as per process defined in Appendices B1 (DLI) and B2 (CCI)	3+
HCI058	In the event of AV controller failure, the operator shall have the controls to implement contingency plans as necessary	3+
HCI059	If an image is stored, additional information to aid exploitation of the image shall also be saved	3+
HCI060	The operator shall have the ability to monitor the status of certain AV and payload parameters	3+
	2.6.2 Imaging Payloads	
HCI061	The operator shall have an imagery display (e.g., video)	3+
HCI062	The imagery display shall have overlays that can be enabled/disabled by the operator	3+
HCI063	The operator shall have the ability to enable/disable individual items in the overlay.	3+
HCI064	The operator shall have controls and displays necessary to correctly operate the imaging payload	3+
	2.6.3 Radar Payloads	
HCI065	The operator shall have access to overlays that can be enabled and disabled	3+
	2.6.4 Laser Based Payloads	
HCI066	The UCS Core shall facilitate upload and selection of Laser Key-Codes. Key Codes need to be selected when the UAV crosses national boundaries	3+
	2.6.5 Communications Relay (CR)	
HCI067	The footprint (of a communications relay payload) shall be easily distinguishable from other sensor footprints that may be present on the operator map display	3+

Req. ID	Description	Applicable LOI
	2.6.7 Data Link/Bearer Systems	
HCI068	The UCS Core shall provide sufficient controls and displays for the operator to operate any data link/bearer systems as is necessary	3+
	2.6.9 Gateway Component	
HCI069	The operator shall have the ability to upload and/or reconfigure the gateway as required	3+
	2.6.10 Stores (Dispensing) Payloads	
HCI070	Where a stores (dispensing) payload is present the operator shall have the necessary controls and displays to operate the system.	3+
HCI071	The release mechanism for the payload shall be clearly identified and labeled to the operator.	3+
HCI072	A safety interlock shall operate such that the operator cannot inadvertently release the payload	3+
	2.6.11 Future Payloads	
	2.6.11.1 Nuclear, Biological and Chemical (NBC) Detection and Monitoring Payloads	
HCI073	Where an NBC detection and monitoring system is present, the operator shall have the necessary controls and displays to operate the payload.	3+
	2.6.11.2 Electronic Warfare (EW) Payloads	
HCI074	Where an electronic warfare system is present the operator shall have the necessary controls and displays to operate the terminal.	3+
HCI075	The HCI shall provide sufficient displays and controls for ESM systems output	3+
HCI076	The HCI shall provide sufficient displays and controls to allow operation of ECM systems.	3+
HCI077	The HCI shall provide sufficient displays and controls to allow operation of EPM systems.	3+
	2.6.11.3 Meteorological Payloads	
HCI078	For meteorological payloads, the operator shall have sufficient controls and displays to control and monitor such payloads	3+
	2.7 Warnings, Cautions, and Advisories	
HCI079	The HCI shall provide the capability to display, track, log, and otherwise manage warnings, cautions, and advisories	2+

Req. ID	Description	Applicable LOI
HCI080	The HCISM shall provide all HCI functionality for the system while the content of individual warnings will be determined by messages from the DLI	2+
HCI081	The operator shall be required to acknowledge all critical warnings.	2+
HCI082	The warning and caution indications shall be located in the operator's primary field of view.	2+
HCI083	Warnings and cautions shall not be obscured by other HCI elements.	2+
HCI084	The HCI shall provide a rapid means for cancellation of such warnings	2+
	2.8 Communications Management	
HCI085	The HCI shall provide the operator with the ability to open and control the communications links between the CUCS and other outside agencies such as: (1) C4I systems via the CCI; (2) Air traffic control systems via both voice and data links; (3) ADT/GDT	1+
HCI086	The operator shall have an antenna/data link situational awareness display	2+
HCI087	Upon loss of data link, an indication shall appear	2+
HCI088	These indications (loss of data link) shall automatically disappear when data link is regained	2+
	2.9 Post Mission Reports	
HCI089	The HCI shall support the ability to create, edit and display post mission reports	2+

Attachment B3-1: Design Principles/Guidelines.

1 General.

Section 2 of STANAG 4586 Annex B Appendix B3 establishes the detailed requirements for the data/imagery types and formats that should be displayed by the UCS. Section 4 (the current section), in contrast, establishes a set of design principles (a style guide) for the core UCS HCI based upon defined standards and scientific consensus.

1.1 General Design Objectives.

UAV operations may be considered as a set of hierarchically ordered task levels: planning, monitoring, and control levels can be distinguished.

At the highest level, operational plans and maintenance schemes are defined on the basis of operational goals, taking into account criteria for safety and efficiency. The activity mainly consists of decision-making based upon information of varying reliability from different sources (e.g., expected supply demands, available resources, and statistics on working conditions).

At the intermediate level, deviations between planned and actual state variables are monitored, on the basis of expectations on future deviations. Consequences of detected deviations are determined, and reconsidered at the planning level. Activities mainly consist of the selection and integration of information from different sources (e.g., sensors, predictive models, and diagnostic rule-bases).

At the lowest level, deviations between planned and actual state variables are compensated on the basis of local feedback control loops.

In present systems, most of the planning and monitoring functions are allocated to the human supervisor, whereas functions at the lowest control level are more and more allocated to automatic control systems. This will result in a shift of the human share in these functions from more specific control activities to more general supervisory activities at the monitoring level.

At the monitoring level and the related planning level however, besides the number of functions to be supervised, the total amount of available data in future process control systems is likely to increase. This may have the complicating effect on the supervision process that available data has to be transformed into relevant information. This may become a critical factor for high-workload conditions. On the other hand, there will be less involvement of the human operator in control activities at the lowest control level, with the effect that the operator will lose direct contact with the system. This may introduce loss of awareness and skill.

To integrate operator characteristics into the design of human-computer interfaces or, in a more general sense, human-computer systems, general design objectives can be defined, such as:

- Compatibility: Minimise the amount of information recording that will be necessary.
- Consistency: Minimise the differences in dialogue both within and across various operator interfaces.
- Memory: Minimise the amount of information that the operator must maintain in short-term memory.
- Structure: Assist the operator in developing a conceptual representation of the structure of the system so that they can navigate through the interface.

- Feedback: Provide the operator with feedback and error-correction capabilities
- Mental Workload: Keep operator mental workload within acceptable limits.
- Individualisation: Accommodate individual differences among operators through automatic adaptation or through operator tailoring of the interface.

These principles are applied to UAV applications in subsequent paragraphs.

1.1.1 Compatibility.

In order to maximise information transfer in a human-computer system; the amount of information recording required of the operator should be minimised. Regarding the HCI, this implies that the interface should be compatible with characteristics of human information processing in terms of perception, evaluation, decision-making, and action.

With respect to the design and arrangement of controls and displays, spatial and movement compatibility is a very important issue. More specific, the principle of Stimulus Response (S-R) compatibility requires the movement of objects displayed on the screen to be consistent with the orientation and direction of input movement of the operator.

On the dialogue level, compatibility refers to the adherence to the operator's organisation of information as well as vocabulary and language for dealing with the information. This is an important issue on designing, for instance, the wording for commands, menus, and error messages, which should be clear and unambiguous. Also, the meaning of graphic icons should be clear and conform to existing population stereotypes.

1.1.2 Consistency.

Differences in interfaces both within and between systems may result in the need for operators to remember different procedures and techniques to accomplish the same thing. Therefore, both operator input and system output should be consistent across displays, modules, programs, and information systems. More specific, computer actions associated with special function keys should be kept constant across menus or tasks, ensuring the system to behave in a predictable way.

1.1.3 Memory.

The dialogue designer should strive to reduce the short-term memory load of the operator. Whenever large amounts of information must be presented to the operator, meaningful units should be grouped together in chunks to reduce short-term memory load.

1.1.4 Structure.

To assist the operator of computer-based systems in developing an internal representation, forming the basis of the operator's system understanding, the interface should be provided with a clear structure, both compatible with operator expectations and internally consistent. In this way, operator experience, accompanied by appropriate system feedback, helps the operator to determine the structure of the dialogue and control systems.

1.1.5 Feedback.

In general, operators of computer-based systems should be provided with clear feedback of where they are in the system, what they have done, and the steps necessary to achieve a specific desired outcome. Feedback should be both clear and timely with respect to related events.

1.1.6 Mental Workload.

An essential step in interface design is the assessment of the operator mental workload. It is known that the probability of operator errors increases in overload or under load situations. The overall goal should therefore be to keep mental workload within acceptable limits: the designer has to consider the operator's capacity for information processing as well as the task requirements. One important factor that affects workload is the density of information. Displayed information should be well organised in order to reduce scanning, and only essential information should be presented. Another important factor that affects workload is the amount of knowledge-based behaviour required to perform the task (e.g., the operator's situation awareness (SA)). Mental workload does not primary depend on the number of tasks that are simultaneously executed but on the quality of SA.

1.1.7 Individualisation.

Human behaviour is characterised by individual differences. Therefore, the interface should be designed to accommodate the various types of individual differences among the operators. Two possible approaches to individualisation are a flexible interface, or an adaptive interface. A flexible interface allows the operator to tailor the interface to his needs or permit various types of interaction. An adaptive interface accommodates the individual operator automatically; the interface characteristics change over time.

1.2 HCI Guidelines for Presentation and Control Tasks.

1.2.1 General Guidelines.

In Europe, the European Directive 90/270/EEC on display equipment addresses minimum requirements necessary to meet objectives for the usability of HCI. These requirements refer to general issues like 'suitability for the task', 'easy to use' and 'applying principles of software ergonomics'. Although these issues seem rather vague, standards are under development by international organisations like the International Organisation for Standardisation (ISO), which may serve as a reasonable alternative for demonstrating compliance with good ergonomics practise. The general consensus is that these ISO standards will become the most likely candidates for future international standards. ISO comprises 107 countries from all over the world, including the USA. Wherever appropriate, ISO standards are adopted by the European Standardisation Organisation (CEN) as part of the creation of the Single Market. CEN standards will also replace national standards in the European Community (EC) and European Free Trade Association (EFTA) member states (e.g., Deutsche Institut fur Normung (DIN), and British Standard (BS)). Furthermore, ISO or its European equivalents are often referenced to by EC member states to implement the obligations placed on them by the European Directive 90/270/EEC on ergonomic requirements for display screen workstations. In doing so the member states transpose these obligations into appropriate national laws and regulations.

The ergonomics committee TC159 "Ergonomics" was formed in 1975 as a result of a proposal by the International Ergonomics Association. Six subcommittees are working on standards. Each standard that is produced will be confirmed at automatic five-yearly reviews.

Sub-Commission SC4 "Ergonomics of Human-System Interaction" has developed the ergonomic standards on visual displays ISO 9241. This standard contains different types of information to be considered and used when designing the ergonomic aspects of a system, or assessing the ergonomic properties of a system. ISO 9241 has been organised into a number of parts, each part dealing with a different aspect of display use. The requirements and tests described in these parts are originally intended for office work, and consequently, primarily focus on the presentation of characters and texts. Still, although the UAV Operator Interface is essentially a graphics display, many of the ISO 9241 recommendations are worth considering.

The relevant material from ISO 9241 presentation and control issues consists of the following parts:

- Part 3 Visual display requirements (ISO, 1992). This part of ISO 9241 deals with the design of screen hardware for visual displays, focusing on the characteristics of the visual display, which determine its effectiveness in presenting an image to the operator. The purpose of this standard is to enable the operator to detect and recognise the displayed information accurately, quickly and without discomfort.
- Part 8 Requirements for displayed colours (Draft International Standard; ISO, 1995). This part deals with the ergonomic requirements for multi-colour displays which supplement the monochrome requirements in Part 3. It can be applied to colours assigned to text and graphic applications and images.
- Because the ISO 9241 parts mentioned above are primarily based on Cathode Ray Tube (CRT) technology, ISO TC 159 SC 4 is preparing the standard ISO 13406-2 that deals with the special issues that arise from the use of flat panel displays. This is done in liaison and consultation with International Electro-Technical Commission (IEC) TC 47 (responsible for flat panel engineering standards).
- ISO 13406 Part 2 Flat panel display ergonomic requirements (Committee Draft International Standard; ISO, 1995). This standard presents the requirements for Visual Display Units (VDU) based on flat panels/Liquid Crystal Displays (LCD). The legibility of the panel is of principal concern. The requirements are largely based on ISO 9241 Parts 3, 7 and 8, but modified and extended to consider the unique trade-offs of flat panels. Especially the issues of viewing distance, viewing direction and screen illumination depart somewhat from the precedents of ISO 9241-3.
- ISO 9241 Part 9 Requirements for non-keyboard input devices. Specifies the ergonomic requirements for non-keyboard input devices which may be used in conjunction with a visual display terminal. It covers such devices as the mouse, trackball, and other pointing devices.
- Subsection 4.5 ("Existing Standards") gives a summary of this material, in terms of Topics, Keywords, and Data.

1.2.2 UAV Specific Issues.

For UAV applications, task performance at the monitoring and control level requires operators to interact with computer-based information displays. Important aspects are:

- Control-display compatibility - The HCI should be compatible with characteristics of human information processing and decision-making. The indicator in a display should generally move in the same direction as its control.
- Control-system compatibility - Control-system compatibility refers to the spatial or movement relationships of stimuli and responses, individually or in combination, that are consistent with human expectations. To ensure high effectiveness and safety of a system, and a reduction of the response time, the system should ensure a high degree of compatibility between control and perception of the controlled process.

- Interface consistency - Differences in interfaces both within and between systems may result in the need for operators to remember different procedures and techniques to accomplish the same thing. A well-known example is the use of the same icons to initiate procedures within different Windows application programmes.
- Control identification - Control identification refers to the awareness of the operator that he addresses the proper control. Although correct identification is often critical, there are circumstances that correct and rapid identification is of major consequence.
- Control arrangement - Control arrangement refers to the physical layout of the controls in the working environment. Controls with related functions, or controls that are frequently used, should be grouped close together. This can be done by physically grouping, or by integration.
- Control dynamics - Control dynamics describe the continuous dynamic characteristics of the controls. Since control devices and system response are often decoupled, displacement feedback is provided by an additional force feedback. Resistance in control provides haptic information about the performed control action and reduces control errors resulting from tremor of the hand and mechanical vibrations (control by displacement). The controlled variable is proportional to the displacement of the control. In case no displacement is provided, control actions take place by putting a force on the control device (control by force, isometric control). The controlled variable is then proportional to that force. The control resistance can be passive or active. Passive controls are generally spring-loaded, supplying information about the zero-point of the control. Active controls provide force feedback regarding the system-status. By feedback of suitable status variables, a higher degree of performance, comfort, and a lower degree of strain can be achieved in comparison with passive controls.
- Integration of controls - Integration of controls means combining different control functions into a single control input device. This causes a reduction of the number of controls and a growing ability of the operator to activate different functions simultaneously, possibly improving control performance and control comfort. The integrated functions can be continuous, or continuous and discrete. Consideration should be given to the fact that integration of controls may cause an increase in the complexity of operating the controls and, as a result, have an adverse impact upon any training requirements.
- Display location - The optimal direct field of view for information displays is 0° to -30° vertical with respect to the horizontal line of sight, and from -25° to +25° horizontal from the neutral line of sight.

1.3 HCI Guidelines for Information and Support Tasks.

1.3.1 General Guidelines.

In the 80's, the Graphical User Interface (GUI) became familiar to more and more users who did not have specific computer expertise. These interfaces were based on the Windows, Icons, Mouse and Pull-down/pop-up menus ('WIMP'-concept). In particular the direct manipulation, provided by WIMP-interfaces, was thought to improve the usability for non-expert users. In the 90's, GUI's are becoming widespread and a standard "look-and-feel" has been developing for user interfaces of different platforms (Macintosh, Motif, Presentation Manager, Windows). Usability guidelines and style guides have been developed for these interfaces. Many of these guidelines are of a more or less overlapping nature.

The following guidelines should be considered:

- ISO 9241 Part 10. Dialogue principles. This part of the 9241 standard presents high-level ergonomic principles that apply to design of dialogues between humans and information systems.
- ISO 9241 Part 12. Presentation of information. This part deals with the specific ergonomics issues involved in representing and presenting information in a visual form. It includes guidance on ways of representing complex information, screen layout and design as well as use of windows.
- ISO 9241 Part 13. User guidance. This part deals with various forms of user guidance including documentation, help screens, within-system aids, and error-handling systems.
- ISO 9241 Part 14. Menu Dialogues. This contains a large number of guidelines concerning dialogue menus, developed from the published literature and from other relevant research.
- ISO 9241 Part 16. Direct Manipulation Dialogues. Provides recommendations for the ergonomic design of direct-manipulation dialogues, and includes the manipulation of objects, and the design of metaphors, objects, and attributes. It covers those aspects of "graphical user interfaces" which are directly manipulated.

Subsection 5 ("Existing Standards") gives a summary of this material, in terms of Topics, Keywords, and Data.

1.3.2 UAV Specific Issues.

For UAV applications, task performance at the planning, monitoring, and control level requires operators to interact with computer-based information displays. Thus, besides more basic ergonomic aspects regarding information presentation and dialogue control, additional guidelines are required. Important aspects are:

- The information presentation should be clearly recognisable, requiring a minimal amount of recording and interpretation by the operator.
- The amount of interaction required from the operator should be minimal. Settings should be limited in number and directly accessible.
- The information presentation and dialogue, both within and across operator interfaces, should be as consistent as possible.

In the following, important aspects relating to these compatibility and functionality issues of the information presentation and human-computer dialogue will be specified in more detail.

1.3.2.1 Information Presentation.

1.3.2.1.1 Compatibility.

According to the compatibility principle, the definition and layout of the different information elements on the information display should be consistent with operator task concepts and orientation. Depending on the different task levels (planning, monitoring, and control) this principle may put different demands on the way information is presented and arranged on the display. At the planning level, for instance, operator orientation is likely to be more according to a World-Referenced Frame, defining the goals to be achieved on the basis of absolute references. The information presentation optimally supporting this world-referenced orientation might be of an exocentric nature, where the display observation point (station point) is independent of the momentary operator viewpoint. On the other hand, at the control level, deviations between the desired state and the actual state are to be compensated, which is a process in which the momentary orientation and dynamical aspects of the operator/vehicle system play an important role. In this process, the information display can assist by providing local guidance according to an egocentric format, based on an Ego-Referenced Frame. According to this presentation format, information is presented from the momentary viewpoint of the operator.

Similarly, for the perception of dynamical aspects like state changes and motion, different ways of information presentation may be discerned according to an inside-out or outside-in model, based on the movement references used by the operator. Especially at the control level, the Stimulus-Response compatibility principle will be optimally supported if the same control actions always result in the same perception of movement or manoeuvres. With an inside-out view, the perceived vehicle's movements will always be consistent with the control actions. When controlling from an outside-in perspective, the operator will have to execute opposite control actions if the perceived vehicle moves towards him, possibly causing confusion because of the mental rotation involved.

1.3.2.1.2 Consistency.

The consistency principle requires the information presentation to be consistent within and across displays, modules, programs, and information systems. Within display, this implies consistency in the information coding applied, addressing issues like frames of reference, scaling units, and principles for colour coding. Across displays and different applications the principle may be extended to the use of harmonised representations (location and layout) of the different functional fields defined on the displays.

1.3.2.1.3 Feedback.

In general, the feedback principle requires operators of computer-based systems to be provided with information of where they are in the system, what they have done, and the steps necessary to achieve a specific desired outcome. More specific, the primary goal of the information displays for UAV applications is to provide operators with additional feedback in the vehicle control and platform status monitoring processes. This 'on-line' application may pose additional requirements on the design of the feedback the operator is provided with. For instance, for an efficient monitoring and control of a UAV mission, besides actual state information, additional information should be present in the form of sufficient preview and history. In general, for the monitoring of process variables the following types of information can be discerned:

- Reference
- Status
- Reference change
- Status change
- Knowledge on future reference
- Knowledge on future status

Furthermore, information should be presented in a timely way in order to build up a proper image of the environment. For instance, task performance may become degraded for low display update rates, because of insufficient feedback with regard to vehicle status and operator input. The same holds true for chart manipulation, like scaling and zooming.

1.3.2.2 Dialogue Design.

1.3.2.2.1 Compatibility.

An important precondition in designing appropriate wording for commands, menus, and error messages, is the need to be clear and unambiguous. Also, the meaning of graphic icons should be clear and conform to existing population stereotypes.

1.3.2.2.2 Consistency.

The definition and placement of control panels and function keys should be consistent across different screens and applications.

1.3.2.2.3 Structure.

The structuring of commands in different menu items should be functional and clear to the operator. Important settings should be clearly recognisable and directly accessible by the operator.

1.3.2.2.4 Feedback.

The operator should be provided with clear feedback of current selections and settings.

1.4 Existing Standards.

This subsection summarises the ISO, NATO, and US-DoD standards that apply to the dialogue and information presentation aspects of user-interface design. The summary table contain the following columns: the "topics" display the main ergonomic aspects that are covered in a norm, the focus of attention is shown in the keywords; if the norm provides quantitative information, these are presented under "data". The following notation is used:

- ISO (International ISO-norm)
- ISO/DIS (Draft International Standard of ISO)
- ISO/CD (Committee Draft of ISO)
- ISO/working document (work doc) (Committee Draft in preparation)
- NATO STANAG (Standardisation Agreement)
- MIL-STD (US Defence Military Standard)

Standards are presented, arranged according to presentation and control aspects and information and support issues. The following selection has been made:

- Presentation and control:
  - ISO/DIS 9241-3 - Visual Display Requirements
  - ISO/DIS 9241-8 - Requirements for Displayed Colours
  - ISO/CD 13406-2 - Flat Panel Displays
  - ISO/work doc 9241-9 - Non-Keyboard Input Devices
- Information and Support
  - ISO/DIS 9241-10 - Dialogue Principles
  - ISO/work doc 9241-12 - Presentation of Information
  - ISO/CD 9241-13 - User Guidance
  - ISO/DIS 9241-14 - Menu Dialogues
  - ISO/CD 9241-16 - Direct Manipulation Dialogues

2 HCI Standards Summary Table.

2.1 Presentation and Control.

ISO 9241-3 Visual Display Requirements (CRT)		
Topics	**Keywords**	**Data**
Legibility The visual properties of *single* Characters or symbols should Provide easy recognition	- Design viewing distance - Character height - Stroke width - Character width-to-height ratio - Character format (matrix) - Character size uniformity - Display luminance - Luminance contrast - Luminance uniformity	- > 400 mm - > 16 arcmin - 1/6 to 1/12 of character height - between 0.5:1 and 1.0:1 - numeric and upper-case: ≥ 5x7 - ≤ 5% of character height - > 35 cd/m² - contrast ratio ≥ 3 - average display luminance from centre to edge: < 1.7:1, Variation of peak luminance of character elements: < 1.5:1
Readability The characteristics of text Should allow groups of Characters to be easily Discriminated, recognised and Interpreted	- Between-character spacing - Between-word spacing - Between-line spacing	- ≥ stroke width / pixel - ≥ character width - ≥ pixel
Coding Should attract attention and/or Be readable	- Luminance coding - Colour coding	- luminance ratio ≥ 1.5 - see ISO/DIS 9241-7 (Table III)
Visual comfort The image should be stable And free of flicker.	- Temporal instability (flicker)	- free of flicker to > 90% of user population

ISO/DIS 9241-8 Requirements for Displayed Colours		
Topics	**Keywords**	**Data**
Colorimetrics Colour specification should be in terms of CIE units	- Luminance - Chromaticity - Uniform colour space - Colour difference	- Y (cd/m^2) - x, y - u*, v*, L* - ΔE^*_{uv}
Default colour set Not too many, mutually discriminable colours, adapted to the lighting conditions	- Number of colours - Number in case of memory Recall or visual search - Reflected ambient light	- ≤ 11 - ≤ 6 - Y_R, u'_R, v'_R
Colour display Should be spatially uniform and free from misconvergence (CRT)	- Uniformity - Misconvergence	- $\Delta E^*_{uv} \geq 0.03$ - $\leq$ 3.4 arcmin
Coloured imagery Colour coded alphanumerics and graphics should be large enough for correct colour identification	- Character height (strings) - Single characters and symbols - Use of saturated blue imagery	- $\geq$ 20 arcmin - $\geq$ 30 arcmin - $\geq$ 120 arcmin
Colour difference Discrimination criteria should be in terms of CIE units	- Minimal discriminability of colour pairs - Idem for luminance difference	- $E^*_{uv} > 20$ - contrast ratio > 3
Polarity Information can be presented in either negative (dark background) or positive (light background) contrast	- Dark background - Light background - Optimal foreground/back-ground colour coding	- avoid deep red (v'> 0.4) and blue (v'< 0.2) - avoid (dim) blue and red - achromatic foreground combined with chromatic background or vice versa

ISO/DIS 9241-8 Requirements for Displayed Colours		
Topics	**Keywords**	**Data**
Depth effects Unwanted depth effects due to Chromatic aberration of the eye optics (chromostereopsis) should be avoided	- Chromostereopsis	- avoid combination of spectral extremes (deep red and blue)

Because ISO 13406 Part 2 on flat panels (LCD) is still in committee draft (CD), it is to be expected that publication will take some time. However, it is possible to provide already an overview for Flat Panel displays, in a format similar to that used for the CRT ergonomic requirements. This overview is shown below.

ISO CD 13406-2 Flat Panel Display Ergonomic Requirements		
Topics	**Keywords**	**Data**
Legibility The visual properties of single Characters or symbols should provide easy recognition	- Design viewing distance - Design viewing direction - Character height - Stroke width - Char. width-to-height ratio - Character format (matrix) - Display luminance - Luminance contrast - Luminance uniformity	- > 400 mm - shall conform to all optical requirements over a *relevant range of viewing directions* - > 16 arcmin - number of pixels in a stroke: 8-20% of number of pixels in character height - between 0.5:1 and 1.0:1.0 - numeric and upper-case: $\geq 5 \times 7$ - > 20 cd/m² - contrast ratio (of the higher and lower luminance): $\geq 1 + 10.L_L^{-0.55*}$ - variation in area luminance between high and low luminance targets on the edges and across the diagonal of the screen shall not exceed a ratio of 1.7:1.
Readability The characteristics of *text* should allow groups of characters to be easily discriminated, recognised and interpreted	- Between-character spacing - Between-word spacing - Between-line spacing	- ≥ stroke width / pixel width - ≥ character width - ≥ pixel width
Coding Should attract attention and/or be readable	- Luminance coding - Colour coding	- contrast ≥ 1.5
Visual comfort The image should be stable and free of flicker.	- temporal instability (flicker)	- free of flicker for > 90% of user population

* LL is the (background) luminance of the lower state in the viewing direction in a dark room, in cd/m² (LL $ 3.177 cd/m²).

Certain LCD's exhibit long formation times. The image may be electrically refreshed every 16 ms or less, but the formation of the full optical effect (luminance, colour) can take more than 200 ms. Contrast loss in applications that require motion effects (including blinking or rapid cursor movements) must be anticipated and should be specially managed. In order to avoid contrast loss during rapid image changes, flat panel display systems should provide a formation time less than 55 ms.. Motion artefacts become undetectable at image formation times less than 3 ms.. In ISO CD 13406-2 the formation time is defined as the time for an image contrast to change from 10% of its maximum value to 90% of its maximum value plus the time for an image contrast to change from 90% of its maximum value to 10% of its maximum value.

ISO/working document 9241-9 - Non-Keyboard Input Devices		
Topics	**Keywords**	**Data**
Suitability for the task The device should be compatible with primary task for which it is intended.	- Efficiency - Space - Effort - Access	N/A
Self-descriptiveness The purpose and use of the device are best when self evident	- Delineation of function groups	N/A
Controllability The system shall appear to be controlled by the user	- Feedback - Non-interference - Non-accidental activation - Grip - Position and shape	N/A
Conformity with user expectations Function, movement and position of control actuators and display elements shall correspond to what the user expects.	- Predictability - Consistency	N/A
Error tolerance The intended result is achieved, despite errors in operation, with little or no corrective action.	- Unintended activation	N/A

ISO/working document 9241-9 - Non-Keyboard Input Devices		
Topics	**Keywords**	**Data**
Individualisation The device shall be flexible enough to adapt to the differences of the user population.	N/A	N/A
Suitability for learning The skills required can be acquired in an appropriate period of time by the average individual likely to use the device.	- Compatibility with other devices - Flexible	N/A

2.2 Information and Support.

ISO/DIS 9241-10 - Dialogue Principles		
Topics	**Keywords**	**Data**
Suitability for the task A dialogue is suitable for a task to the extent that it supports the user in the effective and efficient completion of the task	N/A	N/A
Self-descriptiveness A dialogue is self-descriptive to the extent that each dialogue step is immediately comprehensible through feedback from the system or is explained to the user when requesting the relevant information	N/A	N/A
Controllability A dialogue is controllable to the extent, that the user is able to maintain direction over the whole course of the interaction until the point at which the goal has been met	N/A	N/A
Conformity with user expectations A dialogue conforms with user expectations to the extent that it corresponds to the user's task knowledge, education, experience, and to commonly accepted conventions	N/A	N/A
Error tolerance A dialogue is error tolerant to the extent, if despite evident errors in input, the intended result may be achieved with either no or minimal corrective action having to be taken	N/A	N/A

ISO/DIS 9241-10 - Dialogue Principles		
Topics	**Keywords**	**Data**
Suitability for individualisation A dialogue is suitable for individualisation to the extent, that the dialogue system is constructed to allow for modification to the user's individual needs and skills for a given task	N/A	N/A
Suitability for learning A dialogue is suitable for learning to the extent, that it provides support, and guidance to the user during the learning phases	N/A	N/A

ISO/working document 9241-12 – Presentation of Information		
Topics	**Keywords**	**Data**
Organisation of information - Should ensure that the user interface satisfies task requirements for input and display - Should improve users performance in terms of recognition, visual search and comprehension of displayed information - Should maintain an appropriate level of stress under which users are working by avoiding over- and under load situations - Should provide an aesthetic appeal which pleases users and enhances satisfaction	N/A	N/A
Organisation of area	- Specific areas for key dialogue elements - Consistency in location - Identification and naming - Working area limitations	N/A
Organisation of windows	- Overlapping/tiled format - Default window settings - Window control - Consistency in presentation - Window relationships	N/A

ISO/working document 9241-12 – Presentation of Information		
Topics	**Keywords**	**Data**
Organisation of groups of information	- Functional grouping - Perceptual distinctiveness - Conventions and common formats - Consistency - Display density	N/A
Presentation in tables and lists	- Justification - Item ordering - Column/row spacing - Use of designators	N/A
Presentation of display elements	- Labels - Input/output field differentiation - Unit of measurement - Cursor positioning	N/A
Representation of information with coding techniques Should improve a user's ability to comprehend visual information and the speed and accuracy with which information can be processed	- Legibility - Comprehensibility - Consistency - Discriminability - Detectibility - Conciseness - Lucidity	N/A

ISO/working document 9241-12 – Presentation of Information		
Topics	**Keywords**	**Data**
Alphanumeric coding	- Coding conventions - Coding rules - Mnemonic codes - Code length - Code configuration - Rules for abbreviation	N/A
Symbols and graphics	- Number of graphical or symbolic elements - Geometric shapes - Line coding	N/A
Highlighting	- Use of markers - Blinking/ blink rates - Underlining - Size coding - Brightness coding - Colour coding - Background/foreground colours - Coding conventions	N/A

ISO/CD 9241-13 - User Guidance		
Topics	**Keywords**	**Data**
General	- Presentation of guidance information - Format and syntax - Task specific/generic information - Non-disruptive - Reversibility of operations - Level of guidance	N/A
Prompts Should indicate system is available for input and provide information on the type of action that is valid, given current system state	- Generic/specific prompts - Prompts for data/command entry - Automatic positioning - Format cues - Sequence guidance	N/A
Feedback Should provide information which indicates that the system has accepted input and is acting on it	- Perceptible feedback - Non-intrusive/non-distractive - User skills/task requirements - Indication of acceptance - System response time - Highlighting	N/A
Status Should provide information which indicates the current state of components in system hardware and/or software	- Conditions for continuous or Automatic presentation - Consistency in location - Mode discrimination	N/A

ISO/CD 9241-13 - User Guidance		
Topics	**Keywords**	**Data**
On-line help Should provide additional guidance in the dialogue and user interface	- Conditions for on-line help - Task/input specific - Non-intrusive - Availability - Appropriateness - Ability to browse	N/A
Error management Should provide additional guidance in the dialogue if an error has been detected either by the system or by the user	- Dialogue continuation - Tools for error correction - Diagnostic tools - Means to interrupt, suspend and cancel - Format and syntax - Consistency in location - Unintentional/destructive operations - Information on warnings	N/A

ISO/DIS 9241-14 - Menu Dialogues		
Topics	**Keywords**	**Data**
Structuring into levels and menus Should facilitate the user's ability to find and select menu options and should support the user's flow of work	- Conventional categories - Logical categories - Arbitrary categories - Search time	N/A
Grouping options within a menu Should reflect user expectations and facilitate option search	- Logical groups - Spatial arrangement	N/A
Sequencing options within groups Should facilitate option search	- Consistency - Importance - Conventional order - Frequency and order of use	N/A
Navigational cues Should help users to learn the menu structure and navigate within the structure	- Distinctive titles - Graphic techniques - Simultaneous display - Menu maps	N/A
Rapid navigation Rapid navigation methods for quick access to submenus should be compatible with the user's flow of work	- Access time - Direct node access - Level skipping - Simple return to initial menu - Upward level movement - Multiple pathways	N/A

ISO/DIS 9241-14 - Menu Dialogues		
Topics	**Keywords**	**Data**
Option selection methods The method of selection and the input devices should facilitate option selection	- Provide alternative methods - Separate actions for selection and execution - Fast access - Feedback - Deselection and undoing - Response delay - Multiple selection	N/A
Alphanumeric keyboard If an alphanumeric keyboard is used, selection and execution techniques should be consistent, relate to task requirements and conform to user expectations.	- Minimising keystrokes - Command line location - Case equivalence - Key letter/number designators - Designator structure and syntax	N/A
Function keys Should be applied for fast selection of frequently used options	- Designator correspondence - Displaying assignments - Menu orientation - Consistency of assignment	N/A
Pointing If pointing is used, the technique utilised should be easy and intuitive for the user population, and be suitable for tasks to be performed	- Pointing area - Unintended activation - Keyboard equivalence	N/A

ISO/DIS 9241-14 - Menu Dialogues		
Topics	**Keywords**	**Data**
Placement Users should be able to locate menu options on the basis of expectations, intuitiveness of menu layout, consistency and visual features	- Consistency of layout - Titles - Accelerator keys - Options in columns/rows - Colour - Fonts/legibility - Borders and lines	N/A
Textual option structure and syntax Identification and discrimination should be facilitated by unambiguous, familiar, concise names, consistent typography and syntax	- Use of keywords - Option terminology - Option phrasing - Action and object options - Transition to command language	N/A
Graphic option structure and syntax If icons are used for object/action representation, such icons should be unambiguous, conform to user expectations and be suitable to the task	- Icon labels - Grouping - Visual distinctiveness	N/A

ISO/CD 9241-16 - Direct Manipulation Dialogues		
Topics	**Keywords**	**Data**
Presentation of information Should help users to perform tasks such as searching, discriminating and understanding information more easily and accurately.	- Objects - Attributes - Manipulations - Distinctiveness - Availability	N/A
Access and manipulation Dialogue should give the user a feeling of directness and naturalness of its manipulations	- Pointing - Manipulation syntax - Status indication - Prompting - Feedback - Reversibility	N/A
Metaphors Should enable users to anticipate how to use the system by providing familiar concepts	- Consistent framework - Analogies	N/A
Representations of objects Should be intuitively recognisable, distinct, easily accessible, and directly manipulable	- Object instances - Recovery of object states	N/A
Design/manipulation of attributes Easy access and changeability of attributes should be provided for effective user performance	- Feedback on changes - Combined manipulation	N/A
Manipulation of objects Direct manipulation is intended to minimise learning time and enhance user performance	- Generic manipulations - Selection of objects - Simultaneous manipulation - Access to hidden objects	N/A

ISO/CD 9241-16 - Direct Manipulation Dialogues		
Topics	**Keywords**	**Data**
Manipulation of windows Windows are used to give the user simultaneous access to multiple views on data and objects relevant for the task	- Changeability of window attributes - Position control - View ability - Size manipulation - State manipulation - Icon representation - Control of window contents - Consistency in window control	N/A
Manipulation of controls If controls are used to enhance user recognition of available manipulations, such representations should be unambiguous, conform to user expectations and be suitable for the task	- Pointing - Indication of availability - Menu selection - Pop-up menus/pull-down menus	N/A