Belden's
Industrial Edge Solutions

Lab Hang Ren – Solution Consultant

9th November 2023

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Agenda

1. **Introduction to Belden**

2. **Edge application (problem statement)**

3. **General Edge product portfolio**

4. **OpEdge-8D**

    a) **Specs**

    b) **Architecture & capabilities**

    c) **Use Cases & benefits**

    d) **Live – Demo**

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Cooperate Overview

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Our Purpose

Industrial Automation Solutions

Smart Buildings Solutions

Broadband Solutions

TO BUILD THE FOUNDATION FOR A DIGITAL WORLD

We're going beyond connectivity….
to building the foundation for a digital world.

Belden has a long history as a trusted supplier of products since our founding in 1902.

TV in the 1950s

Now 2023

We're shifting our focus to what we can make possible as a value-added solutions provider.

Radio Broadcasting in the 1920s

Computer Networking in 1980s-90s

Belden has supported radio, TV and computer networks throughout the years, but every day our customer's networks are becoming more complex, more demanding and more data-dependent

Belden Today

Revenue Mix

54%
Industrial Automation Solutions

24%
Smart Buildings Solutions

22%
Broadband Solutions

66%
Americas

20%
EMEA

14%
APAC
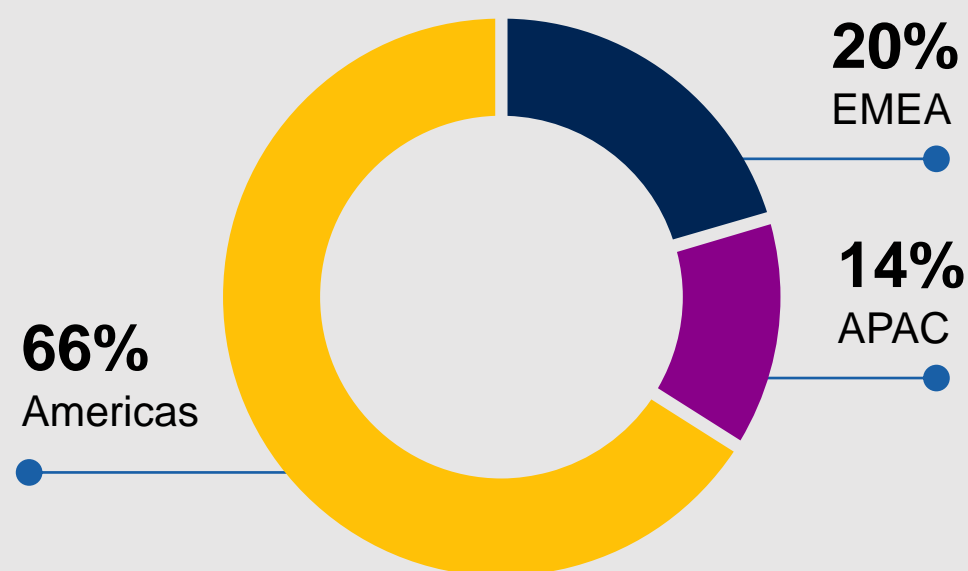
2022 Revenue:
$2.6B USD

NYSE:
BDC

7,700
Associates

Headquarters in St. Louis, MO, USA

Ashish Chand, President & CEO

Industrial Automation Solutions

Accelerated digitization is driving business performance across verticals
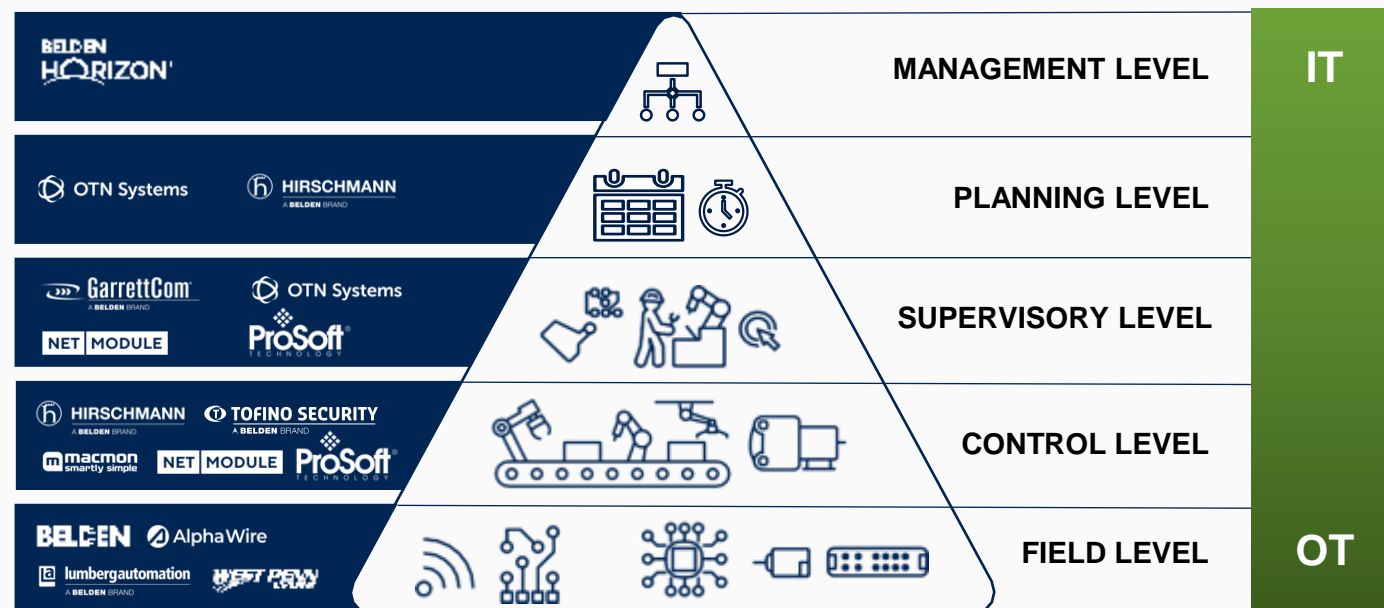
Discrete

Process

Energy

Mass Transit

WHERE WE PLAY

Full spectrum of products enabling data management and connectivity solutions to the control systems, the Edge and Cloud

Brands	Level	IT/OT
BELDEN HORIZON	MANAGEMENT LEVEL	IT
OTN Systems, HIRSCHMANN A BELDEN BRAND	PLANNING LEVEL	IT
GarrettCom A BELDEN BRAND, NET MODULE, OTN Systems, ProSoft TECHNOLOGY	SUPERVISORY LEVEL	
HIRSCHMANN A BELDEN BRAND, TOFINO SECURITY A BELDEN BRAND, macmon smartly simple, NET MODULE, ProSoft TECHNOLOGY	CONTROL LEVEL	
BELDEN, AlphaWire, lumbergautomation A BELDEN BRAND, WEST PENN WIRE	FIELD LEVEL	OT

Accelerate Industry 4.0

The digitization journey is about more than just transforming existing data into a digital format – it's about building a world of possibilities.

As data volumes grow, you need an infrastructure that can handle the influx – all the way to the network edge. Without it, data can't be collected, much less put to valuable use.

You need an enhanced solution, not a product pitch. Our resolve: Helping customers advance their digitization journey – no matter the starting point – to drive desired outcomes. Together, we'll co-create solutions to your most complex operational and business challenges.

The Foundation for Digitization Potential

Across any protocol, vendor or market

Digitize and integrate all operational assets to connect islands of automation – and simplify your technology landscape.

Acquire and transmit data securely – from the field to network management levels and beyond; then, make sense of it so you can act fast.

Solve unique networking needs and drive successful outcomes with the forward-thinking consultants at our **Customer Innovation Centers.**

Transfer your risk to us. See your custom solution design, and its real-world application, verified in our Validation or Proof of Concept labs.

Example for an industrial Edge Application

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Restaurant use case

- You manage a restaurant in town

- The restaurant takes reservations, walk-ins and delivery orders

- You just added a new digitized system to keep track of the restaurant assets

- You want to know how the restaurant is performing and propose improvements

Restaurant Data

Items
Name
Price
Stocked units

Customer
Address
Phone number
Reservation
Food review
Service review
Overall satisfaction

Supplier
Supplier name
Order date
Delivery date
Item cost

Employees
Name
Address
Salary
Gender
Occupation
Start date
End date

Order
Date
Quantity
Order reviews

Database Schema - Entity Relationship (ER) Diagram
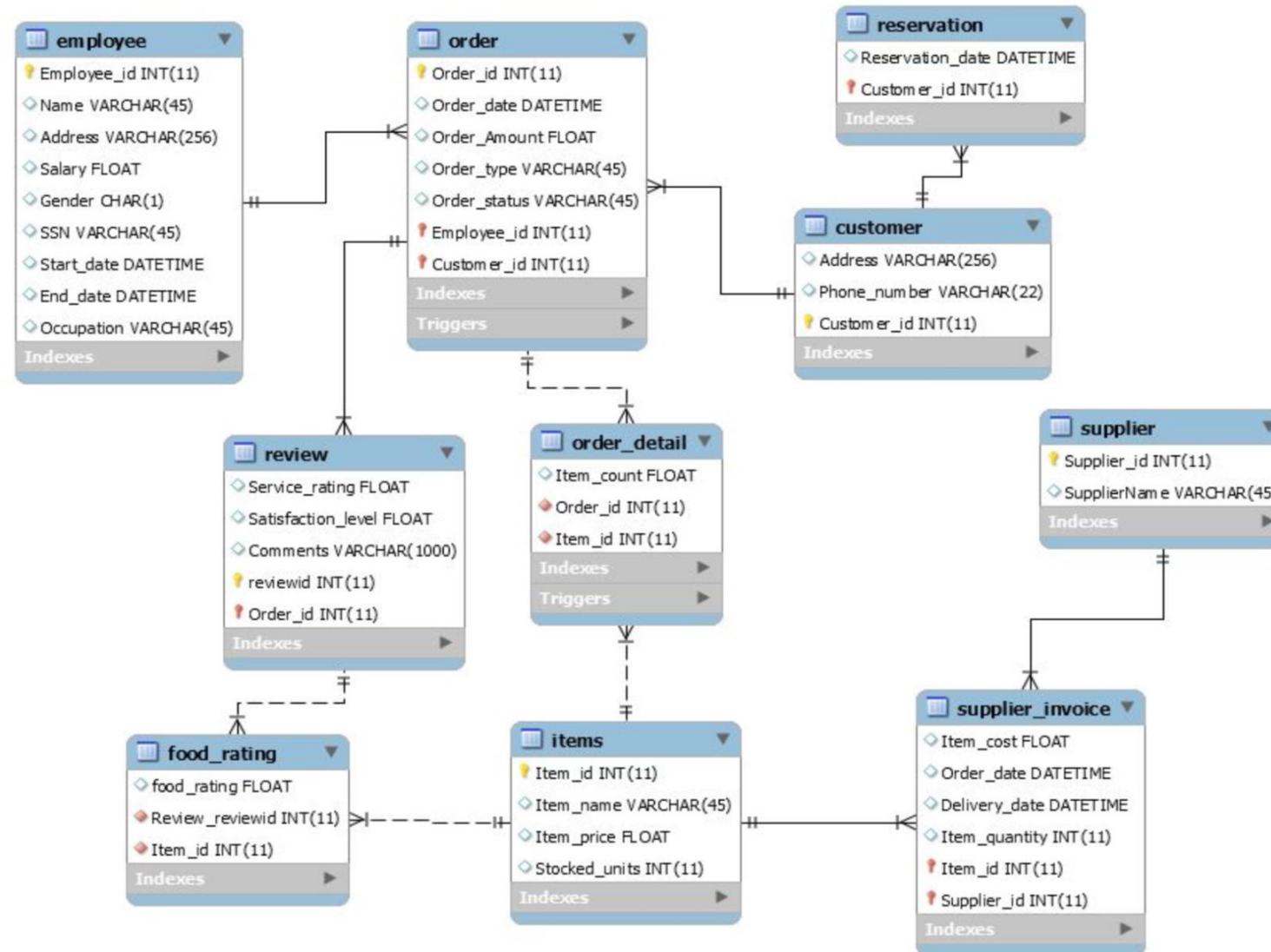
Queries - Management

```
/* Total sales by day */
SELECT sum((i.Item_price*od.Item_count)) AS Revenue, o.Order_date
FROM `Order` o, Items i, Order_Detail od
WHERE o.Order_id = od.Order_id
AND i.Item_id = od.Item_id
GROUP BY 2
ORDER BY 2;
```

	Revenue ⌄	Order_date ⌄
1	74.94999885559082	2018-01-24 00:00:00
2	7.989999771118164	2018-02-01 00:00:00
3	58.950000047683716	2018-02-02 00:00:00
4	36.0	2018-03-03 00:00:00

```
average satisfaction by day */
SELECT avg(r.Satisfaction_level) AS Avg_Satisfaction, o.Order_date
FROM Review r, `Order` o
WHERE r.Order_id = o.Order_id
GROUP BY 2
ORDER BY 2;
```

	Avg_Satisfaction ⌄	Order_date ⌄
1	7.666666666666667	2018-01-24 00:00:00
2	6.0	2018-02-01 00:00:00
3	8.0	2018-02-02 00:00:00

```
/* Average customer reviews for each menu item */
SELECT avg(fr.Food_Rating) as rating, i.Item_id, i.Item_name
FROM Food_Rating fr, Items i
WHERE fr.Item_id = i.Item_id
GROUP BY 3, 2
Order BY 1 DESC;
```

	rating ⌄	Item_id ⌄	Item_name ⌄
1	9.5	6	burger
2	8.0	3	pizza
3	8.0	5	ice cream
4	7.0	4	salad
5	5.0	2	hotdog
6	4.5	1	steak
7	4.0	7	taco

Extract Transform and Load (ETL)

The smart way to work with data
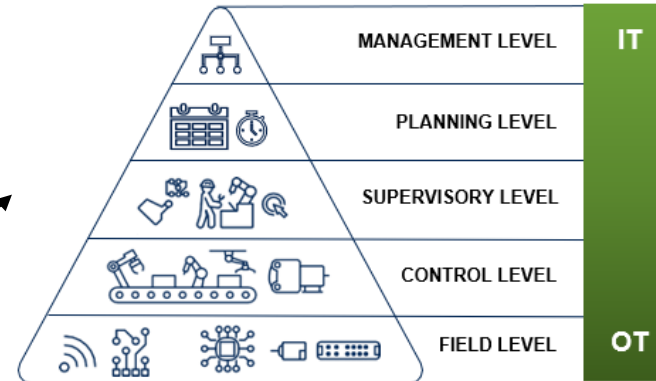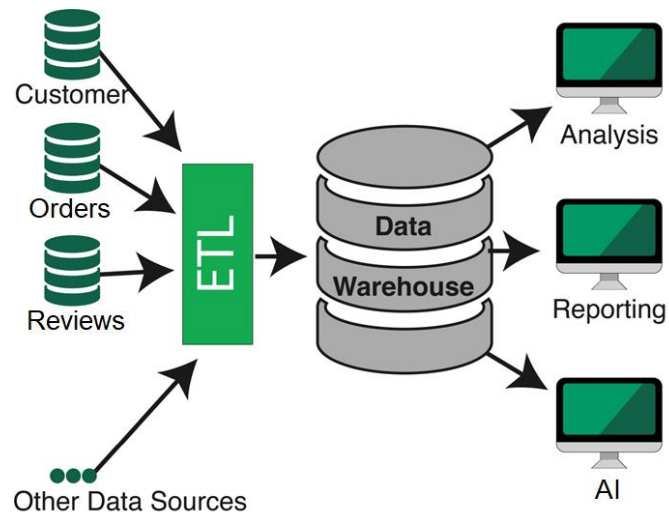
- Centralized system
- Low flexibility
- High costs for maintenance
- High costs for adjustments & changes
- High latency & slow reaction time
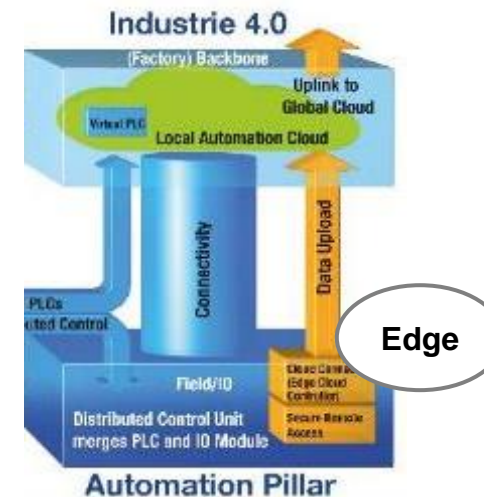
- Decentralized system
- High flexibility & scalability
- Low costs for maintenance
- Low costs for adjustments & changes
- Low latency & fast reaction time

Belden's Industrial Edge product portfolio
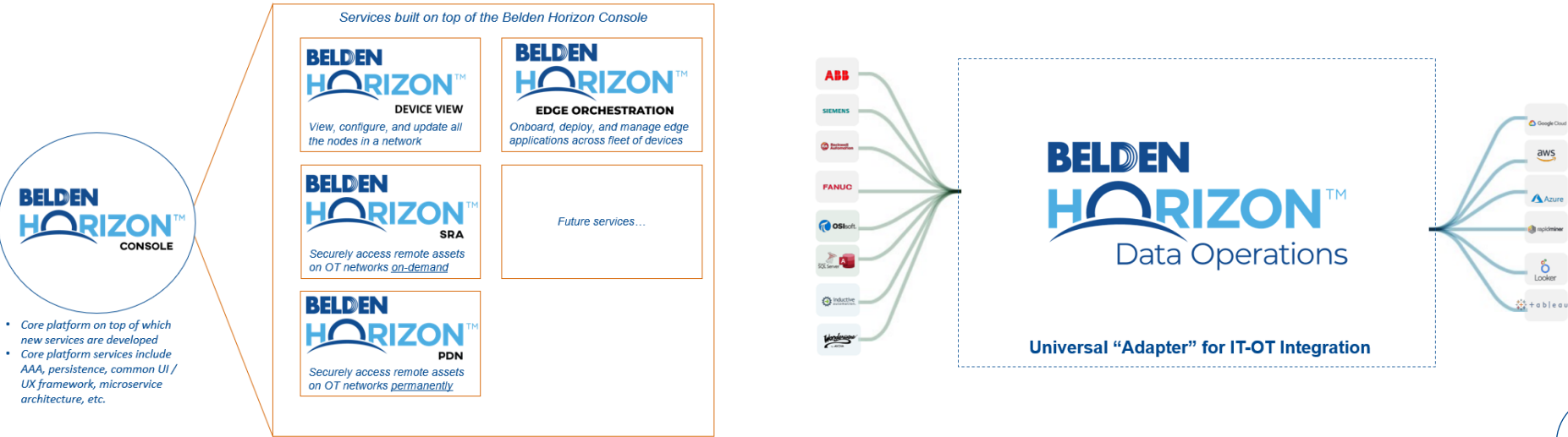
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Belden's Industrial Edge product portfolio

Hardware:

Device	Device View	Secure Remote Access (SRA)	Persistent Data Network (PDN)	Edge Applications	Available for sale
OpEdge-8D	✓	✓	✓	✓	Today
OpEdge-4D	✓	✓	✓	✓	Q1 2024
OpEdge-4D-LTE	✓	✓	✓	✓	Q1 2024

Software:

OpEdge-8D

1. Specs
2. Architecture
3. Use Cases
4. Live-Demo

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Hirschmann OpEdge-8D – Specs

2x USB 3.0

GbE Management Port

4x GbE LAN ports with 1 – pair hardware bypass

2x GbE SFP WAN

2x Serial DB9 RS232

IEC61850-3,
IEEE1613, -40° to 70°C

HIRSCHMANN
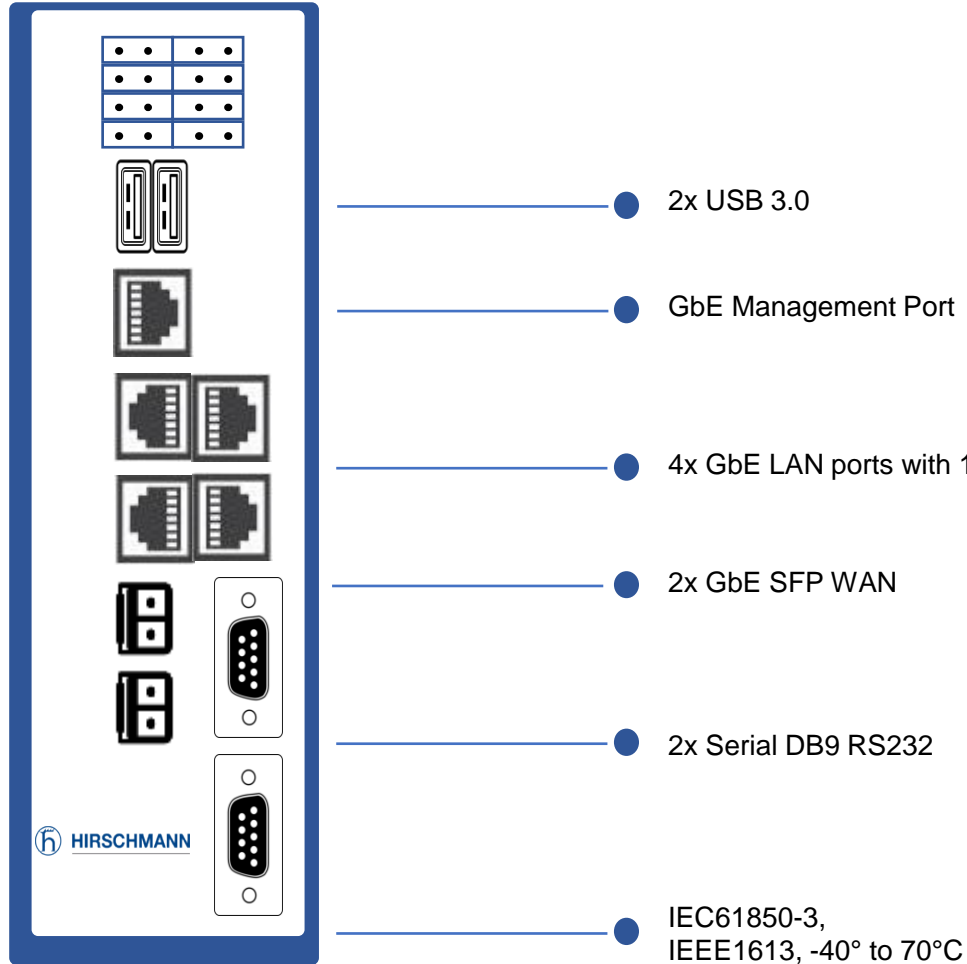
Quad-core CPU
- High Performance
- Virtualization

Memory
- 8GB RAM
- 64GB Storage (Available: 48,5GB)

Scalable Design
- 7x GbE Ports
- Dual power sources
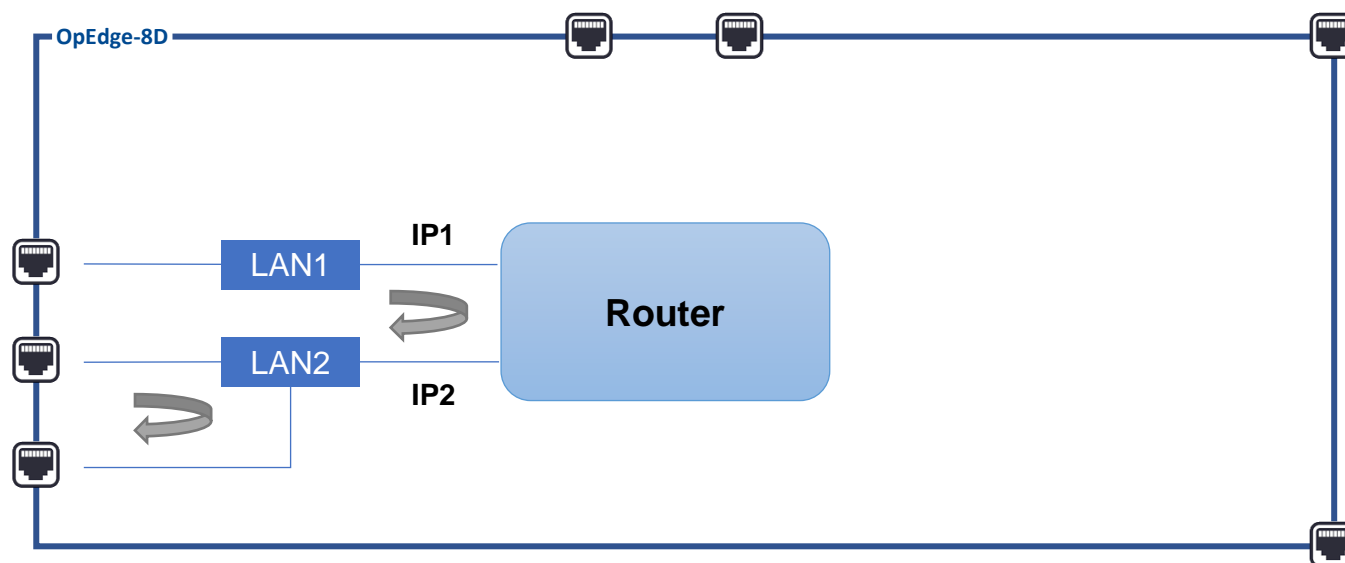
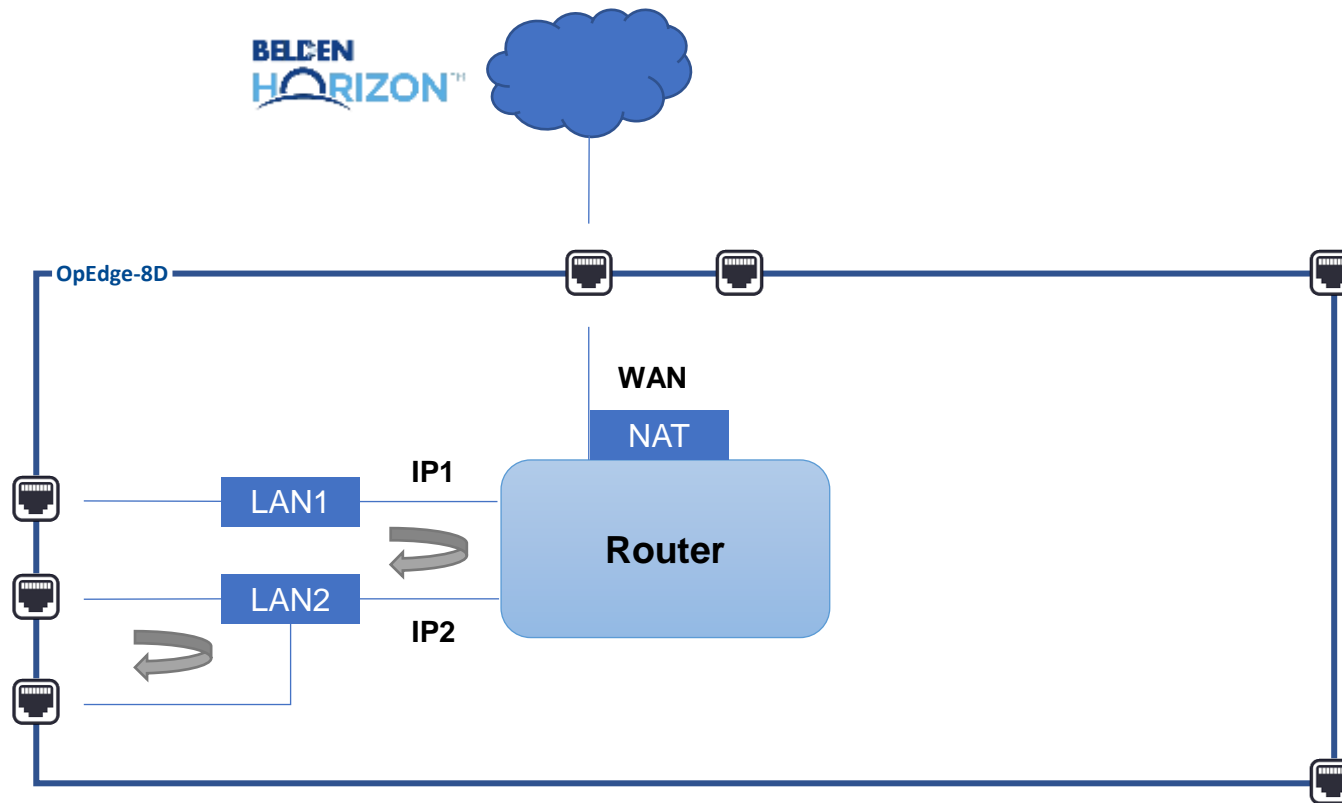| EDGE OS	REMOTE ACCESS	SECURITY	CONTAINERS	VIRTUAL MACHINES

Architecture & capabilities of OpEdge-8D

OpEdge-8D
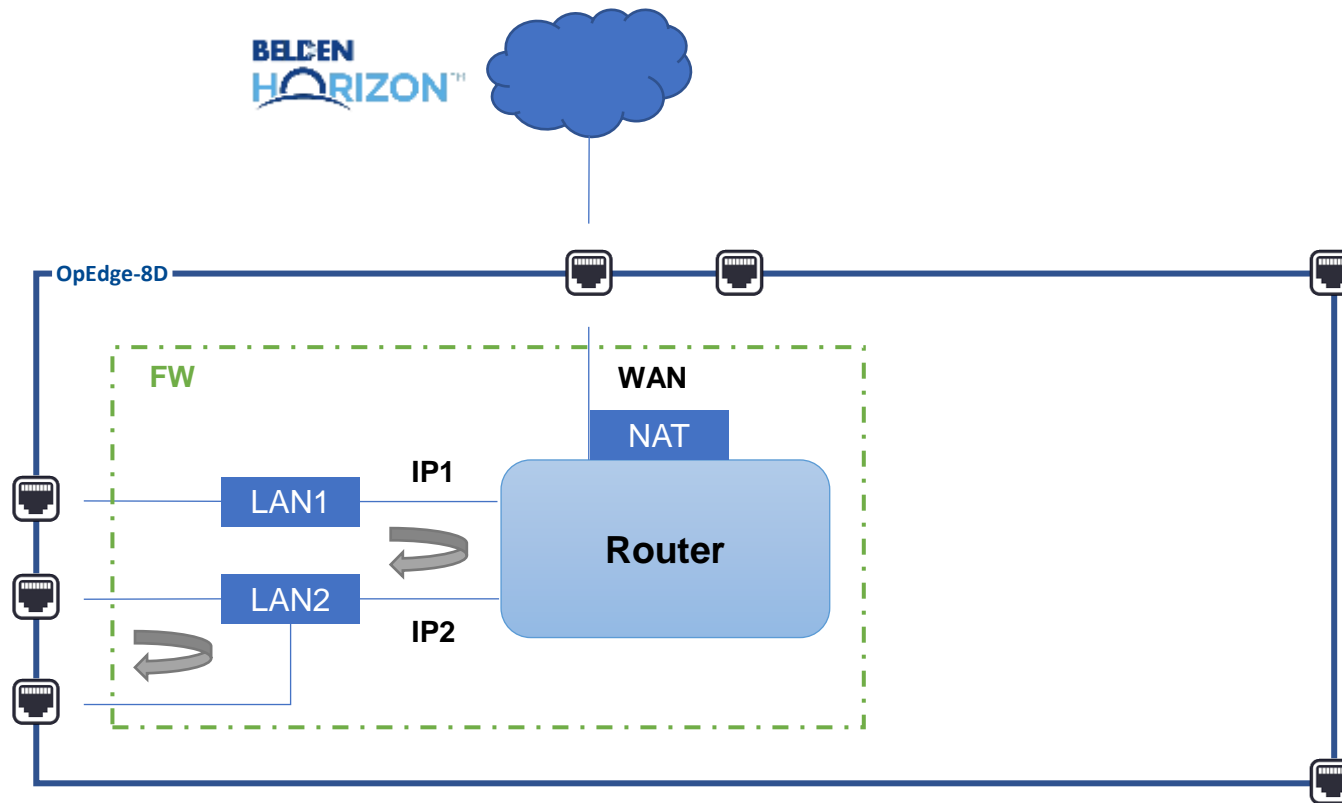
LAN1 — IP1

LAN2 — IP2

Router

- Switching ✓
- Routing ✓
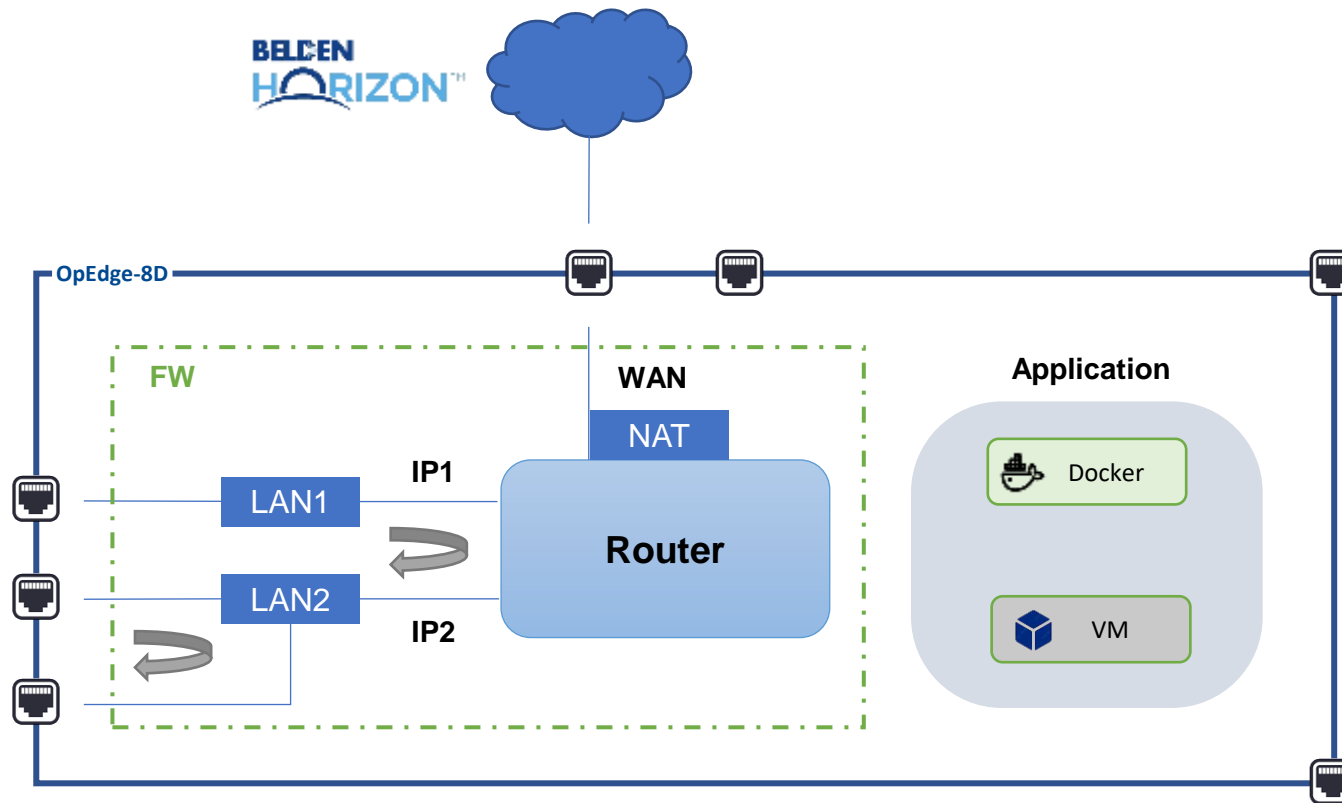
Architecture & capabilities of OpEdge-8D

- Switching ✓
- Routing ✓
- WAN interface ✓

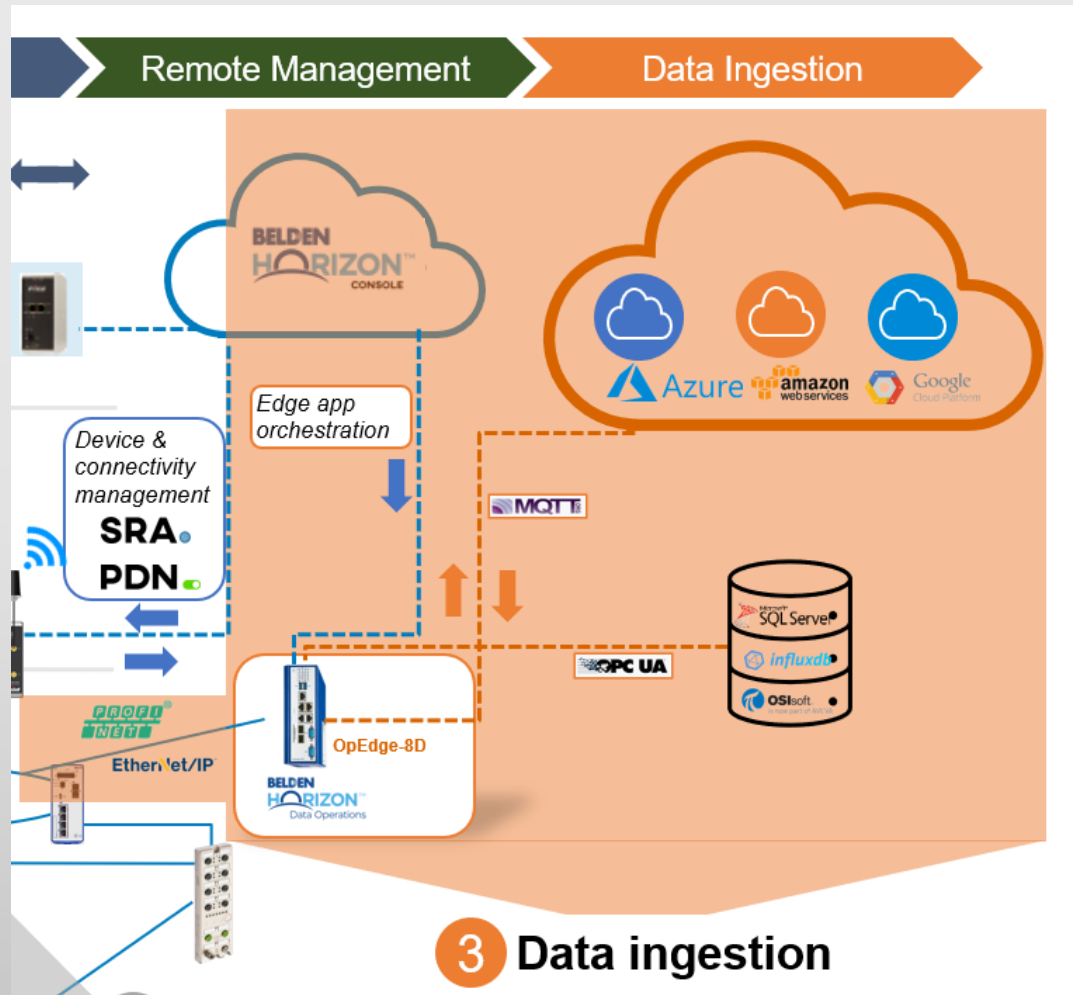# Architecture & capabilities of OpEdge-8D

- Switching ✓
- Routing ✓
- WAN interface ✓
- Firewall ✓

Architecture & capabilities of OpEdge-8D

- Switching ✓
- Routing ✓
- WAN interface ✓
- Firewall ✓
- Run applications ✓
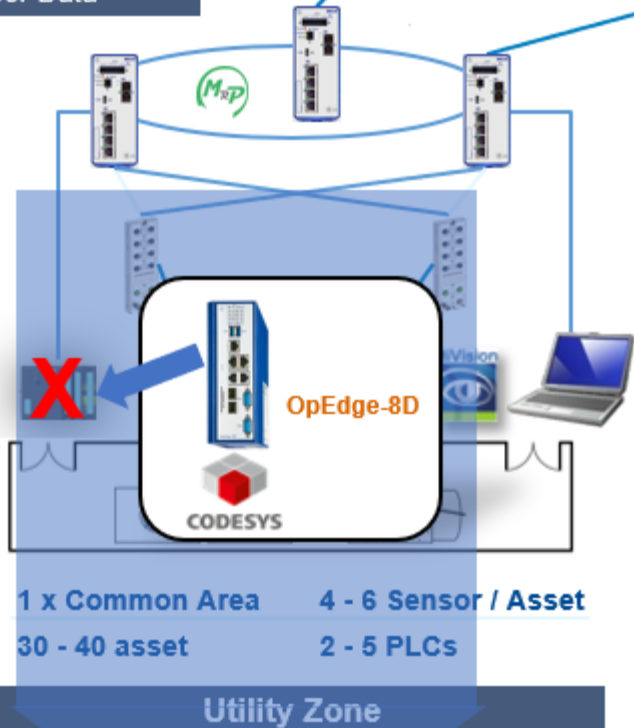
Data Ingestion

- In this use case
  - Hirschmann OpEdge-8D is sitting on a Hirschmann network with BOBCAT HiOS managed switches in a MRP ring
  - Sensors and stack lights are connected to a Lumberg Automation LioN-X IO-Link master
  - Belden Horizon Data Operations application is running on the OpEdge-8D. It is converting Ethernet protocol (EtherNet/IP) to MQTT or OPC UA and normalizing the data for ingestion by Microsoft Azure, Amazon Web Services (AWS), Google Cloud Platform (GCP), or other data destinations

Soft PLC

- In this use case
  - Hirschmann OpEdge-8D is sitting on a Hirschmann network with BOBCAT HiOS managed switches in a MRP ring
  - Sensors and stack lights are connected to a Lumberg Automation LioN-X IO-Link master
  - CODESYS control runtime is running on the OpEdge-8D and this is being used in place of a traditional PLC
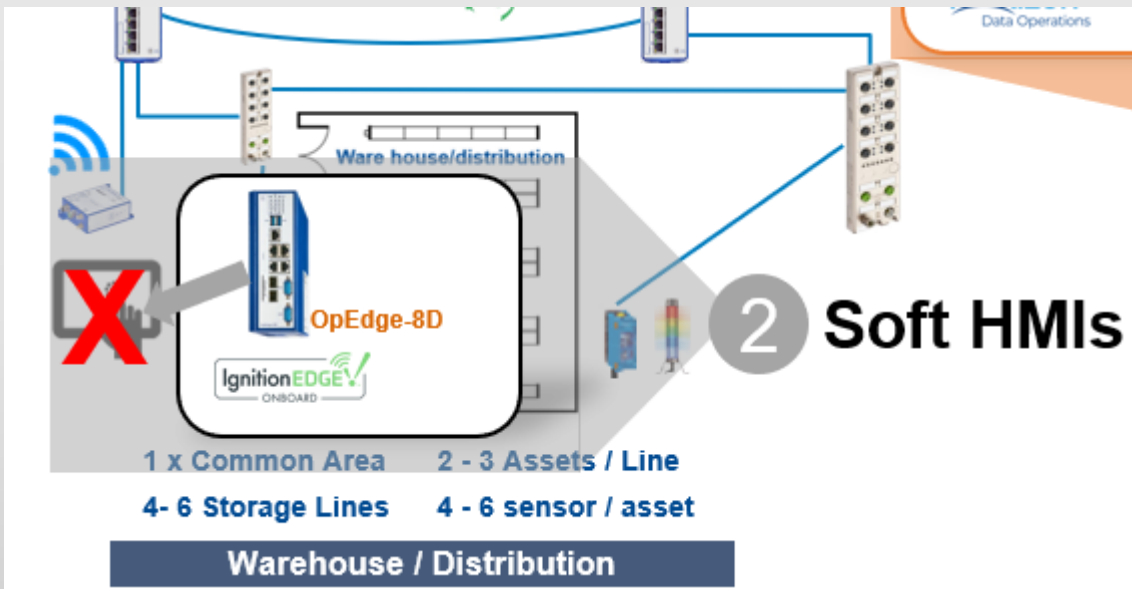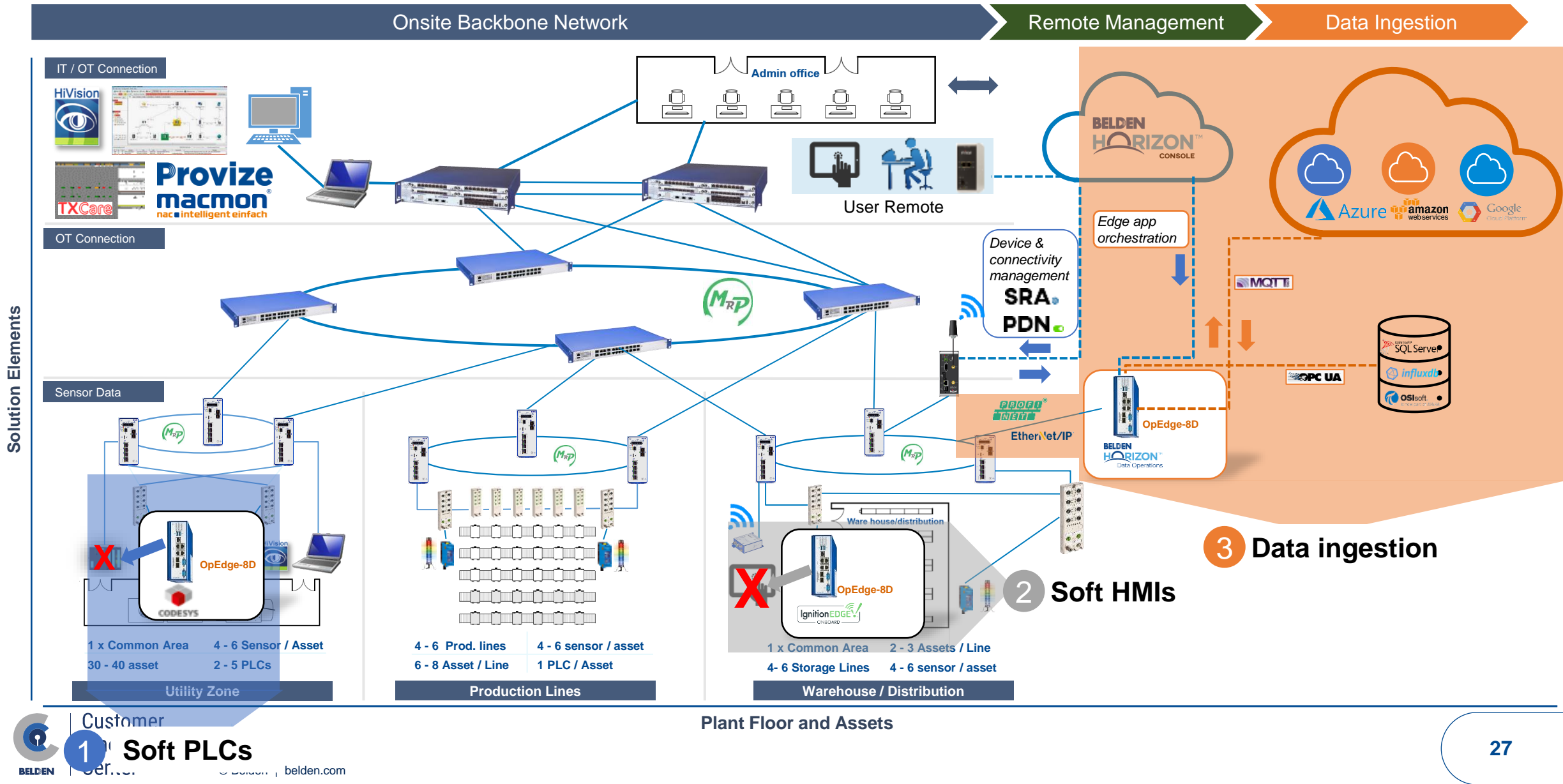
Soft HMI

- In this use case
  - Hirschmann OpEdge-8D is sitting on a Hirschmann network with BOBCAT HiOS managed switches in a MRP ring
  - Sensors and stack lights are connected to a Lumberg Automation LioN-X IO-Link master
  - Ignition Edge is deployed as a container on the OpEdge-8D and this is being used in place of a traditional HMI

Three Industrial Edge Use Cases

SRA
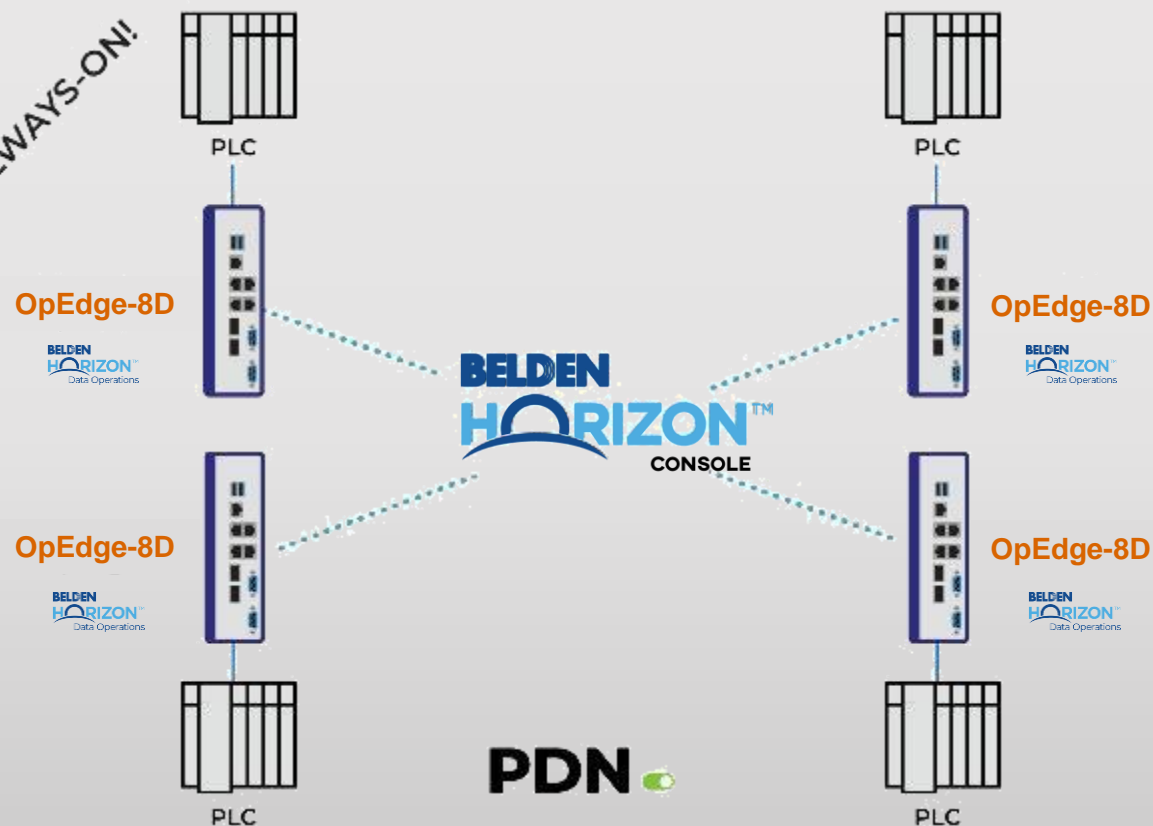

- In this use case
  - Hirschmann OpEdge-8D acts as a gateway for the initiation of a secure VPN tunnel connection via the Belden Horizon Console to end devices for on-demand remote maintenance of those assets
  - Concurrently, the Hirschmann OpEdge-8D is running Belden Horizon Data Operations to ingest data from the PLC to which it is connected for collection, visualization, and analysis
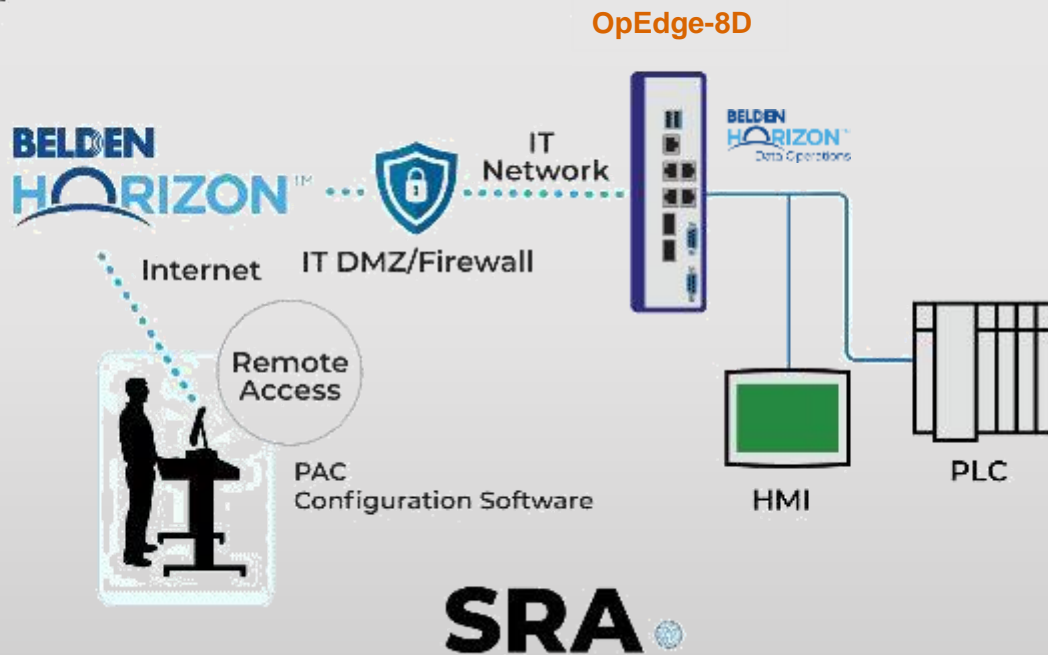
PDN + Edge

- In this use case
  - o Hirschmann OpEdge-8D is operating as a node within network of connected VPN tunnels initiated via Belden Horizon Console that are always operational to allow for constant monitoring of remote assets
  - o Concurrently, the Hirschmann OpEdge-8D is running Belden Horizon Data Operations to ingest data from the PLCs to which it is connected for collection, visualization, and analysis

Live – Demo

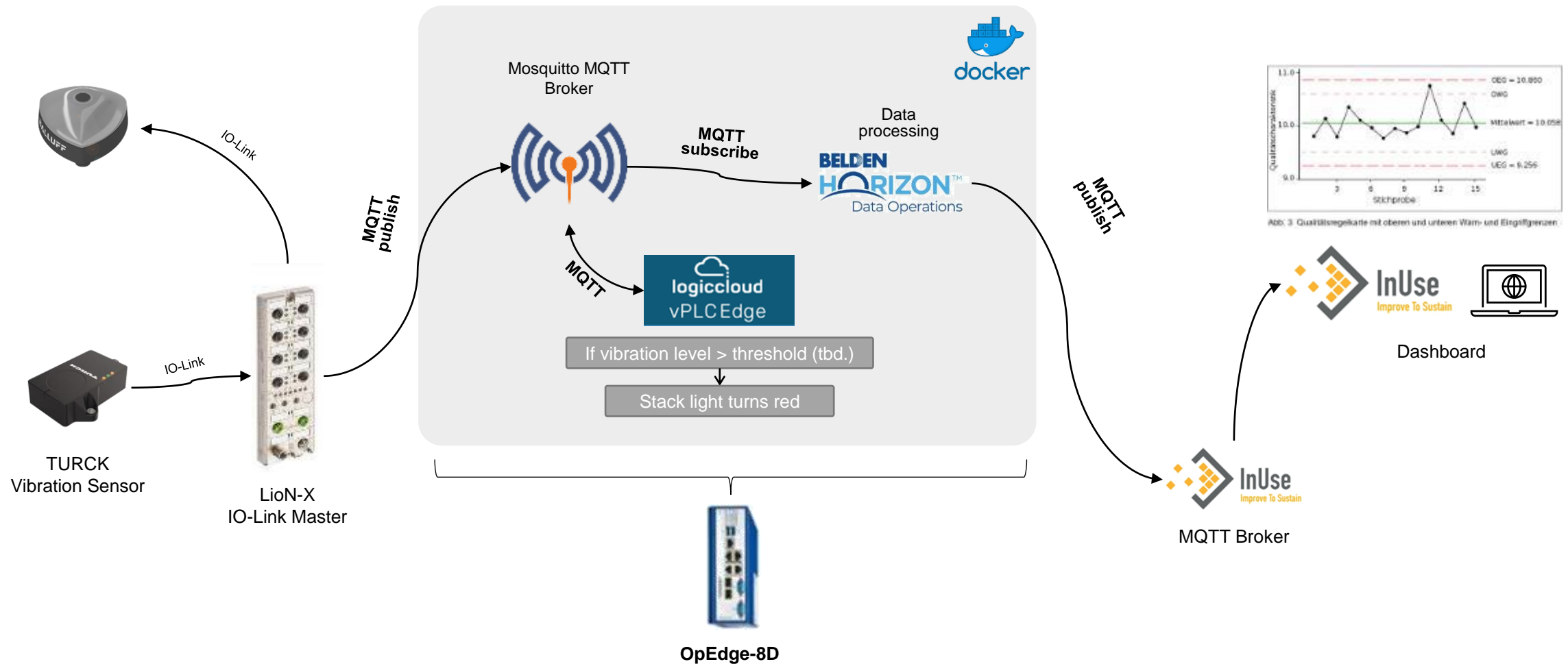**HMI & Soft PLC application:**

TURCK
Vibration Sensor

LioN-X
IO-Link Master

Mosquitto MQTT
Broker

MQTT publish

IO-Link

IO-Link

MQTT subscribe

MQTT

Data processing

BELDEN HORIZON™
Data Operations

logiccloud vPLC Edge

If vibration level > threshold (tbd.)

Stack light turns red

MQTT publish

Dashboard

MQTT Broker

OpEdge-8D

Thank You

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Edge Compute Portfolio Details

	OpEdge-8D	OpEdge-4D (LTE)
CPU	Intel Atom E3950 @ 1.6 GHz	NXP™ i.MX8M Mini Quad Core 1.6GHz ARM® Cortex™-A53
Memory	8GB DDR3L	4GB DDR4
Storage	64GB SSD storage (48,5GB available)	64GB eMMC (17GB available)
Fiber Ports	2	0
RJ45 Ports	5 (gig)	4 (gig)
Serial Ports	2 (RS-232)	1 (RS-232/485)
Temperature Rating	-40C to 70C	-40C to 70C
Approvals	CE, RoHS, REACH, FCC, UL, 62368-1, IEC 61850-3, IEEE 1613, IP40	CE, FCC, RoHS, REACH, UL, IEEE 1613, ATEX, C1D2
Cellular	No	Yes (4D-LTE)
Containers	Yes (x86)	Yes (ARM)
Virtual Machines	Yes	No
Availability	Today	July 2023 (Early 2024 for LTE)
I/O	None	2x DIO

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