



ETSI
NEW INTERNET FORUM

12 October 2018

FACTORY INFRASTRUCTURE MONITORING AND SUPERVISION

Presented by Károly Farkas



OUTLINE

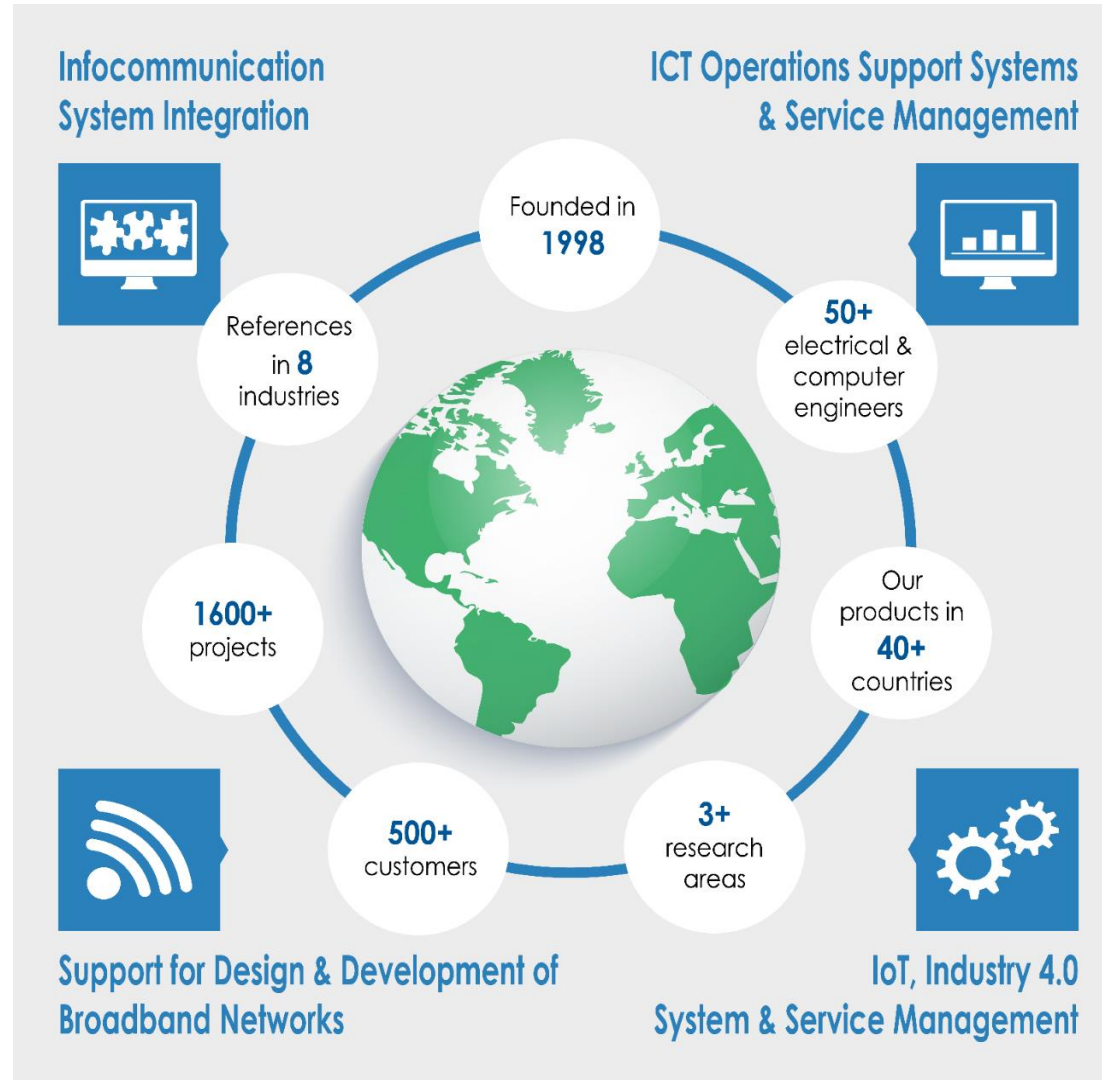
Introduction

Infrastructure monitoring and supervision

Demonstration

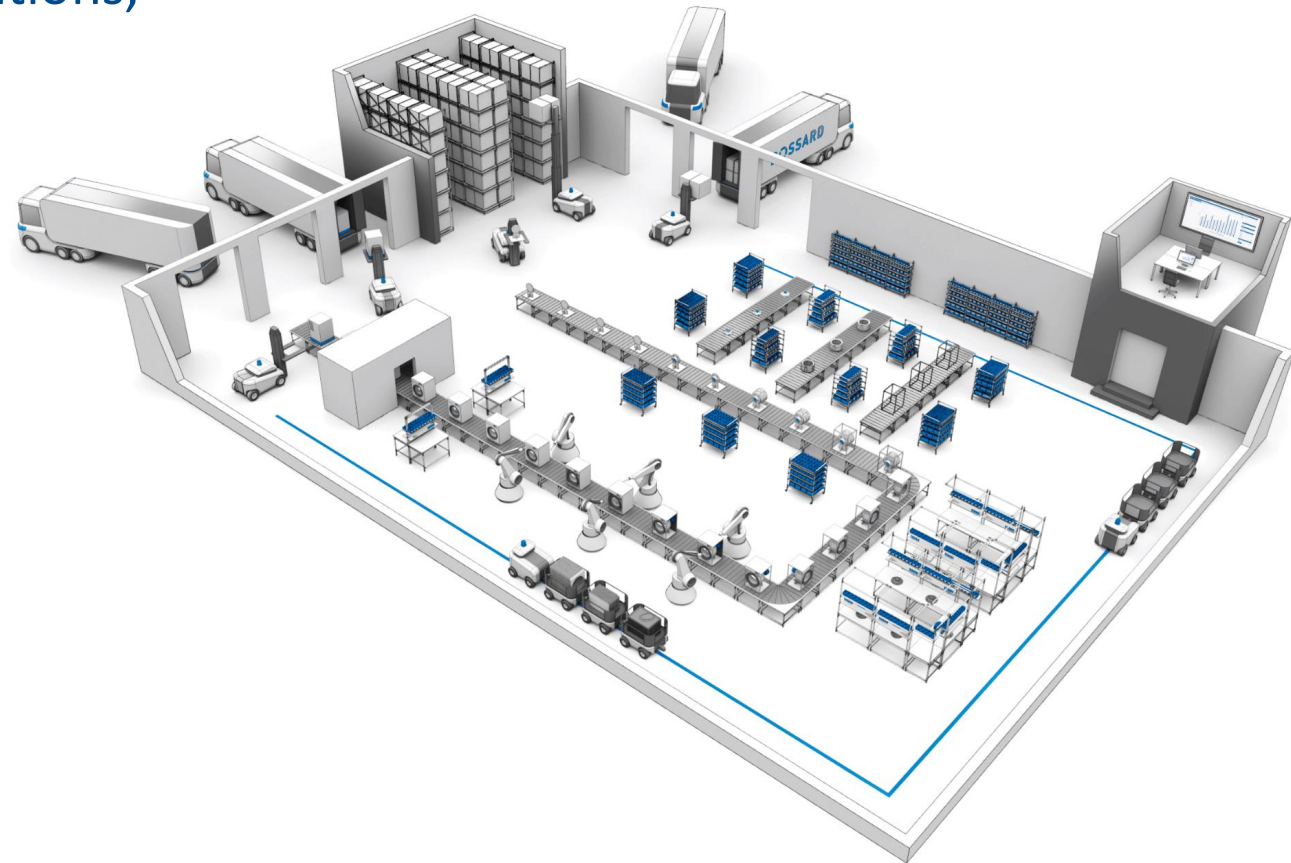
Summary

NETVISOR INTRODUCTION





- Complex industrial production environment
 - PLCs, sensors, SCADA, MES, communications, facility, etc.
- Using unified monitoring and supervision it is easy to implement
 - Unified inventory of the factory infrastructure elements
 - Fault detection, alarms
 - Determination the source of failure
- Benefits
 - Faster fault localization
 - Decreased production downtime
 - Increased production capacity
 - Increased revenue



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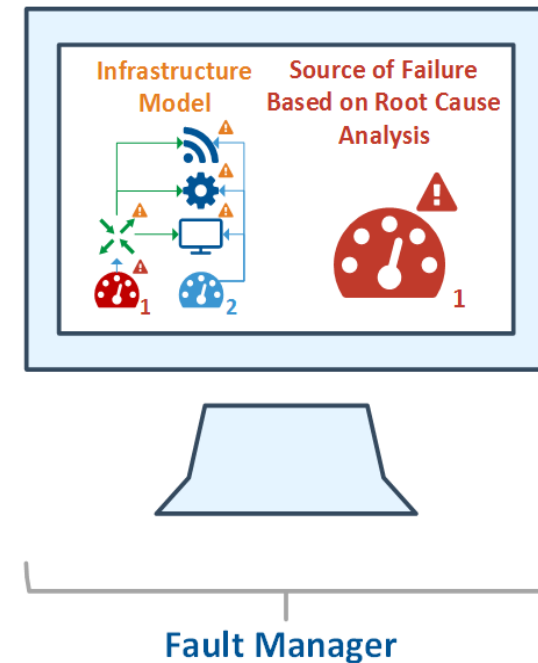
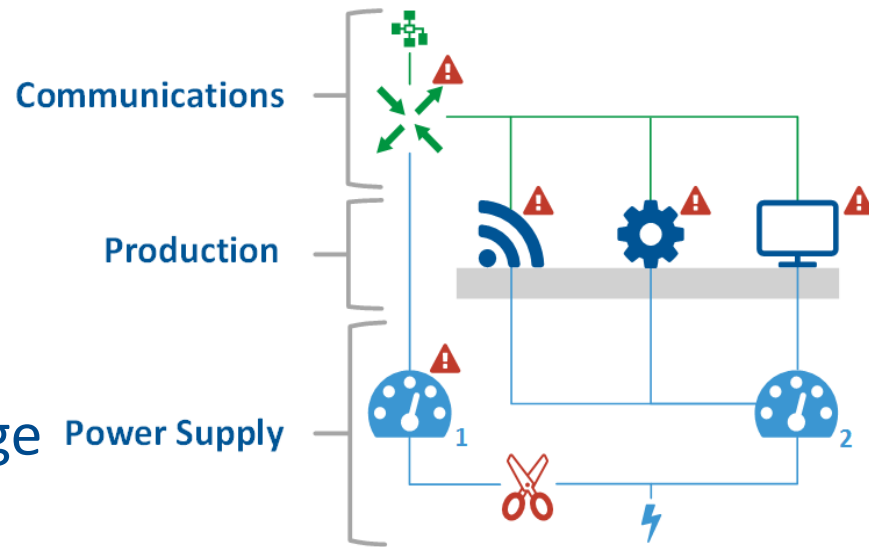
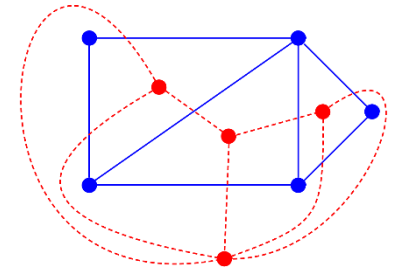
Summary

HOW IS THAT?

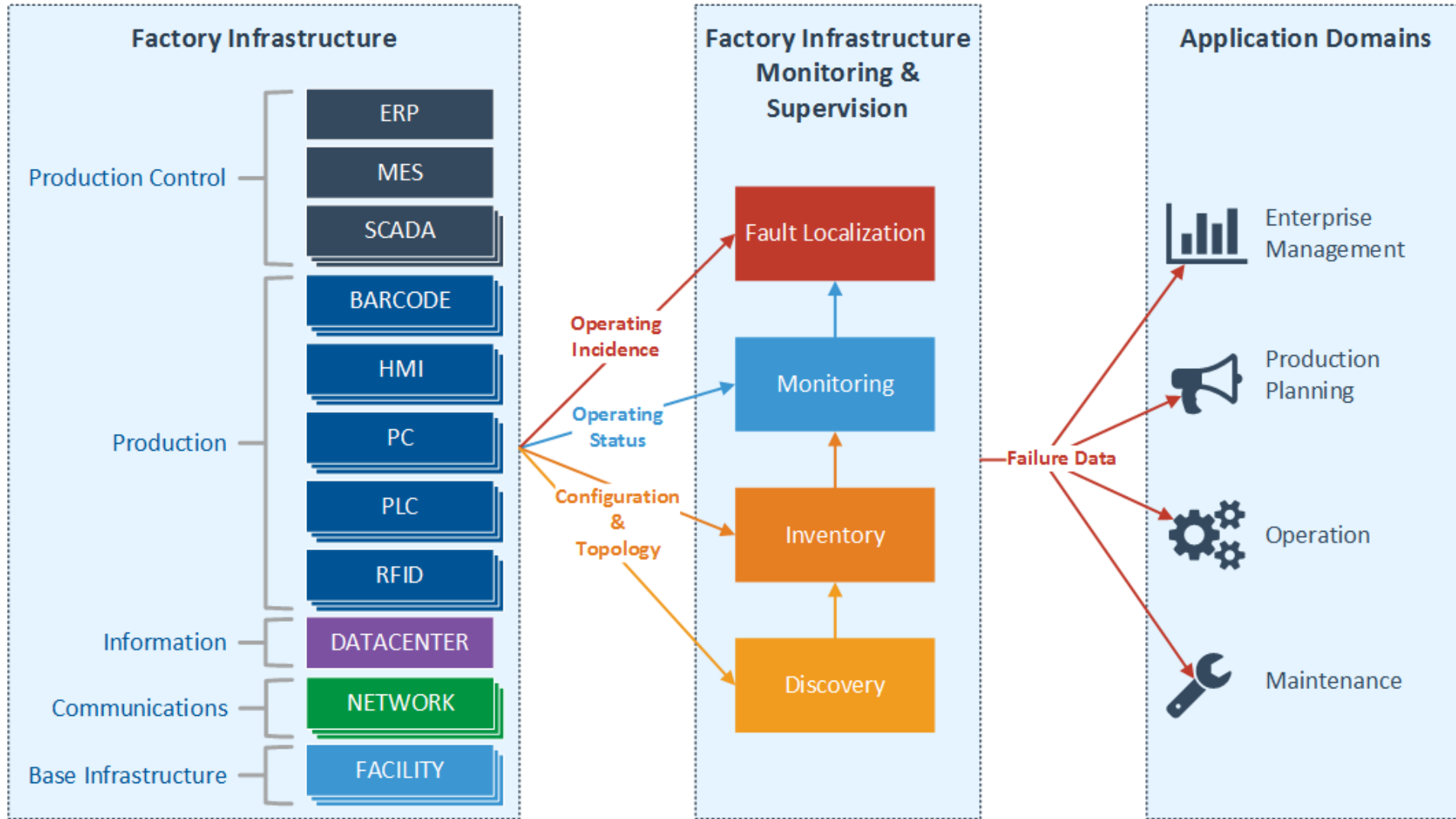
- If we monitor in a unified manner the
 - Communications
 - Production
 - Power Supply
- the **Fault Manager**
 - gathering alarms from these subsystems,
 - based on correlations & rules, and purpose driven data storage & handling,
 - determines easily and quickly the source of failure.



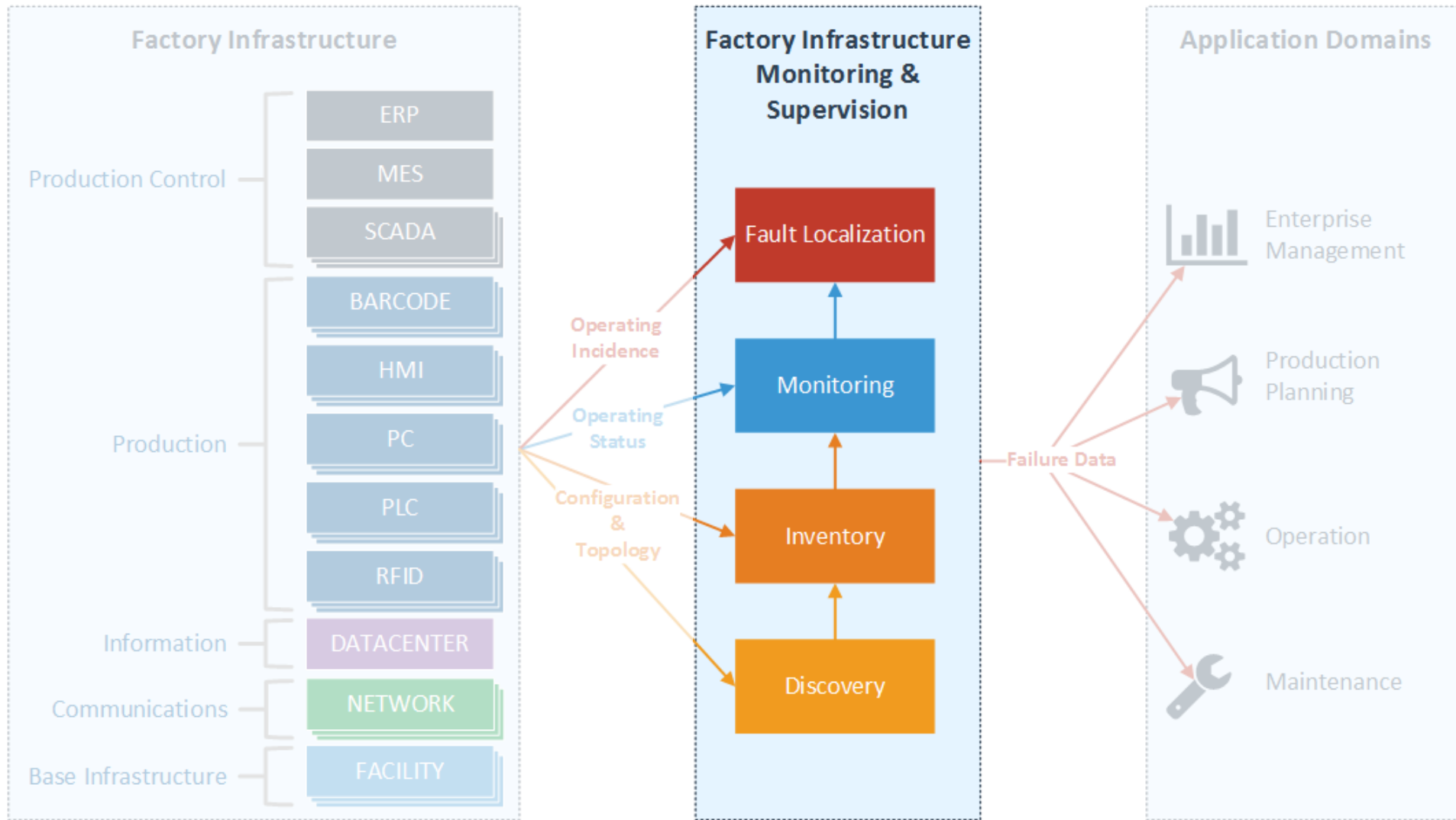
Correlations, Rules



...GENERALIZING AND IN A BIT MORE DETAIL...



...GENERALIZING AND IN A BIT MORE DETAIL...

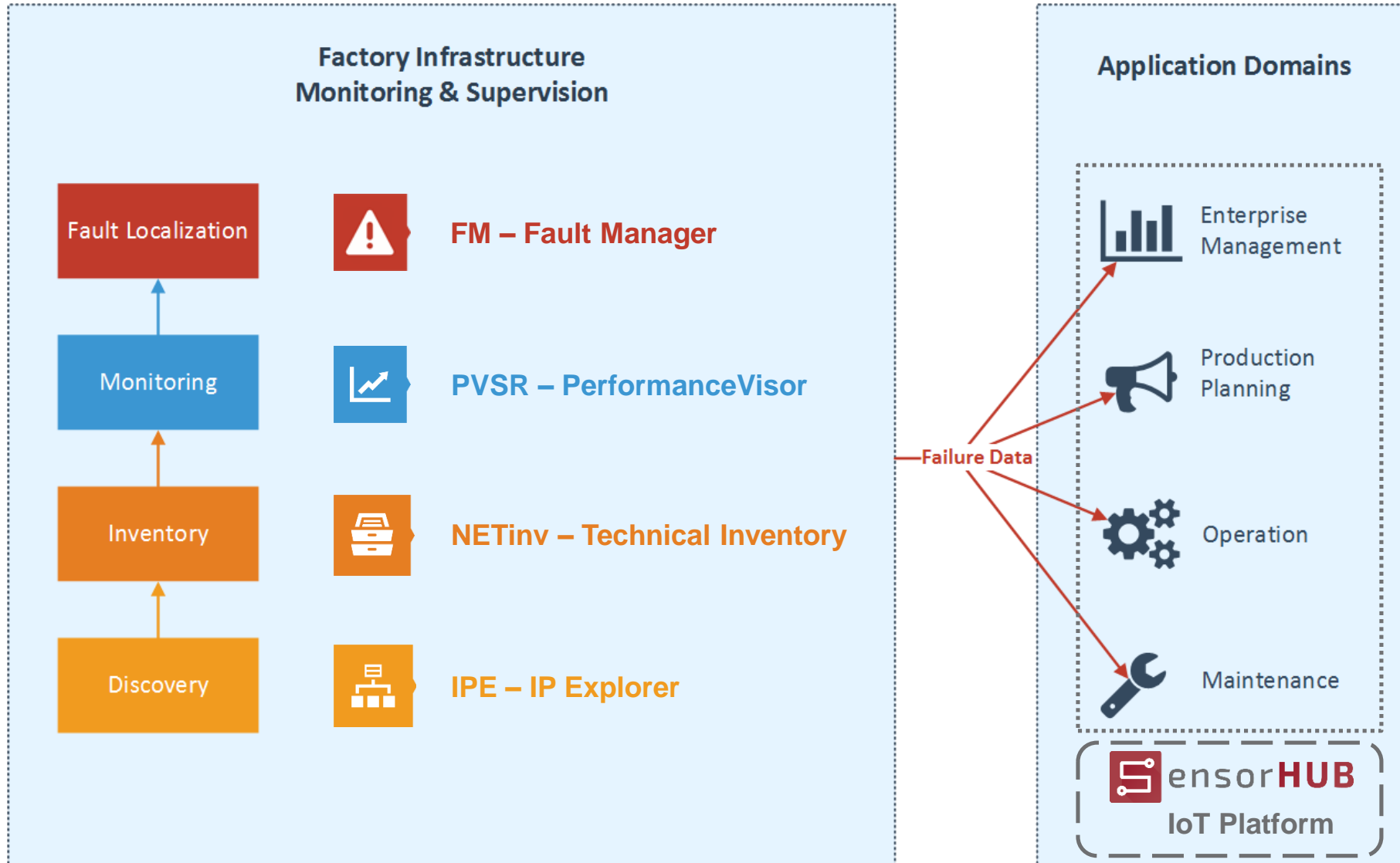


REQUIREMENTS TOWARD THE NETWORK

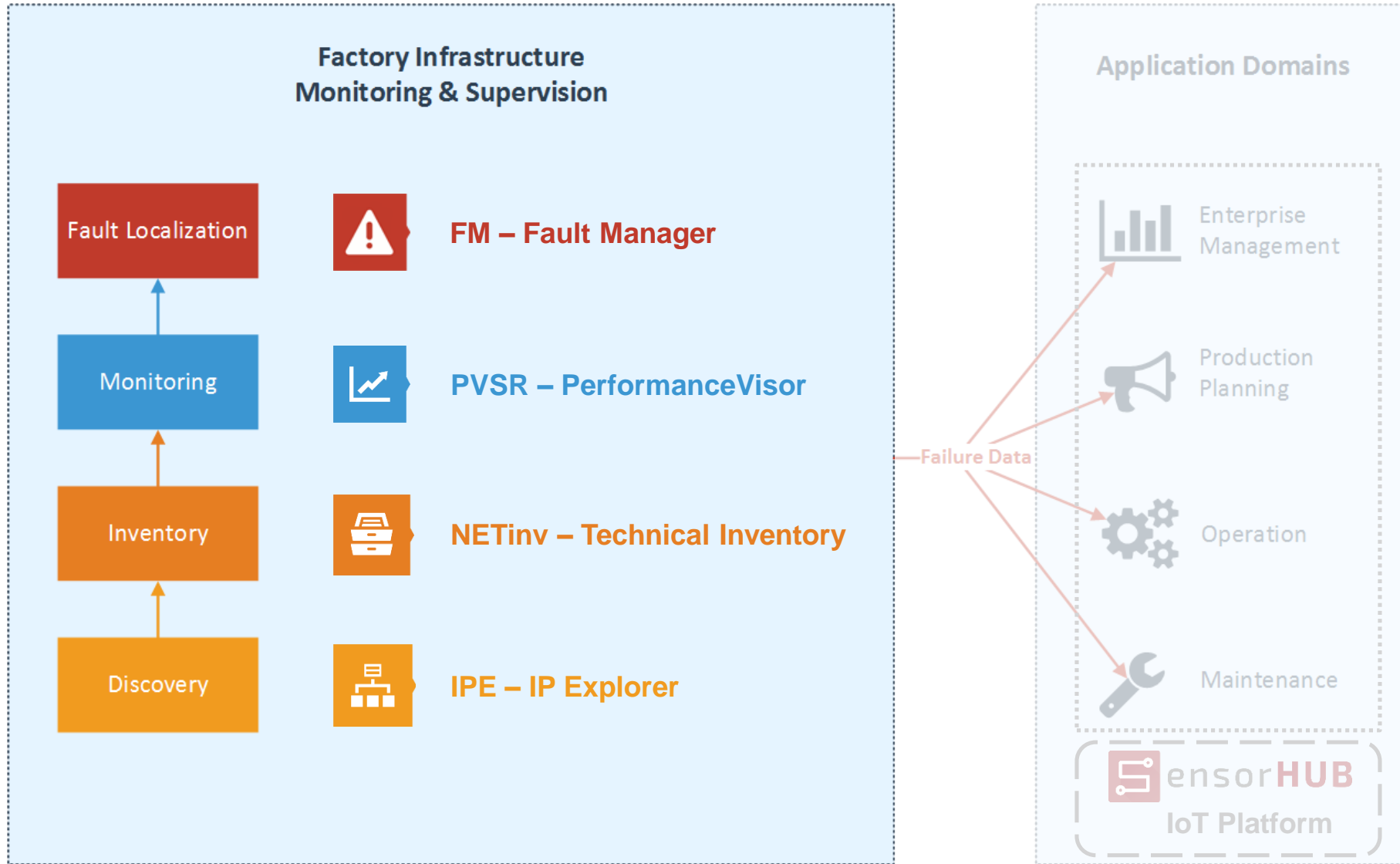


Attribute	Monitoring and Supervision	Production Control
Operation	normal	real-time
Time scale	sec – min	usec – msec
Bandwidth	not critical	not critical
Delay / Jitter	not critical	critical (TSN – Time-Sensitive Networking)
Fault tolerance	(less) critical	critical
Security	critical	critical
Synchronization	not critical	critical (distributed real-time scheduling)
Technology	wired / wireless	wired
Standards / Protocols	SNMP, MQTT, etc.	OPC UA TSN, OMG DDS, etc.

OUR TOOLS / OUR APPROACH



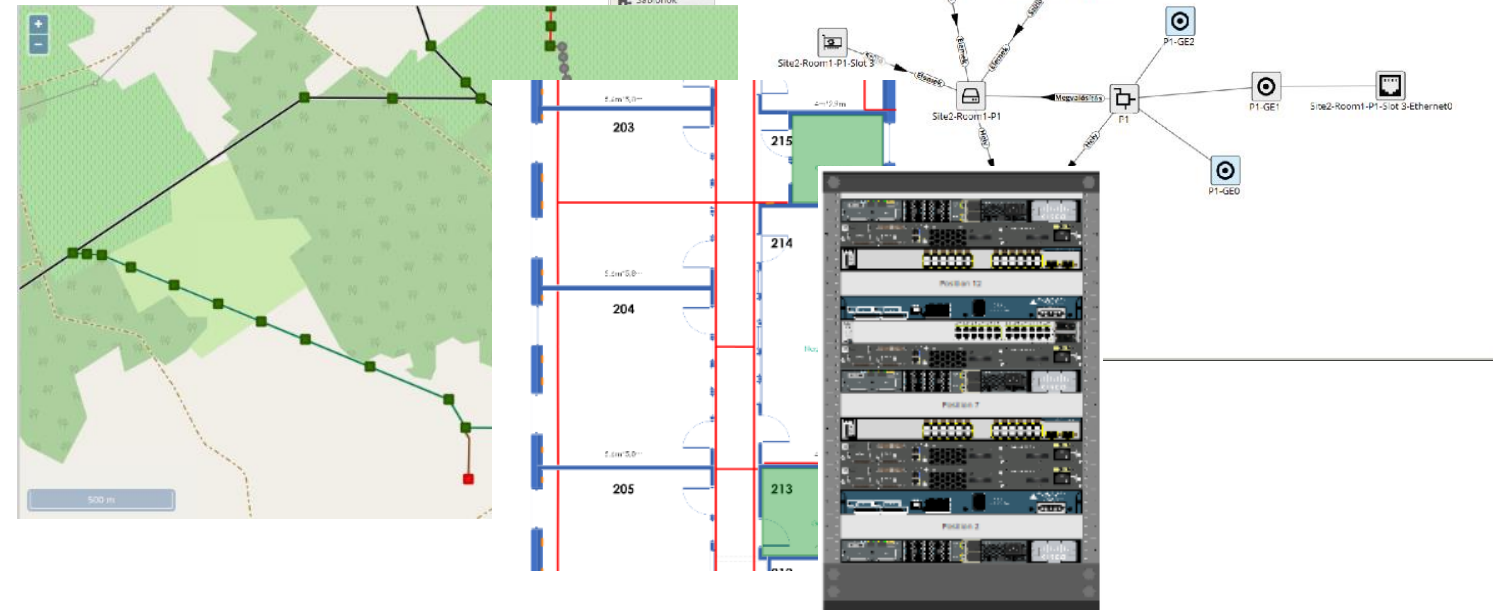
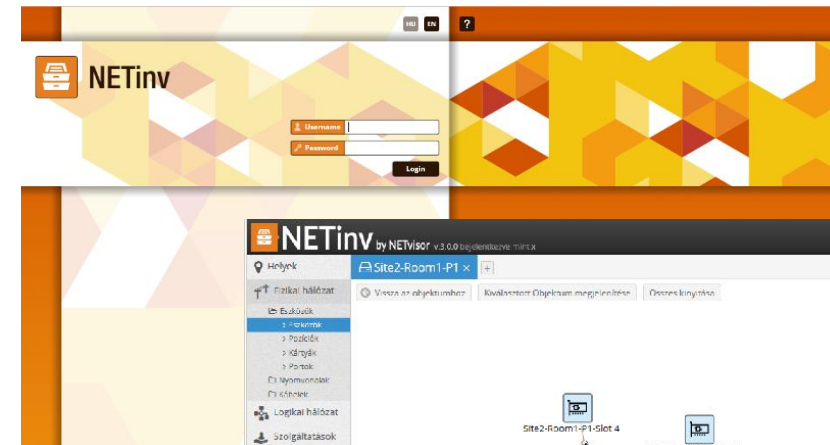
OUR TOOLS / OUR APPROACH



NETinv – TECHNICAL INVENTORY



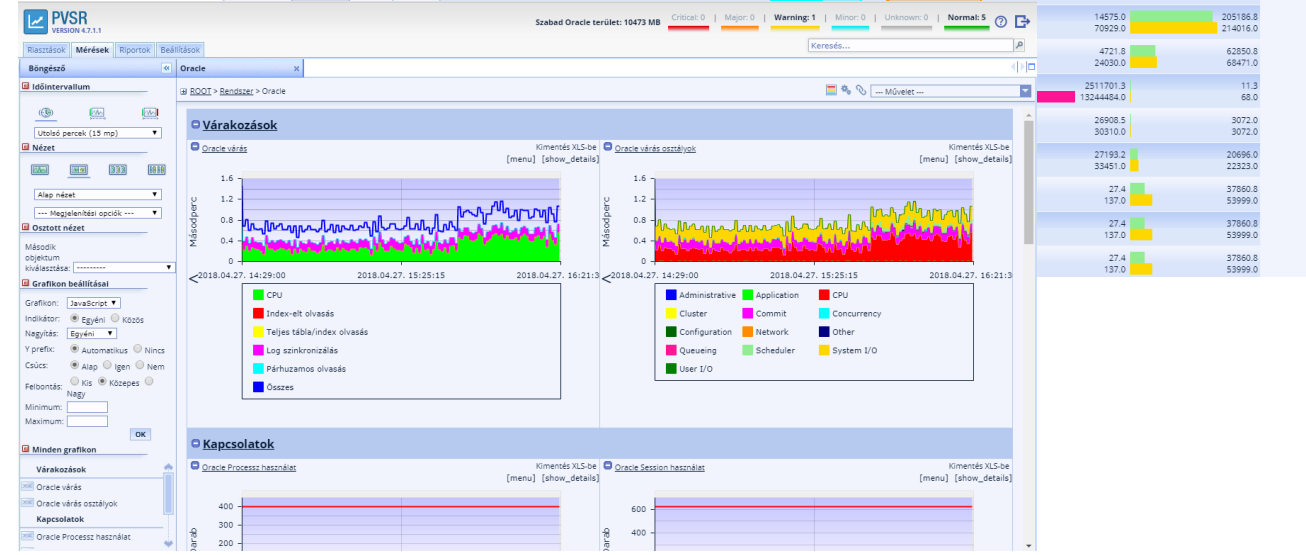
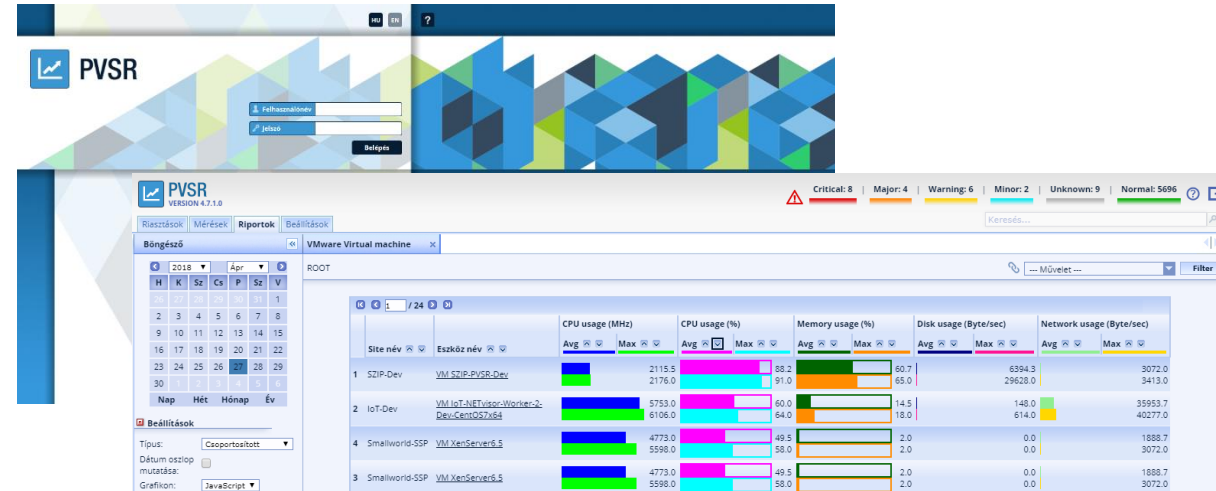
- Comprehensive inventory of ICT services, logical and physical resources
- Supports capacity and resource management
- Inventory visualization
- Supports daily operation
- Supports failure recovery



PVSR – PERFORMANCEVISOR



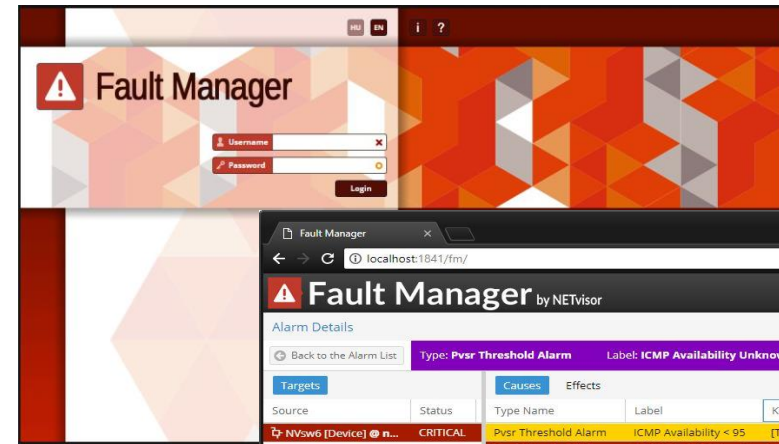
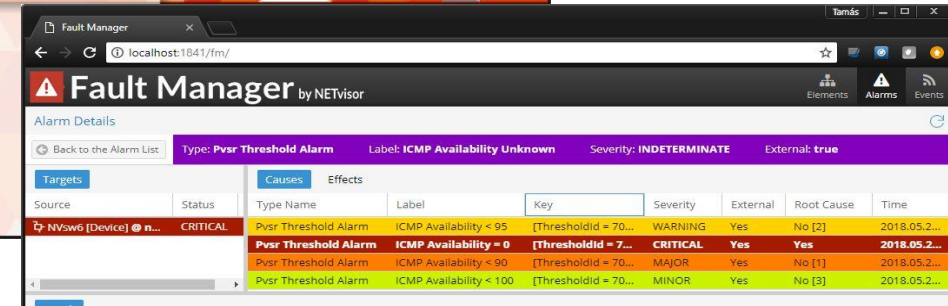
- Comprehensive performance monitoring of information systems
- Definition and visualization of measurements, alarms
- Extreme scalability
- Works together with arbitrary management tools/protocols
- Available also on mobile devices



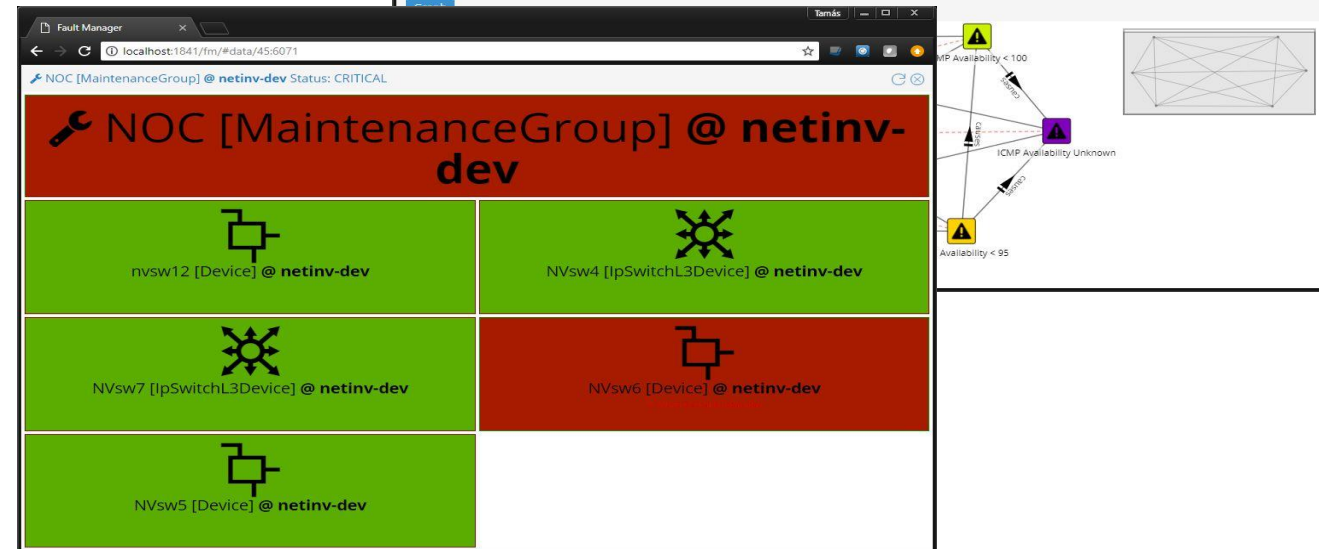
FM – FAULT MANAGER



- Fault localization via root cause analysis
- Failure model based on correlations and rules
- Alarm handling
- Efficient data storage and handling using graph databases
- Works together with arbitrary management tools/protocols
- Still under development

Source	Status	Type Name	Label	Key	Severity	External	Root Cause	Time
NVsw6 [Device] @ n...	CRITICAL	Pvsr Threshold Alarm	ICMP Availability < 95	[Thresholdid = 70...	WARNING	Yes	No [2]	2018.05.2...
		Pvsr Threshold Alarm	ICMP Availability = 0	[Thresholdid = 7...	CRITICAL	Yes	Yes	2018.05.2...
		Pvsr Threshold Alarm	ICMP Availability < 90	[Thresholdid = 70...	MAJOR	Yes	No [1]	2018.05.2...
		Pvsr Threshold Alarm	ICMP Availability < 100	[Thresholdid = 70...	MINOR	Yes	No [3]	2018.05.2...



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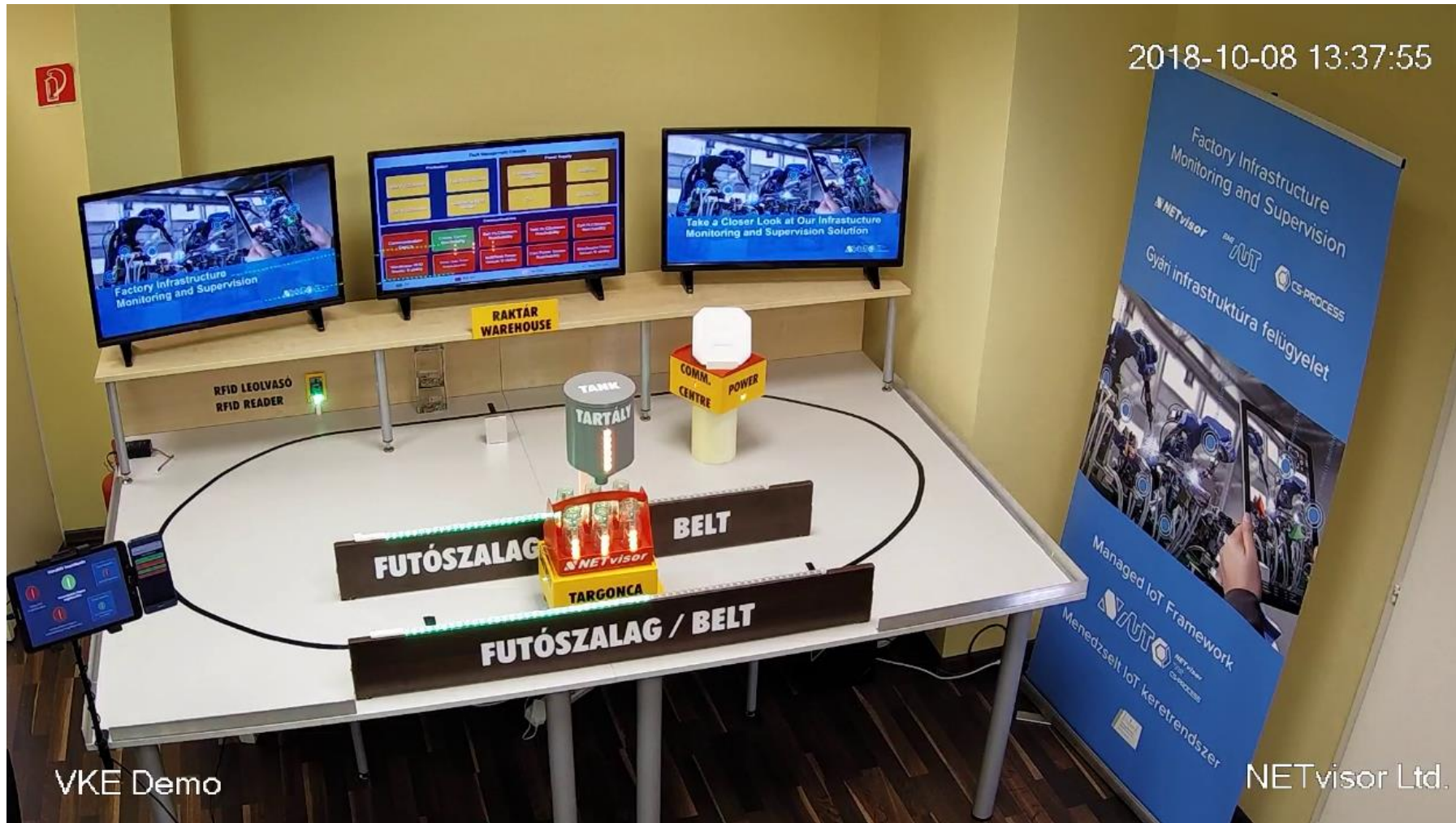
Infrastructure monitoring and supervision

Demonstration

- BME Industry 4.0 Technology Centre, Budapest
- ACM SIGCOMM 2018 Conference, Budapest

Summary

BOTTLING PLANT MONITORING & SUPERVISION



VKE Demo

NETvisor Ltd.

DEMO TABLE



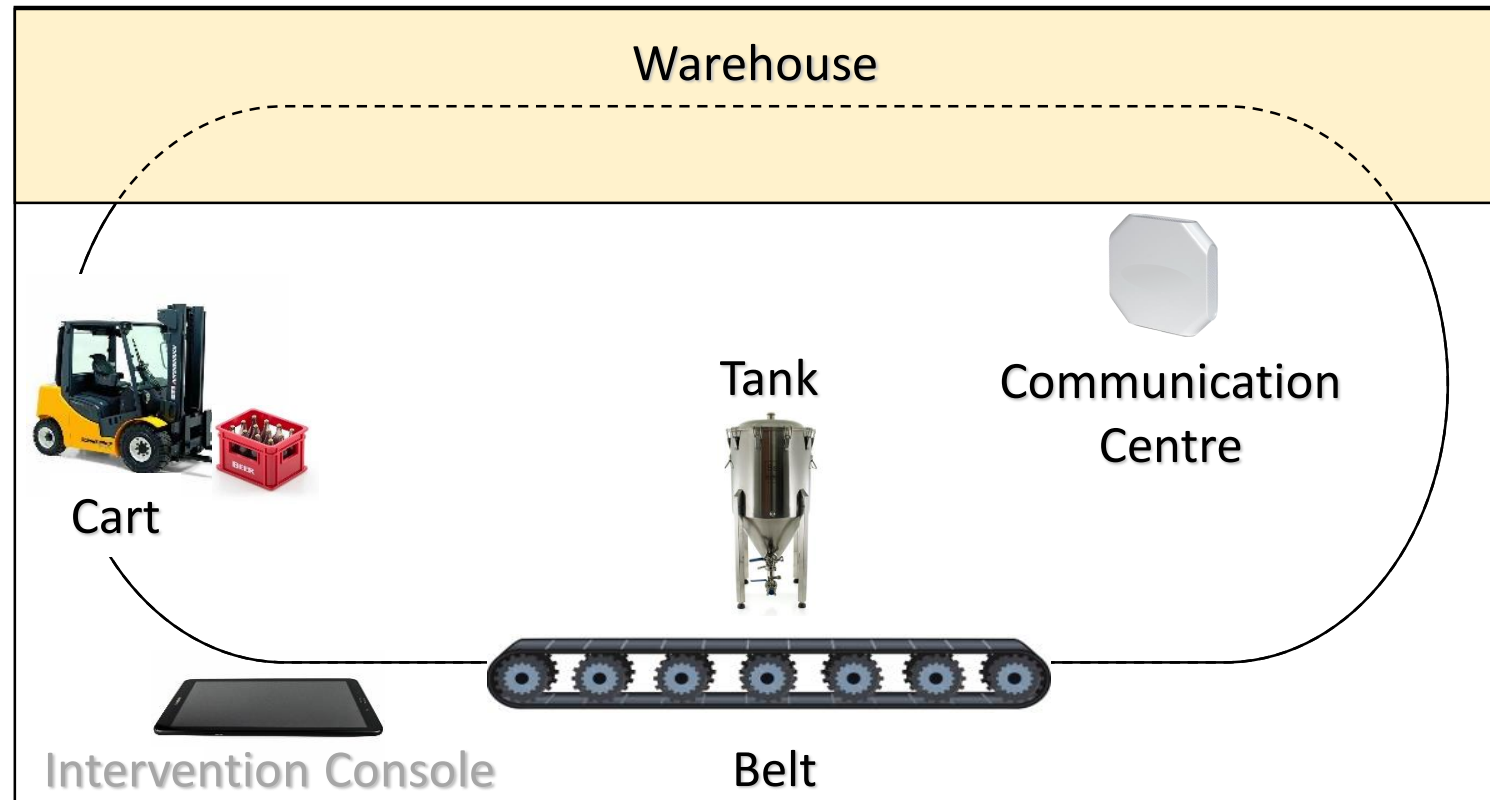
- Demonstrated **production process** on the plotting board

- Case movement
- Bottle filling up
- Case swap
- **Plant units**
 - Warehouse
 - Cart
 - Belt / Tank
 - Communication Centre
 - Monitoring & Supervision Centre
- Intervention Console



Monitoring & Supervision Centre

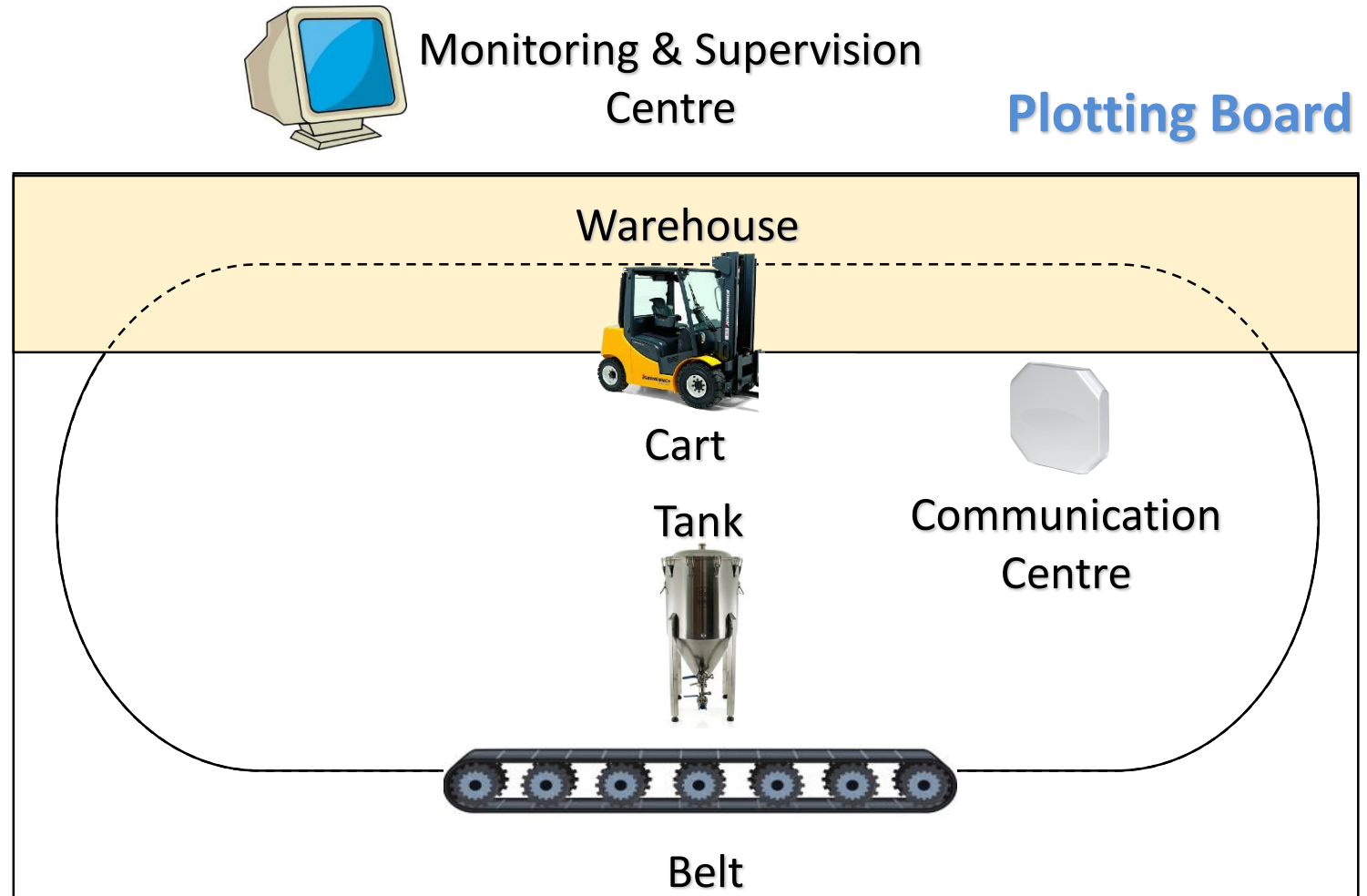
Plotting Board



NORMAL OPERATION



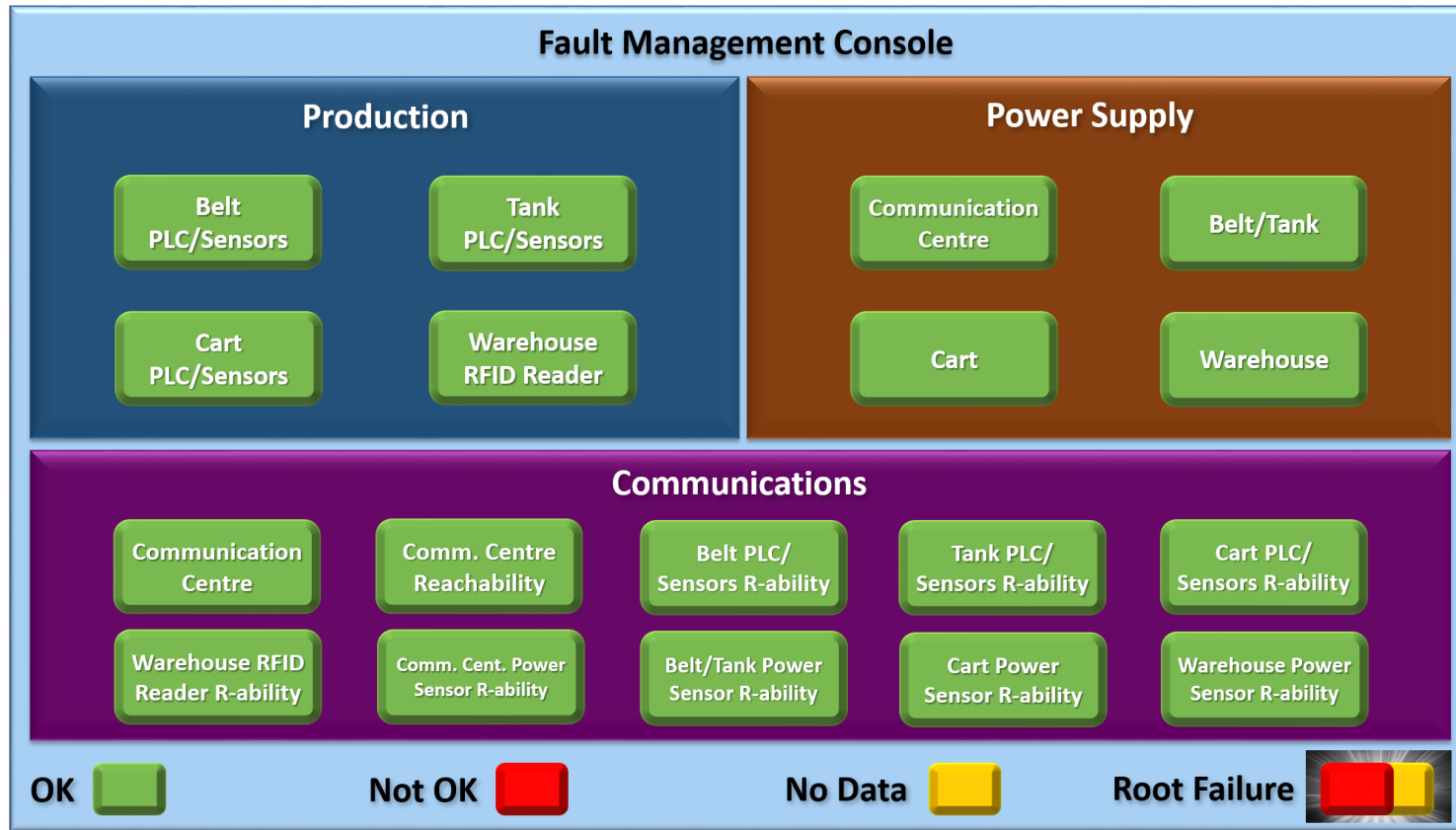
- Operation phases
 1. The Cart moves the case with **empty bottles** to the Belt
 2. Imitating the Belt, the Cart travels through along the Belt sides, while the **bottles** in the case are **filled up** from the Tank, whose liquid level drops
 3. The Cart moves the case with the **filled up bottles** to the Warehouse
 4. The filled up **bottles** are **swapped** with empty bottles



HOW DO WE SUPERVISE THE OPERATION?



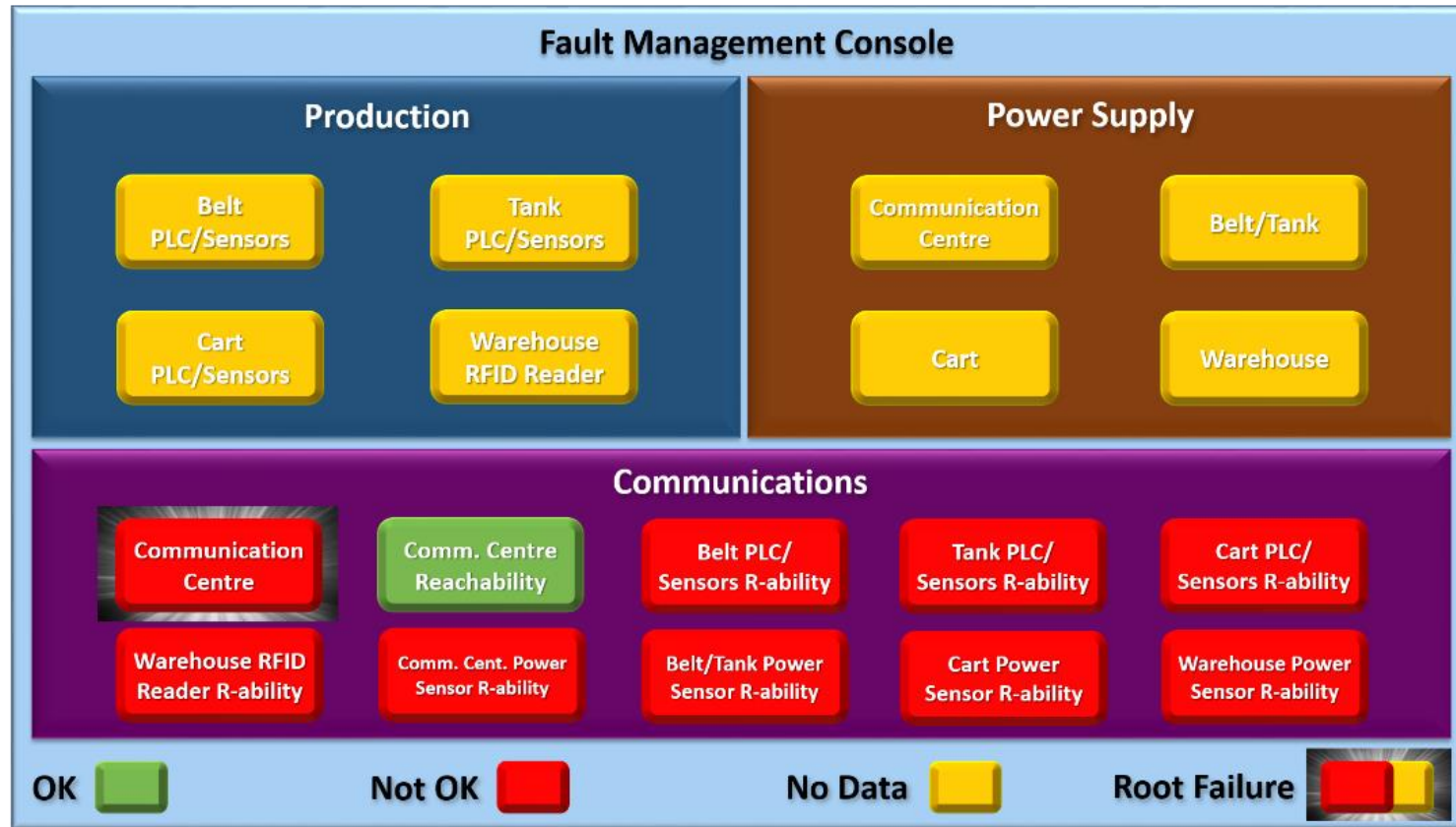
- Via measurements we monitor the status of the plant units and visualize it on the Fault Management Console



HOW DO WE SUPERVISE THE OPERATION?



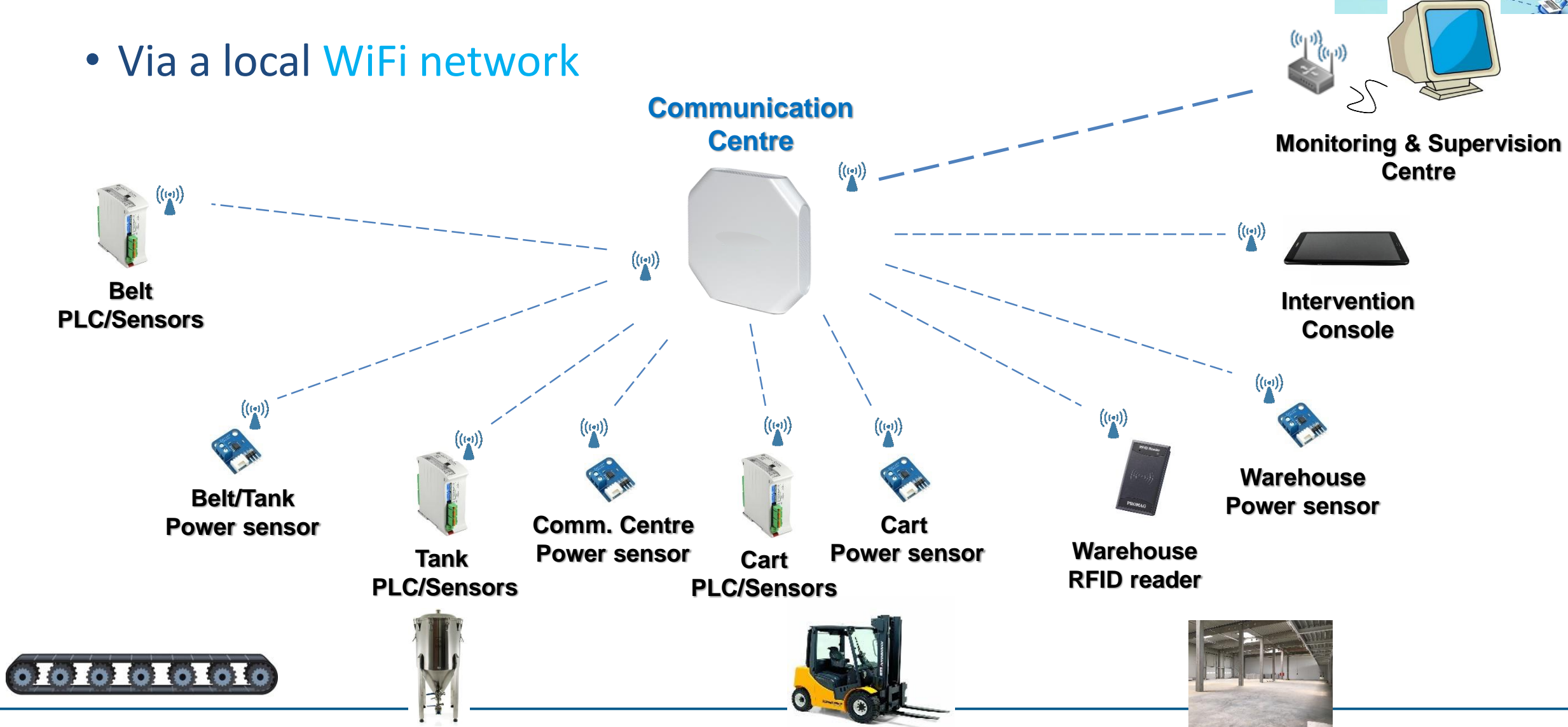
- In case of failure, the **Fault Management Console** shows the impact of the failure if any, and its root



HOW DO THE DEVICES COMMUNICATE?



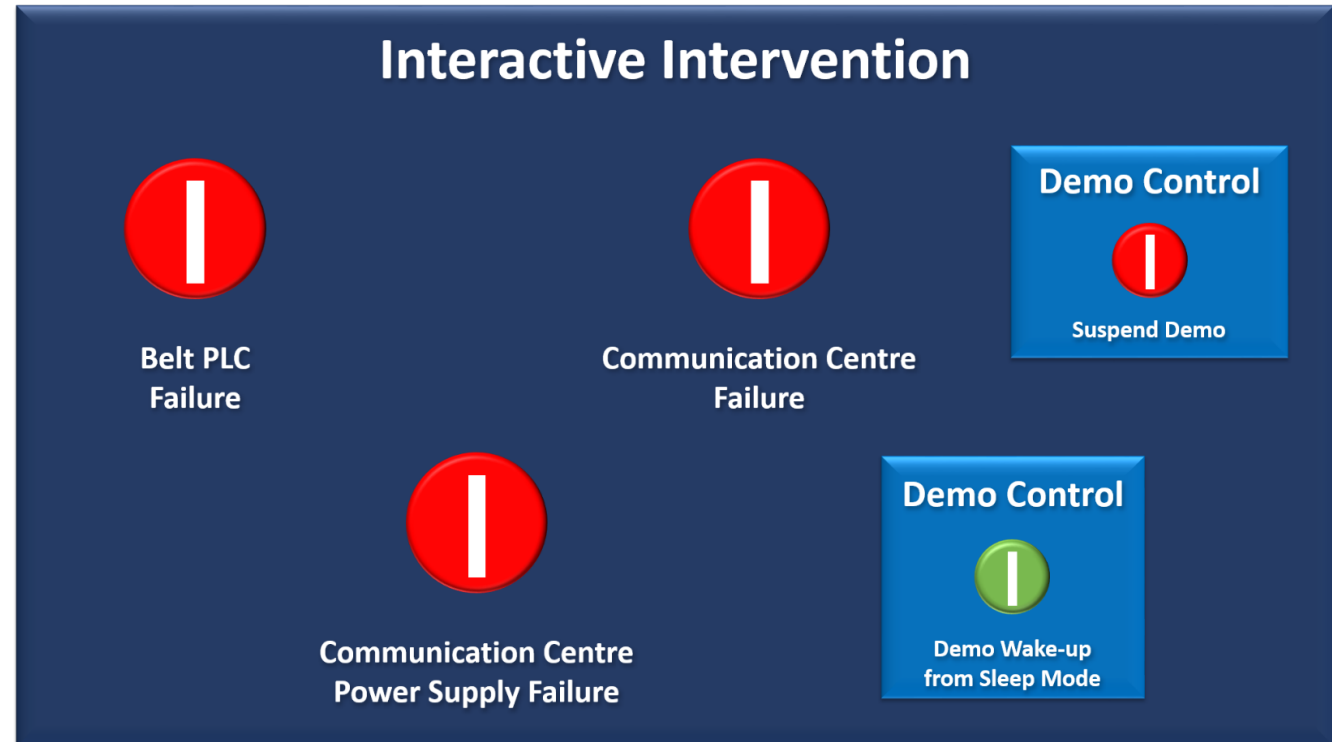
- Via a local WiFi network



AND HOW DOES THE FAILURE GET INTO THE SYSTEM?




- Programmed failures
 - Generated automatically from time to time
 - 1-1 failure per subsystem
- Manually generated failures
 - Ingested via the Intervention Console
 - 1-1 failure per subsystem
 - *Furthermore, the demo can be woken up from sleep mode and suspend/resume also here*
- +1 Joker failure...





JUST TRY IT!




Interactive Intervention



Belt PLC Failure





Communication Centre Failure




Demo Control

Suspend Demo



Communication Centre Power Supply Failure



Demo Control

Demo Wake-up from Sleep Mode




Fault Management Console

Production				Power Supply	
Belt PLC/Sensors	Tank PLC/Sensors	Communication Centre	Belt/Tank		
Cart PLC/Sensors	Warehouse RFID Reader	Cart	Warehouse		
Communications					
Communication Centre	Comm. Centre Reachability	Belt PLC/Sensors R-ability	Tank PLC/Sensors R-ability	Cart PLC/Sensors R-ability	
Warehouse RFID Reader R-ability	Comm. Cent. Power Sensor R-ability	Belt/Tank Power Sensor R-ability	Cart Power Sensor R-ability	Warehouse Power Sensor R-ability	
OK ■	Not OK ■	No Data ■	Root Failure ■ ■		


JUST TRY IT!



Interactive Intervention




Belt PLC Failure




Communication Centre Failure

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Suspend Demo

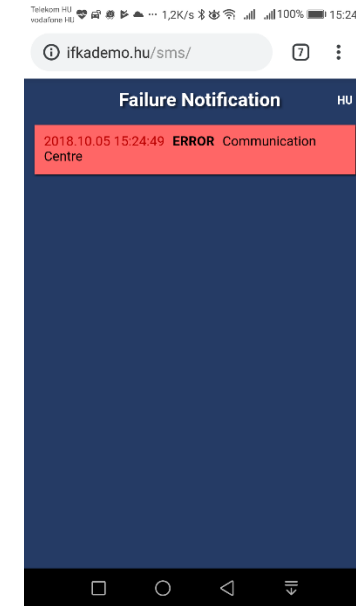


Communication Centre Power Supply Failure

Demo Control



Demo Wake-up from Sleep Mode



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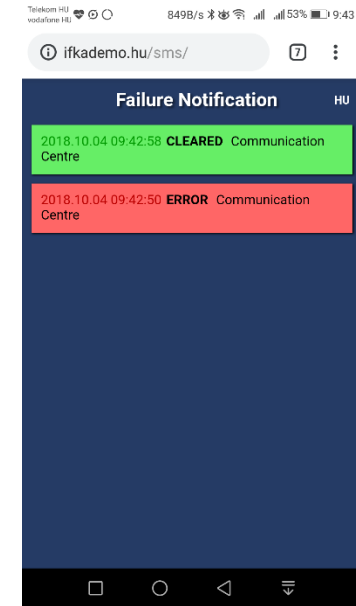


Communication Centre Power Supply Failure



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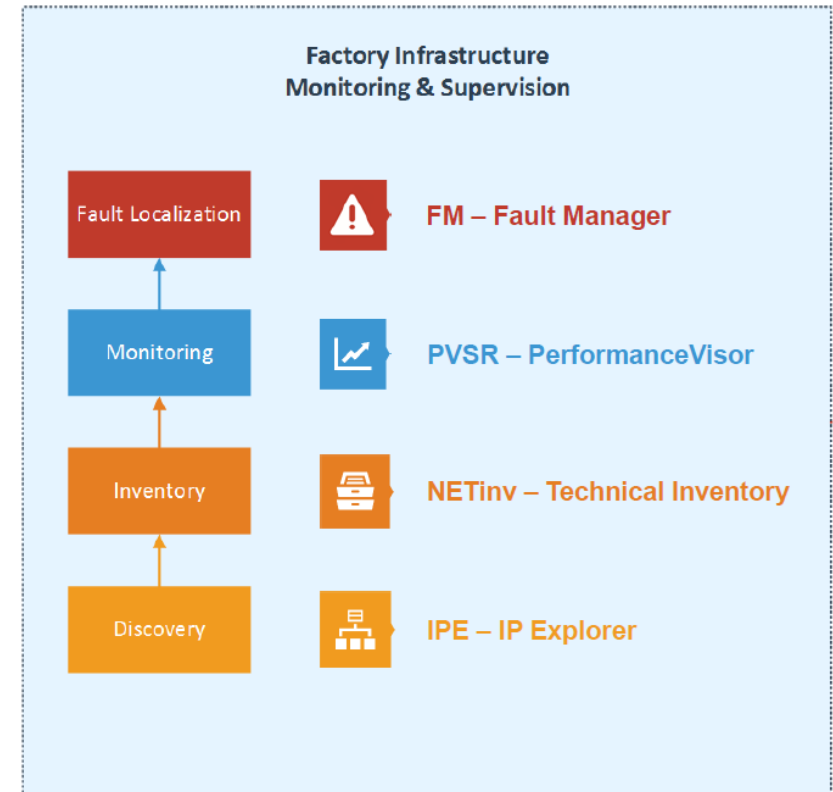
Infrastructure monitoring and supervision

Demonstration

Summary



- Factory infrastructure monitoring and supervision
 - Subsystems are handled in a unified manner
 - Our solution: IPE, NETinv, PVSR, FM
 - Demonstration: Bottling Plant

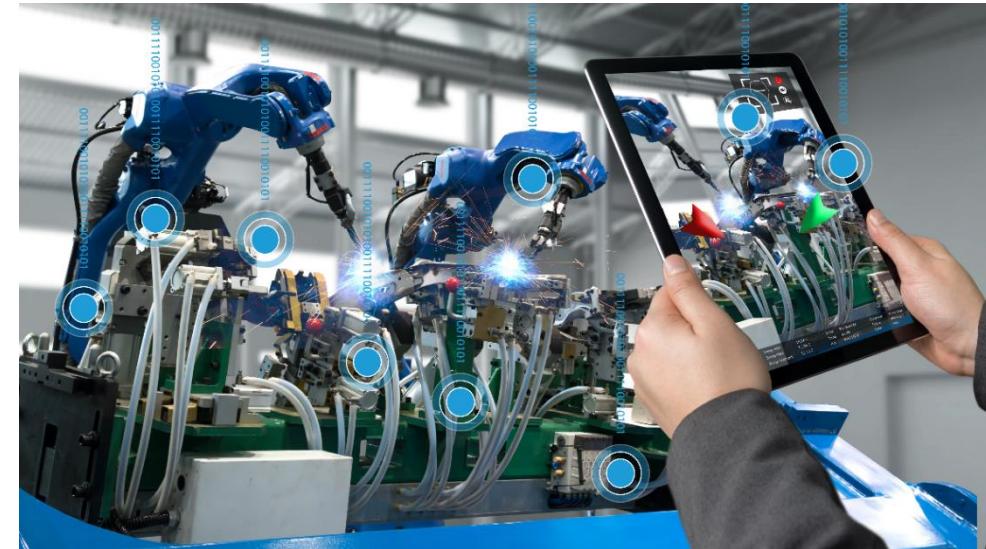




- Reference deployments
 - Richter Gedeon PLC., Hungary
 - IPE: 750 end points; daily refresh
 - PVSR: 500 monitored devices/services; 12k measurements in every 5 min; 50GByte data store; raw data for the last 90 days otherwise hourly average
 - BorgWarner Ltd., Hungary
 - IPE: 2.5k end points; daily refresh
 - PVSR: 400 monitored devices; 14k measurements in every 5 min; 50GByte data store; raw data for the last 120 days otherwise hourly average
 - Suez Water Ltd., Hungary – FM pilot
 - IPE: 300 end points; daily refresh
 - NETinv: 300 devices; incremental updates
 - PVSR: 350 monitored devices/services; 18k measurements in every 5 min; 50GByte data store; raw data for the last 90 days otherwise hourly average
 - FM: pilot deployment



- **Mass deployment** of sensors, IoT devices
 - Some hundreds – thousands per site
- **Support** to decision making / optimization / maintenance / etc. **based on big data analysis**
- **Real-time applications** in production control
- **VR / AR applications** to assist daily work
 - Full HD (1080p), 30fps: 10 Mbit/s
 - 2k (1440p), 60fps: 30 Mbit/s
 - 4k (2160p), 60fps: 66 – 85 Mbit/s



ACKNOWLEDGEMENTS



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FROM THE NRDI FUND

MOMENTUM OF INNOVATION

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THANK YOU FOR YOUR ATTENTION!

www.netvisor.hu