US Army Corps of Engineers
e-Navigation related programs and projects
e-Navigation Underway North America
12 November 2019
Tampa, FL

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US Army Corps of Engineers
2019 e-Navigation programs and projects

- “Operationalize” AIS capabilities
  - AIS AtoN (and GN) processes
  - Incorporate into system(s)
- Expand information transmitted via AIS
  - AIS AToNs
  - Weather, water levels, lock queue
  - Geographic Notices (GN)
- Implement River Information Services (RIS)
- Weather observations via shipboard AIS
Operationalizing AIS capabilities

- USACE has been transmitting information via AIS for over 13 years
  - Real Time Current Velocity (RTCV)
  - ASMs for met/hydro, lock queue
  - Geographic notices
  - AIS AtoNs
- Coordination with USCG
- Development of standards
Operationalizing AIS capabilities

- Joint USCG-USACE workshop held in St. Louis 4-5 Sept 2019
- Initial draft of procedures, encoding guidelines, use of standard nav systems, approval process
- Baseline of requirements to be built into (USCG and USACE) systems
Process

- Determine if use of AIS is appropriate
- Determine whether to use AIS AtoN or GN
  - Precise location, channel-related: AIS AtoN
  - Less specific location, large area: GN
- Positioning requirements
  - Use official ENC/IENC
- Determine transmission location(s)
- AIS AtoN and GN encoding guidelines
  - AtoN: Type, lateral significance, name
  - GN: Description, shape, name, linked text
- Approval process
- Actions once established
  - Quality assurance/maintenance of level of service
  - Monitoring
  - Disestablishment procedures
Ohio River High Water 2018 & 2019
John T Myers Lock & Dam
Navigation over fixed weir & through chute
Information delivered to vessels via AIS

Weather observations

Water Level

Lock Order
AIS Geographic (Area) Notice message

11. Area notice

11.1 This message provides dynamic information concerning a specified geographic area, polyline or positions. It should only be used to convey pertinent time-critical navigation safety information to mariners or authorities, and not as a means to convey information already provided by current official nautical charts or publications.

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>10</td>
<td>Caution: Survey operations</td>
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<tr>
<td>14</td>
<td>Caution: Underwater operation</td>
</tr>
<tr>
<td>15</td>
<td>Caution: Seaplane operations</td>
</tr>
<tr>
<td>16</td>
<td>Caution: Fishery - nets in water</td>
</tr>
<tr>
<td>17</td>
<td>Caution: Cluster of fishing vessels</td>
</tr>
<tr>
<td>18</td>
<td>Caution: Fairway closed</td>
</tr>
<tr>
<td>19</td>
<td>Caution: Harbor closed</td>
</tr>
<tr>
<td>20</td>
<td>Caution: Submerged pipeline or cable</td>
</tr>
<tr>
<td>21</td>
<td>Caution: Unmanned vehicle operation</td>
</tr>
<tr>
<td>22</td>
<td>Caution: other (define in associated text field)</td>
</tr>
<tr>
<td>34</td>
<td>Restriction: Entry approval required prior to transit</td>
</tr>
<tr>
<td>35</td>
<td>Restriction: Entry prohibited</td>
</tr>
<tr>
<td>36</td>
<td>Restriction: Active military OPERAREA</td>
</tr>
<tr>
<td>37</td>
<td>Restriction: Firing - danger area</td>
</tr>
<tr>
<td>38</td>
<td>Restriction: Drifting mines</td>
</tr>
<tr>
<td>39</td>
<td>Restriction: other (define in associated text field)</td>
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</table>
Geographic Notices (GN)
Closure of Mississippi River at St Louis

AIS GEOGRAPHIC NOTICE

Restriction: Entry prohibited

BNM 0273-19
START 2019-05-05 17:00:00
END 2019-05-11 23:59:00
MMSI 003660654 LINKAGE ID 3
River Information Services

Working definition:

River Information Services (RIS) makes navigation data more accessible and usable in support of USACE Navigation operations and maintenance.

Technical Services
- Inland Navigation Charts (IENC)
- Vessel tracking (AIS)
- Notices to Mariners
- Electronic Reporting
- Reference Data

Operational Services
- Navigation channel information
- Vessel traffic information
- Traffic/lock operations
- Incident response support
- Law enforcement support
- Transport logistics support
- Statistics support
RIS Technical and Operational Services

Technical services

Indirect Operational Services

Direct Operational Services

- Channel Information
- Vessel Traffic Information
- Vessel traffic/lock operations
- Electronic charts
- Digital communications
- Notices to Mariners
- Vessel tracking
- Reference Data
  - Geographic
  - Vessel
- Transport Logistics
- Incident response
- Law Enforcement
- Statistics
Way ahead for US RIS implementation

- Build on existing capabilities
- Governance
  - USACE RIS team established Fall 2018
- External engagement:
  - Initial interagency workshop held 8 November 2019
  - Industry
- Implementation project
National RIS Implementation Project

Phase 1 [Short Term] Interoperability of Systems

- Increase sharing of data between systems
- Transmit additional information via AIS
- Improve ability to update and disseminate lock maintenance schedule information
- Marine Safety Information Harmonization

Phase 2 [Mid Term] Electronic Information Exchange

- Improve information exchange among RIS stakeholders and systems

Phase 3 [Long Term] Navigation Planning Tools

- Develop and deploy advanced tools in support of navigation planning
RIS Portal

- “Landing place” for delivery of new capabilities
- "Value added" info
  - Voyage planning, travel time, etc.
  - Reference/links to source data
Lock Maintenance Scheduling

**Solution**

- Develop lock maintenance scheduling and enterprise dashboards to automatically generate lock status alerts to stakeholders. Goal: Automate weekly maintenance status reports
- Apply machine learning within RISE to optimize lock maintenance scheduling by combining projected maintenance with historical and projected lockages to minimize river traffic impact

**Benefits**

- Reduce cost, time and manpower required to update and disseminate lock maintenance status information
- Reduce impact of lock maintenance on river operations through better situational awareness scheduling

**Challenge**

- Lock maintenance scheduling is currently done manually with limited situational awareness of upcoming lockages and impact on river traffic
- Status reports are currently updated in MS PowerPoint requiring significant daily coordination to obtain and correlate pertinent information for email distribution to stakeholders
- Lockmasters are only required to alert mariners if lock maintenance takes greater than four hours. Goal: Reduce to no more than two hours

**Plan**

- Phase 1 Proof of Concept – Manual input form for lock maintenance. Data displayed on map interface – click on lock to get details. Initially on RISE Test Site then moved to USACE Navigation Information Portal when available. ETC: Oct 2019
- Phase 2 – Add impact of maintenance on navigation due to lock maintenance activities
- Phase 3 – Develop maintenance resource scheduling environment
- Phase 4 – Maintenance optimization tool
- Phase 5 – Incorporate preventative maintenance scheduling and alert system plus linkages to FEM, NTNI, AIS, etc.
- Working up resource requirements plan to execute Phases 2-5
NTNI/NTM Harmonization

- **Challenge**
  - NTNI inform mariners of information describing events that affect waterway navigation such as maintenance projects, hazards to navigation, and other pertinent information.
  - This is currently done via a website that permits download of a PDF file that is incompatible with IENC format nor interoperable with machine-to-machine (M2M) electronic data interchange (EDI).
  - USCG generated Notices to Mariners (NTM) use same PDF format also making incompatible with IENC updates and M2M EDI.

- **Solution**
  - Make NTNI announcements available in a variety of file formats as a web service so they can be uploaded into IENCs as well as used for other purposes.
  - Collaborate with USCG to use similar data formats and dissemination approach to stakeholders.

- **Benefits**
  - Near-real time M2M updates of IENCs to foster safe navigation.
  - Makes NTNI data available for predictive analytics in voyage planning and travel time predictions.

- **Plan**
  - IWR taking lead in modifying current system to provide NTNI as a web service.
  - IWR to provide project plan and resource requirements to RIS CAT for consideration.
  - Next meeting with USCG in St. Louis on 5 Sep 2019.
RIS Implementation
Next Steps

• Continue project development
  - Overall RIS structure
  - Individual efforts
• Continue Interagency outreach and coordination
  - CMTS FutureNav IAT
• Plan for test bed events
  - Existing capabilities demonstration – Spring 2020 (Louisville)
  - Advanced capabilities demonstration – Fall 2020 (Vicksburg)
Problem

- Weather forecasters need more observations
- Small fraction of vessels provide voluntary observations
- Observations are usually manually collected
- Communication of observations from vessel to weather offices can be problematic
To the National Oceanic and Atmospheric Administration:

Coordinate with the National Weather Service, vessel operators, automatic identification system (AIS) service providers, and required onboard technology vendors to perform a “proof-of-concept” project to establish whether AIS, or another suitable alternative, can practically deliver, in a single message, (1) meteorological and oceanographic data obtained directly from automated instrumentation and manual observation on board vessels at sea, (2) vessel position and time of observation, and (3) other important metadata, by satellite and land-based receivers, to global meteorological authorities via the Global Telecommunication System with acceptable time delay. (M-17-52)
Test aboard CAPE WRATH October 2018

- Following successful bench test
- Real-world proof-of-concept
- Initial equipment and software
- Terrestrial reception
- Data parsing and logging

Weather sensor

Software to generate AIS messages
Test aboard TS KENNEDY
January-February 2019

- Test in real-world, offshore environment
  - Automated and manually-entered data
- Improved software
- Weather Service provided sensor
- Test of satellite reception
Mintaka Duo

Pilot Port

AIS laptop

Turbowin

AISWeatherTransmitter

Mintaka 

Star

Ship’s Class A 

(Furuno FA150)

USB interface

Test – WiFi to ... 

Plug (on 
bridge)

Final Install – USB to 
PilotPort Cable

AC power

Mintaka 

X

Y-cable

Open 
Pilot 
Port
Messages received via Satellite from TS KENNEDY 12 Jan – 26 Feb 2019
Next steps

- Test aboard commercial vessels
  - Get mariner/company/Pilots feedback
  - Various environments, types of ships, AIS equipment
- Deep sea (trans-Atlantic/Pacific) routes
  - Better test of satellite reception
- New message optimized for satellite reception
- New equipment – compact processor
- Test data transfer to NOAA-NWS
  - Format
  - Data rate
  - Quality assurance
  - Usability for forecast models
Commercial ship installations
Pacific: Hawaii, Transpacific

MV MANOA - Matson

MV MARJORIE C - Pasha

MV PRESIDENT WILSON - APL
Commercial ship installations
Atlantic: Jacksonville - Puerto Rico

MV EL COQUI - Crowley

MV PERLA DEL CARIBE - TOTE
Commercial ship installations
Great Lakes – Interlake Steamship Company

MV MESABI MINER

MV JAMES R BARKER

MV STEWART J CORT

MV PAUL R TREGURTHA
Typical Ship Installation

Weather Station
Pri: Airmar
Sec: Mintaka

USB interface for Mintaka
RS422 interface for Airmar

Moxa embedded computer

DC power

PilotPort Cable – RS422

AC power outlet

Existing VHF Antenna

Ship’s Class A

Pilot Plug (on bridge)

Open Pilot Port

Y-cable
Airmar weather station installation

Airmar mounted to pipe on top of pilothouse – port side

Cable run through gooseneck
Processor installation and pilot port connection

- Airmar cable run down side of window from overhead
- Power
- Pilot Port with Y, backside of AIS
- Moxa mounted to side of console on port side of bridge
# Messages for commercial ship trials

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<tr>
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<th>Title</th>
<th>Slots</th>
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<tbody>
<tr>
<td>001/21</td>
<td>Wx obs from ship</td>
<td>2</td>
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<tr>
<td>001/31</td>
<td>Met/hydro data</td>
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<tr>
<td>367/33</td>
<td>Environmental</td>
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<td>367/23</td>
<td>Satellite Ship wx</td>
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<tr>
<td>367/24</td>
<td>Satellite ship wx small</td>
<td>&lt;1 (128 bits)</td>
</tr>
<tr>
<td>367/25</td>
<td>Satellite ship wx tiny</td>
<td>&lt;1 (96 bits)</td>
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</table>
Manoa results

M/V Manoa - ExactEarth Reception Percentages

%Msg27 %FI21 %FI23 %FI24 %FI25 %FI33
Marjorie C results

M/V MARJORIE C - ExactEarth Reception Percentages

%Msg27 %FI21 %FI23 %FI24 %FI25 %FI33
President Wilson results
Thank you for your attention!

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