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DISTRIBUTION UTILITY MEET DUM 2025

SESSION 4: DIGITAL ENERGY GRIDS AND THE EMERGING ERA OF ENERGY INTERNET

Digitalization of Rural Substation by IOT device

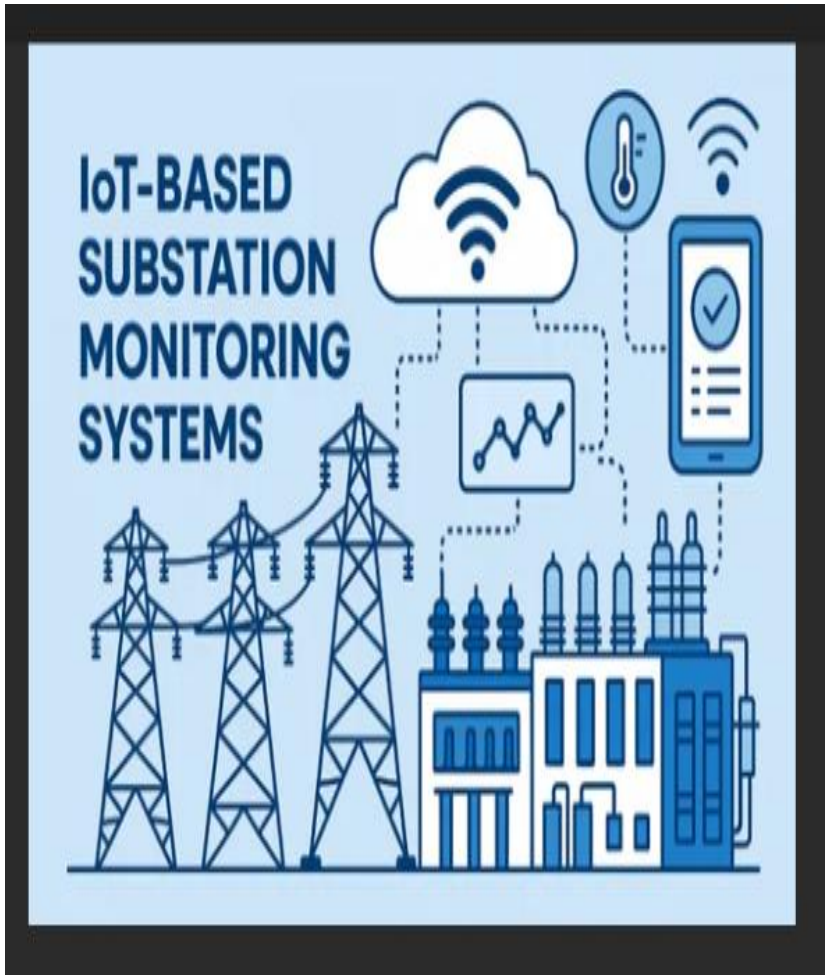
Presented By

RS Selvam, VP R&D Stelmec Ltd





INTRODUCTION



As the distribution network has become highly complicated nowadays, **Utilities** need to look forward to automating substations to enhance their functionality and efficiency and improve power transmission quality.

A remote monitoring and controlling system is needed to reduce cost, time, labour and save energy for sustainable development.

CONTEXT

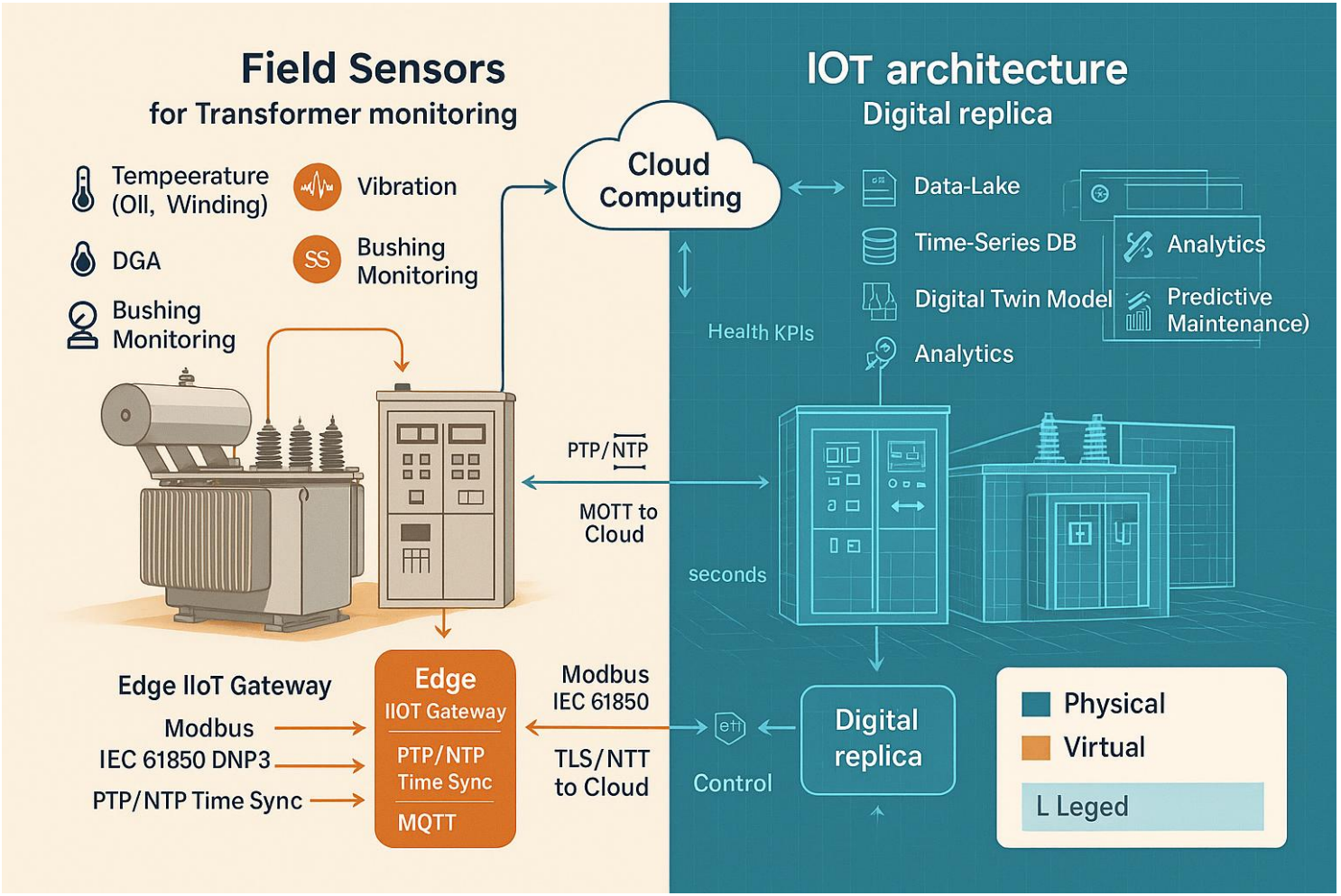
1. Introduction
2. Relevance of IOT device
3. About IOT Device
4. Key Components & Architecture
5. Benefits of IOT based SS
6. Future trends
7. Conclusion

Importance of IOT

Stelmec has supplied both Indoor & Outdoor VCB switchgear panel to the various utilities and we have established a solution with IOT device to make Automation in Rural Distribution Substation to facilitate the customer with required Data by remotely.

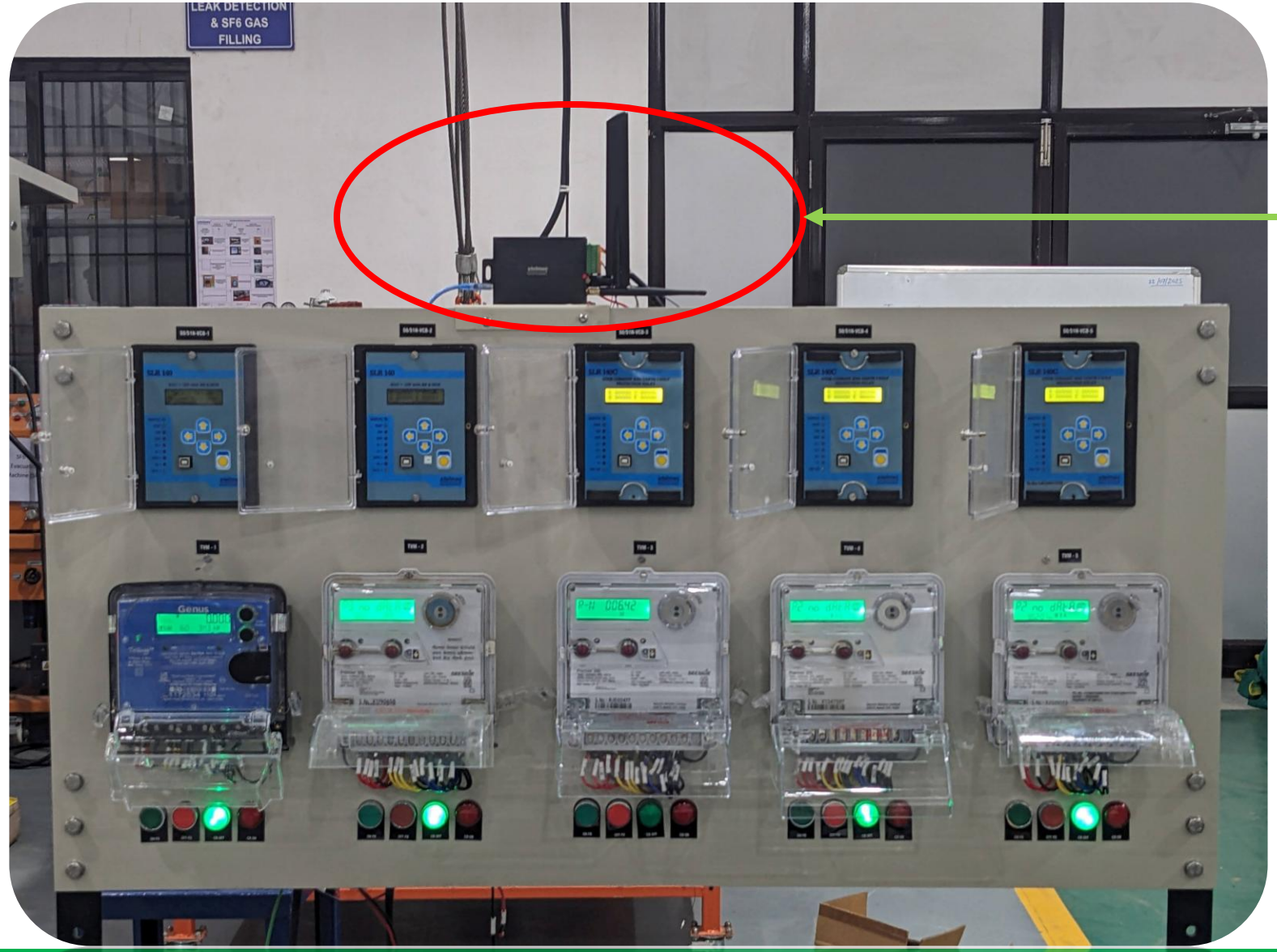
Substations are often located in remote, rural, or difficult to access locations where the monitoring of substations **using IoT** will assist the distribution network in diagnosing the local faults , Power management, Statues of the Transformer , CB, etc. and displaying them on a web server for remote monitoring and a power station on an LCD. This will help prevent faults and damage to power system equipment from unfavourable conditions and thus maintain the power supply.

About IoT Architecture & Possibilities



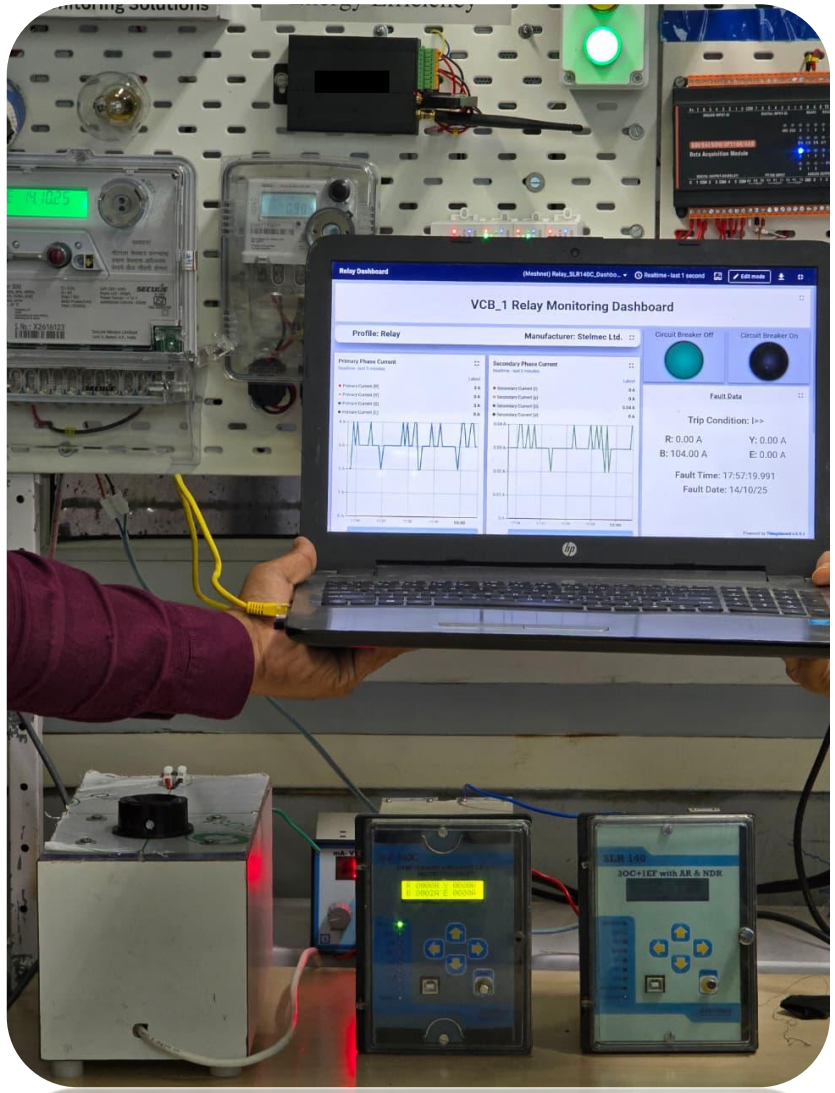
- IoT is also a natural extension of SCADA, a category of software application programs for process control, the gathering of data in real time from remote locations to control equipment and conditions.
- Receives data from sensor /Relays /IED device Meters, Transformer, etc. using RS 485 or Ethernet Port, RS 232,etc
- Can Convert Multiple Protocols such as Modbus RTU/TCP or 61850 to MQTTs
- Performs Pre processing, filtering and cleaning on unfiltered data.
- Sends data to cloud & with remote telemetry allows local control
- Provides local storage on SD Card with store & forward .
- Pay per use model in Cloud Architecture.

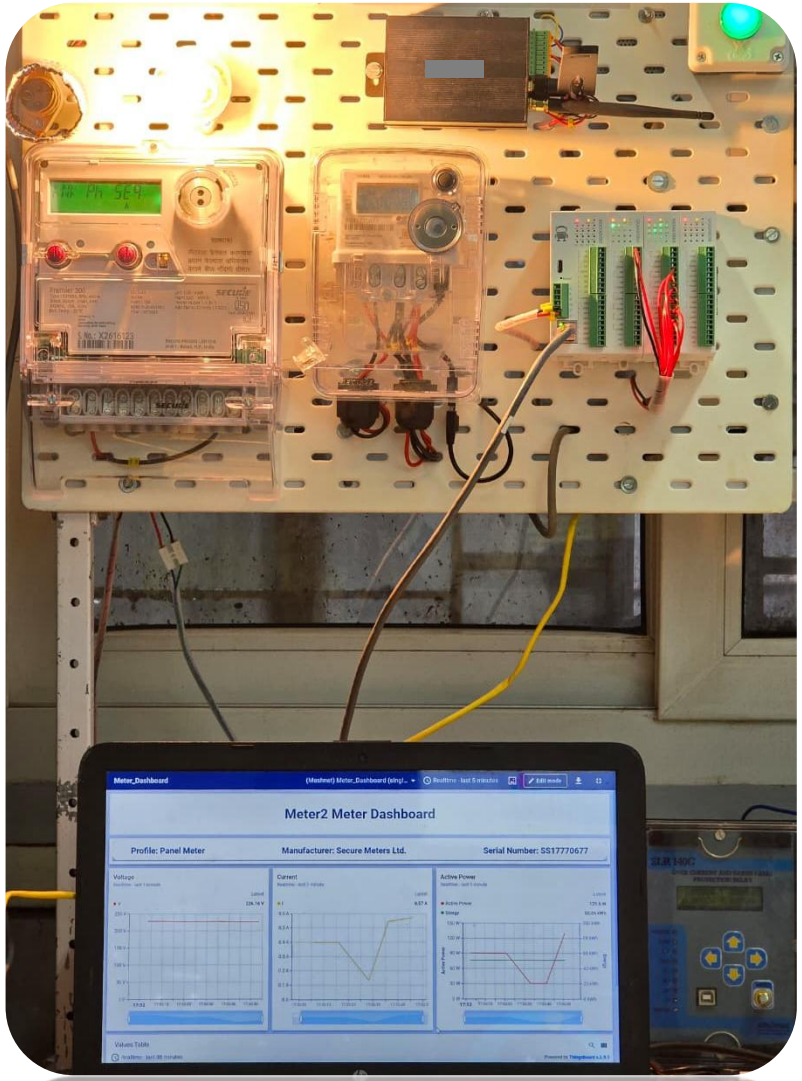
USE CASE : Indoor/Outdoor VCB Panel Monitoring & Control



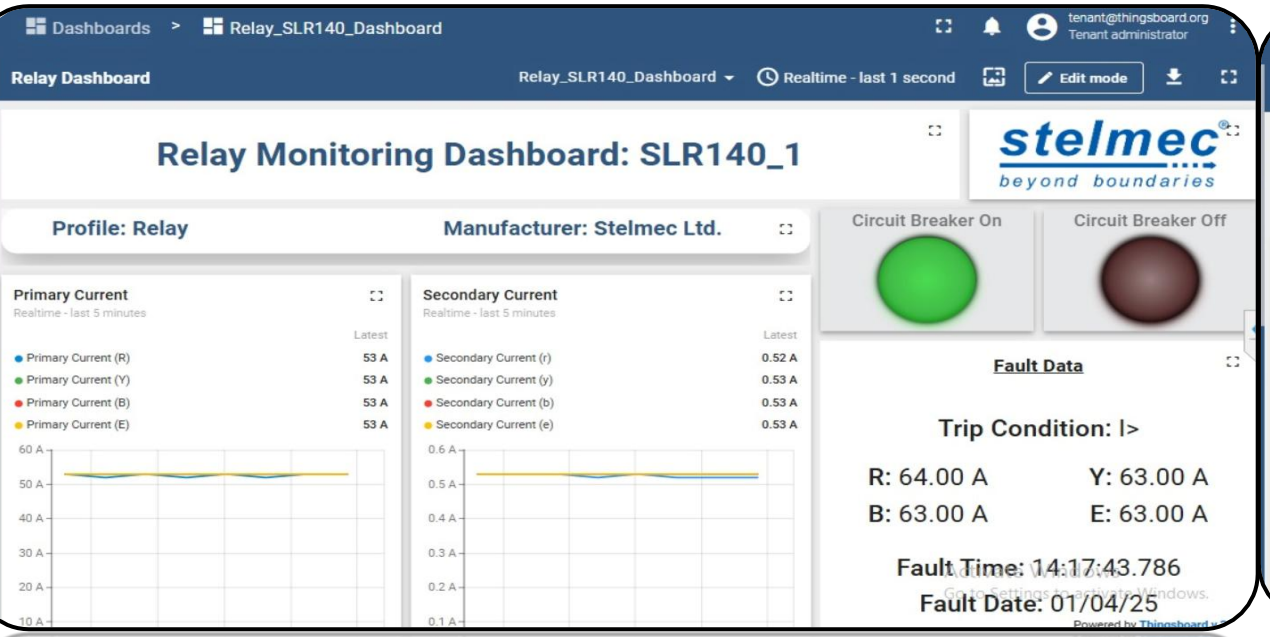
IoT Edge Gateway

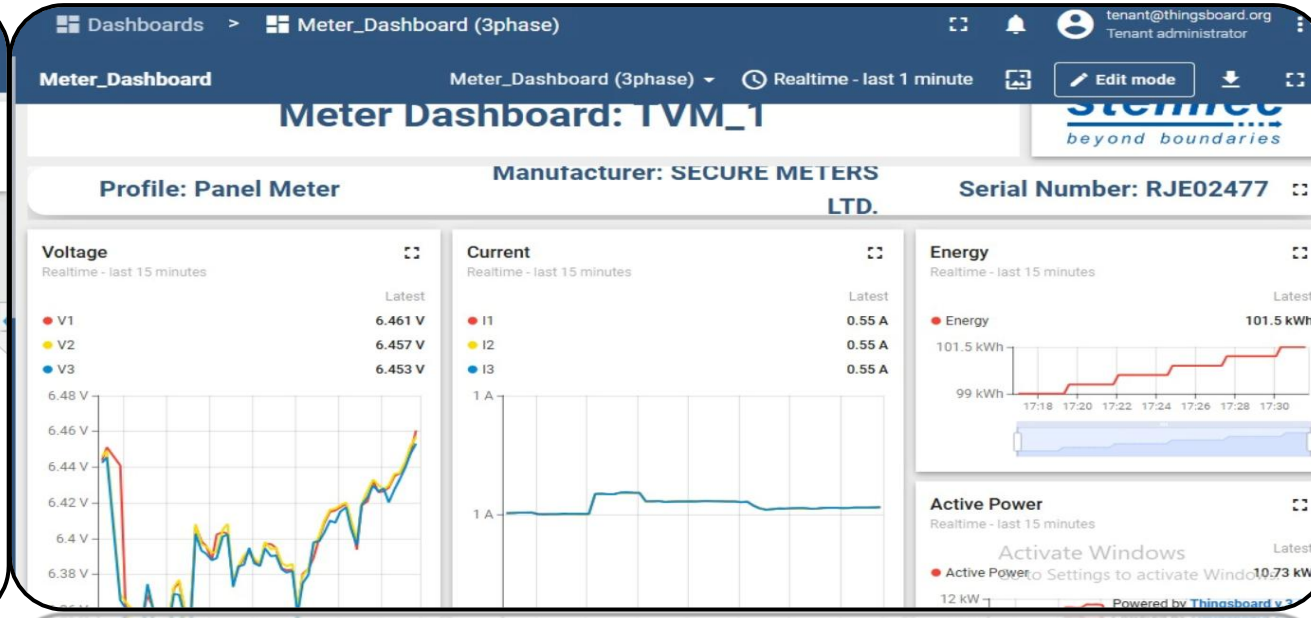
USE CASE : Indoor/Outdoor VCB Panel Monitoring & Control



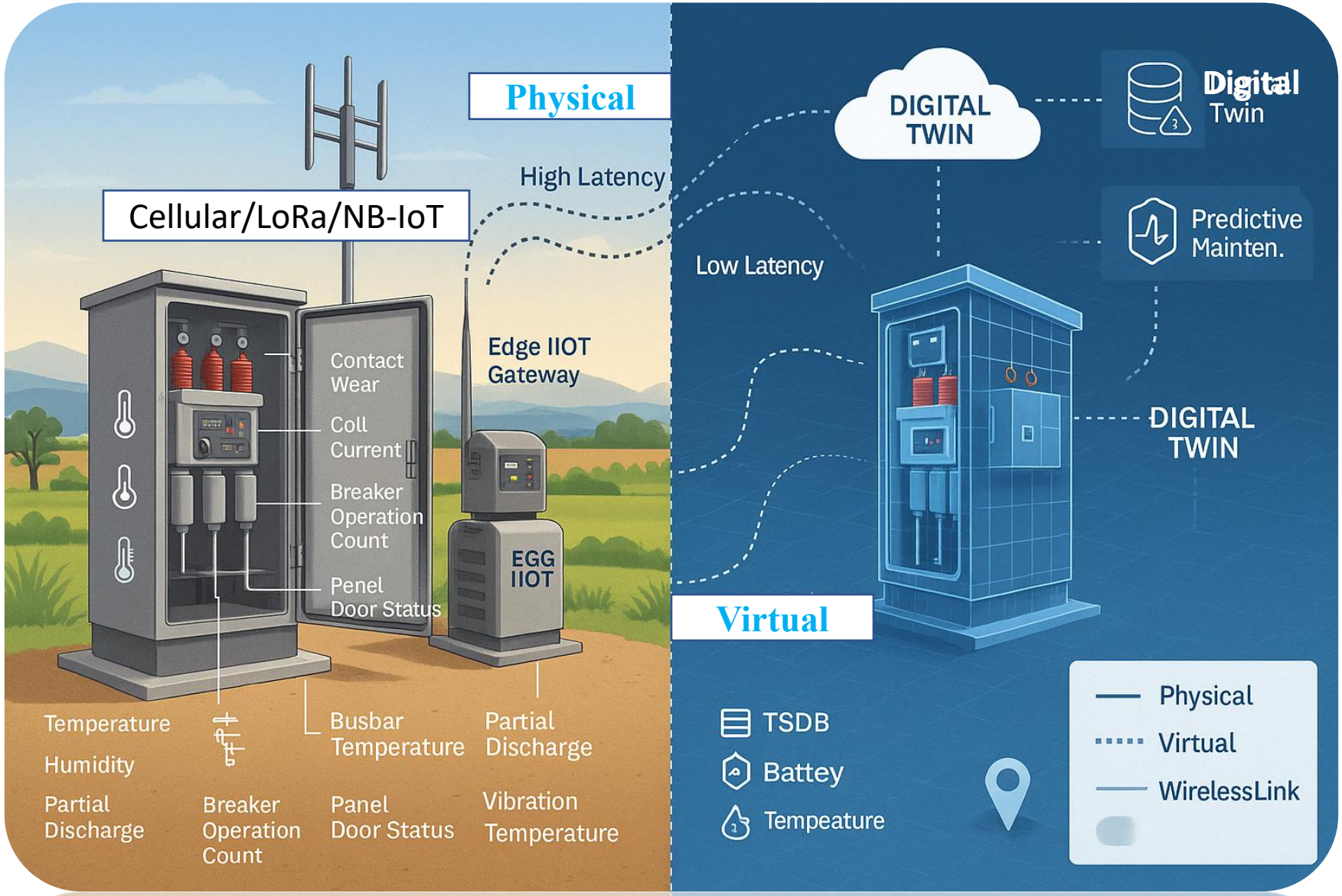


USE CASE : Indoor/Outdoor VCB Panel Monitoring & Control





USE CASE / CASE STUDY



KEY TAKEAWAYS / Key Components of IOT

1. Sensor Networks

IoT-based substation monitoring relies on a network of sensors placed throughout the substation to monitor critical assets which could range from VCB Panels & Meters to Transformers. Deploying an array of sensors within substations allows for the real-time monitoring of various parameters critical to substation operations. These sensors capture a wide range of data, including temperature, humidity, voltage, current, and equipment status and aggregate it to an edge computing resource

2.. Communication Infrastructure

The sensors are connected upstream through a robust communication infrastructure, often using protocols such as MQTT or CoAP. This connectivity ensures easy data transmission from the substation to centralized monitoring systems.

3. Edge Computing

Edge computing capabilities are employed to process and analyse data locally within the substation allowing control if needed & enabled. This reduces latency and allows for quick decision making based on real-time insights

4. Cloud-Based Platforms

Processed data is then transmitted to cloud-based platforms for further analysis, storage, and visualization. Cloud solutions provide scalability, accessibility, and the ability to harness advanced analytics for predictive maintenance.

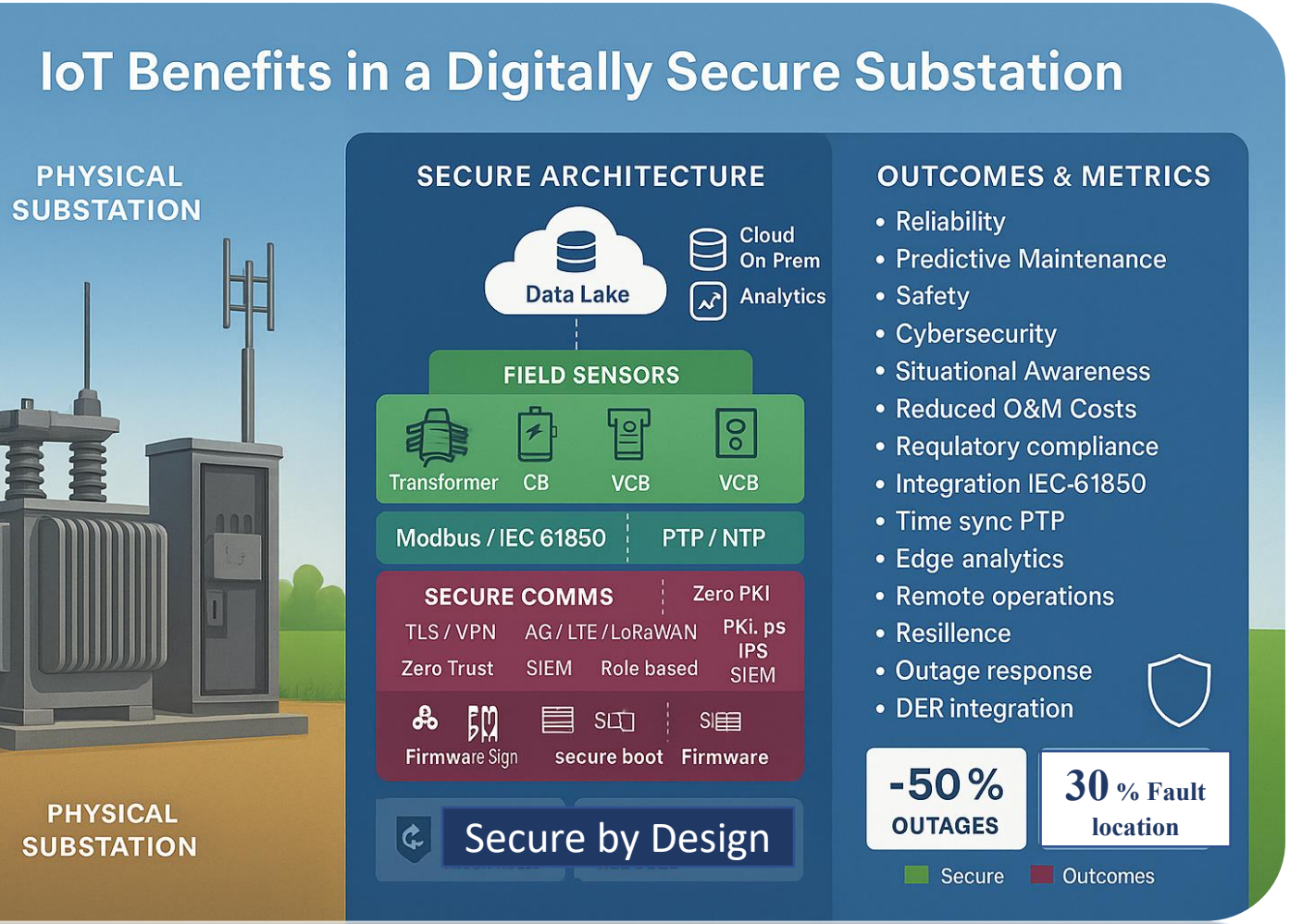
5. Predictive Analytics

IoT substation monitoring uses advanced analytics to predict equipment failures or anomalies, enabling strategic maintenance scheduling and reducing downtime and costs.

6. Scalability and Interoperability

The modular nature of IoT solutions allows for scalability, accommodating the addition of new sensors and devices as needed. Interoperability ensures seamless integration with existing substation infrastructure and compatibility with different communication protocols.

KEY TAKEAWAYS / Benefits of IOT



1. Real-Time Visibility

Continuous monitoring in real-time provides operators with a comprehensive view of substation performance. Any anomalies or potential issues can be identified promptly, allowing for easy intervention.

2. Predictive Maintenance

By leveraging data analytics and machine learning, IoT-based solutions enable predictive maintenance. This approach helps utilities anticipate equipment failures, reduce downtime, and optimize maintenance schedules.

3. Efficient Resource Allocation

With insights into equipment health and performance, utilities can allocate resources more efficiently. This includes targeted maintenance, equipment upgrades, and optimized energy distribution.

4. Enhanced Safety

Continuous substation monitoring using IoT minimizes the need for manual inspections in hazardous environments, improving overall safety for maintenance personnel. In case of emergencies, immediate alerts can be triggered for rapid response.

5. Cost Savings

Proactive maintenance and optimized operations translate into cost savings for utilities. Reduced downtime, lower maintenance costs, and improved energy efficiency contribute to a more economically viable power distribution network.

6. Quick Response to Faults

Real-time alerts and remote monitoring capabilities empower operators to respond swiftly to faults or anomalies, minimizing the impact on the electrical grid.

KEY TAKEAWAYS / IOT security

The Edge IoT Ecosystem is secured by

- Hardware Security: Secure Boot Enabled
- Software Security: Encryption of code and transmission
- Protocol Security: Encryption at protocols
- Update Security: Secure Remote Over the Air update with HTTPS/MQTTS and signed certificates.
- Code Security: Code Encryption with device specific key
- Remote Access Security: via Wire guard VPN

KEY TAKEAWAYS – Future Trends

Cloud-based SCADA

- Leveraging the cloud for scalable, cost-effective, and secure SCADA deployments.

AI-powered Analytics

- Utilizing machine learning and artificial intelligence for predictive maintenance and optimization.

IoT Integration

- Integrating IoT devices to enhance data collection and enable smart grid applications.

AR/VR Visualization

- Leveraging augmented and virtual reality for improved situational awareness and remote operations.

IEC 61850 Relay

- IEC 61850 is a critical standard for substation automation, enabling seamless communication between intelligent electronic devices (IEDs) like protective relays and SCADA systems.

Transformer & circuit Breaker monitoring

Cost effective solution to monitor & Control of humidity ,Temperature, Gas pressure, Arc sensors, CB life cycle, Mechanical operation etc. will enhance the substation's efficiency including operator safety.

KEY TAKEAWAYS – Conclusions

Digital substations represent a transformative shift in power grid management, offering enhanced efficiency, reliability, and resilience. As the industry continues to evolve, further advancements in artificial intelligence, IoT, and renewable energy integration will shape the future of these intelligent substations.

IOT-based Substation Monitoring Solutions are at the forefront of the ongoing transformation in the energy sector. By harnessing the power of data, connectivity, and advanced analytics, utilities can ensure the resilience, efficiency, and safety of their substations.

As we continue to advance in the era of smart grids, embracing these innovative solutions is not just a choice but a necessity for the sustainable and reliable distribution of electrical power. The convergence of IoT and substations for improved monitoring is a testament to the possibilities of technology in shaping the future of our energy infrastructure.

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THANK YOU

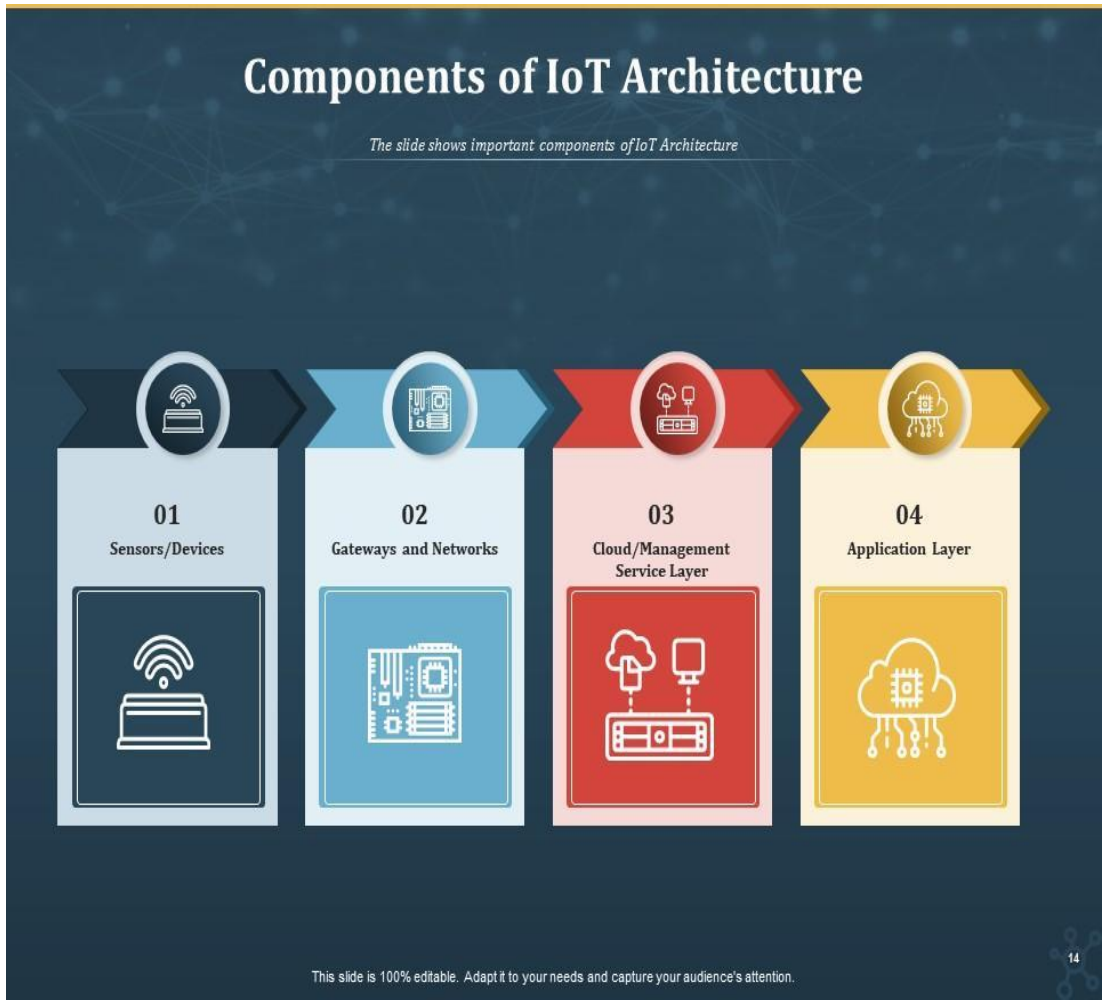
For discussions/suggestions/queries email: ***dum@indiasmartgrid.org***

www.dumindia.in

Links/References (If any)






Components of IoT Architecture
The slide shows important components of IoT Architecture
01
Sensors/Devices
02
Gateways and Networks
03
Cloud/Management Service Layer
04
Application Layer
This slide is 100% editable. Adapt it to your needs and capture your audience's attention.
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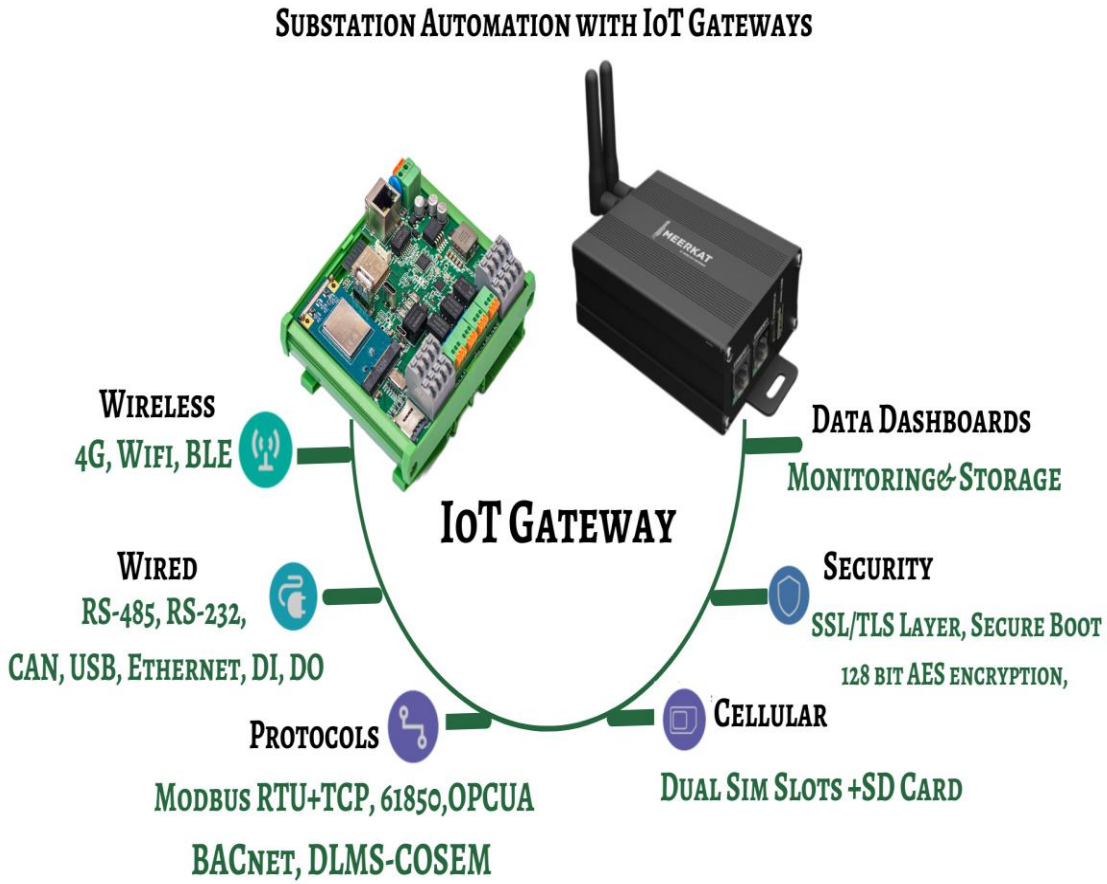
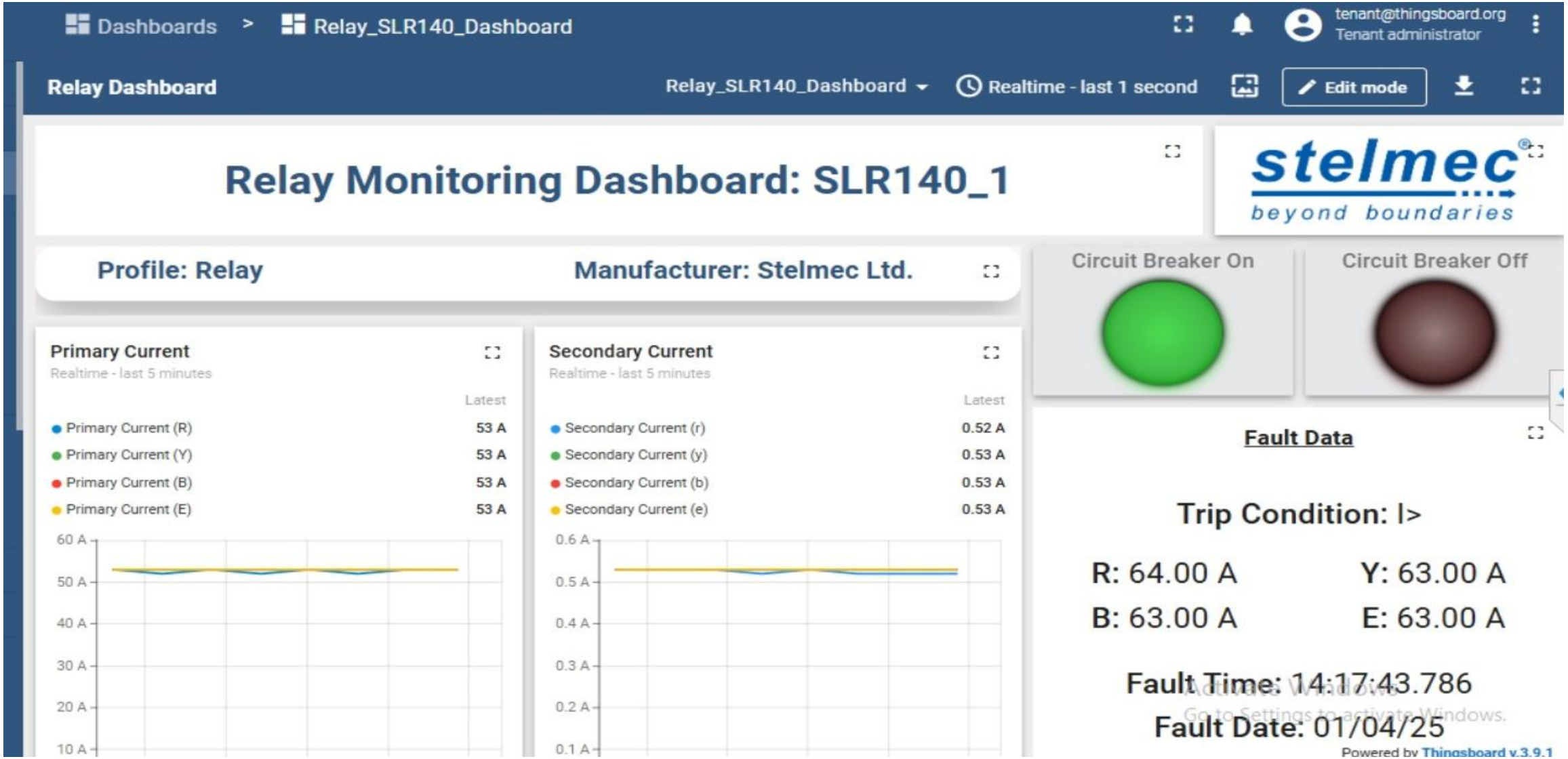

SUBSTATION AUTOMATION WITH IOT GATEWAYS
MEERKAT
IOT GATEWAY
WIRELESS
4G, WIFI, BLE
WIRED
RS-485, RS-232,
CAN, USB, ETHERNET, DI, DO
PROTOCOLS
MODBUS RTU+TCP, 61850,OPCUA
BACNET, DLMS-COSEM
DATA DASHBOARDS
MONITORING& STORAGE
SECURITY
SSL/TLS LAYER, SECURE BOOT
128 BIT AES ENCRYPTION,
CELLULAR
DUAL SIM SLOTS +SD CARD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tenant@thingsboard.org
Tenant administrator
Relay Dashboard
Relay_SLR140_Dashboard
Realtime - last 1 second
Edit mode
Relay Monitoring Dashboard: SLR140_1
stelmec
beyond boundaries
Profile: Relay
Manufacturer: Stelmec Ltd.
Circuit Breaker On
Circuit Breaker Off
Primary Current
Realtime - last 5 minutes
Latest
Primary Current (R) 53 A
Primary Current (Y) 53 A
Primary Current (B) 53 A
Primary Current (E) 53 A
60 A
50 A
40 A
30 A
20 A
10 A
Secondary Current
Realtime - last 5 minutes
Latest
Secondary Current (r) 0.52 A
Secondary Current (y) 0.53 A
Secondary Current (b) 0.53 A
Secondary Current (e) 0.53 A
0.6 A
0.5 A
0.4 A
0.3 A
0.2 A
0.1 A
Fault Data
Trip Condition: I>
R: 64.00 A
Y: 63.00 A
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E: 63.00 A
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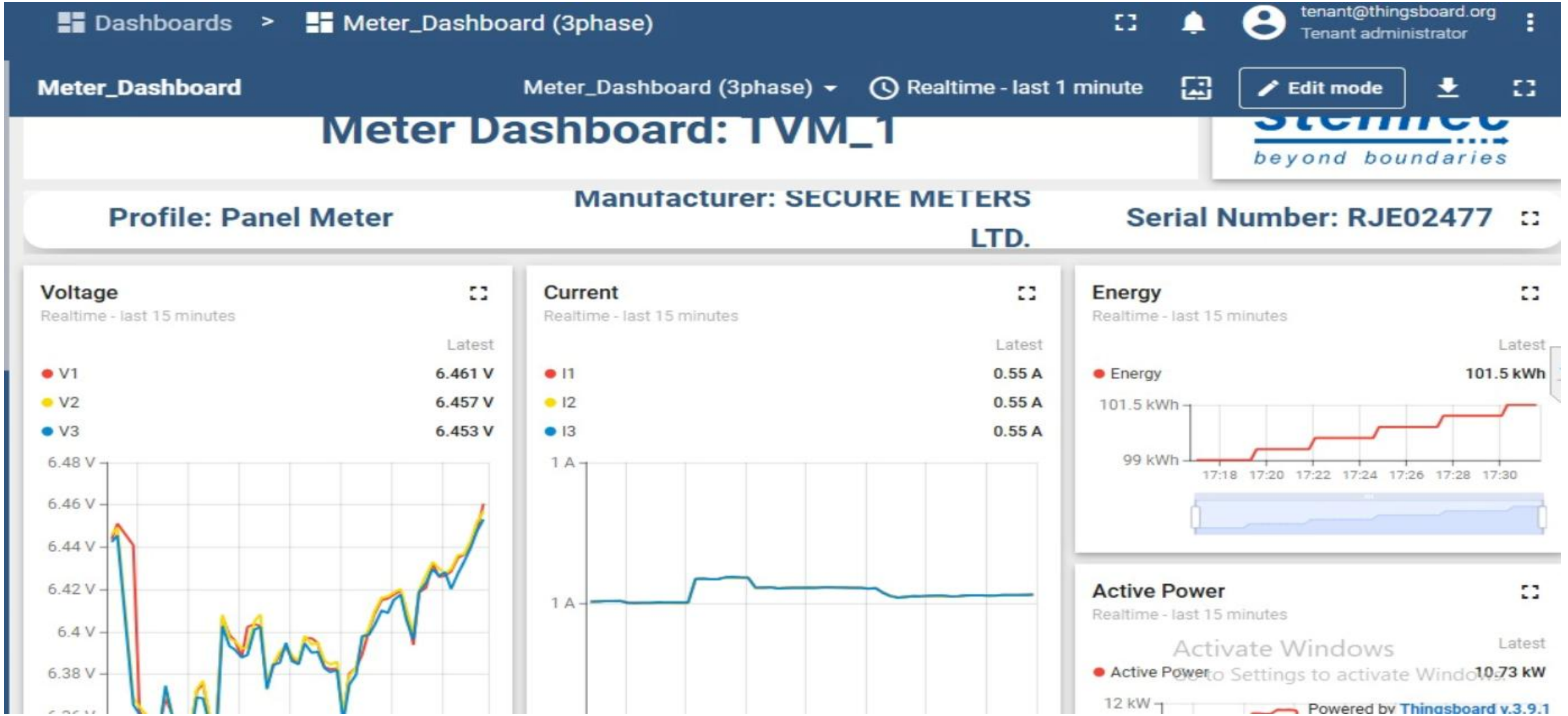
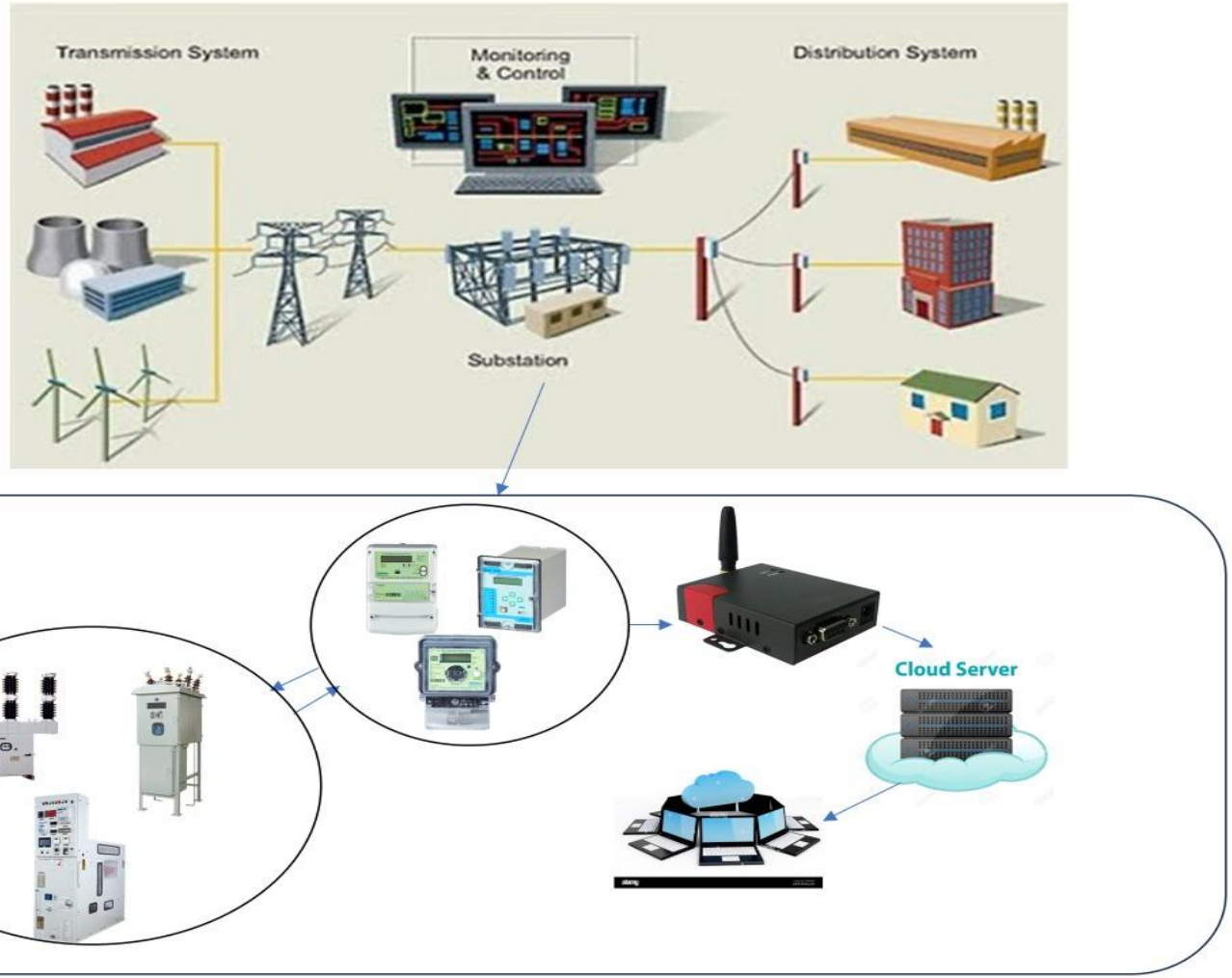
Fault Date: 01/04/25
Powered by Thingsboard v.3.9.1


Dashboards > Meter_Dashboard (3phase)
tenant@thingsboard.org
Tenant administrator
Meter_Dashboard
Meter_Dashboard (3phase)
Realtime - last 1 minute
Edit mode
Meter Dashboard: TVM_1
beyond boundaries
Profile: Panel Meter
Manufacturer: SECURE METERS LTD.
Serial Number: RJE02477
Voltage
Realtime - last 15 minutes
Latest
V1 6.461 V
V2 6.457 V
V3 6.453 V
6.48 V
6.46 V
6.44 V
6.42 V
6.4 V
6.38 V
Current
Realtime - last 15 minutes
Latest
I1 0.55 A
I2 0.55 A
I3 0.55 A
1 A
1 A
Energy
Realtime - last 15 minutes
Latest
Energy 101.5 kWh
101.5 kWh
99 kWh
17:18 17:20 17:22 17:24 17:26 17:28 17:30
Active Power
Realtime - last 15 minutes
Activate Windows
Latest
Active Power 10.73 kW
12 kW
Powered by Thingsboard v.3.9.1


Transmission System
Monitoring & Control
Distribution System
Substation
Cloud Server

A Gateway to the future!