The Substation of the Future

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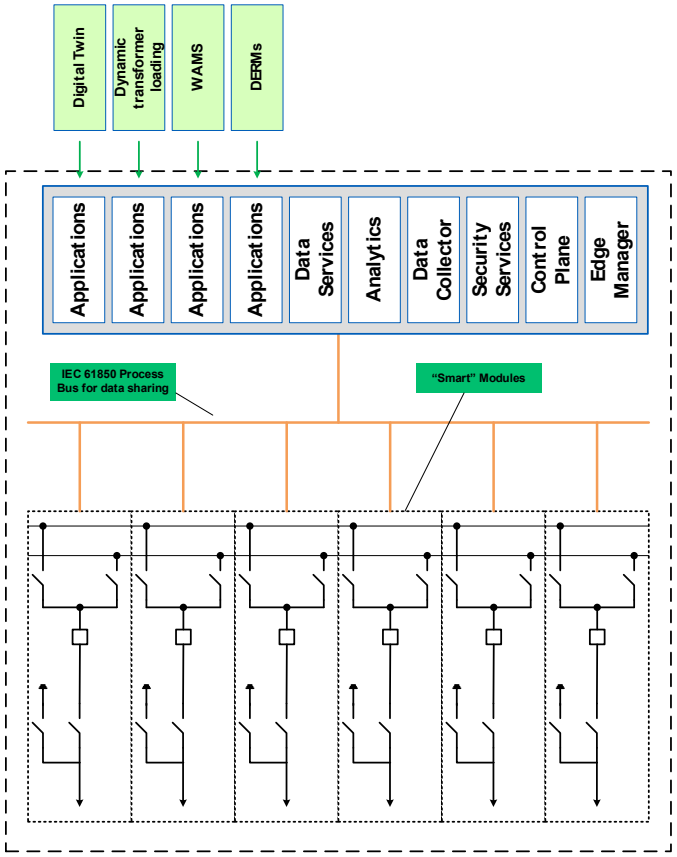
Substation of the Future

Concept



What is it?

Fully modular

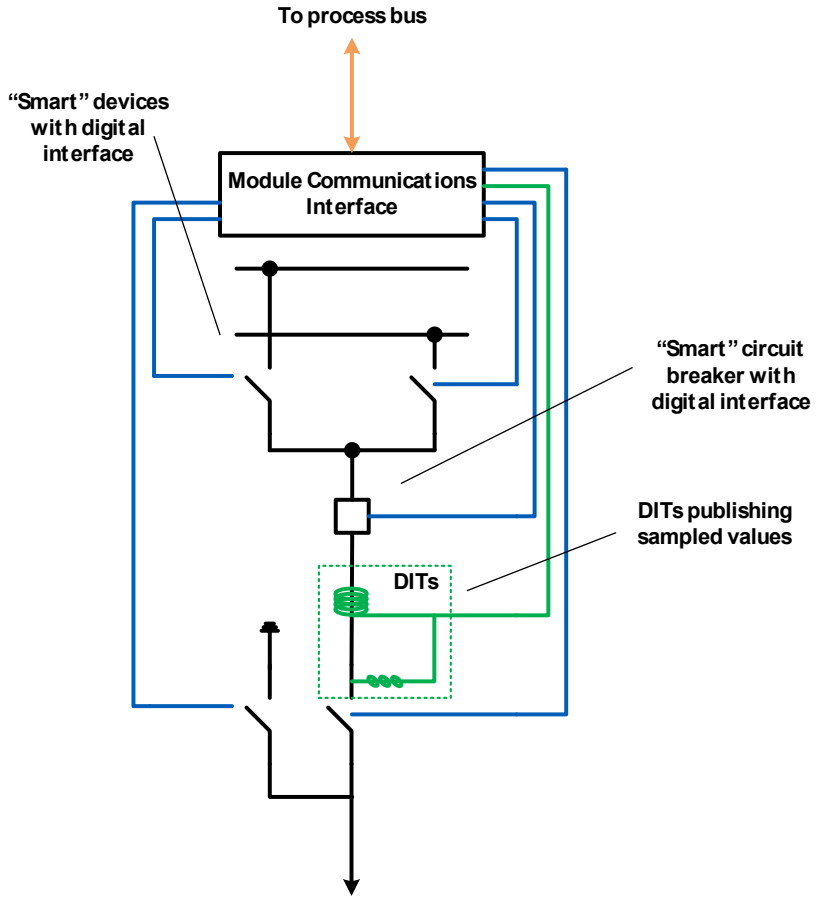
Fully digital

Virtual

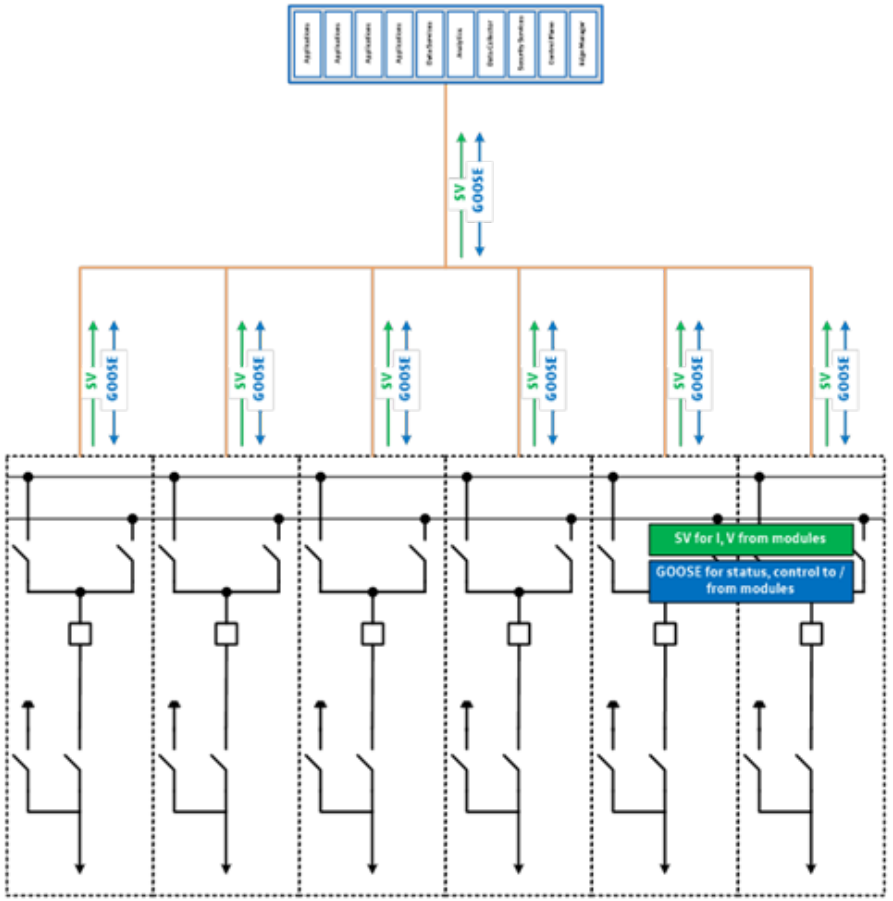
Why:

- Build efficiently
- Adapt quickly

Smart primary equipment module



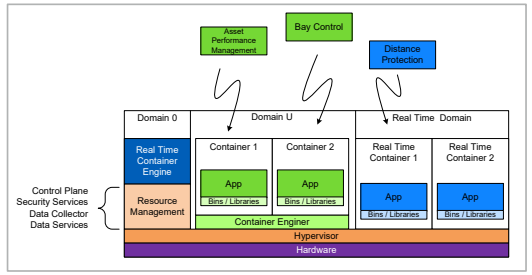
Process bus


SV
GOOSE
SV for I, V from modules
GOOSE for status, control to / from modules

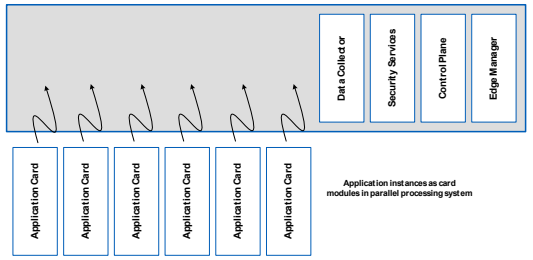
Local Application Server Concept

Application server - realization

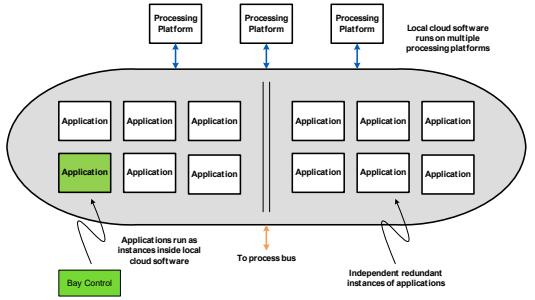
Container-based



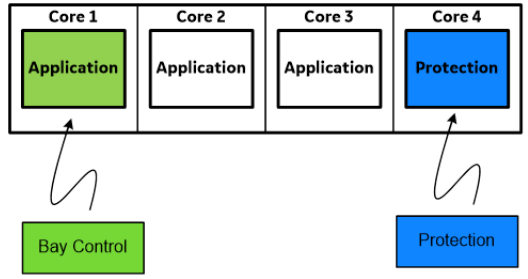
Card modules



Local cloud

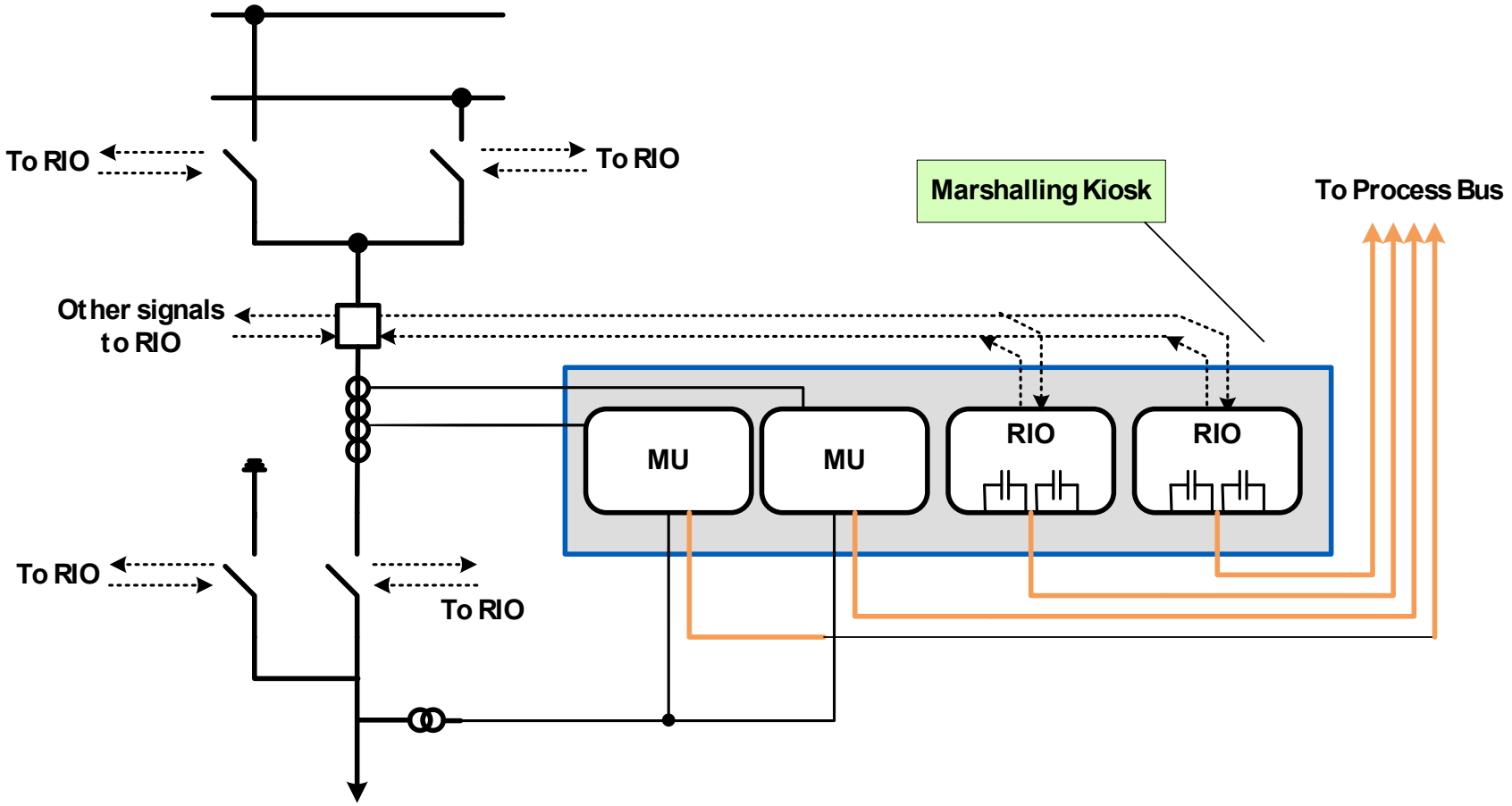


Multi-core processor

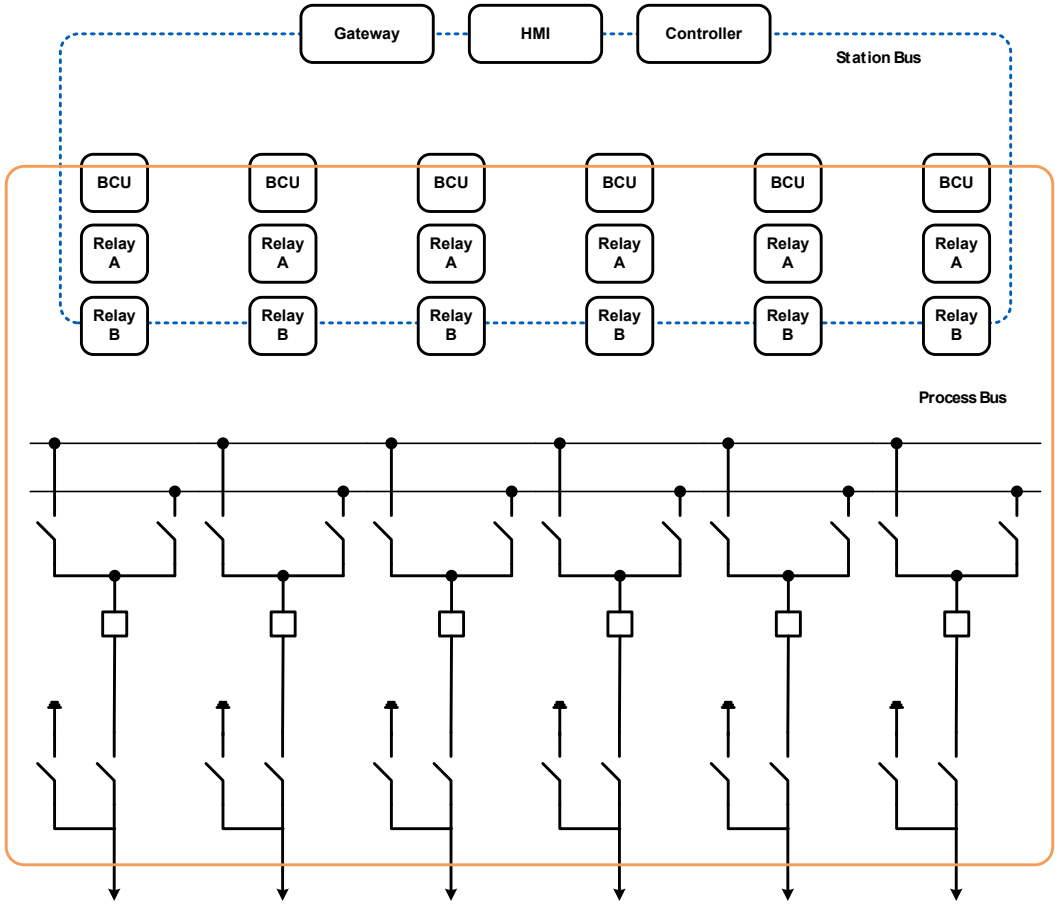


Where we are today

“Modules” today



Substation – individual application devices



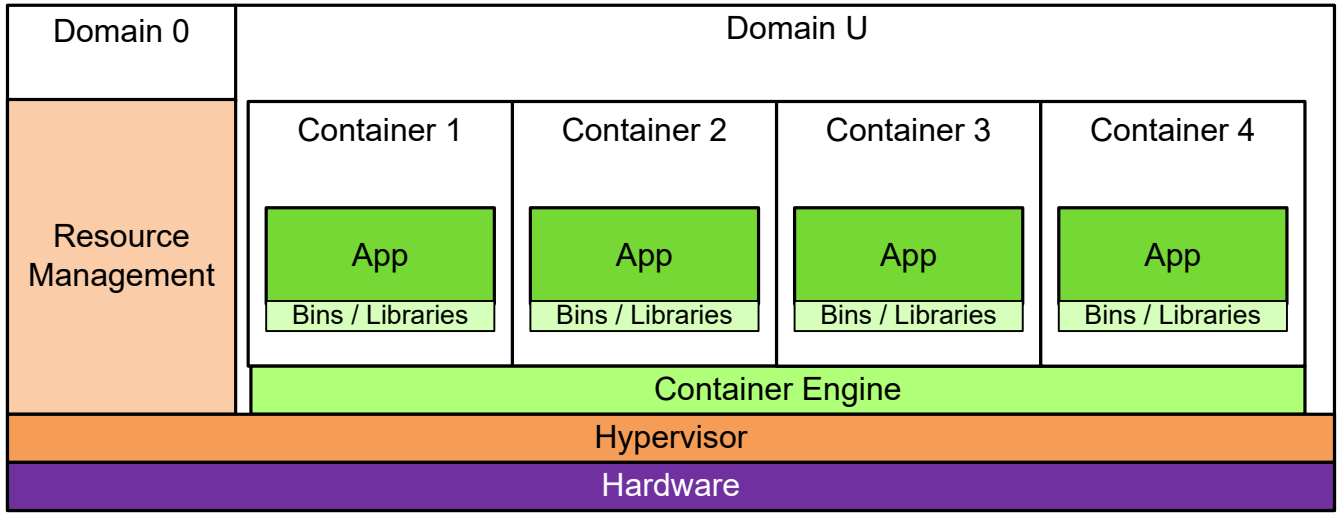
DITs today

Freestanding

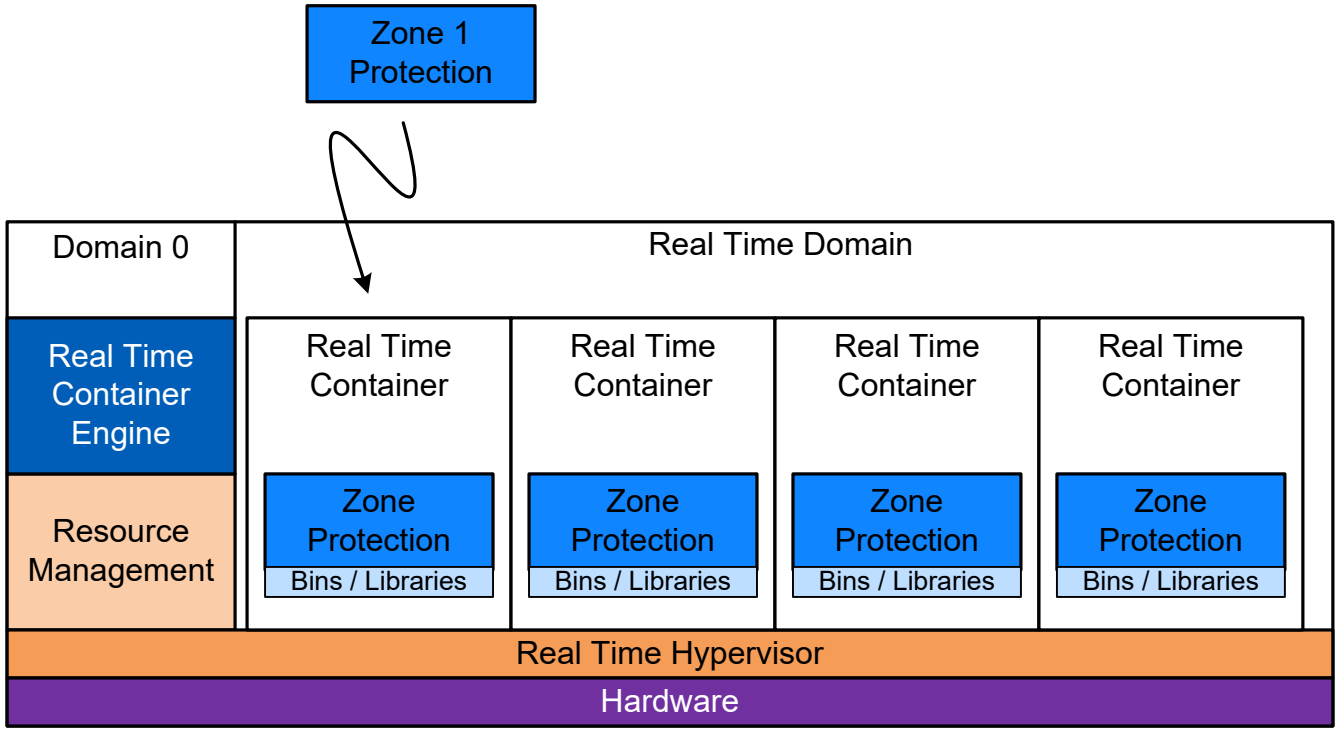
Added to existing equipment

Next technology steps

Advanced gateway application server



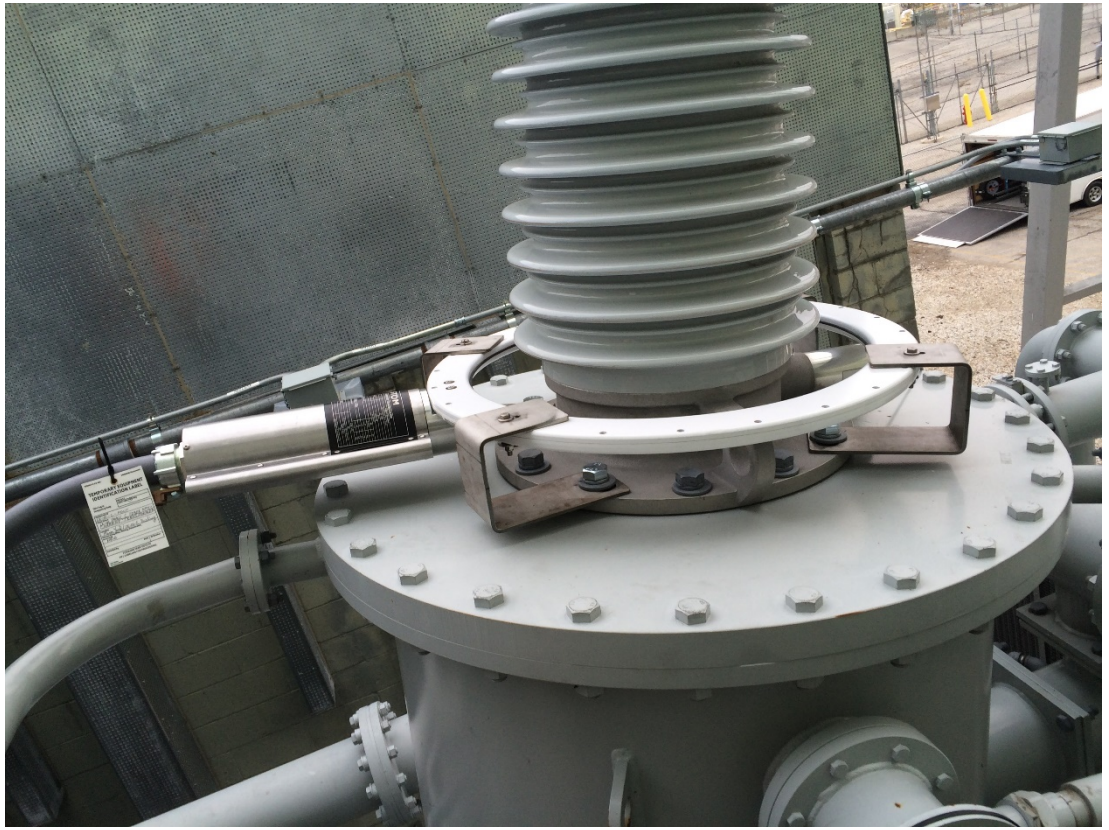
Multizone protective relay



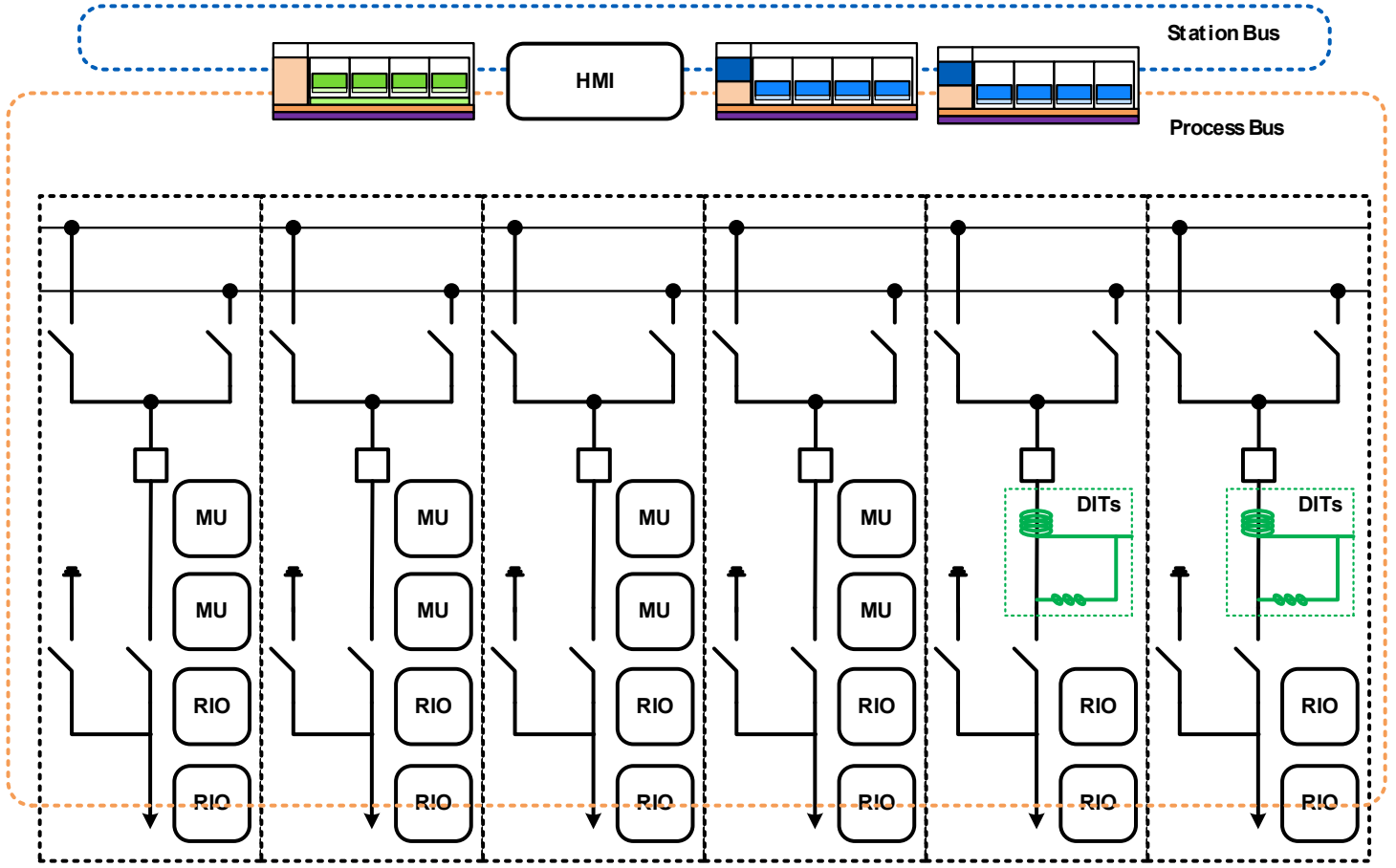
DITs integrated into primary equipment

On live tank circuit breakers

Bushing mount on dead tank circuit breakers



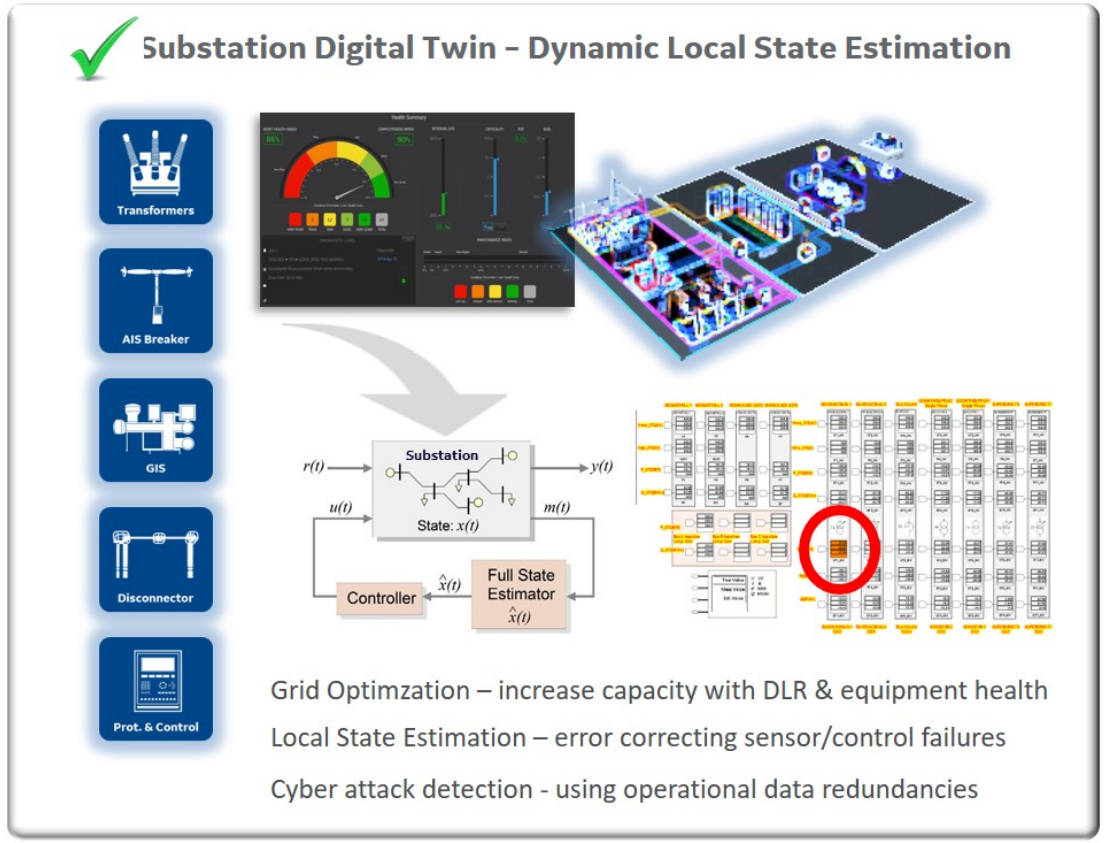
Next generation substation



Applications enabled by this concept

Digital Twin / AI

Concept



Application

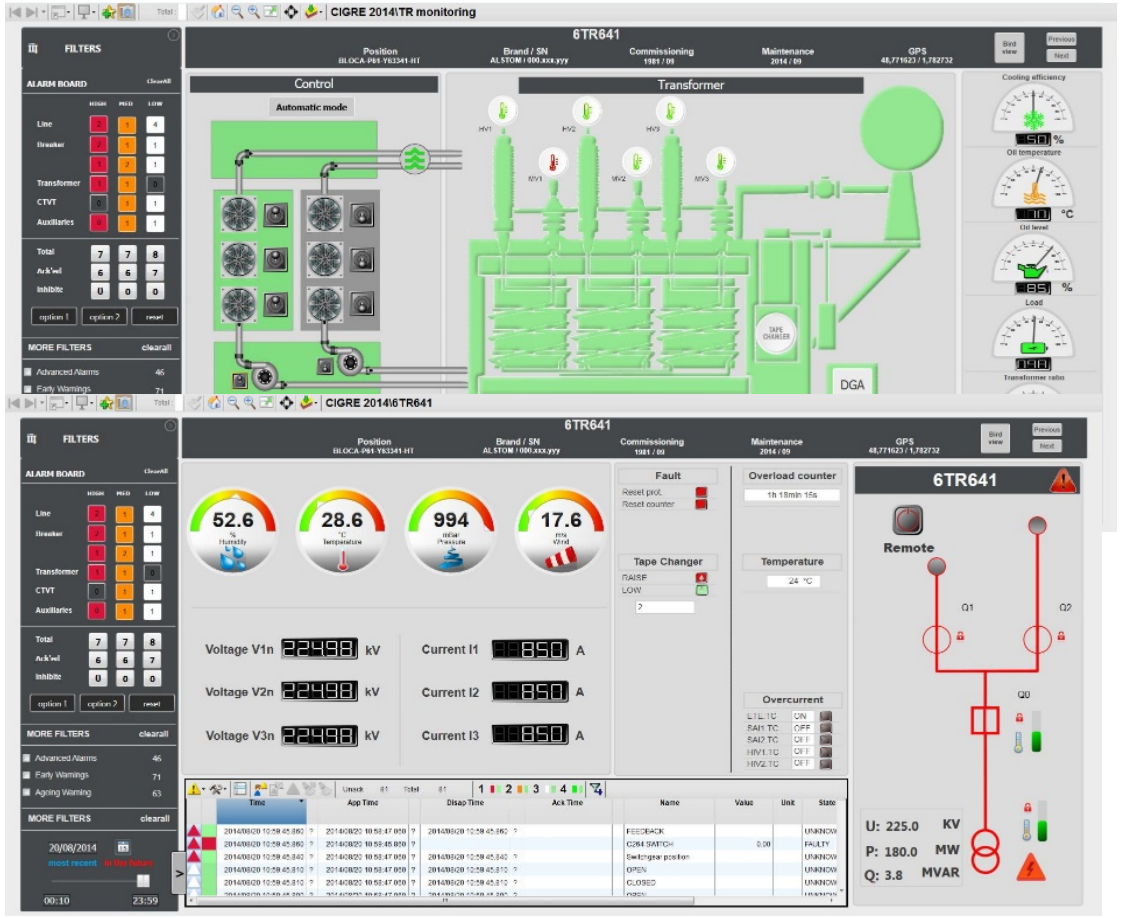
Interface with cloud, SCADA

Dynamically adapt substation to changing system conditions

Update protection settings on real-time basis

Adaptive Transformer loading

Visualization



Application

Take:

- Transformer monitoring data
- Meteorological data
- Load and predicted load

Then

- Control cooling to pre-cool transformer
- Extend service life

Dynamic line ratings

Concept

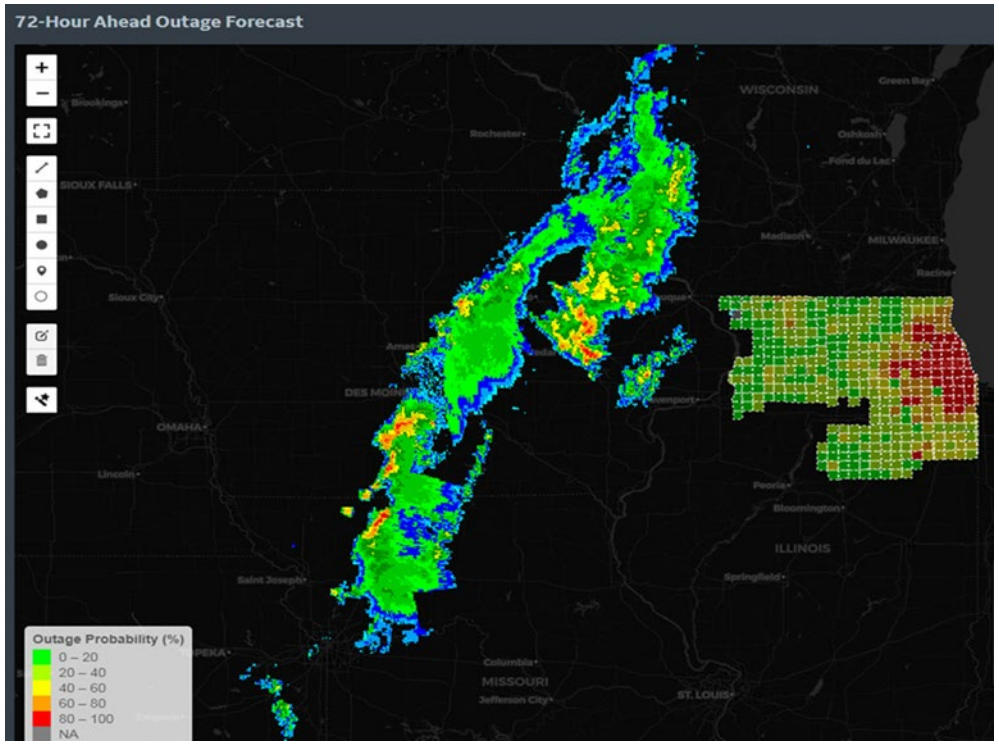
Static line loading ratings limit response to peaks

Application

- Use data for dynamic line ratings
- Real-time condition visibility
- Meterological data
- Predicted flow
- Result:
  - adjusting line ratings for conditions allows dynamic temporary overloading.
  - Up to 30% increase in power flow limits

New Analytics

Visualization



Applications

- Predictive & prescriptive analytics
- Recommend responses to forecasted storms
- Adjust system operations
- Better resource staging
- Reduce outage times

WAMS

For transmission and distribution

Visualization

Concept

- PMUs and microPMUs
  - Near Realtime Stability Monitoring
  - Sub Synchronous Oscillations and active dampening
  - Advanced Islanding Resynchronization and blackstart
  - Short Circuit Capacity
  - System Disturbance Monitoring
  - Fast Voltage Stability Assessment for Transmission Corridors

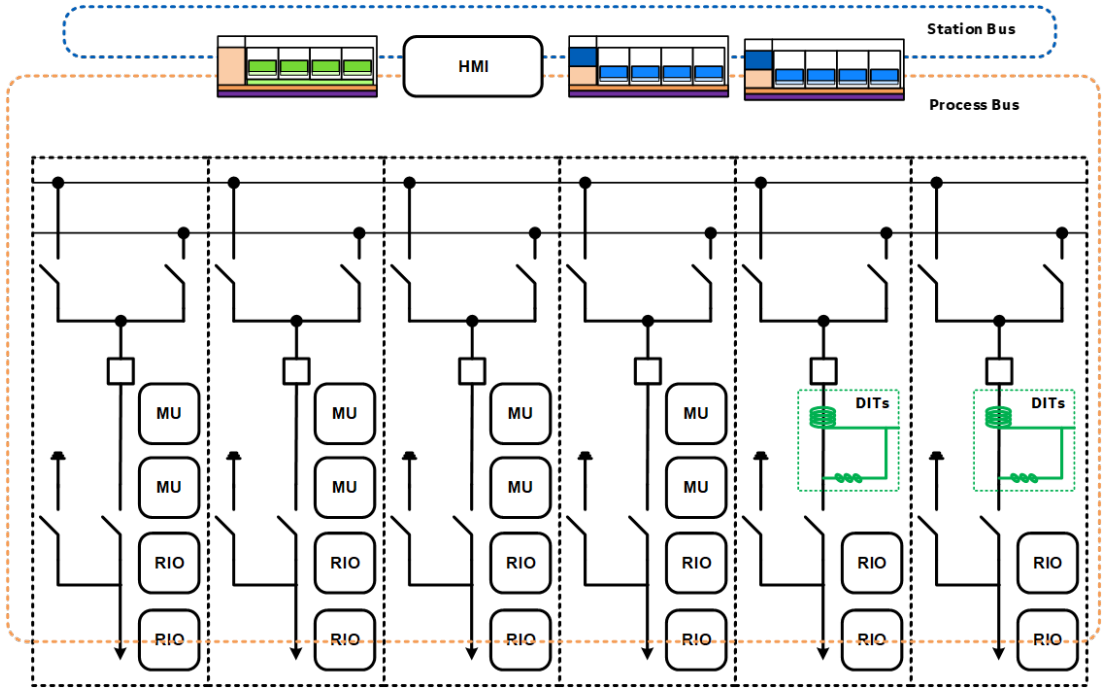
Distributed Energy Resources Management Systems (DERMS)

Visualization

Concept

- Visualize and plan DER deployment
- Calculate capacities
- Mitigate negative impacts on voltage, grid capacity, power flow
- Optimize and control DERs
- Input to market operators

Summary



Substation of the Future:

- Modular
- Fully digital
- Virtual

Quickly adapt to changing power system operating conditions