# Big Data for Big Power

## Smart Meters ≠ Smart Grid

Brett Sargent
COO/President - GridSense

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# Big Data From a Sensor Manufacturer Perspective

Photoacoustic Gas Monitors


NDIR Infrared Gas Modules & Instruments

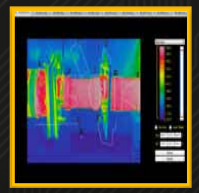
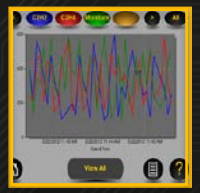



Temp Measurement and Transformer Monitoring


Infrared Thermal Imaging

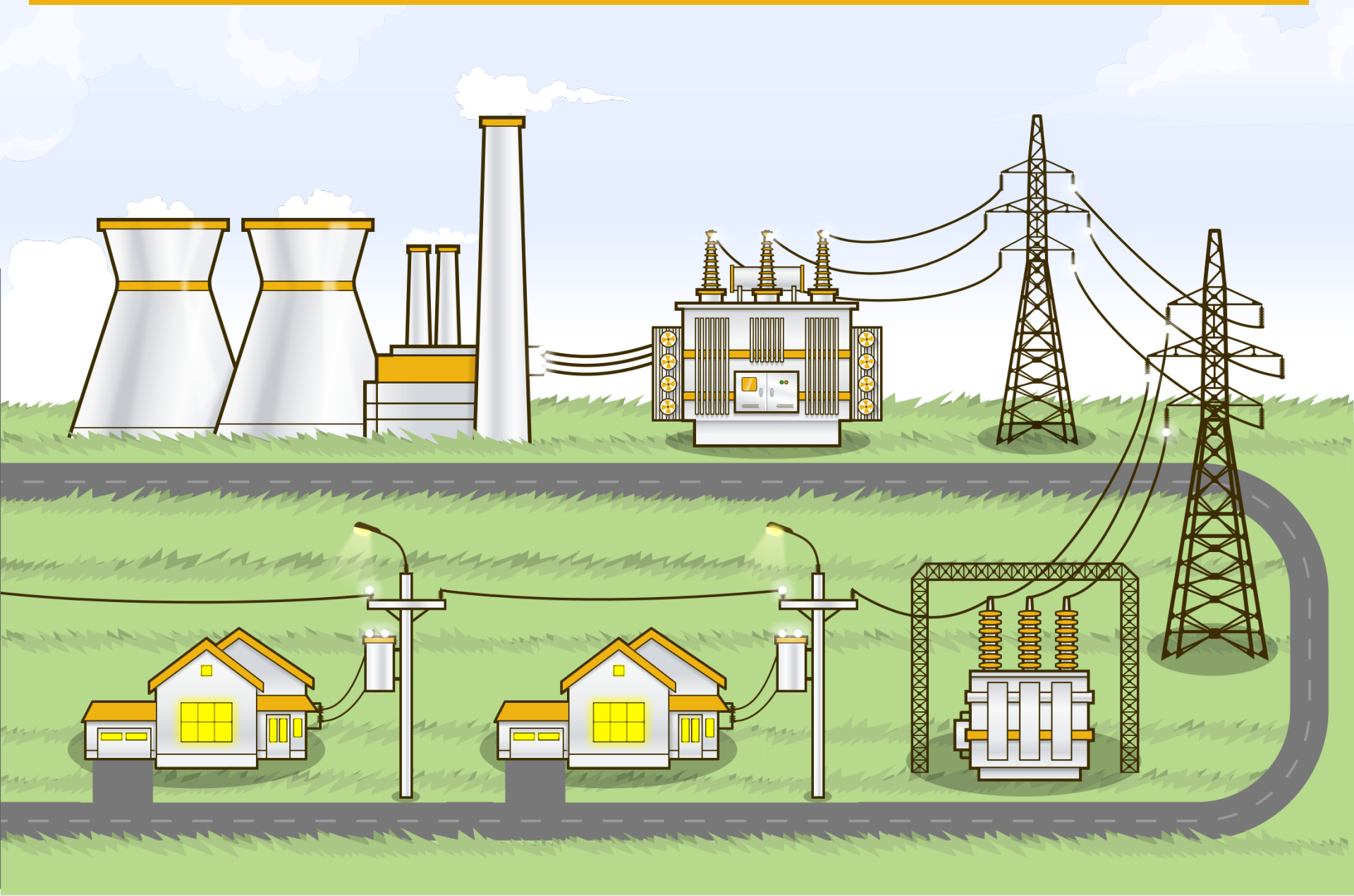


Infrared Thermometry for Non-Contact Temperature Measurement

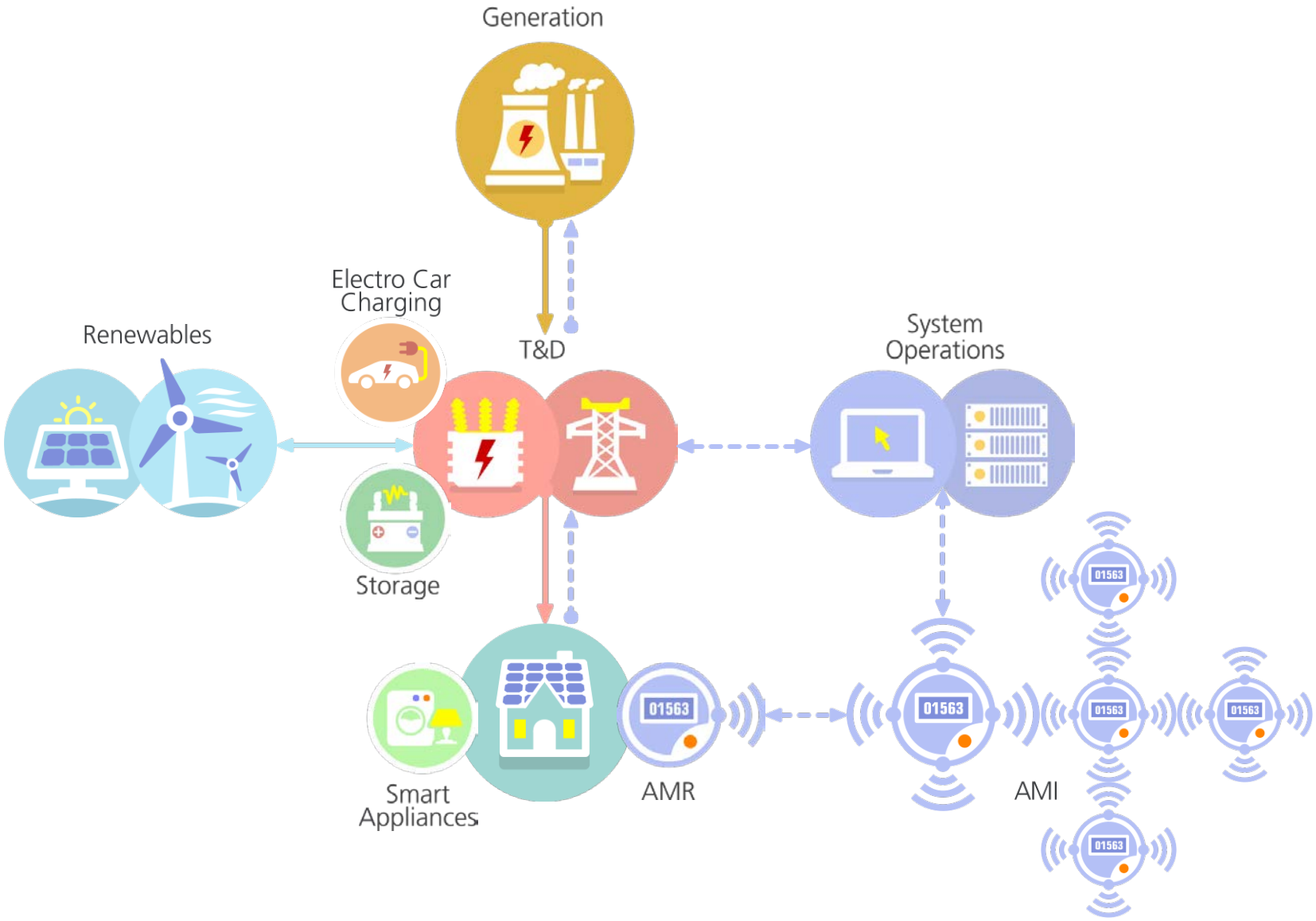
Software & Integrated Solutions

# Electric Grid



# Electric Grid

# Development of the Smart Grid



# Obstacles to Building a Smart Grid Infrastructure



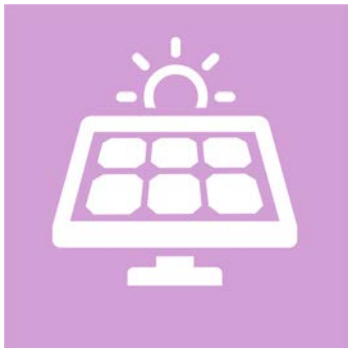
01. **Budget**

02. **Time**




03. **Not In My Back Yard**

04. **Downtime needed to build new infrastructure**



05. **Integration of Renewables**

06. **Qualified Personnel**




07. **Build Absolutely Nothing Anywhere Near Anyone**



08. **Cyber Security**

# Today's "Old" Substations

- 40-50 years in age
- Limited communications in/out of substation
- Assets running at 75% to 100% of nameplate

- Limited ability to do maintenance (criticality, parts, personnel)
- Knowledgeable people on substations retiring and/or leaving

- Minimal sensors and data
- Cannot afford to replace or update (budget, disruption)
- Huge risk of failure

Doing Nothing

*is*

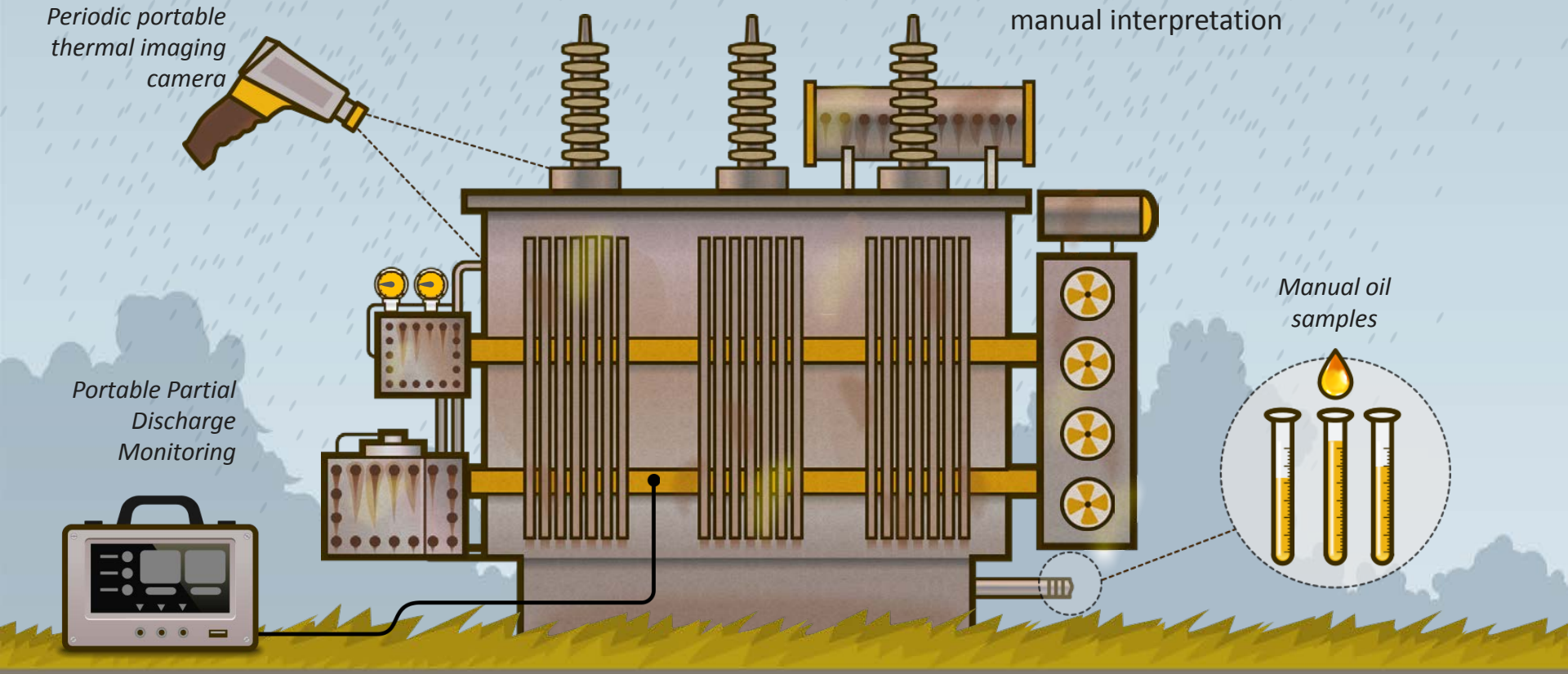
**Not an Option**

# Covering Your Substation Assets

## OLD SUBSTATION

- Analog Gauges: analog outputs, log readings
- Visual indicators and sight glasses
- Shifty log readings looking for physical wear and broken parts

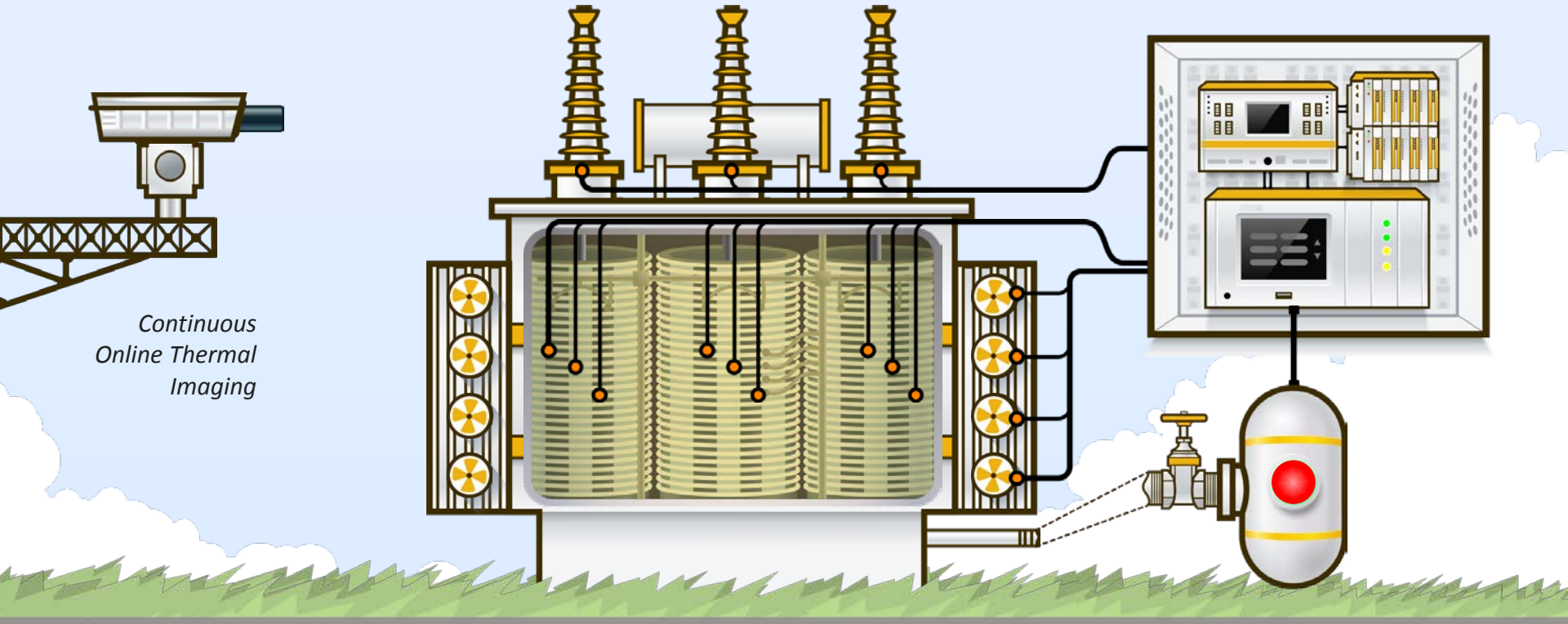
- Assets over 40 years old, overdesigned and heavily loaded to 100% nameplate or higher
- Aged workforce, in general less experienced
- Manual samples, manual analysis, manual interpretation



# Covering Your Substation Asset

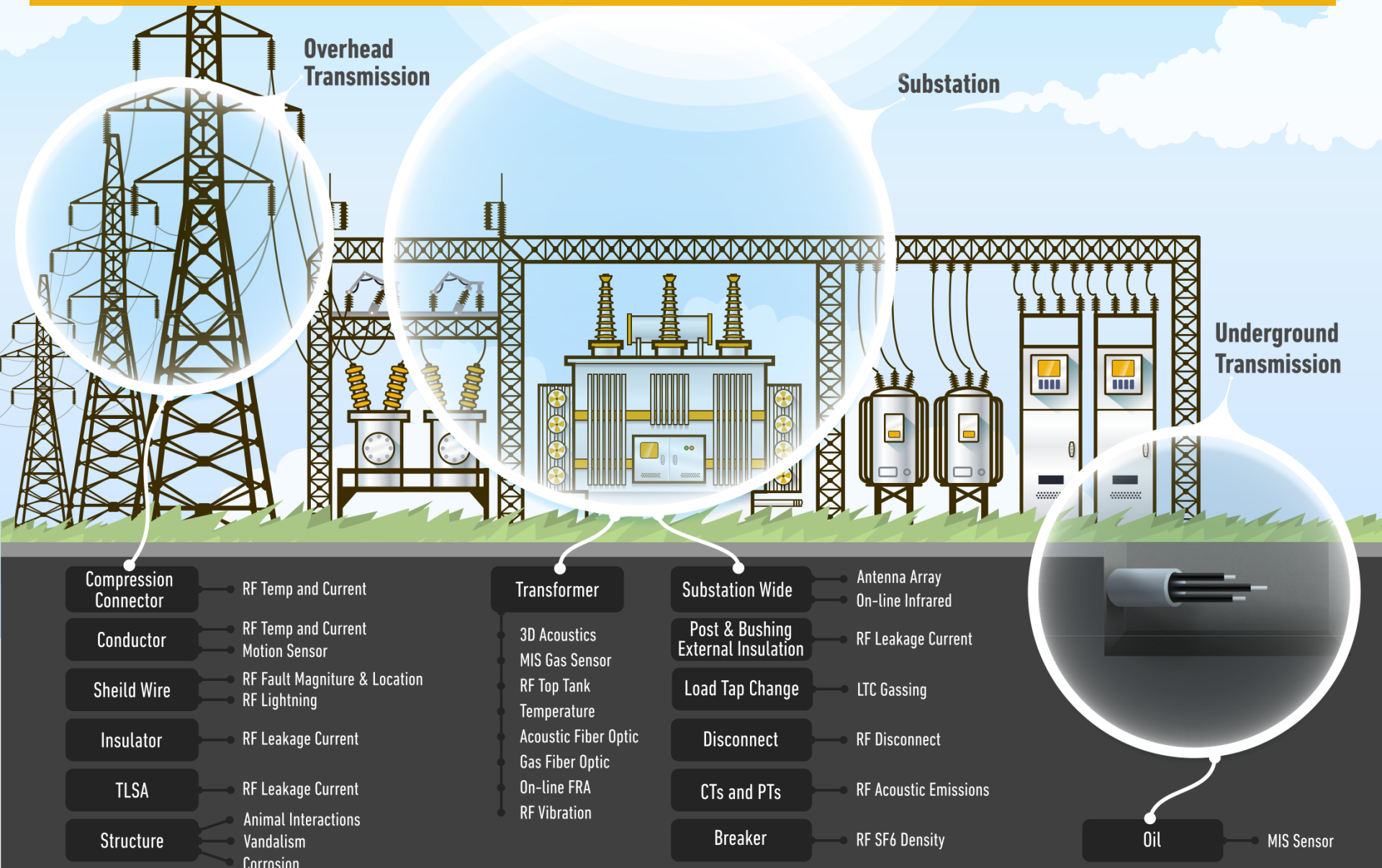
**NEW SUBSTATION**

- Solid state sensors with intelligence
- Data concentrator to pull data together from multiple sensors
- More remote, less local
- Most assets under 20 years old
- Aged workforce, in general less experienced
- 10-fold increase in sensors, 1,000-fold increase in data
- Assets designed to nameplate and loaded 75-100%



*Continuous Online Thermal Imaging*

# Sensor Technologies for Transmission and Substations



# SLEx™ - Substation Life Extension

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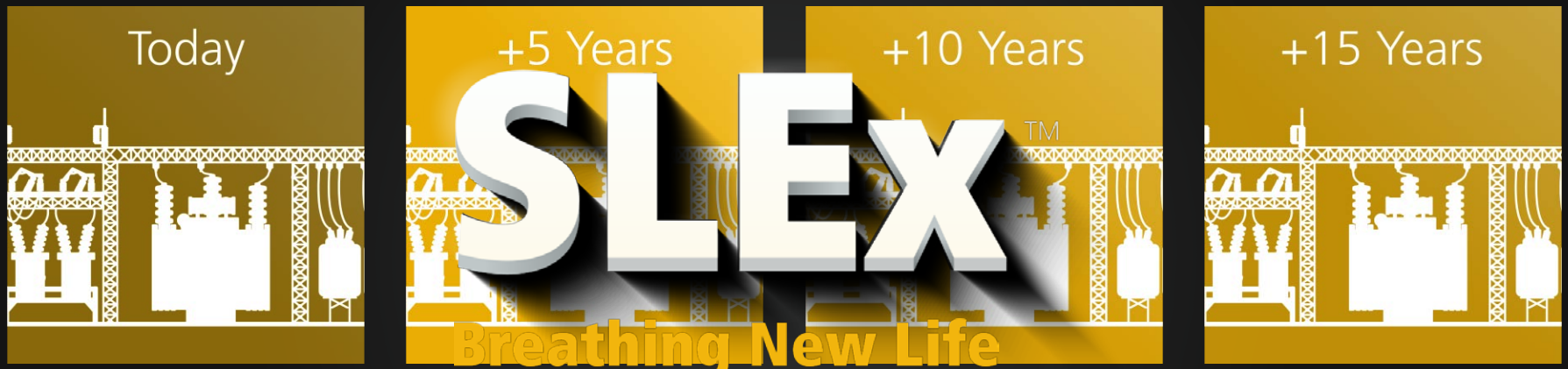
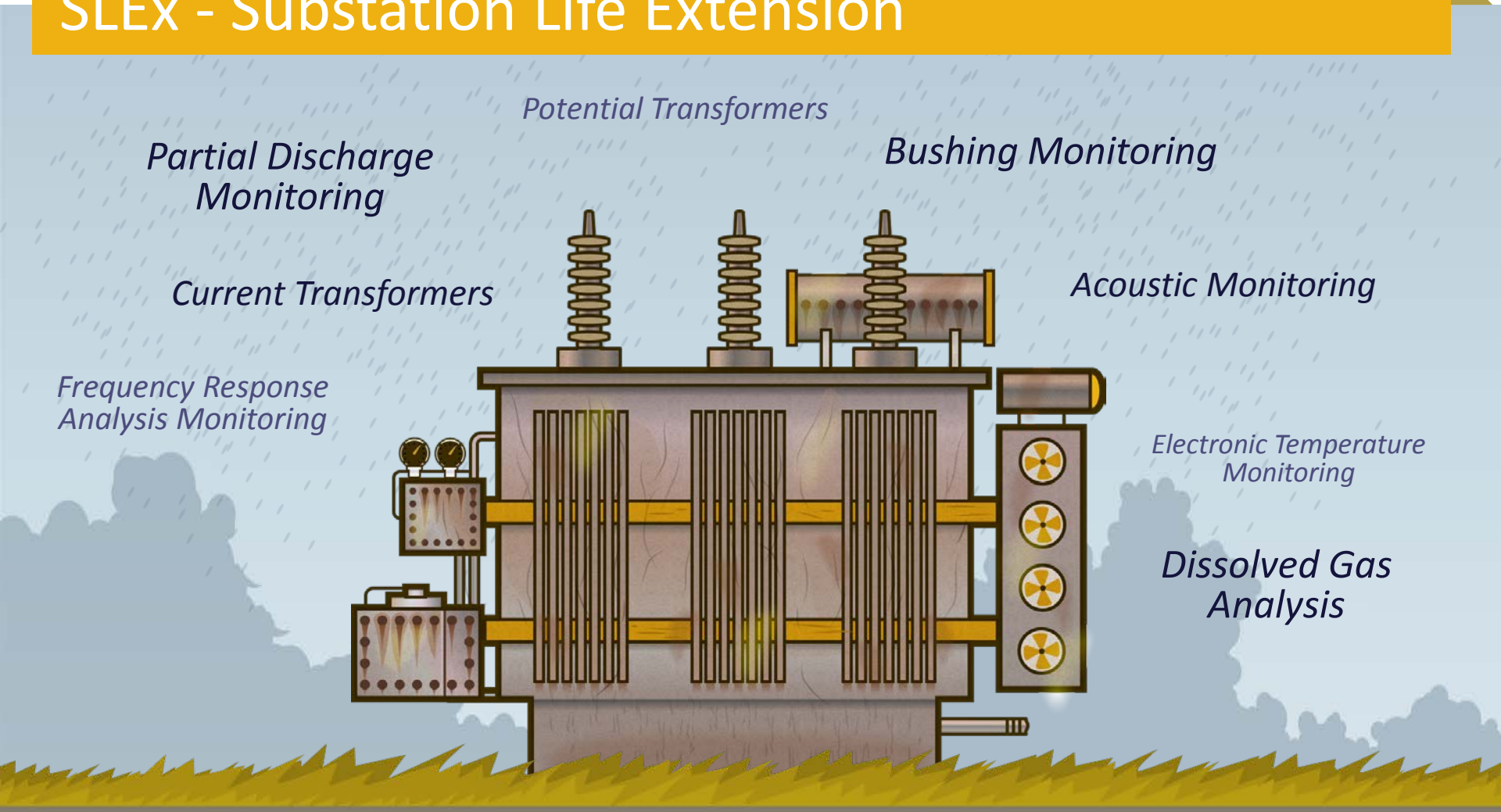


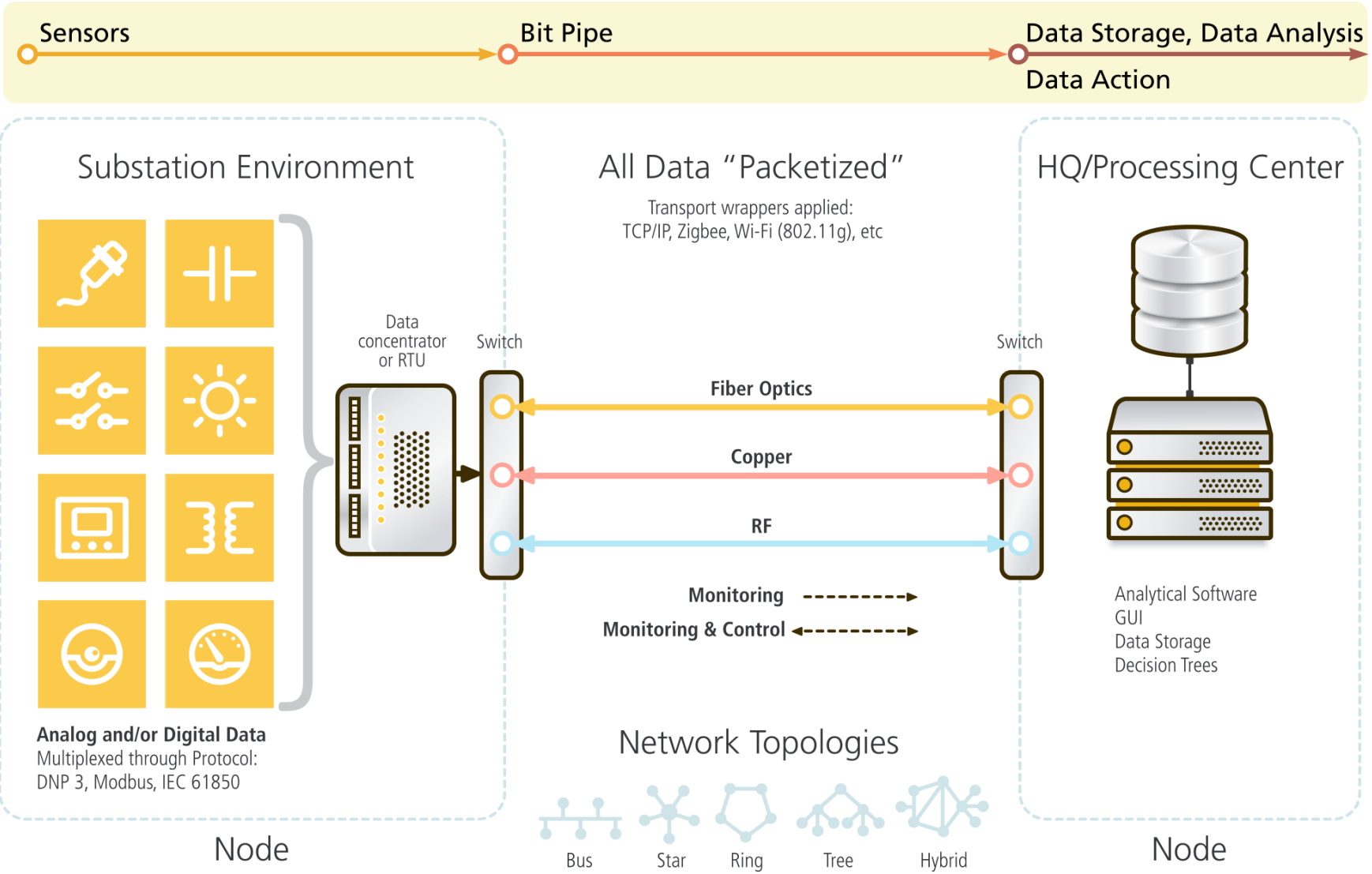

**Extending the life of aged assets by "sensoring up" components to provide insight and information on their condition to enable:**

- Condition Based Maintenance
- Safe Dynamic Loading
- ICR – Intelligent Component Replacement
- Maximize Asset Performance
- Safe Life Extension
- Safety
- Workforce Deployment
- Forensic and Diagnostic Analysis
- Probabilistic Risk Assessment

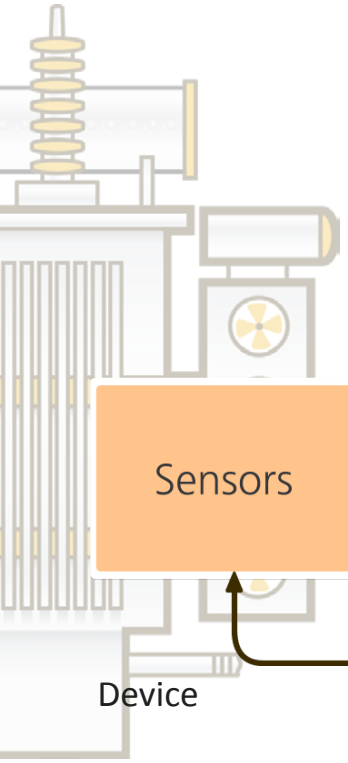
# SLEx - Substation Life Extension



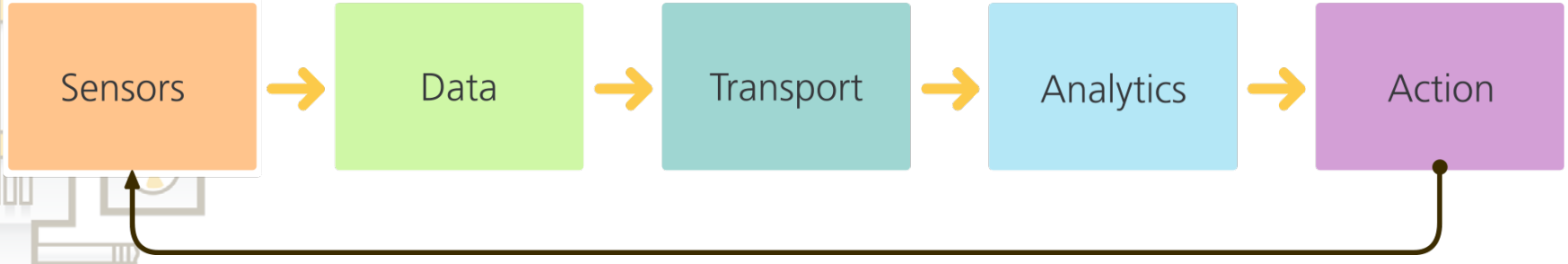
# Typical Data Flow



# Where Do You Process Your Data?



## BIT PIPE

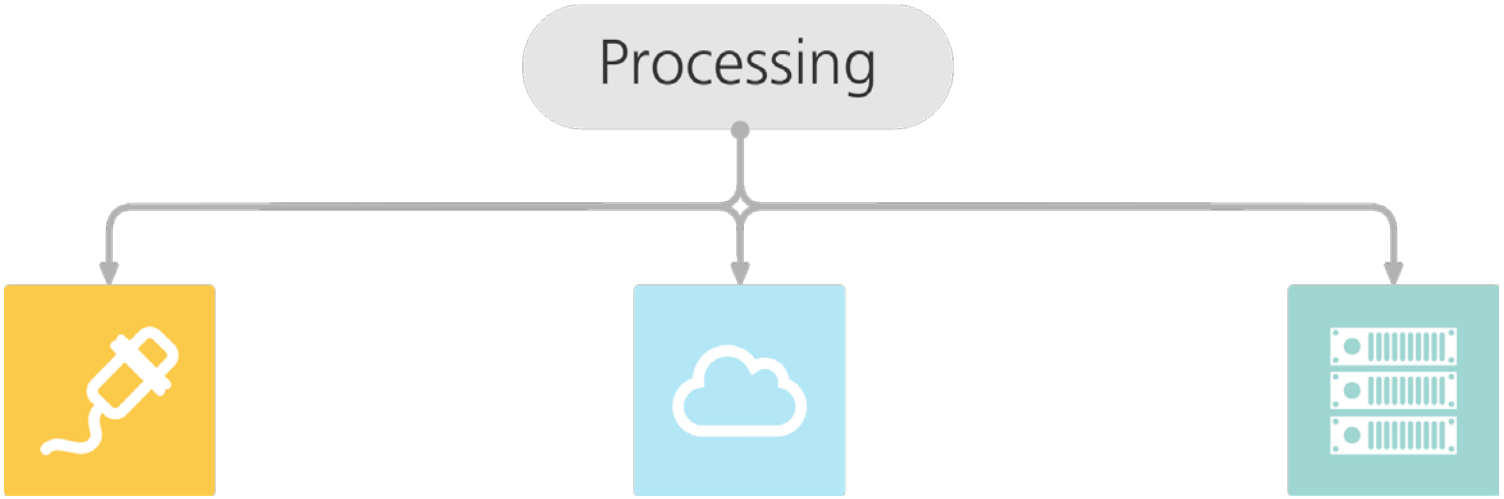



Device

**Factors to consider on where to process your data?**

- Cost
- Bandwidth
- Security - NERC CIP
- Stability/Reliability
- Integrity
- Size of Network

# Where Do You Process Your Data?




## AT THE EDGE

- Moving processing/intelligence to the sensor head
- Will drive the cost of the sensor up - "sensor protection"
- Must be comfortable with data and decisions occurring somewhere else - outside of headquarters
- Allows for fast data action with minimal chance of interruption

## IN THE CLOUD

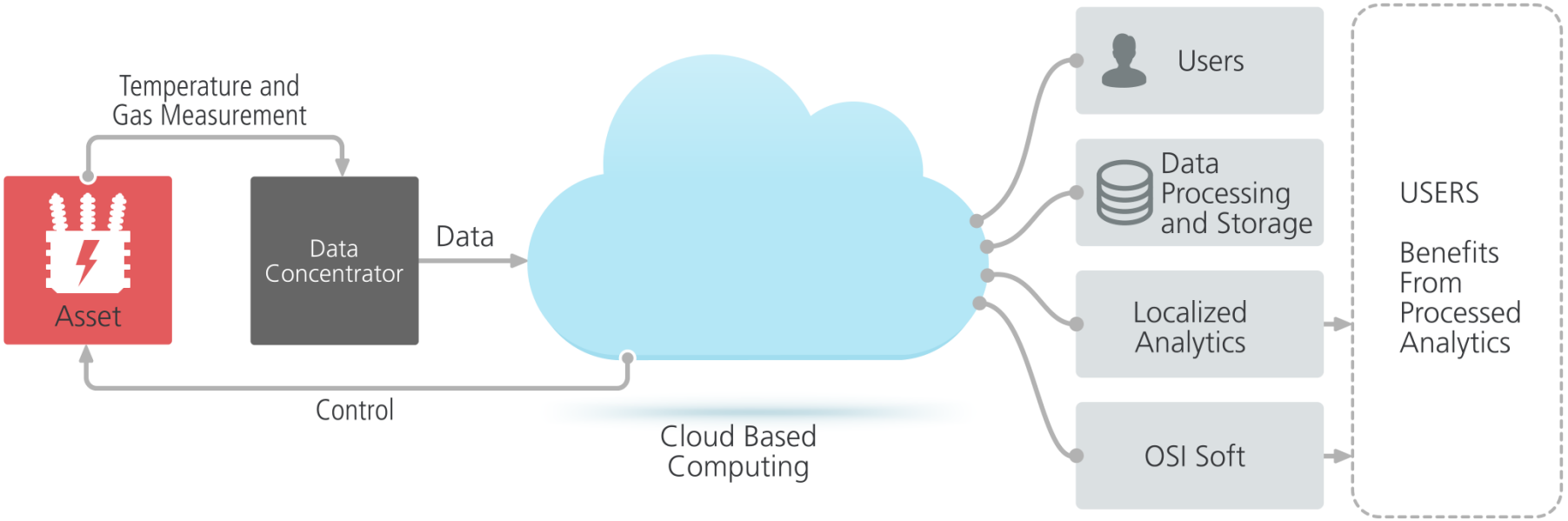
- Easy to get information into and out of the cloud
- Concerns of virtual and physical attacks, disabling infrastructure and stealing data
- NERC CIP concerns on data security in the “CLOUD”

## IN THE SERVER

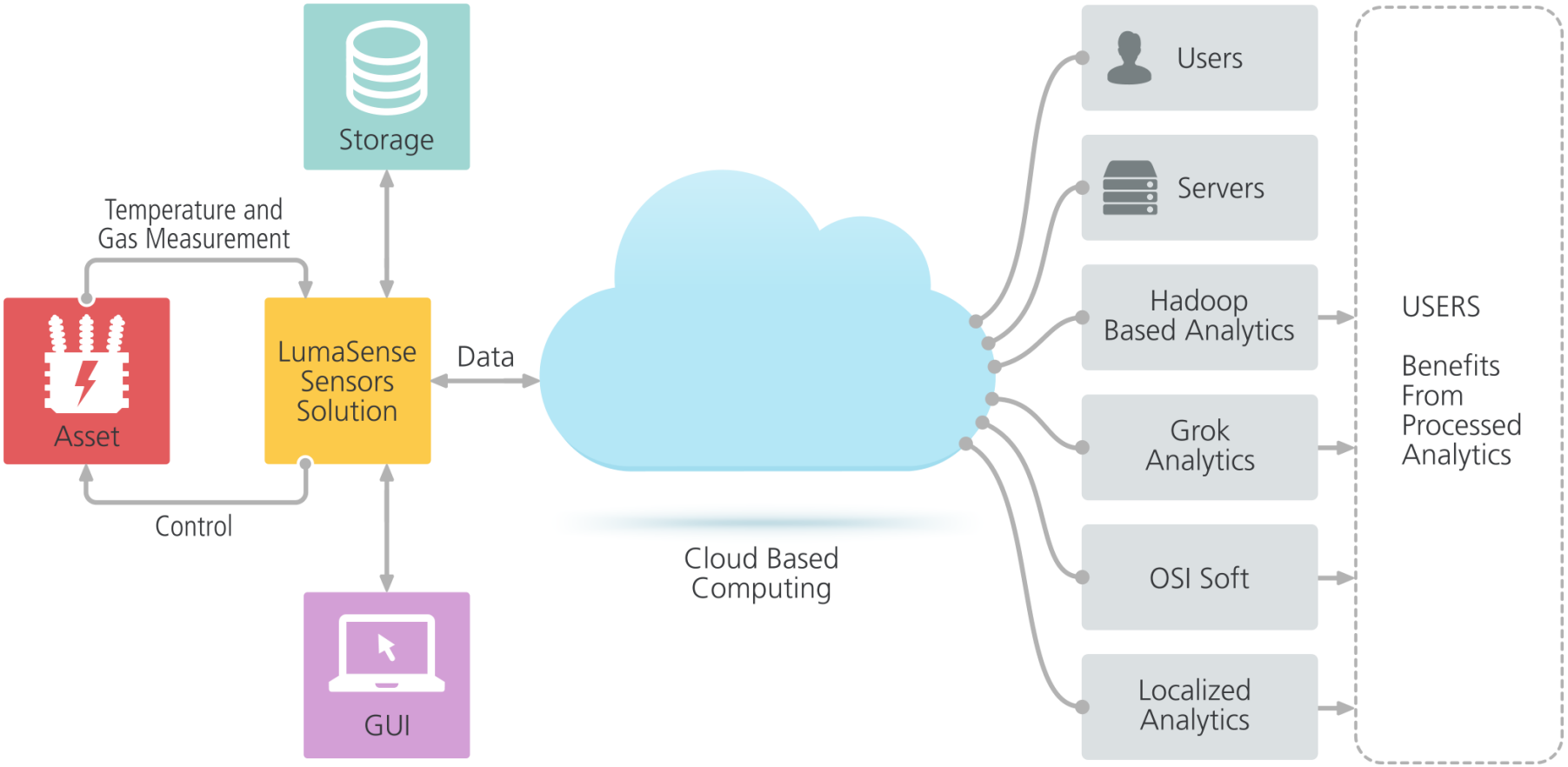
- Processing to occur at one location and can physically secure and control this data storage and analytics
- Provides an infrastructure overload scenario by having to allow for such large bandwidth to accumulate streams of data pouring in
- Will involve "inherent" delays in processing and decisions

# Sensors Can Deliver Big Data

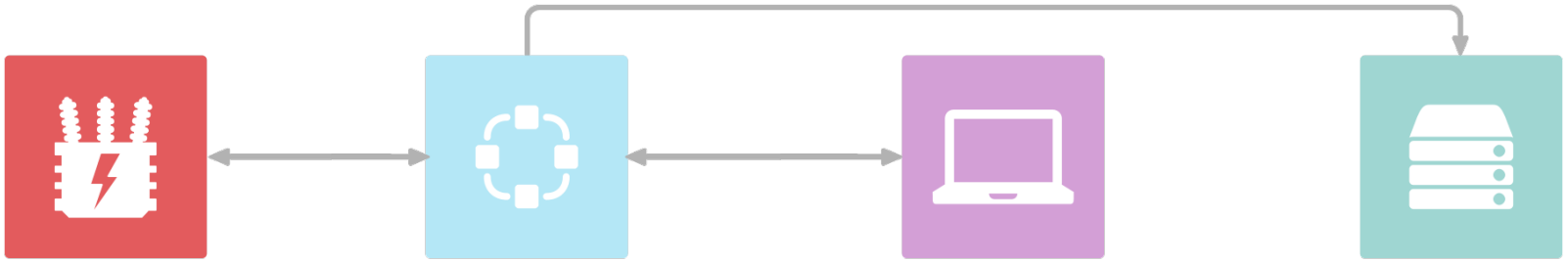
# Past Sensing Philosophy



# Future Sensing Philosophy



# Data Flow Failure Mechanisms



**SUBSTATION**

- Sensor Failure
- Environmental
- "Cut" Communications
- Power Failures
- Physical Attack
- Interference
- Failed Redundancy
- Data Corruption
- Encoding Issues
- Decoding Issues

**TOPOLOGY DEPENDENT FAILURES**

- Data Corruption
- Hacking
- Environmental
- Overload/Bandwidth
- Physical Attack
- Virtual Attack
- Wrong Configuration
- Failed Redundancy
- Physical Connection Failure
- Switch Failure
- Power Failure
- Interference

**SERVER**

- Server Attack
- Server Virus
- Server/Component Failure
- Power Failures
- Decoding Issues
- Encoding Issues

**USER STATION**

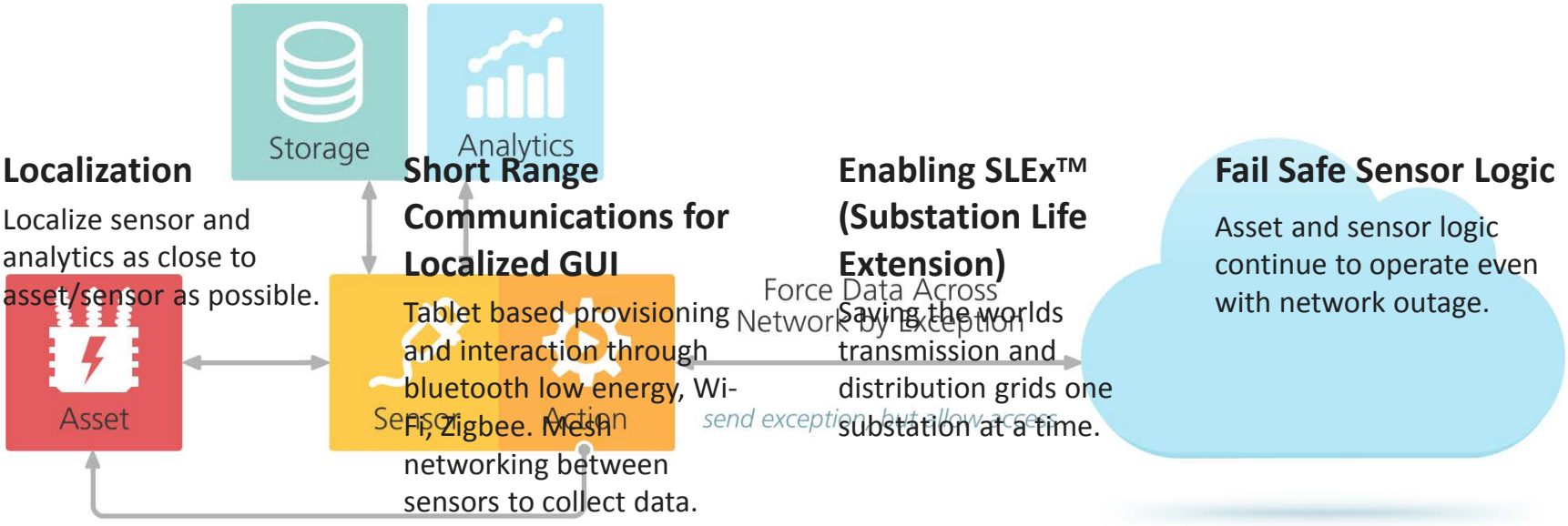
- User Station Virus
- User Hacking
- User Error

# What is Intelligent Sensing at the Edge?

## Intelligent Sensing at the Edge

- Move decisions/actions/analytics as close to senor head as possible.

- Data Storage
- Report by exception only... not all data




**Localization**

Localize sensor and analytics as close to asset/sensor as possible.

**Short Range Communications for Localized GUI**

Tablet based provisioning and interaction through bluetooth low energy, Wi-Fi, Zigbee. Mesh networking between sensors to collect data.

**Enabling SLEx™ (Substation Life Extension)**

Saving the worlds transmission and distribution grids one substation at a time.

**Fail Safe Sensor Logic**

Asset and sensor logic continue to operate even with network outage.

# SUMMARY

- Intelligent Sensing Is Needed To Enable The Smart Grid Reality
- Building New Everything Is Not A Reality Given Many Obstacles
- The Distribution Network Will Be Key For Lean Grid Automation Starting At The End Of The Driveway – **Lean Grid Automation = Smart Grid**

## BIG SENSORS CREATE BIG DATA

- And It Is Needed And It Is Here To Stay
- Will Enable M2M In The Future And Usage Of Industrial Internet

## THE DATA CREATED BY SENSORS IS NEEDED

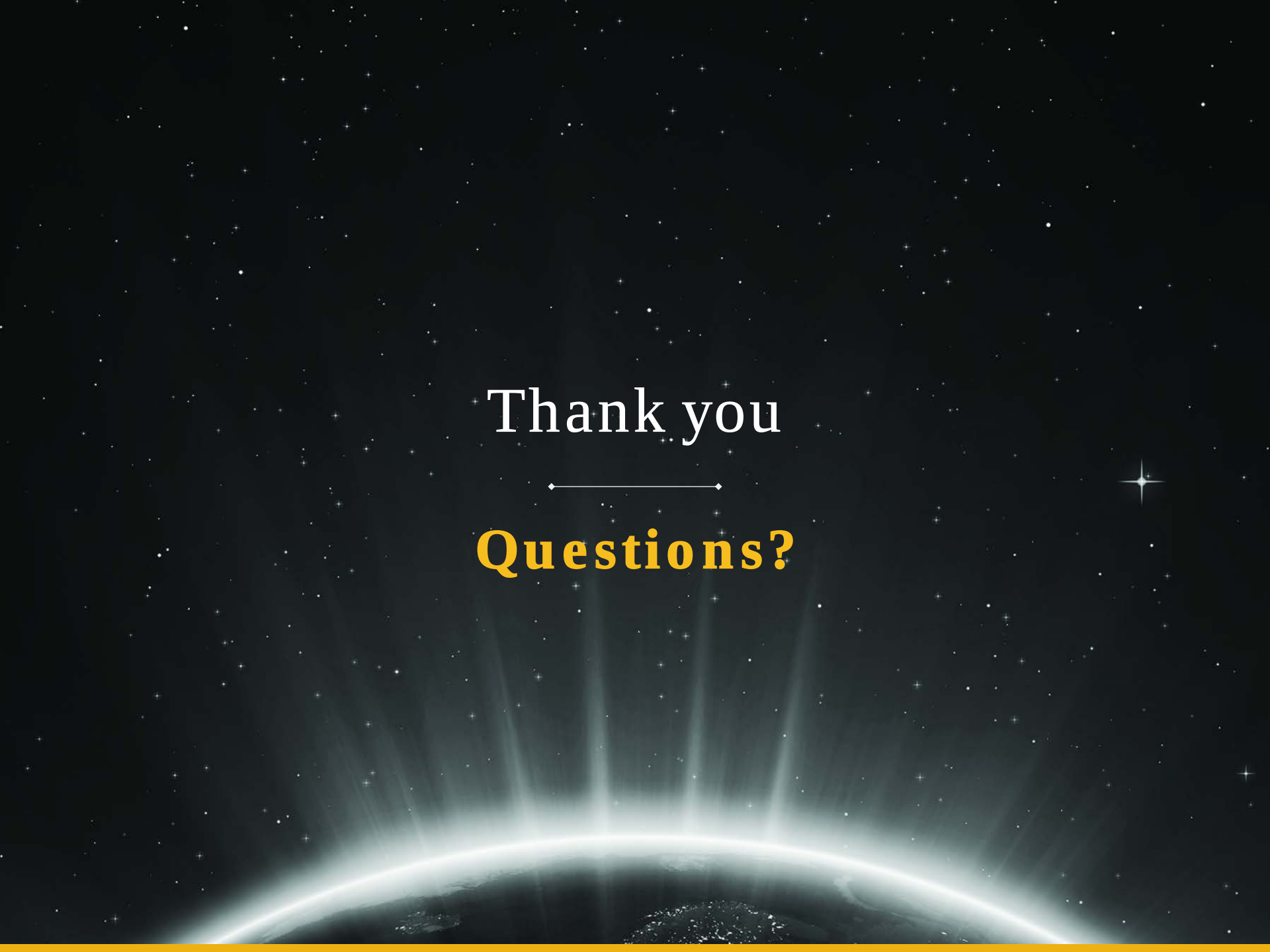
- Enhance SLEx™
- Enable CBM and Asset Optimization

## MOVE TO HAVE MORE ANALYSIS, DATA STORAGE, AND CONTROL TO THE SENSOR HEADS

- Save the Bit Pipe
- Security Concerns
- Minimize the Effects of Communication Failures
- Minimize Time to Decision

## REPORT BY EXCEPTION

- Not continuous Streaming Data
- Intelligent Sensing at the Edge
- Data Buffered When Network is Offline


Thank you
Questions?