As I reflect at the half way point of my tour as Commanding Officer of the Navigation Center, I clearly see the positive influence this unit has on the entire maritime community. Whether it's managing the daily operations of the Differential Global Positioning System, publishing light lists and other marine safety information for mariners, managing the electronic chart portfolio for Coast Guard vessels, or responding to hundreds of inquiries from the public on navigation products and services, NAVCEN continues to make a difference.

I am pleased to share highlights of NAVCEN’s strong success in 2016. I believe you will find this a useful summary to reflect on the challenges, opportunities and accomplishments impacting safe, secure and resilient maritime navigation.

NAVCEN’s commitment is to never stop innovating. We are relentlessly focused on proactively identifying issues and offering solutions, while working closely with headquarters program offices and other stakeholders - all in an attempt to create the "best future" for the Coast Guard’s navigation and marine safety information services. NAVCEN remains at the forefront of developing improved methods to disseminate critical maritime and navigation safety products to the public and analyze historic data derived from the Nationwide Automatic Identification System to assist decision makers.

As the latest officer to have the privilege to command this one of a kind unit, I continue to cherish this opportunity to serve the maritime community. We anticipate NAVCEN will transfer some billets and functions to Coast Guard Cyber Command in 2017. We will use this opportunity to focus our efforts on our traditional information management functions in order to provide even better products in the future. We look forward to working with you throughout the year to continue the evolution of NAVCEN.

Russell Holmes
CAPT Russell Holmes
## Contents

NAVIGATION CENTER (NAVCEN) OVERVIEW ................................................................. 3

- NAVCEN Mission ........................................................................................................ 3
- NAVCEN Vision ........................................................................................................... 3
- Organizational Structure .......................................................................................... 3

OPERATIONS DIVISION ............................................................................................... 4

MARITIME INFORMATION OPERATIONS CENTER (MIOC) ........................................ 4
  - Navigation Information Service (NIS) ........................................................................ 4
  - GPS Information Sharing, Interference Detection and Mitigation (IDM) ......................... 5
  - Long Range Identification and Tracking (LRIT) .......................................................... 7
  - Nationwide Automatic Identification System (NAIS) ................................................ 8
  - Nationwide Differential GPS (NDGPS) ...................................................................... 9

NAVIGATION CENTER WEBSITE (www.navcen.uscg.gov) ........................................... 10

ENGINEERING DIVISION ............................................................................................. 11

MARITIME INFORMATION BRANCH ............................................................................ 11
  - U.S. Aids to Navigation Information Management System (USAIMS) ......................... 11
  - Local Notice to Mariners (LNM) ............................................................................... 11
  - Electronic Chart Portfolio Management ..................................................................... 12

ELECTRONIC TRACKING (E-Tracking) BRANCH ......................................................... 13
  - Data Management .................................................................................................... 13
  - MIOC Application Support ....................................................................................... 15
  - NAIS System Analysis ............................................................................................. 15

POSITION, NAVIGATION AND TIMING (PNT) GPS BRANCH .................................... 16
  - NDGPS .................................................................................................................... 16
  - GPS Civil Interface Duties & Civil GPS Services Interface Committee (CGSIC) ............ 17

STATUS OF PROJECTS .................................................................................................. 20

- Enhanced Marine Safety Information (eMSI) – Focus on migrating from analog to digital formats: .... 20
- Electronic Charting: ................................................................................................... 20
- Improved USCG and Port Partner BFT Compliance: .................................................. 21
- AIS Data Integrity and Quality Assurance Oversight: ................................................ 21
- AIS ATON Monitoring: ............................................................................................. 21
- NAIS Data Sharing Services: ..................................................................................... 21
- GPS Services and Products: ....................................................................................... 22
- NAVCEN Services Outreach: .................................................................................... 22

PATH FORWARD FOR UPCOMING YEAR .................................................................... 23
NAVIGATION CENTER (NAVCEN) OVERVIEW

NAVCEN Mission
The Navigation Center operates services and provides information that enhances the safety, security, and efficiency of U.S. waterways and civil Global Positioning System (GPS) users. These services include:

- Operating the Nationwide Differential GPS System
- Operating the Long Range Identification and Tracking business helpdesk
- Operating the Nationwide Automatic Identification System
- Publishing Notices to Mariners and the Light List
- Disseminating navigation information through 24/7 operations center and the NAVCEN website
- Managing the Integrated Aids to Navigation (ATON) Information System
- Managing electronic charting portfolios for U.S. Coast Guard (USCG) units
- Serving as the primary U.S. Government interface with GPS users (except aviation and military)
- Receiving and coordinating investigation of GPS disruption reports

NAVCEN Vision
The Navigation Center serves as the U.S. focal point for implementation of maritime e-Navigation

Organizational Structure
NAVCEN is organizationally positioned under USCG Headquarters Marine Transportation Systems Management Directorate (CG-5PW) and located as a tenant command at the Telecommunication and Information Systems Command (TISCOM) base in Alexandria, VA.

NAVCEN Personnel
- 20 Officers
- 40 Enlisted
- 18 Civilians

1 The harmonized collection, integration, exchange, presentation, and analysis of maritime information onboard and ashore by electronic means to enhance berth to berth navigation and related services, for safety and security at sea and protection of the marine environment (IMO document MSC 85/26/Add.1, Annex 20, paragraph 1)
OPERATIONS DIVISION

MARITIME INFORMATION OPERATIONS CENTER (MIOC)

Navigation Information Service (NIS)

NIS is a 24/7 watch in the Maritime Information Operations Center (MIOC) which answers any questions dealing with navigation, receives GPS disruption reports, fields approximately 23,000 emails annually and coordinates responses to about 1,000 inquiries per year. NIS watch disseminates information on Global Positioning System (GPS), Differential GPS (DGPS), Automatic Identification System (AIS), Nationwide Automatic Identification System (NAIS), Long Range Identification and Tracking (LRIT), Maritime Safety, Maritime Communications, Maritime Regulations and Local Notice to Mariners (LNMs). There are approximately 200,000 page views monthly to the NAVCEN website and more than 30,000 List Server subscribers for GPS status, GPS advisories, and LNMs. Below is the breakdown of the 948 inquiries the NIS responded to in 2016.
GPS Information Sharing, Interference Detection and Mitigation (IDM)

NIS coordinates Civilian GPS interference detection and mitigation response and is the civil interface for non-aviation GPS users. NAVCEN NIS is part of a Triad of Operations Centers with the Federal Aviation Administration (FAA) (representing aviation) and the U.S. Air Force (representing the military), to collect GPS problem reports and lead multi-agency IDM coordination.

During 2016, NAVCEN coordinated with FAA, the USAF, and other governmental agencies for the following:

- 2 training exercises
- 124 GPS disruption reports
- 104 GPS test events

GPS Disruption Reports:
Reports ranged from construction vessels in Qatar, telecommunications manufacturers in Japan to recreational runners in Moscow, Russia and truck drivers on the I-35 in Texas. Very often the perceived disruptions were due to equipment problems, however sometimes the cause was unable to be determined. All disruptions received by NAVCEN were forwarded to the USAF GPS Operations Center (GPSOC), FCC, NCC, and FAA for input on possible disruption causes. Many of the cases in 2016 were due to a need for firmware upgrade on equipment. Below is a brief summary covering the 11 reports impacting the maritime community, including one that was attributed to an ongoing GPS Test. While none of the following reports were confirmed to be related to GPS disruptions, it should be noted that by correlating various available commercial information, there is a possibility that at least one of these events may have been related to intentional or unintentional GPS interference.

- January 31st: Vessel lost GPS signal for 2 minutes while in the Gulf of Mexico. Operations centers had no correlating information.
- February 19th: Security system on a marine vessel experienced continuous disruption to functionality. Issue determined to be equipment related to chipset using an inactive satellite.
- February 23rd: Vessel lost GPS twice, both times for less than 5 minutes, off the coast of the United Kingdom. Operations centers had no correlating information.
- March 15th: Vessel operating in the Black Sea experienced intermittent GPS disruptions, the longest for 15 minutes. Operations centers had no correlating information.
- March 19th: Vessel reported loss of GPS for about an hour off of Westport, WA. Operations centers had no correlating information.
- April 23rd: Vessel reported a High Dilution of Precision (HDOP) alarm on device 20 times over the course of an hour. Operations centers had no correlating information.
- August 8th: Vessel off the UK coast reported GPS displaying incorrect course and speed over the course of an hour. Operations centers had no correlating information.
• October 14th: A USCG cutter reported disruptions to GPS off the coast of CA. Disruption determined to be related to GPS testing in the area.
• October 25th: Offshore construction vessel off the coast of Qatar experienced complete loss of GPS for a period of time. GPSOC found that space weather likely impacted GPS performance.
• November 11th: A USCG cutter reported disruptions to GPS off the coast of CA. Operations centers had no correlating information.
• November 27th: Vessel reported loss of GPS 4 times while near the west coast of FL. Operations centers had no correlating information.

GPS Test Coordination:
Through the US Air Force, GPS testing is coordinated with the USCG and other agencies to ensure these US government tests do not cause undue risk to other government operations. NAVCEN coordinates GPS Testing with the appropriate USCG Districts to ensure testing does not interfere with maritime operations. An LNM is published when GPS testing events are forecasted to disrupt GPS in maritime areas.

The following updates/changes to GPS testing operations occurred in 2016:
• NAVCEN updated the 1999 COMDTINST 16575 Processing of Global Positioning System (GPS) Interference Test Requests. The changes brought the instruction up to current procedural and administrative details.
• NAVCEN coordinated with NASA, FAA and Space-X regarding GPS-Testing protocol to determine the proper authority to suspend GPS testing in the event testing interferes with commercial space operations, including planned satellite/rocket launches. Tests are suspended when there is a safety of life concern.
Long Range Identification and Tracking (LRIT)

LRIT Business Help Desk (BHD) is a 24/7 watch in the MIOC. The satellite based LRIT system provides an enhanced level of Maritime Domain Awareness (MDA), with a real-time reporting mechanism that allows unique visibility to position reports of vessels that would otherwise be invisible and potentially a threat to the United States. LRIT is used internationally with over 100 participating countries. The U.S. LRIT boundary is 1000 nautical miles from U.S. and territories where Safety of Life at Sea (SOLAS) class vessels (300 gross tons or greater and engages in international voyages) are required to report. The LRIT watch currently monitors over 7000 international vessels within the area of interest, and over 700 U.S. vessels around the world.

NAVCEN NIS operates the LRIT Business Help Desk to receive and respond to phone, email or web inquiries from ships, ship agents, maritime entities, data centers, International Maritime Organization (IMO), industry representatives, and other LRIT customers and stakeholders. The watch monitors the frequency of vessel reporting rates and resolves issues related to shipboard position transmissions and equipment related issues (system integration/conformance testing, failures, securing of equipment, entering dry-dock, etc.) with the appropriate application service provider and/or owner/operator/captain of the vessel to ensure vessels are reporting as required.

All values are average per month for calendar year 2016:

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<table>
<thead>
<tr>
<th></th>
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<tr>
<td>U.S. flag vessels reported</td>
<td>581</td>
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<tr>
<td>Position Reports received from U.S. vessels</td>
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<tr>
<td>Average number of U.S. flag Position Reports per day</td>
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<tr>
<td>Foreign vessels reported</td>
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<tr>
<td>Foreign Position Reports received</td>
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<tr>
<td>Average number of foreign Position Reports per day</td>
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<tr>
<td>U.S. vessels reported (LRIT or Satellite AIS (SAIS))</td>
<td>2,931</td>
</tr>
<tr>
<td>Foreign vessels reported (LRIT or SAIS)</td>
<td>50,507</td>
</tr>
</tbody>
</table>
Nationwide Automatic Identification System (NAIS)

NAVCEN maintains a 24/7 NAIS watch to support system users and monitor 120+ live feeds to USCG commands and other government agencies and authorized partners. AIS is a VHF radio frequency system used between vessels for collision avoidance. NAIS is the USCG system that receives AIS data to maintain Maritime Domain Awareness and Environmental Stewardship. User notifications to affected Sectors and Districts are issued when the system is not operating properly.

The following are the primary NAIS statistics for 2016:
- 269 user notifications issued
- 270 CG FIXIT tickets opened by NAIS Watch
- 23 Casualty Reports (CASREPS) issued

NAIS Site Availability Requirement is >96%. For 2016, the average site availability was 99.45%

The following updates/changes to NAVCEN’s NAIS operations occurred in 2016:
- Implemented watchstander Smooth Log for more accurate record keeping than available in the System Operations Center (SOC) Tool
- Implemented Maestro as the primary monitoring tool for Interval 2 (I-2) sites
- Watch assumed Blue Force Tracking (BFT) encrypted key change monitoring and tracking
- Six sites were upgraded from Increment 1 (I-1) to I-2, providing transmit capability for those areas of the system
- NAIS watch began monitoring the status of US Army Corps of Engineers (USACE) AIS sites in support of a Memorandum of Understanding between the USCG and USACE to provide USCG with terrestrial-based AIS data from the Inland and Western Rivers. The Watch monitors one outgoing feed of AIS data to USACE and 9 USACE hubs of AIS data incoming to USCG. The 9 USACE hubs are comprised of 135 individual AIS sites; these sites are not individually monitored by the USCG.
- NAIS Watch continued to monitor the Marine Exchange Alaska (MXAK) AIS feed, consisting of two routers
- The number of AIS ATON being broadcast by NAIS increased to 363 by the end of 2016
Nationwide Differential GPS (NDGPS)

NAVCEN maintains a 24/7 watch to monitor NDGPS sites throughout the U.S. and coordinate maintenance and unplanned down time with Command, Control and Communications Engineering Center (C3CEN), local Electronic Support Detachments (ESDs), and Department of Transportation (DOT)/USACE contractors. DGPS is an augmentation system comparing received GPS signals to a surveyed reference point to provide corrections and in turn provide for a more accurate GPS position with sub-meter accuracy typical. DGPS site integrity monitors recognize an unhealthy satellite before the U.S. Air Force sets a satellite to unusable; this integrity monitor has a 10 second time-to-alarm.

The following are the primary NDGPS statistics for 2016:

• 648 BNMs issued for DGPS service disruptions
• 22 Notice to Airmen (NOTAM) issued for DGPS Broadcast tower aviation hazard light outages

NDGPS Site Availability Requirement is 99.7%. For 2016, the overall average site availability was 97.73%, broken down further as follows:

  o USCG Sites: 97.33%
  o USACE Sites: 88.62%

The following updates/changes to NAVCEN’s NDGPS operations occurred in 2016:

• With the decommissioning of 41 DGPS sites in August 2016, the watch was reduced from two to one 24/7 watch section. The one section ably monitors the remaining 45 sites.
• Annual Reprogramming Review in 2015 led to a watch stander billet and rating change from Operations Specialists (OS) to Electronic Technicians (ET).
  o Phased-in approach started AY16 with the watch supervisor (E7) and 4 watchstander (E5) billets being filled with ETs.
  o Anticipate remaining DGPS watchstander billets to be filled by ETs by Assignment Year 2018.
NAVIGATION CENTER WEB SITE (www.navcen.uscg.gov)

In a repeat of previous years, the Navigation Center website was again one of the most popular Coast Guard websites. Approximately 1,800 visitors per day logged over 2,260,000 page views throughout the year. 32% of the page views were from smart phones and tablet-type devices. The most popular products or sections were the Local Notices to Mariners (and the chart corrections contained therein), maritime telecommunications, nautical rules of the road, and many GPS-related products and information tools including GPS almanacs used for accuracy prediction by many commercial entities. Other sections and products such as the Automatic Identification System section (which contains the mariner’s authoritative AIS Guide to correctly setting AIS receivers) and the International Ice Patrol’s ice prediction charts were very popular and important to worldwide navigation safety. While the majority of the users were located in the United States, thousands of people used the website from places such as the Philippines, Canada, the United Kingdom, India, and Japan, indicating the importance of the website throughout the world.

Navigation Systems Information Dissemination Network (NSIDN), the network developed and maintained at the Navigation Center specifically for hosting the NAVCEN website, maintained its Federal Information Systems Management Act (FISMA) accreditation and Authority To Operate by meeting federal standards for cyber security, data management, and the Privacy Act. Several initiatives and upgrades are planned for 2017 to enable both improved experiences and security, as well as new tools for improving navigation safety.
ENGINEERING DIVISION

MARITIME INFORMATION BRANCH

U.S. Aids to Navigation Information Management System (USAIMS)

USAIMS and the legacy system, Integrated Aids to Navigation Information System (Legacy IATONIS), are the applications used as the official electronic record of all USCG and Private Aids to Navigation. Legacy IATONIS produces the weekly and annual Light List which mariners are able to download from the NAVCEN website. USCG District offices use Legacy IATONIS to create a weekly Local Notice to Mariners also available to download from the NAVCEN website. ATON units use USAIMS to perform on-scene aid information management. Legacy IATONIS is over ten years old and plans are to migrate functionality from Legacy IATONIS to USAIMS to create one integrated application for all ATON activities.

USAIMS – IATONIS Support Requests for 2016:

• 173 general support requests from Districts, Field Units, OSC, and USCG Headquarters
• Data Query Requests:
  o 25 District/ATON Units
  o 8 CG-NAV-1/NAVCEN/National Oceanic and Atmospheric Administration (NOAA)

In 2016, minimal progress was made on USAIMS updates because OSC stopped all development work due to the higher priority Cyber security Discipline Implementation Plan (CDIP). One USAIMS release in March 2016 initiated property tracking for certain ATON equipment.

NAVCEN continues to work with CG-NAV on a port resiliency project sponsored by DHS. Using a contractor via the Navy, work is underway to develop a tool for USAIMS to assist in portraying the 'health' of a waterway for District and Sector users.

Local Notice to Mariners (LNM)

LNMs are a method to release navigation requirements and warnings when hazards exist such as a buoy that is off station, an abandoned vessel, or a chart change. LNMs are also used to broadcast safety and security zones. Each USCG District LNM is released on the Navigation Center’s website with the newest information provided on Wednesday of each week.

Public Inquiries for 2016:

• 340 on Local Notice to Mariners (LNMs), charts, chart corrections, or Light Lists
• 181 on general ATON
• 77 on navigation
• 139 on general comments or questions
• 27,085 subscribers for weekly emails regarding the LNM and critical marine information
Electronic Chart Portfolio Management

NAVCEN acts as the Electronic Chart Portfolio Manager for all USCG Cutters and Boat Forces. NAVCEN provides electronic charts covering U.S., Caribbean, Mesoamerican waters, and other select areas for the USCG fleet.

Electronic Charting Portfolio Management statistics for 2016:
• 321 cutters/boats (49’ and above) using Electronic Chart Display and Information System (ECDIS) and Electronic Charting System (ECS); Electronic Navigation Chart (ENC), Digital Nautical Charts (DNC), Raster Navigational Charts (RNC) and custom build (2015 Navigational Standards hierarchy)
• 1190 boats (station, Maritime Security Response Team (MSRT), Aids to Navigation Team (ANT) etc.) with proprietary chart data

Other changes in 2016:
• NAVCEN identified a support gap for electronic charts on over the horizon cutter boats. We identified a workable solution, gained approval, and in late 2016 NAVCEN’s E-Charting branch took over electronic chart management for Cutter Boat – Over the Horizon navigation system.
• Upgraded NAVCEN ECDIS lab with Furuno 3D, AIS and Global Navigation Satellite Systems (GNSS) capability allowing for enhanced USCG fleet support (i.e. chart data resolution, chart loading, basic system support)

Field support statistics for 2016:
• 205 cutter chart requests
• 245 boat chart requests
• 69 technical assistance requests
• 212 ATON discrepancy reports (received directly or passed from the NIS watchstander)
ELECTRONIC TRACKING (E-Tracking) BRANCH

The E-Tracking Branch provides three core services to internal and external stakeholders. These include Data Management, MIOC application support, and NAIS system analysis.

Data Management

NAIS Data Management consists of Live Data Feeds, Historical Data Requests, and AIS Compliance/Data Integrity Monitoring.

NAIS Live Data Feeds:

At the end of 2016, NAIS was maintaining 78 Live Data Feeds. ‘Live’ or ‘streaming’ data feeds offer government partners and USCG Programs, Vessel Traffic Services (VTS), port partners and other stakeholders near real time AIS data fed directly from NAIS production servers located at OSC. NAVCEN, C3CEN, and OSC work together to establish data feed permissions, configuration and data management requirements to:

• Monitor for anomalous or missing data, analyze and report system status and failures
• Provide NAIS architecture performance monitoring, system health and development of operational parameters and criteria
• Notify customers of data feed expiration and assist with data feed renewals or terminations

NAIS Historical Data Requests (HDRs):

E-Tracking Branch processed 244 HDRs in 2016, a similar number to 2015. Fourteen HDR requests were pending at the end of 2016. This was the first year in the last 5 years that we did not see 40% per year growth. Customers submit HDRs to re-create events, to see a snapshot of something that happened at a particular point in time, or establish trends and norms for the maritime environment. Examples include marine incidents such as the sinking of the M/V EL FARO, historical vessel tracks, ship traffic patterns, geographic animation, heat maps, standard graphics, etc.
E-Tracking Branch works with the OSC staff to provide customers with various file formats. Comma Separated Values (CSV) files are useful to a variety of applications and permits the customer to extract meaningful information from NAIS data. Other common formats include standard graphics, animated re-creations of vessel movement (KML timed), and heat maps (density plots).

In 2016, E-Tracking Branch created the NAIS Data Sharing Product Catalog, which contains a description of each of our products, examples of how they may be used, images, and instructions for completing the Historical Data Request (HDR) Form.

**AIS Compliance and Data Integrity Monitoring:**
E-Tracking Branch took a multi-faceted approach aimed at driving down AIS broadcast errors. These efforts relied heavily on collaborative efforts with numerous internal and external maritime stakeholders and resulted in the following 2016 accomplishments:

- 224 Commercial Vessel Static AIS errors corrected
- 452 USCG Vessel Static AIS errors corrected
- 154 Port Partners Vessel Static AIS errors corrected
- Blue Force Tracking (BFT) was adjusted to remove the confusion associated with having inconsistent key change dates, which promoted stronger compliance among Blue Forces
- Partnered with Command, Control, Communications, Computers and Information Technology Service Center (C4ITSC) to implement more efficient BFT key distribution processes; this initiative resulted in significant BFT key error reduction in the USCG fleet
- Collaborated with C3CEN to create Keyset Change and Static AIS Error Maintenance Procedure Cards for the fleet, and Special Inspection cards for cutters; this initiative was also successful in reducing both BFT key and static AIS errors in the USCG fleet
MIOC Application Support

E-Tracking Branch identifies and resolves technical issues to support MIOC watchstander applications and to help improve NAIS and LRIT watch processes.

Watchstander tools and process work for 2016 included:

- Critical NAIS site transmit monitoring alarm details have been identified and NAVCEN is currently working with C3CEN and the software manufacturer CNS Systems to further develop the Maestro AIS Services Tool to provide NAIS watch transmit monitoring functions
- There were LRIT Business Help tool improvements scheduled and funded in 2016 but all were deferred by OSC due to the higher priority Cyber security Discipline Implementation Plan (CDIP)
- The Branch supported CG-7611 and Contracting Officer resolution of LRIT BHD watch process problems due to transition of the LRIT Application Service Provider (ASP) from one contractor to another

NAIS System Analysis

The ETracking branch provides NAIS system analysis to monitor and trouble shoot system performance criteria and serve as technical liaison to the system sponsor and product line.

The following updates to NAIS system analysis and trouble-shooting work occurred during 2016:

- At the end of the year there were 5 sites remaining for NAIS Spiral 2 Transmit implementation
- Supported the initial and follow on testing with OSC and C3CEN of AIS ATON management utilizing USAIMS; additional testing is necessary
- Identified and coordinated correction of a USCG Cutter reporting in the wrong District; issue originally identified as possible AIS spoofing which was not the case
- Resolved erratic vessel AIS data reporting within Puget Sound, identified problem being caused by base station repeater issue
- Initiated work to develop a NAIS Analysis Service Agreement with C3CEN to improve internal NAIS system analysis processes
- Provided mitigation of 5th District electronic Aids to Navigation (eAtoN) being broadcast by Pacific Area NAIS base stations
The DGPS team provides NDGPS system performance analysis and support to identify, document, and resolve deficiencies and implement improvements. Projects are managed and executed in coordination with other involved USCG units and other government agencies.

The following updates to NDGPS operational support efforts occurred in 2016:

• Conducted Operational Assessments (OA) at 18 DGPS sites; OA Reports are available at http://www.navcen.uscg.gov/?pageName=ndgpsOAReports
• Conducted Quality Assurance (QA) inspections at 14 DGPS Sites; QA Reports are available at http://cglink.uscg.mil/QA_Reports
• In conjunction with OA and QA travel, briefings on NAVCEN’s missions were provided to the following USCG units and maritime stakeholder committees:
  o Sector New York
  o Sector Houston-Galveston
  o Sector St. Petersburg
  o Sector Puget Sound
  o Sector San Francisco
  o Sector New Orleans
  o Sector Hampton Roads
  o New York Harbor Safety, Navigation and Operations Committee
  o Houston Pilots Association
  o Port of Tampa VTS
  o Puget Sound Harbor Safety Committee
  o San Francisco Harbor Safety Committee
  o Greater New Orleans Port Safety Council
  o Hampton Roads Marine Transportation Subcommittee
• On 30 Sep 16, published an article in the Maritime Commons Blog titled, “NAVCEN conducts DGPS operational assessments,” describing NAVCEN’s efforts to conduct DGPS Operational assessments and public outreach in the maritime community
• Assisted with Nationwide Control Station (NCS) Uninterruptable Power Supply (UPS) upgrade; this provided DGPS servers located at NAVCEN with improved UPS capability and greater resiliency during power outages
• Assisted with and monitored crucial communications circuit upgrades at 35 sites from legacy frame relay network service to multiprotocol label switching (MPLS)
• Conducted a 24 hour study on the accuracy comparison of GPS/ WAAS/DGPS for CG-NAV. Results are available at http://cglink.uscg.mil/24hrGPSWAASDGPS
• Assisted CG-NAV with review and distribution of a Federal Register Notice noting that the number of DGPS sites would be reduced from 84 to 46. In coordination with the DOT and other USCG units, secured the operational broadcast at 37 sites on 4 Aug 2016. Assisted C3CEN Product Line personnel with equipment
removal from 28 decommissioned DOT DGPS locations across the US. Teams completed work one week ahead of schedule and accounted for over $1 Million in property.

- Met regularly with USACE to discuss and coordinate issues pertaining to 7 DGPS broadcast sites owned by USACE and operated by NAVCEN.
- Hosted annual inter-agency DGPS meeting with the Canadian Coast Guard (CCG). Also held semi-annual teleconference meeting with CCG DGPS counterparts. The Memorandum of Intent to Cooperate was reviewed and status regarding each country’s system was shared.
- Per the request of the USACE, permanently disestablished and secured the operational broadcast from the Sallisaw, OK DGPS broadcast site on 31 Dec 2016.

**GPS Civil Interface Duties & Civil GPS Services Interface Committee (CGSIC)**

In 1986, the Civil GPS User Interface Committee (CGSIC) was organized and in 1989, GPS became a dual use (military/civilian) system. Commanding Officer NAVCEN serves as the Deputy Chair and NAVCEN staff serves as Executive Secretariat as well as liaisons for the world’s civil GPS users. NAVCEN fulfills the role of operational interface for dissemination of GPS operational information.

The following work in support of CGSIC occurred in 2016:

- Visits to NAVCEN, to include site familiarization and mission overview, were coordinated for Position Navigation and Timing (PNT) partners including:
  - Director and Deputy Director of DHS NCC
  - USAF 2nd Space Operations Commander and the 2nd Space Operations Director of Operations
  - CGSIC International Information Subcommittee Chair
  - USAF GPS Systems Directorate Deputy Director
  - U.S. Naval Observatory Deputy Director
  - USAF Chief GPS Plans and Requirements, GPS Directorate
  - Deputy Director of the National Coordination Office for Space-Based PNT
- NAVCEN members participated in visits to the U.S. Naval Observatory, the DHS NCC, and USAF 2nd Space Operations and the GPSOC to build on existing working relationships and to learn about partners that will be joining the team to respond to interference and disruptions to GPS civil users.
- NAVCEN members participated in an interference conference with FCC, FAA and CG Spectrum Management to discuss future joint response efforts for GPS interference.
- The PNT Branch provided technical support and content for the NIS watch to respond to 72 inquiries regarding GPS and for 124 GPS Disruption Reports.
- NAVCEN coordinated the 56th meeting of the CGSIC which is a two-day event coordinated in conjunction with the Institute of Navigation’s (ION) annual Global Navigation Satellite Systems (GNSS) conference which included industry representatives, universities, and GNSS providers from around the globe. The program included a day of subcommittee meetings, followed by the plenary session and a question and answer session with industry and government subject matter experts. NAVCEN members developed agendas, coordinated speakers, and conducted the meetings. Presentations were provided to GPS.gov for upload. Over 250 people attended over the course of the two-day event.
- NAVCEN members attended the ION GNSS+ 2016 in Portland, OR, the world’s largest technical meeting and showcase of GNSS technology, products and services bringing together international leaders in GNSS and related positioning, navigation, and timing fields to present new research, introduce new technologies, discuss current policy, demonstrate products and exchange ideas.
The United Nations hosted International Committee on GNSS (ICG) promotes voluntary cooperation on matters of mutual interest related to civil satellite-based positioning, navigation, timing, and value-added services. NAVCEN participates as the CGSIC Deputy Chair and Secretariat, the U.S. lead for Working Group C (Information Dissemination and Capacity Building), and as Co-Chair of the WG-A Interference Detection and Mitigation (IDM) Task Force. Related to ICG, NAVCEN participated in:

- Five Department of State (DOS) planning meetings and one interagency meeting in support of ICG.
- An ICG planning meeting hosted by the United Nations Office for Outer Space Affairs in Vienna, Austria.
- The 11th UN International Committee on GNSS (ICG-11) to foster interoperability, compatibility and transparency between existing and emerging global navigation satellite systems (GNSS), Sochi, Russia.

In support of the GPS constellation, providing GPS products to the public, and interference detection and mitigation, NAVCEN members:

- Attended four GPS International Working Group (GIWG) meetings, a forum for developing, coordinating, and implementing international strategies related to GPS. The GIWG, hosted by the DOS, meets to review the nation’s many on-going bilateral and multilateral cooperation activities and to discuss future opportunities for international engagement and outreach.
- Attended three Civil GPS Program Management Review meetings (PMR) hosted by the USAF GPS Directorate at Los Angeles AFB, and co-chaired by DOT and DOD. The PMR reviewed the status and coordination of funding and ongoing civil GPS programs.
- Attended the National PNT Engineering Forum (NPEF) hosted by the USAF GPS Directorate and the FAA. The NPEF is a permanent inter-agency working group that provides coordination of systems engineering issues and technology development as tasked by the National PNT Executive Committee.
- Attended quarterly GPS Constellation Sustainment Assessment Team (CSAT) meetings hosted by the STRATCOM Joint Space Operations Center to represent civil user prospective in USAF constellation management decisions. This year included an emergency meeting to dispose of a GPS satellite earlier than planned to ensure it could be safely moved to its disposal orbit.
- Attended the GPS Operations Summit coordinated by USAF Space Command Civil Liaison. This event was hosted at USAF 2nd Space Operations at Schriever AFB, Colorado Springs, CO. Interagency partners responsible for executing Annex A (Interagency Procedures for the Reporting of GPS Interference Affecting the User Segments and Critical Infrastructure Sectors) attend this annual meeting to discuss the Interagency Memorandum of Agreement (MOA) with Respect to Support to Users of The Navstar Global Positioning System (GPS), review events of the past twelve months and discuss process improvement between the agencies.

The GPS Interface Control Working Group (ICWG) is made up of DOD, DOT, and other contractors/organizations involved in the development, deployment, and operation of Navstar GPS assets. There are three segments of GPS: Space, Control, and the User. NAVCEN, as a signatory of three Interface Control Documents pertaining to civil users of GPS, reviews pending changes to documents, participates in discussions with partners, and provides input on revisions to documents affecting NAVCEN operations (distribution of GPS information products) and civil users. As a result of these responsibilities, NAVCEN:

- Reviewed and provided feedback on 29 Request for Change (RFC) documents affecting 23 different Interface Control Documents. Attended 4 related teleconferences.
- Attended a review and planning teleconference in preparation for the 2016 Public ICWG.
- Attended the 2016 Public ICWG and open forum which reviewed eight requested revisions affecting five public documents. NAVCEN is the signatory of two of those documents as they deal with the transfer of unclassified GPS information products from the control segment to NAVCEN for distribution to civil GPS users via email and NAVCEN website.
- Attended teleconferences and in-person meetings for the External Interfaces Working Group responsible for building the transition plan and supporting documentation for the GPS Next Generation Operational Control Segment (OCX).
Attended teleconferences and provided feedback on proposed changes in support of the GPS Contingency Operations (COps) program that will implement changes to the current ground control system (AEP) to support the operation of GPS III satellites within the constellation in advance of the transition to OCX.

In support of CG-NAV on the Federal Radionavigation Plan, 2016 version, NAVCEN members attended interagency working groups to review proposed changes to the Federal Radionavigation Plan; collected input from CG-NAV and NAVCEN to provide a consolidated comment resolution matrix to the DOD representative coordinating the review and update of this biennial document. NAVCEN also provided updated DGPS service coverage graphics. The document is pending DOD, DOT, and DHS signature in 2016.

NAVCEN members reviewed and updated the Interagency MOA and Annex A. Changes discussed during the May 2016 GPS Operations Summit were implemented into Annex A. Annex A was reviewed by the five agencies that are signatories and approved for signature. The MOA was reviewed and approved by USCG Legal and is under concurrent review by DOD and FAA.

NAVCEN members supported the interagency coordination of GPS IDM by participating in interagency teleconferences. These teleconferences allow interagency partners to share lessons learned, results of reports of GPS IDM, and coordinate response procedures in support of the MOA and Annex A.

As part of NAVCEN’s continuing commitment to providing education about our role in GPS IDM, the following events were coordinated or provided by NAVCEN:

- Webinar presentation on the US government to Inside GNSS magazine on GNSS IDM.
- GPS Workshop at USCG HQ brought awareness to CG policy-makers about NAVCEN’s role in the civil GPS program, provided updates from the USAF GPS Directorate (DOD joint acquisition program office for GPS), and an introduction to the GPS IDM framework. Presentations were given by the National Coordination Office for Space-Based Positioning, Navigation, and Timing, National Geospatial-Intelligence Agency, DHS, and NAVCEN Operations.
- Arranged and participated in a port facility site visit with DHS staff to discuss the use of PNT and associated risks, risk management and incident response with the Port of Virginia staff and Captain of the Port Hampton Roads.

Other conferences or events attended by NAVCEN members in 2016:

- Purposeful Interference Response Team (PIRT) Table-Top Exercise – participated and facilitated one of the two GPS interference scenarios that discussed response procedures put in place through the CRUCIBLE process, involving FAA, FCC, DHS NCC, NAVCEN and DoD.
- Cyber Security Threats to the Maritime Transportation System (MTS) Maritime Industry National Maritime Interagency Advisory Group (NiAG) two day meeting - provided a GPS cyber security, vulnerability and awareness briefing to maritime port/vessel operators and government stakeholders.
- The GPS Adjacent Band Compatibility (ABC) Assessment Workshop. The GPS ABC Assessment Workshop Summary discussed results from the testing of various GPS/GNSS receivers and the development of use-case scenarios. The USCG provided GPS receivers for testing. This was the fifth workshop hosted by DOT on the GPS ABC Assessment.
- Navigator of the Navy invited key service personnel to participate in a PNT technical exchange meeting at the US Naval Observatory. Discussions included naval PNT issues, capabilities and some developing technologies.
- North American Sychrophasor Initiative (NASPI) teleconference to discuss the December 31, 2016, Leap Second to be added to Universal Time Coordinated (UTC) and potential problems within the US power industry. GPS does not add UTC leap seconds to GPS Time, but does include the offset between GPS Time and UTC in an auxiliary message broadcast by each satellite. Problems have occurred during past UTC Leap Second with GPS user equipment that does not properly monitor GPS Time offset message.
- Radio Technical Commission for Maritime Services (RTCM) Special Committee 131 meetings working on draft U.S. industry standard for a multi-system navigation receiver.
STATUS OF PROJECTS

NAVCEN is committed to excellence by optimizing available resources to meet the present and future challenges of the Coast Guard. To support the Vice Commandant’s direction we undertook several initiatives in 2016. These were identified in our 2015 Year in Review. Despite resource challenges, especially within the Coast Guard’s information technology infrastructure, we made significant progress on several initiatives. The status of these projects is outlined below:

Enhanced Marine Safety Information (eMSI) – Focus on migrating from analog to digital formats:
Collect, centralize, and publish BNMs: We ran into a few cyber security concerns and IT capability limitations this year in pursuit of our goal to automatically share BNMs already in the CG messaging system (OIX) with the public, along with making them available in both human and machine readable formats. We were unsuccessful in leveraging the USACE’s capabilities since the CG does not have an automated capability to pull/push internal CG OIX data to the public, but we were successful in getting a Capabilities and Requirements Oversight Panel (CROP) request approved to move forward toward building this capability within the Coast Guard. Manual uploading is not realistic since CG units issue approx. 17-20 thousand BNMs per year nationwide.
Continuing future work includes:
• Under the Marine Safety Information Consolidation Integrated Policy Team that was developed this year, NAVCEN, CG-NAV and COMCOM are reviewing the policy, format and process aspects of the BNM in order to incorporate geo-referencing and to enhance both human (pdf) and machine readability (xml) formats online, as well as ensure a higher degree of format consistency.
• Improve the quality of the eMIS deliverables generated by the IPT to test and vet solutions; NAVCEN may beta test product delivery through our website.
• Continue support of CG-NAV contract work with USN (Dahlgren) to develop a standard Waterway ID nomenclature that will meet the needs of USCG, NOAA, USACE, and National Geospatial Intelligence Agency. NAVCEN expects to provide the USN contractor with sample USCG ATON data sets that are currently available.

Electronic Charting:
• In 2016 as part of the SINS II IPT, NAVCEN served as a SME for the SINS II procurement process. As such, NAVCEN began developing a chart comparison test plan to determine electronic chart suitability, using commercially available chart products, to ensure the highest product specification will be used. NAVCEN will develop a draft test plan for CG-761 during 2017 for chart comparison after the SINS II contract is awarded. The chart comparison test plan should validate that the SINS II delivered products meet or exceed specifications.
• Continue outreach with other DHS components (Immigration and Customs Enforcement (ICE), Customs and Border Protection (CBP)) to look for Department efficiencies in electronic chart use and procurement.
Improved USCG and Port Partner BFT Compliance:

- We recognized that the policy unnecessarily complicated and degraded Blue Force Tracking (BFT) capability. NAVCEN drafted policy and worked with the appropriate Headquarter offices to change the policy. We expect the new key-change policy to be implemented early in 2017 for over 1500 USCG and 440 port partner assets. Over the Air Re-Keying (OTAR) for the next generation of the USCG BFT transponder has been added to the requirements for the next equipment re-capitalization cycle (FY19 estimated timeframe). We will stay involved with the equipment acquisition process to promote the importance of OTAR capability.
- We continue to work with C3CEN to improve Maintenance Procedure Cards for each platform which will require validation of the key and the platform’s static AIS information.

AIS Data Integrity and Quality Assurance Oversight:

- We have been working diligently with the C4IT community (C4ITSC/C3CEN) to correct CG asset and Port Partner asset AIS static errors. In 2016, our engaged efforts significantly reduced CG errors (69%) from over 655 down to 203 and port partner errors were reduced 45%, from 439 to 285.
- We continue to engage with commercial stakeholders to correct AIS errors (currently a 56% error rate).
- We continued development/implementation of needed tools to support successful enforcement of AIS carriage requirements. New AIS carriage requirements went into effect in March 2016, but the CG does not have any useful formalized tools to verify maritime vessels are broadcasting the correct information. We are developing a front end web user interface for the NAVCEN external website to allow the public to access this information and also make it easier for inspectors and others to verify the info. The site is being developed and we anticipate beta testing with select stakeholders in the coming months before officially going live around April 2017.
- In the interim, this year we worked with OSC Martinsburg to receive an Excel data dump, which we post to our NAVCEN Portal Page, to allow CG users to verify whether or not commercial and recreational vessels are broadcasting correct AIS information and quickly determine what information is incorrect.

AIS ATON Monitoring:

- Work is underway to implement AIS ATON alarm procedures.
- We have completed with CG-761 the NAIS SOC 3.0 requirements. We will continue to work with CG-761 to compete NAIS SOC 3.0 priority and funding with other OSC work in 2017.
- We submitted a request (Trouble Ticket) to add an AIS ATON layer to EGIS so CG units can view AIS ATON in a readily available system.
- We started to provide on the NAVCEN portal page a listing of active AIS ATON by District.

NAIS Data Sharing Services:

- Improve internal tracking and processing of the NAIS data stream and pursue implementation of CG ability to search AIS data back up to 3 years; including data from Satellite AIS (SAIS).
- Collaborate with CG-761 on replacement of NAIS Query tool and explore ways to migrate this to a CG enterprise service. This tool, once approved, will provide CG users access to NAIS data, create a file, and import the data into viewers available on CGOne. For example, a Sector would be able to pull a day’s worth of data on a specific vessel by MMSI, download the data as CSV File, and then import it into CG1View, Google Earth, E-GIS 2500, or ArcGIS Explorer and view the vessels track history.
• We started a collaborative effort to collect, document and articulate CG Historical AIS analysis needs and requirements based on limitations experienced using CG EGIS and SWIII. While there is an Operational Requirements Document for NAIS, no CG wide systematic requirements documents exist for analyzing and accessing the large amounts of historical AIS data stored at OSC Martinsburg. We know others use NOAA Marine Cadastre, ArcGIS, AIS Port Vision Viewer, MADAS, marinetrack.com and other AIS viewers and we are working with CG-761 and the IT community for solutions.

GPS Services and Products:
• The NDGPS OA program was expanded to include a Quality Assessment and outreach to both Sector and Maritime Stakeholders. NAVCEN conducted traditional DGPS signal validation but also provided outreach presentations and performed DGPS site Quality Assurance Inspections. The expanded OA program maintained proven benefits of conducting signal validations, established new lines of communications with USCG and external stakeholders, and served as a CG-DCMS force multiplier to ensure site standards are maintained. In 2017, with the shift from OAs as the primary driver to conducting outreach visits, the Operations Division will take over responsibility of outreach.
• Continue to work with USACE, CG-NAV, and DGPS Product Line to decommission sites, as appropriate, and implement critical system lifecycle equipment upgrades including: continued transition from frame-relay circuits to Multi-Protocol Layers System (MPLS) circuits and mandated cyber security upgrades.
• Building on the success of two previous GPS workshops at CGHQ, a GPS basic training seminar is being developed for Spring of 2018.
• In a continuing endeavor to improve GPS-related services to the world’s GPS users, all necessary documents have been submitted to the US Air Force to add the GPS Satellite Outage File, a machine-readable archive of maintenance events in the GPS constellation, to all applicable GPS Interface Control Documents. Once included, this will add to the list of GPS data products NAVCEN hosts for public dissemination.

NAVCEN Services Outreach:
• Continue building out the NAVCEN CG Portal Page to effectively communicate to and support CG stakeholders that use our products and services. AIS HDR product catalogue now available.
PATH FORWARD FOR UPCOMING YEAR

In November 2016, the Deputy Commandant for Operations and Deputy Commandant for Mission Support approved a transfer of 21 billets from the Navigation Center to CG Cyber Command (CGCYBER) to support the formation of a Network Operations Security Center. Several functions historically performed by the NAVCEN were identified for transfer to CGCYBER along with the associated billets. As a result, NAVCEN has been afforded the unique opportunity to examine the remaining functions to successfully support the modernized Coast Guard.

In 2017 we intend to:

- Transition the DGPS watch and NAIS watch, with their associated billets and functions to CGCYBER as part of the Network Operations Security Center.
- Build more robust NAIS analysis capability at NAVCEN. This will be done by working towards four goals:
  - Goal 1 - Improve NAIS data quality
  - Goal 2 - Improve NAIS governance within the Coast Guard
  - Goal 3 - Improve NAIS derived products & delivery
  - Goal 4 – Market NAIS and expand usefulness
- Continue to make progress towards Enhanced Marine Safety Information (eMSI) with a focus on migrating from analog to digital formats. This will include:
  - Ongoing collaboration with the Committee on the Marine Transportation System (CMTS), example is working with USACE to identify existing MSI products that could be provided online in a central location.
  - Reviewing BNM process/policy to recommend more streamlined and consistent BNM mechanisms
  - Continuing to work toward BNM eMSI data in human (pdf) and machine readable (xml) format online
- The Navigation Center website will undergo an overhaul to modernize the “look and feel” of the website, while still maintaining its standards for accessibility by persons with disabilities, security, and ease of use.
  - Secure sockets layer (SSL) will be implemented (shift from http to https) so that pages and data will be encrypted from the Navigation Center’s web servers to the users’ browsers and vice-versa.
  - Multi-factor authentication will be implemented on Navigation Systems Information Dissemination Network (NSIDN) computers to upgrade the cyber-security posture.
  - The Web Services Branch will be investigating Amazon Web Services, a certified Federal Risk and Authorization Management (FedRAMP) cloud service provider, initially as a backup to current web services, and then potentially as a platform to host the website as the primary provider.
- Work towards identifying long term DGPS needs for maritime users with the goal of developing a timeline for decommissioning DGPS as a Coast Guard system.
- Continue to support DHS efforts to build PNT/GPS program management office and expertise.
- Build out USAIMS capabilities to better support ATON data collection and waterway safety information dissemination.
- Support Area, District, and Sector waterway planning efforts through ports and waterways safety assessments (PAWSAs) and other recognized waterway planning efforts.
- Expand outreach efforts to include instruction at the Sector Department Head Course and Waterways Management ‘C’ School.