



Australian Government

Australian Maritime Safety Authority

International developments in e-Navigation

WWNWS SC 8

Norway, 12-16 September 2016

Mahesh Alimchandani
Australian Maritime Safety Authority

Origins - submission to IMO

Seven IMO Member States - to the Maritime Safety Committee in May 2006

IMO to develop (by 2008):

- ✓ a strategic vision to use **existing and new navigational tools** in a holistic manner
- ✓ an overarching system ...to provide a greater level of safety & incident prevention...reduce navigation-related accidents

Concern: *Uncoordinated introduction of new technology will result in a **lack of standardization on board ...and an increased level of complexity.***

From individual equipment & systems





To this

The case for e-Navigation

- ✓ Majority of collisions and groundings are caused by human error
(costs to industry and administrations are rising each year)
- ✓ Despite BRM training, decision-making for navigation and collision avoidance being made in isolation (partly due to reduced manning)
- ✓ **A check on decision-making can improve human reliability by a factor of 10**
 - Well designed on-board systems
 - Close cooperation with systems ashore

In 2008, IMO

✓ Approved a [strategy for e-Navigation](#)

✓ The strategy has:

- Vision

1. On board (standard user interfaces, alert & alarm management etc.)
2. Ashore (more effective Vessel Traffic Management)
3. Communications (seamless information exchange: ship-ship & ship-shore)

- 11 core objectives (safe navigation, data exchange, global coverage etc.)

A plan to implement the strategy....and a definition ...



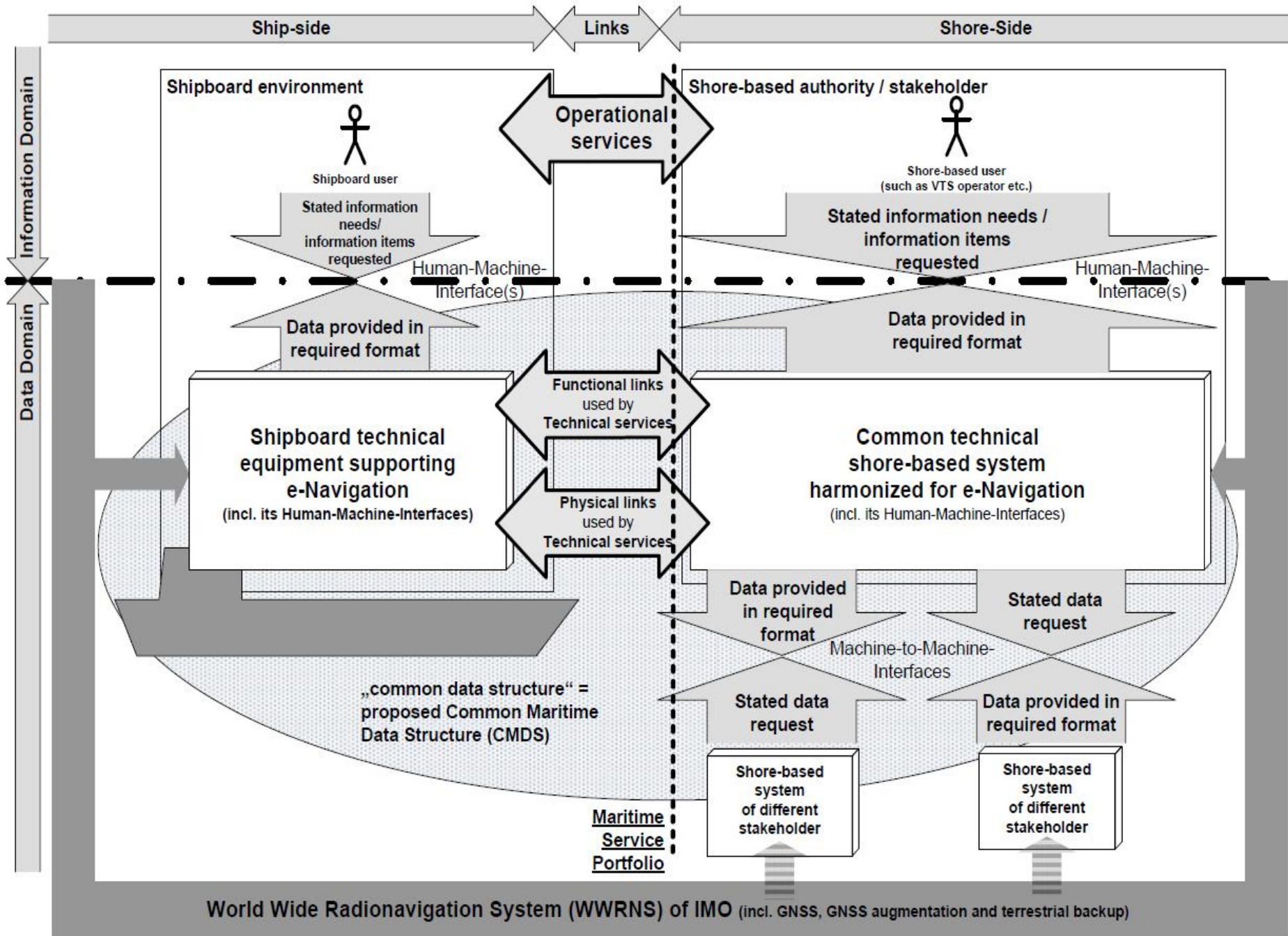
IMO definition

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.

IMO, July 2007

What is e-Navigation ?

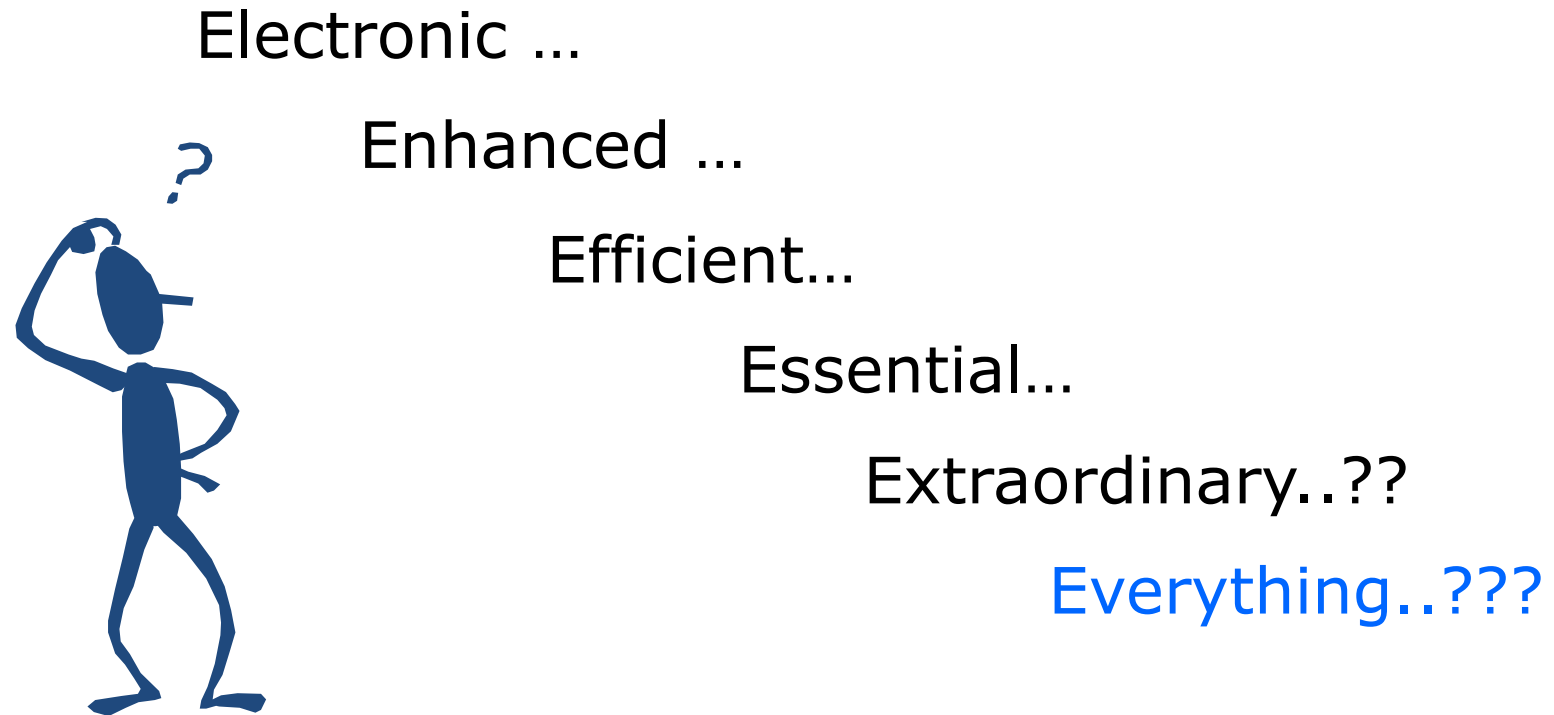
1. The harmonised exchange and presentation of navigational information in electronic formats.
2. Improved and harmonized **data exchange** and **communications**.
3. Creation of a 'wide area navigation team' with the OOW and VTS Operator sharing tactical and planning information.
4. Improved design of navigational equipment.



Note: There are operational and technical interactions between different shipboard environments. These are not shown for simplicity's sake in this figure.

e-Navigation...

What does the 'e' stand for ??



International agreement - no need to define 'e' !

Modernisation of navigation systems

1 Adding modules on harmonisation of bridge design and display of information to the INS Performance Standard

- ✓ Links to work by Australia, Korea and international organizations on the standardised (or S) Mode of operation of equipment
- ✓ Completion due by 2017

2 Harmonized display of navigation information received via communication equipment

- ✓ Focus on Maritime Safety Information (MSI)
- ✓ Completion due 2017

Modernisation of navigation systems

3 Revised guidelines on ship reporting systems

- ✓ Norway & others - use of a test bed to inform the revision
- ✓ Korea - proposed amendments to include automation, data harmonisation, security and communications framework
- ✓ Completion due 2017

4 Guidance on the Standardized (or S) Mode of operation of navigation equipment

- ✓ Australia leading an informal group
- ✓ Due for completion in 2019

Modernisation of navigation systems

5 Built In Integrity Testing (BIIT)

- ✓ Users – need indication of quality and integrity of data
- ✓ Task is to update IEC test standards
- ✓ Completion due 2019

6 Resolution on Maritime Service Portfolios

- ✓ Define and harmonize the format and structure of MSPs.
- ✓ IALA & IHO leading this work. Completion due 2019.

Number	Services	Responsible Service Provider
MSP 1	VTs Information Service (IS)	National Competent VTS Authority
MSP 2	Navigational Assistance Service (NAS)	National Competent VTS Authority/Coastal or Port Authority
MSP 3	Traffic Organization Service (TOS)	National Competent VTS Authority/Coastal or Port Authority
MSP 4	Local Port Service (LPS)	Local Port/Harbour Operator
MSP 5	Maritime Safety Information Service (MSI)	National Competent Authority
MSP 6	Pilotage Service	Pilot Authority/ Pilot Organization
MSP 7	Tug Service	Tug Authority
MSP 8	Vessel Shore Reporting	National Competent Authority, Shipowner/
		Operator/Master
MSP 9	Tele Medical Assistance Service (TMAS)	National health organization/dedicated health organization
MSP 10	Maritime Assistance Service (MAS)	Coastal/Port Authority/Organization
MSP 11	Nautical Chart Service	National Hydrographic Authority/ Organization
MSP 12	Nautical Publications Service	National Hydrographic Authority/
MSP 13	Ice Navigation Service	National Competent Authority Organization
MSP 14	Meteorological information service	National Meteorological Authority/WMO/ Public Institutions
MSP 15	Real time hydrographic and environmental information Service	National Hydrographic and Meteorological Authorities
MSP 16	Search and Rescue Service	SAR Authorities



IALA E-Navigation Committee

Shore aspects of e-navigation

- **Positioning, navigation and timing**
Guidance on SBAS, high accuracy positioning and DGPS in R Mode
- **Communications**
Newly-approved VDES
- **Maritime Services Portfolios**
- **Harmonisation (S-100)**
- **Implementation & testbeds**

Bridge design principles

- ✓ SOLAS Regulation V/15 – decisions shall aim to:
 - Navigate ship safely
 - Promote BRM and easy access to essential information
 - Standardised symbols
 - Minimise extra work, distractions and risk of human error
- ✓ No actionable responsibility associated with bridge design-related issues
- ✓ Linking IMO guidance to Regulation V/15 – a non-regulatory approach
- ✓ Role of insurers - risk of ships not compliant with V/15



DAILY NEWS

**WHAT'S
NEXT?**

Future....

“ It is difficult to make predictions, especially about the future ”

Neils Bohr, Danish physicist

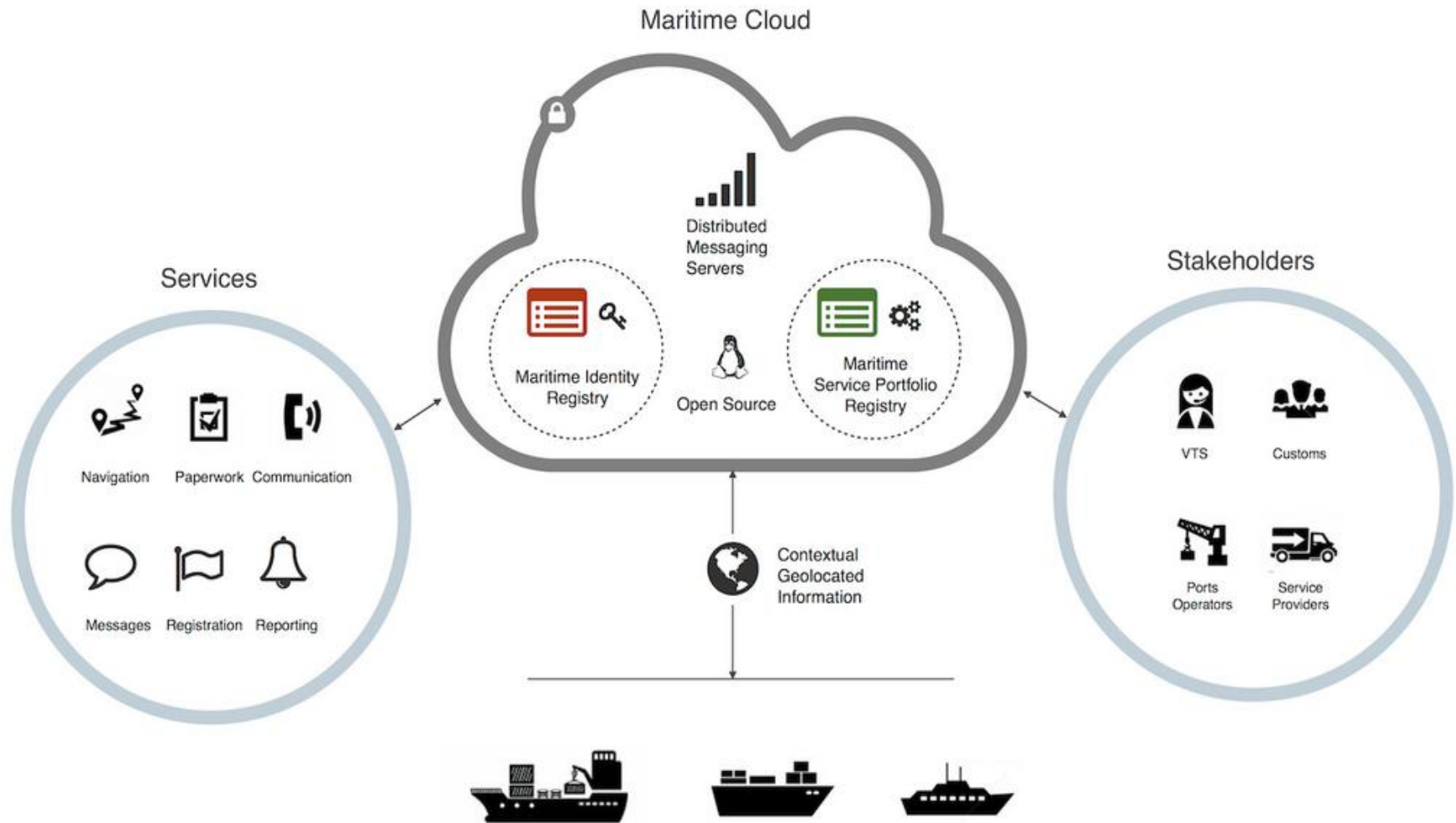


The Maritime Cloud



- ✓ A proposed communication framework for efficient, secure and reliable electronic information exchange between authorised stakeholders
- ✓ Standards, protocols, infrastructure and governance
- ✓ NOT a storage cloud ..nor is it cloud computing
- ✓ Introduced in the North Sea Region for the ACCSEAS project (*which was completed in 2015*)

Acknowledgement: Danish Maritime Authority



Development influenced by the System Wide Information Management (SWIM) concept

(SWIM - United States' Federal Aviation Administration initiative for better sharing of Air Traffic Management system information)

Maritime Resource Name



Maritime ‘actors’ must have a unique maritime ID with attributes such as role, nationality, etc.

- ✓ Concept builds on the URN (Universal Resource Name) adopted by the IETF (Internet Engineering Task Force)

An example: ***urn:mrn:iala:aton:us:1234.5***

- ✓ Registered with the Internet Assigned Numbers Authority (IANA)
- ✓ Two ongoing European projects – EfficienSea 2 and Sea Traffic Management - aim to develop the concept through testbeds.

VHF Data Exchange System (VDES)

The problem ...

- ✓ The success of AIS. Proliferation of its many uses.
- ✓ Significant loading on VHF Data Link in busy areas.
 - Gulf of Mexico (64%), Japan and Korea (40% each)*
 - No loading concerns in Australia !*
- ✓ Existing AIS system will not cope with future requirements for data exchange
- ✓ e-Navigation will need more capacity for data exchange

VHF Data Exchange System (VDES)

VDES concept addresses the need for additional capacity for digital data exchange:

- ✓ protects the original function of AIS (collision avoidance, VTS tool & information transfer)
- ✓ provides data exchange capability with globally interoperability and availability



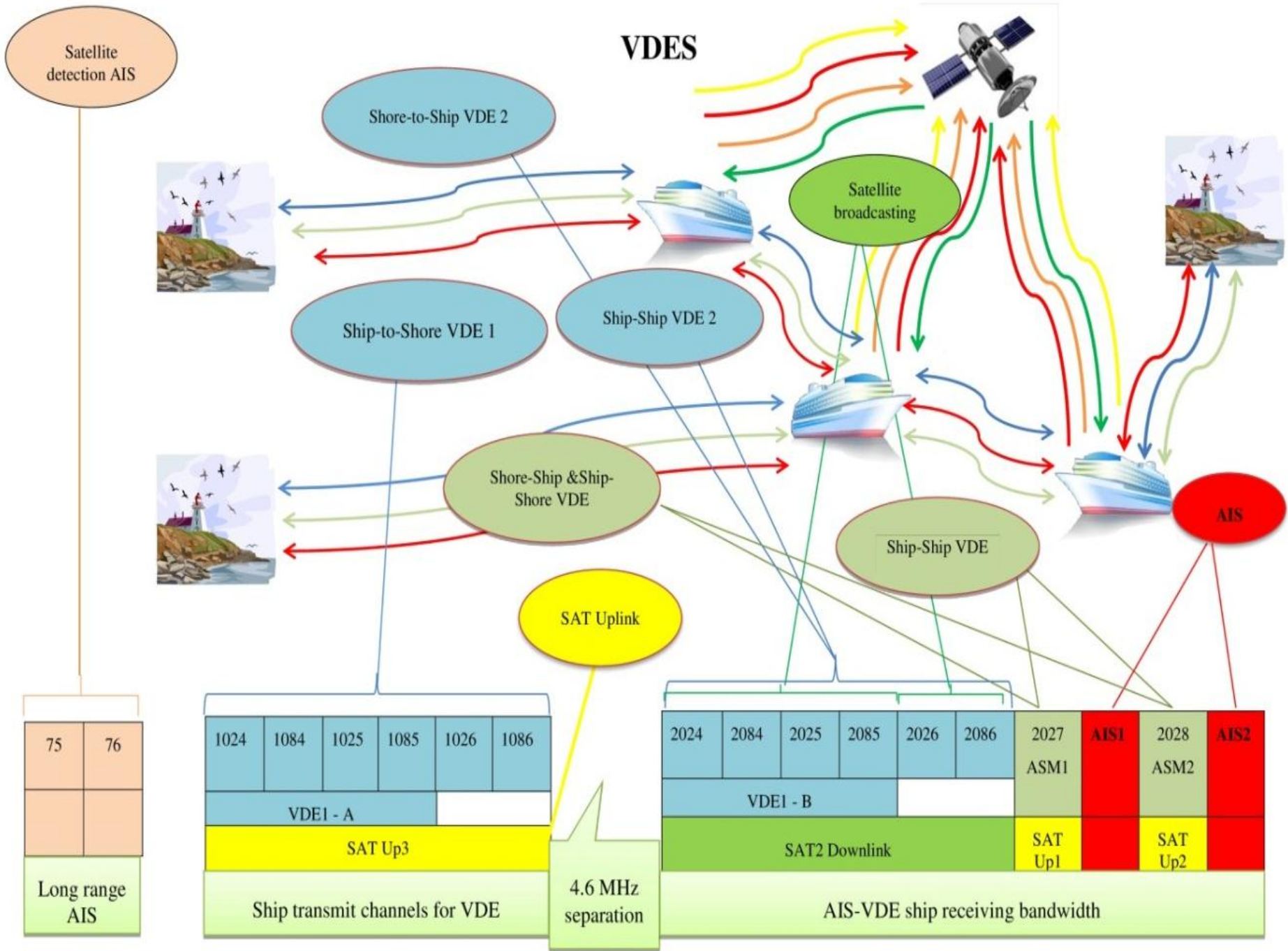
VHF Data Exchange System (VDES)

World Radio Conference 2015 (WRC-15):

- ✓ AIS 1 and 2 to remain as is – no change
- ✓ From 1 Jan 2017, six VHF channels (24, 84, 25, 85 and 26, 86) are to be made available for use of VDES

Promotes higher reliability of message reception and provides the additional capacity

- ✓ From 2019, can merge the first four channels to provide 'broadband capacity at sea'
- ✓ Satellite transmission on VHF not agreed (at this stage)



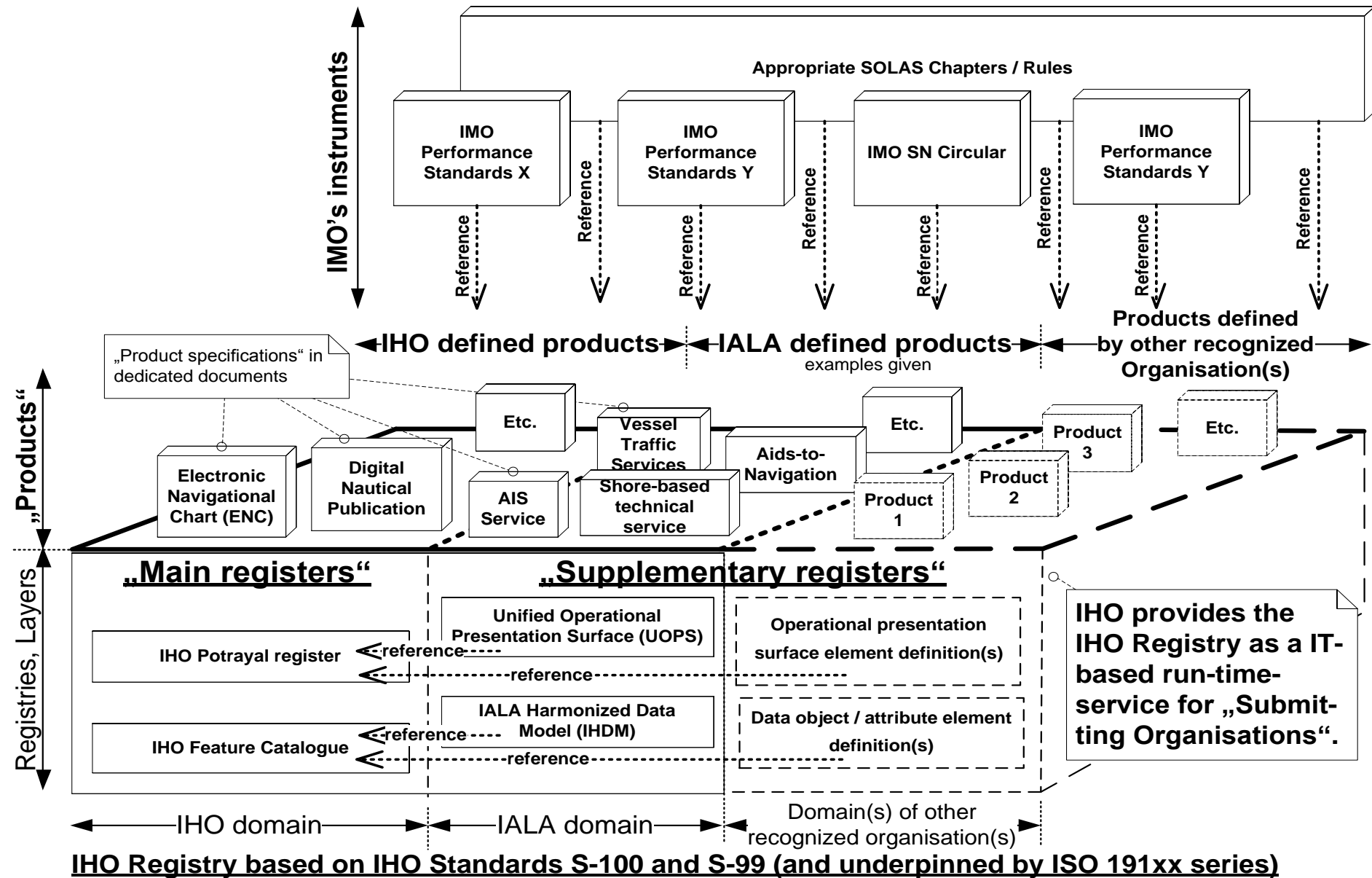
VDES – what's next ?

From ITU:

- ✓ Participate in field trials
- ✓ Provide for VDES terrestrial component in Australian coast networks (work with ACMA)
- ✓ Develop operational and technical standards (IALA, IEC, IMO and ITU)
 - IALA – developing suite of guidance documents
 - IMO – to develop performance standard

IHO's S-100 Geospatial Information Registry

- ✓ Published as an international standard in 2010
- ✓ ISO-conformant registry
- ✓ Has many registers – for different user communities
- ✓ 2011: IMO agreement to use S-100 for e-navigation data exchange
- ✓ IALA & others (e.g. WMO) developing 'product specifications' (data for technical and operational services)
- ✓ Supermarket analogy



Note 1: The IHO Registry (based on S-100/S-99) is capable of supporting additional recognized organisations, other than and in addition to IHO and IALA, such as IEC, ISO, etc. This is indicated by „recognised organisation(s)“.

Note 2: The „references“ introduced between the registries and layers of the „main register“ and the „supplementary registers“ are provided as examples, only, for simplicity's sake. There could be, by default, „references“ between any registry of any international organisation, provided they are of the same kind (i. e. features/attributes or portrayal elements).

S-100 Based Product Specifications
Spécifications de produits basées sur la S-100

No / N°	Title / Titre	Status / Etat	Edition (English version) (version anglaise)	Business Case Use Case <i>Justificatif</i> <i>Etude de cas</i>
Product Specifications being developed by the IHO (Numbers S-101 to 199) Spécifications de produits élaborées par l'OHI (Numéros S-101 à 199)				
S-101	Electronic Navigational Chart (ENC) / Cartes électroniques de navigation	Under Development En cours d'élaboration	S-101 Information Page	Roadmap Impact Study
S-102	Bathymetric Surface / Surface bathymétrique	Published / Publié	Ed 1.0.0 (April 2012)	Impact Study
S-103	Sub-surface Navigation / Navigation sous la surface	Planned / Prévu		
S-104	Tidal Information for Surface Navigation / Information de marée pour la navigation de surface	Under Development En cours d'élaboration		
S-111	Surface Currents / Courants de surface	Under Development En cours d'élaboration	Working Draft 1.0	Impact Study
S-112	Dynamic Water Level Data / Données dynamiques de hauteur d'eau	Under Development En cours d'élaboration	Working Draft 0.0.0	
S-121	Maritime Limits and Boundaries / Limites et frontières maritimes	Under Development En cours d'élaboration		Impact Study
S-122	Marine Protected Areas / Aires marines protégées	Under Development En cours d'élaboration	S-122 Information Page	NIPWG Wiki
S-123	Radio Services / Services radio	Under Development En cours d'élaboration		
S-124	Navigational Warnings / Avertissements de navigation	Under Development En cours d'élaboration		Scenarios
S-125	Navigational Services / Services de navigation	Under Development En cours d'élaboration		
S-126	Physical Environment / Environnement physique	Under Development En cours d'élaboration		
S-127	Traffic Management / Gestion du trafic	Under Development En cours d'élaboration		
S-128	Catalogues of Nautical Products / Catalogues de produits nautiques	Planned / Prévu		
S-1xx	Marine Services / Services maritimes	Planned / Prévu		
S-1xx	Digital Mariner Routing Guide / Guide numérique du navigateur sur l'organisation du trafic	Planned / Prévu		
S-1xx	Harbour Infrastructure / Infrastructure portuaire	Planned / Prévu		
S-1xx	(Social/Political) / (Social / Politique)	Planned / Prévu		

Product Specifications being developed by the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) (Numbers S-201 to 299) <i>Spécifications de produits élaborées par l'Association internationale de signalisation maritime (AISM) (Numéros S-201 à 299)</i>				
S-201	Aid to Navigation Information / <i>Information sur les aides à la navigation</i>	Under development <i>En cours d'élaboration</i>		
S-210	Inter-VTS Exchange Format / <i>Format d'échange inter-STM</i>	Under development <i>En cours d'élaboration</i>		
S-230	Application Specific Messages / <i>Messages d'applications spécifiques</i>	Planned / <i>Prévu</i>		
S-240	DGNSS Station Almanac / <i>Almanach de station DGNSS</i>	Under development <i>En cours d'élaboration</i>		
S-245	eLoran ASF Data / <i>Données FAS eLoran</i>	Under development <i>En cours d'élaboration</i>		
S-246	eLoran Station Almanac / <i>Almanach de station eLoran</i>	Planned / <i>Prévu</i>		
Product Specifications being developed by the Intergovernmental Oceanographic Commission (IOC) (Numbers S-301 to 399) <i>Spécifications de produits élaborées par la Commission océanographique intergouvernementale (COI) (Numéros S-301 à 399)</i>				
Product Specifications being developed by other Organizations (Numbers from S-401) <i>Spécifications de produits élaborées par d'autres organisations (Numéros à partir de S-401)</i>				
S-401	Inland ENC (Inland ENC Harmonization Group [IEHG]) / <i>ENC intérieures (Groupe d'harmonisation des ENC intérieures [IEHG])insère</i>	Under Development <i>En cours d'élaboration</i>		
S-411	Ice Information (WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology [JCOMM]) / <i>Information sur la glace (Commission technique mixte OMM-COI pour l'océanographie et la météorologie marine [JCOMM])</i>	Under Development <i>En cours d'élaboration</i>	Draft Ed 1.1.0 (June 2014)	External Link
S-412	Weather Overlay (JCOMM) / <i>Couche d'information météorologique (JCOMM)</i>	Under Development <i>En cours d'élaboration</i>		External Link
	Last update / à jour : 09/03/2016			

The quest for resilient PNT

A system to complement GNSS:

- ✓ Independent and dissimilar (low frequency, high power)
- ✓ Similar levels of performance
- ✓ Support all phases of navigation – [precision for berthing](#)

eLORAN - led by Trinity House, UK.

- ✓ No progress (so far) to implement by any nation
- ✓ *Europe ceased transmissions in 2015. US reviewing.*

‘Third way’: Ship-sensed position
(e.g. ePelorus, eRacons)

The Ranging (or R) Mode

- ✓ Terrestrial backup system, based on ranging signals transmitted from MF radio beacons (DGPS) and AIS base stations
- ✓ Modifications to existing infrastructure can create a terrestrial backup
- ✓ Concept proved in 2015
- ✓ Development work in NW Europe and IALA



Pilotage matters ..

Obvious

- ✓ Local knowledge
- ✓ Ship handling expertise
- ✓ Expert navigator
- ✓ Part of the bridge team

Not-so-obvious

- ✓ 'Keeper' of the port - key role in supply chain efficiency
- ✓ Deal with a great variety of ships, wheel house designs and bridge teams (*know what works and what does not*)



e-Navigation and pilotage

- ✓ Pilots (via peak bodies) can make significant contributions to:
 - Design of navigational systems and bridge layout (e.g. S-Mode)
 - S-100 product specifications and Maritime Service Portfolios
 - UKCM chart overlay S-100 product specification
- ✓ Pilots can expect:
 - More user-friendly systems
 - Better sharing of navigational information between ships and ship & shore
 - Improved situational awareness and incident prevention
 - Somewhat reduced workload

Pilots (via IMPA) have maintained

1. Predominance of the human element

- ✓ mariners - the most crucial element in safe navigation
- ✓ the expert human element **on the bridge** must be at the center of decision-making

2. Meet the needs of the bridge team and the pilot

- ✓ e-Navigation must – first and foremost – give priority to responding to the needs of the bridge team and the pilot. Reduce information overload.

3. Looking out of the window remains vital

- ✓ e-Navigation data must be complemented and validated through all the other traditional methods available to pilots

Risks

- ✓ Some governments are not waiting for IMO developments. Regional, bespoke solutions being developed:
 - Non-standard displays and data transfer formats - lack of harmonisation. Increases complexity.
 - Detrimental to safety
 - Added costs to shipowners
- ✓ Parallel training of seafarers
- ✓ Extra expense to shipowners in the short term
- ✓ R&D costs for new products and reduced sales of existing equipment
- ✓ Increased automation ...with resultant reduction in human engagement

The next iteration...

- ✓ Success of “Phase 1” will be pivotal for success of concept
- ✓ Prevent e-Navigation development fatigue:
 - More user needs surveys, gap analyses, risk and cost benefit analyses - all led by IMO ?
- ✓ The shipping industry is (understandably) somewhat sceptical
- ✓ Avoid:
 - being driven by vendors / marine electronics industry
 - the prescriptive ECDIS experience
- ✓ Development outside the IMO processes ?

**‘An invasion of armies
can be resisted, but not
an idea whose time has
come’**

***Victor Hugo, French poet
and novelist***



A serene sunset scene over a calm body of water. The sun is a bright, glowing orb on the left side of the horizon, casting a long, shimmering reflection across the water's surface. The sky is a mix of soft blues, oranges, and yellows, with wispy clouds catching the low light. In the distance, a large ship is visible on the horizon, moving away from the viewer and leaving a white wake behind it. The overall mood is peaceful and contemplative.

Thank you for your attention !

Mahesh Alimchandani
Head of Navigation, AMSA

Tel: + 61 2 6279 5927

E-mail: Mahesh.Alimchandani@amsa.gov.au