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3 February 2005

Evolution of a Standard: The STANAG 4607 NATO GMTI Format

By Clem H. ("Hamp") Huckins

Imagine the following scenario, set in a dark, moonless night. No, this isn't a horror movie or a spooky thriller. Just visualize a convoy of enemy tanks and trucks moving in the darkness along a roadway towards an assembly point or to an attack position. They think they are invisible to surveillance, but what they don't suspect is the presence of high-flying radar systems that could be observing their every move.

The US and the NATO nations have deployed a wide range of surveillance radar systems on fixed-wing, rotary-wing, and satellite platforms, all of which are highly capable of observing, perhaps from a stand-off distance or from space, moving traffic on the earth. One type of data collected from these systems, known as Ground Moving Target Indicator (GMTI) data, provides a wealth of information pertaining to the movement of those potential targets. However, the raw data from the radar system (also referred to as the sensor) must first be changed to a form appropriate for transmission to a system capable of receiving and utilizing the data.

And that's where the STANAG comes in. STANAG 4607, the NATO Ground Moving Target Indicator (GMTI) Format, provides a format for sending GMTI data to systems which are capable of extracting usable information from the data. The format can be tailored to send very detailed GMTI data to support activities such as targeting or less detailed data for applications such as situational awareness, as required by the Warfighter.

Exploitation is the common name for the process by which usable information is developed from the GMTI data. In the general case, the exploitation system may be on-board the sensor platform or it may be located at a ground facility. The figure illustrates a sensor platform which includes an on-board exploitation system as well as a datalink to carry the 4607-formatted GMTI data to a ground station and its exploitation system. The exploited MTI data from the exploitation system, used in conjunction with information from other sources such as Synthetic Aperture Radar, Video, and Intelligence reports, provides significant inputs for the creation of an Operational Picture of the battlefield to support the Warfighter.

ORIGINS OF THE GMTI FORMAT

STANAG 4607 originated in May 1999 when a small group of US Air Force military, government representatives, and contractors met at SAF/AQIJ in Rosslyn, VA, to establish an Integrated Product Team (IPT) to develop a common MTI data format to replace the multiple MTI message formats then in use. Senior Government officials

Arthur L. Money, OASD Senior Civilian Official, and Brigadier General David Nagy, Office of the Assistant Secretary of the Air Force (Acquisition) for Information Dominance, directed the development of a "common MTI data format that will serve a user base extending to all services, the Intelligence Community, and our coalition partners." The initial product of the IPT, designated as the Common Ground Moving Data Indicator (CGMTI) Format, was designed from the ground up as a "universal" standard to meet the requirements of legacy and future US radar systems for GMTI products.

NATO ENTERS THE PICTURE

In April of 2000, NATO Air Group 4 for Intelligence, Surveillance, and Reconnaissance (ISR), one of six Air Groups under the NATO Air Forces Armaments Group (NAFAG), established the NATO GMTI Technical Support Team (TST).

The NAFAG is one of the three Armaments Groups subordinate to the NATO Conference of National Armaments Directors (CNAD), the NATO organization at the Secretary (or Minister) of Defense level under which the major part of the work undertaken within NATO to identify opportunities for collaboration in the research, development and production of military equipment and weapon systems for the armed forces (to include data formats and STANAGs) takes place. The CNAD, in turn, reports to the Ambassadorial-level North Atlantic Council, the governing authority in NATO. Through its six subordinate groups and six Working Groups, the NAFAG is responsible for promoting co-operation and standardization in the area of Air armament via Joint activities and information exchange. Air Group 4 is responsible for Intelligence, Surveillance, and Reconnaissance (ISR). The ISR Interoperability Working Group (ISRIWG) is responsible under Air Group 4 for the development of STANAGs related to ISR.

The NATO Standardisation Agency (NSA) is the organization within NATO responsible for the preparation of the work and the overall administration of all STANAGs. The NSA is set up by the North Atlantic Council and is responsible to the NATO Standardisation Committee for the coordination of issues between all fields of standardization. It sets out procedures, planning and execution functions related to standardization for application throughout the Alliance.

STANAG 4607, the NATO GMTIF, is one of several ISR STANAGs called out under the NATO Intelligence, Surveillance, and Reconnaissance (ISR) Interoperability Architecture (NIIA). The multi-volume Allied Engineering Documentation Publication Number 2 (AEDP-2) provides the basis for the technical aspects of an architecture that provides interoperability between NATO nations' ISR systems. Other STANAGs related to STANAG 4607 and called out in the NIIA include: STANAG 4545, the NATO Secondary Imagery Format (NSIF); STANAG 7023, the NATO Primary Imagery Format; and STANAG 4559, the NATO Standard ISR Library Interface (NSILI).

The GMTI TST, which includes government representatives and contractors from several NATO nations, was directed by the ISRIWG to: evaluate possible formats, existing procedures and standards; recommend a "way ahead" consistent with existing STANAGs and the NIIA; and provide a new STANAG or an addendum to an existing STANAG. The work being undertaken by the CGMTI IPT soon came to the attention of the GMTI TST and, as a result, the TST began to participate in the CGMTI meetings and in the development of the CGMTI format. This led to a transformation from the US-centered CGMTI Format into the standard form for a NATO STANAG, the subsequent acceptance and designation of the standard by NATO as STANAG 4607, the NATO GMTI Format (GMTIF), and merging of the CGMTI IPT into the GMTI TST.

THE METHODOLOGY FOR DEVELOPMENT OF STANAG 4607

The present version of STANAG 4607 represents the culmination of five years of work by a dedicated technical team of GMTI experts. The technical group met periodically to develop technical details then reported their issues to a higher-level group, which typically included members of other STANAG Support teams, for guidance and doctrine. During the early stages of development, it was also necessary to meet with representatives of the various program offices having an interest in GMTI (the "stake-holders") to learn about their systems and their requirements for GMTI data dissemination.

The basic methodology for developing the STANAG was to: survey applicable legacy standards (such as the NATO Exploitation Format, the National Imagery Transmission Format, or NITF, and others); determine which data elements (including data fields, parameters, and values) were required for the new standard; and to develop a clear, easy to implement standard based on those elements. The starting point was to learn about the systems which could utilize a common MTI standard, and the means for this was a series of briefings on the technical parameters of those systems. After a data call to accumulate standards for those systems, the next step was to analyze those standards for applicability, develop a "strawman" standard, and convene a technical working group to review the "strawman" version and determine the required parameters. Due to the complex nature of the subject, it was convenient to establish three sub-groups, with each sub-group assuming responsibility for particular subject areas. The three sub-groups established for the STANAG 4607 development effort were the Coordinate Systems and Time Standards sub-group, the High-Range Resolution (HRR) sub-group, and the Structure and Definitions sub-group. The Coordinate Systems and Time Standards sub-group was responsible for selecting those parameters to be included in the STANAG and the sub-group responsible for High Range Resolution (a sophisticated form of image recognition based on detailed radar detections) defined their parameters. The Structures and Definitions subgroup was the core group for the effort, with the overall responsibility for editing the document and providing the final product. The Coordinate Systems/Time Standards and HRR sub-groups were later disbanded after their work was completed, and the burden for completion of the STANAG fell to the Structure/Definitions sub-group, which then evolved into the full-scale GMTI Technical Support Team (TST).

Each ISR STANAG is typically developed in parallel with an associated AEDP. AEDP-7, the Implementation Guide for the NATO Ground Moving Target Indicator, provides detailed technical guidance on the implementation and testing of STANAG 4607. In addition to details of test, validation, and configuration management, the AEDP includes background information and an employment concept for the STANAG, descriptions of the relationships between STANAG 4607 and other ISR STANAGs, and technical details concerning data fields, data transmission considerations, coordinate location systems, and other key parameters of the STANAG.

RATIFICATION AND PROMULGATION

By October 2002 the STANAG had been developed to the point where it was substantially complete and ready to start the Ratification process. The October version was presented to the ISR Interoperability Working Group (ISRIWG) in November 2002, which approved it for submittal to Air Group 4. The Air Group endorsed the STANAG and submitted it to the NATO Standardisation Agency for preparation of the Ratification Draft Request dated March 2003 and subsequent submission of the document to the nations for their Ratification.

"Ratification" is the procedure under which a NATO member nation formally accepts, either with or without reservation, the content of a STANAG. "Reservation" is the stated qualification by the member nation that describes the part of a STANAG that it will not implement or will implement with reservations. The member nation also has the right to state whether or not they intend to implement the STANAG. A STANAG is considered ratified when a sufficient number of member nations have stated their intentions to adopt and implement the STANAG. In practice, the number of nations required for ratification will vary with the STANAG and its intended purpose. In the case of STANAG 4607, it was considered ratified when seven of the nations which would potentially use STANAG 4607 agreed to ratify it. Of those seven nations, three committed to immediate implementation and the remaining four stated that they will not implement STANAG 4607 at this time but it may be possible in the future. Two other nations have stated verbally their intention to ratify the document as soon as it completes their staffing process.

After Ratification, the next step for a STANAG is Promulgation, which is simply a statement or announcement by NATO that the document has been approved as a legitimate STANAG. This will occur after the document has been translated into the two NATO languages (French and English) and approved in those forms. STANAG 4607 is presently in the Promulgation cycle, awaiting translation from English to French, which is expected to be completed by the Spring of 2005.

SUCCESSES

Early implementations of STANAG 4607 have been proven in several exercise and experimental venues. Within the Coalition Aerial Surveillance and Reconnaissance

(CAESAR) project, which involves efforts to establish interoperability between the GMTI and Synthetic Aperture Radar (SAR) assets of seven nations (Canada, France, Germany, Italy, Norway, the United Kingdom, and the United States), STANAG 4607-formatted data has been successfully passed from multi-nation GMTI simulators to multi-nation exploitation systems in a distributed testbed environment. Tests and demonstrations were completed for both the binary (native) version of STANAG 4607 and an Extensible Markup Language (XML) version based on the binary version. The follow-on project to CAESAR, the Multi-Sensor Aerospace-Ground Joint ISR Interoperability Coalition (MAJIIC) project, will continue to use the binary and XML versions of STANAG 4607 as the basis for GMTI dissemination.

Within the US, the Air Force Research Laboratory (AFRL) funded a contractor demonstration of STANAG 4607 embedded in a NITF 2.1/STANAG 4545 data stream using pre-recorded data. The XML version of STANAG 4607 has also been utilized in Horizontal Fusion exercise Quantum Leap 2, also using pre-recorded or "canned" GMTI data from US and Coalition platforms.

STANAG 4607 was identified as an "emerging" standard in an earlier edition of the Joint Technical Architecture (JTA), which identifies standards (mandated and emerging) that should be included in new system designs. Efforts are currently under way to identify STANAG 4607 as a "mandated" standard in the DoD Information Technology (IT) Standards Registry (DISR), the successor document to the JTA.

THE WAY AHEAD

When STANAG 4607 is promulgated in the Spring 2005 time frame, it will constitute a standard defining a format for the transmission of GMTI radar detections, to include GMTI "dots" and HRR data. However, that doesn't mean the work stops at that point. As implementation and testing of the STANAG continues, there will be a need to correct minor errors and clarify some areas of the standard. Also, the STANAG must be capable of growing and expanding to accommodate new requirements and new sensor platforms. Some examples of new features for future versions of the STANAG include: Track Data; Space Borne Radar; MTI derived from Motion Imagery; and Maritime Mode Radar. A driving concern, however, is that future versions always remain backwards-compatible with earlier versions.

In order to accommodate this future growth, the GMTI Technical Support Team (TST), the experts who carried the STANAG from initial inception to the Promulgation phase, will be re-designated as the Custodial Support Team (CST). The CST, working in conjunction with the STANAG 4607 Custodian, will be responsible for continued maintenance and configuration management during the lifetime of the STANAG.

CONCLUSION

So, where does that leave us with the convoy moving in darkness? We have seen how their moving vehicles could be under observation from US and NATO surveillance radar

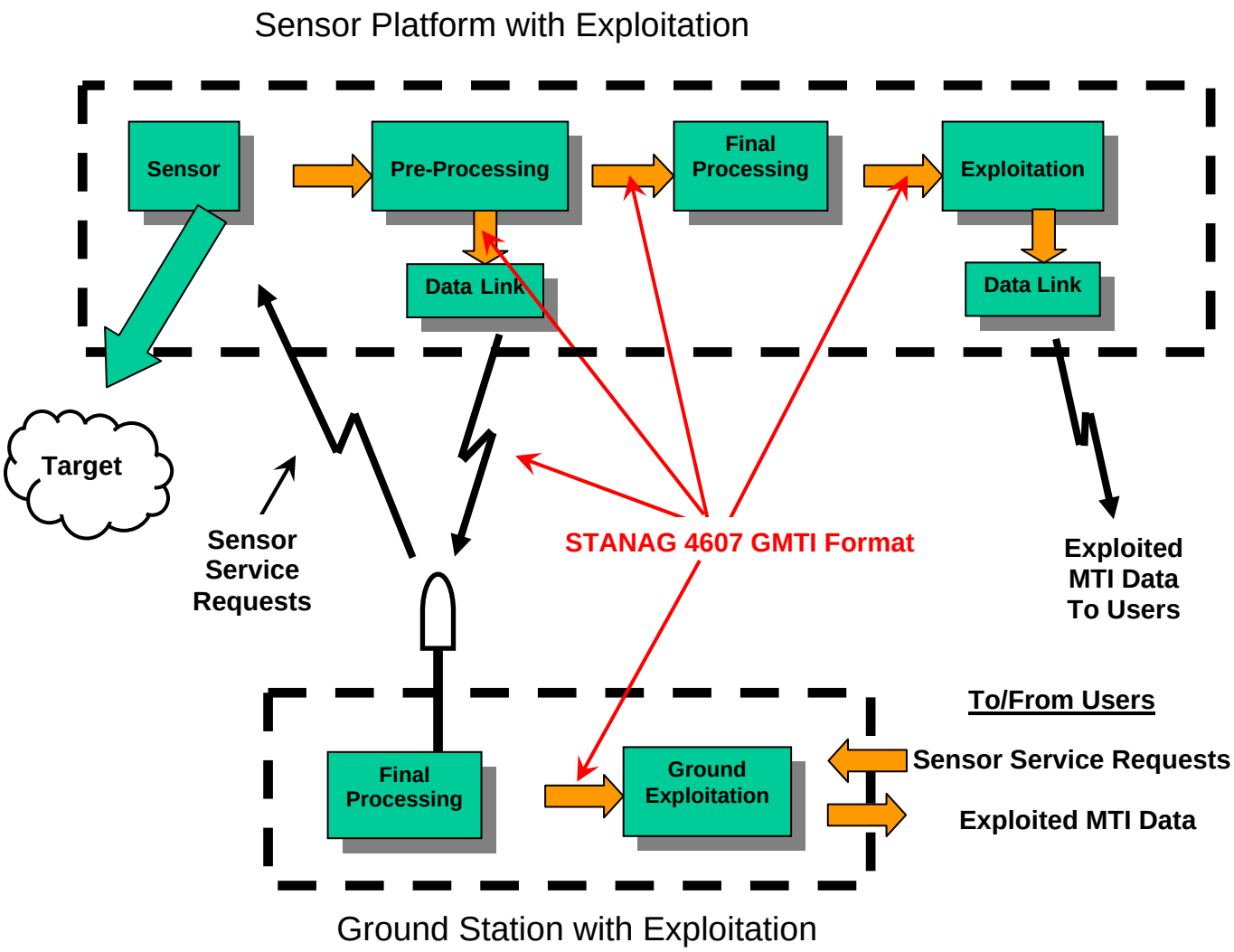
systems and how the GMTI radar detections from those observations could be transmitted to exploitation systems and the exploited data used to support an operational picture of the battlefield. STANAG 4607 provides an unprecedented means of providing that information. It is the result of an intensive effort by a dedicated team of professionals and is expected to be used for many years to come. The bottom line for STANAG 4607 is improved interoperability of Joint and Coalition forces for GMTI data and enhanced support for the Warfighter, especially in the visualization of the batlefield.

About the Author

Clem H. ("Hamp") Huckins is a Systems Engineer for the MITRE Corporation. He was formerly in the Joint STARS Program Office and is currently working in the Air Force Distributed Common Ground System (AF-DCGS) Program Office at Hanscom Air Force Base, Massachusetts. He began his career as an analog circuit designer, designing specialized test equipment to verify the operation of communications equipment for NASA's Lunar Module spacecraft. In his present capacity as Systems Engineer, he is the Technical Lead and Chief Editor of STANAG 4607. He also chairs the Technical Interoperability Working Group (TIWG) for the CAESAR coalition project and the Technical Working Group (TWG) for the MAJIIC coalition project. His special interest is in communications interoperability between coalition systems.

SIDEBAR: SOME TECHNICAL TALK

- STANAG 4607 is primarily intended for the data exchange between GMTI radar systems and their exploitation systems, and is intended to facilitate transmission, fusion, and display.
- STANAG 4607 provides a structured approach for various types of users (i.e., low- bandwidth or high-bandwidth) and an incremental fielding approach, depending on the user's particular data requirements.
- STANAG 4607 can be used either stand-alone, "embedded" into other STANAGs, such as 4545 or 7023, or disseminated in an XML version.
- STANAG 4607 is a binary, message-oriented format for the dissemination of GMTI data, also referred to as radar "dots".
- STANAG 4607 is organized in packets, with each packet including a number of segments. Each segment carries a particular type of information, such as information pertaining to a radar dwell (i.e., the point on the earth where the radar beam strikes the earth), and the radar targets detected within that dwell.
- STANAG 4607 provides a means in the Dwell Segment for tailoring the transmitted information to the user's particular requirements or capabilities. For example, a user responsible for target attack would require significantly more information for a relatively small number of movers or targets, in comparison to a user who is interested only in situational awareness or knowing the general location of many potential movers.
- STANAG 4607 currently includes "mandated" segments for Mission, Dwell, High-Range Resolution, Job Definition, Free Text, Test and Status, Processing History, and Platform Location, which can be selected and transmitted within a packet in any desired order, as determined by mission requirements.
- STANAG 4607 also includes Job Request and Job Acknowledge segments, which are "recommended" rather than "mandated", and which may be transmitted when there is a requirement to provide a request for sensor service or to acknowledge such a request.


Sensor Platform with Exploitation
Sensor
Pre-Processing
Final Processing
Exploitation
Data Link
Data Link
Target
Sensor Service Requests
STANAG 4607 GMTI Format
Exploited MTI Data To Users
To/From Users
Final Processing
Ground Exploitation
Sensor Service Requests
Exploited MTI Data
Ground Station with Exploitation

STANAG 4607 GMTI Format

- Synopsis: Mr. Clem H. Huckins (Joint STARS/MC2A International ESC/JSI-MAI (MITRE)) led the development of Standardization Agreement (STANAG) 4607 by the NATO GMTI Technical Support Team (TST). The team included Government and Contractor representatives from the U.S., five NATO nations (Canada, France, Germany, Denmark, and the United Kingdom), and the NATO Consultation, Command and Control Agency (NC3A). The format provides an international standard for the dissemination of GMTI data from airborne, space borne, and ground-based radar systems.
- Author: TBD