STANAG 5066 Edition 5

Isode

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This white paper provides an overview of the new capabilities anticipated to be introduced in AComp-5066 Edition B, which is expected to be ratified as STANAG 5066, Edition 5.

STANAG 5066 is the NATO Standard HF Link Level protocol, summarized in the Isode white paper STANAG 5066: The Standard for Data Applications over HF Radio. STANAG 5066 Edition 4 is the promulgated (official) version of STANAG 5066. Edition 5 will introduce a substantial number of optional changes. These changes are now stable, and the formal NATO ratification process is expected to start in 2026.

This white paper assumes some familiarity with STANAG 5066.

STANAG 5066 Availability

STANAG 5066 specification is NATO UNCLASSIFIED. Edition 3 was publicly distributable. Subsequent versions remain NATO UNCLASSIFIED but are not publicly distributable. They are distributable to selected other nations, including Australia, New Zealand, and Norway. Individuals from these nations and NATO nations may access the specification through a NATO representative.

Subsequent to STANAG 5066 Edition 3, specifications are published as AComPs, so STANAG 5066 Edition 4 is published as AComP-5066 Edition A. The AComP is the document, and the STANAG is the NATO ratification.

This white paper provides a publicly distributable summary of the changes for AComP-5066 Edition B, which will be standardized as STANAG 5066 Edition 5 and is referenced in this paper as Edition 5.

Edition 3 and Edition 4

STANAG 5066 Edition 4 (AComP-5066 Edition A) introduced two major changes:

1. Support of Wideband HF (STANAG 5069)
2. Use of ALE (Automatic Link Establishment).

Edition 4 also added other features and underwent significant restructuring. More details are provided in the Isode white paper STANAG 5066 Edition 4.

Compatibility with Previous Editions

All of the changes in Edition 5 are optional. They build around the core of Edition 4. Backward compatibility with Edition 3 remains optional, but it is no longer mandatory to support.

Changes to Existing Annexes

This section reviews each Edition 4 annex with non-editorial changes in Edition 5.

Annex A (SIS)

Added an optional performance optimization of client acknowledgment, as the current mechanism is inefficient, although not commonly used. The new mechanism is straightforward and fully backward compatible.

Annex B (CAS)

Added an ALE Collision Avoidance Procedure to improve resilience.

The ALE Service Definitions are expanded and clarified, primarily to support the new Annex AF. There are no CAS interoperability implications, as service definitions are not normative.

Annex C (DTS)

Added an optional alternative End of Transmission (EOT) approach based on modem block count. This is not a protocol change, but all nodes must agree to this semantic change as a priority; it is a network-wide choice.

Further information is provided in the Isode technical proposal Block Based EOTS (S5066-EP8) on which this change is based.

Annex D (Sync Serial interface to Modem/Crypto)

This annex is mandatory in Edition 4 and made optional in Edition 5. This is because Edition 5 provides several valid options, with annexes T and AF, that work without annex D.

Annex F (Assignments)

Changes made to reflect new annexes.

Annex S (SIS Access Protocol)

A new optional security layer using TLS and Strong Authentication Security is added. It is specified as a new “Security Layer” profile option so that it can be procured.

A new option framework is specified so a SIS client can determine which new options a server supports. This enables smooth and backward-compatible use of new extensions.

Seven new optional SIS extensions are specified. These are mainly to improve control and monitoring. They will significantly improve some applications.

Extended addressing provides an optional extension to allow more than 16 applications. This change is needed to enable extended addressing in Annex Q (ACP 142) and applications built on Annex W (SLEP).

Annex T (Encryption Layer)

A number of detailed changes have been made to Annex T. In particular, it adds:

1. Reliable Mode to optimize performance over reliable modems. This is an important optimization for use with modem layers from STANAG 5657 and STANAG 4538 in conjunction with Annex AF.

2. Agreed Key mode to enable working with pre-agreed keys.

Core Annex T is defined as a layer service. This is convenient for Annex T implementation integrated with the STANAG 5066 server. A new protocol interface is defined for interfacing a "crypto box" running Annex T with a modem and red side STANAG 5066. This is helpful when a Crypto Box is provided by a third party. A simple protocol is defined for use with crypto/modem and 5066/crypto. It is a simple protocol with TLS security and Strong Authentication. It can support crypto boxes running the Annex T protocol but also works for other crypto protocols.

New Annexes

Edition 5 adds twelve new Annexes, summarized here:

Annex W – SIS Layer Extension Protocol (SLEP)

SLEP provides three key protocol building blocks:

- Reliable Datagram
- Unreliable Datagram
- Streaming Service

Annexes X, AB, AD, AE, and AH use SLEP. XEP-0365 also uses it to provide XMPP chat services over HF.

Further information is provided in the specification "S5066-APP3 SIS Layer Extension Protocol (SLEP)" on which Annex W is based.

Annex X – HF-PEP

HF-PEP provides optimized TCP transfer over HF following the Performance Enhancing Proxy (PEP) model. It is based on the Annex W streaming service. It can support applications such as C2 and Web Browsing over HF.

Details are provided in the Isode white paper Providing TCP Services over HF Radio.

Annex Y – IP Crypto

Annex Y enables IP Crypto to encrypt user data. The central approach is that STANAG 5066 runs black side, with all data from the red side going through an IP crypto.

There are two modes. IP Only Mode operates with only IP services being provided on the red side. This provides a "Compatibility Mode". It supports low-volume traffic.

Full-Service Mode adds a red-side SIS so all STANAG 5066 applications and layer services can run red-side. It is critical for bulk applications and heavier loads. This mode enables full STANAG 5066 capability. It needs to use Crypto Bypass to work correctly.

- Black-to-Red is needed for flow control monitoring and correlation.
- Red to Black is needed for modem control.

Details and measurements are provided in the Isode white paper "Using IP Crypto over HF". This work is based on Isode open specifications that are the basis for Annex Y. The model is the same, and measurements are expected to be similar to the results achieved with Annex Y.

Annex Z – IP Optimizations

Annex Z defines two useful (optional) performance enhancements for use with an IP client. Annex Z is primarily intended for use in conjunction with Annex Y.

Annex AA – HF-LISP

HF-LISP (Location and Information Services Protocol) allows the Mobile Unit to report location and related information either by broadcast or point-to-point. It is modeled on AIS (Automatic Identification System) used for Marine traffic. It operates on the red side and can share an HF link using STANAG 5066.

Further information is available in "S5066-APP10: HF Location & Information Sharing Protocol", which is the open specification on which Annex AA is based.

Annex AB – HF-RIP

HF-RIP (HF Routing Information Protocol) provides a simple HF routing protocol based on the well-known RIP family of protocols. Using standard IP routing protocols consumes too much link capacity. HF-RIP enables operation in a MANET-type architecture, which is increasingly important.

Details provided in the Isode white paper "IP Routing Over HF".

Annex AC – Testing and Discovery Protocol

Annex AC provides Simple discovery, ping, and throughput protocols. This supports vendor-independent performance measurements and testing to demonstrate implementation conformance. Testing with applications or IP can be awkward and gives limited testing, as it uses STANAG 5066 in constrained ways.

Further information is available in "S5066-APP2: HF Discovery, Ping and Traffic Load", which is the open specification on which Annex AC is based.

Annex AD - HFBP

HFBP (HF Broadcast Protocol) follows the ACP 127 BRASS model to provide efficient Broadcast and EMCON support. It provides efficient operation for multiple protocols, including: ACP 127; STANAG 4406; SMTP; XMPP.

HFBP fills an important gap in the HF Protocol Suite.

Further information is available in "S5066-APP11: HF Broadcast Protocol (HFBP)", which is the open specification on which Annex AD is based. It gives a rationale for adding this protocol.

Annex AE – File Transfer

HFFTP (HF File Transfer Protocol) specifies a simple file transfer protocol optimized for HF. This capability adds a useful additional component to the HF tool set.

Further information is available in "S5066-APP8: HF File Transfer Protocol (HFFTP)", which is the open specification on which Annex AE is based.

Annex AF – Variable Rate Modem

The core STANAG 5066 approach needs fixed-speed modems with speed control and transmission time handled by STANAG 5066.

Annex AF provides a mechanism to support modems different from the "fixed speed" default. The model is that the modem controls speed, and the modem asks STANAG 5066 for data. Annex AF specifies a service interface between STANAG 5066 and modems, which covers both traditional fixed-speed and variable-speed modems.

The annex also specifies a protocol for use between STANAG 5066 and the modem. This protocol is specified using CDDL, as specified in RFC 8610 "Concise Data Definition Language (CDDL): A Notational Convention to Express Concise Binary Object Representation (CBOR) and JSON Data Structures". PDUs are encoded in CBOR, as specified in RFC 7049, "Concise Binary Object Representation (CBOR)".

Key targets for Annex AF are:

- STANAG 4538 using xDL for ARQ. Usage will be specified in a new STANAG 4538 Annex E.
- The new STANAG 5657 waveform uses Packet Protocol for ARQ.

Annex AG – Lightweight DTS

Annex AG Optimizes 5066 ARQ performance when operating over modems that provide ARQ. For example, when using Annex AF with STANAG 5657 Packet Protocol or STANAG 4538 xDL, it avoids duplicating ARQ functionality and improves performance.

Annex AH – UDP PEP

Annex AH specifies HF-UDP-PEP: UDP Performance Enhancing Proxy Protocol. It defines a PEP for UDP (User Datagram Protocol), which is widely used. It provides performance benefits over just using Annex U (IP Client) by:

- Removing the overhead of IP and UDP headers.
- Providing compression.
- Avoiding repetition of addressing information.

Isode's Role in Edition 5

Steve Kille, Isode's CEO, is the editor of STANAG 5066. Isode has provided most of the new specifications in Edition 5 and has validated many aspects in its product set. Isode initially published several new annexes in Edition 5 as open specifications, and they are already shipping in Isode products.

NATO BRIPES Project

The NATO BRIPES (BRASS IP Enhanced Services) is a software package being delivered to NATO for deployment by nations. BRIPES follows the NATO BRE1TA (BRASS Enhancement 1 Technical Architecture). BRIPES is already using two Edition 5 capabilities:

1. The T-Web service uses the Annex X TCP HF Proxy.
2. The T-Chat XMPP service uses the SLEP Streaming Service specified in Annex W.

More Edition 5 capabilities are expected to be used in due time, as many of the new annexes add capabilities that will help BRIPES target deployments.

Isode Product Support for Edition 5

Isode has added several Edition 5 capabilities ahead of standardization. Compliance information is specified here, covering both Icon-5066, Isode's STANAG 5066 server, and Isode applications that operate over STANAG 5066.

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