

Solutions and Product Technology

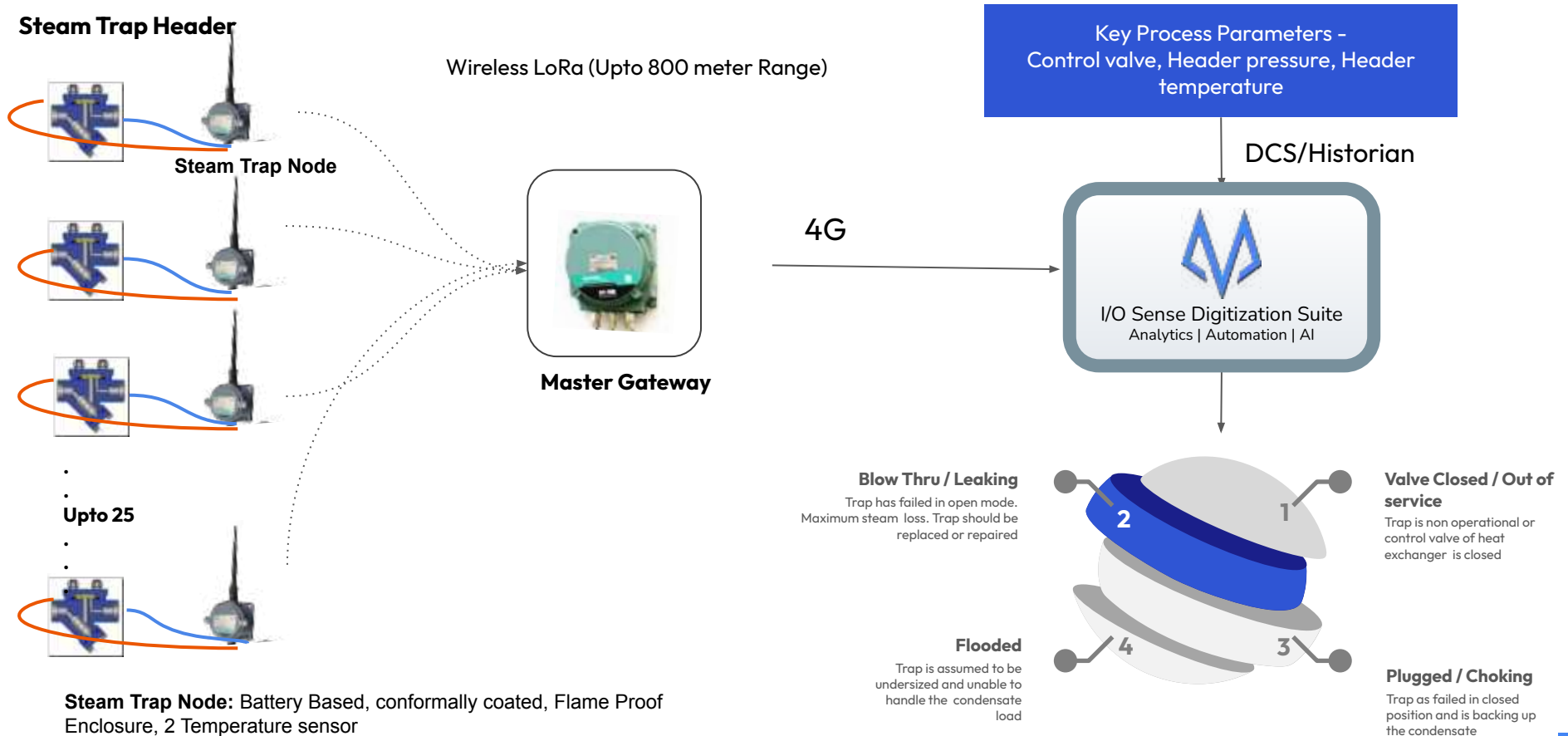
Asset Reliability



Steam Trap Failure Detection



Steam Trap Failure Detection - Architecture



Benefits - Reducing the Time to Correct

Unlocking value with Steam Trap Monitoring

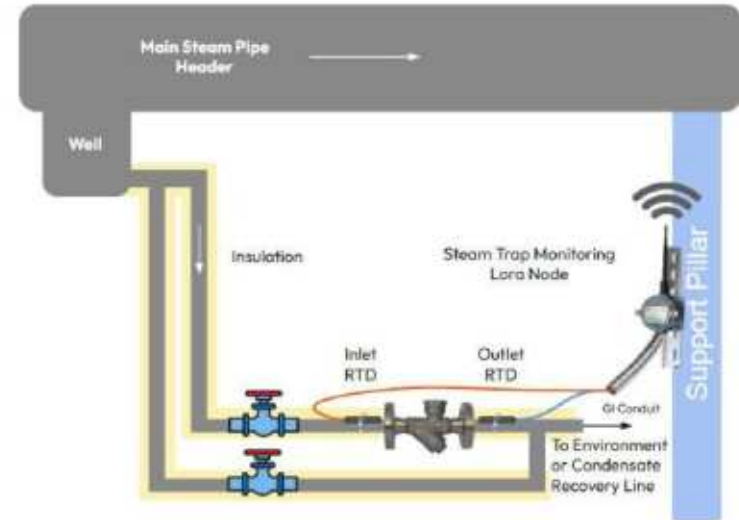
- Real time monitoring and failure diagnostics will reduce the response time for trap correction
- Reduced risk of water hammering in header and condensate recovery lines
- Manpower savings in data collection
- Reduced dependency of manual reading and analysis
- Reduced loss of steam
- Improved quality of steam delivered
- Reduced risk of worker safety concerns
- Reduced risk of boiler downtime
- Improved overall efficiency
- Improved quality of heat exchange



Steam Trap Failure Detection - Benefits

Cost saving calculation

4G Lora Gateway Installed on Open Location at Height



Configurations	HP (15-16 Bar)	MP (10-8 Bar)	LP (4-7 Bar)	
Steam traps	125	125	125	-
Average failure rate per year	10%	10%	10%	-
Average time to catch failure	45	45	45	days
Total Leaking traps	13	13	13	10% leaks assumed
Average Leaking rate in steam trap	150.0	100.0	50	kg/hr
Total steam savings	2025000 kg	1350000 kg	675000 kg	kg steam/year
Cost of steam (lowest assumed)	2.70	2.70	2.70	INR/kg steam
Savings per year	₹ 54,67,500	₹ 36,45,000	₹ 18,22,000	INR/year

Node Device Specifications

- Will be implemented on steam traps
- LoRa RF based
- 865-867 MHz (Free ISM Band)
- 2 X Temperature Sensor (upto 400 C) for on inlet and outlet temperature measurement with insulation cover
- Mounting - Wall or metal clamp/tie mounting with canopy
- Battery operated ~ 3-4 years
- PESO/BIS Certified Flameproof Enclosure / Fibreglass Enclosure
- External Antenna
- Power Ratings compliant to Zone 0
- IP-67 Compliant
- LoRa Data Transmission Range Up-to 1 km in free line of sight
- Data frequency 30 mins
- Conformal Coating

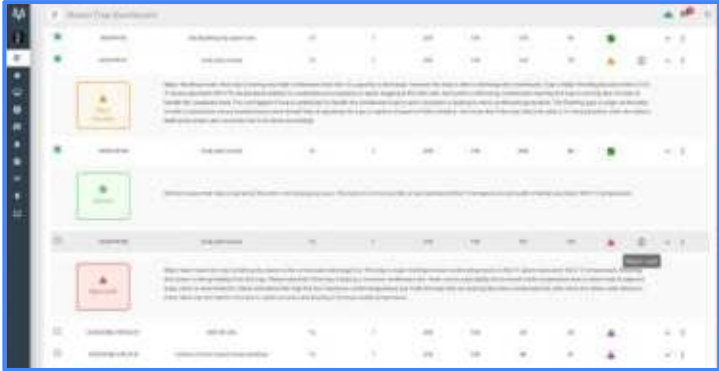


Gateway Specifications

- LoRa Receiver
- Connects upto 25 traps
- IP67 Compliant
- Outdoor gateway
- Flameproof enclosure
- Ethernet/4G uplink
- Power supply to be provided by client and installation will be at a central location at certain height
- Conformal coating
- 2 year warranty



I/O Sense Platform Key Features



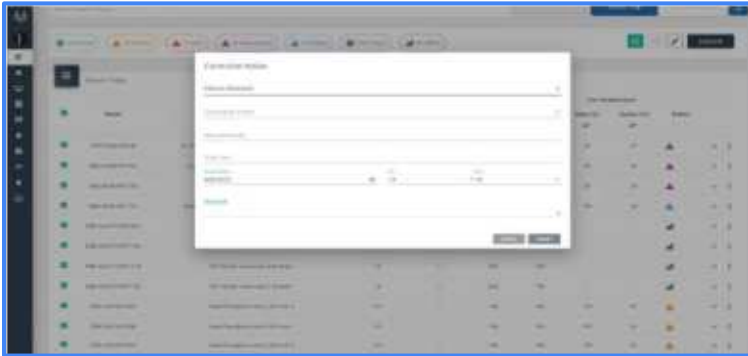
Automatic Failure Detection



Steam Loss, Saving and Status Overview



Trend Analysis



Corrective Action Recording

Installation Images

Understanding the Culprits Behind Inefficiency

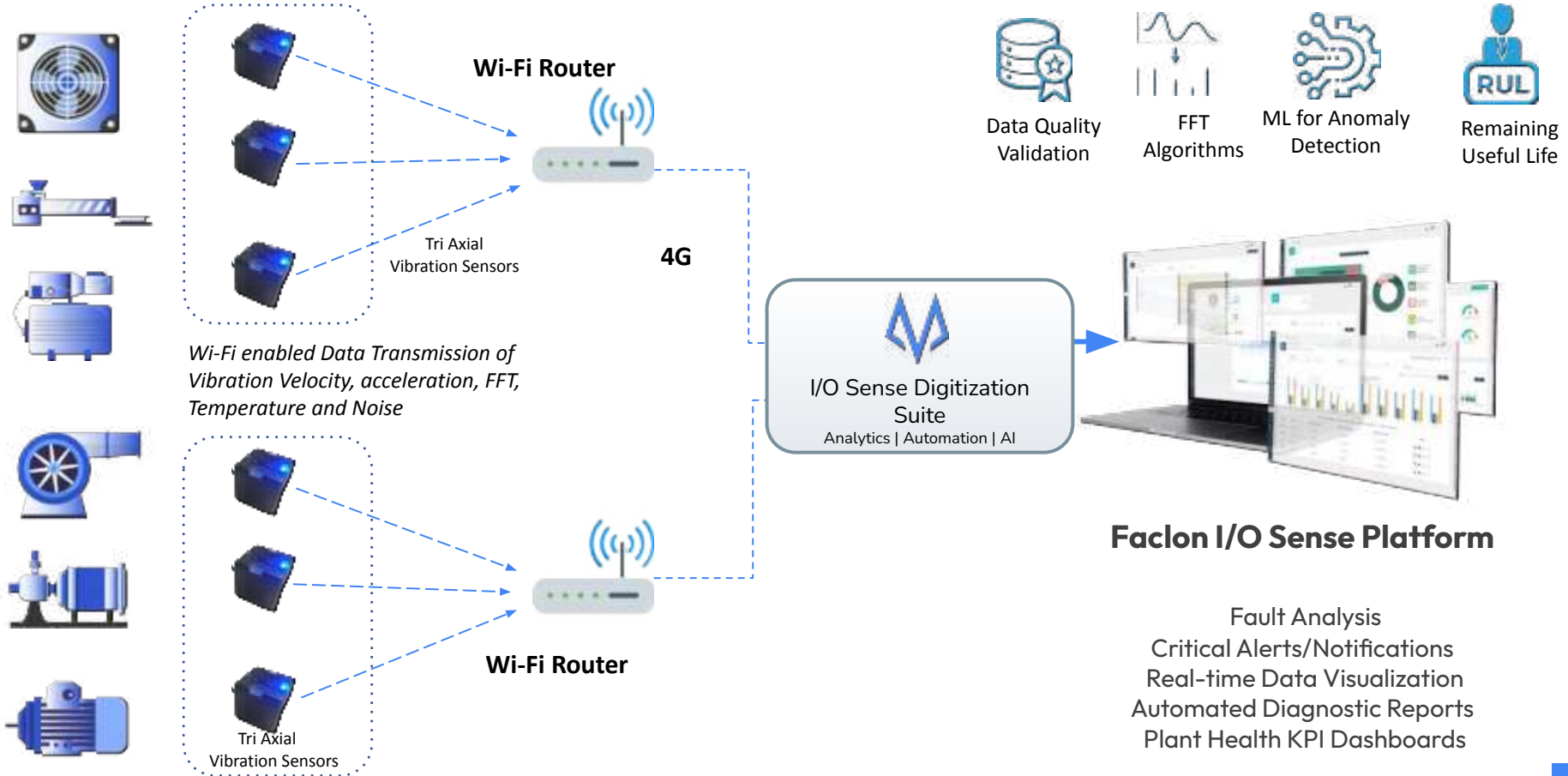




Predictive Maintenance



Predictive Maintenance - Architecture



Predictive Maintenance - Benefits



Reduced Safety Risk :

Proactive hazard identification using remote means eliminates on-site data collection



20% Enhanced Capacity Utilization

Higher availability of machines resulting in increased capacity for production



15% Reduced Unplanned Downtime:

Early detection cuts downtime, maintenance expenses, and production losses.



Improved Manpower Utilization:

Automated data collection and AI analysis reduce the need for manual labor, saving costs.



10% Maintenance Cost Savings:

Significant cost savings by avoiding expensive repairs and minimizing production losses.

50+ common problems identified....

- Unbalanced
- Coupling Misalignment
- Structural Looseness
- Rotating looseness
- Defective bearings
- High noise
- **Gear Tooth Wear**
- Backlash, Broken tooth
- **Bearing lubrication, faults**
- Cavitation
- **Soft foot**
- **Eccentric Rotor**
- Frequent burning and heating of drive motors
- Leakage
- High power consumption
- **And a host of others**

...Across a variety of assets

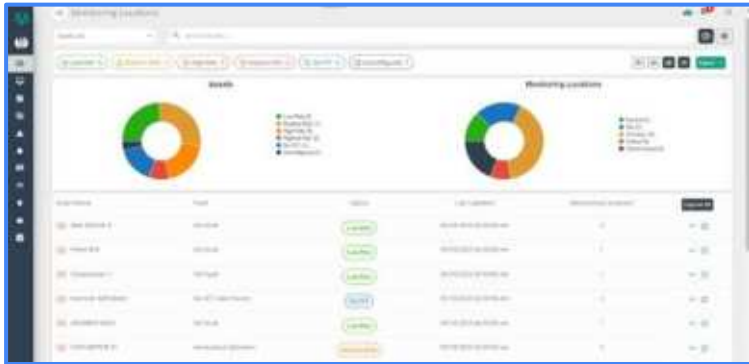
- Pumps
- Motors
- Blowers
- Machine tools
- Gearbox
- Chiller
- Fans
- Extruder
- Mixer
- Compressors
- Conveyors
- Roller
- And a host of others

Sensor Details

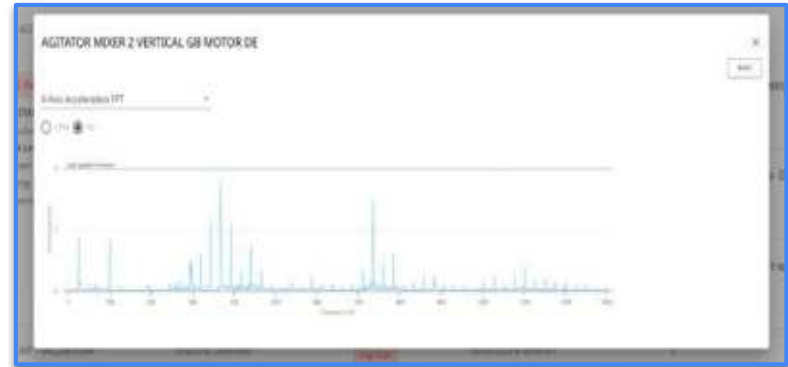
- Vibration Sensor 3-axis MEMS Sensor
- Temperature Sensor: -40°C to $+100^{\circ}\text{C}$, 0.2°C accuracy
- Noise Sensor
- Connectivity: Wifi (upto 80 meters), Bluetooth, Modbus RS 485
- Power Supply External 24VDC/-10%
- Operating temperature -40°C to $+100^{\circ}\text{C}$
- Size 40mm (L)X 40mm (W)X 33mm (H)
- Weight 78 gms
- Frequency Range 0.2Hz to 6kHz
- Shock Tolerance 10,000g for 0.2ms
- Linear Acceleration sensitivity 0.122mg/LSB (Max 2%)
- Low Noise 75 ug/sqrt(Hz)
- Enclosure Polycarbonate, IP67
- LED indication Red, Green, Blue, Orange
- Stud is provided for mounting, Magnetic mounting also possible



I/O Sense Platform Key Features



Overview



FFT Spectrum

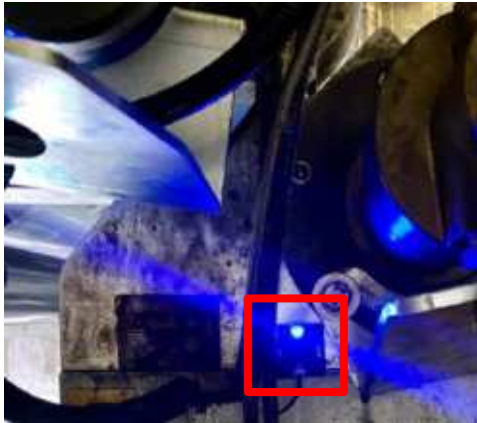
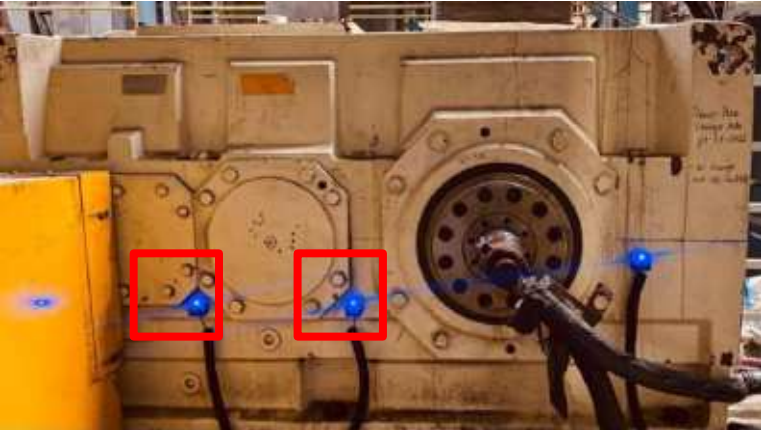
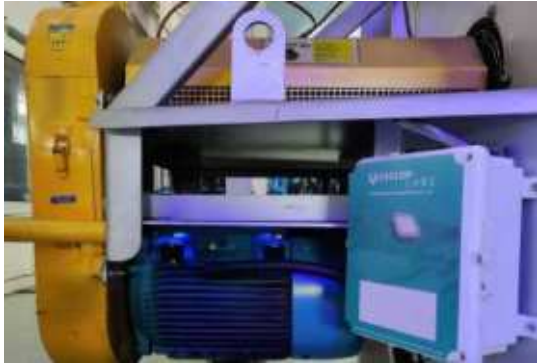
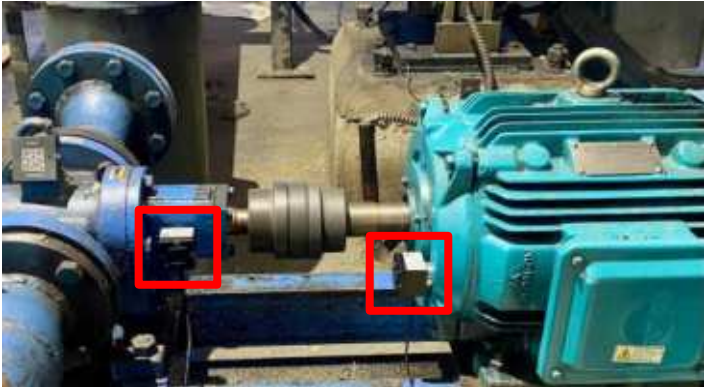


XYZ Velocity, Acc and Temp Trends



Automated Diagnostics

Installation Images



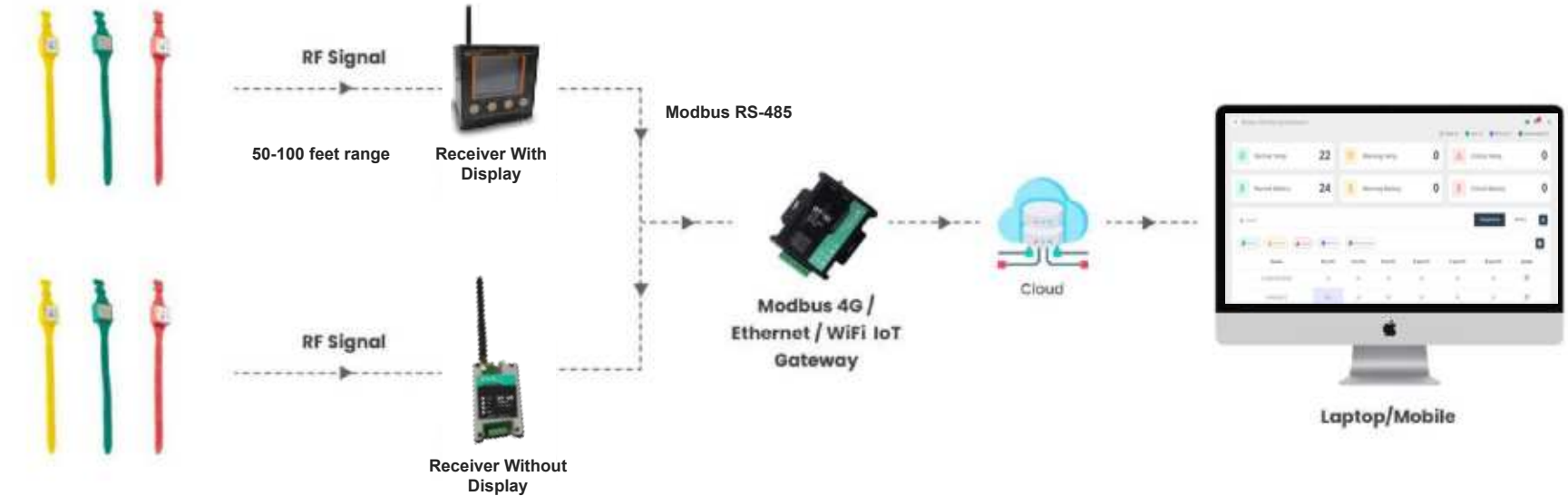


BusBar Temperature Monitoring



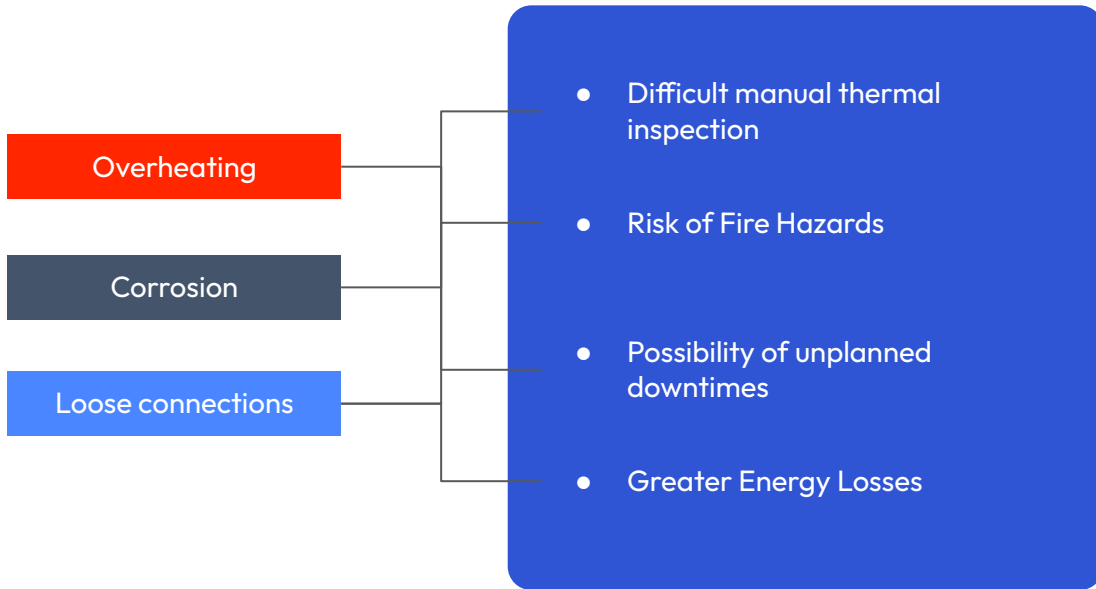
Online Bus-bar Health Monitoring - Architecture

Temperature sensor



Online Continuous Monitoring of data with critical alerts can help **avert major losses, increase safety and improve upkeep** of electrical operations

Online Bus-bar Health Monitoring - Benefits



Calculations for ROI justification for 30 Critical Bus-bar joints

2 major Incidents averted as a result of online monitoring	₹50 Lakh
15% Reduction in Downtimes	₹7.5 Lakh
20% Reduction in Insurance costs	₹4 Lakh
Net Annual Return	₹60 Lakh

Hence it becomes necessary a **REAL TIME** solution which provides bus-bar temperature data online to avert these problems

Hardware: Wireless BusBar Sensor Straps

Technical Specifications

- RF Data Communications
- Non conducting silicon strap can withstand up-to 350 degree C
- Operating temperature - -40 to 125 degree C
- Accuracy - 0.5 degrees
- Digital Sensor - No Calibration Required
- Transmission Interval -30 to 300 second
- Range - 50 to 100 feet
- Dimension 45mm x 45mm x 20mm x 350mm(belt)
- Weight - 30 grams
- Quick installation via Strapping
- Battery - 12 years in Ambient, 3-4 years in 70-100 degrees
- Non Explosive Lithium Magnesium replaceable battery



Hardware: Receivers and Controllers

Controller Type 1 (With Display)



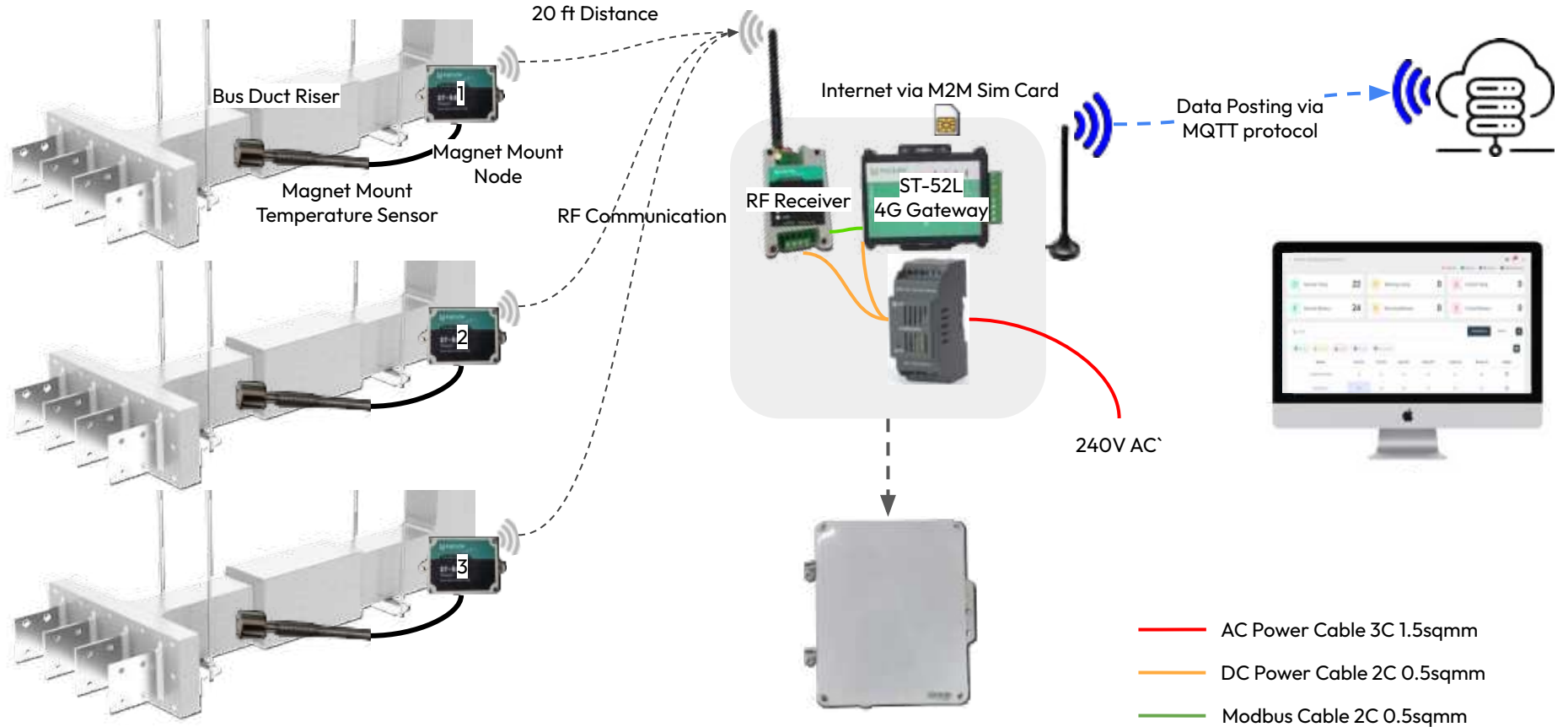
- Two Variants: 9 & 27 Sensor Communication
- 2.4 GHz IEEE 802.15.4
- Modbus RS 485 Output
- 2 Relay Output
- 24V DC power supply
- Dimension: 96mm x 96mm x 72 mm
- Panel Mount
- Weight 500 Grams
- Operating Temperature: -28 to 85 degree C

Controller Type 2 (Without Display)



- 27 Sensor Communication
- 2.4 GHz IEEE 802.15.4
- Modbus RS 485 Output
- Wi-Fi Output, Omni directional 300 fts line of sight
- 24V DC power supply
- Dimension: 100mm x 55mm x 32mm
- Panel Mount, Din rail mount
- Weight 150 Grams
- Operating Temperature: -28 to 85 degree C

Bus Duct Riser Temperature Monitoring



Hardware: Wireless BusBar Duct Sensor

Technical Specifications

- RF Data Communications
- Operating temperature - -40 to 125 degree C
- Accuracy - 0.5 degrees
- Digital Sensor - No Calibration Required
- Transmission Interval -30 to 300 second
- Range - 50 to 100 feet
- Quick installation- magnetic (Sensor and Hardware)
- Battery - 12 years in Ambient, 3-4 years in 70-100 degrees
- Non Explosive Lithium Magnesium replaceable battery



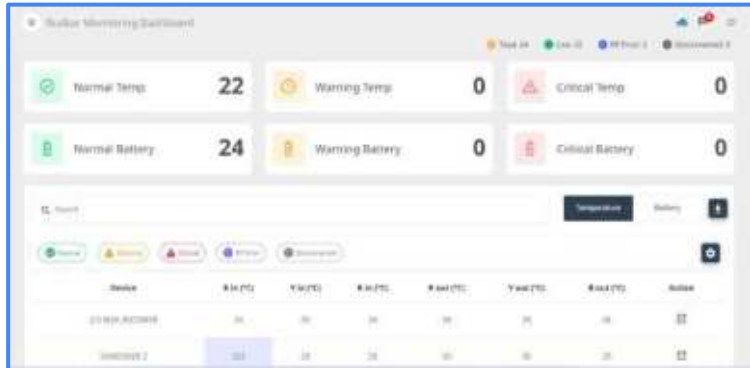
Hardware: Gateway

Technical Specifications

- Upto 16-20 busbar controllers integration on Modbus RS 485
- Multiple connectivity options: 4G , GPRS, Wi-Fi, Ethernet
- Local backup data storage
- ABS/Flameproof enclosure
- Over the air update
- 1 year warranty
- 230V AC / 12-24 VDC power supply



I/O Sense Platform Key Features



Overview

This table lists all system alerts and events, including the date, event tag, device name, duration, start time, and stop time.

Date	Event Tag	Device Name	Event duration	Start Time	Stop Time
14/07/2023	Warning Temp	SHREDDER 1	10 Sec	09:43:31 am	09:43:41 am
14/07/2023	Warning Temp	SHREDDER 1	10 Sec	09:27:56 am	09:28:06 am
14/07/2023	Warning Temp	AFCC INCOMER	10 Sec	09:22:33 am	09:22:43 am
14/07/2023	Warning Temp	AFCC INCOMER	10 Sec	09:22:38 am	09:22:48 am
14/07/2023	Warning Temp	AFCC INCOMER	10 Sec	09:48:36 am	09:48:46 am
14/07/2023	Warning Temp	AFCC INCOMER	10 Sec	09:48:38 am	09:48:48 am
14/07/2023	Warning Temp	AFCC INCOMER	10 Sec	09:48:39 am	09:48:49 am
14/07/2023	Warning Temp	AFCC INCOMER	10 Sec	09:48:40 am	09:48:50 am
14/07/2023	Warning Temp	AFCC INCOMER	10 Sec	09:48:41 am	09:48:51 am
14/07/2023	Warning Temp	AFCC INCOMER	10 Sec	09:48:42 am	09:48:52 am

Alerts & Events



Temp Trends

This table provides a summary of temperature data for three specific devices on July 17, 2023. It lists the device name, sensor name, data parameter, and the average temperature.

Device Name	Sensor Name(unit)	Data Parameter	Jul 17, 2023 (Mon)
2.5 MVA INCOMER	R PHASE INCOMER TEMPERATURE (°C)	Avg	33.148
	Y PHASE INCOMER TEMPERATURE (°C)	Avg	34.525
	B PHASE INCOMER TEMPERATURE (°C)	Avg	30.415
AFCC INCOMER	R PHASE INCOMER TEMPERATURE (°C)	Avg	25.33
	Y PHASE INCOMER TEMPERATURE (°C)	Avg	41.813
	B PHASE INCOMER TEMPERATURE (°C)	Avg	39.325
SHREDDER 1	R PHASE INCOMER TEMPERATURE (°C)	Avg	30.559
	Y PHASE INCOMER TEMPERATURE (°C)	Avg	30.477
	B PHASE INCOMER TEMPERATURE (°C)	Avg	33.471

Reports

Installation Images

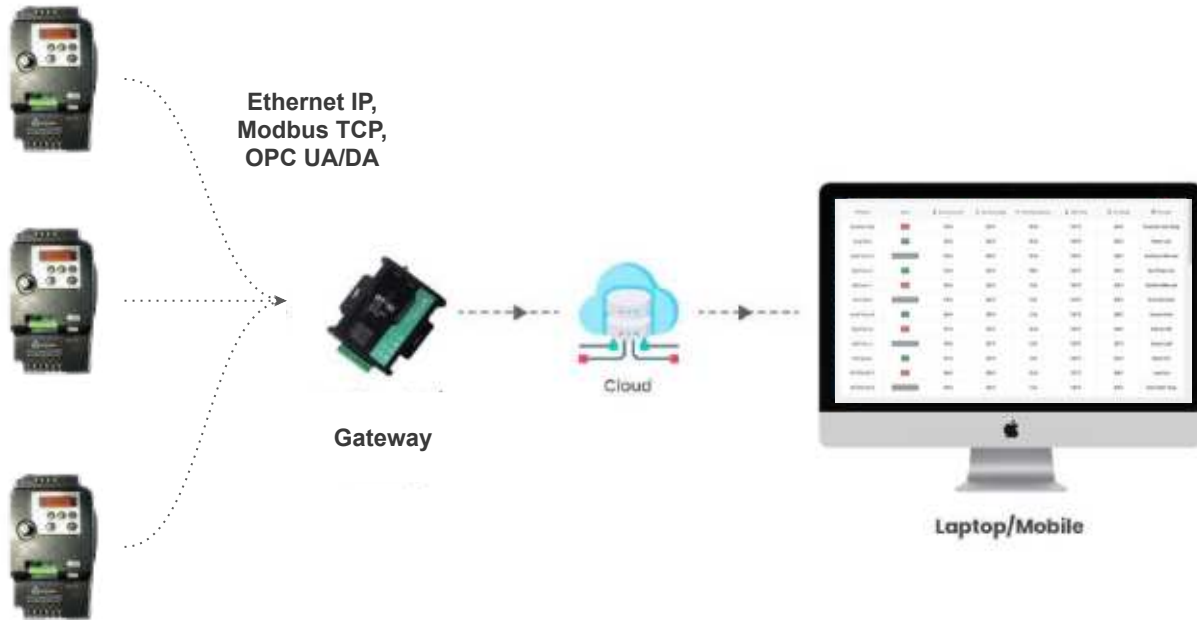




VFD Condition Monitoring



VFD Monitoring and Analysis





Faclon I/O Sense Platform

- Overheating
- Current abnormalities
- Faults
- Costly Failures Prevention

Tracking and Analytics on health of numerous VFDs spread across the infrastructure to improve maintenance and upkeep to prevent any unwarranted failures or breakdowns

I/O Connect | IoT Gateways for VFD monitoring

GATEWAY	IDEAL FOR CONNECTING	INPUT / PROTOCOL	COMMUNICATION	SALIENT FEATURES
	Energy meters, flow meters, IO Cards, PLCs, VFDs, other sensors etc.	Modbus RS 485, Modbus TCP	Variants in 4G, Wifi or Ethernet. MQTT protocol, Bi Directional	Local backup, FOTA
	OPC server, VFDs, PLCs, DCS, SQL Server etc.	OPC UA/DA, BACNET, Profinet, Ethernet IP, Modbus TCP, SQL Query, IEC 61850	Ethernet, MQTT protocol, Bi Directional	Local backup, FOTA



Benefits - To Track and Protect VFD failures

Parameters Monitored

- IGBT Temp (degC)
- Output Frequency
- Commanded Frequency
- Output Current
- Output AC Volt
- Output Power
- DC Bus Voltage
- Drive Temp (degC)
- Last Fault Code
- Drive Overload Count
- Elapsed Kwh
- Elapsed Runtime
- Output power factor
- Torque current feedback

Faults Highlighted

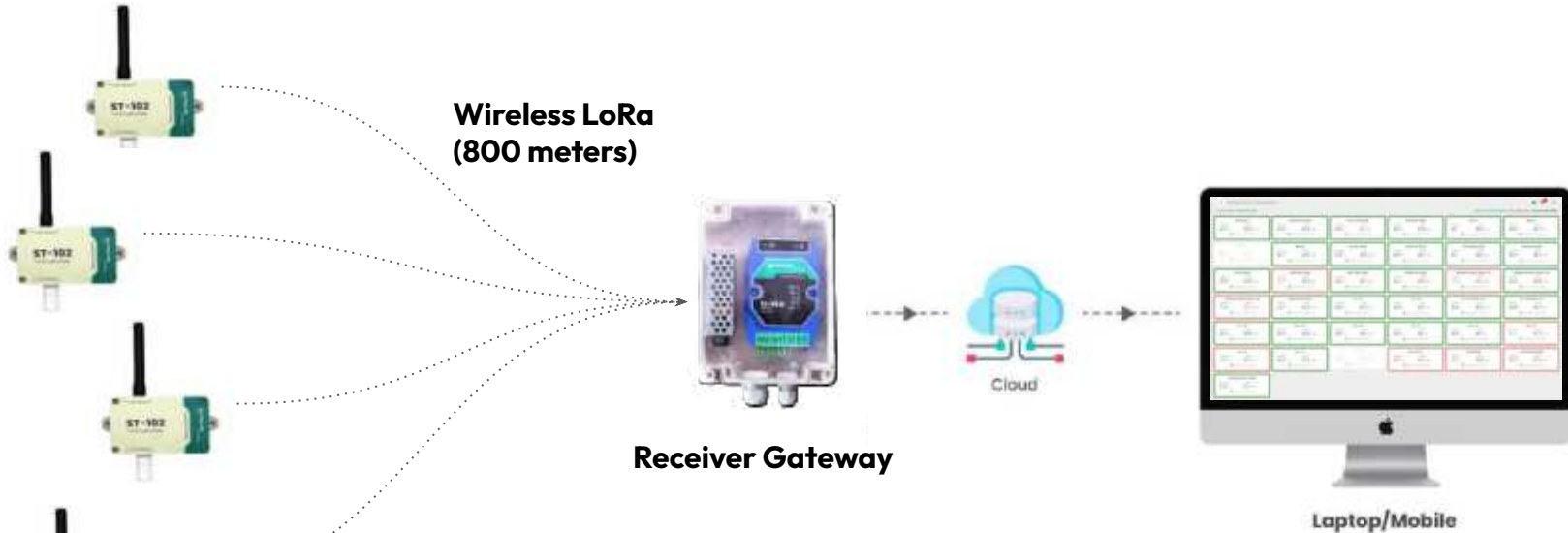
- Power Loss
- Under Voltage
- Motor OL
- Load Loss
- In Phase Loss
- Out Phase Loss
- Decel Inhibit
- Shear Pin 1
- Shear Pin 2
- Primary Fdbk Loss
- Alternate Fdbk Loss
- Auxiliary Fdbk Loss
- Position Fdbk Loss
- Ext Pr Chrg Err
- Auxiliary Input Fault
- OverVoltage
- Drive Overload
- Heatsink Over Temp
- Transistor Over Temp
- Sink Under Temp
- Excess Load
- Over speed limit
- Prchrg Open
- Safety board fault
- IR Volt Range
- Flux Amp Range
- IXO Volt Range
- Au Rst Exhaust



Wireless Ambient Monitoring



Solution Architecture



Battery based, wall mountable node

Faclon I/O Sense Platform

- Temperature Management
- Trends and Alerts
- Health Dashboard
- Energy Savings

Sensor Node Specifications

- LoRa based
- 865-867 MHz (Free ISM Band)
- Temperature Measurement Range -40 to 85 degrees C
- Humidity Measurement Range - 0 to 100 RH
- Ambient Temperature $\pm 0.3^{\circ}\text{C}$ and RH $\pm 2\%$ sensor
- Mounting - Wall or metal clamp/tie mounting
- Battery operated ~ 2 year
- External Antenna
- Range Upto 200m for indoor conditions and 1 km in outdoor conditions
- Data frequency configurable 5 to 30 mins



Receiver Gateway Specifications

- 4G uplink
- LoRa based
- 865-867 MHz (Free ISM Band)
- Mounting - Wall or metal clamp/tie mounting
- External Antenna
- Range Upto 200m for indoor conditions and 1 km in outdoor conditions
- Power supply to be provided by client and installation will be at a central location at certain height



I/O Sense Platform Key Features



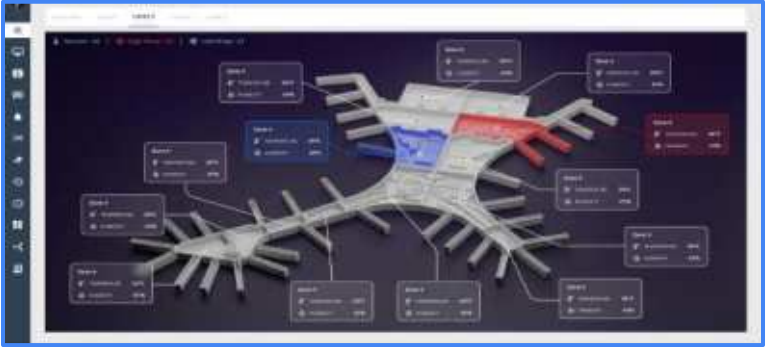
Real time Health Overview

Date	Event Type	Device Name	Event duration	Start time	Stop time
14/07/2023	Temperature	444000001	4 mins	06:45:31 am	06:49:31 am
14/07/2023	Temperature	444000001	30 Sec	07:27:30 am	07:28:00 am
14/07/2023	Temperature	444000004	37 Sec	08:22:34 am	08:23:11 am
14/07/2023	Temperature	444000004	10 Sec	08:52:30 am	08:52:40 am
14/07/2023	Temperature	444000004	37 Sec	09:08:36 am	09:10:03 am
14/07/2023	Temperature	444000004	1 MA BTW	09:40:33 pm	09:40:33 pm
14/07/2023	Temperature	444000004	5 Secs	09:48:38 pm	09:53:00 pm
14/07/2023	Temperature	444000004	4 Secs	09:54:30 pm	09:58:30 pm
14/07/2023	Temperature	444000004	10 Sec	09:59:30 pm	10:09:30 pm

Alerts & Events



Trends



Map View

I/O Sense Platform Key Features

Name	Status	Voltage	Current	Power	Temperature
Motor 1	OK	120 V	2.5 A	300 W	55°C
Motor 2	OK	120 V	2.5 A	300 W	55°C
Motor 3	OK	120 V	2.5 A	300 W	55°C
Motor 4	OK	120 V	2.5 A	300 W	55°C
Motor 5	OK	120 V	2.5 A	300 W	55°C
Motor 6	OK	120 V	2.5 A	300 W	55°C
Motor 7	OK	120 V	2.5 A	300 W	55°C
Motor 8	OK	120 V	2.5 A	300 W	55°C
Motor 9	OK	120 V	2.5 A	300 W	55°C
Motor 10	OK	120 V	2.5 A	300 W	55°C

Health Overview

Date	Event Type	Device Name	Event Duration	Start Time	Stop Time
10/10/2023	Over Temp	SHREDDER 1	10 Sec	10:45:31 am	10:45:41 am
10/10/2023	Over Temp	SHREDDER 1	10 Sec	10:47:16 am	10:47:26 am
10/10/2023	Over Temp	SHREDDER 2	10 Sec	10:52:29 am	10:52:39 am
10/10/2023	Over Temp	SHREDDER 2	10 Sec	10:53:58 am	10:54:08 am
10/10/2023	Over Temp	SHREDDER 2	10 Sec	10:56:36 am	10:56:46 am
10/10/2023	Over Temp	SHREDDER 2	10 Sec	10:58:04 am	10:58:14 am
10/10/2023	Over Temp	SHREDDER 2	10 Sec	10:59:32 am	10:59:42 am
10/10/2023	Over Temp	SHREDDER 2	10 Sec	11:01:00 am	11:01:10 am
10/10/2023	Over Temp	SHREDDER 2	10 Sec	11:02:28 am	11:02:38 am
10/10/2023	Over Temp	SHREDDER 2	10 Sec	11:03:56 am	11:04:06 am

Alerts & Events



Trends

Device Name	Sensor Name(unit)	Data Parameter	Jul 17, 2023 (Mon)
2.5 MVA INCOMER	R PHASE INCOMER TEMPERATURE (°C)	Avg	33.148
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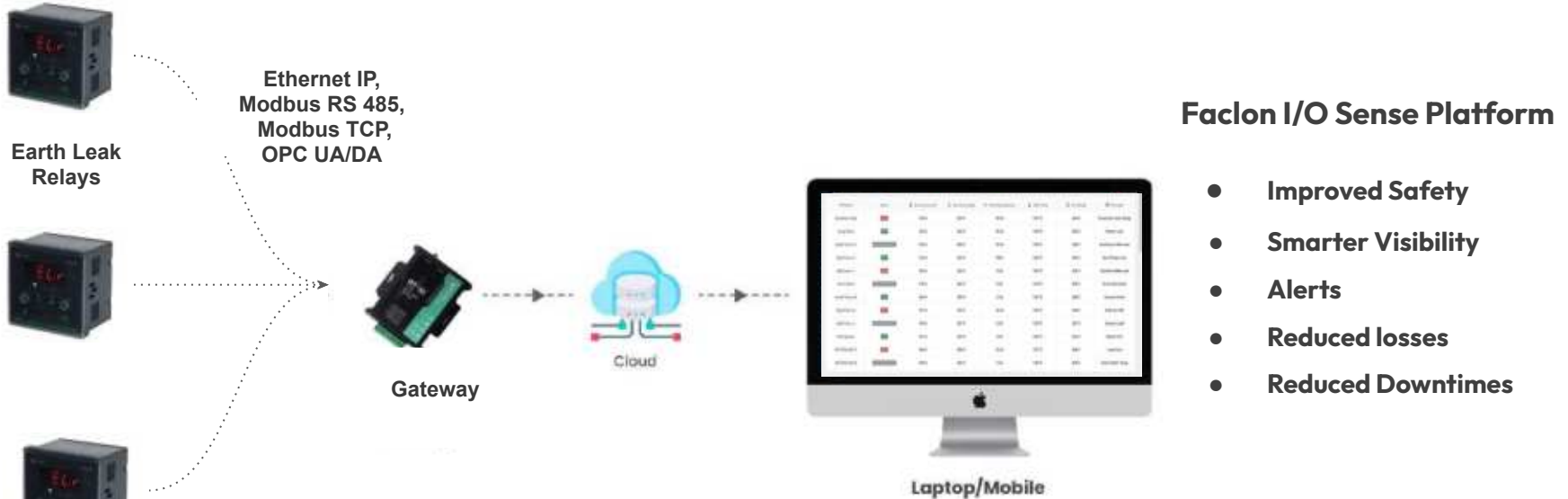
Reports



Earth Leak Detection





VFD Monitoring and Analysis



Tracking and Analytics on health of numerous VFDs spread across the infrastructure to improve maintenance and upkeep to prevent any unwarranted failures or breakdowns

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	Energy meters, flow meters, IO Cards, PLCs, VFDs, other sensors etc.	Modbus RS 485, Modbus TCP	Variants in 4G, Wifi or Ethernet. MQTT protocol, Bi Directional	Local backup, FOTA
	OPC server, VFDs, PLCs, DCS, SQL Server etc.	OPC UA/DA, BACNET, Profinet, Ethernet IP, Modbus TCP, SQL Query, IEC 61850	Ethernet, MQTT protocol, Bi Directional	Local backup, FOTA

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