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Co-developing a pilot integration using OPC UA and MQTT - Deepening Integration in Manufacturing

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FINNISH SOCIETY OF AUTOMATION
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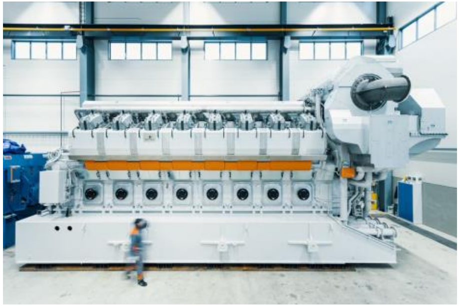
Who we are?

WÄRTSILÄ

Wärtsilä is a global leader in innovative technologies and lifecycle solutions for the marine and energy markets. Our team of 17,500 professionals in more than 200 locations in 79 countries shape the decarbonization transformation of our industries across the globe.



KONECRANES

Konecranes is a global leader in material handling solutions, serving a broad range of customers across multiple industries worldwide. With 16,500 professionals across 50 countries, we consistently set industry benchmarks for safety, productivity, and sustainability worldwide.

What is DIM?

- **D**eepening **I**ntegration in **M**anufacturing is a co-innovation project linked to multiple Veturi programs set to strengthen Finland's position as a global leader in **innovation collaboration, with the support of the data economy**. The project involves developing application prototypes for visualization and analysis material flows. Scope of the collaboration is to **research and develop digital tools** to enhance a **non-solicitation ecosystem** principle in which we share and learn by exchanging ideas, experiences and knowledge.

- For Wärtsilä, sustainability focused on decarbonization is the main driver, this requires acceleration on digital transformation to support changes in the products without any negative impact on performance. Accelerating digital transformation involves leveraging shared data, building trust within a connected ecosystem, and fostering a growth mindset, with innovating collaborative knowledge creation and sharing.

- Konecranes is interested in further enhancing the integration platforms for automatic tracking of material movements and routes, as well as developing application prototypes for material flow visualization and analysis. Research in this scope explores integrating sensor systems, human workers, material handling equipment, and control systems as data sources into the platform as data sources, contributors, and users.

What is the end goal?

- As DIM WS4 partners we currently work on finding out **what information from the crane environment data (KC + W) is useful for the crane users (W)**, and **how can we ensure reliable, on-demand data availability,** focusing on data sources such as the crane's control system and other digital systems around it

  - Without compromising the Crane capabilities
  - Ensuring network security
  - Making the solution scalable for any/many cranes
  - Ensuring value for the users
  - Without restricting innovation capabilities for both KC and W

What is the end goal?

- Some other requirements
  - Integrate cranes as manufacturing assets to a digital platform (shared or open data backbone)
  - Develop an automatic material tracking prototype supported on data from cranes and MES (heterogeneous data models)
  - Integrate tracking technologies usable by both W and KC for better material flow analysis
  - Study details about value creation from this enabler in material flow optimization and correlate with bigger scope goals

Solving One Specific problem

- Wärtsilä's STH **pathways get congested**, and lifting **scheduling is a difficult task** with the current communication methods available. Every year hundreds of engines and parts flow through dozens of cranes.

- As a crane user, Wärtsilä needs to **optimize the load flow** transported in STH's shopfloor by connecting, collecting and analyzing data from the cranes in STH

Research questions

- **How to connect our data source (crane)?**
- **How to comply with cybersecurity in 2 companies at the same time?**
- **What protocols and architectures should we use?**
- **What data do we need from the crane? (extensive namespace)**
- What data do we need from the user? (multi source context)
- Where should we collect (store) the data?
- **How can the information be displayed?**
- How will take ownership of the application?
- Who will carry the maintenance cost?
- How can we add enterprise context to the data

Means of Production as Prototype

How to connect the data source (Crane) to a digital infrastructure?

Connection should be wireless, with low latency and continuous connection stability.

- 5G:
  - Costly for 1st PoC and needs a subscription / private network, service, maintenance only for this case.
  - Could be considered if whole fleet of cranes and other devices would be connected the same way.

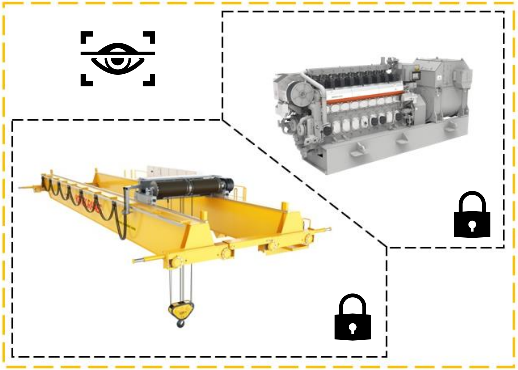
- Point to point:
  - Possible, but requires hardware and maintenance investment, challenging to scale.

- **WiFi**: Using local campus network is supported by IT (roaming through multiple AP). Security, observability and support processes are in place. Requires to use 5GHz channels.
  - After site survey, signal coverage was good enough to provide connectivity across all travel distance with relatively low latency and high connection stability.
  - WiFi client device fits standard devices trusted by Konecranes and provides enough freedom to configure key parameters to ensure compatibility (band, channel, authentication, routing).

How to comply with cybersecurity in 2 companies at the same time?

Main requirements:

- Konecranes cybersecurity needs (resilience):
  - Full segregation of asset network
  - Should not affect to existing protected service connection with own standard architecture
  - No gateway, routing or IP conflicts – Crane should operate 24/7 eventual issues should not propagate across enterprise assets
  - IoT network should not put stress on control network
- Wärtsilä cybersecurity needs (enterprise management):
  - IEC62433
  - Waterfall approach (Unidirectional way of starting TCP connections, from High level of security to low level of security)
  - Purdue (layered segregation)
  - Edge oriented solution
  - Observability and control over remote access



What Protocols and Architectures should we use?

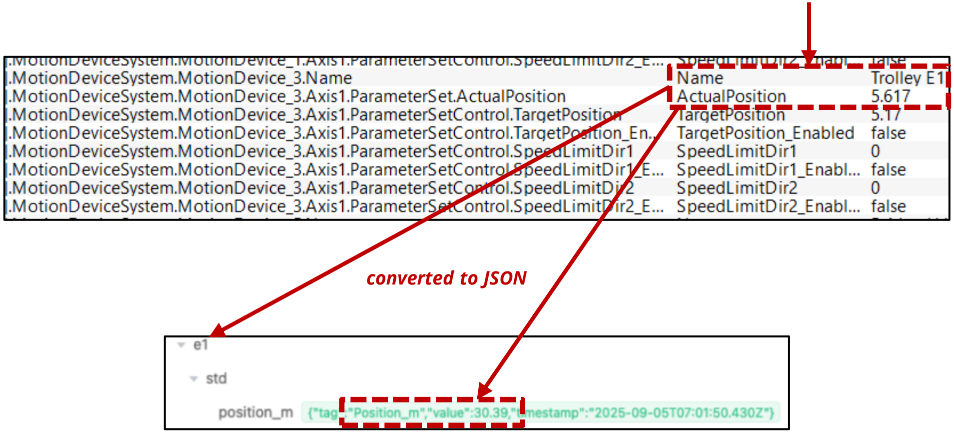
- OPC-UA available in the Crane
- Crane OPC-UA data model ready and discoverable
- OPC-UA client at Wärtsilä was technically doable but violates some cybersecurity architecture principles
- MQTT infrastructure available in Wärtsilä side both in OT and IT
- MQTT supported for ingestion and interfacing
- No control signals intended to be consumed by PLC, this is a monitoring case (i.e. one-way network traffic)
- Event driven architecture (relying on underlying pub-sub) – Reported by exception and custom timed polling as backup when signals are not changing

What data do we need from the crane?

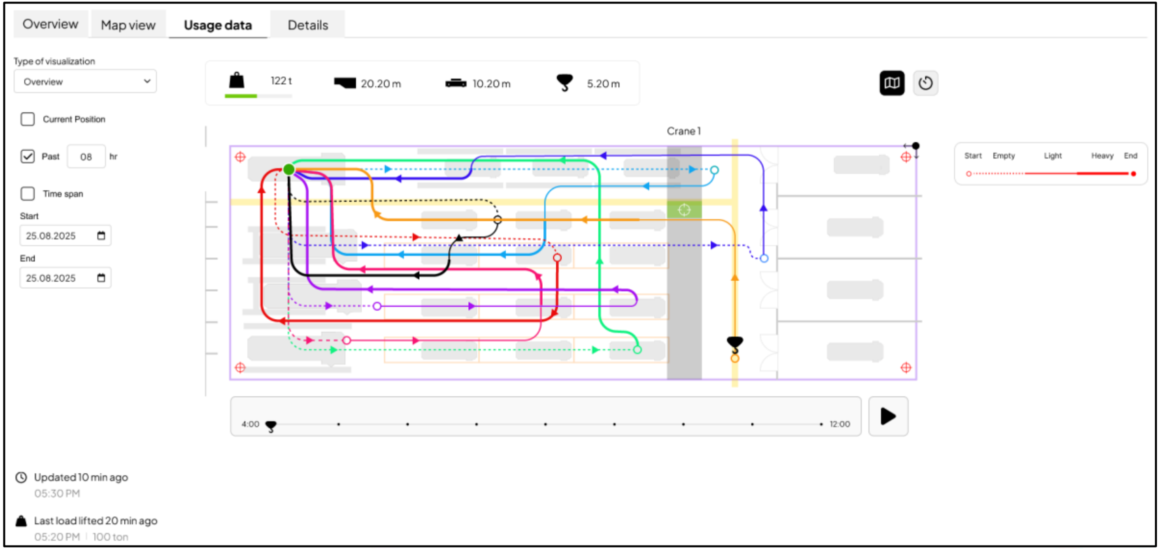
- Context:
  - Enterprise
  - Site
  - Area
  - Line
  - Station
  - Device

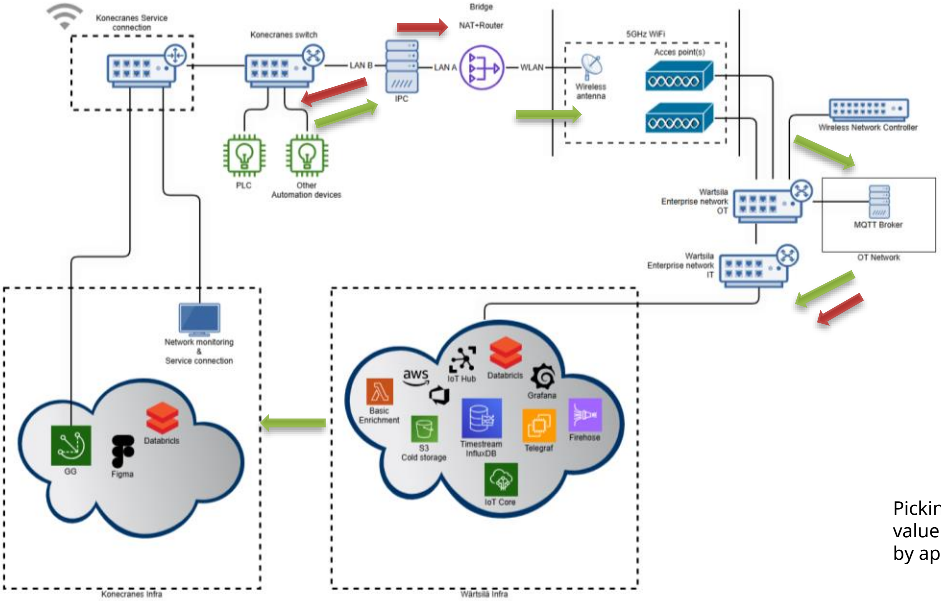
- Trolley, bridge, hoist
  - Position (meters)
  - Run direction 1 (bool)
  - Run direction 2 (bool)

- Hoist:
  - Nominal load (tons)
  - Weight (tons)



Data Visualization





Picking technologies based in proven value by solving a problem known better by application experts

Findings & Learnings

- Digital machine integration between manufacturers requires not only flexibility from the data source, but as well flexible system integrations on the consumer end.
- The more flexible the technology enablers, the better for digital machine integration. In other words, it is very important to have freedom to customize without breaking business models or vice versa
- OPC-UA Client with MQTT forwarder integration gives enough freedom while remains easy and lightweight to use, enabling cost efficient solutions for data sharing from OPC-UA Server sources to cloud infrastructure/services

Findings & Learnings

- In this case multiple tools aligned as enablers rather than constraints. A cloud agnostic approach and technology centered architecture allowed us to mix open-source tools, multiple cloud suppliers, licensed software products, and technology partners into an ecosystem-oriented project.

- Special thanks to our subcontracting partner Brightly Works Oy for supporting the implementation of an edge component flexible enough to support our architecture requirements.

What's next?

- Data context on extensive data models is critical, so people will easily know what to pick and how to align their IT applications to multisource IoT data
- Adaptive interfaces are a nice feature to have, so we transfer what is needed and can react to changes on requirements
- Fix our NTP issues
- Continue using more data sources (MES, internal location and identification systems)

Thank You