



Sealite 

Monitoring and Managing Aids to Navigation in the Digital World

Malcolm Nicholson

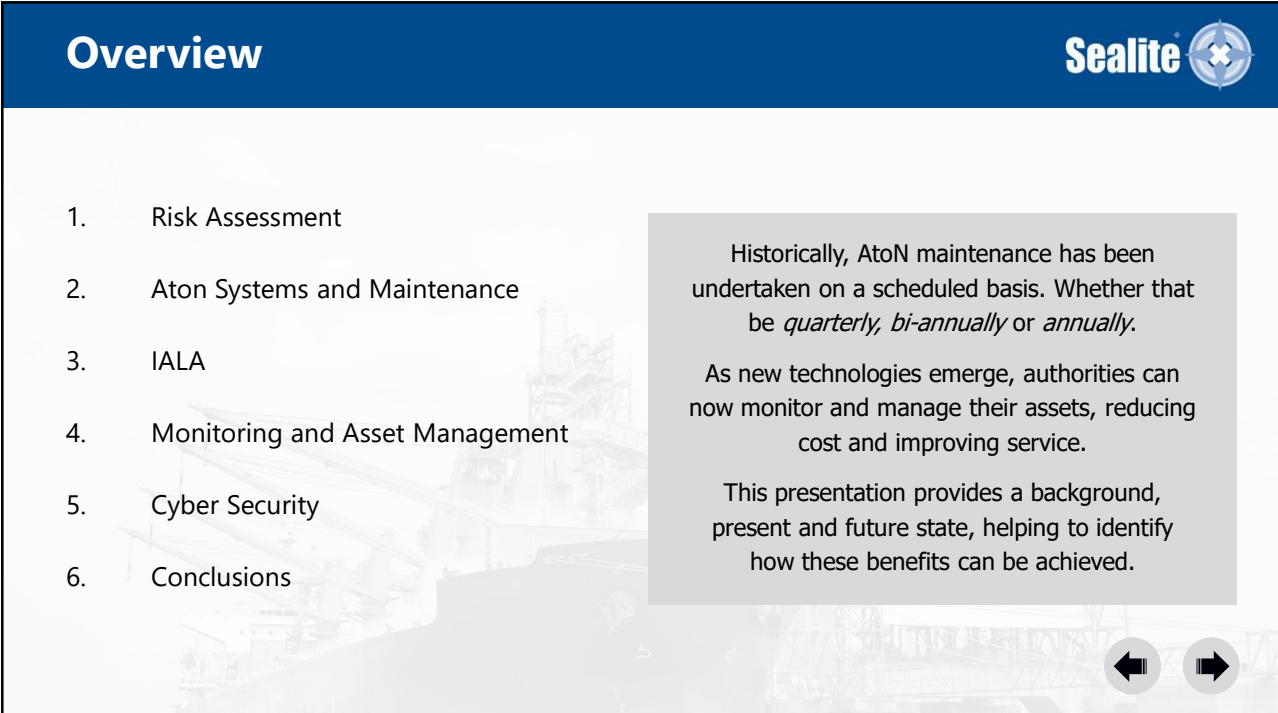
FRIN

Global Product Manager – Marine
Sealite, Australia


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Overview



Sealite 

1. Risk Assessment
2. Aton Systems and Maintenance
3. IALA
4. Monitoring and Asset Management
5. Cyber Security
6. Conclusions

Historically, AtoN maintenance has been undertaken on a scheduled basis. Whether that be *quarterly*, *bi-annually* or *annually*.

As new technologies emerge, authorities can now monitor and manage their assets, reducing cost and improving service.

This presentation provides a background, present and future state, helping to identify how these benefits can be achieved.

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Risk Assessment



The SOLAS (Safety of Life at Sea) Convention is published by the **IMO** (International Maritime Organisation) at which the ISAF have Consultative Status.

SOLAS Chapter V refers to the Safety of Navigation for all vessels at sea.



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Risk Assessment



1. Why?

- SOLAS Chapter V, Regulation 13 - Each Contracting Government undertakes to provide, as it deems practical and necessary either individually or in co-operation with other Contracting Governments, such Aids to Navigation as the volume of traffic justifies and the degree of risk requires.
- In order to obtain the greatest possible uniformity in Aids to Navigation. Contracting Governments take into account the international recommendations and guidelines* when establishing such aids.

* Refer to the appropriate recommendations and guidelines of IALA and SN/Circ.107 – Maritime Buoyage System.



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Risk Assessment

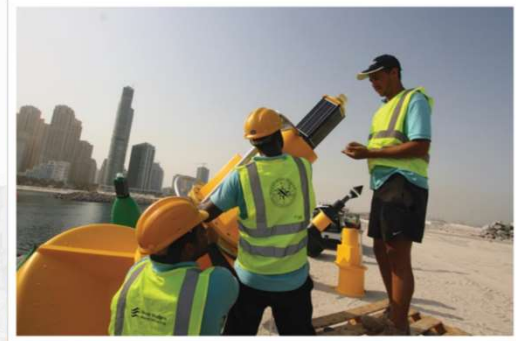


2. When?

Before establishing a new AtoN or re-engineering or replacing an end of life AtoN.

3. How?

IALA – IWRAP, PAWSA, SIRA



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IALA Risk Management Tools



1. IWRAP - Quantitative

- IWRAP is a modelling tool useful for maritime risk assessment.

Using IWRAP you can estimate the frequency of collisions and groundings in a given waterway based on information about traffic volume/composition and route geometry. (G1123)

2. PAWSA - Qualitative

- PAWSA provides an assessment of risk in a defined waterway by means of a structured two-day workshop.

It is undertaken by carrying out a subjective assessment of the probable risk in that waterway. It is based on the experience of teams of maritime experts and other stakeholders under the supervision of a Facilitator. (G1124)



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IALA Risk Management Tools



3. SIRA

- The SIRA process is based on the principles set out in IALA Guideline 1018 on risk management.
- Risk is defined as the product of two factors – the probability (or likelihood) of an undesirable incident occurring and if it does occur, the severity of its potential long and short-term impact (or consequence).
- The management of risk involves a structured process that identifies hazards and scenarios with associated risk before taking action to reduce the risk to “As Low As Reasonably Practicable (ALARP)” which is acceptable to stakeholders.

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IALA Risk Management Tools



1. SIRA – Risk Criteria

Description	Score	Service Disruption Criteria	Human Impact Criteria	Financial Criteria	Environment
Insignificant	1	No service disruption apart from some delays or nuisance.	No injury to humans, perhaps significant nuisance.	Loss, including third party losses, less than US\$1,000.	No damage
Minor	2	Some non-permanent loss of services such as closure of a port or waterway for up to 4 hours.	Minor injury to one or more individuals, may require hospitalization	Loss, including third party losses, less than US\$1,000-50,000.	Limited short term damage to the environment.
Severe	3	Sustained disruption to services such as closure of a port or waterway for 4-24 hours.	Injuries to several individuals requiring hospitalization	Loss, including third party losses, less than US\$50,000-5,000,000.	Short term damage to the environment in a small area.
Major	4	Sustained disruption to services such as closure of a port or waterway for 1-30 days or permanent or irreversible loss of services.	Severe injuries to many individuals or loss of life.	Loss, including third party losses, less than US\$5,000,000 - 50,000,000.	Long term to irreversible damage to the environment in a limited area.
Catastrophic	5	Sustained disruption to services such as closure of a port or waterway for months or years	Severe injuries to numerous individuals and/ or loss of several lives.	Loss, including third party losses of over 50,000,000.	Irreversible damage to the environment in a large area.

Classification	Score	Probability
Very rare	1	Very rare or unlikely, will occur only in exceptional circumstances and not more than once every 20 years.
Rare	2	Rare, may occur every 2-20 years.
Occasional	3	Occasional, may occur every 2 months to 2 years
Frequent	4	Frequent, may occur once weekly to every 2 months.
Very frequent	5	Very frequent, may occur at least once every week.

	PROBABILITY (LIKELIHOOD)				
	Very Rare (1)	Rare (2)	Occasional (3)	Frequent (4)	Very Frequent (5)
Catastrophic (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Severe (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Insignificant (1)	1	2	3	4	5

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IALA Risk Management Tools



1. SIRA – Example

- Lighthouse with irregular power supply (Frequent mains outage)
- Probability – 4, Impact – 2 = 8

2. Risk Control Options

- Install UPS Battery back up

3. Revised Risk

- Probability – 1, Impact – 2 = 2

Risk Value	Risk Category	Action Required
1 - 4	Green	Low risk not requiring additional risk control options unless they can be implemented at low cost in terms of time, money and effort.
5 - 8	Yellow	Moderate risk which must be reduced to the "as low as reasonably practicable" (ALARP) level by the implementation of additional control options which are likely to require additional funding.
9 - 12	Amber	High risk for which substantial and urgent efforts must be made to reduce it to "ALARP" levels within a defined time period. Significant funding is likely to be required and services may need to be suspended or restricted until risk control options have been actioned.
15 - 25	Red	Very high and unacceptable risk for which substantial and immediate improvements are necessary. Major funding may be required and ports and waterways are likely to be forced to close until the risk has been reduced to an acceptable level.



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AtoN Systems



Platform or Structure

- Lighthouse
- Buoy
- Pile, Beacon



Signal Transmission

- Visual
- Non Visual
- Audible



Power Supply

- Mains or Battery Solar



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The Weakest Link



Light Source

- Incandescent lights

Battery

- Wet Lead Acid

Chain

- Poor Steel



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The Present



Light Source

- LED

Antenna

- Robust

Battery

- NiMH, SLA, Li-ion

Chain

- Synthetic

The Mariner!



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Maintenance



Traditional

- Planned, Scheduled.
- We must go every 6 months!



Conditioned Based

- If it isn't broken don't touch it!



Reactive

- It's broken, we need to fix it!



Predictive

- Lets get there before it breaks!

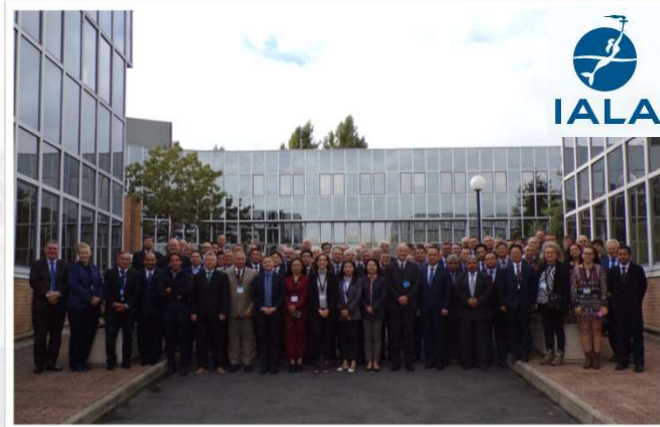


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IALA





- Successful Voyages, Sustainable Planet
- NGO
- Based in Paris since 1957
- Technical Experts from Authorities and Industry
- Recommendations and Guidelines



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IALA Recommendation Example






R0130 (O-130) Categorisation and Availability Objectives for Short Range Aids to Navigation.


- **Cat 1** – Vital Navigational Significance. Primary route, channel or danger
- **Cat 2** – Important Navigational Significance. Secondary routes.
- **Cat 3** – Necessary Navigational Significance.

CATEGORY	AVAILABILITY OBJECTIVE	CALCULATION PERIOD
1	99.8%	Availability Objectives are calculated over a continuous three-year period, unless otherwise specified
2	99.0%	
3	97.0%	



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IALA Next Steps



- Moving to IGO
 - 6 ratifications of the convention (to date)
- Standards
 - Normative
 - Informative

- IALA Compliance
- Audit

The Recommendations are normative provisions, and shall be observed if compliance to this Standard is claimed.

AIDS TO NAVIGATION PLANNING








- R1001 – The IALA Maritime Buoyage System
- E-111 – Port Traffic Signals
- O-113 – The marking of fixed bridges over navigable waters
- Marking of Man-Made Offshore Structures O-139


LEVELS OF SERVICE

- R0130(O-130) – Categorisation and Availability Objectives for Short Range Aids to Navigation

RISK MANAGEMENT

QUALITY MANAGEMENT

 S1010	S1010 Marine Aids to Navigation Planning And Service Requirements
 S1020	S1020 Marine Aids to Navigation Design and Delivery
 S1030	S1030 Radionavigation Services
 S1040	S1040 Vessel Traffic Services
 S1050	S1050 Training and Certification
 S1060	S1060 Digital Communication Technologies
 S1070	S1070 Information Services

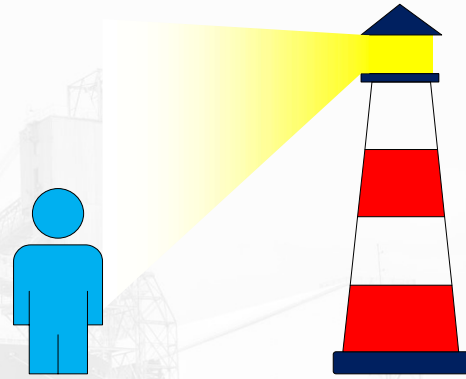


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Monitoring

Developments in Monitoring

- Historically AtoN's were unmonitored and relied on human observation to determine outage.
- Over time the human interface changed to a connected solution, inter-alia:
 - PSTN
 - RF
 - GSM
- These connected interfaces were traditionally closed systems with no access to the outside world.

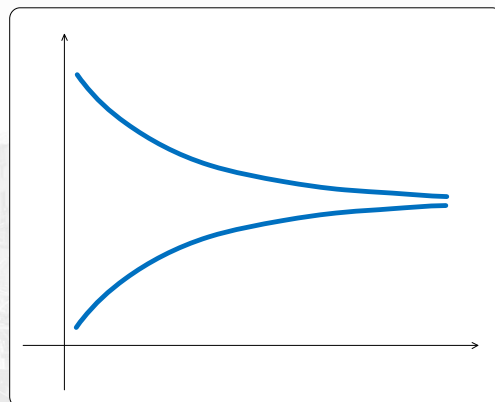


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Monitoring

IT / OT Technology Convergence

- The proliferation of IoT has increased the appetite for the connected world – everything is now connected to your fingertips.
- IoT uses IT networks.
- Traditional OT / SCADA networks have now merged with IT networks to provide fully connected systems – accessible anywhere.
- OT Networks are now using the same technologies as IT networks.

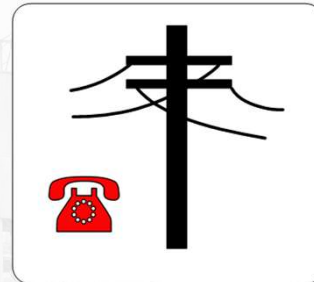


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Technology History

PSTN Networks

- Are now legacy systems but were instrumental in connecting devices in the late 80's and 90's.
- Used for monitoring, either via X.25 or Circuit Switched Dial-up interfaces.
- Dial-up was only initiated by the asset to be monitored, and generally only used for alarming, not control or other monitoring services.
- Unfortunately, only limited coverage and dependant on local infrastructure and distance for Telco switch.

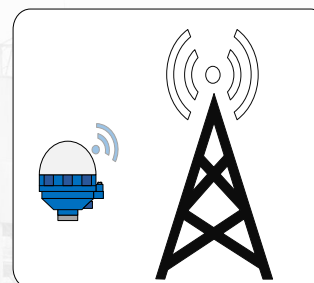


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Technology History

RF Networks

- Took over from where PSTN networks could not service.
- Popular as a last mile solution from coast to buoy.
- Required regulatory approval in most countries except for ISM band.
- ISM band became congested because of the proliferation of Wi-Fi and other RF devices.



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Technology History

GSM

- Provided good coverage and became the industry standard for many applications.
- Unfortunately, still limited coverage in many areas.
- Quick technology refresh cycle has meant many customers are playing catchup in changing modems from **2G** to **3G** to **4G** to **5G**.



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Technology History

Bluetooth and Zigbee

- IoT proliferation has increased the need of low power RF devices for communications.
- Bluetooth and Zigbee have become popular for communications for sensors and ancillary devices.
- Short range is a limitation but can be used as a last mile solution for monitoring several assets from a hub.



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Technology History

Satellite

- Initially was cost prohibitive with low bandwidth, but now with multiple players in the market cost has reduced and technology has advanced at a rapid rate.
- Satellite's come in three main orbital slots, namely:
 - Low Earth Orbiting (LEO)
 - Medium Earth orbit (MEO)
 - Geostationary Earth Orbit (GEO)
- Provides global coverage, the preferred option for remote or offshore locations.



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Applications

Buoys

- For monitoring of signals, and metrological sensors.
- Connectivity includes:
 - RF to shore through PSTN
 - GSM direct
 - Sat
 - IoT*



* More susceptible to interference and vulnerabilities



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Applications

Lighthouses and Shore Beacons

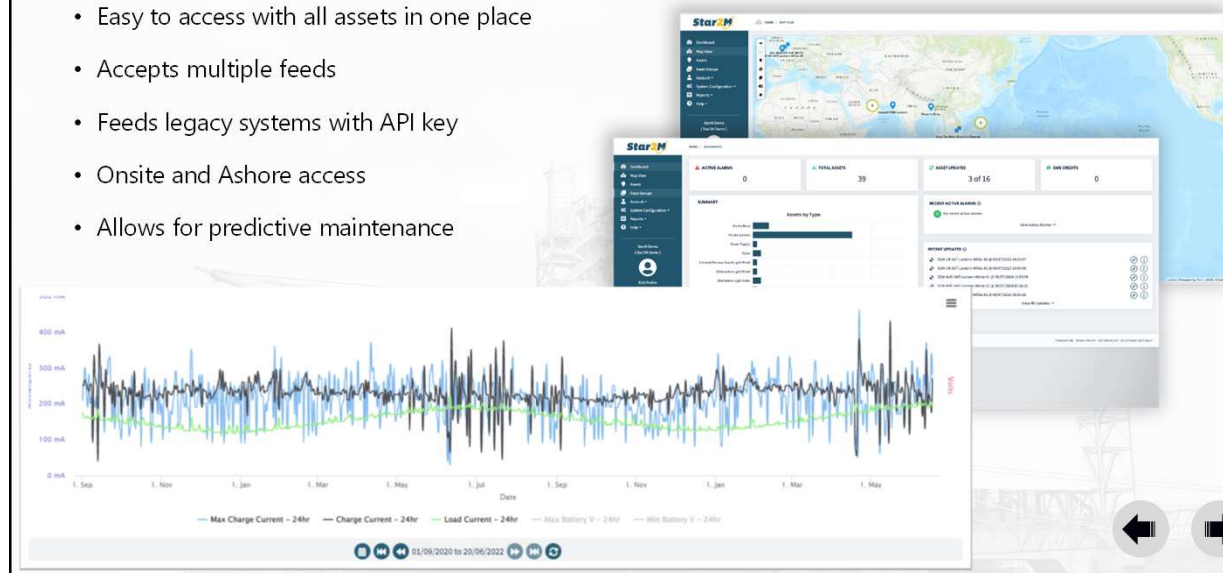
- For monitoring of system performance and outages.
- Connectivity includes:
 - PSTN (X.25)
 - GSM
 - SAT



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Digital Monitoring Platforms

- Easy to access with all assets in one place
- Accepts multiple feeds
- Feeds legacy systems with API key
- Onsite and Ashore access
- Allows for predictive maintenance



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Risk to AtoN's

Accidental Risks

- Human Factor
 - Asset – incorrect configuration
 - Accidentally Switched off
- Data Corruption
 - Software updates
 - Bad Actor
- Connectivity Risk
 - Network interference



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Risk to AtoN's

Reasons for Hacking:

- Ransomware is one of the top threats.
(System Lock out)
 - Primary motive is money.
 - Affected services, is secondary.
- Once a company is compromised, they generally be come a more frequent target.
 - Lists of targets are frequently published on the dark web
- Terrorist attacks on AtoN's are low probability – but are high impact.
- AtoN Data is low risk.

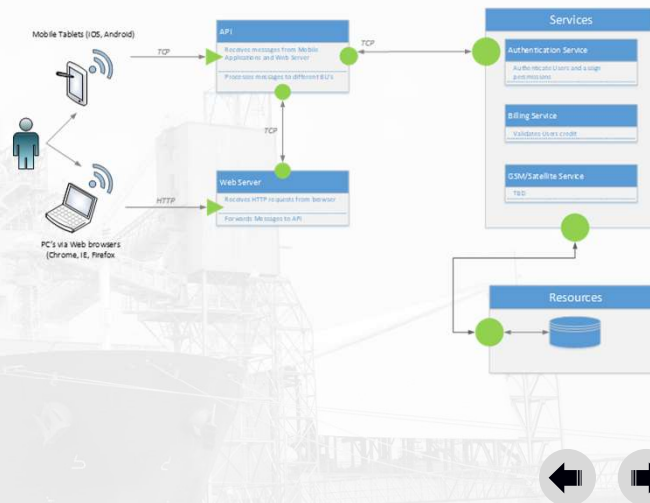


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Risk Mitigation: Data Management Platform

Design considerations should include:

- Encryption Levels for PII and possibly asset data
 - As a minimum use AES-256 for encryption and SHA-256 for Hashing
- Segregation of PII and configuration data from asset data
- Authentication methodologies, such as MFA.
 - Do not expose AD to public
- Password complexity enforcement.



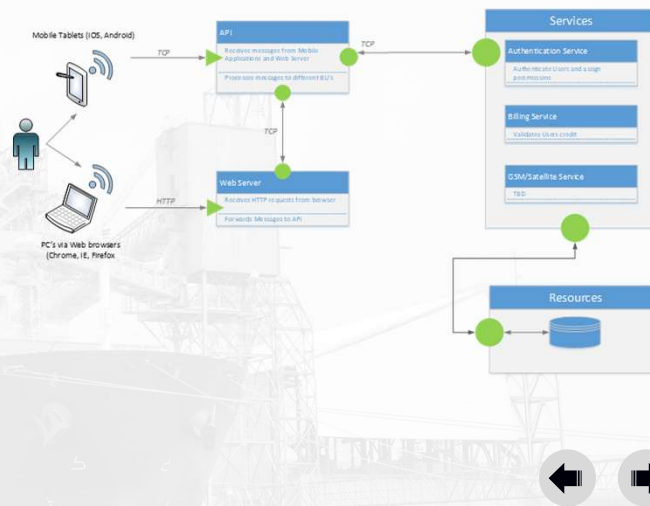
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Risk Mitigation: Data Management Platform

Data Management Platform

(Continued)

- Access layers for separation of:
 - Database
 - API
 - Front-end systems
- End-to-End encryption for REST API and transit data
 - SSL / TLS
- Conduct penetration testing not only for system validation, but continuously.
- Backup and restore management.



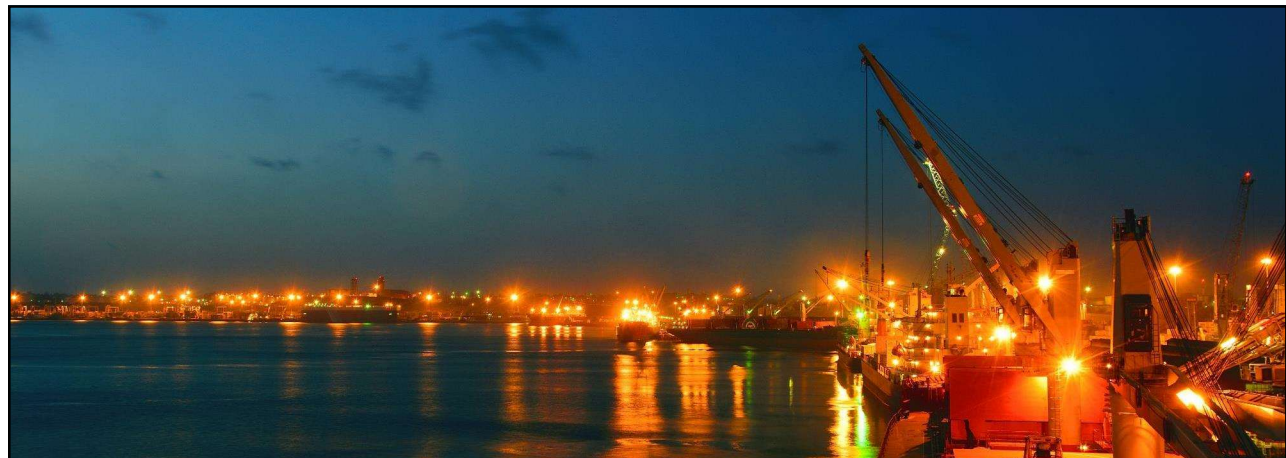
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Conclusions

- Risk Assessments can provide Business Cases for Improved AtoNs, which informs Asset Management Plans.
- Technology has enabled automation.
- Further advancements has led to more reliable means of monitoring.
- The technology has enabled the ability to reduce maintenance costs through remote diagnostics.
- Has lead to longer duration between preventative maintenance cycles.
- Cyber Security is low risk for AtoNs with appropriate mitigation
- Helping to achieve IALA availability targets (CAT1 99.8%)



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Thank you!

Malcolm Nicholson
Global Product Manager
- Marine
Sealite Pty Ltd



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