Workshop on Cybersecurity in Inland Navigation

River Information Services, e-Navigation ….

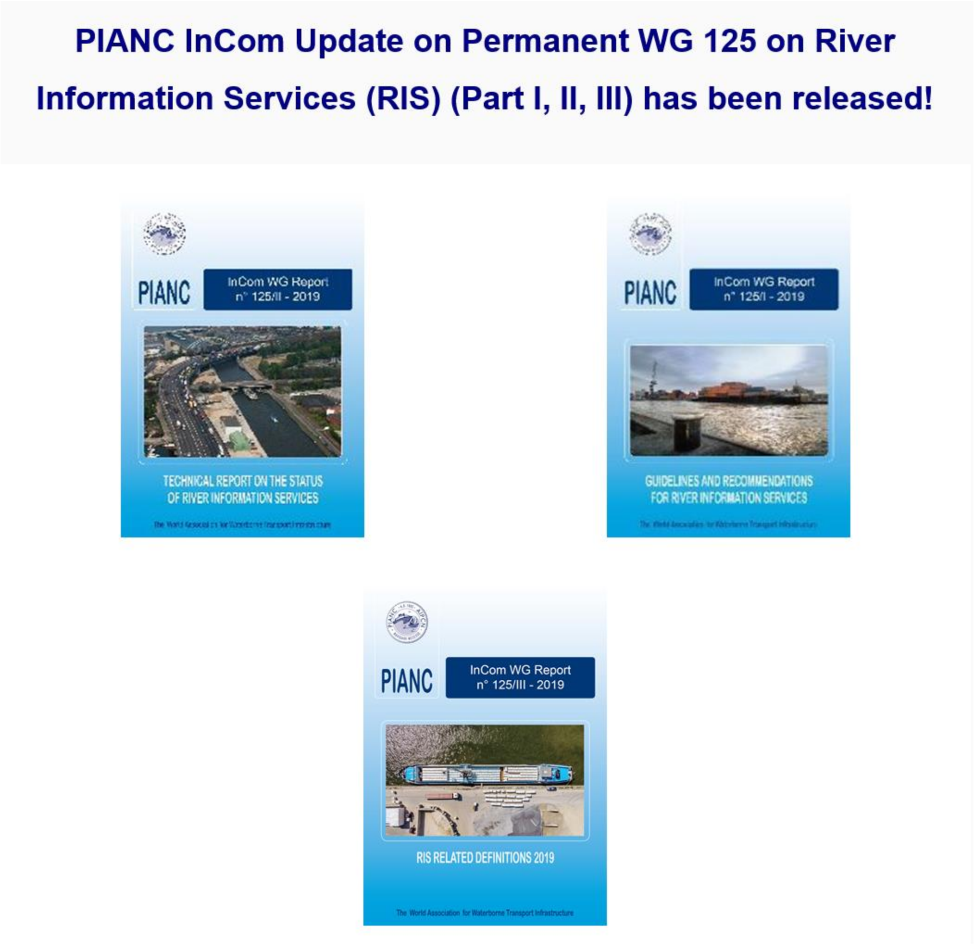
An overview of ICT in Inland Waterways vulnerable to Cyber Threats

Bonn – 05/09/2019

Overview

- Focus on RIS for the Inland Waterways
  - River Information Services (Operational Services)
  - RIS Key Technologies (Technical Services)
  - Reference Data
- A short introduction on Cyber…….
- Cyber Threats in Inland Waterways
- Mitigation measures

Guidelines and Recommendations for River Information Services (WG125) – 2019



PIANC InCom Update on Permanent WG 125 on River Information Services (RIS) (Part I, II, III) has been released!

PIANC

InCom WG Report n° 125/II - 2019

TECHNICAL REPORT ON THE STATUS OF RIVER INFORMATION SERVICES

The World Association for Waterborne Transport Infrastructure

PIANC

InCom WG Report n° 125/I - 2019

GUIDELINES AND RECOMMENDATIONS FOR RIVER INFORMATION SERVICES

The World Association for Waterborne Transport Infrastructure

PIANC

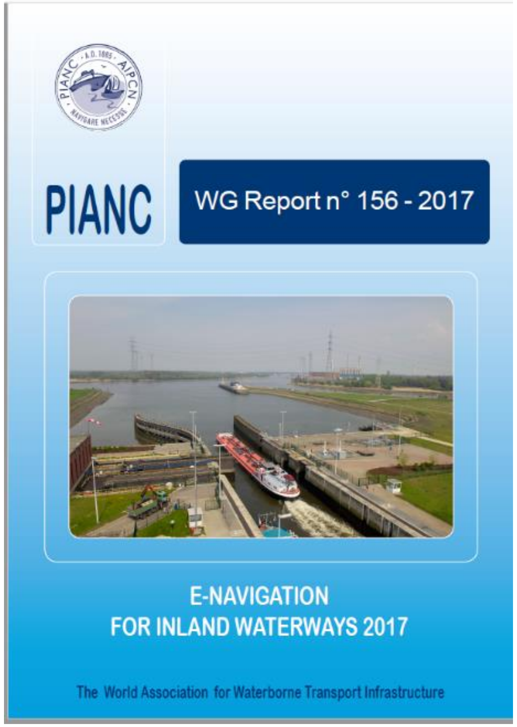
InCom WG Report n° 125/III - 2019

RIS RELATED DEFINITIONS 2019

The World Association for Waterborne Transport Infrastructure

e-Navigation for Inland Waterways (WG156)

- Provide a definition of e-Navigation for Inland Waterways
- Whether inland navigation could benefit from the developments in the maritime environment.
- In what way the required interaction between maritime transport and inland navigation in this context can be guaranteed to safeguard the required interoperability of future maritime and inland navigation systems.
- Identify opportunities for improving the safety, efficiency of transport, logistics and administrative processes.



PIANC

WG Report n° 156 - 2017

E-NAVIGATION
FOR INLAND WATERWAYS 2017

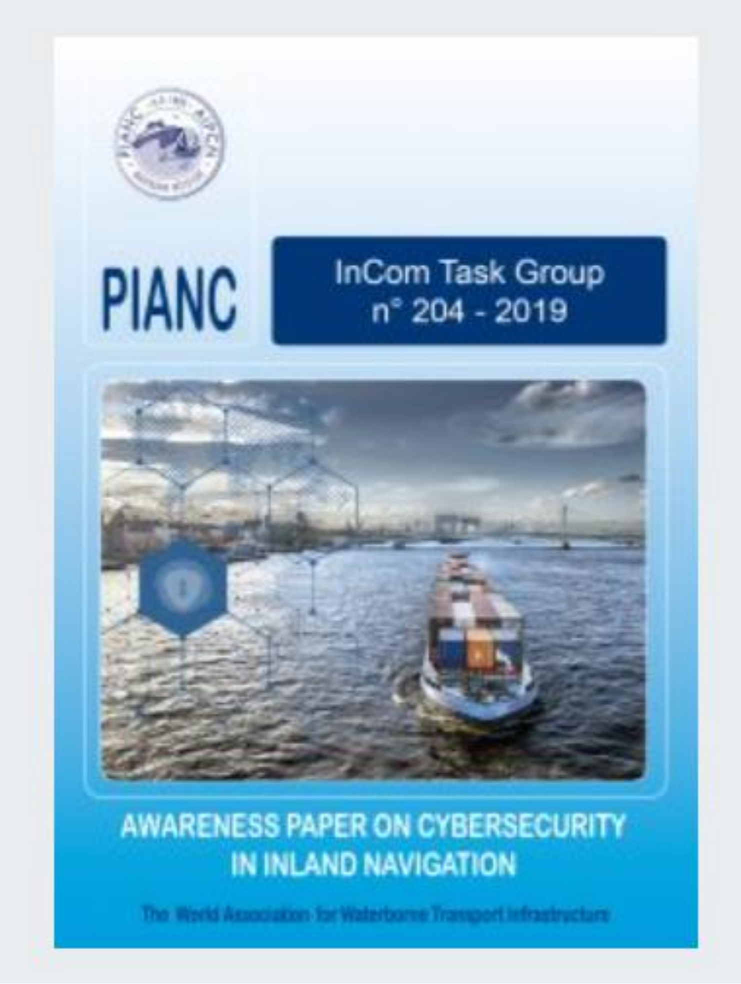
The World Association for Waterborne Transport Infrastructure

Goal of the Task Group 204

Raise awareness for cybersecurity in inland navigation among:

- the management of inland waterways,
- ports,
- shipping companies,
- skippers,
- ……..

which is due to a dramatically increased complexity of navigational and information systems for IWT based on ICT.



PIANC

InCom Task Group
n° 204 - 2019

AWARENESS PAPER ON CYBERSECURITY IN INLAND NAVIGATION

The World Association for Waterborne Transport Infrastructure

Definition River Information Services (RIS)

(PIANC WG125 Guidelines)

RIS means the *harmonised information services* to support *traffic and transport management* in inland navigation, including *interfaces to other transport modes*. RIS aims at contributing to a *safe* and *efficient* transport process and utilising the inland waterways to its fullest extent.

Digitalisation of
the Inland Waterway Transport (IWT)

River Information Services (RIS) – IWT Operational Services

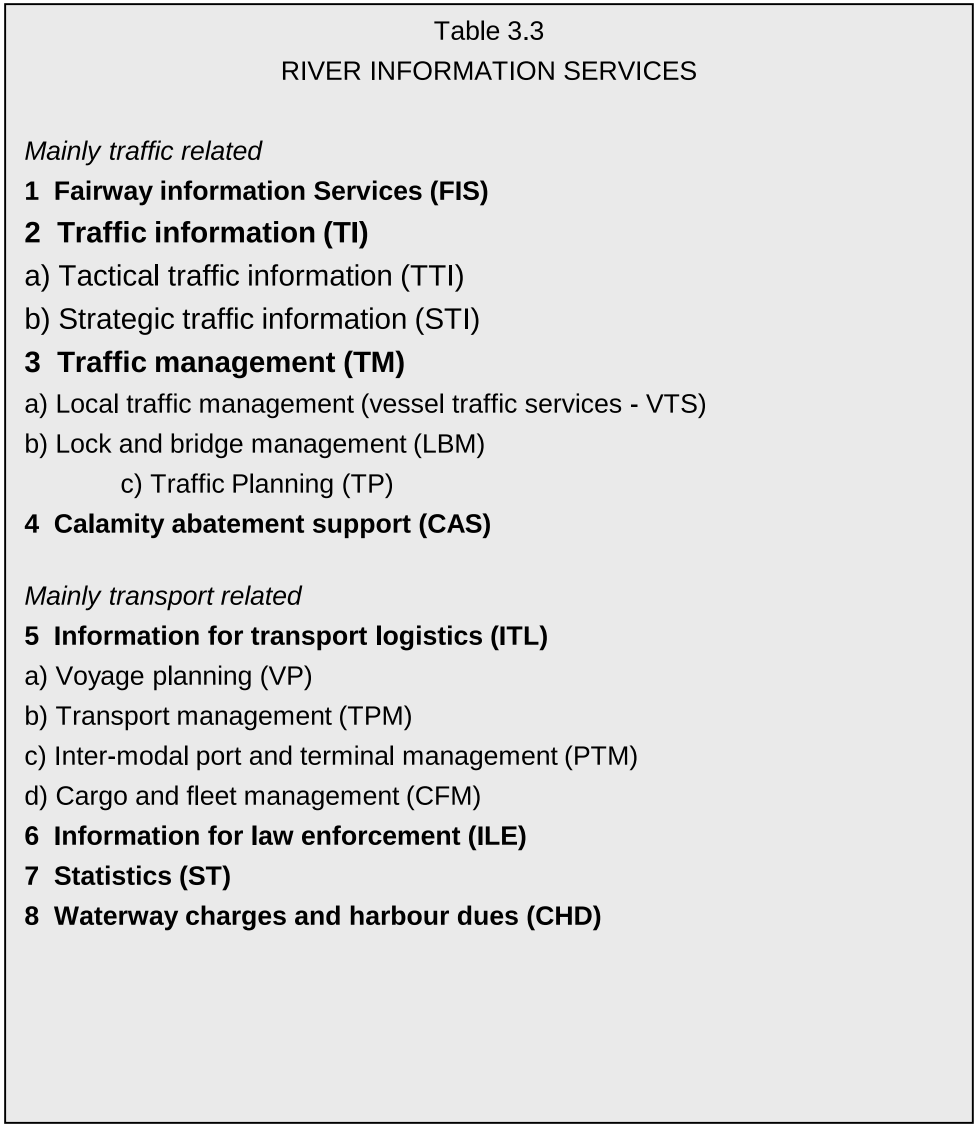


Table 3.3

RIVER INFORMATION SERVICES

Mainly traffic related

1 Fairway information Services (FIS)

2 Traffic information (TI)

a) Tactical traffic information (TTI)

b) Strategic traffic information (STI)

3 Traffic management (TM)

a) Local traffic management (vessel traffic services - VTS)

b) Lock and bridge management (LBM)

c) Traffic Planning (TP)

4 Calamity abatement support (CAS)

Mainly transport related

5 Information for transport logistics (ITL)

a) Voyage planning (VP)

b) Transport management (TPM)

c) Inter-modal port and terminal management (PTM)

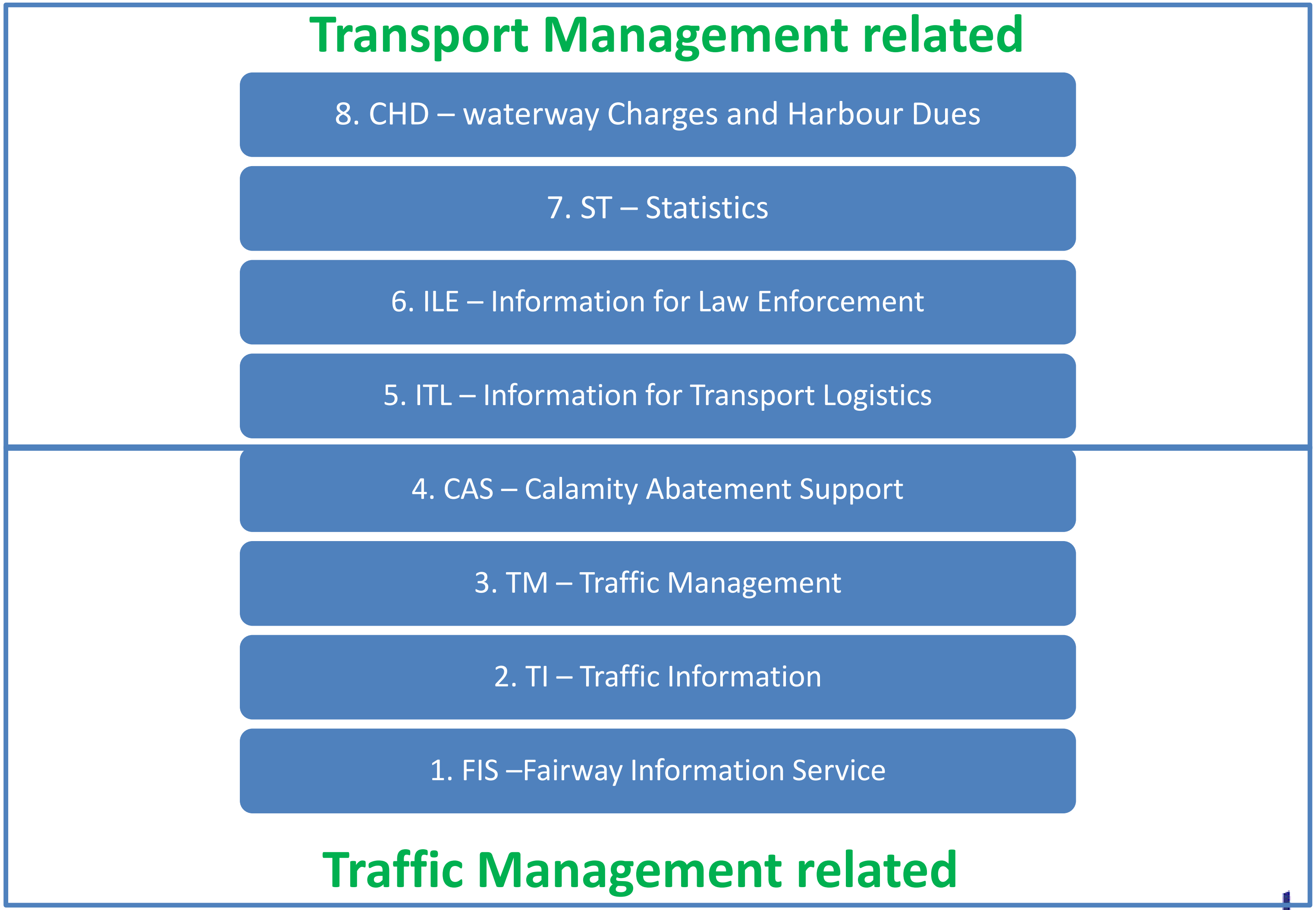
d) Cargo and fleet management (CFM)

6 Information for law enforcement (ILE)

7 Statistics (ST)

8 Waterway charges and harbour dues (CHD)

Structured approach of the implementation of RIS services



Transport Management related

8. CHD – waterway Charges and Harbour Dues

7. ST – Statistics

6. ILE – Information for Law Enforcement

5. ITL – Information for Transport Logistics

4. CAS – Calamity Abatement Support

3. TM – Traffic Management

2. TI – Traffic Information

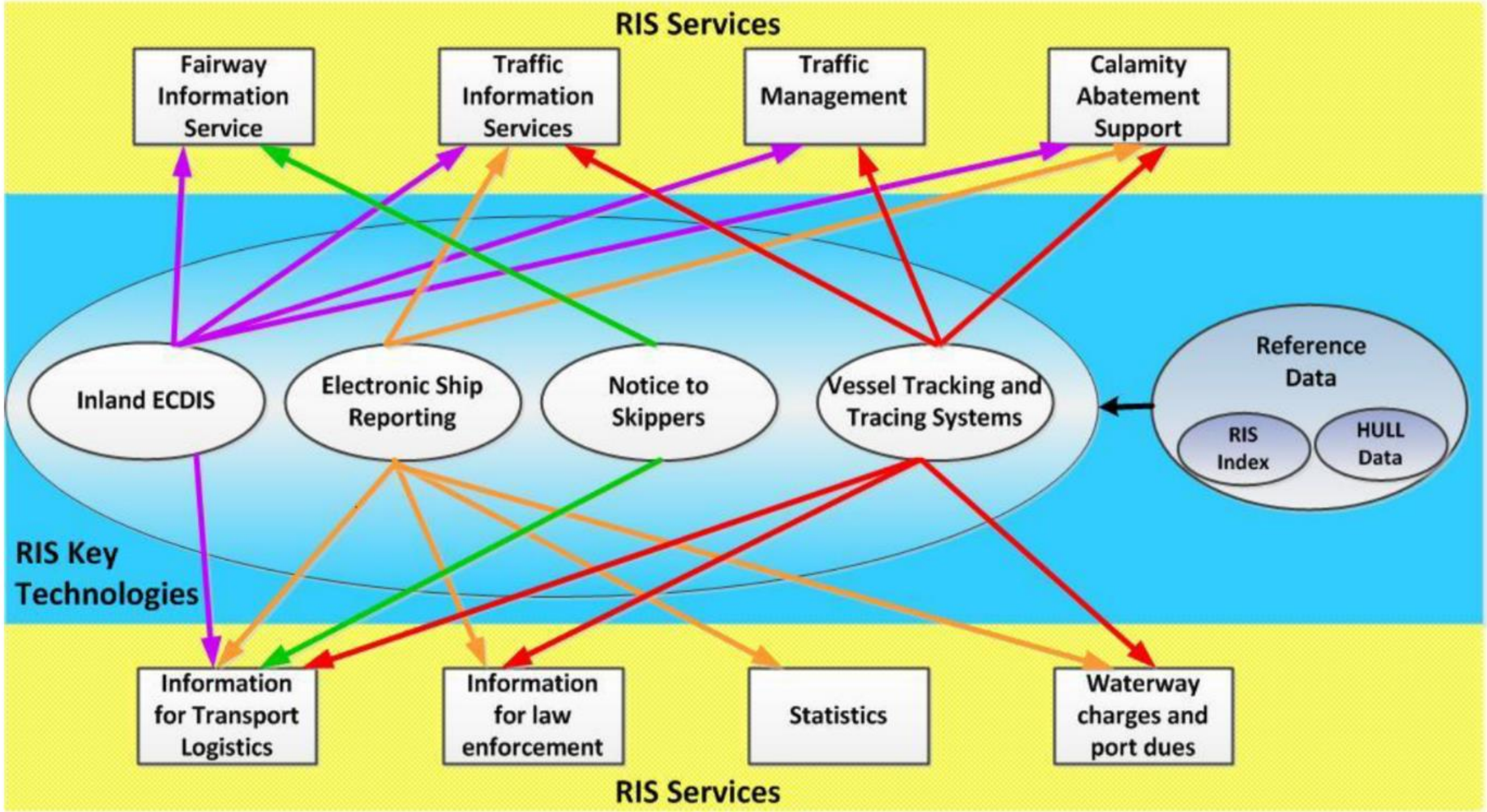
1. FIS –Fairway Information Service

Traffic Management related

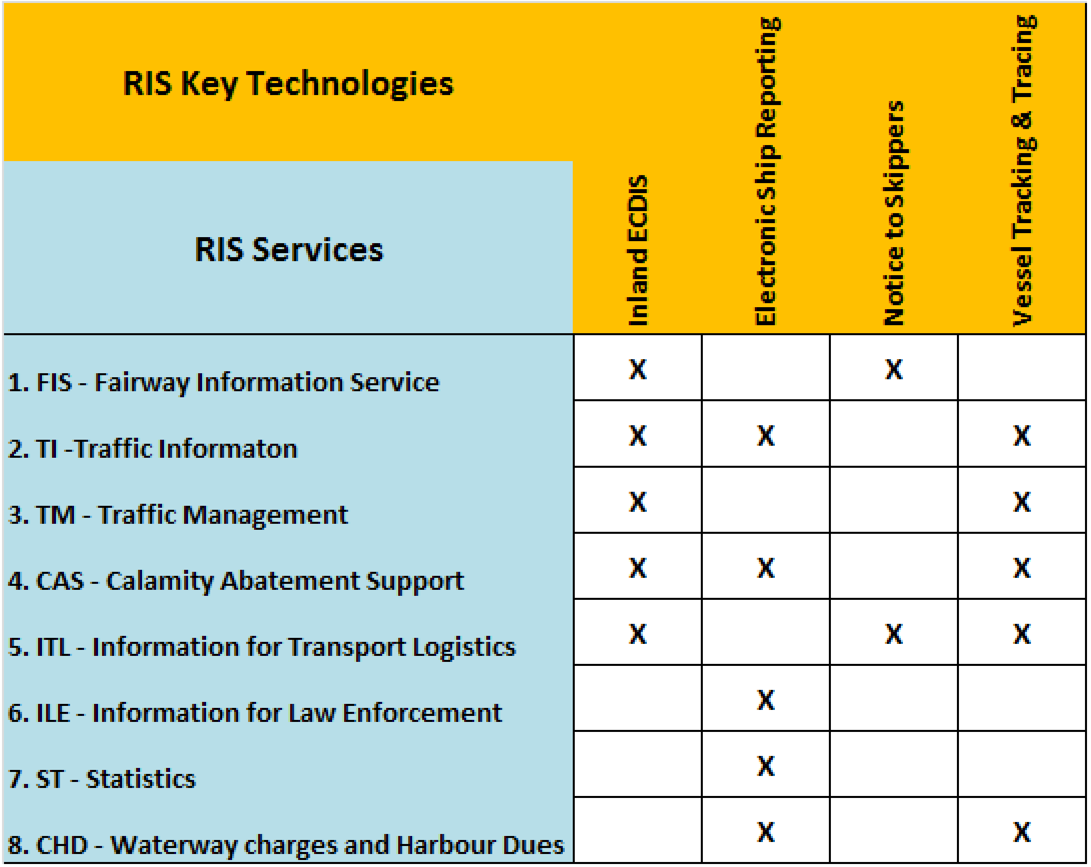
The 4 RIS Key Technologies – Technical Services

- The RIS Directive 2005/44/EC – 7/09/2005 defines 4 Technical regulations:
  - ❖ **Tracking and Tracing** standard – No 415/2007 22 March 2007 - concerning the technical specifications for Vessel Tracking and Tracing systems (Inland AIS).
  - ❖ **Notice to Skippers** standard - No 416/2007 of 22 March 2007 concerning the technical specifications for Notices to Skippers.
  - ❖ **Electronic Reporting standard** - No 164/2010 of 25 January 2010 concerning the technical specifications for Electronic Reporting.
  - ❖ **Electronic Chart Display and Information System for Inland Navigation** – No 990/2013 concerning the technical specifications for Inland ECDIS.

Operational versus Technical Services

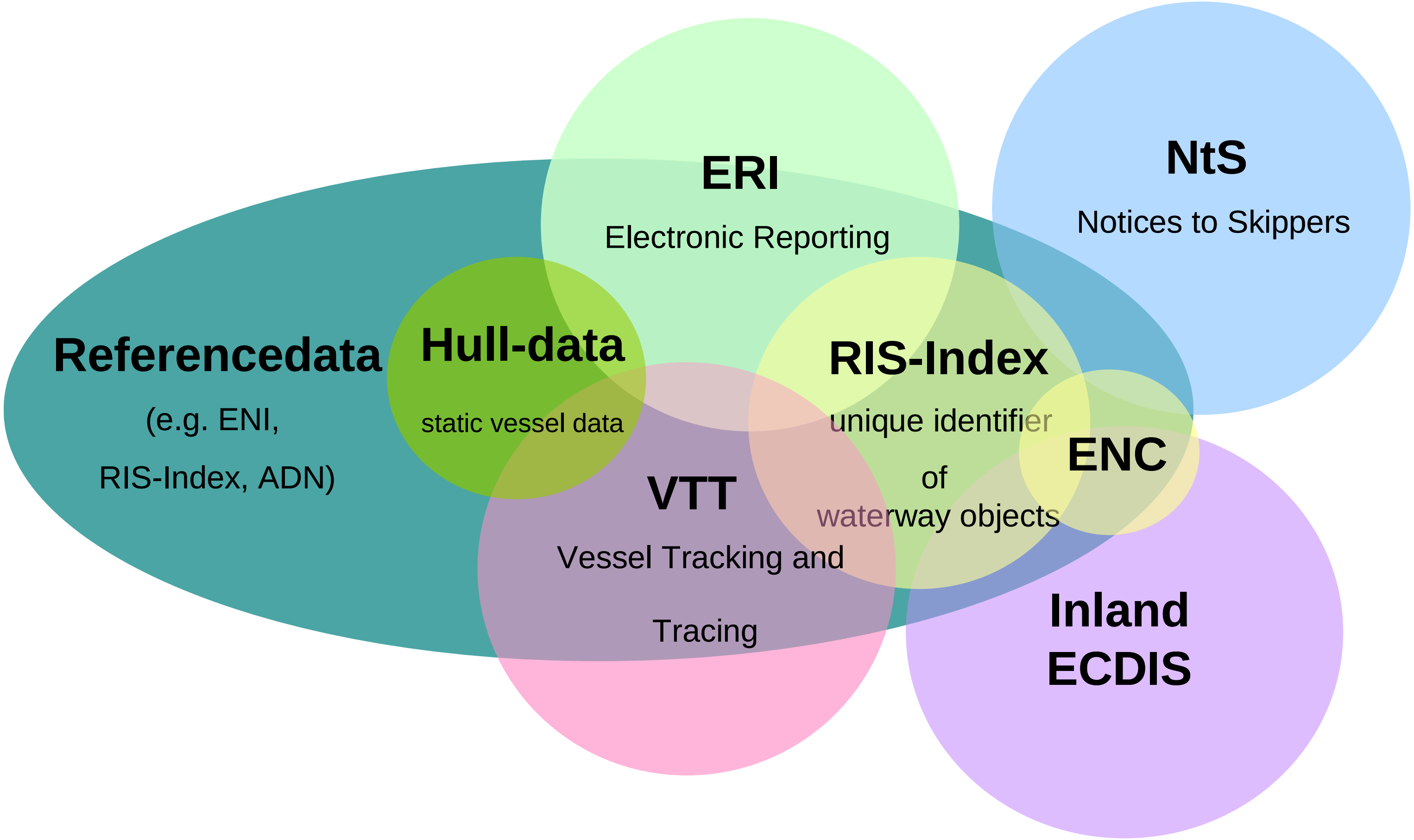

RIS Services
Fairway Information Service
Traffic Information Services
Traffic Management
Calamity Abatement Support
Inland ECDIS
Electronic Ship Reporting
Notice to Skippers
Vessel Tracking and Tracing Systems
Reference Data
RIS Index
HULL Data
RIS Key Technologies
Information for Transport Logistics
Information for law enforcement
Statistics
Waterway charges and port dues
RIS Services

Matrix RIS Technical versus Operational Services

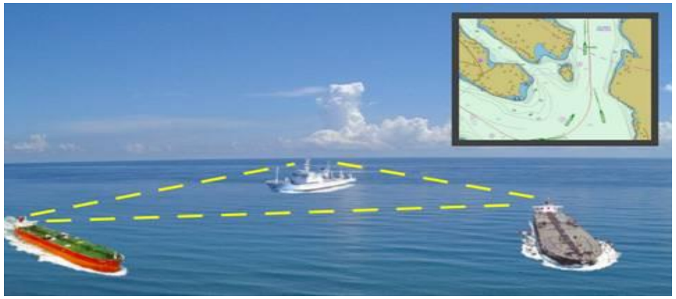


RIS Key Technologies RIS Services	Inland ECDIS	Electronic Ship Reporting	Notice to Skippers	Vessel Tracking & Tracing
1. FIS - Fairway Information Service	X		X	
2. TI -Traffic Informaton	X	X		X
3. TM - Traffic Management	X			X
4. CAS - Calamity Abatement Support	X	X		X
5. ITL - Information for Transport Logistics	X		X	X
6. ILE - Information for Law Enforcement		X		
7. ST - Statistics		X		
8. CHD - Waterway charges and Harbour Dues		X		X

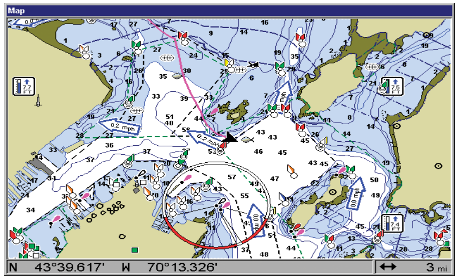
Reference Data



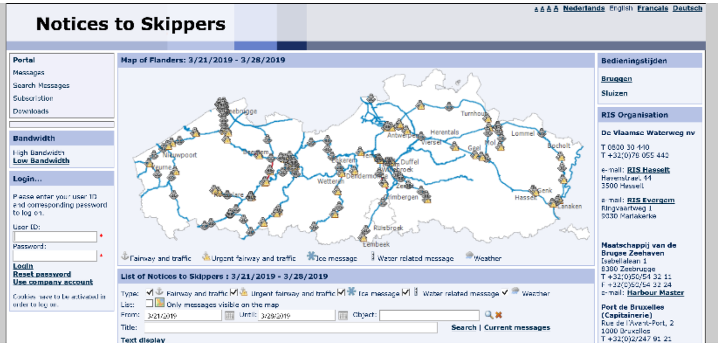
Comparison with the Maritime World



Automatic Identification System (AIS)



GPS / Electronic Nautical Charts



A A A A **Nederlands** English **Francais** **Deutsch**

Notices to Skippers

Portal
Messages
Search Messages
Subscription
Downloads

Bandwidth
High Bandwidth
Low Bandwidth

Login...
Please enter your user ID and corresponding password to log on.
User ID: ________ *
Password: ________ *
Login
Reset password
Use company account
Cookies have to be activated in order to log on.

Map of Flanders: 3/21/2019 - 3/28/2019

⚓ Fairway and traffic ⚠ Urgent fairway and traffic ❄ Ice message ▯ Water related message ☁ Weather

List of Notices to Skippers : 3/21/2019 - 3/28/2019

Type: ☑ ⚓ Fairway and traffic ☑ ⚠ Urgent fairway and traffic ☑ ❄ Ice message ☑ ▯ Water related message ✓ ☁ Weather
List: □ Only messages visible on the map
From: 3/21/2019 Until: 3/28/2019 Object: ________
Title: ________ **Search** | **Current messages**
Text display

Bedieningstijden
Bruggen
Sluizen

RIS Organisation

De Vlaamse Waterweg nv
T 0800 30 440
T +32(0)78 055 440

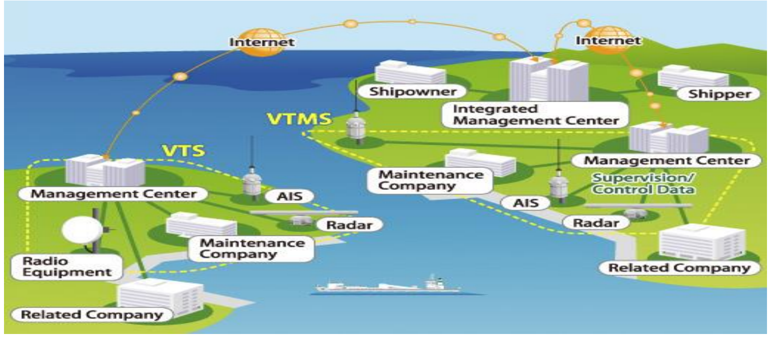
e-mail: **RIS Hasselt**
Havenstraat 44
3500 Hasselt

e-mail: **RIS Evergem**
Ringvaartweg 1
9030 Mariakerke

Maatschappij van de Brugse Zeehaven
Isabellalaan 1
8380 Zeebrugge
T +32(0)50/54 32 11
F +32(0)50/54 32 24
e-mail: **Harbour Master**

Port de Bruxelles (Capitainerie)
Rue de l'Avant-Port, 2
1000 Bruxelles
T +32(0)2/247 91 21

Notes to Mariners



Vessel Traffic Services / Logistics

Some Cyber…. keywords

- We are using the term ***Cyber*** to emphasize that our focus is on electronic systems, computers, computer networks, …
- We need ***Cybersecurity*** because there are ***Cyber Risks*** due to ***Cyberattacks***.
- ***Cybercrime*** is a crime with ***ICT as a mean and as a target***.

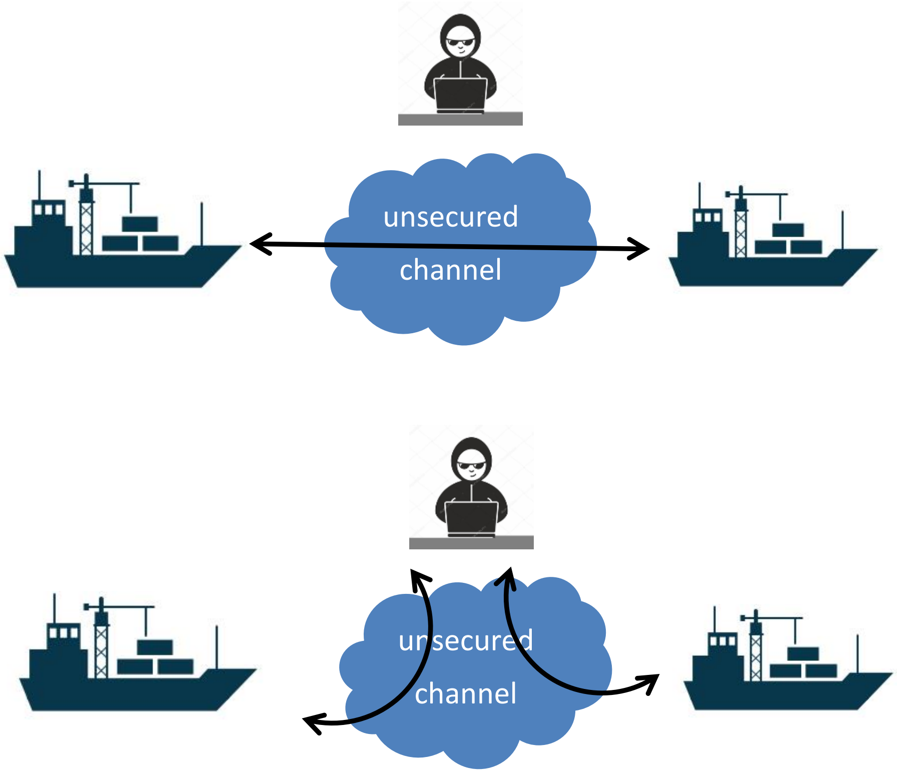
Cybercrime

- We have moved from the Nerd to the ***Cybercriminal***.
- Information is money and power:
  - Stealing Information becomes a business case.
  - Cybercrime is very professionally addressed as a business with a high ROI.
  - Don’t forget espionage.
- *Cybersecurity should be/is THE object/concern for all functionalities produced/provided in IWT which is driven by Digitalisation.*

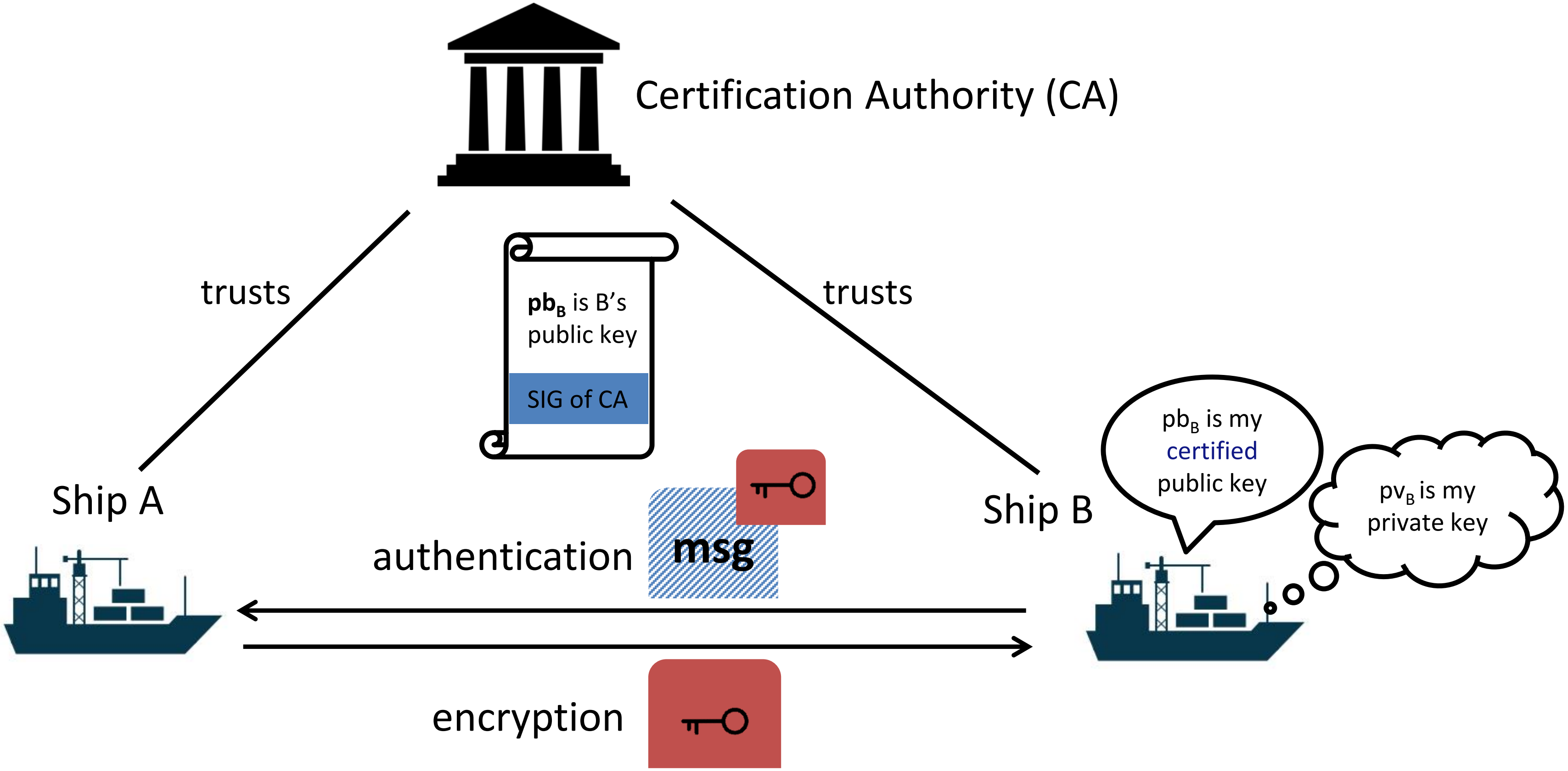
Some Populair CyberAttacks/Crime Methods

- (D)DoS: (Distributed) Denial of Service (jamming)
- Brute-force attack
- Malware
- Spoofing (e.g. the man in the middle)
- Phishing
- Social engineering
- Hijacking

The man in the middle (spoofing)

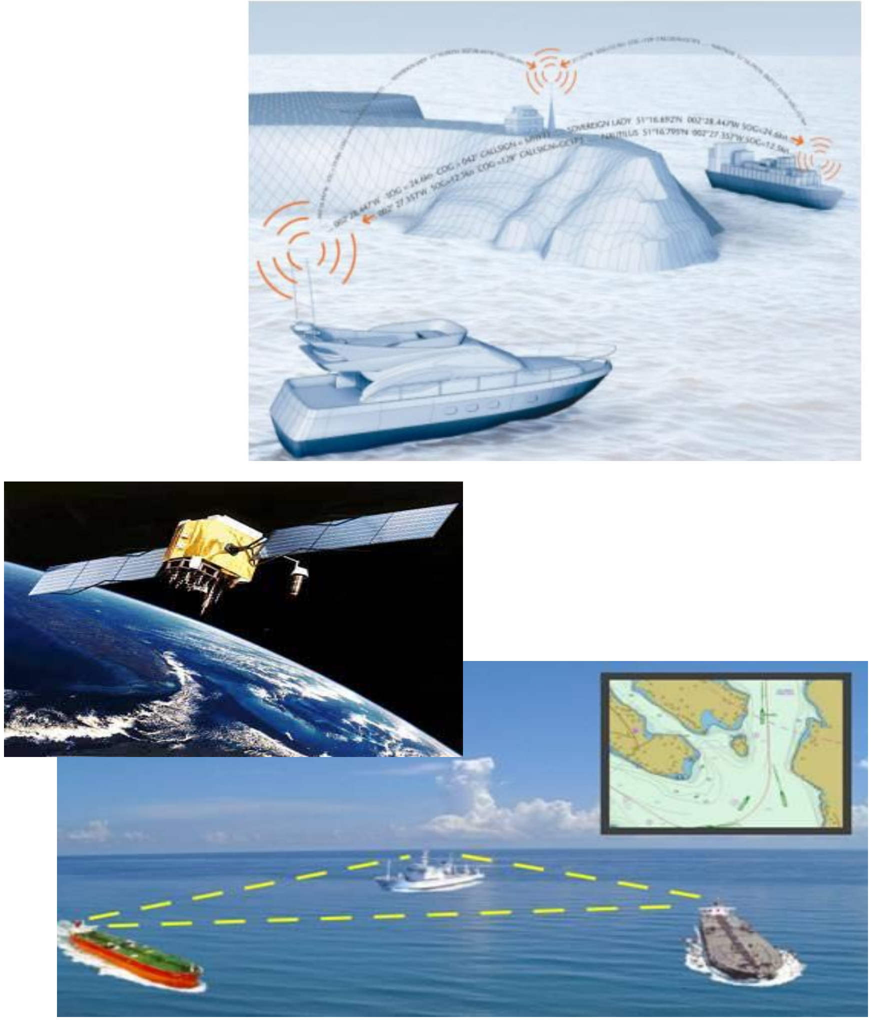


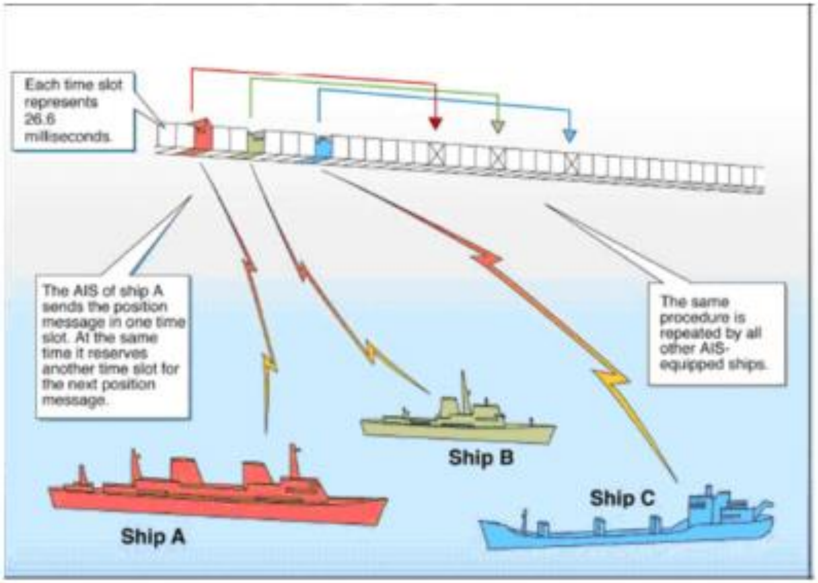
Public Key Encryption with PKI Certificates


Certification Authority (CA)
trusts
trusts
$\mathbf{pb_B}$ is B's public key
SIG of CA
pb_B is my certified public key
pv_B is my private key
Ship A
Ship B
authentication
msg
encryption

Source: e-Nagivation Underway 2019 - OFFIS

Inland Automated Identification System (AIS)





Each time slot represents 26.6 milliseconds.

The AIS of ship A sends the position message in one time slot. At the same time it reserves another time slot for the next position message.

The same procedure is repeated by all other AIS-equipped ships.

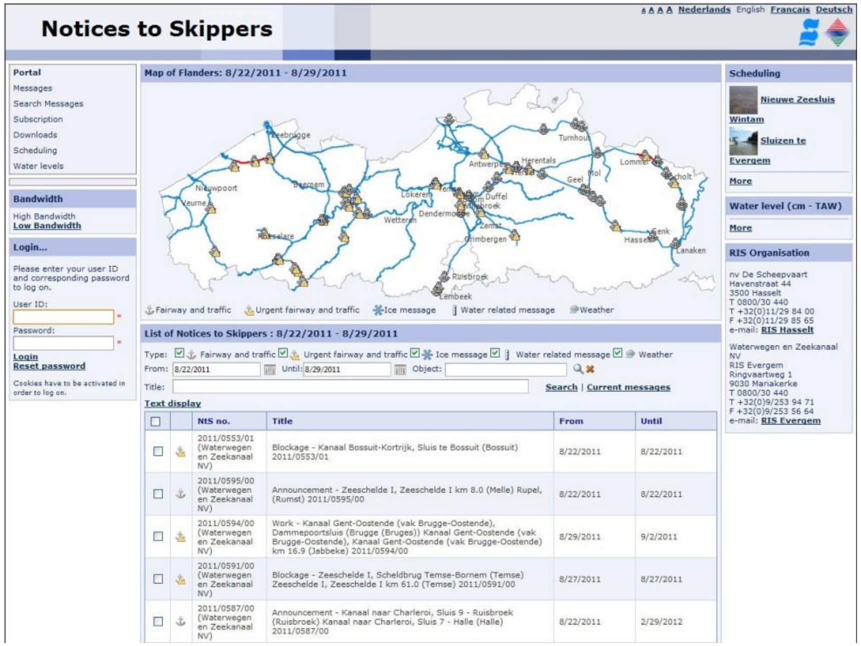
Inland AIS/GPS

- Navigation: position, speed, heading other data about the vessel, ….
- Radio-frequency-enabled technologies are an “easy target” for malicious individuals.
- The signal is unencrypted and access to the service requires no authorisation.
- Old technology based on poor bandwidth
- Possible Attacks:
  - DoS
  - Spoofing
  - Jamming
  - Hijacking
  - ……………

Notice to Skippers (NtS)

- Notices to Skippers(NtS) is a RIS key technology which provides in a standardised manner and language independent:-
  - fairway and traffic related information, as well as
  - hydrographical information such as weather information, water level information and ice information.

- Notices to Skippers is supporting Fairway Information Services (FIS) and transport planning as part of the Information for Transport Logistic (ITL).



A A A A Nederlands English Francais Deutsch

Notices to Skippers

Portal
Messages
Search Messages
Subscription
Downloads
Scheduling
Water levels

Bandwidth

High Bandwidth
Low Bandwidth

Login...

Please enter your user ID and corresponding password to log on.

User ID: *
Password: *

Login
Reset password

Cookies have to be activated in order to log on.

Map of Flanders: 8/22/2011 - 8/29/2011

⚓ Fairway and traffic ⚠ Urgent fairway and traffic ❄ Ice message ℹ Water related message ☁ Weather

List of Notices to Skippers : 8/22/2011 - 8/29/2011

Type: ☑ ⚓ Fairway and traffic ☑ ⚠ Urgent fairway and traffic ☑ ❄ Ice message ☑ ℹ Water related message ☑ ☁ Weather
From: 8/22/2011 Until: 8/29/2011 Object:
Title:
Search | Current messages

Text display

□		NtS no.	Title	From	Until
□	⚠	2011/0553/01 (Waterwegen en Zeekanaal NV)	Blockage - Kanaal Bossuit-Kortrijk, Sluis te Bossuit (Bossuit) 2011/0553/01	8/22/2011	8/22/2011
□	⚓	2011/0595/00 (Waterwegen en Zeekanaal NV)	Announcement - Zeeschelde I, Zeeschelde I km 8.0 (Melle) Rupel, (Rumst) 2011/0595/00	8/22/2011	8/22/2011
□	⚠	2011/0594/00 (Waterwegen en Zeekanaal NV)	Work - Kanaal Gent-Oostende (vak Brugge-Oostende), Dammepoortsluis (Brugge (Bruges)) Kanaal Gent-Oostende (vak Brugge-Oostende), Kanaal Gent-Oostende (vak Brugge-Oostende) km 16.9 (Jabbeke) 2011/0594/00	8/29/2011	9/2/2011
□	⚠	2011/0591/00 (Waterwegen en Zeekanaal NV)	Blockage - Zeeschelde I, Scheldbrug Temse-Bornem (Temse) Zeeschelde I, Zeeschelde I km 61.0 (Temse) 2011/0591/00	8/27/2011	8/27/2011
□	⚓	2011/0587/00 (Waterwegen en Zeekanaal NV)	Announcement - Kanaal naar Charleroi, Sluis 9 - Ruisbroek (Ruisbroek) Kanaal naar Charleroi, Sluis 7 - Halle (Halle) 2011/0587/00	8/22/2011	2/29/2012

Scheduling

Nieuwe Zeesluis Wintam
Sluizen te Evergem
More

Water level (cm - TAW)

More

RIS Organisation

nv De Scheepvaart
Havenstraat 44
3500 Hasselt
T 0800/30 440
T +32(0)11/29 84 00
F +32(0)11/29 85 65
e-mail: RIS Hasselt

Waterwegen en Zeekanaal NV
RIS Evergem
Ringvaartweg 1
9030 Mariakerke
T 0800/30 440
T +32(0)9/253 94 71
F +32(0)9/253 56 64
e-mail: RIS Evergem

Electronic Ship Reporting (ERINOT)

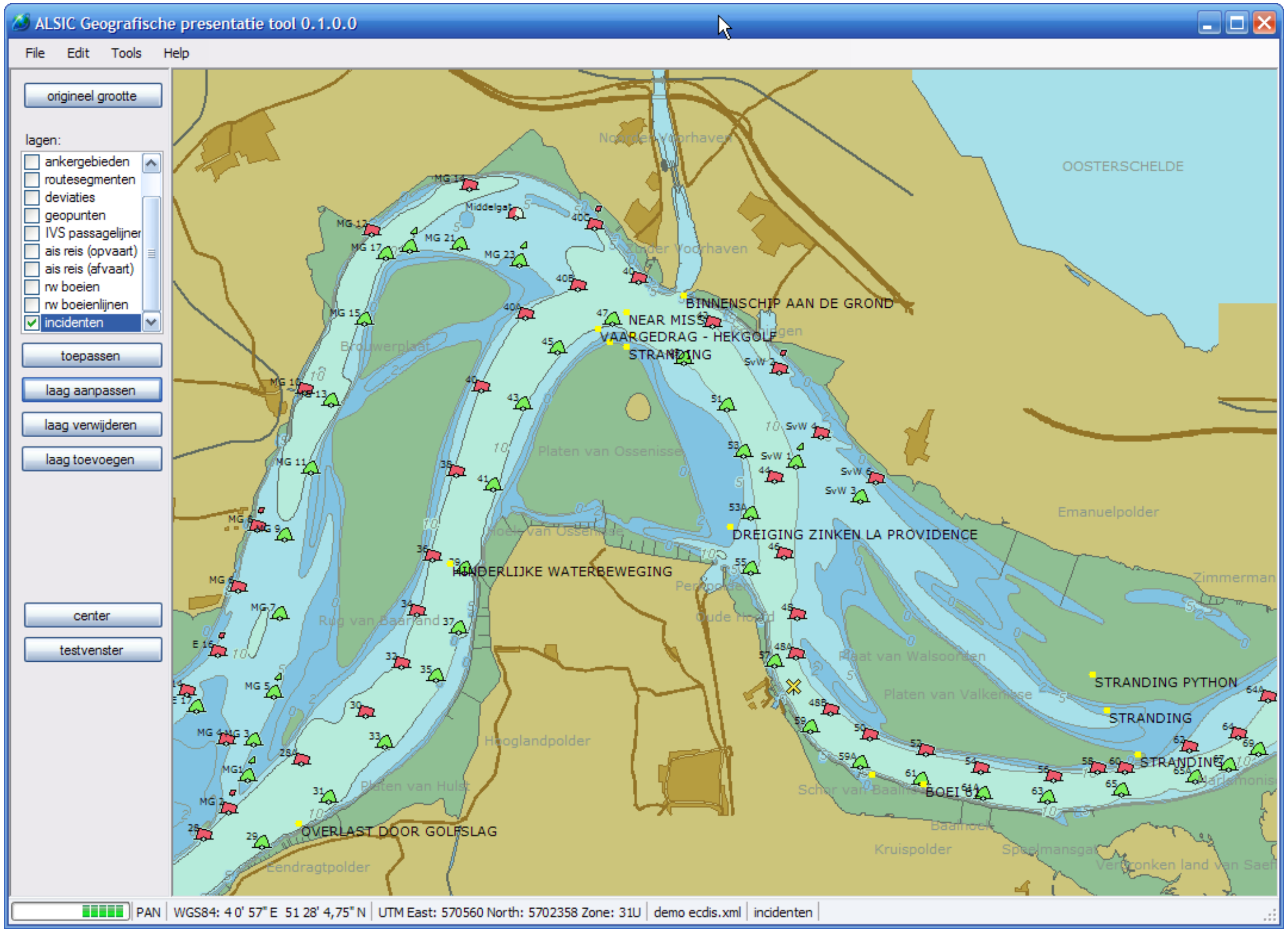
- Electronic (Ship) reporting (ERI) is a RIS key technology that facilitates the RIS services; Strategic Traffic Information (STI), Traffic Management (TM), Calamity Abatement Support (CAS), Statistics (ST), Law enforcement (ILE), Waterway charges and harbour dues (CHD) as well as Transport Logistics (TL).

- Electronic Reporting in Inland Navigation facilitates electronic data interchange (EDI) between partners in inland navigation as well as partners in the multi-modal transport chain involving inland navigation, and avoids the reporting of the same information related to a voyage several times to different authorities and/or commercial parties.

Notice to Skipper/Electronic Ship Reporting

- Provides information to users via websites, M2M communications (webservices).
- Possible Attacks
  - Related to Internet Connection and ICT infrastructure (Web/Database servers)
  - (D)DoS: (Distributed) Denial of Service (jamming)
  - Brute-force attack
  - Malware
  - Spoofing (e.g. the man in the middle)
  - Social engineering
  - Hijacking
  - ……………………

Inland Electronical Navigation Chart (IENC) and Inland ECDIS



ALSIC Geografische presentatie tool 0.1.0.0

lagen:

- ☐ ankergebieden
- ☐ routesegmenten
- ☐ deviaties
- ☐ geopunten
- ☐ IVS passagelijner
- ☐ ais reis (opvaart)
- ☐ ais reis (afvaart)
- ☐ rw boeien
- ☐ rw boeienlijnen
- ☑ incidenten

PAN | WGS84: 4 0' 57" E 51 28' 4,75" N | UTM East: 570560 North: 5702358 Zone: 31U | demo ecdis.xml | incidenten

Inland ECDIS/Inland IENC

- Contains:
  - ICT infrastructure / Internet connection
  - Inland IENC's / NtS Messages
  - Radar overlay / AIS information
- Possible Attacks
  - Related to AIS/GPS
  - Related to NtS Messages
  - Related to Hydro-Meteo Information (water levels, …..)
  - Related to Internet Connection and ICT infrastructure
  - Attacks due to update of the IENC charts, via Internet or USB stick
  - …………………..

Cross-border/Corridor Management

- Data exchange/provision from different waterway authorities to fulfil new RIS services like for example corridor management.
- Information is provided to the users via websites, M2M communications, webservices, mail communication, notifications, ……
- Possible Attacks
  - Related to Internet Connection and ICT infrastructure (Web/Database servers)
  - (D)DoS: (Distributed) Denial of Service (jamming)
  - Brute-force attack
  - Malware
  - Spoofing (e.g. the man in the middle)
  - Social engineering
  - Hijacking
  - ………………….
- Need to be addressed with cross-border/international cooperation between the involved parties.

New Developments / Smart Shipping

- ***Problem:*** Today ship control systems; power/valve remote control systems; ballast water systems; wheelhouse systems, remote controls for locks and bridges are driven/monitored by ***Supervisory Control And Data Acquisition (SCADA) systems***. Which are often based on very simple (and old) protocols whitout any encryption. Thus easy to hack.
- Removal of crew removes an element of monitoring which might be needed in the event of a cyberattack.
- The ship becomes an ***IoT*** (Internet of Things).
- ***Assurance will be needed that systems on-board of automated ships would be cyber hardened.***

Important Mitigation Measures

- Each solution as a result of a Digitalisation should be subject to a ***Cyber Risk Assessment*** to identify the ***Cyber Risks*** and how to monitor/detect them and define ***mitigation measures.***
- Solve all the issues on the physical and logical level of security.
- Monitor your environment continuously and foresee good reporting/alerting tools and define KPI's.
- Educate and train your users/ make them aware of their actions (it's so easy/tempting to open a mail).
- ***Be aware of social engineering!!!!***
- Take procedures for maintenance personnel and their equipment, certainly for external services (internal and remotely).
- Avoid obvious intruders, may I use your USB stick for a moment …
- ……………..

Some important Standards

- In the US, ***the National Institute of Standards and Technology (NIST)*** is in the process of issuing a series of profiles intended to help the maritime industry make the most of the wider voluntary *Framework for Improving Critical Infrastructure Cybersecurity*.
- The **NIS Directive (EU 2016/1148)** is the first piece of EU-wide cybersecurity legislation. The goal is to enhance cybersecurity across the EU. (ENISA: European Union Agency for Network and Information Security)
  - a Computer Security Incident Response Team (CSIRT) and a competent national NIS authority
- EU ***General Data Protection Regulation (GDPR REGULATION (EU) 2016/679)*** on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.
- ***ISO/IEC 27032:2012 - Guidelines for cybersecurity***, provides guidance for improving the state of Cybersecurity, drawing out the unique aspects of that activity and its dependencies on other security domains, in particular:
  - information security,
  - network security,
  - internet security, and
  - critical information infrastructure protection (CIIP).

Thank you for your attention

Ir. Dierik Vermeir
Past Chairman WG156
Vice-Chairman WG125
Vice-Chairman NtS expert group
IALA Industrial Member

CEO ALSIC BVBA
Derbystraat 25
B-9051 Sint Denijs-Westrem

Tel: +32-9-265.91.11
GSM: +32-475-43.66.19

www.alsic.be
dierik.vermeir@alsic.be