A Reconfigurable Operations Centre for the Maritime Transport Industries

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IMAGINE 4D

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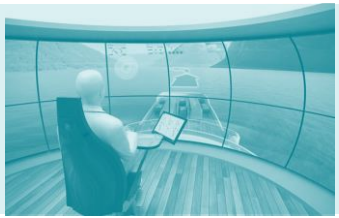
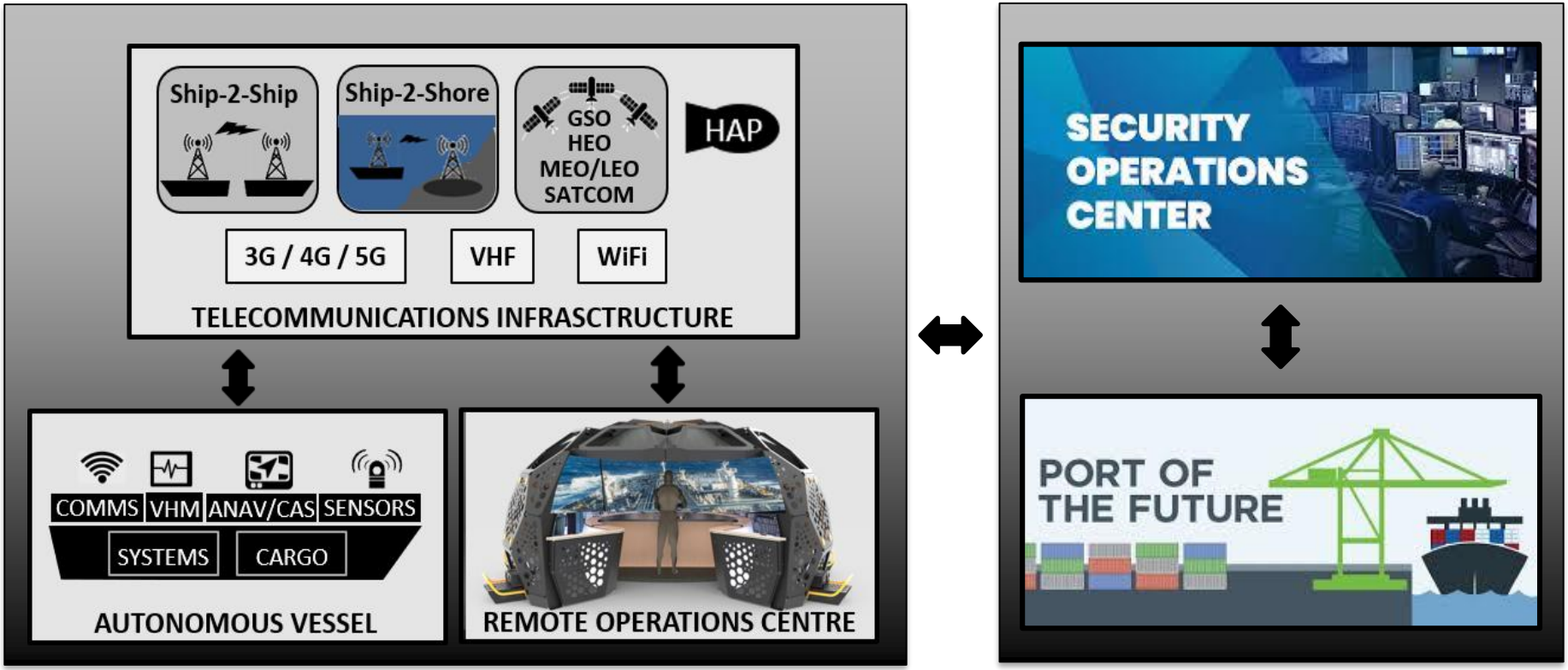
A Reconfigurable Platform for : Testbeds & Pilot Projects

OPERATION CENTERS	• Remote Vessel Control • Port Operations • Security Operations • Maritime Traffic Control • Search & Rescue
ACTIVITIES	• Technology Validation • Concept Development • Interoperability Tests • Cybersecurity Automation



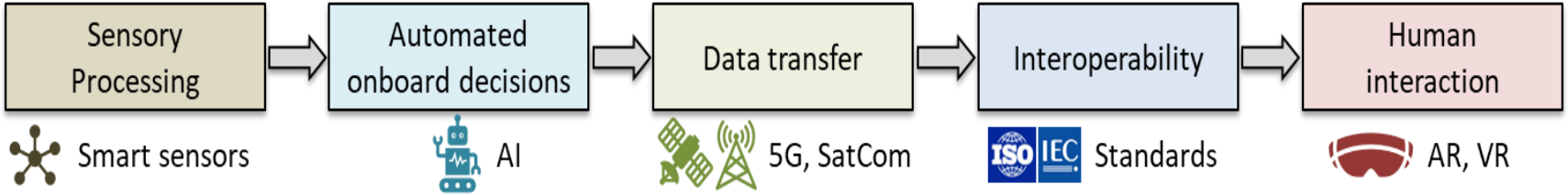
MASS Ecosystem : A Control Centres Perspective



MASS Ecosystem : Insurance & Liability Perspectives

Shipowners	Yards & System Suppliers	Remote Operators	Classification Societies	Insurers
1. Overall function unchanged 2. Relation to remote operators 3. Goods, ship & incident Liability	1. Services 2. Compliance 3. Maintenance 4. Connectivity 5. Product Liability	1. Multiple operational concepts 2. Division of existing duties & obligations 3. Operator Liability	1. Verification & Certification of MASS 2. Drive regulatory development	1. Insurability 2. Risk associated with higher levels of autonomy 3. Access to operational data 4. Cyber risk management

MASS Ecosystem : Technology Perspective



Smart Sensors

LiDAR, Camera Arrays,
RFID, GPS
Synthetic Aperture Radar

Shared Data Services

Canada Ice Services, CHS, CSA
S-100 Maritime Data
Sea Traffic Management Services
TBD

Ai

Decision Aids, Automation
Intelligent Adaptive Interfaces
Object/Pattern Recognition

STD

ISO TC8 MASS
Canadian ITS RA,
US National ITS Architecture,
Sea Traffic Management Services

5G

LEO Satellites
Shore Antenna Arrays
Ship-to-Ship
Ship-to-Shore

AR
360°

VR Headsets, Walls
Domes, Immersion, 3D
Enhanced User Interactions

Problem 1: How to validate MASS technology ?

1. Technologies for autonomous ships not ready.
2. No interoperability framework for future Maritime Transport Ecosystem.
3. Integration with global supply chain requires better information exchange.

***Technology Validation Testbeds* can accelerate the development of the ecosystem of autonomous vessels and intelligent ports.**

Problem 2: Defining a new generation of operations centers

1. Autonomous Ships require Remote Operations Centres.
2. Role, jurisdiction and required functionality of ROC still unclear.
3. Projected increase in maritime traffic; requires automation, more coordination.
4. New requirements for security and port operations centres.

Pilot projects using networked, reconfigurable platforms can provide operational validation for AI-enabled maritime operations centres

Problem 3: How to connect multiple initiatives ?

1. Canadian Digital Seaway
2. Smart Ship Coalition (Great Lakes Saint-Lawrence Seaway)
3. Sea Traffic Management Services (European)
4. Canadian Intelligent Transportation System Reference Architecture
5. IMO MSC 101.1/Circ.1604 on "INTERIM GUIDELINES FOR MASS TRIALS "
6. Quebec Intelligent Maritime Corridor

Interoperability is key to enabling critical information flows.
It is essential to connect the dots across initiatives.

Need

TECHNOLOGY VALIDATION

OPERATIONAL VALIDATION

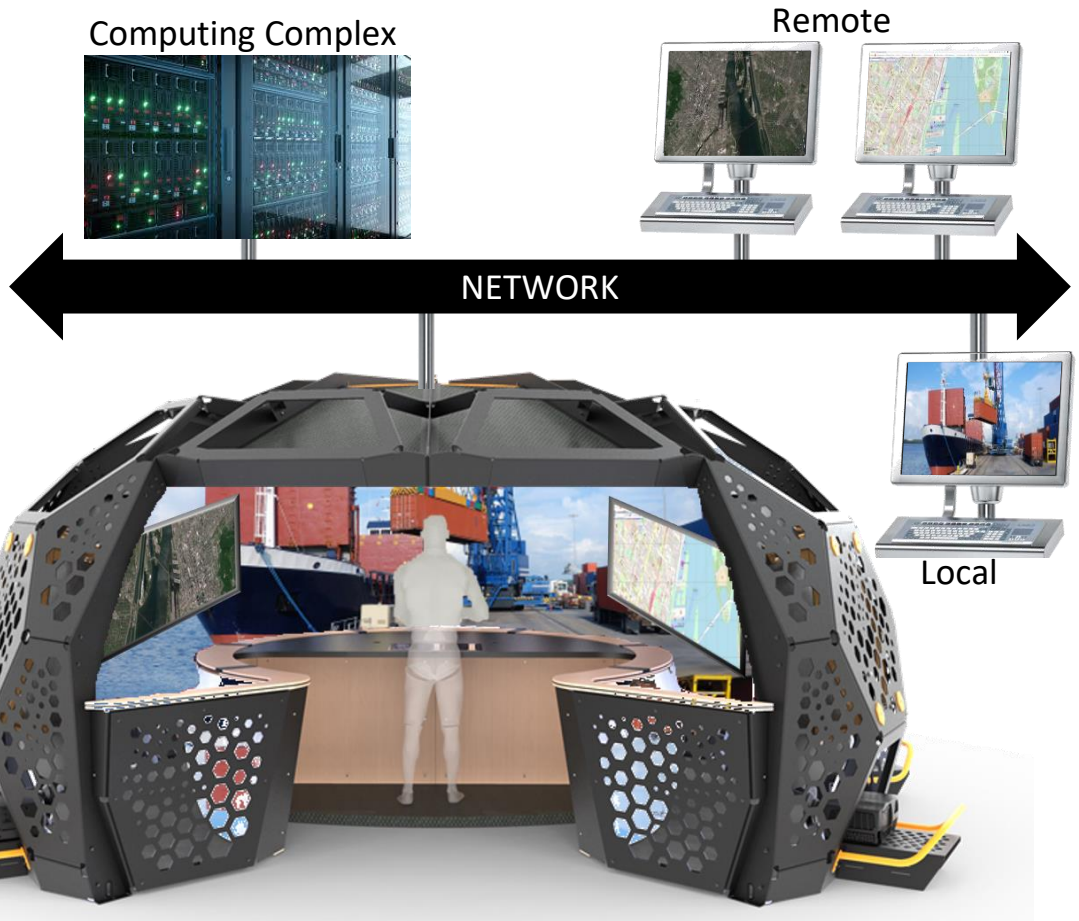
Experimentation and testing is necessary to validate emerging technologies and technical standards and prepare the transition for new regulations and operating procedures.

Prototyping and operational validation activities will accelerate the evolution of existing security and port operations centres and the development of remote vessel operations centres.

Solution: A Reconfigurable Operations Center

Features

- 3D Immersion
- Simulation ready
- Live streaming capability
- Connected, Networked
- Reconfigurability
  - Black box Plug & Play Integration
  - Modular Operator Station
- Intelligent Adaptive Interface
  - Built-in Augmented Reality
  - Gestural Control
  - Voice Commands
  - Operator State Monitoring



Solution: A Reconfigurable Operations Center

Canada

Nautical Charts, Data Products & Services

Canada Ice Services

Connected systems are streamed as 3D images or reconfigurable, dynamic 2D virtual monitors.

System 2

System 3

NETWORK

STM
SEA TRAFFIC MANAGEMENT

Integration with external services

unity

UNREAL ENGINE

Virtual Integration Environment

Integration Environment with support for COTS simulation and visualization engines

System 1

Operator controls the systems using standard keyboard & pointing device or gestural control interface.

National Research Council Canada | Conseil national de recherches Canada

Canada

CANADA'S DIGITAL SEAWAY

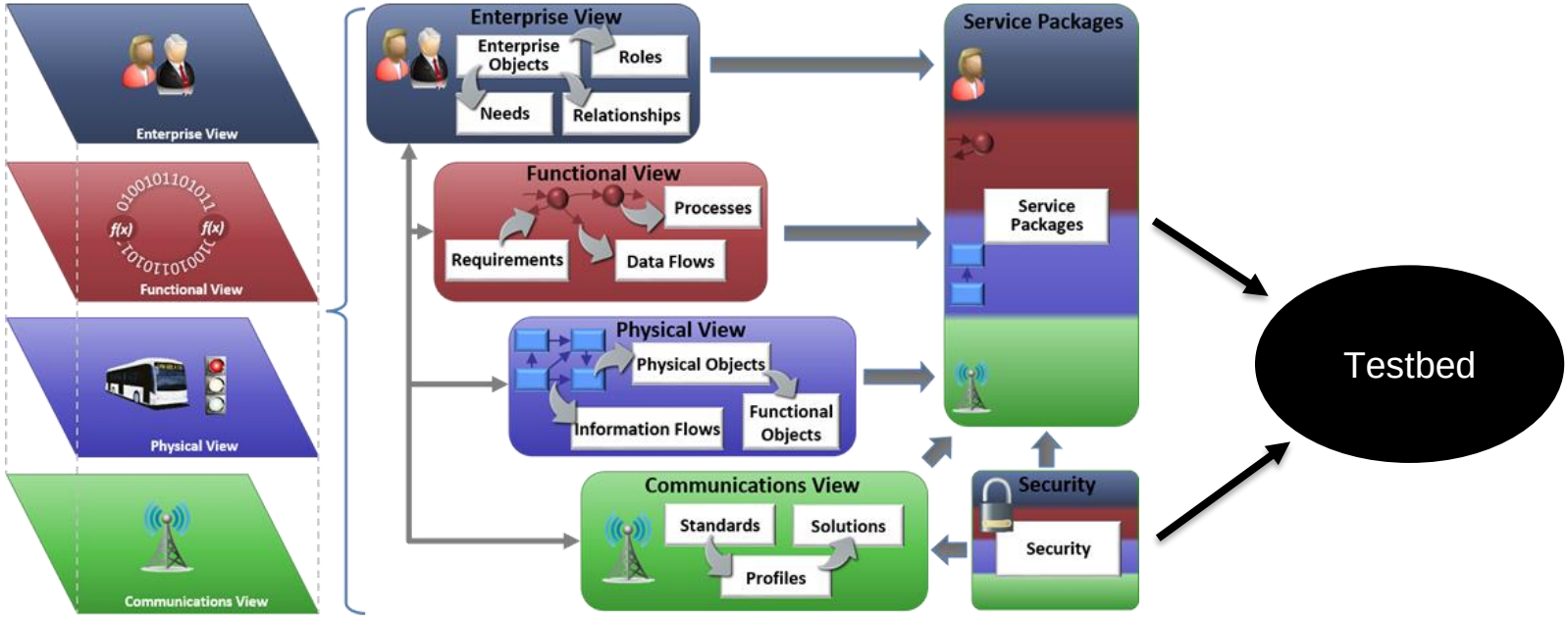
Creating the world's first digital inland waterway – from the ocean to the Great Lakes

GREAT LAKES-ST. LAWRENCE MARITIME STRATEGY

- **Governors' & Premiers' Maritime Initiative** - double maritime trade!
- **Focus** - port infrastructure, vessel efficiencies (including **autonomy**)
- **Regional strengths** - maritime, automobile manufacturing, engineering, IT
- **Smart Ships Coalition** launched:
  - Collaborations w/Norwegian Forum for Autonomous Ships (**NFAS**) and **INAS**
  - Establish Great Lakes **Test Bed**
- Action Plan w/**recommendations** - improve technology, safety & public acceptance

Transports Canada

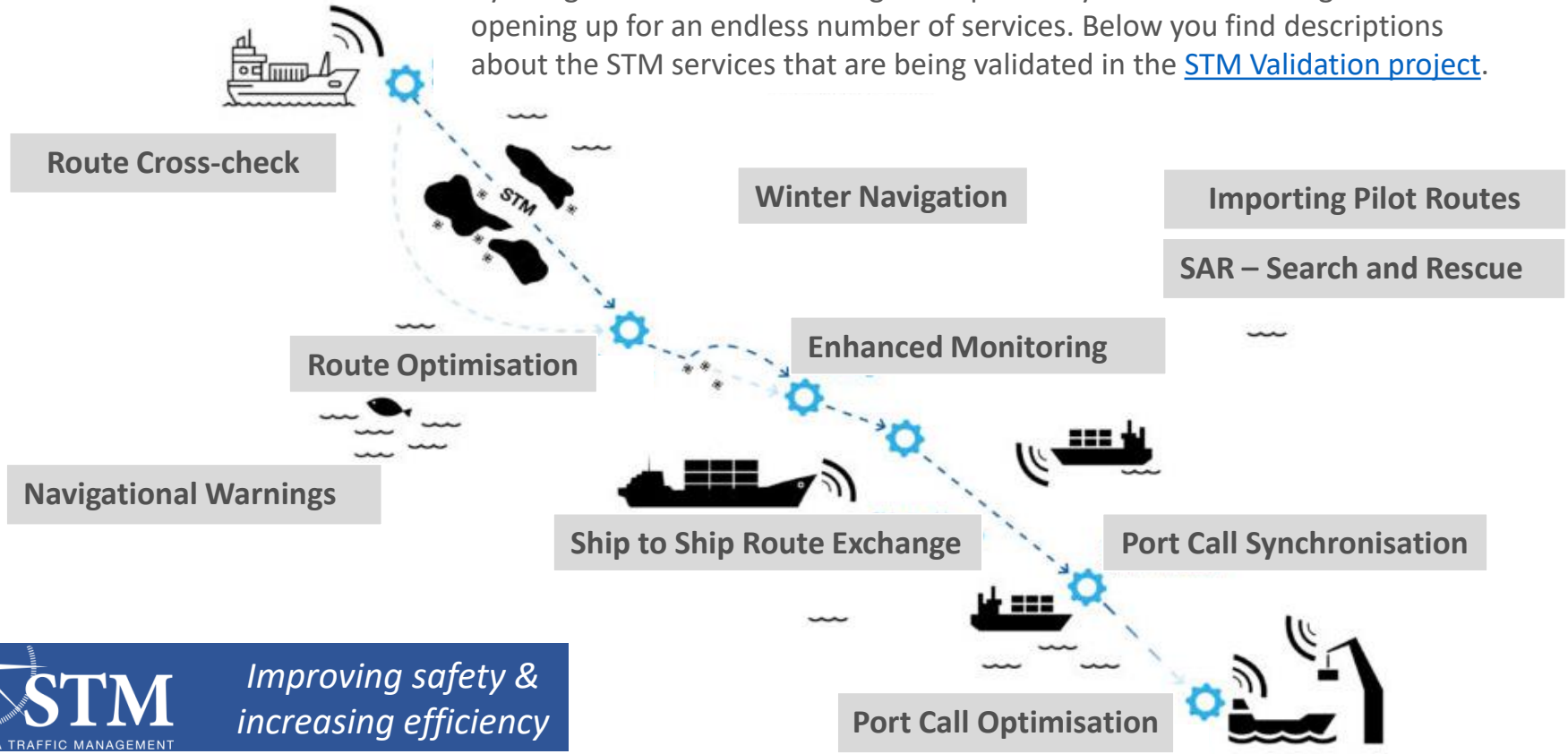
Transport Canada



Sea Traffic Management Services

STM Services

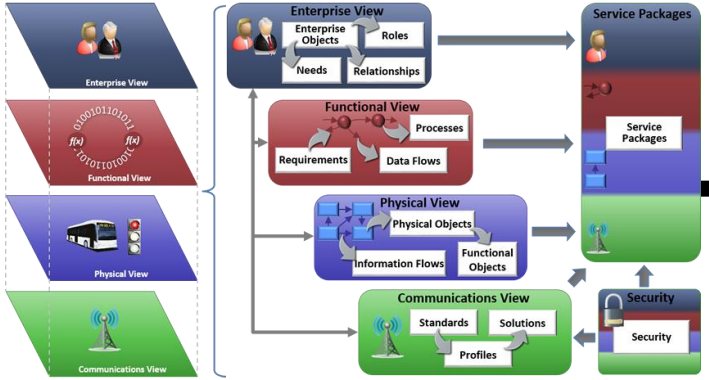
By using standards and creating interoperability Sea Traffic Management is opening up for an endless number of services. Below you find descriptions about the STM services that are being validated in the STM Validation project.

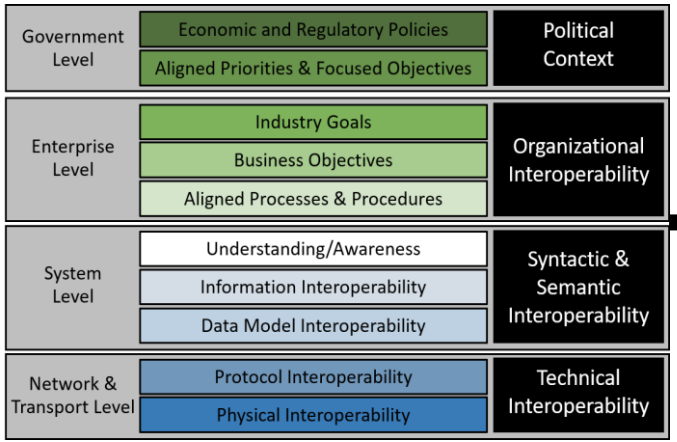


STM
SEA TRAFFIC MANAGEMENT

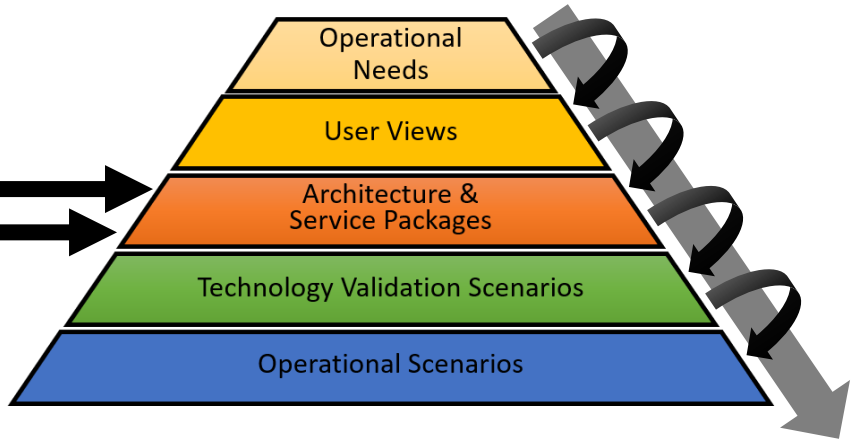
Improving safety & increasing efficiency

Using the Canadian ITS RA to advance interoperability





- Testbed supports a top-down approach starting with operational needs.
- Consistent with Canadian ITS Reference Architecture and toolset.



RAD-IT

Reference Architecture Tool

SET-IT

Systems Engineering Tool

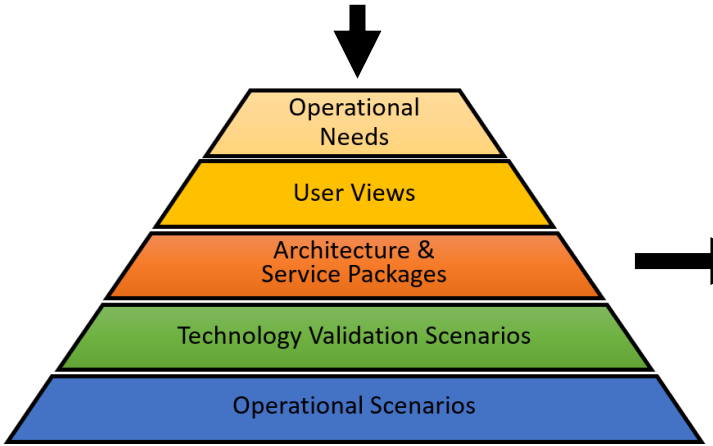
Using the Canadian ITS RA to Advance Interoperability

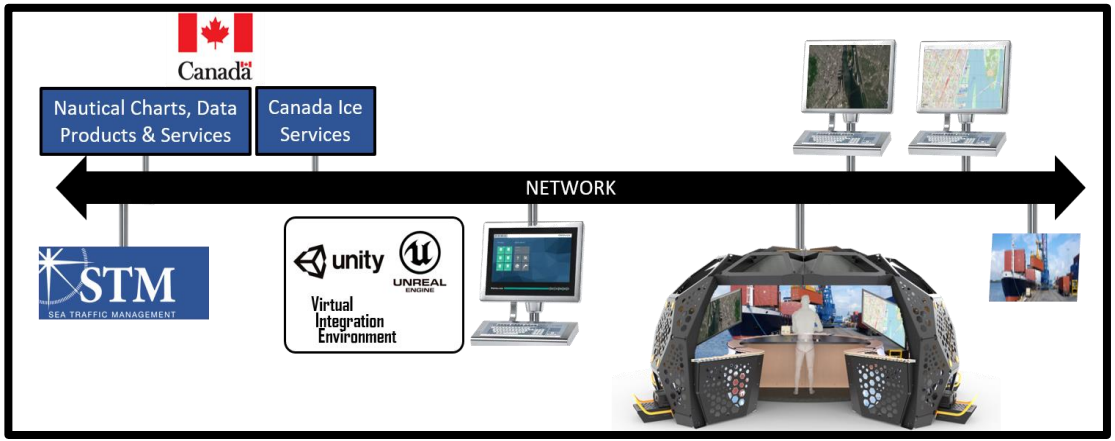
Using the Canadian ITS RA to specify the architecture and data exchange services architecture for target applications.

Following services integration, validation scenarios are executed in testbed.

TARGET APPLICATIONS

- Port Operations & Supply Chain
- Intelligent Corridor Navigation Aids
- Oil & Gas Offshore Autonomous Supply, Maintenance and Repair Vessel



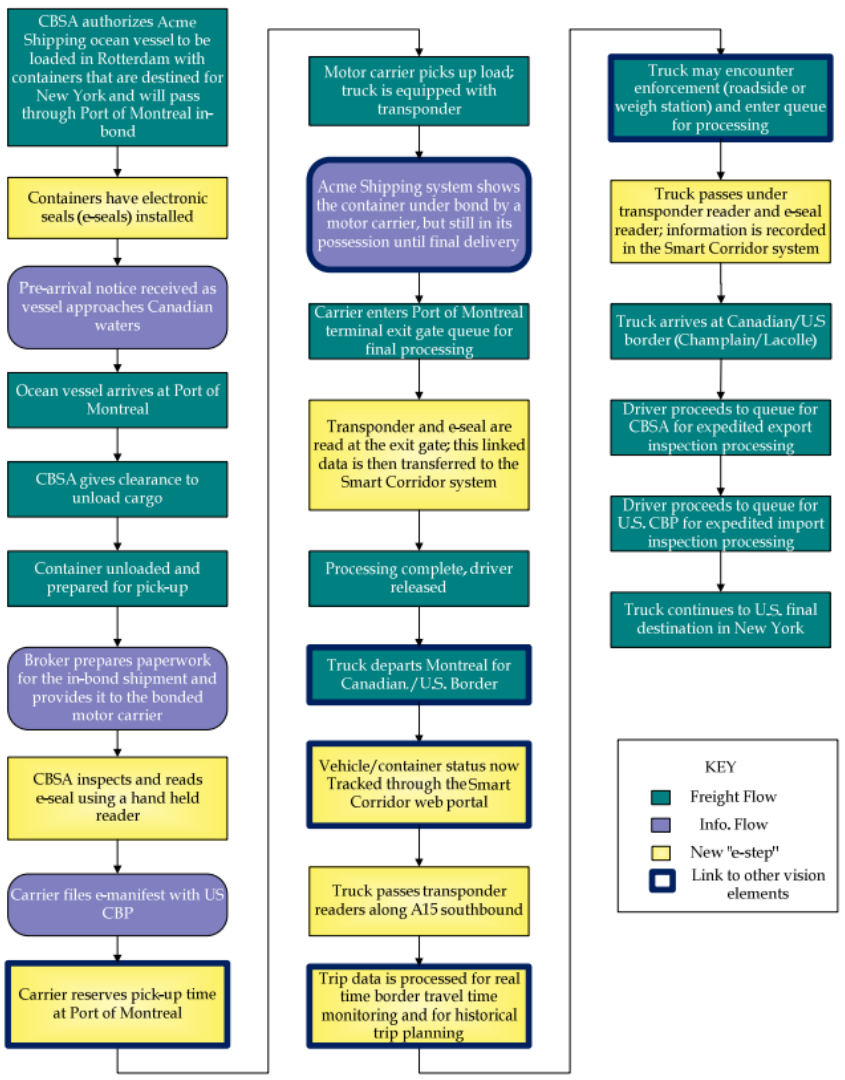


Example User View*

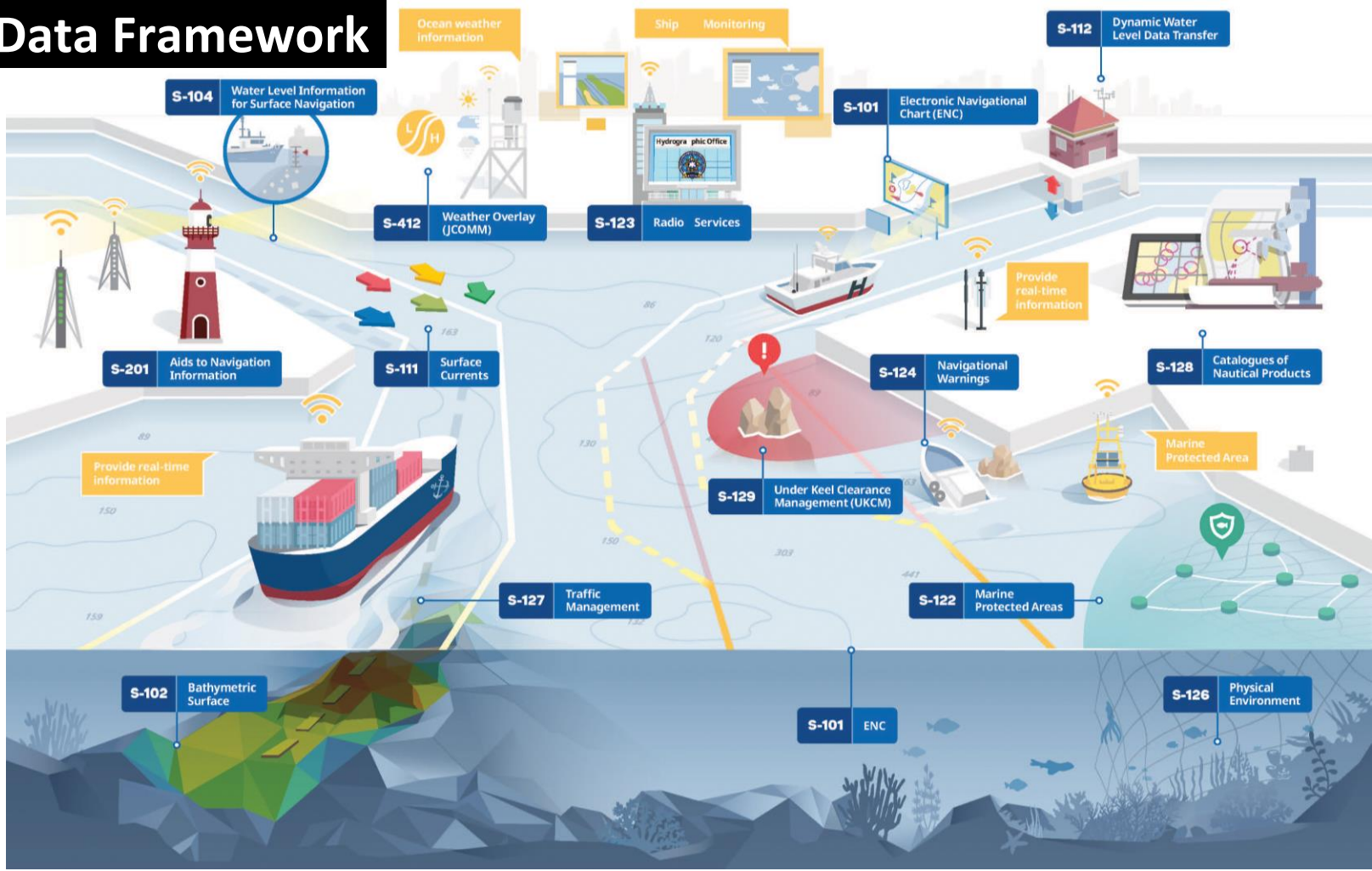
SMART CORRIDOR
Border & Port of Entry Transit of In-bound Container

- Canadian Federal and Quebec Provincial initiatives for Smart Corridors
- Scenario is defined in terms :
  - Flow of goods
  - Flow of information
  - Digitization requirements
  - Links to related global supply chain initiatives
- Excellent basis for defining testbed validation activities.

*From the Canadian ITS Reference Architecture



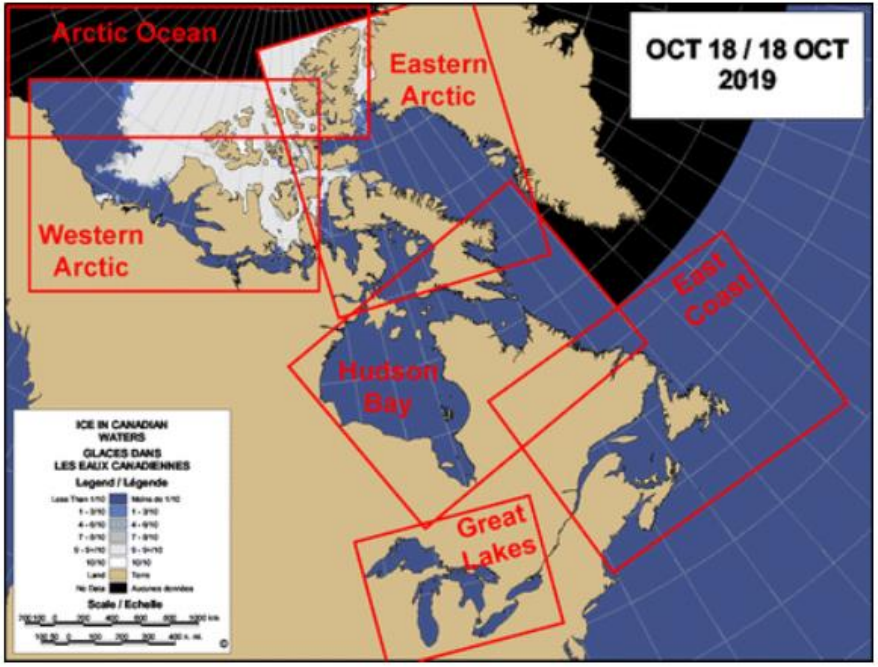
Maritime Data Framework

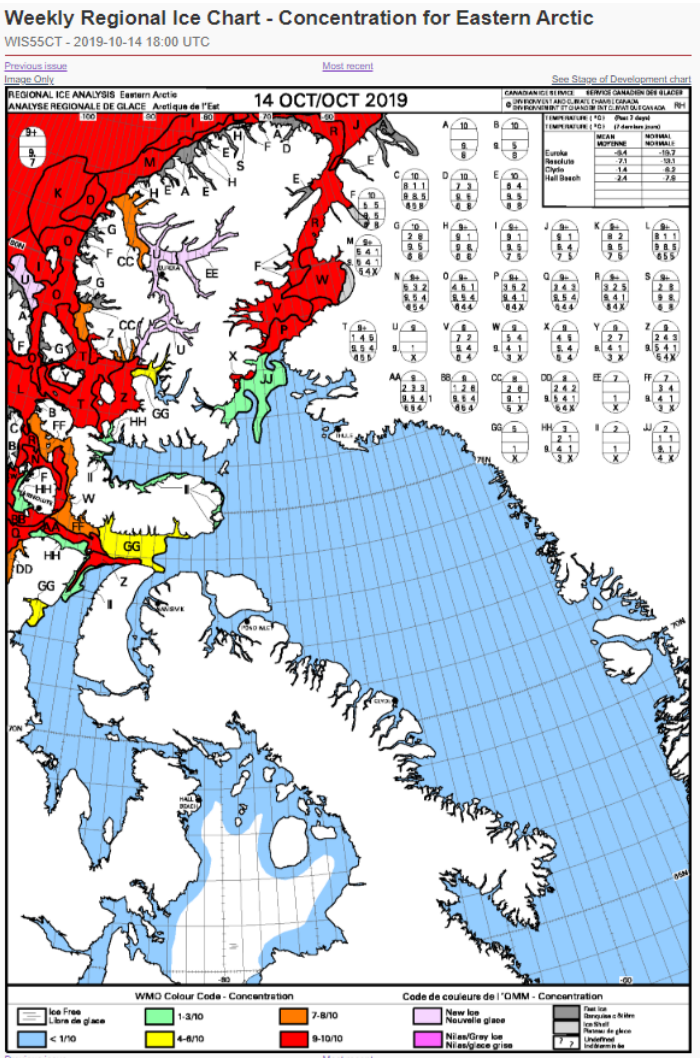


https://www.nauticalcharts.noaa.gov/updates/the-world-of-s-100-updated-framework-of-maritime-data-standards-to-be-released-in-2018/

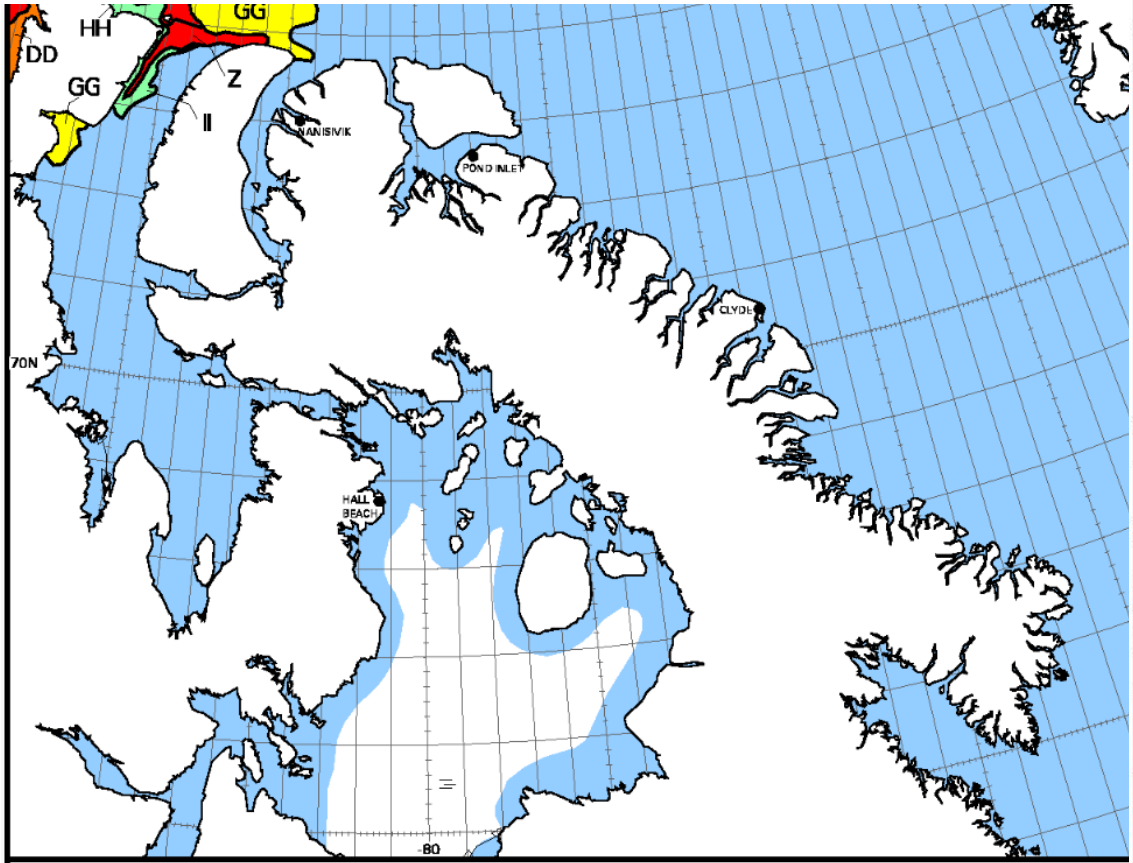
Canada Ice Services

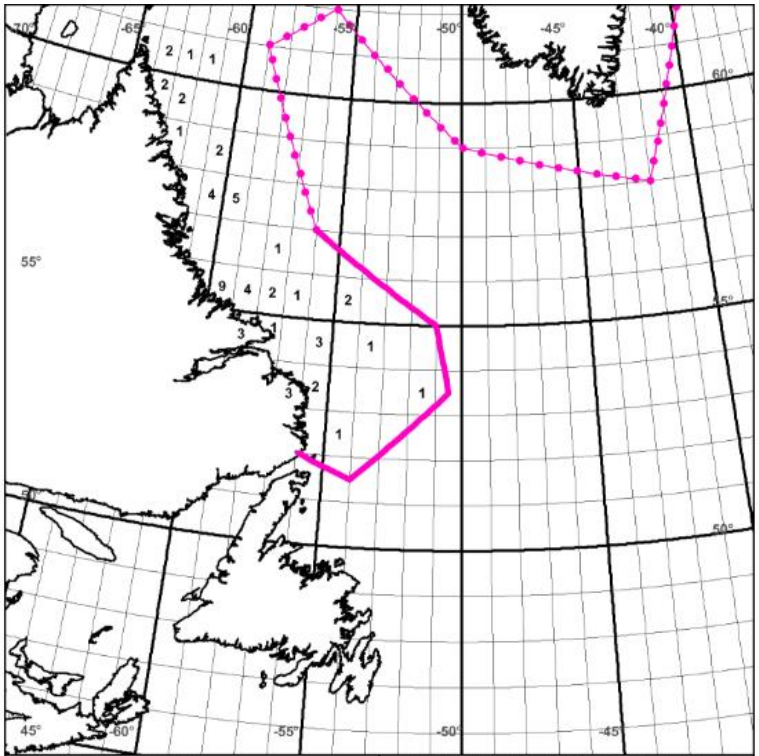
Daily ice charts
Regional ice charts
Departure from normal concentration charts
Image analysis charts
Aircraft ice charts
Iceberg charts
St. Lawrence River observed ice charts





Canada Ice Services – Iceberg Free Zones





NORTH AMERICAN ICE SERVICE
SERVICE DES GLACES DE L'AMÉRIQUE DU NORD

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ENVIRONMENT AND CLIMATE CHANGE CANADA
ENVIRONNEMENT ET CHANGEMENT CLIMATIQUE CANADA

ICEBERG ANALYSIS / ANALYSE D'ICEBERGS
FOR /POUR 0000 UTC

18 OCT / OCT 2019

ICEBERG LIMIT / LIMITE DES ICEBERGS

ESTIMATED ICEBERG LIMIT
LIMITE DES ICEBERGS ESTIMEE

SEA ICE LIMIT / LIMITE DES GLACES

ICEBERGS PER DEGREE SQUARE
ICEBERGS PAR DEGRE CARRE

RADAR TARGET OUTSIDE ICEBERG LIMIT
CIBLE RADAR A L'EXTERIEUR DE LA LIMITE DES ICEBERGS

Most recent reconnaissance :
Southern Limit Iceberg Flight 09OCT2019.
La reconnaissance la plus récente :
Vol Iceberg Limite Sud 09OCT2019.

WMO Colour Code - Concentration

Code de couleurs de l 'OMM - Concentra

Ice Free
Libre de glace

< 1/10

1-3/10

4-6/10

7-8/10

9-10/10

New Ice
Nouvelle glace

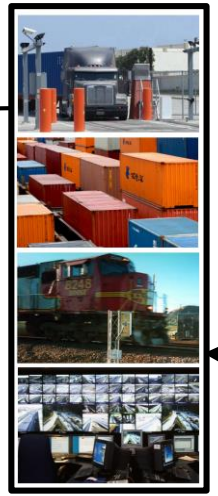
Nilas/Grey Ice
Nilas/glace grise

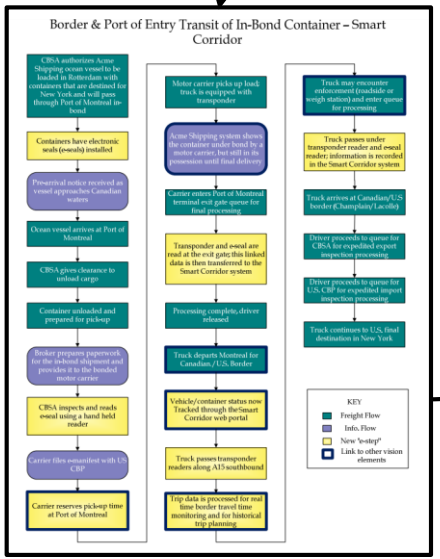
Ice Shelf
Plateau de glace

Undefined
Indéterminée

Connecting Canada to International Maritime Shipping Initiatives

Example Testbed Activity: Integrating the Sea Traffic Management (STM) and Canadian Services using the Canadian Intelligent Transportation System (ITS) Reference Architecture.





TARGET APPLICATIONS

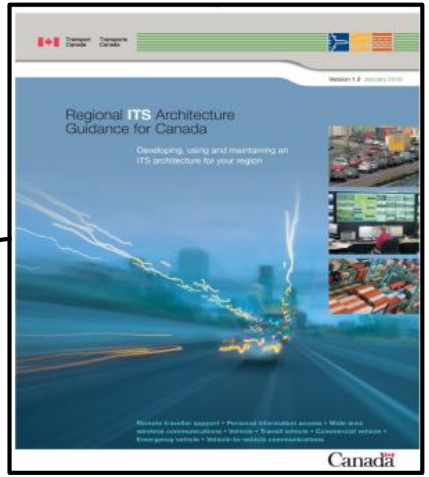
Operational Needs

User Views

Architecture & Services Packages

Technology Validation Scenarios

Operational Scenarios



STM
SEA TRAFFIC MANAGEMENT

Canada

Testbed Integration Environment

- An environment built using an integration platform and immersive visualization system ideal for implementing distributed service-oriented architectures.
- Plug & play integration of standard video outputs and http streams (e.g. CCTV, web applications)
- Support to develop streamable applications using publicly available simulation and visualization engines or customized virtual integration environment.
- Can support stand-alone validation activities involving individual operators or small teams of networked operations scenarios across multiple sites.

Reconfigurable Operations Centre Testbed Summary

- A Reconfigurable Operations Centre Testbed can satisfy requirements for technical validation of key technologies for future MASS operations.
- Testbed can be used for operational validation of new concepts and procedures for remote operating centres and for the evolution of port operations centres and security operations centres.
- Testbed can be used to validate interoperability products required to connect Canadian federal, provincial, regional and international initiatives, including the Canadian ITS RA.
- The Imagine-4D Station IX Visualization System and Integration Platform has the features required for building a state-of-the-art Reconfigurable Operations Centre.

Backup slides

Smart Sensors

Surveillance Cameras & Object Recognition

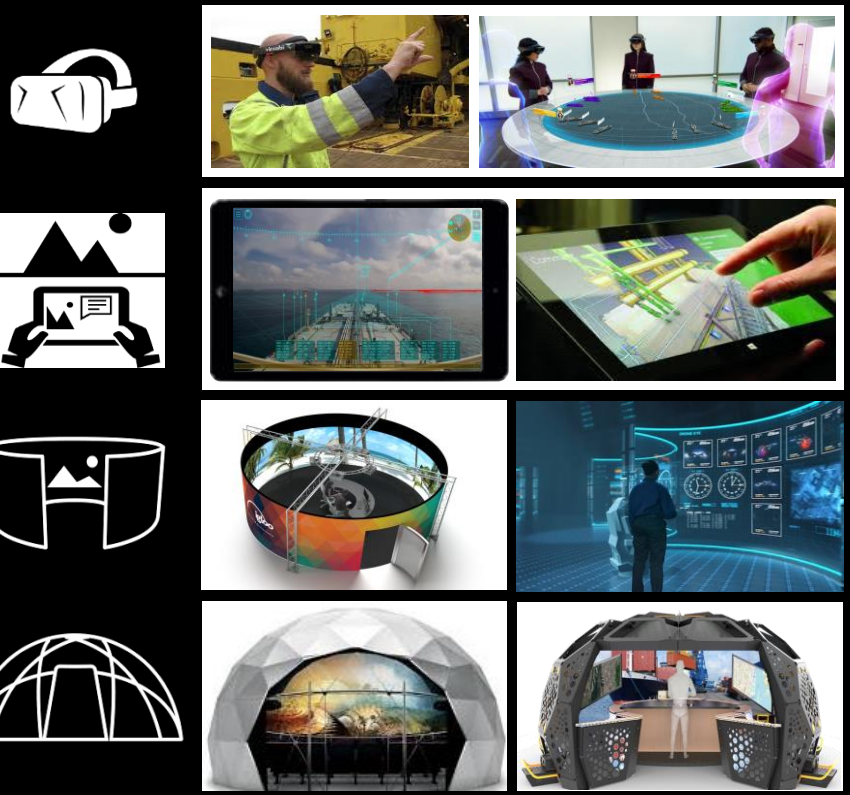
EXTRACTING INFORMATION FROM SURVEILLANCE CAMERAS

Live security camera Rejkjavik Iceland
https://www.insecam.org/en/view/802373/

Live security camera Rejkjavik Iceland
https://www.insecam.org/en/view/802374/

Virtual Reality (VR) & Augmented Reality (AR)

What's in it for Maritime Transport Industry ?



- Already commercially available today
- Ubiquitous, low-cost VR/AR Headsets
- Address many (but not all) needs
- Technology gaps still exist !

SOURCE: readwrite: Feb 6, 2019
https://readwrite.com/2019/02/06/6-ways-to-implement-ar-vr-into-your-business-today/

VR & AR for the AEC-FM Industry

Do VR Headsets really work ?

Yes, for a subset of applications… **but**

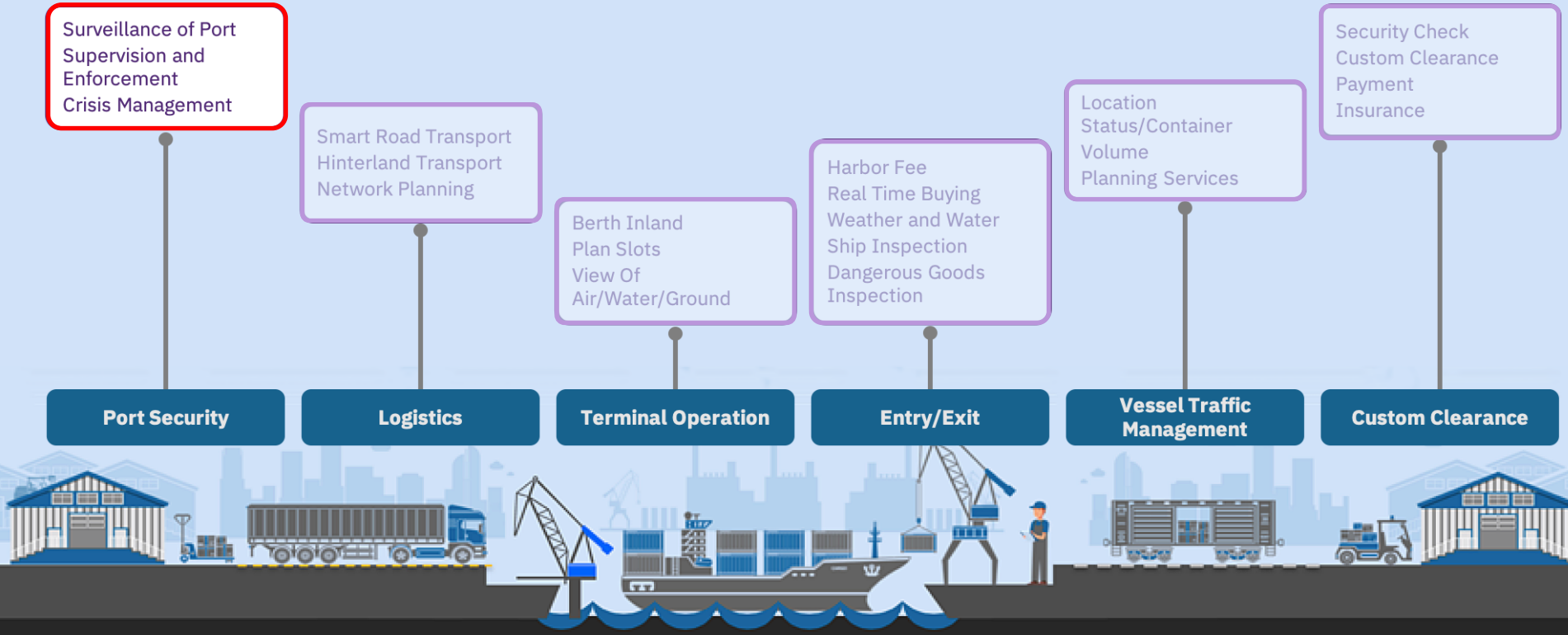
- Depth perception limitations
- Adverse side effects
  - Nausea, headaches, dizziness, fatigue, seizures…
- Limited duration of use < 30 min.

The makers of the most popular VR headsets, the Oculus Rift and HTC Vive, recommend taking "at least a 10 to 15 minute break every 30 minutes, even if you don't think you need it."

SOURCE: Business Insider, Mar 4, 2018, https://www.businessinsider.com/virtual-reality-vr-side-effects-2018-3

Application to Port Operations

Proposed Focus Area



Source: https://www.ibm.com/blogs/insights-on-business/government/the-cognitive-port-of-the-future/

Standardization & Interoperability

What does it mean to the Maritime Transport Industry ?

Organizational Interoperability :

The ability of groups or organizations to work together to achieve common goals.

System Interoperability :

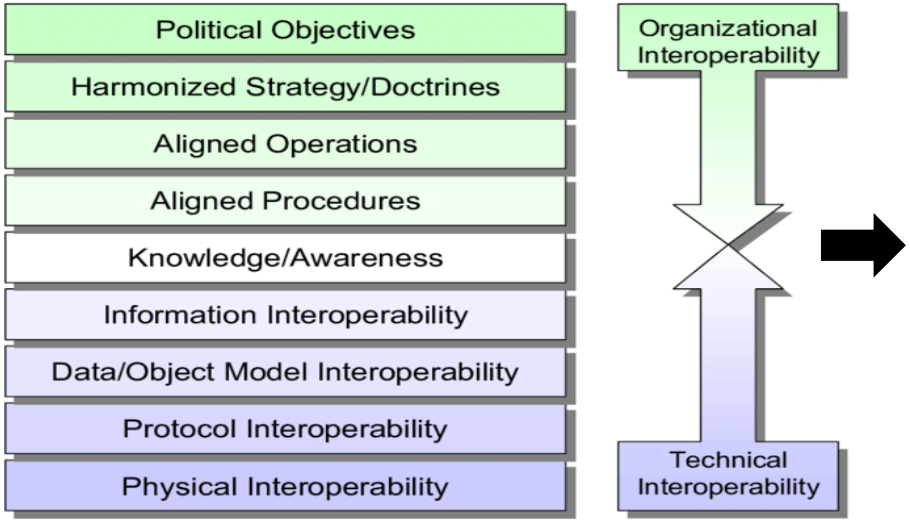
The ability of computer systems or software to exchange and make use of information.

Technical Interoperability :

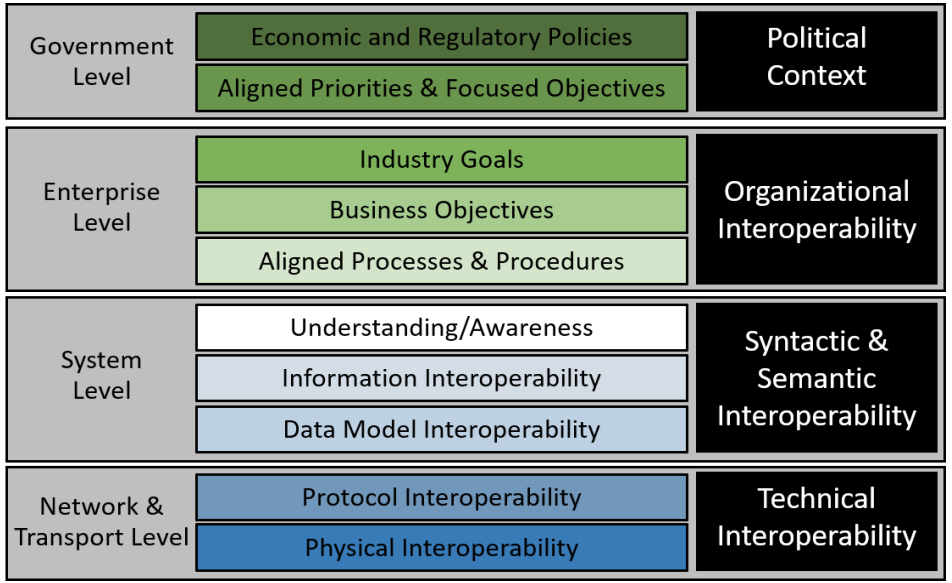
Ensures the interconnection of systems and data exchange via standardized transmission protocols and data formats.

Standardization & Interoperability

What does it mean to the Maritime Transport Industry ?



LEVELS OF COALITION INTEROPERABILITY (TOLK, 2003)



LEVELS OF INTEROPERABILITY (HEFFNER, 2019)

STANDARDIZATION IS A MEANS TO ACHIEVE INTEROPERABILITY

Automation, AI & Standardization

What does it mean to the Maritime Transport Industry ?

Automated Information	Automated, secure information processing pipelines are required.
Machine Learning	Machine Learning will be essential to building these pipelines.
Deep Learning	Deep Learning can be used for threat/anomaly detection and object detection/classification/identification.
Standards (IMO, ISO)	Both an enabler and an obstacle to achieving automation. Standards need to part of an interoperability strategy.
Interoperability	A journey, not a destination. End goal is organizational interoperability among stakeholders for safe and cost-effective MTI operations.

REQUIRES TESTING AND VALIDATION THROUGH EXPERIMENTATION