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NATO Intelligence, Surveillance, and Reconnaissance (ISR) Interoperability Architecture (NIIA)

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1. AEDP-2 (Edition 1) - NATO INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) INTEROPERABILITY ARCHITECTURE (NIIA) VOLUME 1: ARCHITECTURE DESCRIPTION - is an NATO UNCLASSIFIED publication.

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J MAJ
Brigadier General, POL(A)
Director, NSA

RECORD OF CHANGES

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FOREWARD

The NATO Intelligence, Surveillance, and Reconnaissance (ISR) Interoperability Architecture (NIIA) provides the basis for the technical aspects of an architecture that provides interoperability between NATO nations' ISR systems. It is recognized that a complete architecture requires a technical view, a systems view, and an operational view to be complete. However, the systems and operational views are dependant on the specific scenario, with the systems involved determined by the participating nations, and the operational view defining how the various systems are actually interconnected. While a acquisition group such as Air Group IV could theorize hypothetical scenarios and generate the systems and operational views based on those hypothetical scenarios, it is more important to focus on the technical issues of providing the interconnectivity options within national and NATO-owned systems, and leave the operations planning to the military community.

This AEDP provides the technical and management guidance for implementing the NIIA in ISR systems. It is divided into four volumes. Volume 1 provides the introduction and explanation of the technical architecture. Volume 2 contains guidance for managing the NIIA, specifically, the configuration management and test and certification guidance to the NIIA Custodians. Volume 3 is the technical guidance relevant to multiple parts of the architecture. Finally, Volume 4 provides terms and definitions. The four volumes are published as separate documents due to the large size of each volume.

This volume focuses on providing an introduction to the architecture and a description of the philosophy behind and key elements of the architecture. The specific standards to be implemented are identified and a description of how the standards fit together into the architecture is provided.

For the first time aspects of both imagery (IMINT) and signals intelligence (SIGINT) interoperability are addressed within a single architecture framework. Up to now, NATO's nations have more experience in working together in the IMINT than in the SIGINT fields of ISR employment. This is reflected in the number of existing imagery-related STANAGs compared to the nascent SIGINT standards set. This is changing, however, and this volume incorporates the first specifically electronic intelligence (ELINT) related STANAG into this interoperability architecture.

In addition to AEDP-2, users of the NIIA should obtain copies of each of the STANAGs incorporated into the architecture. These STANAGs provide the key interface standards needed to provide the systems interoperability. Many of the STANAGs also have separate Implementation Guides for the standard, published as separate AEDPs. In addition, specific guidance on sanitization and declassification of advanced memory recording systems (solid state and advanced disk arrays) is provided in a separate document for ease of dissemination. This document is AEDP-3. A complete list of the documents included in the set of STANAGs/AEDPs is in Annex A of Volume 1 of this document.

Questions or comments on this document can be provided to either the Secretary of Air Group IV or the Custodian. Correspondence to the Secretary should be addressed to: Secretary, Air Group IV; Air Armaments Section, International Staff; HQ NATO; B-1110, Brussels, Belgium (telephone: +32-2-707-4291; telefax: +32-2-707-4103). Correspondence to the Custodian should be addressed to: Custodian, AEDP-2; SAF/AQIJ; 1060 Air Force Pentagon; Washington D.C. 20330-1060; United States (telephone +1 703-588-2669; telefax: +1 703-588-1340).

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Executive Summary

The NATO ISR Interoperability Architecture (NIIA) defines the overall structure of the elements of the Intelligence, Surveillance, and Reconnaissance (ISR) community. The intent of this document is to provide the context for the standards developed by NATO Air Group IV, as well as commercial and international standards that are applicable to the ISR mission. It should be noted that while the original NIIA document was a description of an imagery-only architecture, the work of Air Group IV has suggested that the scope of the Group's activities should include other sources of intelligence. Therefore, this updated volume begins to address SIGINT collaboration among NATO partners as well.

A description of operational environment, including a number of variations on the basic data flow, is provided. This description includes notional task flow descriptions and timelines. When examining the ISR data flow, it is noted what interfaces will be exercised during the two primary ISR Integration Working Group (ISRIWG) demonstrations. These two demonstrations, one to show interoperability at the input to the ground/exploitation system by using the NATO Advanced Data Storage Interface, and one to show interoperability at the output of the ground/exploitation system by using the NATO Secondary Imagery Format and NATO Standard Imagery Library Interface.

Each of the currently ratified and developmental standards developed under Air Group IV is also reviewed. Each standard is discussed in terms of its application and use. Other documents needed to complete the architecture are also discussed.

Finally, the actual architecture is introduced and discussed. Four levels of interoperability, as defined in NATO interoperability publications, are reviewed. They are:

- Degree 1: Unstructured Data Exchange. Involves the exchange of human-interpretable unstructured data such as the free text found in operational estimates, analysis and papers.
- Degree 2: Structured Data Exchange. Involves the exchange of human-interpretable structured data intended for manual and/or automated handling, but requires manual compilation, receipt and/or message dispatch.
- Degree 3: Seamless Sharing of Data. Involves the automated sharing of data amongst systems based on a common exchange model.
- Degree 4: Seamless Sharing of Information. An extension of degree 3 to the universal interpretation of information through data processing based on co-operating applications.

It should be noted that the objective of the NIIA is to achieve interoperability at Degree 2, with some specific interfaces achieving Degree 3. Degree 4 can be considered a long-term objective, but it was determined that lower degrees of interoperability should not be delayed in favour of ultimately achieving a higher degree. Degree 2 interoperability is a significant accomplishment, and will provide a high level of capability to NATO and coalition forces. Higher degrees of interoperability will be addressed once degree 2 is achieved and demonstrated.

Finally, a review of the standards as they fit into the architecture is performed. The standards are mapped against the International Standards Organisation (ISO) 7-Layer Interface Model. This mapping is performed to identify how the standards fit together and include commercial and international standards, as well as to identify the holes in the architecture that must be addressed by the activities of the ISRIWG and its subordinate groups. During the analysis, it was determined that most interfaces are adequately defined, and those requiring additional standardization can be filled with existing commercial and/or international standards. The key issue remaining is the multitude of choices provided by many of the standards, thereby allowing multiple implementations that would not be interoperable. It will be important to develop interface profiles that define the specific choices within each standard, thereby ensuring interoperability.

Although this version of the NIIA does not fully integrate SIGINT, NATO does realize the significant contributions this intelligence discipline has to offer. The first step towards this end is the adoption of STANAG 4633, whose aim is to promulgate the necessary ELINT/ESM data exchange standards needed for ISR assets to work effectively together. Future revisions of this document will add more detail on how SIGINT fits into the NIIA.

In summary, it is noted that the ISR architecture is applicable across all levels of NATO and coalition operations, including both Article 5 (war operations) and non-Article 5 (peacekeeping, peacemaking, etc.) campaigns. Finally, while it is recognised that the standards are complete, there is a large volume of support documentation, including configuration management plans, test and certification plans, implementation guidance, and acquisition guidance, that are available to the community. It is recommended that STANAG custodians consolidate this documentation into a single volume to accompany each standard. The accepted form of this volume is as an Allied Engineering Documentation Publication (AEDP). Combining the AEDPs with this document and the standards forms the complete NIIA definition and documentation set.

1.0 INTRODUCTION

1.0.1 This paper describes the NATO Intelligence, Surveillance, and Reconnaissance (ISR) Interoperability Architecture (NIIA), which defines how reconnaissance and surveillance assets within Air Group IV's (AG IV) area of responsibility will achieve interoperability. The main aim of the NIIA is to outline a top-level architecture which will provide a context and structure for Air Group IV's STANAGs and other interoperability initiatives. The NIIA will enable identification of where interoperability is achievable and will highlight any gaps or deficiencies in the interoperability architecture.

1.0.2 Air Group IV has the basic responsibility for interoperability of airborne ISR reconnaissance systems. Specifically, it has the responsibility for specifying standards for surveillance and reconnaissance assets to achieve interoperability within coalition and NATO environments. The goal of the NIIA will be to develop a concept to achieve data exchange interoperability between NATO reconnaissance and surveillance assets. The NIIA follows a methodology, which will enable AG IV's Intelligence, Surveillance, and Reconnaissance (ISR) Interoperability Working Group to identify where higher levels of interoperability may be achieved. At the same time, this methodology will align and harmonise the NIIA with other complimentary NATO architectures, minimising duplication of effort and maximising the benefit from previous and parallel interoperability initiatives, including the NATO Interoperability Framework (NIF).

1.1 Scope

1.1.1 This document outlines the concepts for the development of a reconnaissance and surveillance architecture for NATO. The NIIA is focused on promoting interoperability of NATO and national ISR assets among NATO nations and is one of the top 10 priorities of the NAFAG, for which AGIV has the primary responsibility.

1.1.2 The reconnaissance cycle, as shown in Figure 1, includes a number of functions. It is recognised that although the reconnaissance cycle has numerous interfaces, many of these are outside AG IV's area of responsibility. Therefore, the main focus of the NIIA is on the ISR interfaces between airborne and surface-based elements and between the output of the surface-based elements and the rest of the ISR community. Other interfaces such as Collection Coordination & Intelligence Requirements Management (CCIRM), mission tasking, mission planning, sensor control and tasking, operational concepts, mapping, sensor-to-shooter, and unmanned air vehicle (UAV) control are considered only from a perspective of how they may impact the ability of the NIIA system-of-systems to efficiently collect and exploit ISR intelligence.

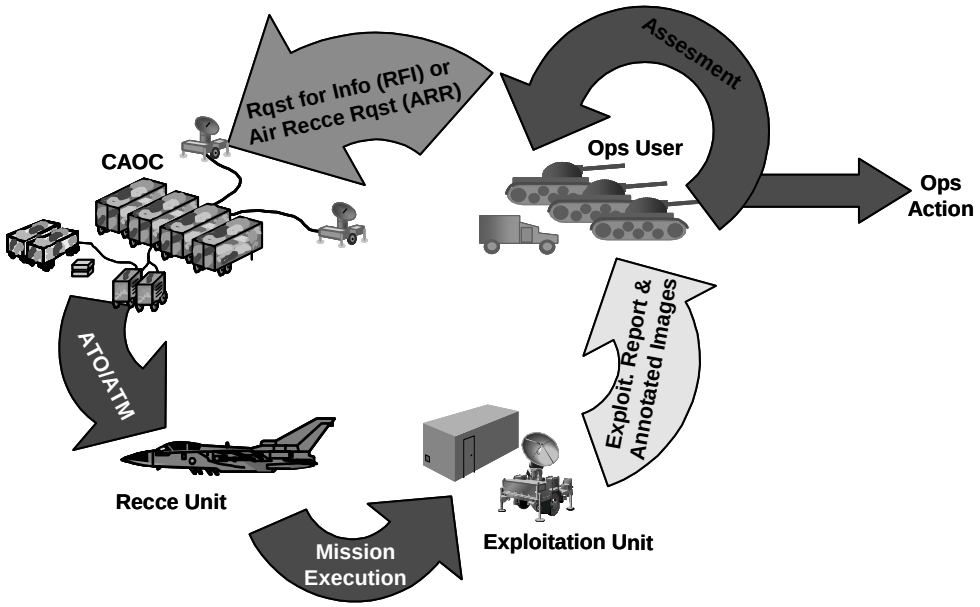

Figure 1 - Reconnaissance Cycle

1.1.3 If interoperability is the goal, then the NIIA must describe the structure of components and their relationships for NATO reconnaissance and surveillance systems. The NIIA is expected to provide the minimum information for the interoperability of NATO airborne reconnaissance and surveillance systems. The NIIA will be a living document continually improving by assessing technology and requirements and migrating changes into the architecture over time based on shared operational experience and available resources.

1.1.4 The NIIA must be the key tool to providing interoperability between independently developed ISR systems. As systems become more and more complex, the concept of system interoperability can grow equally complex. The complexity of an interoperable interface is driven by the military requirement. Today, trying to achieve interoperability of complex systems without an architecture is impossible.

1.1.5 To take full advantage of a robust NIIA, NATO will also need to correlate the NIIA with an information architecture that capitalizes on the concepts of net-centricity. In a net-centric environment, producers and users of information are all interlinked (e.g., the Internet), enabling secure access to distributed databases to ensure redundancy and rapid posting of perishable data. Once ISR information/data is posted, users will be able to establish customized profiles to 1) automatically push data to appropriate users, and/or 2) execute a “smart pull” to automatically request (or be alerted to) relevant data.

1.1.6 This document outlines the concepts for the development of a reconnaissance and surveillance architecture for NATO. The NIIA is focused on promoting interoperability of national intelligence, surveillance, and reconnaissance assets among NATO nations and is one of the top 10 priorities of the NAFAG, for which AGIV has the primary responsibility.

1.1.7 Figure 2 is a key element of the NIIA as it shows AG IV's area of responsibility and the broader area of interest that makes up the reconnaissance cycle. Achieving interoperability between nationally owned systems represents a significant challenge. All ISR domains, from Strategic to Surveillance and Tactical Reconnaissance, will benefit from the interoperability standards defined in the NIIA. Military benefits that can be derived from interoperability between the reconnaissance and surveillance systems in the NIIA domain include:

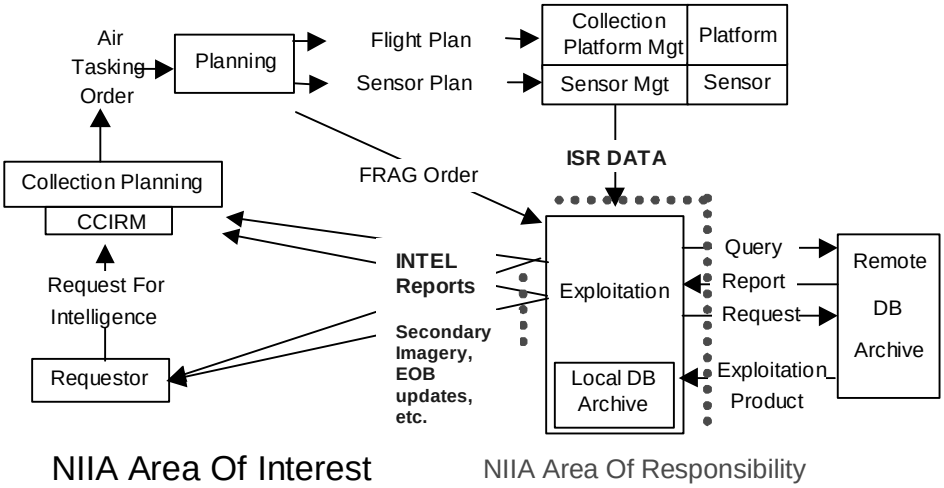

Figure 2 - NIIA Scope

a. Improved quality of intelligence through data fusion
b. Improved availability of intelligence at all levels of command
c. Improved accessibility to all areas of terrain
d. Improvement in the capacity for dissemination
e. Improvement in timeliness of information & intelligence
f. Improved area of coverage, revisit rate, endurance and time of coverage
g. Improved flexibility of operation and increased redundancy in the event of attrition

1.2 Background

1.2.1 Technological advances in weaponry and communications continue to drive the need for NATO forces to field responsive ISR assets that possess capabilities for interoperability. Rapid and accurate collection, exploitation, and dissemination of relevant information are vital to achieving operational objectives. This applies equally to information derived from imagery (IMINT) and the electronic spectrum (SIGINT).

1.2.2 NATO previously addressed interoperability among film-based imaging systems in a series of STANAGs. As NATO reconnaissance systems transitioned from film to electronic systems, interoperability issues became much more complex. The original NATO reconnaissance cross-servicing requirement required each NATO nation to be able to prepare an air platform for a reconnaissance mission as well as process and exploit the data collected during the mission. With film systems interoperability basically involved standardizing on the film and film processing specifications. The exploitation of film was essentially a manual process using manual tools. With standardized tasking and exploitation procedures (STANAG 3596) and standardized products (STANAG 3377), the exploitation cross-servicing of reconnaissance imagery was essentially a straightforward procedure.

1.2.3 One of the advantages of electronic imagery is the potential for the use of electronic tools to manipulate, modify, enhance, measure and report. Even though the process for the exploitation of electronic imagery is basically the same as for film, the tools to assist the interpreter are being implemented in software. Another advantage of electronic imagery is the ability to electronically transmit the imagery to another location. The use of electronic data links enabled the imagery to be exploited even before the air platform returned to base. In addition, airborne systems would record the imagery on electronic recorders and transfer the recorded medium to a ground station for replay. So we now see that we have a possibility for many different electronic: imagery formats, transmission techniques, recording mediums, and processing tools.

1.2.4 The NATO Interoperability Design Study was conducted in the early 1990s to investigate ways to enable interoperability of electronic systems. One of the approaches considered was to mandate that all nations procure and operate the same systems. However, it was emphasised at this time that NATO could not mandate interoperability of national reconnaissance systems, but that interoperability among national systems would be purely voluntary. It was not considered a good idea to have one contractor monopolise the reconnaissance systems in NATO. Instead, a comparison was drawn between communications between reconnaissance systems and computer-to-computer communications. By carefully defining an interface between two computers we can be assured of a successful exchange of data between them. The analogy was drawn to reconnaissance systems by standardizing on an interface between the air platform and ground station. This would require:

a. Standardizing on an electronic format for sensor data.

b. Standardizing on an electronic data link transmission channel.

c. Standardizing the physical recording medium, such as magnetic tape.

1.2.5 By defining a common interface between the air and ground systems, each nation would be able to build their own systems and enable data interchange (i.e. cross servicing) through this common interface of the mixed systems during joint operations. The following efforts in AG IV to promote electronic interoperability were to develop STANAGs for: the sensor data (STANAG 7023), the tape recorder (STANAG 7024), and the wireless data link (STANAG 7085). This original 1990's NATO Imagery Interoperability Architecture concept reflected the technologies of the time. This document updates the original concept with the technology advances that have occurred in the interim. Further, because AG IV has the mandate for all of the ISR community, and further because the various sources of intelligence are all looking to standardize interfaces and use common standards, studies by Air Group IV suggest that it may be appropriate to expand the scope of this document to include the entire ISR community.

1.2.6 For a variety of reasons, SIGINT has not had that same measure of scrutiny and policy collaboration as IMINT. Nations have their own systems and procedures for collecting SIGINT. Sharing, if done at all, has been done on an ad hoc basis. Procedures for exchanging SIGINT information need to be refined so that allied forces can be reasonably confident of working from the same information base for mission planning and dynamic retasking.

1.2.7 The value of sharing SIGINT data, particularly ELINT/ESM information for suppression of enemy air defenses (SEAD) missions, is obvious. The near real-time information that SIGINT can contribute to dynamic force protection is unique. SIGINT data can provide equally vital information on other aspects of adversary activities, such as weapons status, situational awareness, and adversary intent.

1.2.8 As with imagery, current technological trends for SIGINT offer a mixed bag of opportunities. While potential adversary electronic capabilities are becoming more difficult to exploit, there also exists processing and dissemination technologies that enable efficiencies in the sharing of information among allied assets. Capturing these processing and dissemination technologies in a set of community-accepted standards and processes is another challenge for this architecture.

2.0 CURRENT SITUATION

2.0.1 "The Defence Capabilities Initiative is designed to ensure that all Allies not only remain interoperable, but that they also improve and update their capabilities to face the new security challenges."[1]. According to the Defence Capabilities Initiative (DCI) item EE-6, NATO military systems will be required to interoperate among one another more effectively than ever before. Based on the fact that future conflicts will continue to involve command structures that utilise diverse information systems, information interoperability will be crucial for the success of joint military operations. From the AG IV DCI road map, it appears that many nations will be implementing the AG IV STANAGs in their reconnaissance systems procurements and upgrades within the next few years.

2.0.2 As NATO is an alliance of nations formed by a multinational agreement it has no real authority to mandate requirements for national procurements. Therefore, it is a commitment on behalf of each nation to be interoperable with NATO systems and systems from other nations. Each nation will need to assess the benefit of interoperability against the cost. Nations may opt for different degrees of interoperability based on their assessment. AG IV's responsibility is to ensure that the tools to provide interoperability at any degree are in place. Currently, there are no NATO owned reconnaissance systems. Systems, which provide reconnaissance and surveillance for NATO are nationally owned and loaned to NATO.

2.0.3 A number of imagery-related initiatives have been taken to illustrate how nationally owned ISR systems can operate in coalition operations. The first, conducted in 2002 and 2003, was the bilateral exchange of STANAG 7023 formatted data, including imagery and auxiliary data, between France and the U.K., France and Germany, Germany and the U.K., and the U.K. and U.S. These exchanges used commercially standard exchange media. The next was the exchange of CD-ROMs using the NITF/STANAG 4545 format. (See section 2.2 for further discussion of each of these standards.). Figure 3 shows the NSILI Demonstration for ground station image server interoperability, as sponsored by the Intelligence, Surveillance, and Reconnaissance Integration Working Group (ISRIWG). This exchange included seven nations plus the NATO C3 Agency, each providing a CD-ROM with imagery from their national collection systems. The data was then viewed by each participating nations on their imagery workstations. This initial phase will be followed by two additional phases. Firstly, all imagery was placed on a single imagery server and nations accessed the images using the NSILI (STANAG 4559) protocols via the Internet. Secondly, the imagery was stored on multiple national servers and access performed from each of the servers as appropriate. This demonstration showed interoperability at the output of the ground station with each nation accessing imagery, text, and graphics from all other nations.

[1] Secretary General Lord Robertson, Introduction to the Defence Capability Initiative, during the Washington Summit on 23-24 April, 1999.

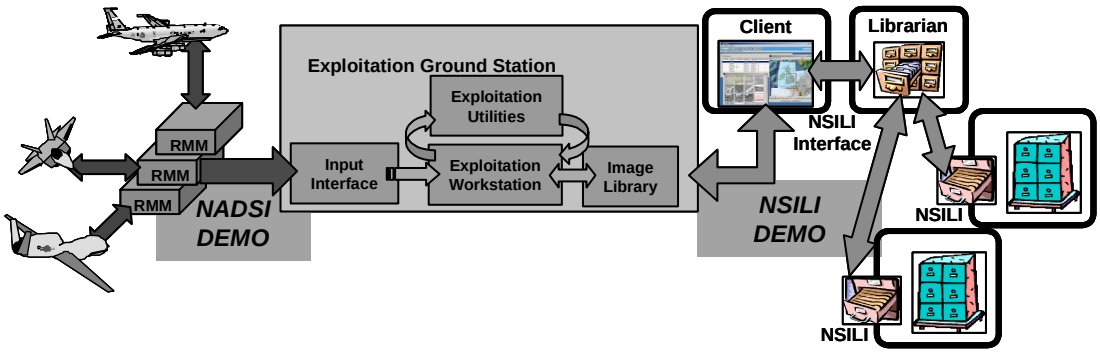

Figure 3 - ISRIWG Demonstrations

2.0.4 The second demonstration planned within the ISRIWG for late2004, also shown on Figure 3, is to show interoperability on the input side of the ground station. The NATO Advanced Data Storage Interface (NADSI) is designed to provide the connection between advanced media such as solid state or hard disk memory systems and the ground station. This demonstration will use a variety of removable memory modules (RMMs) from various vendors and will connect each to ground stations from NATO member nations. Prerecorded imagery will then be transferred to the ground station to demonstrate the flexibility of the NADSI interface and the interoperability provided between dissimilar reconnaissance systems.

2.1 IMINT Operational Environment

1. Figure 4 represents a high-level activity diagram of the execution, processing, and exploitation phases of the reconnaissance cycle. Although the detailed activities depend on the operational objectives, the high-level reconnaissance objectives for the various types of missions include:

a. Provide Indications and Warnings (I&W)

b. Intelligence Preparation of the Battlespace (IPB)

c. Identify enemy orders of battle/force disposition

d. Situation development

e. Monitor enemy activity

f. Support to force protection

g. Support to targeting objectives

h. Assessments such as BDA

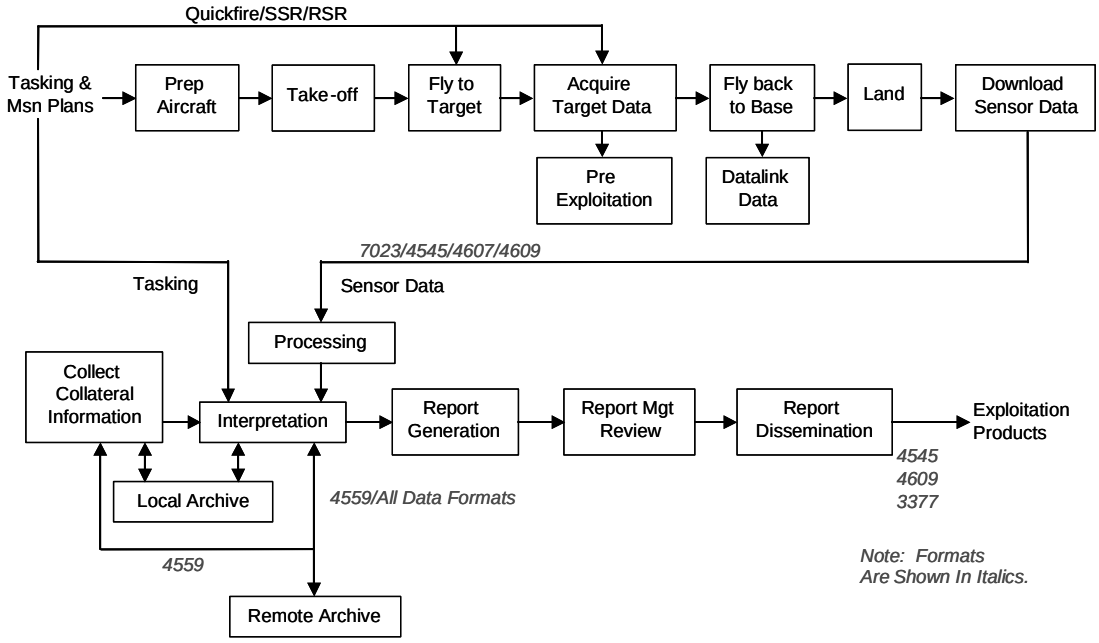

Figure 4 – Activity Diagram of Execution and Processing/Exploitation Phase of the IMINT Recce Cycle

2. It is important that the operational requirements, capabilities, and limitations are understood before considering the technical architecture description. The high level operational functional flow of information through the phases of the reconnaissance cycle shown in Figure 4 is important to the design of the technical interfaces.

2.1.1 Tasking and Mission Plan (ATO/ATM)

The mission plan consists of a flight plan, sensor plan, communications plan, and exploitation plan. Control of the air platform, sensor, and datalink will be guided by these plans. The control can be automatic, manual, or a combination of the two. In the case of UAV's (see STANAG 4586), control may be remote from the air platform or the UAV may operate autonomously given pre-programmed instructions. A variant on the pre-programmed plan is the Quickfire request or sometimes referred to as sensor services requests (SSR) or radar service requests (RSR). This dynamic tasking of the platform and sensor while the air
platform is airborne. The origination of the Quickfire request varies, but should be centrally controlled for each airborne platform. The data collection process begins with an original tasking and the collection plan. Since we are assuming an interoperable environment, the sensor plan and requestor information (i.e. name address, target identification, essential elements of information…) are merged with the sensor imagery at the source. This exploitation support data is necessary because the primary imagery stream may be the only source of tasking information to the exploitation cell in times of degraded capabilities. The original tasking identifies the information requested (RFI) of the mission. This tasking will be sent to both the collection and the exploitation function to instruct the interpreters on what essential elements of information (EEI) are required of the sensor data. The collection plan includes both the plan for the air platform and a plan for sensor operations.

2.1.2 Pre Mission Preparation

The process starts with the preparation of the air platform and sensors for the reconnaissance mission. The sensors are configured, recording media is loaded, and flight, communications, and sensor plans are loaded into the air platform for automatic or semiautomatic operation of sensor and platform during the flight. Currently there are no known standards for the flight and sensor plans. So cross servicing of air platform is not possible in this area.

2.1.3 Enroute To Target

After the air platform, whether manned or unmanned, takes off, it flies the pre-planned route to acquire the pre-planned targets. On manned aircraft, the flight crew if used or the ground observer of the UAV should have the opportunity to acquire any target of opportunity along the route. Similarly, UAVs may also provide an opportunity to acquire targets of opportunity.

2.1.4 Data Collection

During the data collection flight, the sensors may be switched on and off manually or automatically based on the sensor plan. Sensor systems onboard the air platform capture data both about the air platform environment and remote imagery. Many sensors may be operating simultaneously. Mainly, we think of imaging sensors such as electro-optical, infrared, and radar sensors. As most of these sensors generate an image over an interval of time, relative motions between the air platform and ground play a significant role. Air platform position and attitude sensors are capturing this data so it can be correlated in time to the imagery. This provides a spatial reference for the positioning of the imagery. Other sensors such as linear and angular velocity and acceleration sensors provide the information to correct for dynamic air platform motions. If any of the sensors are gimballed, then sensors must capture the gimbals positions to determine the imaging sensors look direction. It is very important that the data from these sensors are correlated very precisely in time. All of these sensors have different update rates, which make it difficult and inefficient to poll their status on a periodic basis. It is preferable to capture them in an ad hoc interrupt process. As auxiliary sensor (e.g. global positioning system (GPS)) data is captured at their natural rates, interpolations between updates will provide accurate results.

2.1.5 Transfer of Primary Imagery to Exploitation

The primary imagery may or may not be further processed before sending it to the exploitation function. This transfer depends on the physical configuration of the reconnaissance subsystems. To get the data from the air platform to the exploitation workstation can take many different routes depending on where the exploitation workstation is located. If the exploitation is located onboard a manned aircraft, the workstation can access the sensor imagery from a local network. If the exploitation workstation is located elsewhere, the data must either be data linked or passed via removable media. If data link can be established during acquisition, data can be sent to the exploitation workstation in real time with minimal time lag. Usually, the link will not be able to be established until the air platform is within line of sight of the ground station. Thus the data link acquisition location and link on-time should all be part of the pre-mission plan. However, contingency plans mandate that acquisition flexibility be built into the design of the data link acquisition procedures. If the ability to data link the sensor imagery is not available, then the air platform must return to base where the recorded media is removed from the air platform and transported to the exploitation workstation.

2.1.6 Collect Collateral Information For Exploitation

Prior to the exploitation station receiving the data, the mission plan and tasking information would normally be provided to the ground station, including what EEIs are to be gathered from the imagery. There may be some research that the interpreter has to accomplish prior to receiving the imagery. For example, he may query other imagery databases for prior reports and reference imagery of targets to be exploited.

2.1.7 Exploitation

2.1.7.1 After the interpreter exploits the imagery, the exploitation products are reviewed by the supervisor and disseminated into the intelligence network, where they are provided to the requester.

2.1.7.2 There are many variations of the above scenario. The following activity tables show top-level timelines of events that occur during four different variants of this scenario. Table 1 is the activity sequence of the scenario utilising a data link of imagery during acquisition. This is the real time sequence where the data link can be established from the collection platform to a ground station, either directly through line of sight, through a relay link platform, or through a satellite link. Note that while the data link activities are continuing, the exploitation process can proceed. Incoming imagery is screened and exploited while additional images are collected and data linked.

Activity	Time
Receive Tasking & Msn Plans	
Prep Aircraft	
Take Off	
Fly To Target	
Acquire Target Data	
Acquire Link	
Data Link Imagery & Data	
Gather Exploit. Support Info.	
Screen Targets	
Detailed 1st Phase Exploit.	
Generate Reports	
Review Reports	
Archive & Dissem. Reports	

Table 1 – Activity Sequence for the Data Link Transfer of Imagery During Collection

2.1.7.3 Table 2 represents the sequence of activities for exploitation accomplished onboard the air platform. The same activities are performed, but the point at which the data link is used is different. The products transmitted via the data link are secondary imagery products, fully exploited, with reports and annotated images.

Activity	Time
Receive Tasking & Msn Plans	
Prep Aircraft	
Take Off	
Fly To Target	
Acquire Target Data	
Screen Targets	
On Board Exploitation	
Generate Reports	
Review Reports	
Acquire Link	
Archive & Dissem. Reports via Secondary Dissem. (D.L.)	

Table 2 - Activity Sequence for Data Link Transfer of Secondary Imagery

2.1.7.4 Table 3 shows the activities for transferring imagery from the air platform to the exploitation station via a data link after the data has been collected. This is the type of scenario one would experience if the line of sight from the air platform to the ground station or relay platforms could not be achieved. For example, a low flying penetrating platform would likely not be able to maintain line of sight with ground-based facilities. Note that in this scenario, the acquisition of the imagery and the data link of the imagery do not overlap, but rather are truly sequential events.

2.1.7.5 Finally, Table 4 provides the scenario for transferring removable media from the air platform to the exploitation station. This requires that the air platform return to a base and transfer the imagery to the ground station. This transfer can be accomplished by the removal of the media, for example a wideband tape, disk array, or solid state cartridge, and physically transferring it to the ground station, or by electronically dumping the imagery and associated data to ground station facilities. Two concepts have been proposed. One is to use an aerospace ground equipment (AGE) cart with a computer and large memory device (likely a disk array), which is connected to the air platform systems for the download. The AGE cart is then physically moved to the ground station as would be done with the physical media. The other approach is to have a connection directly to the ground station facilities through a flight line connector. This latter approach has been proposed for carrier operations, allowing the reconnaissance air platform to be downloaded while still on the flight deck. The connection would be via a cable that is directly connected to the ground station facilities below decks.

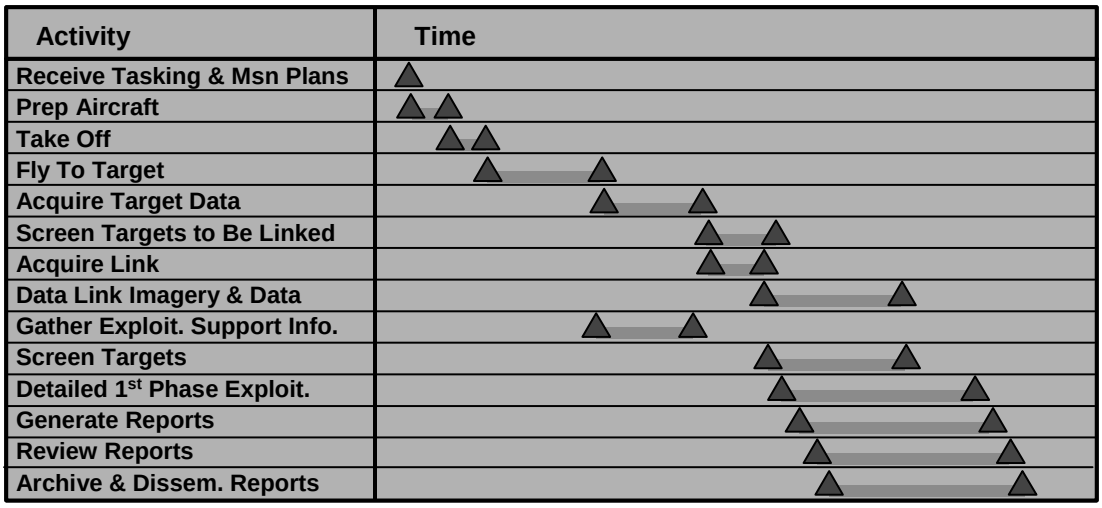

Table 3 - Activity Sequence for the Data Link Transfer of Imagery after Collection

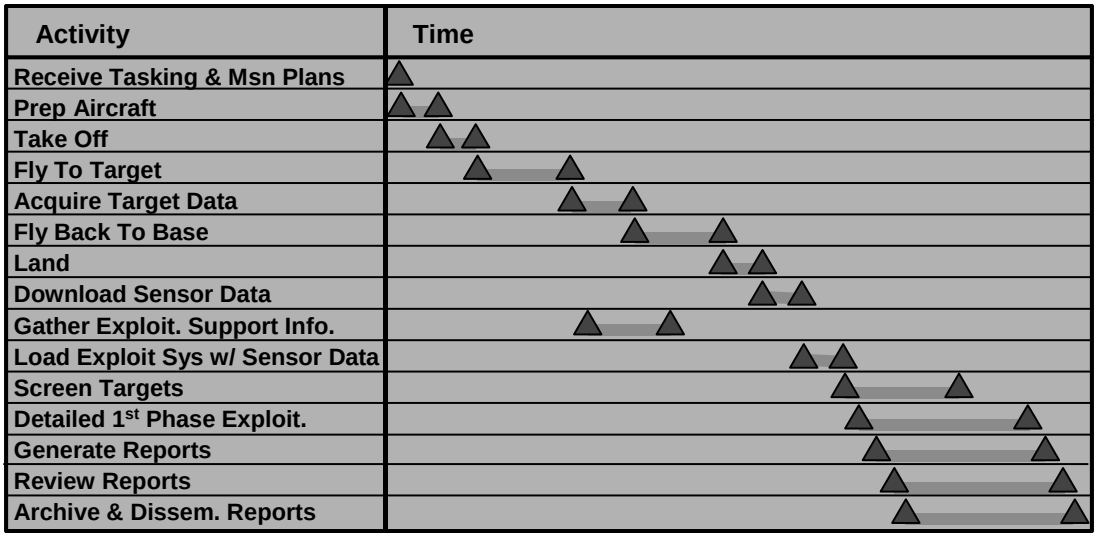

Table 4- Activity Sequence for the Recorded Transfer of Imagery

2.2 SIGINT Operational Environment

1. The development of a consistent set of SIGINT-related mission tactics, techniques, and procedures for NATO assets is still in the formative stage. Since the SIGINT assets provided by nations will vary with each scenario, it is important to recognize the common procedures, techniques, and interfaces that have been used in recent NATO operations as a starting point for further development.

2. As with imagery, the detailed activities of SIGINT missions depend on the operational objectives. The high level objectives for the various types of SIGINT missions include:

a. Provide Indications and Warnings (I&W)

b. Intelligence preparation of the battlespace

c. Identify enemy orders of battle/force disposition

d. Situation development

e. Monitor enemy activities

f. Provide adversary intent

g. Force protection

h. Support to targeting objectives

i. Support to assessments such as BDA

2.2.1 Tasking and Mission Plan (ATO/ATM)

The mission plan consists of a flight plan, sensor tasking plan, communications plan, and exploitation plan. Control of the air platform, sensor, and datalink will be guided by these plans. The control can be automatic, manual, or a combination of the two. In the case of UAV's, platform and sensor control may be remoted from the air platform or the UAV may operate autonomously given pre-programmed instructions. The data collection process begins with an original tasking and the collection plan. The original tasking identifies the information needs of supported commander. Collection management personnel will break out the essential elements of information (EEI) for the SIGINT missions. The collection plan includes the operating area for the air platform, blue force/allied positions, and target requirements list.

2.2.2 Pre Mission Preparation

The process starts with the preparation of the collection crews reviewing known adversary order of battle information and intelligence briefs of recent pertinent activity. The mission crews (airborne or ground-based collection personnel) plan out the flight plan to optimize the collection profile to meet the tasking. The mission crew will plan out a collection strategy designed to satisfy their tasking. Dynamic tasking of the platform and sensor may occur while the mission is enroute to the target area or on its flight path. The collection strategy can be modified in an ad hoc fashion during the mission to adjust to observed target activity.

2.2.3 Enroute To Target

After the air platform, whether manned or unmanned, takes off, it flies the pre-planned route to the target area. During the transit to the operational area, the mission collection crews bring up the collection systems and test them out to make sure they are operational. Once the system is checked out, the system can be used to acquire targets of opportunity while en route to the operational area.

2.2.4 ISR Data Collection

During the ISR collection flight, the mission crew will use order of battle information and data from pre-mission planning to develop and/or modify a collection plan to satisfy mission tasking. The ISR mission crew will send out activity tippers based on intelligence requirements via approved communications and data links. In the event of a direct threat to NATO forces, the ISR crews will also pass threat information directly to the affected forces over the most expedient communications means available (usually voice networks). In order to support NATO's Electronic Warfare (EW) mission, reporting of ELINT should meet the standards provided in STANAG 4633.

2.2.5 SIGINT Data Correlation

SIGINT can make a major contribution during NATO operations through its ability to report locations and identification of adversary forces and equipment. The capability to identify and geolocate adversaries can support the variety of NATO missions. These capabilities will support all of the high-level reconnaissance objectives, from providing indications and warnings to supporting assessments such as BDA. Specific examples of improved support that SIGINT can provide to NATO include support to EW for SEAD operations and enhancing force protection capability.

2.3 NATO Standardization Agreements (STANAGs)

2.3.1 STANAG 3377, "Air Reconnaissance Intelligence Report Forms"

This STANAG defines the standard reporting formats for intelligence reports disseminated to operational users. The report formats include specialised reports for time critical reporting and unique imagery such as SAR, as well standard formats for routine reporting. This STANAG is under the control of the NATO Standardisation Agency, Air Reconnaissance Panel.

2.3.2 STANAG 4545, "NATO Secondary Imagery Format" (NSIF)

This STANAG establishes the format for exchange of electronic secondary imagery. Secondary imagery is sensor data that has been previously exploited and/or processed into a human readable picture. This format enables an operator at one workstation to compose and capture a multimedia image on his workstation, and send it to another workstation where it is capable of being reproduced exactly as it was composed on the origination workstation. The NSIF format can be composed of images, graphics and text. Because of the wide variety of display capabilities, the implementations of NSIF readers and writers are classified by their level of complexity, where the highest level will handle very large images with many bands of data, and the simplest level will only handle small, single band images. For interoperability considerations, a reader of an NSIF file must be greater than or equal to the complexity level of the image it is reading in order to display it. There are reserved segments at the end of the NSIF file and within the different segments of the file for other types of information not currently defined in the baseline standard (e.g. GMTI data or motion imagery). For example a reconnaissance exploitation report (RECCEXREP) formatted in an ADatP-3 format could be attached to an image segment through a text segment.

2.3.3 STANAG 4559, "NATO Standard Imagery Library Interface" (NSILI)

This STANAG is to provide interoperability between NATO nations' reconnaissance databases and product libraries by defining an interoperable interface to each nations' image library systems, without altering the internal architecture each individual system. This STANAG standardizes on the commands that pass back and forth between database systems and the clients as well as the parameters that can be used to search for a particular image in a remote database (e.g. date, time, and location). The interface relies on facilities and services to collaborate database request, reports and orders. The STANAG does not cover the delivery of the requested images to the requestor. It does recommend that products be delivered in STANAG 4545 format, although all of the other data formats are being added. In addition, further capabilities, such as subscription services are being added to the standard to provide more functionality.

2.3.4 STANAG 4575,"NATO Advanced Data Storage" (NADS)

This STANAG defines an interface for advanced digital storage systems, such as solid state memories or disk arrays, with the aim of providing cross servicing capabilities for NATO nations' reconnaissance and surveillance assets as well as the exploitation of the imagery data in any reconnaissance ground station. The interface is a high data rate port to allow direct download of the imagery and auxiliary data, either at the air platform or at the ground station. Once the memory has been transferred to a reconnaissance exploitation ground station, it can be exploited using normal tools.

2.3.5 STANAG 4586, "UAV Control System (UCS) Architecture"

The objective of this STANAG is to facilitate communication between a UCS and different UAVs and their payloads as well as multiple C4I users. The implementation of the standard UCS architecture and the interfaces will also ease the system integration process of subsystems from different sources. This standardization will allow the continued utilisation and the integration of legacy systems. This STANAG is under the control of the NATO Naval Armaments Group (NNAG).

2.3.6 STANAG 4607, "NATO Ground Moving Target Indication Format (GMTIF)"

This effort addresses a GMTI format interface for NATO. The format provides a flexible format for target information, such that simple GMTI systems can use a small subset of the format with limited bandwidth channels, while robust systems can encode all aspects of the output data for use with wideband channels, including high range resolution (HRR) and pulse Doppler modes. It is also configured to be used as a stand-alone format, or can be encapsulated in either STANAG 4545 or 7023 data streams. Target reports include such information as target location and radial velocity. Further value-added processing of the target movement can produce track histories of the individual targets.

2.3.7 STANAG 4609, "NATO Digital Motion Imagery Standard"

The team that developed this standard investigated the applicability of commercial digital video standards and defined the metadata requirements for airborne motion imagery collection. The standard specifies the commercial standards to be used for the military community within NATO. In addition, careful consideration was taken to define the relationship between the motion imagery standard and STANAG 7023 and STANAG 4545. The military-unique metadata considerations for motion imagery were analysed and included in the standard.

2.3.8 STANAG 4633, “NATO Common ELINT Reporting Format”

The purpose of this STANAG is to identify and promulgate a set of data exchange standards for the efficient sharing of Electronic Intelligence (ELINT) and Electronic Support Measures (ESM) information among alliance assets in support of NATO or NATO led operations, specifically EW. The intent is to also to identify and promulgate message format standards to facilitate allied access to ELINT/ESM databases for dynamic analysis and adaptive mission planning and execution. This study is progressing under the direction of the ELINT-ESM Ad Hoc Working Group.

2.3.9 STANAG 7023, “NATO Primary Imagery Format” (NPIF)

This STANAG establishes a standard data format and a standard transport architecture for the transfer of reconnaissance and surveillance imagery and associated auxiliary data between reconnaissance collection systems and exploitation systems. The concept behind STANAG 7023 is to describe the sensor data structure in a space-time domain. This enables STANAG 7023 to describe any sensor data structure without modification to the STANAG. STANAG 7023 is capable of handling any type of sensor. It is simply a shell for capturing multi-source data for the purpose of data correlation at a later time and place. It is also possible from a STANAG 7023 data stream to replicate events in precisely the same order in which they occurred at acquisition.

2.3.10 STANAG 7024, “Air Reconnaissance Tape Recorder Interface”

This STANAG establishes the physical format for the exchange of magnetic tape cartridges for 4 different technologies of recorders. All the recorders in STANAG 7024 are sequential access. The four technologies are each listed in a separate annex as shown below.

Annex A - 19mm helical scan ANSI ID-1 digital instrumentation recorder with large, medium and small tape cartridge formats

Annex B – 8 mm, helical scan Hi-8 digital, and 8mm analogue

Annex C – 12.65 mm helical scan SVHS analogue recorder

Annex D – 25.4 mm transverse scan AMPEX DCRSi digital instrumentation recorder

When specifying interoperability between two or more STANAG 7024 recorders, you must state whether the recorder is Annex A, B, C, or D compliant.

2.3.11 STANAG 7085, “Interoperable Data Links for Imaging Systems”

This STANAG provide the interoperability standards for 3 classes of imagery DL used for primary imagery data transmission: analogue links described in Annex A, point-to-point digital links described in Annex B, and broadcast digital links described in Annex C. Command and control of the sensors and platform is an auxiliary mission. Annex B is organized in 2 chapters “General Requirements” and “Implementation Directives” which describe point-to-point digital links. Different implementation profiles are possible: the U.S. Common Data Link (CDL) is described in Implementation 1. The STANAG is structured such that it provides a number of options for the specific data link configuration, such as simplex or duplex operation, data rate, carrier frequency, channel multiplexing, interleaving, encryption, and many others that must be matched prior to passing data from transmitter to receiver. STANAG 7085 data links can handle any form of data (e.g. 7023, 4545, or GMTI), and can operate in different configurations, including two way (half or full duplex) modes. Further study continues to update the standard to reflect current data link philosophies, and major reorganization of the standard will be completed for the next edition.

A topic of discussion for the STANAG 7085 custodian is the issue on link acquisition and data link tracking. Coordination of link acquisition and connections will require planning and management. The group is also currently looking at a minimal mode based on a civilian standard to insure interoperability as well as on the definition of the Qualification, Validation, and Interoperability document which describe compliance and interoperability testing.

2.4 Other Documents

The NIIA uses commercial standards wherever applicable to encourage use of the commercial off-the-shelf hardware and software. Some of these standards are required to complete the interoperability channels used. For example, ISO 9660 was used for the CD-ROM data format standard during the STANAG 4545 interoperability demonstration, Phase I. In some cases, where network connectivity is needed, protocols such as the transmission control protocol/internet protocol (TCP/IP) are used.

2.5 Legacy Video Systems

The fundamental direction for NATO motion imagery systems is to move to common standards featuring all digital, progressive scan processing. STANAG 4609 provides common methods for the exchange of digital motion imagery across systems within and among NATO nations.

Analog motion imagery systems are still in use. In order to be able to attach such systems to NIIA, legacy analog motion imagery should be converted to standardized digital formats as soon as practical in the image processing chain, or digital still images or video sequences should be captured from the original data by appropriate image processing equipment. The resulting digital products shall represent the original data with a minimum loss of information.

2.5.1 STANAG 4609 Motion Imagery

According to STANAG 4609, all NATO motion imagery production systems that currently use analog video waveforms shall convert to the ITU-R BT.601-5 Component (4:2:2) digital sampling structure; for streaming applications, MPEG-2 Transport Streams shall be used.

2.5.2 STANAG 4545 Secondary Imagery

STANAG 4545 is the NATO standard for digital still images. Once an image has been captured for individual still image processing, exploitation, and dissemination, the image is no longer considered to be motion imagery and should be handled according to the specifications of STANAG 4545.

2.5.3 STANAG 4559 Library Interface

Imagery could be held in image libraries and offered to NATO nations by providing an external interface according to STANAG 4559 for querying and retrieving such imagery. At present, STANAG 4559 supports imagery mainly in STANAG 4545 format. However, it is to be expected that in the near future these capabilities will be extended to a wider range of data entities, including motion imagery according to STANAG 4609.

3.0 NIIA ARCHITECTURE

3.0.1 An architecture is the structure of components, their relationships, and the principles and guidelines governing their design and evolution over time. The NATO C3 Organisation has researched system architecture descriptions and provides guidance for the development and description of subordinate architectures within NATO. The NATO Interoperability Framework (NIF) provides the overarching architecture for subordinate architectures. Utilising system models such as the OSI 7-layer model, the NIIA provides guidance for implementing interoperable elements within each nation. These models of architectures utilise modular components, and provide the maximum use of commercial off-the-shelf (COTS) technology and reuseability of components, and promote shared development. The Theatre Missile Defence, Land Combat Operations, and the Airborne Command and Control Architectures are examples of other subordinate architectures under the NC3 umbrella. The concept is to facilitate some degree of interoperability among these subordinate architectures that may be required to interoperate with the ISR architecture in theatre wide operations.

3.0.2 As shown in Figure 5, the NIIA provides the basis for an overall ISR architecture. While the focus to date has been on the handling of imagery, work undertaken by Air Group IV has suggested that the scope of the work of the Group should include a broader spectrum of intelligence sources, such as signals intelligence (SIGINT). Additional analysis is underway to completely define this requirement and the ISR Architecture in these other areas. As additional intelligence sources are included, modifications to the existing standards may be required, as will new standards such as STANAG 4633. However, much of the current architecture is applicable to the entire spectrum of intelligence collection.

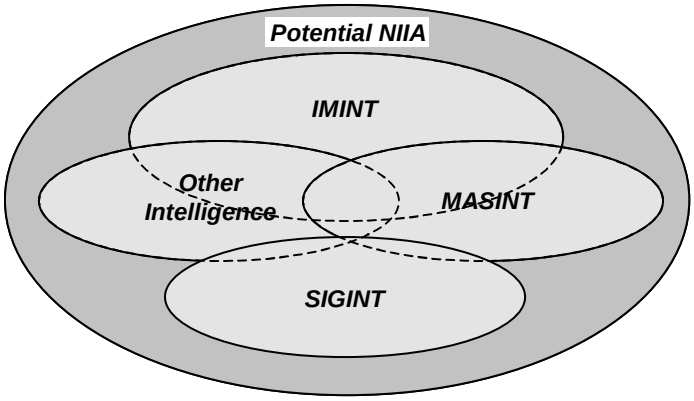

Figure 5 – The NIIA Is The Overarching ISR architecture

3.0.3 Further, the multi-role UAVs being developed require additional analysis in order to assure that the NIIA completely incorporates their capabilities. Since the current sensors fielded on UAVs are parallels to those used on manned ISR platforms, it follows that the NIIA elements would be applicable to the UAV mission. However, due to the unique capabilities of UAVs and the additional interaction required, some modification to the current NIIA standards may be required.

3.0.4 There are many levels of interoperability defined in AAP-10 NATO Interoperability Planning Document and Volume 4 of the NC3TA. The required degree of interoperability will mandate how rigorous the systems interoperability needs to be. For collaborative computing environments among heterogeneous systems very high degrees of interoperability are required. File exchange with manual intervention requires a low degree of interoperability.

3.0.5 Interoperability is defined as the ability of systems, units or forces to provide and accept services from other systems, units or forces and to use the services so exchanged to enable them to operate effectively together. In order to classify NIIA Interoperability, four degrees of interoperability are defined. These degrees are intended to classify how structuring and automating the exchange and interpretation of data can enhance operational effectiveness.

a. Degree 1: Unstructured Data Exchange. Involves the exchange of human-interpretable unstructured data such as the free text found in operational estimates, analysis and papers.

b. Degree 2: Structured Data Exchange. Involves the exchange of human-interpretable structured data intended for manual and/or automated handling, but requires manual compilation, receipt and/or message dispatch.

c. Degree 3: Seamless Sharing of Data. Involves the automated sharing of data amongst systems based on a common exchange model.

d. Degree 4: Seamless Sharing of Information. An extension of degree 3 to the universal interpretation of information through data processing based on co-operating applications.

3.1. NIIA Approach

3.1.1 The concept of the original NIIA paper written in 1995 was to standardize imagery interfaces, thereby allowing each nation to develop its own unique equipment while still meeting interoperability requirements within coalition operations. Two interfaces were defined as the critical junctions. The first interface was between the air and surface systems, and the second interface was the output of the surface systems, whether to another surface system or to the command and control elements. These interfaces were defined by the set of STANAGs and commercial standards. The resulting interoperability will provide level 2 or level 3 interoperability for imagery between ISR assets used in coalition operations.

3.1.2 The approach for this NIIA will be to investigate candidate interface configurations that will be considered the most likely combinations for data exchange and look at identifying those interface configurations using the NIIA STANAGs and other standards as appropriate. Gaps in the interfaces will be identified. It should be noted that there are some interfaces that are external to the NIIA due to the custodianship of the related standards. For example, the transmission of a reconnaissance exploitation report (RECCEEXREP) on a standard message communications channel (such as AUTODIN), while important to the overall success of the intelligence process, is beyond the scope of this architecture. The report formats are under the direction of the NATO Standardisation Agency, Air Reconnaissance Panel (NSA/ARP), and the communications channels are controlled by the NATO Communications Agency.

3.2 NIIA Architecture Description

3.2.1 The original NIIA architecture was relatively simple, reflecting the technologies available at the time. Figure 6 shows the original flow diagram.

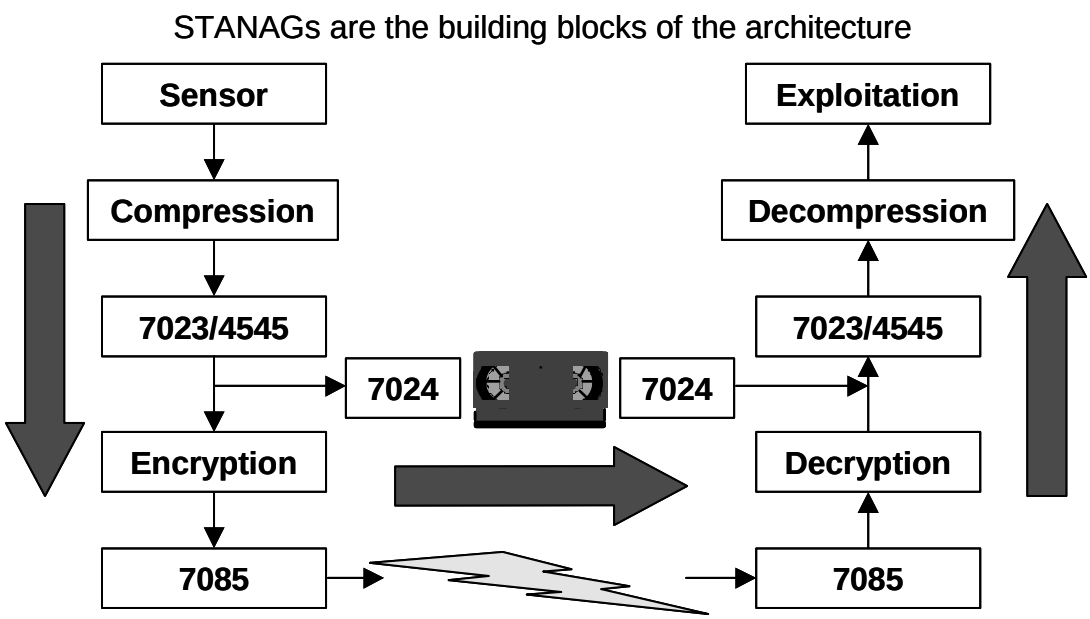

Figure 6 - Original NIIA Concept Diagram

3.2.2 With advances in technology and concepts of operations, the architecture has become more complex and complete as shown in Figure 7. This change represents the additional capabilities identified by AG IV and embodied by the additional standards for advanced data storage and imagery libraries

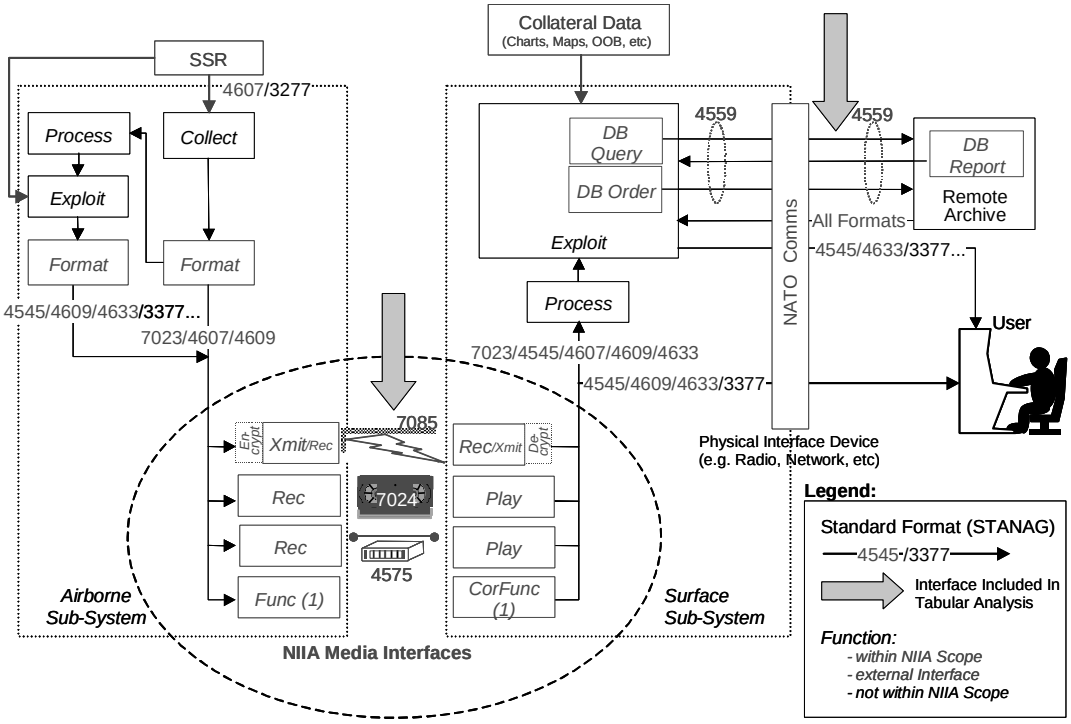

Figure 7 - NATO ISR System Interfaces

3.2.3 While Figure 7 provides the connectivity and identifies the use of each standard in the functional flow of the ISR data, it does not provide a complete picture of the connectivity of each interface. The interfaces between the airborne segment and the ground segment (or another airborne segment) and the ground segment outputs are defined as the critical interfaces for coalition interoperability. These interfaces are highlighted on the figure and addressed in the analysis that follows. Table 5 shows how the specific interfaces are mapped against the ISO 7-Layer interface model.

3.2.4 Note that each interface includes at least two specific standards to define the protocol, and in most cases, assumes the existence of applications to provide the top level of interoperability. For example, if STANAG 4545 formatted image data is to be transferred via wideband tape, the application layer would entail at least a image processing software package to write the proper file on the transmit side and a compatible 4545-capable image reader on the receive side. This was highlighted during Phase I of the ISRIWG Interoperability Demonstration. Although the images were all properly formatted according to STANAG 4545 (actually the U.S. NITF format, which is functionally compatible), the reader software packages used by the various nations had different functionality. The result was that the displayed image and associated information was different for each package, and in some cases, did not provide the complete functionality required to use the data in the file.

3.2.5 In Table 5, it can be seen that in some cases more than two standards are required. In others, standards are not required for specific layers. For example, the direct connection data link provides the necessary protocol to make and maintain the connection without additional overhead. It does, however, limit the ability of the link to make other connections. Note, however, that the configuration using STANAG 7023 is more robust, including some of the session layer due to the synchronisation fields that allow for reestablishment of the link. For the network configuration of the data link, note that the session and transport layers are not defined in either of the existing standards. Current programs using this configuration of the data link have adopted different commercial protocols for these layers, which unfortunately make the implementations of the links incompatible.

Table 5
ISO 7-Layer Model Mapping Of ISR Interfaces

ISO Layer	***Data Link***				***Wideband Tape***	***Advanced Data Storage***	***CD-ROM Transfers***	***Image Library***
	Direct Connection		***Network Connection***					
7. Application Layer	Note: The NIIA assumes that applications are available that provide application layer interoperability for most interfaces.							4559
6. Presentation Layer	4545/ 4607/ 4633 [*1]	7023	4545/ 4607/ 4633	7023	4545/4607/ 4633/7023	4545/4607/ 4633/7023	4545/4607/ 4633/7023	4545 (4607/ 7023)
5. Session Layer	Not Rqd.	Not Rqd.	Netwrk Proto. [TBD]	Netwrk Proto. [TBD]	Not Required	4575	Not Required	4559
4. Transport Layer								
3. Network Layer								Defined By Communications Network(s) Being Used
2. Data Link Layer	7085	7085	7085	7085			ISO 9660	
1. Physical Layer					7024 [*2]			
Notes:		Protocol not explicitly defined in current NIIA.					Protocol not required for this configuration.	
	*1: STANAGs 4545 and 4607 include most aspects of Presentation Layer. *2: Wideband tape applications do not require management layers – only physical layers.							

3.2.6 For the exchange of CD-ROMs, the process is much simpler. The presentation layer is defined by the existing format standards, and the lowest layers are defined by the commercial CD-ROM standard, ISO 9660. This latter standard provides the description of how the data is organised on the CD-ROM. It is not necessary to have a NATO STANAG for this level of the interface, since the guidance from NATO is to use commercial and international standards first, and develop NATO STANAGs only when existing standards do no provide the functionality or capability required by the military. While the technology for optical disks is rapidly expanding, including digital versatile disk (DVD), the multiple formats currently in use precludes a single solution at this point. The commercial market will eventually define the best choice for data storage on DVDs and the ISRIWG should continue to monitor this technology and recommend a specific standard when appropriate.

3.2.7 The image library interface actually consists of two interfaces. The first is the command protocol to query the various sources of imagery, receive the lists of available images, and then request the appropriate images to be delivered. This is represented by the right side of the library interface in the table. The last step is the delivery and viewing of the imagery. STANAG 4559 recommends the use of STANAG 4545 formatted data, but does not preclude the use of other formats. Thus both STANAG 7023 and STANAG 4607 are shown in parenthesis as options. The left column under the library also requires a separate image viewer, and thus the application layer is shown as requiring separate definitions.

3.2.8 While it may seem from Table 5 that the interfaces are completely defined, each of the standards provides for multiple options in the implementation. For example, STANAG 4545 provides for multiple compliance levels indicating level of capability, while STANAG 7085 allows a number of variable parameters, including bandwidth, duplex format, and channelisation. As a result, interface profiles are required to define the specific configuration of the interface. The term profile is used, rather than interface control document, since the information provided by NATO is informative in nature. NATO does not have the authority to mandate a particular interface configuration on a national acquisition program. If the profile is adopted by a particular acquisition program, the profile can be used as the interface control document for the program. However, within the context of the NIIA, profiles should be created and appended to this document as Annexes.

3.2.9 While the primary input for the profiles rests with the respective custodians, the coordination of the profiles to assure compatibility is the responsibility of the ISRIWG. The finished profiles should be organised by interface type as shown in the table, and variations of the interface configuration within the given interface type (e.g. an Annex for direct connection data links, with different configurations as separate Appendices sequentially in the Annex). This on-going activity will result in a series of standards, both NATO STANAGs and commercial standards, and the associated profiles.

3.2.10 This set of interface descriptions can apply to all ISR applications. This includes manned and unmanned platforms, surveillance and tactical reconnaissance systems, and potentially other intelligence disciplines.

3.2.11 Additional documentation being developed includes explanatory information, current configurations, configuration management guidance, and certification and test documents. For the certification and test documentation, the ISRIWG recognises that in order to properly prepare for potential coalition operations, systems should be tested in advance. There are two techniques accepted for this process: cross tests in a bilateral fashion, or formal certification testing of each system. Both techniques have been proposed and used for the STANAGs within the NIIA. This additional documentation should be formally published within NATO. The approved form of this document is as an Allied Engineering Documentation Publication (AEDP). It would be appropriate for each STANAG to have an associated AEDP. This document forms the overarching guidance for the standards, and the standards and accompanying documentation are included under it to form the complete documentation for the NIIA. This is shown in Figure 8.

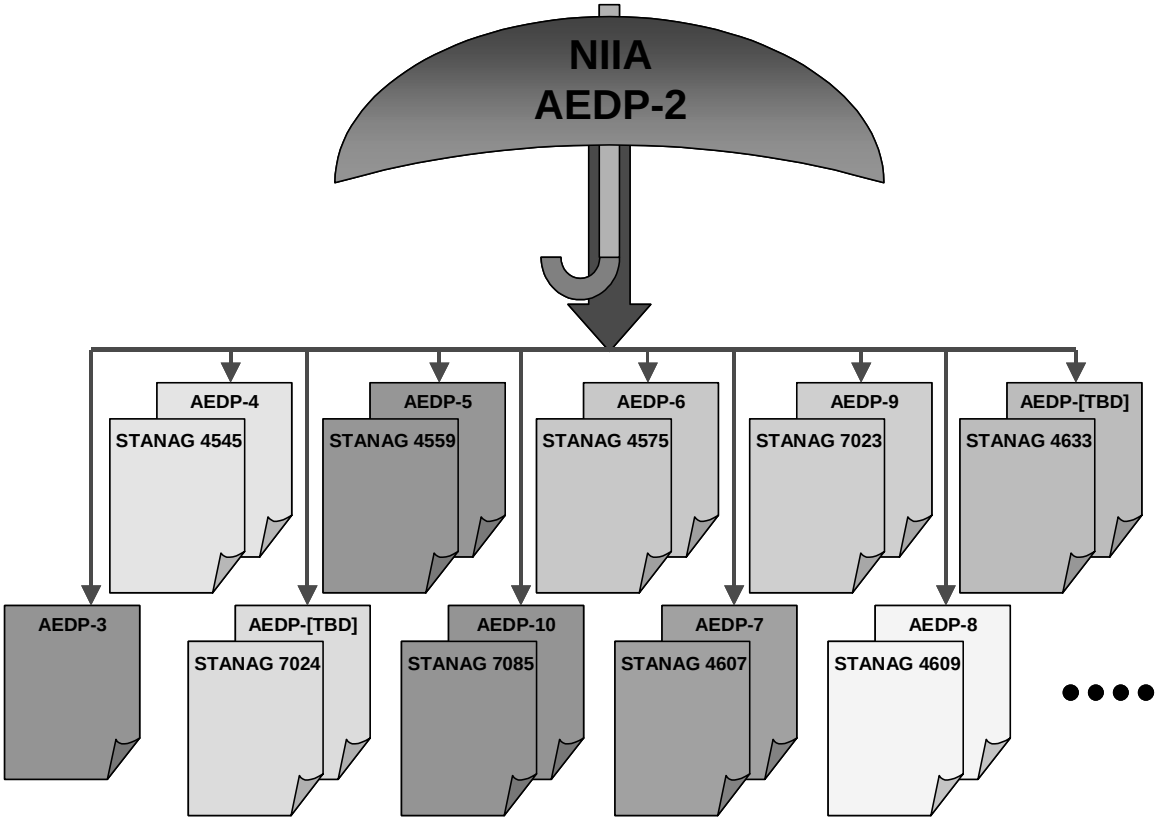

Figure 8 – NIIA Documentation

3.2.12 Finally, a significant collection of technical information applicable to multiple elements in the NIIA has been developed and is included in the supplemental volumes in this document. This includes policies to help the Custodian manage their respective documents, terminology, and technical information. The technical information includes image compression guidance, file naming convention guidance, results of studies on encryption, frequency management, and ground station definitions.

4.0 SUMMARY

4.0.1 The military benefits of interoperability were analysed and documented during the SOSTAS Interoperability Working Group study, and the key benefits include improvements in intelligence quality; probability of acquisition; and access to all areas of terrain. In addition, in recent conflicts the need to quickly refute claims of collateral damage has highlighted the need to be able to quickly disseminate intelligence products. This architecture can be applied regardless of whether the operation is conducted under Article 5 of the North Atlantic Treaty or whether it is a non-Article 5 coalition operation. In Article 5 actions, the purpose of the ISR mission is typically to support delivery of weapon systems. In non-Article 5 operations, such as peacekeeping, the focus of the missions shifts to identification and location of the potential combatants and the verification of the status of forces on each side of a disagreement. While the Article 5 and non-Article 5 operations can have different objectives, the ISR systems employed are essentially the same and the NIIA framework developed in this document are still applicable. The two critical interfaces, the input and the output of the exploitation process, with potentially air-to-air, air to ground, and ground-to-ground connectivity, are still the best sources for establishing interoperability. While national systems may strive for the higher degrees of interoperability, making possible seamless transfer of information between systems, the differing requirements of each nation drives different solutions. This variability of solution limits the potential interoperability to degree two or three and provides for the establishment of this architecture based on interface standards.

4.0.2 Further, this architecture applies to all sources of intelligence. While there are technical differences between IMINT and SIGINT, the functional flow is the same and the standards defined can be used. It may be necessary to modify the current standards and add new standards to incorporate the full capabilities of the other sources of intelligence. This adaptation is one of the tasks facing the ISRIWG.

4.0.3 Similarly, the appearance of UAVs in the battlespace requires an analysis to ensure the capabilities are properly incorporated into the NIIA. While the sensors are direct parallels to those used in manned air platform and therefore should be directly adaptable to the NIIA standards, the unique capabilities of UAVs and the requirement to have more direct command of the vehicle and sensors may require adaptation of some of the current NIIA standards. Again, this task is assigned to the ISRIWG.

4.0.4 In examining the architecture, it appears that most of the critical interfaces are documented in either NATO STANAGs or applicable commercial/international standards. In the cases where there are still gaps in the protocol stack, it is likely that the final choices will be based on commercial standards. For example, the transmission control protocol/ internet protocol (TCP/IP) can be used to complete the network, transport, and session layers for the networked data link. (Note that STANAG 4575 adopts the commercial Fibrechannel and small computer systems interface (SCSI-III) protocols as part of the standard, and thereby includes these layers in the NATO STANAG.) The ISRIWG will monitor developments in these areas and make appropriate recommendations for standardizing these selections.

4.0.5 The selection of the communications protocols used in the library interface is situationally dependent and is not defined within this document. The libraries will be typically connected through non-dedicated network facilities and can include ground based or space based links. The specific connections will be established as available and the protocols to be used will be defined by the links. Appropriate authorities, including the NATO C3 Agency and international bodies, maintain the configuration documentation for the protocols for the communications links.

4.0.6 Another critical task yet to be completed is to establish profiles of each interface configuration to provide the specific parameters to be used. As the custodians work with users of the standards, specific implementations should be documented for reference by other potential users.

4.0.7 It is recognised that users of the standards require considerable additional documentation. This documentation will take the form of an Allied Engineering Documentation Publication (AEDP). Each standard that has a need to have associated information published will have an accompanying AEDP. Together, the standards, AEDPs, and this document form the NIIA documentation set.

REFERENCE DOCUMENTS

Document Reference	Title
AEDP-02	"NATO Intelligence, Surveillance, and Reconnaissance (ISR) Interoperability Architecture (NIIA)" Volume 1; Architecture Description Volume 2; NIIA Management Guidance Volume 3; NIIA Technical Guidance Volume 4; NIIA Terms and Definitions
AEDP-03	"Advanced Memory System Declassification And Sanitization Guidance"
AEDP-04	"NSIF Implementation Guide (STANAG 4545)"
AEDP-05	"NSILI Implementation Guide (STANAG 4559)"
AEDP-06	"NADSI Implementation Guide (STANAG 4575)"
AEDP-07	"NATO Ground Moving Target Indication (GMTI) Format Implementation Guide"
AEDP-08	"NATO Digital Motion Imagery Format Implementation Guide"
AEDP-09	"STANAG 7023 Implementation Guide"
AEDP-10	"STANAG 7085 Implementation Guide"
AEDP-[TBD]	"STANAG 7024 Tape Handling Guide"
AEDP-[TBD]	"STANAG 4633 Implementation Guide"
ATP-47	"Handbook for Air Reconnaissance Tasking and Reporting"
ISO 9660	"CD-ROM Data Format"
ISO/IEC 7498-1	"Open systems interconnection - Basic reference model: The basic model"
STANAG 3377	"Air Reconnaissance Intelligence Report Forms"
STANAG 4545	"NATO Secondary Imagery Format (NSIF)"
STANAG 4559	"NATO Standard Imagery Library Interface (NSILI)"
STANAG 4575	"NATO Advanced Data Storage Interface (NADSI)"
STANAG 4586	"Standard Interfaces of UAV Control System (UCS) for NATO UAV Interoperability"
STANAG 4607	"NATO Ground Moving Target Indicator Format (GMTIF)"
STANAG 4609	"NATO Digital Motion Imagery Standard"
STANAG 4633	"NATO Common ELINT Reporting Format"
STANAG 5500	"NATO Message Text Formatting System (FORMETS) - ADatP-3"
STANAG 7023	"NATO Primary Image Format (NPIF)"
STANAG 7024	"Air Reconnaissance Tape Recorder Standard"
STANAG 7085	"Interoperable Data Links for Imaging Systems"