

**U.S. Department of
Homeland Security**

**United States
Coast Guard**



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MEMORANDUM

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To: COMDT (CG-652)
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Subj: COMPLETION OF RDC PRODUCT "TECHNICAL INPUTS TO NATIONAL MARINE ELECTRONIC ASSOCIATION (NMEA) 2000 & ONENET STANDARDS AND 0183 STANDARD" (2419) (UDI 1452)

1. The United States Coast Guard (USCG) Research and Development Center (RDC) is pleased to provide notification of technical inputs to National Marine Electronic Association (NMEA) 2000, NMEA OneNet, and NMEA 0183 Standards. Following is a brief introduction to each of the NMEA standards:

The NMEA 2000 standard contains the requirements of a serial data communications network to interconnect marine electronic equipment on vessels. It describes a low cost moderate capacity bi-directional, multi-transmitter/multi-receiver instrument network to interconnect marine electronic devices. It is multi-master and self-configuring, and there is no central network controller. The network design is based on existing Controller Area Network (CAN) technology. This standard is the only open non-proprietary marine real-time network standard available today and is referenced by International Electrotechnical Commission (IEC) in the IEC 61162-3 standard. NMEA 2000 and NMEA OneNet use the same set of NMEA Network Messages, also referred to as Parameter Group Numbers (PGN). The USCG has now begun implementing NMEA 2000 networks on USCG vessels.

The NMEA OneNet standard contains the requirements of Internet Protocol (IP) networking to interconnect marine electronic equipment on both vessels and shore. NMEA OneNet is being designed based on IPv6 and to provide a common and non-proprietary Ethernet solution. Like NMEA 0183, OneNet will be suitable for both shipboard and shore based application. This standard is expected to be published by NMEA in 2015. The primary goals of OneNet are:

- To allow transport of NMEA 2000 Network Messages over IP in a standardized manner.
- To complement and interoperate with the established industry standard NMEA 2000 Network.
- To establish standardized Gateway rules between NMEA 2000 and OneNet.
- To support high bandwidth applications such as video data transport (which is not possible with the NMEA 2000 Network).

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The NMEA 0183 standard contains the requirements for Interfacing Marine Electronic Devices. This standard is developed to permit ready and satisfactory data communication between electronic marine instruments, navigation equipment, and communications equipment when interconnected via an appropriate interface. This standard is intended to support one-way serial data transmission from a single talker to one or more listeners. This data is in printable American Standard Code for Information Interchange (ASCII) form and may include information such as vessel position, speed, depth, radio frequency allocation, etc. This standard supports shipboard, non-shipboard, and shore based equipment and networks for maritime and other industry uses. The NMEA 0183 standard addresses all marine equipment for both shipboard and shore applications and is the basis for the IEC 61162-1 standard - which only considers Safety of Life at Sea (SOLAS) shipboard applications. The NAIS network protocol is based upon this standard.

2. Incorporation of USCG requirements within the NMEA national standards development processes is the economical direct approach to guiding industry development of safe marine electronics products and services (including Automatic Identification System [AIS] technology) that satisfy USCG operational performance, budget, and technical needs. This approach also facilitates automatic improvement of the Nationwide AIS (NAIS) through the enhancement of shipboard AIS technology as that technology is improved.

Specific to FY14, RDC technical inputs to the NMEA 2000, OneNet, and 0183 Standards included:

NMEA 2000 Standard - Standard for Serial-Data Networking of Marine Electronic Devices:

- Provided assistance to Mr. Parsons (C3Cen) on the development of a USCG proprietary Parameter Group message supporting encrypted Automatic Identification System (eAIS) which meets USCG requirements for Sensitive But Unclassified (SBU) Tactical Information Exchange and Display System (STEDS) and Blue Force Tracking (BFT). The Parameter Group message is named “USCG STEDS Configuration Command/Report,” and it will be used in the USCG Interface Design Document for eAIS.
 - RDC purchased a NMEA 2000/OneNet Manufacturers Code (591) for the USCG; a necessary component to be used in the construction of USCG proprietary messages, as described above. The code is placed in the message and used by devices receiving the USCG defined message in order to determine where the contents of the proprietary message are defined. This USCG Manufacturers Code is published by NMEA and should be recognized by all marine equipment manufacturers supporting NMEA 2000, IEC 61162-3, and NMEA OneNet interfaces. The USCG Manufacturers Code can be used for any future USCG applications or equipment requiring STEDS messages or additional USCG defined messages for NMEA 2000 or OneNet.
- Drafted three new AIS Parameter Group messages corresponding to ITU-R M.1371-5 messages 25, 26, and 27. These will apply to mobile AIS equipment supporting NMEA 2000 (IEC 61162-3), and potentially future shore based AIS equipment using the NMEA OneNet Ethernet interface.

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- Worked with IEC Working Group (WG) 15 and NMEA on some minor clarifications and improvements to the NMEA 0183 Transport, Annotate, and Group (TAG) Block protocol controls for sentence grouping. These changes will be backwards compatible and were the result of desired capabilities for shore-based AIS equipment, specifically for the 2nd edition of IEC 62320-1 for AIS Base Stations. NMEA expects to publish this update in early FY15.
- Drafted new Distress Alert PGN supporting Digital Selective Calling (DSC). This is one of up to ten new PGNs supporting DSC distress and safety communications for NMEA 2000, IEC 61162-3, and NMEA OneNet. These new messages are in accordance with ITU-R M.493-13. Similar data field structuring will be used in development of future NMEA 0183 (IEC 61162-1) sentences for DSC equipment.
- Reviewed and finalized revisions to the Heartbeat PGN; to provide inherent diagnostic and equipment status information. This will apply to future mobile AIS equipment supporting either NMEA 2000 or OneNet. NMEA published this as Technical Corrigendum (TC) # 2000 201401033.
- Drafted methods for versioning NMEA Network messages. This will improve backwards compatibility of existing messages when there are necessary changes - such as when new editions of ITU-R M.1371 are published.
- Worked on developing information and methods supporting new network and device diagnostics and configuration for both NMEA 2000 and NMEA OneNet.
- Assisted with revisions to device identification (NMEA Function and Class Codes) and improvements to NMEA 2000 addressing protocols. This work applies to both mobile and fixed AIS Stations and will be applicable to NMEA OneNet.
- Assisted with development of NMEA TC# 2000 201401032 resolving incorrect data fields in the Inverter Status PGN #127509.
- Supported development of NMEA TC# 2000 201401031 for NMEA 2000 PGN #126208 Clarifications. This corrigendum further clarifies the multiple usages of PGN #126208. There are seven group functions associated with PGN #126208. Clarified and revised text descriptions for each specific group function within the header of each group function. The clarification of the “Read Fields” and “Write Fields” group functions (and their associated “Reply” group functions) was necessary to clarify their use to interrogate and configure Parameter Group messages that have at least one instance field. This applies to both shipboard and shore-based equipment, and also to both IEC 61162-3 and NMEA OneNet.
- Drafted clarifications to the NMEA 2000 International Organization for Standardization (ISO) Address Claim PGN #069028 with respect to identifying unique devices on the NMEA 2000, IEC 61162-3, and NMEA OneNet networks. This impacts all networked marine devices, including AIS shipboard and shore-based equipment.

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NMEA OneNet – Standard for IP Networking of Marine Electronic Devices:

- Assisted with defining the application of IPv6 addressing to be used in NMEA OneNet. This is a significant advancement for shipboard and shore-based marine equipment, and will facilitate and support future eNav efforts, with connectivity of AIS ship-based and shore-based information.
- Worked on developing information and methods supporting new network and device diagnostics and configuration for both NMEA 2000 and NMEA OneNet.
- Assisted with revisions to device identification (NMEA Function and Class Codes) and improvements to NMEA 2000 addressing protocols. This work applies to both mobile and fixed AIS Stations and will be applicable to NMEA OneNet.
- Assisted in further development of specifications for gateways between NMEA 2000 and OneNet.
- Assisted with the development and drafting of the certification test procedures for NMEA OneNet Interfaces.

NMEA 0183 - Standard for Interfacing Marine Electronic Devices:

- RDC has taken the lead in the development of a Search and Rescue (SAR) Return Link Message (new NMEA 0183/61162-1 RLM data sentence) for Copas/Sarsat. This message will be used to inform the person(s) in distress that their Distress Beacon signal has been received by SAR authorities. The first draft has been completed with a finalized message to be completed in FY15. The completed message will be able to provide limited information and instruction beyond a basic acknowledgement. The work is based upon the Galileo Open Service Signal in Space Interface Control Document Issue 1.2. Other Global Navigation Satellite Systems are expected to be capable of supporting this in the future. This is related to Global Maritime Distress and Safety System (GMDSS) and previous Inmarsat-C SafetyNet interface efforts (for CG-652).

Background: The International Cospas-Sarsat Program is a satellite-based SAR distress alert detection and information distribution system, best known for detecting and locating emergency beacons activated by aircraft, ships and backcountry hikers in distress. The International Cospas-Sarsat Program began as a joint effort of Canada, France, United States of America (USA), and the former Soviet Union in 1979. It was formally constituted as an intergovernmental organization in 1988 through the International Cospas-Sarsat Program Agreement signed by the four “Parties” to the Agreement: Canada, France, USA, and the Union of Soviet Socialist Republics (USSR). The Russian Federation replaced the USSR as Party to the Agreement in January 1992. Including the four Parties to the Agreement, 41 States and 2 organizations (the Participants) are now currently formally associated with the Program and actively participate in the management and the operation of the Cospas-Sarsat System.

- Reviewed and contributed on a draft sentence named Heel and Roll Measurements (HRM) for ISO specified Inclinometer equipment. Publication of final HRM specification by NMEA is anticipated to be during 2015.

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- Reviewed and contributed on a draft sentence named ROV containing three-axis speed and position information for underwater vessels. Publication of final ROV specification by NMEA is anticipated to be during 2015.
- Reviewed and contributed to the NMEA proposed Heave (HVE) sentence.
- Completed and provided a draft corrigendum to NMEA containing updates to NMEA 0183 v4.10 for the ABK, AGA, and BCL sentences supporting the second edition of the IEC 62620-1 Base Station standard. NMEA published the corrigendum in October, 2013.
- Completed and provided a draft amendment to NMEA containing legacy IEC AIS base station interface sentences no longer maintained by IEC and not to be used for new designs. These include the BCE, BCF, CAB, and TSP sentences, and also an early version of the TAG Block protocol named Comment Block. The second edition of the IEC 62320-1 Base Station standard will reference NMEA and use other approved NMEA sentences for these functions. NMEA published the amendment in October, 2013.
- Completed and provided a draft amendment to NMEA containing three interface sentences supporting AIS Class A Mobile (IEC 61993-2) and AIS Repeater Stations (IEC 62320-3). The sentences are: “EPV – Command or Report Equipment Property Value;” “SPW – Security Password Sentence;” and, “TRL – AIS Transmitter Non-Functioning Log.” NMEA published the amendment in December, 2013.
- Finalized new NMEA 0183 Talker IDs for the following Global Navigation Satellite System (GNSS):
 - GB - Beidou Navigation System.
 - GQ - QXSS - Quasi Zenith Satellite System.
 - GI - IRNSS - Indian Regional Navigation Satellite System.
- Developed a SOLAS section for NMEA 0183 and the procedures and methods for updating it by IEC TC80. Multiple documents were completed and will be sent out for international voting to determine if the 5th edition of 61162-1 will reference the proposed SOLAS section in the NMEA 0183 standard. Sentences supporting AIS are the biggest challenge as there are differences between many of the “draft” AIS sentences IEC published versus the finalized AIS sentences published by NMEA. International voting on IEC application of the NMEA SOLAS section is expected to occur during FY15.

3. Benefits realized from this work include:

- Provides USCG acquisition and regulatory decision makers with U. S. National reference standards that support future acquisitions and regulatory actions.
- Ensures that the integrity and interpretation of AIS derived information remains uncorrupted throughout its data flow; and serves to provide a valid source of AIS data for use in shipboard safety, navigation, and control systems.

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- Reduces the occurrences of maritime incidents due to failure of shipboard navigation and control systems.
- Improves waterway efficiency and safety through the advancement of marine technology, and use of live shipboard information and control systems.
- Reduces the overall cost to implement and operate advanced safety, navigation, and control systems aboard both private and government vessels.

4. The RDC is continuing with planned participation in development of national and international marine electronics interface standards (including AIS equipment). Work continues on the further enhancements and additions to both IEC and NMEA Standards. This work gives the USCG a voice in the change processes at NMEA & International Marine Electronics Association (IMEA), IEC, International Telecommunications Union (ITU), International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), and the Radio Technical Commission for Maritime Services (RTCM); and provides the USCG with an avenue for introducing necessary technical improvements benefiting the USCG operations and Nationwide AIS service.

5. It continues to be a pleasure to work with you on this project. If you have any questions or comments, please contact my project lead, Mr. Lee Luft, (860-271-2685) or email at Lee.A.Luft@uscg.mil. For information about the CG RDC, including access to our current project portfolio, please scan the below code with your iOS or Android device to access our website.

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