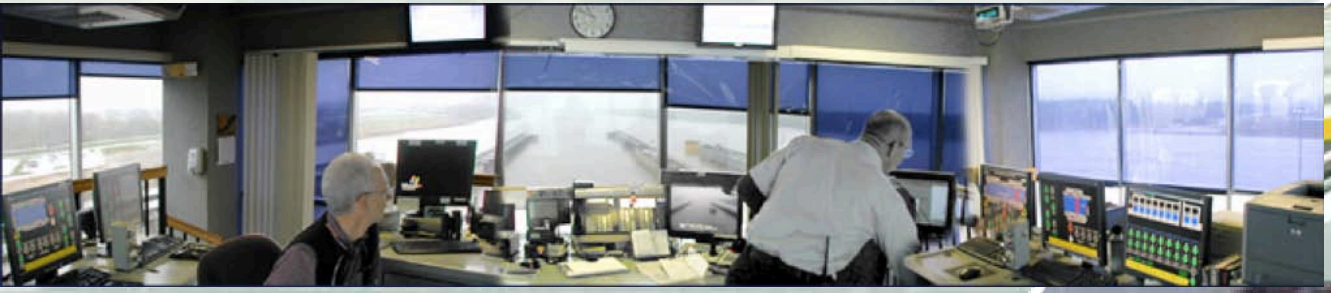
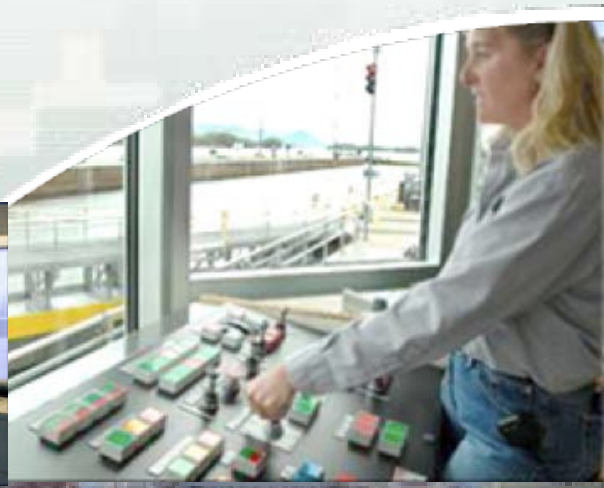
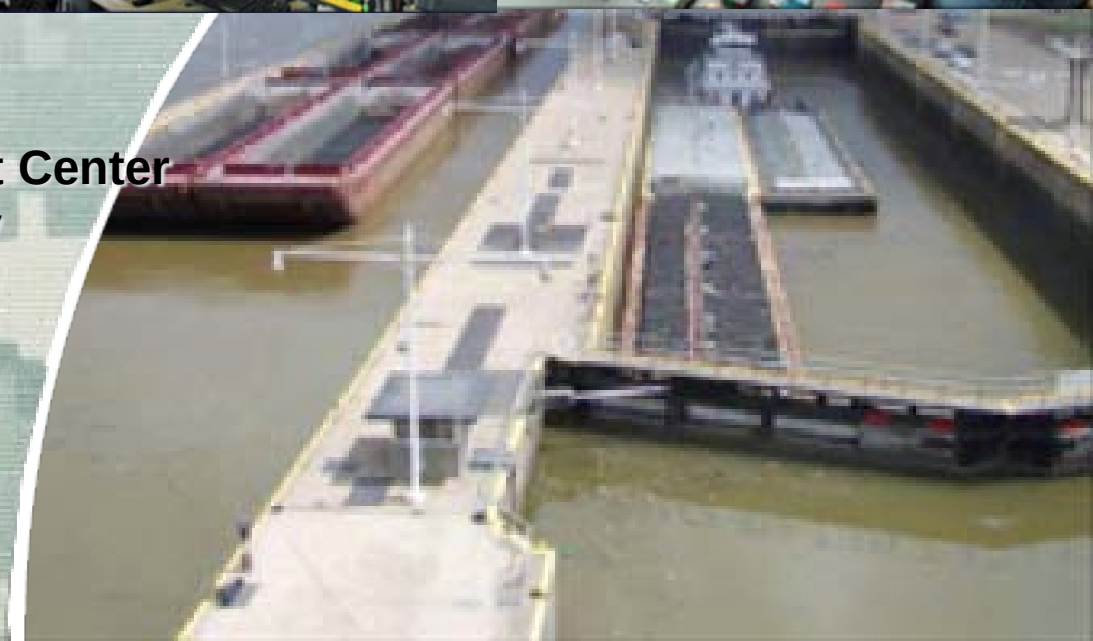
e-Navigation and practical applications to monitor and improve the Marine Transportation System

TRB-CMTS R&D Conference 26 June 2012
Diagnosing the Marine Transportation System:
Measuring Performance and Targeting Improvement





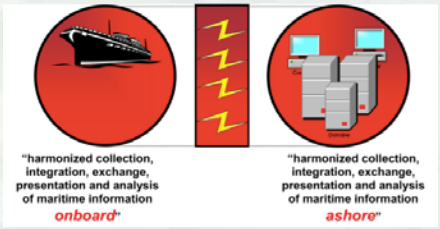
Brian Tetreault
US Army Corps of Engineers
Engineer Research & Development Center
Coastal and Hydraulics Laboratory

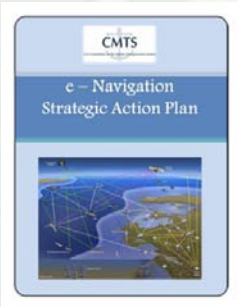


US Army Corps of Engineers
BUILDING STRONG®

Overview

- e-Navigation
- US e-Navigation Strategy
- Emerging e-Navigation capabilities
  - ▶ River Information Services
  - ▶ Lock Operations Management Application
- Applying e-Navigation to improve the MTS





e-Navigation

International definition:

"e-Navigation is the harmonised 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"

MSC85/26/Add.1 annex 20

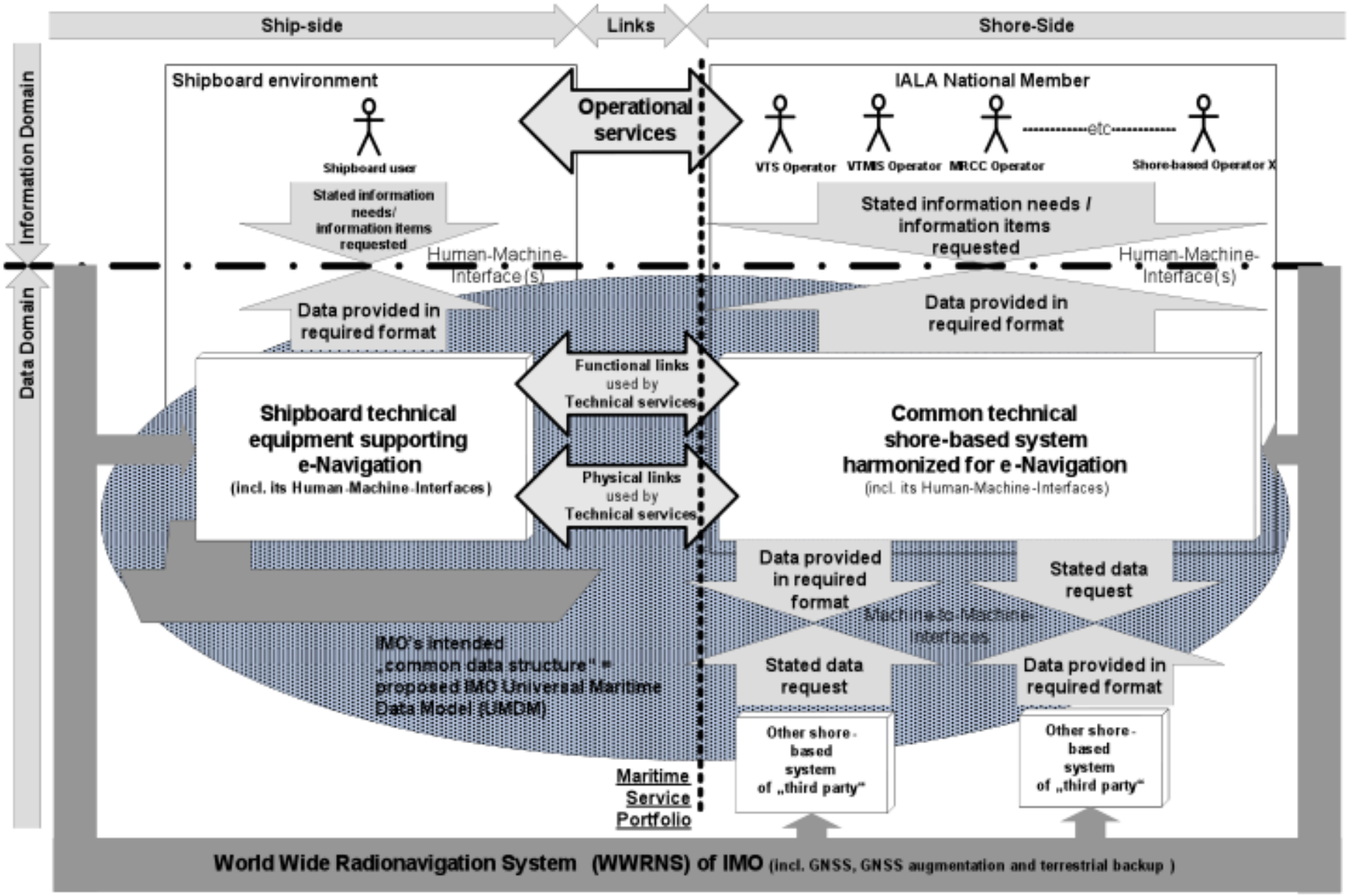
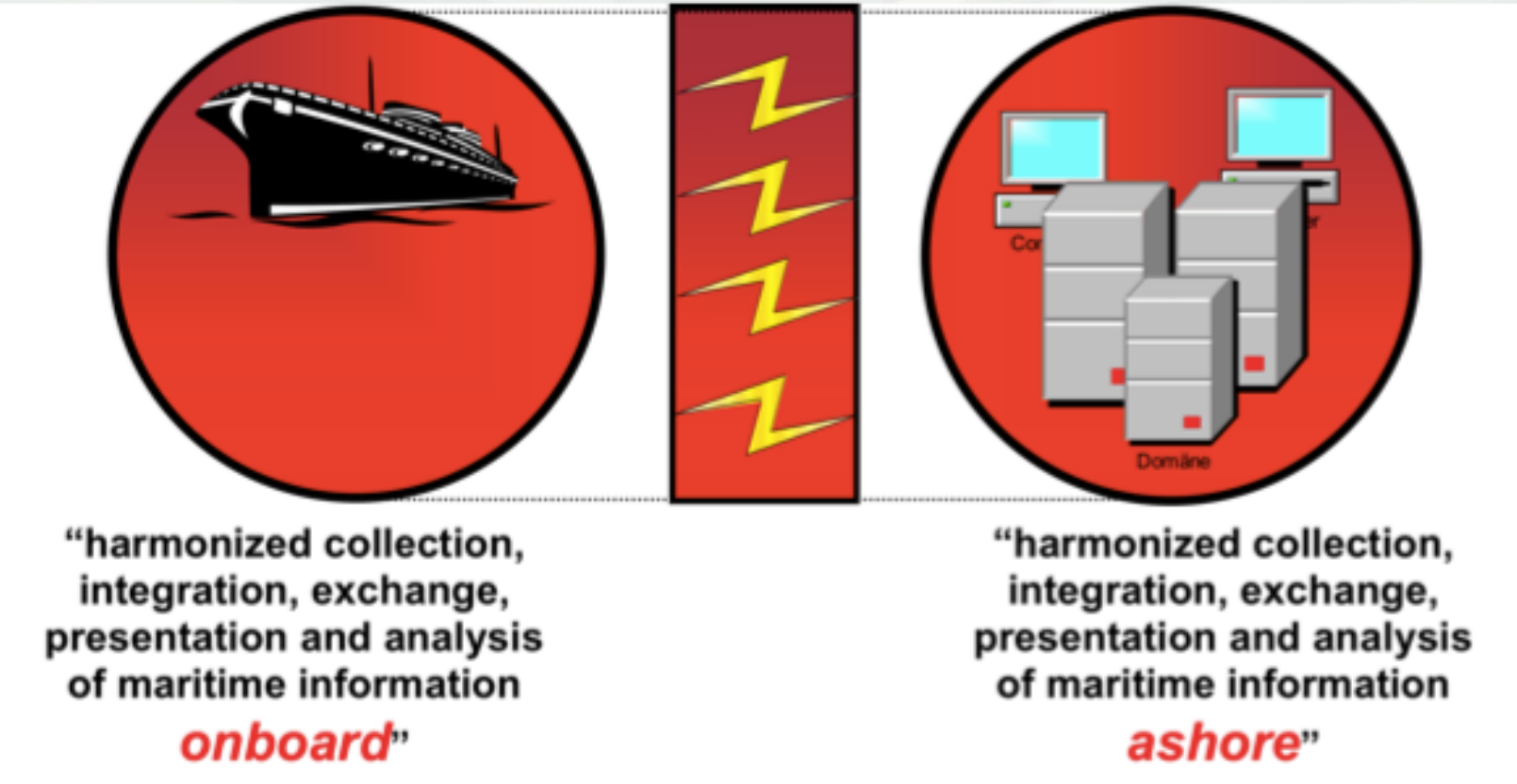


Figure 4 The overarching e-Navigation architecture – complete presentation

e-Navigation:

“three sides of the coin”



“Information Paper on the Draft IALA Recommendation e-Nav 140 on e-Navigation Architecture – the shore perspective”

Key elements of e-Navigation

- Standard technology onboard and ashore
  - Provides commonality for users and known capabilities
- Communications capabilities
  - Flexible wireless comms, adaptable to dynamic needs
  - AIS, VHF Data Exchange, WiMAX, etc.
- Data architecture
  - Common understanding - “speak the same language”
  - Authoritative data sources/stewards

International e-Navigation implementation

Proposed joint plan of work for the COMSAR, NAV, and STW sub-committees

A coordinated approach to the implementattion of IMO's e-navigation strategy overall planning 2012-2014 by strategy element.

Meetings	2012					2013				2014				
	COMSAR 16	**STW 43**	**MSC 90**	**NAV 58**	**MSC 91**	**COMSAR 17**	**STW 44**	**MSC 92**	**Nav59**	**COMSAR 18**	**STW 45**	**MSC 93**	**NAV 60**	**MSC 94**
User Needs														
Overeaching Architecture														
Gap Analysis	Correspondence Group			Final										
C-B and Risk Analysis						Correspondence Group			Final					
Strategy Implementation Plan	2012 : Intersessional WG (to be decided)			Updated outline		2012 : Intersessional WG (to be decided)			Updated outline	Correspondence Group			**Final**	**Adoption**

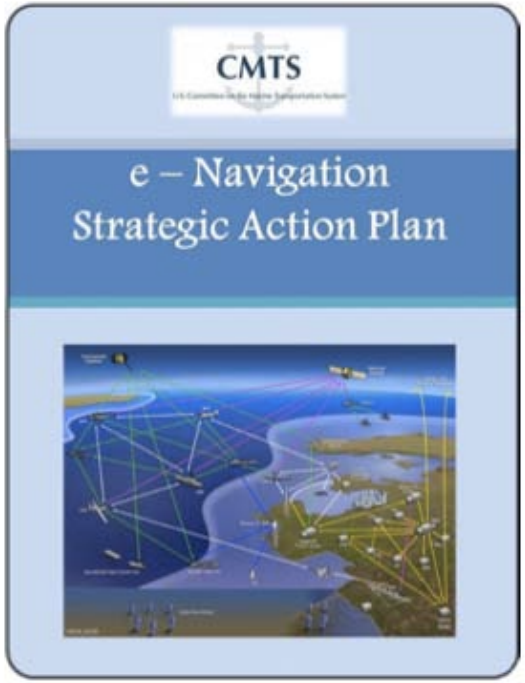
NAV 57/15 annex 6

US CMTS
e-Navigation Strategic Action Plan

Published February 2012

Principles:

- Action – from concept to capabilities
- Alignment with international efforts
- Built on existing capabilities
- User needs



Activities:

- CMTS e-Nav IAT established March 2012
- Initial work plan approved 12 Jun 12

CMTS e-Nav Integrated Action Team Work Plan

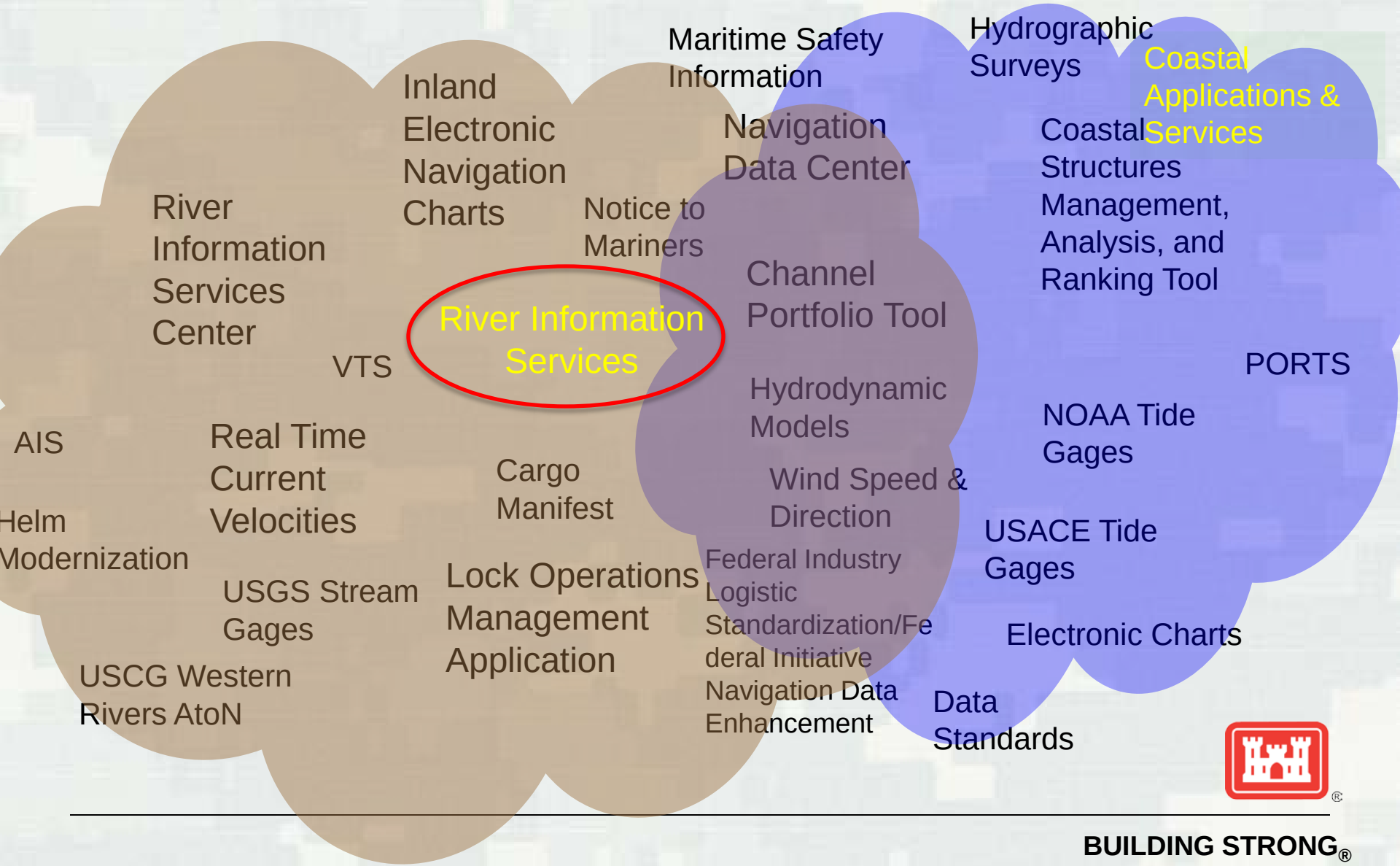
CMTS e-Navigation IAT – Work Plan			
Task	**Responsible Party(ies)**	**Target Completion**	**Status**
Develop Implementation Plan	Co-Chairs	15 May 12	Completed
Develop Initial Work Plan	Co-Chairs	29 May 12	Completed
Develop Initial Capabilities Inventory	e-Nav IAT	1 Oct 12	Pends
Identify e-Navigation Accomplishments/Successes	Co-Chairs	29 May 12	Completed
Inventory e-Navigation-related Regulations	e-Nav IAT	15 Aug 12	Pends
Identify Key Stakeholders	e-Nav IAT	15 Sep 12	Pends
Conduct Stakeholder Outreach; Participate in e-Navigation Conferences	e-Nav IAT	Ongoing	Pends
Identify Stakeholders' Requirements	e-Nav IAT	Ongoing	Pends
Review and Compare IMO Gap Analysis to inventory results	e-Nav IAT	Jan 2013	Pends
Identify collaborative opportunities to deliver short-term value added e-Navigation Products and Services	e-Nav IAT	Ongoing	Pends

CMTS e-Nav Integrated Action Team Significant events

CMTS e-Navigation Significant Events	
CMTS e-Navigation Strategic Action Plan Finalized	Feb 2012
CMTS e-Navigation IAT Approved by CB	13 Mar 2012
CMTS e-Navigation IAT Terms of Reference Approved by CB	13 Mar 2012
CMTS e-Navigation IAT Inaugural Meeting	19 Mar 2012
HSC/RIS Workshop (Pittsburgh)	Aug 2012
RTCM Conference (Orlando)	Sep 2012
Dredging 2012 (San Diego)	Oct 2012
e-Nav Conference (Seattle)	Nov 2012

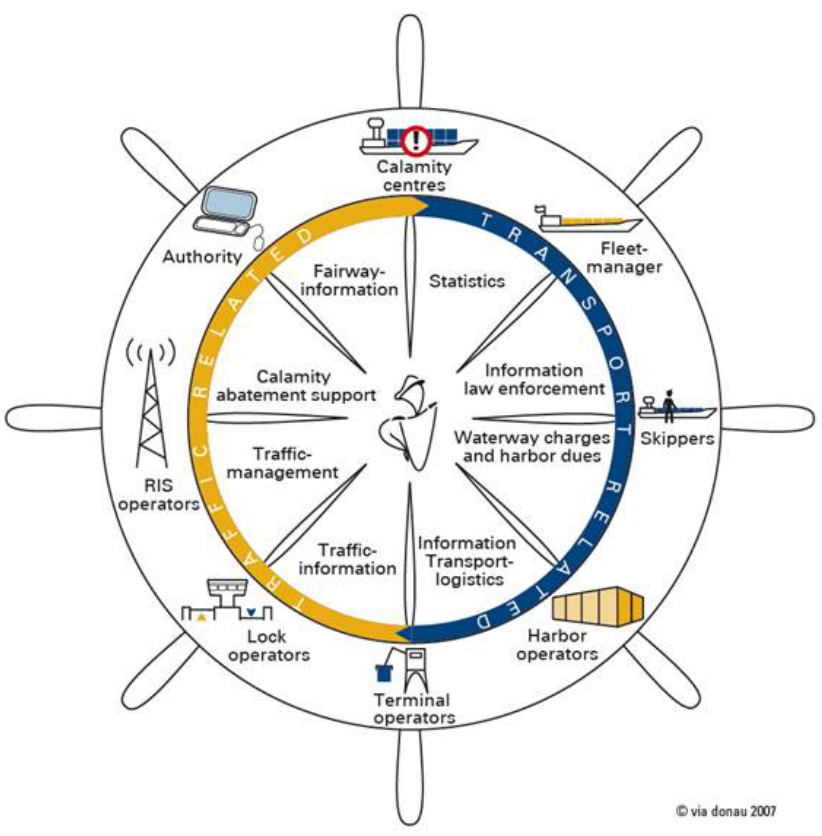
Next e-Nav IAT meeting: 16 July 2012

Existing capabilities



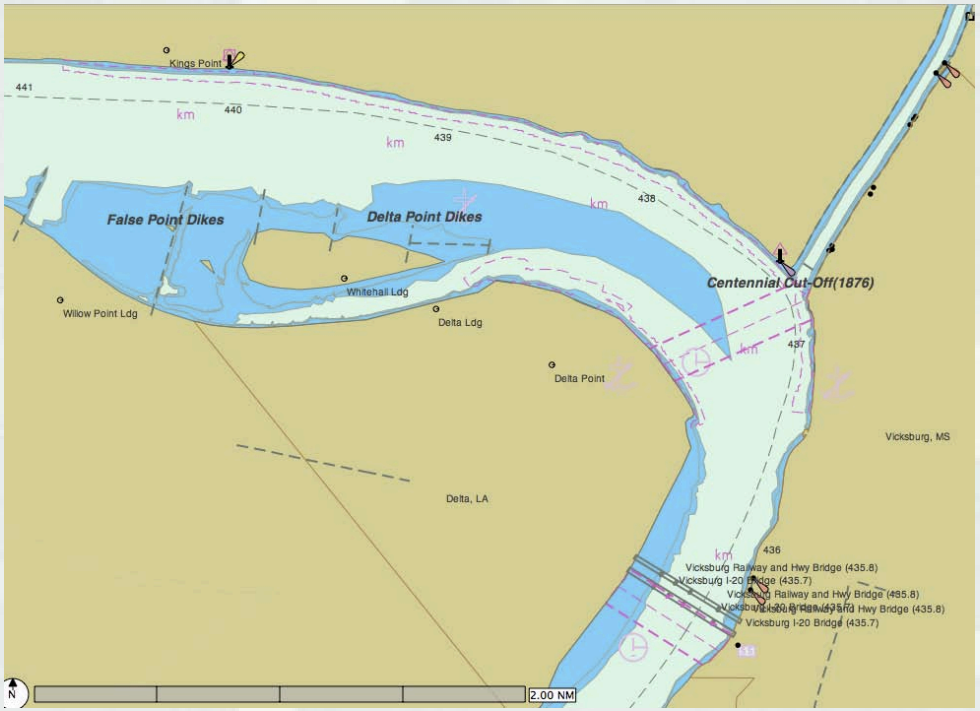
Main functions of RIS

- Fairway information services
  - IENCs
  - Notices to Skippers
- Vessel traffic information services
  - Traffic monitoring
- Traffic management
  - Lock management
- Calamity abatement support
  - Support for responders
- Transport logistics support
  - Voyage information
  - Electronic cargo reporting
  - Voyage planning
  - Navigation Notices/Notices to Mariners



RIS Key Technologies

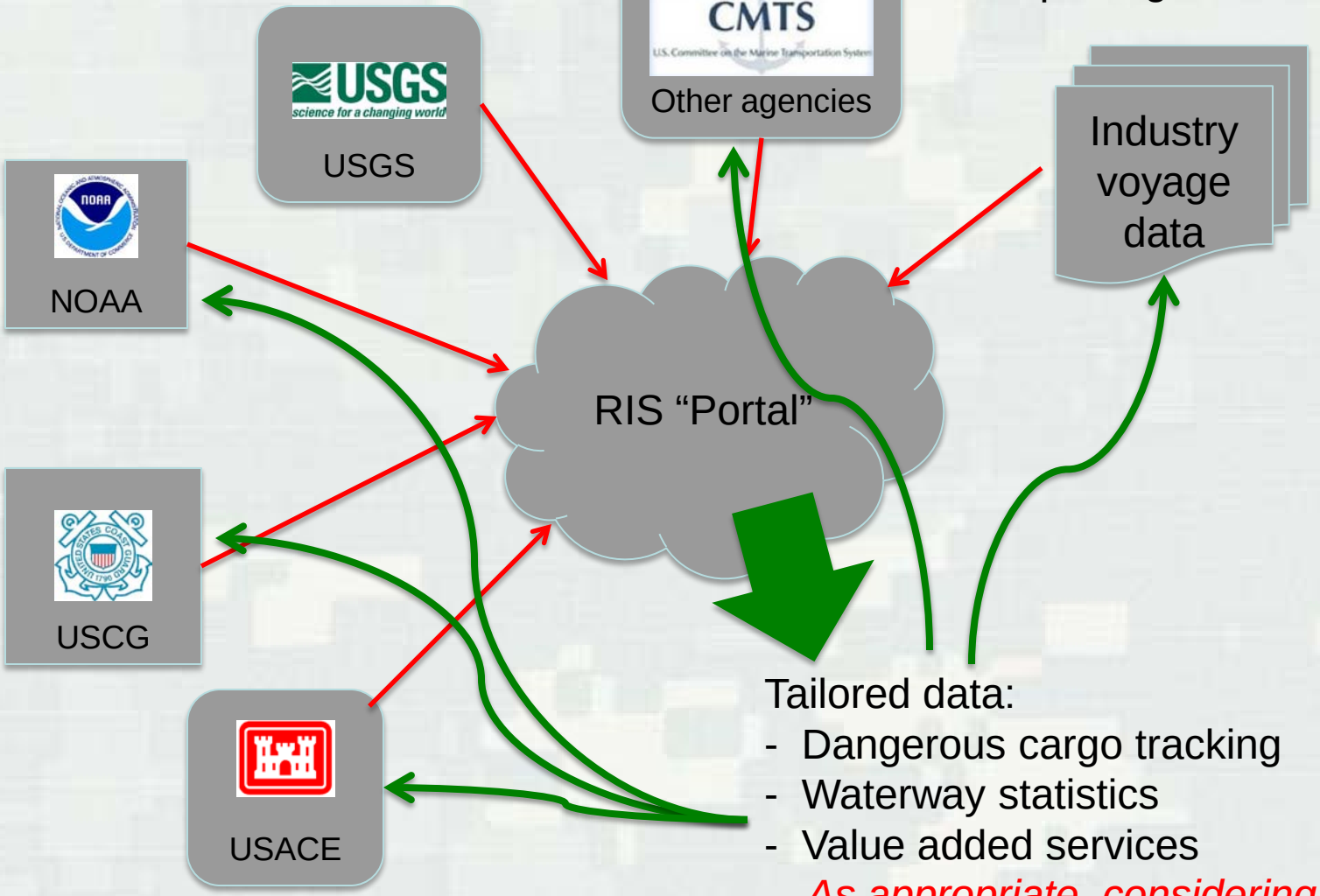
- Inland ECDIS
  - ▸ IENCs
- Inland AIS
  - ▸ LOMA, USCG NAIS
- Electronic Reporting
  - ▸ Industry, interagency
- Notices to Skippers
  - ▸ Harmonization between USACE and USCG
- RIS Index
  - ▸ FILS/FINDE, Master Docks+



U.S. RIS concept

electronic reporting

One-time, standardized reporting



Tailored data:

- Dangerous cargo tracking
- Waterway statistics
- Value added services
- *As appropriate, considering protection of information*

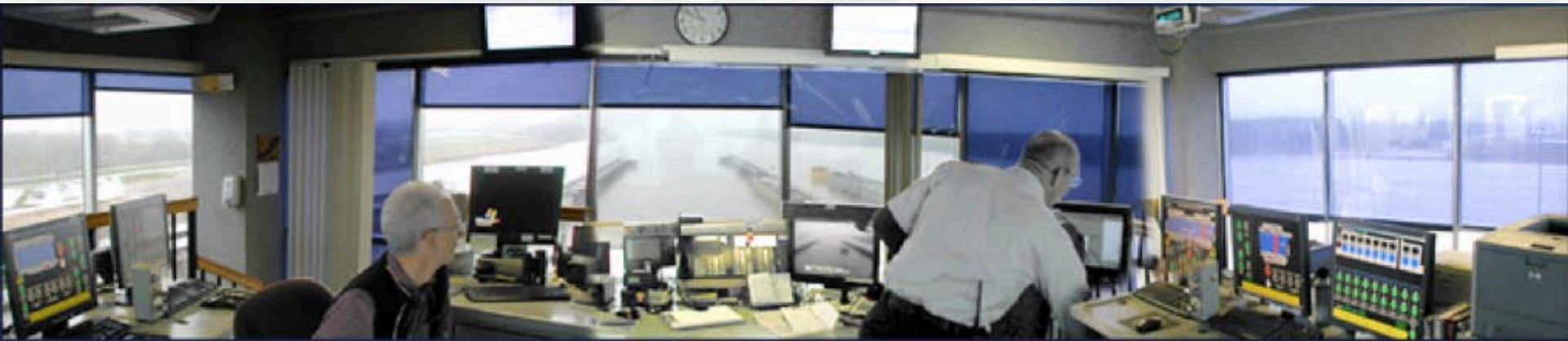
US RIS Implementation

- Build on existing capabilities
  - USACE: LOMA, FILS/FINDE*, LPMS
  - USCG: Vessel data, NAIS services
  - NOAA/USGS: met/hydro obs and predictions
- Start providing services
  - “low hanging fruit”
  - Lock operational information
  - Water levels, met/hydro observations and forecasts
- Establish a RIS Center
  - Public-private partnership
  - Personnel

* Session 3B, Weds 11:00 am, Room 120

Lock Operations Management Application (LOMA)

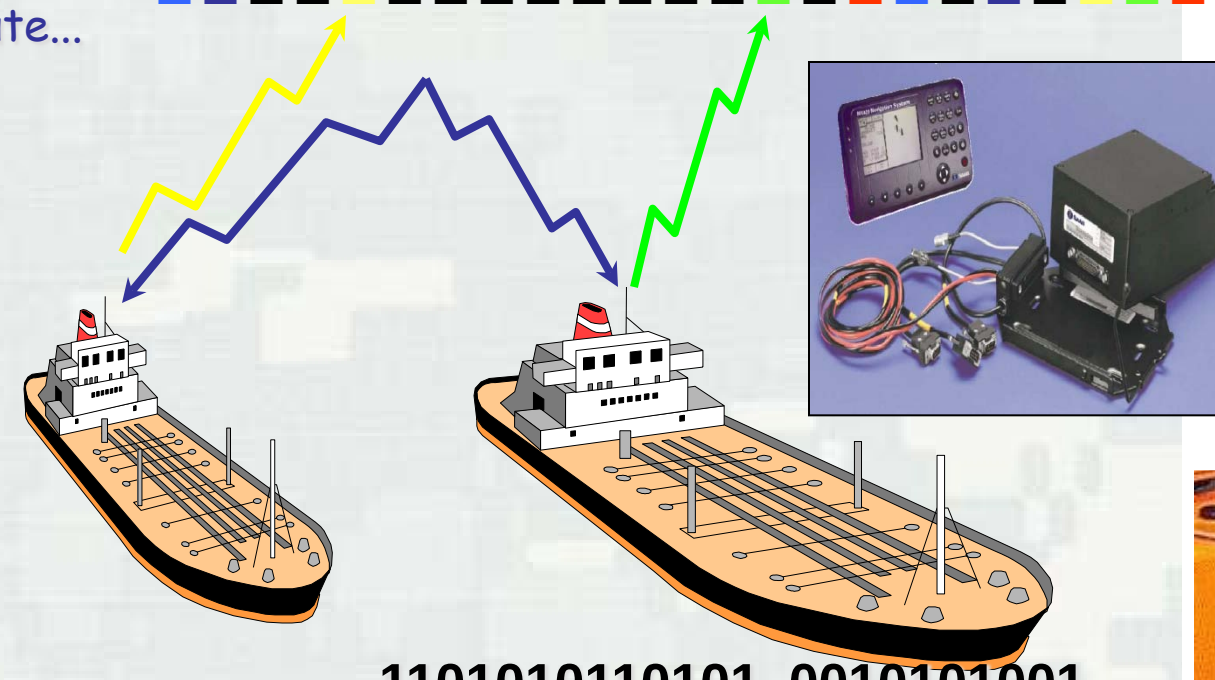
- Purpose:
  - Provide end users information needed for decision support
- Goals:
  - Increase lock operator situational awareness
  - Provide vessel operators better information
  - Provide better information to Corps management
  - Exchange information with external users
- AIS is the central LOMA technology



Automatic Identification System (AIS)

Self Organizing Time Division Multiple Access

4500+ rpts per minute...



...1101010110101..0010101001....

GPS, nav sensors

Heading Rate of Turn Other sensors

Dynamic (2-10 sec)
- MMSI / IMO#
- POSITION
- ACCURACY (+/-10m)
- UTC
- COURSE (COG)
- SPEED (SOG)
- HEADING
- NAV STATUS
- RATE OF TURN

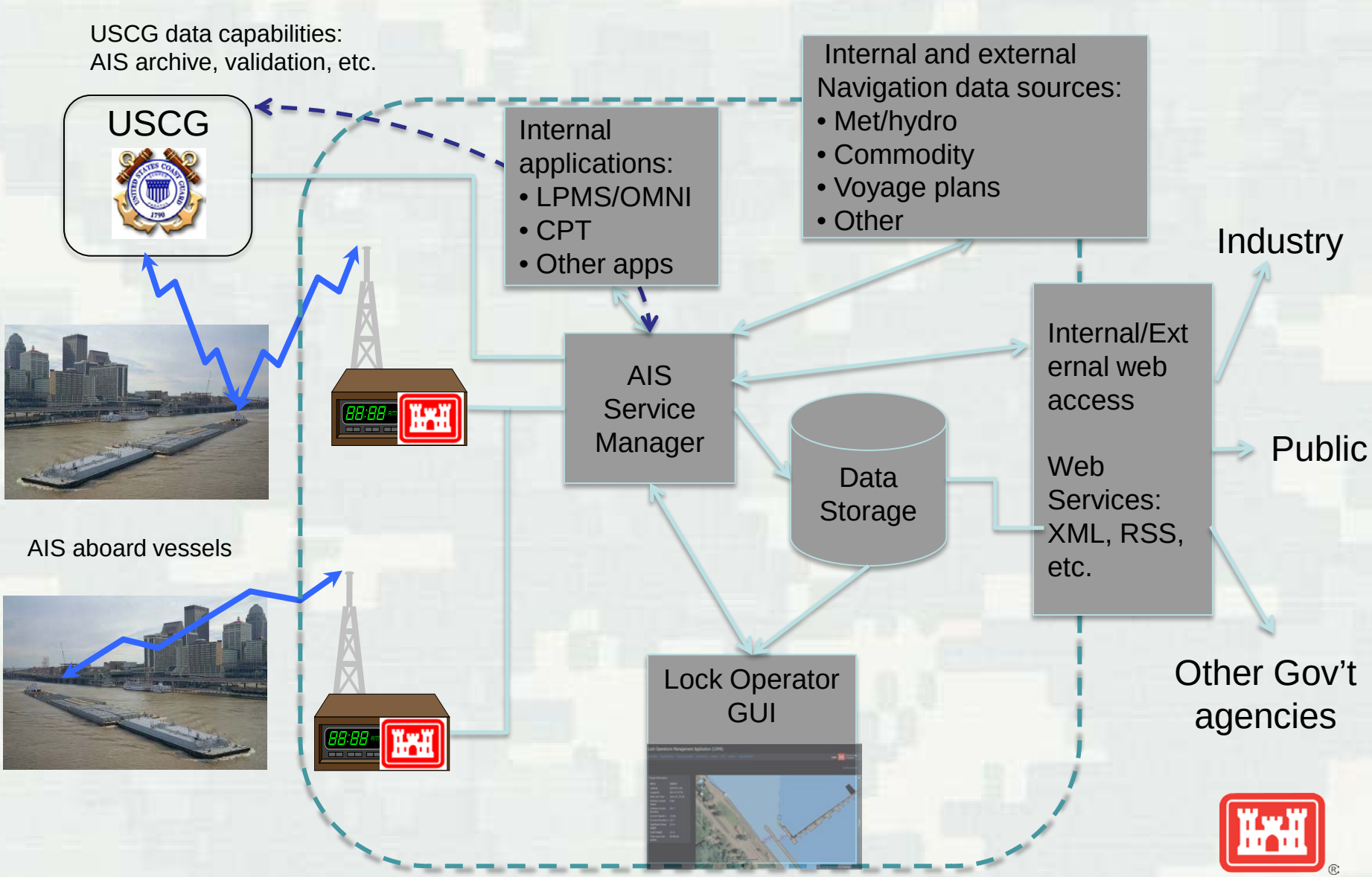
Static (6 min)
- VESSEL NAME
- CALL SIGN
- LENGTH / BEAM
- TYPE OF SHIP
- ANTENNA LOCATION
- HEIGHT OVER KEEL *

Voyage Related
- DRAUGHT
- HAZARDOUS CARGO ONBOARD
- ETA AT DESTINATION *
- ROUTE PLAN *
- PEOPLE ONBOARD *

Safety Related
- SHORT TEXT MESSAGES *

Additional Functions
- Binary Applications
- Telecommands

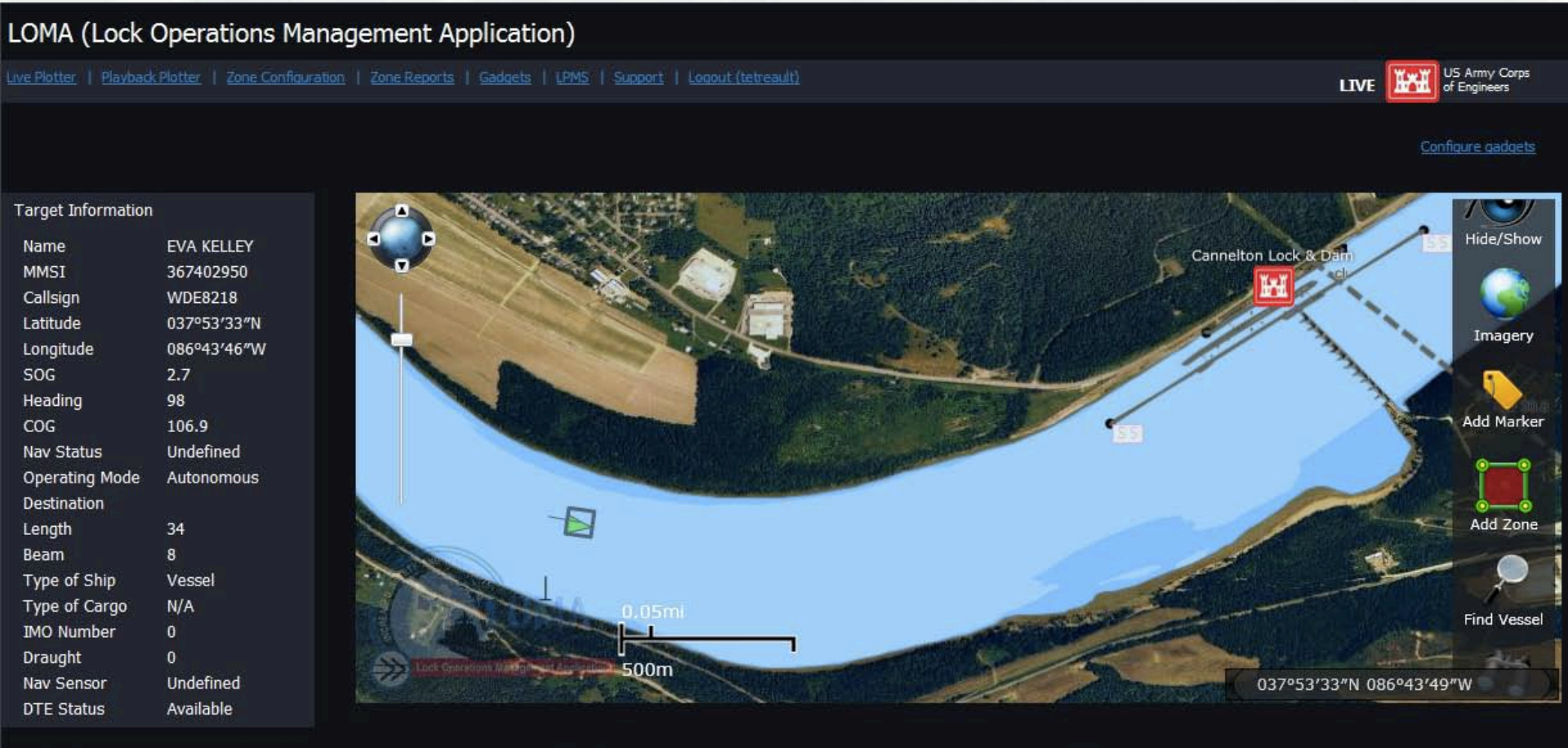
LOMA overview



LOMA AIS equipment deployment June 2012

Current LOMA Capabilities

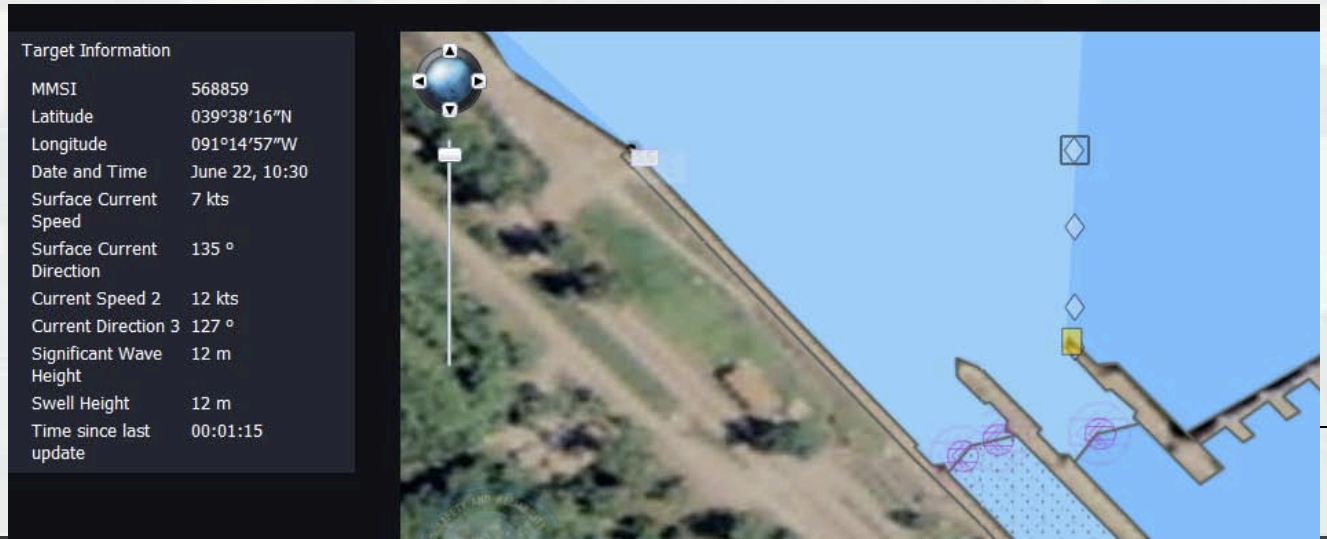
- Lock operator situational display
- AIS vessel information
- Zone management
- Playback capability



Developing Capabilities

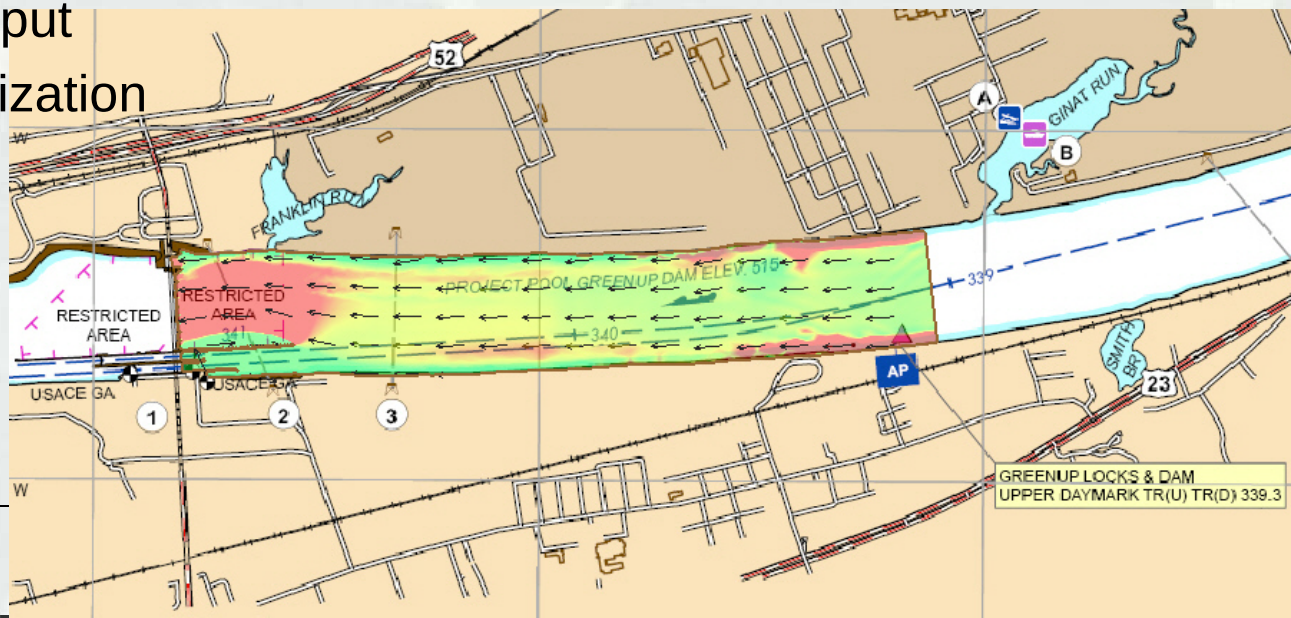
- Integration with other systems
  - Channel Portfolio Tool*
  - SMARTGate
- Industry data
  - Approaching tow information
- Real time met/hydro information
  - Sensors
  - Observations
  - Predictions

* Session 2A, rm 118 (now)



Future Capabilities: Predictive tools

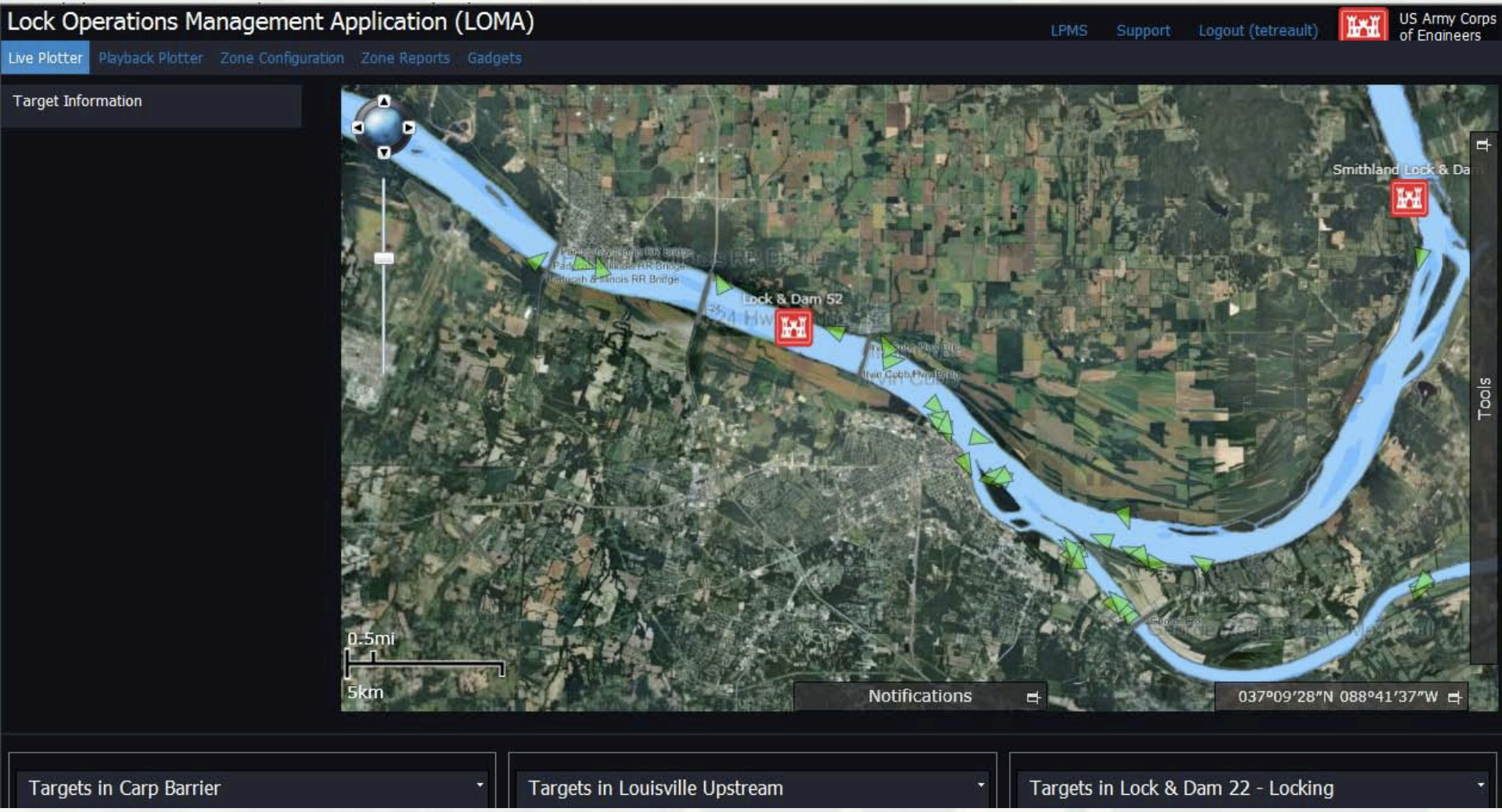
- Hydrodynamic modeling
  - Historical observations and analysis
  - Match to historical AIS tracks – provide suggested vessel approach
- River system optimization
  - Transit time
  - Long term predications
  - Maximize throughput
  - Emergency prioritization



Applying e-Nav to measure and improve the MTS

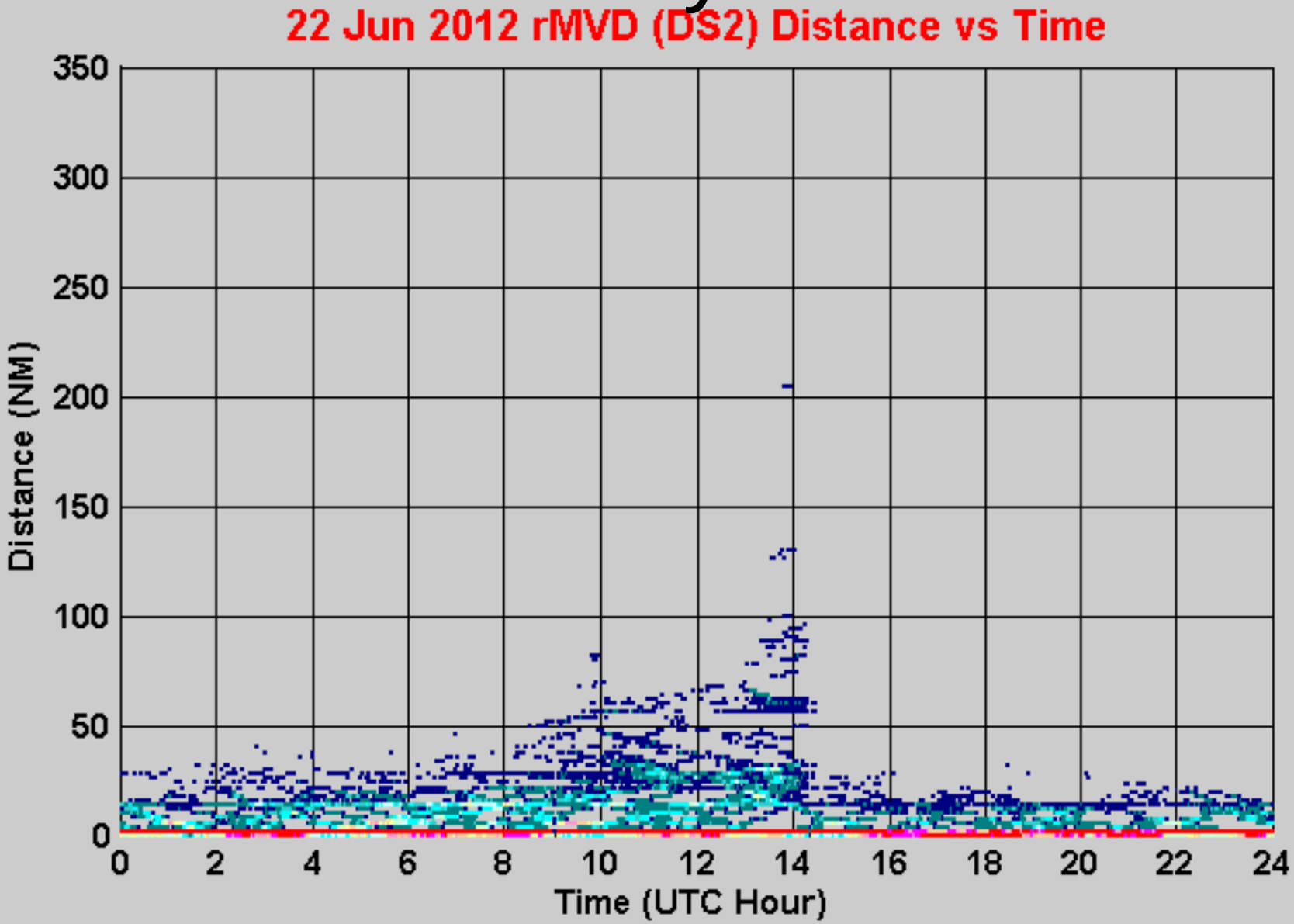
- e-Nav mainly deals with “real-time” information
- However…
  - Data architecture
  - Standards
  - Communication and interface
- Some examples and possibilities…

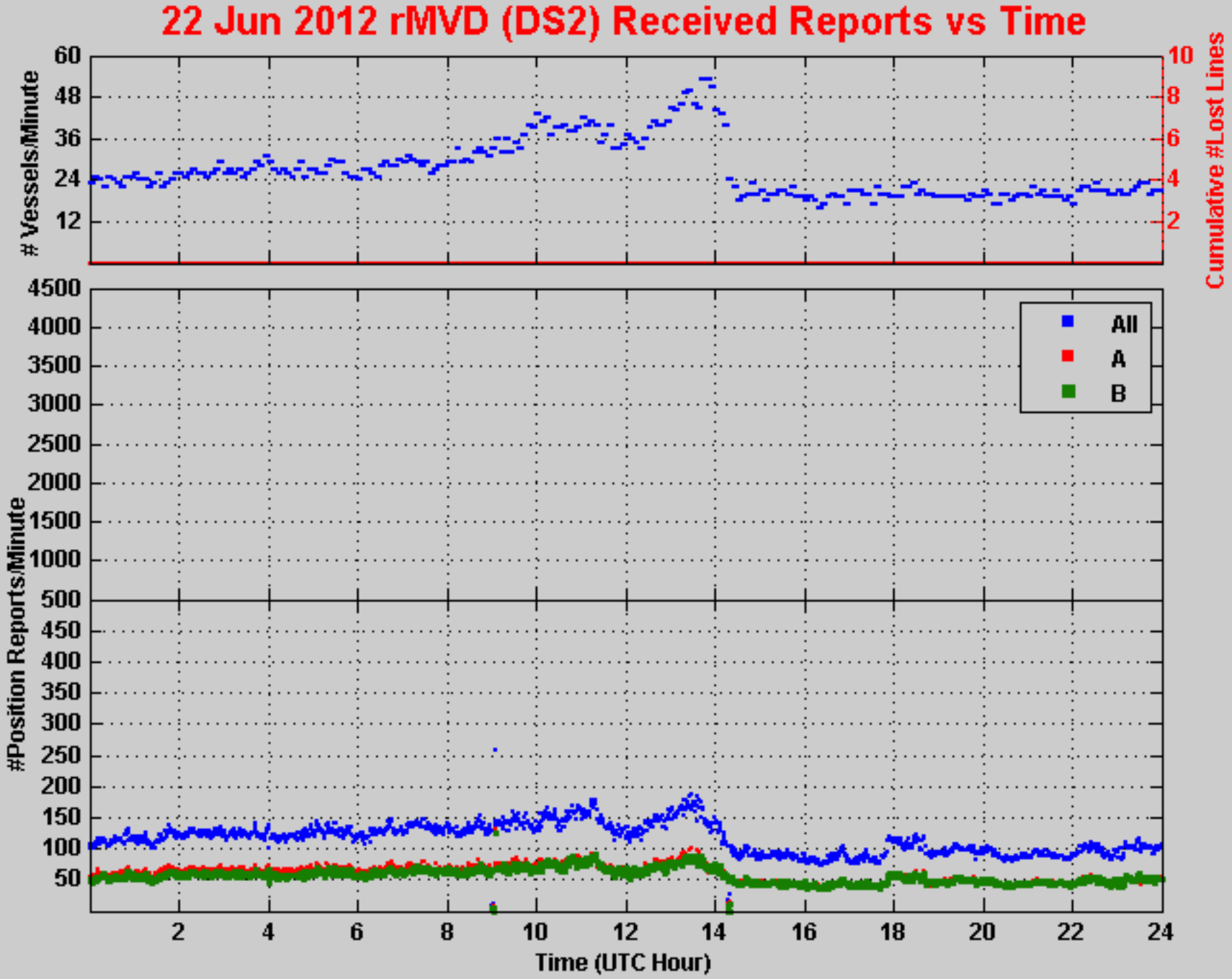
Real-time monitoring and management



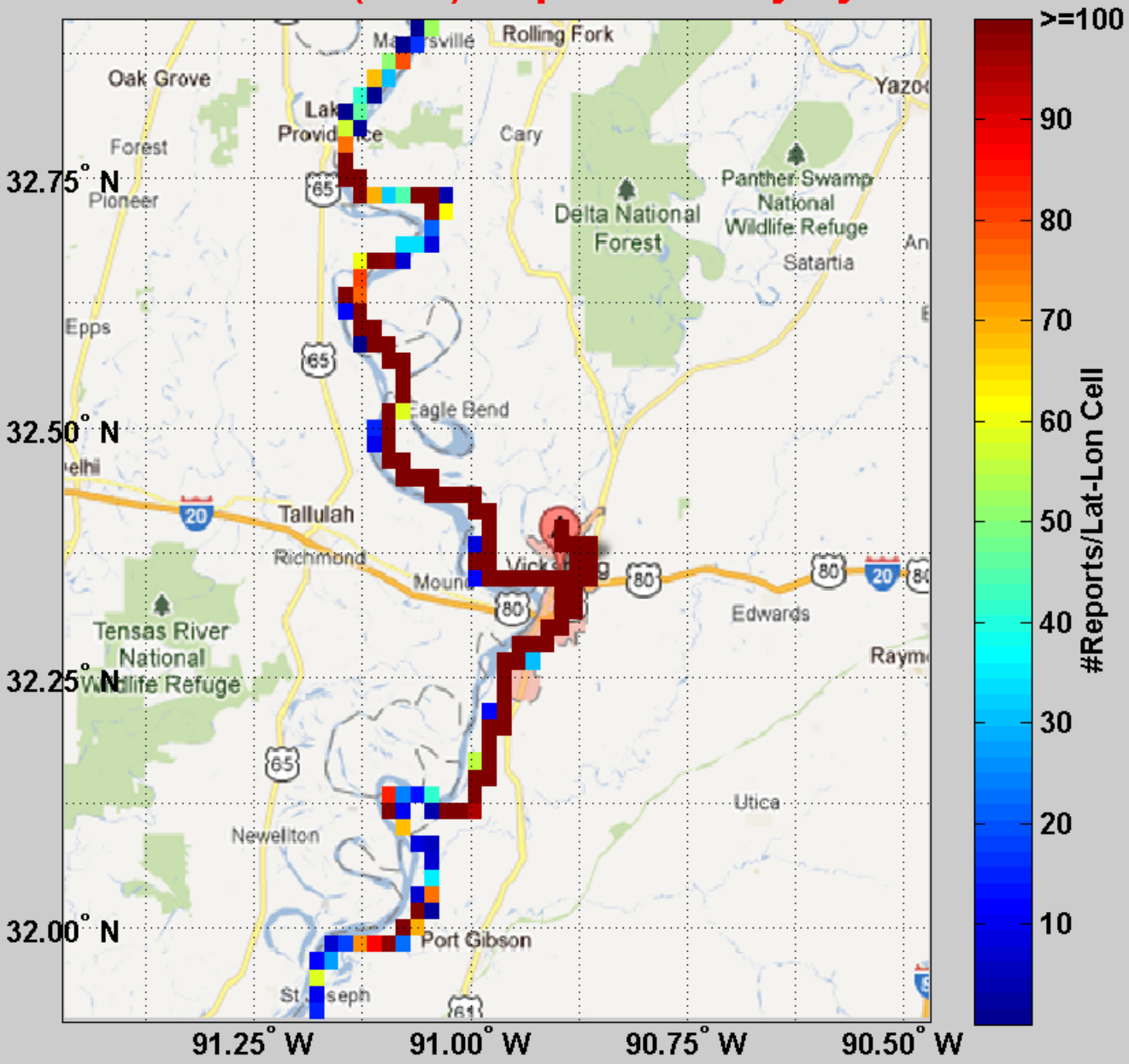
Heat maps (and beyond)

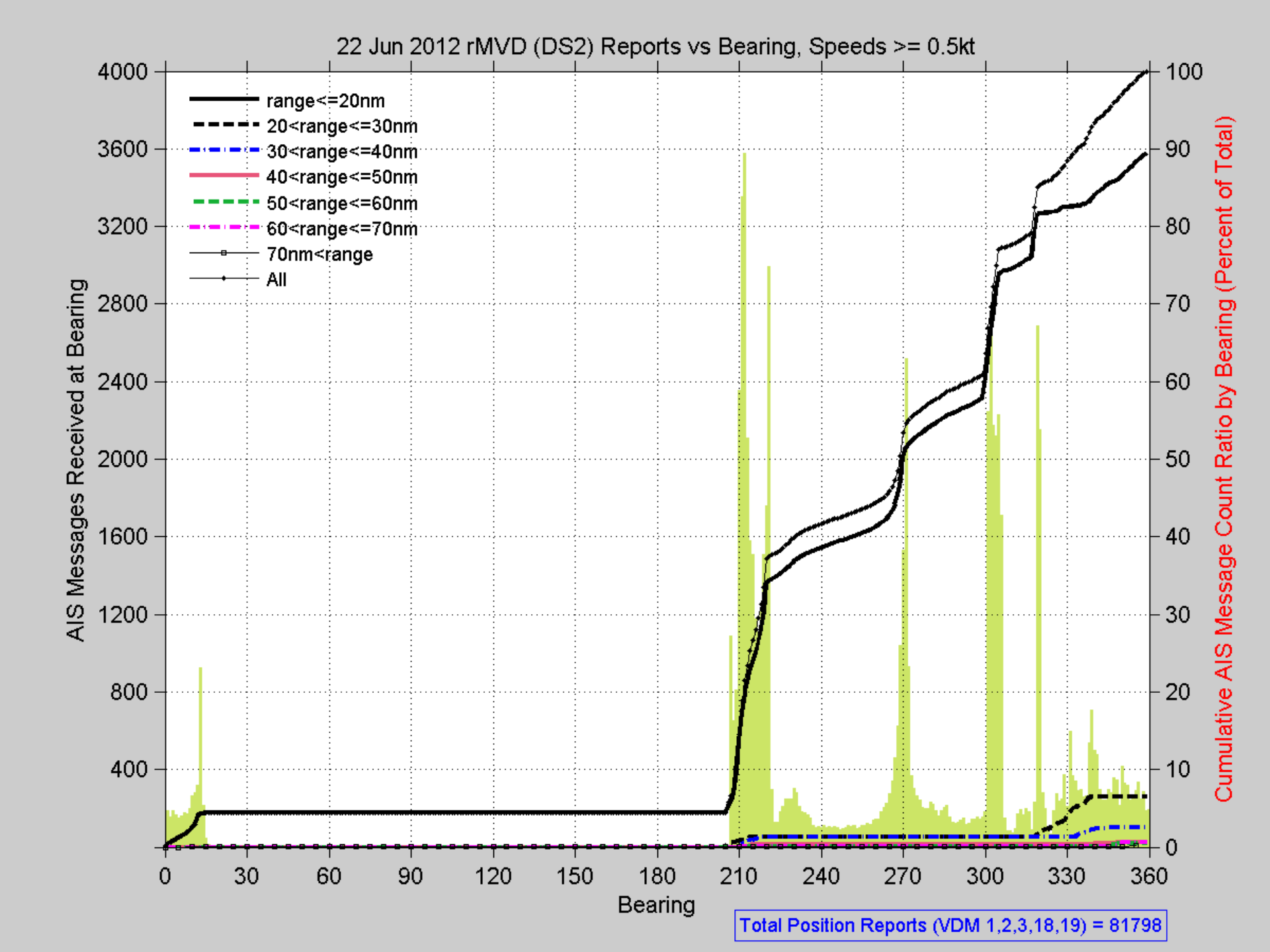
Analysis


22 Jun 2012 rMVD (DS2) Distance vs Time
Distance (NM)
350
300
250
200
150
100
50
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (UTC Hour)

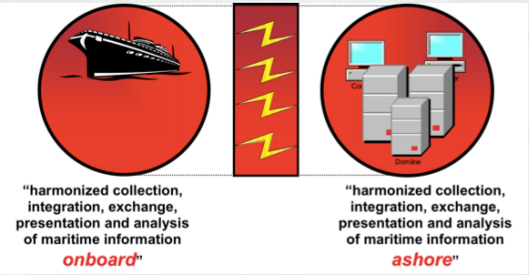

22 Jun 2012 rMVD (DS2) Received Reports vs Time
Vessels/Minute
Cumulative #Lost Lines
#Position Reports/Minute
Time (UTC Hour)
All
A
B

21 Jun 2012 rMVD (DS2) Report Density by Lat/Lon

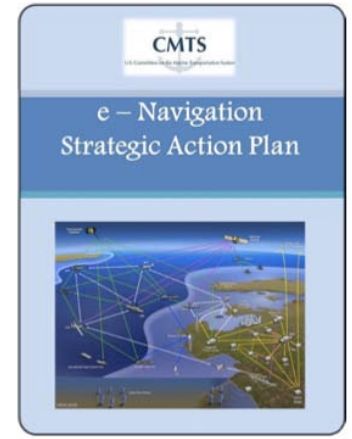



22 Jun 2012 rMVD (DS2) Reports vs Bearing, Speeds >= 0.5kt
range<=20nm
20<range<=30nm
30<range<=40nm
40<range<=50nm
50<range<=60nm
60<range<=70nm
70nm<range
All
AIS Messages Received at Bearing
Cumulative AIS Message Count Ratio by Bearing (Percent of Total)
Bearing
4000
3600
3200
2800
2400
2000
1600
1200
800
400
100
90
80
70
60
50
40
30
20
10
0
0
30
60
90
120
150
180
210
240
270
300
330
360
Total Position Reports (VDM 1,2,3,18,19) = 81798

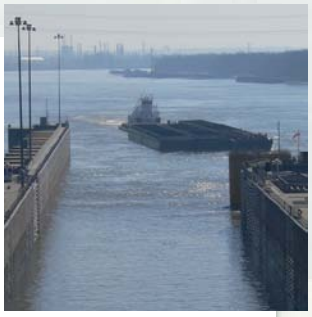
Summary



- e-Navigation concept and US implementation
- US RIS implementation
- LOMA as foundational RIS capability
  - ► AIS capabilities
  - ► Interoperability – e.g., USCG data exchange
  - ► Future capabilities
- e-Nav contribution to MTS
  - Real-time
  - Measuring and improvement
- And a question…



Thank you for your attention!



INCREASED SAFETY AND RELIABILITY

LOMA

Lock Operations Management Application

US Army Corps of Engineers®

Engineer Research and Development Center

Brian Tetreault

brian.j.tetreault@usace.army.mil