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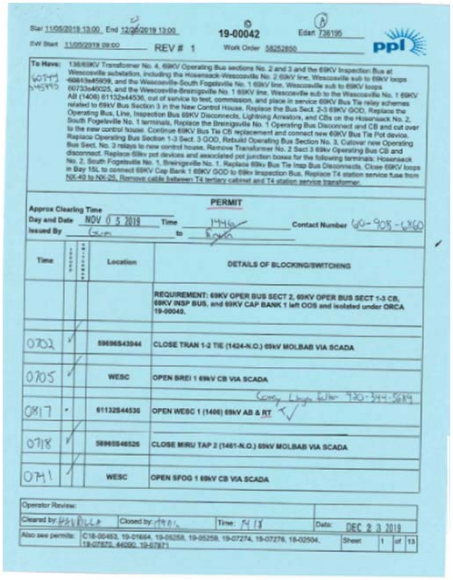
We Deliver.

Dynamic Line Ratings Strategy

Current PPL Transmission Grid



- Heavily rebuilt & strengthened physical plant
- ~50% penetration of microprocessor relays
- Primitive “smart” devices
- No automation
- People-dependent
  - Manual switching / paper permits
  - Reactive to failed equipment
  - Engineer calculated fault locations
  - Isolated voltage control

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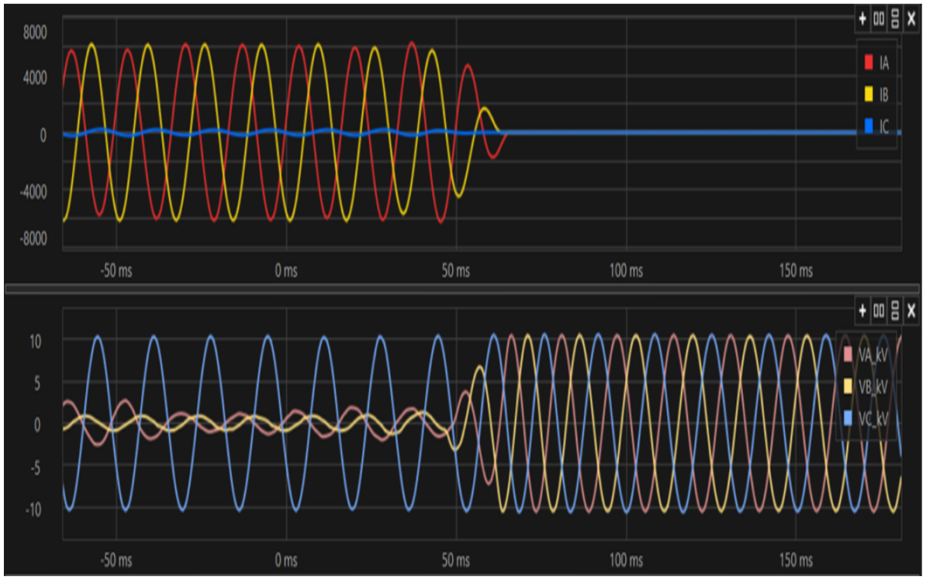
Business Use

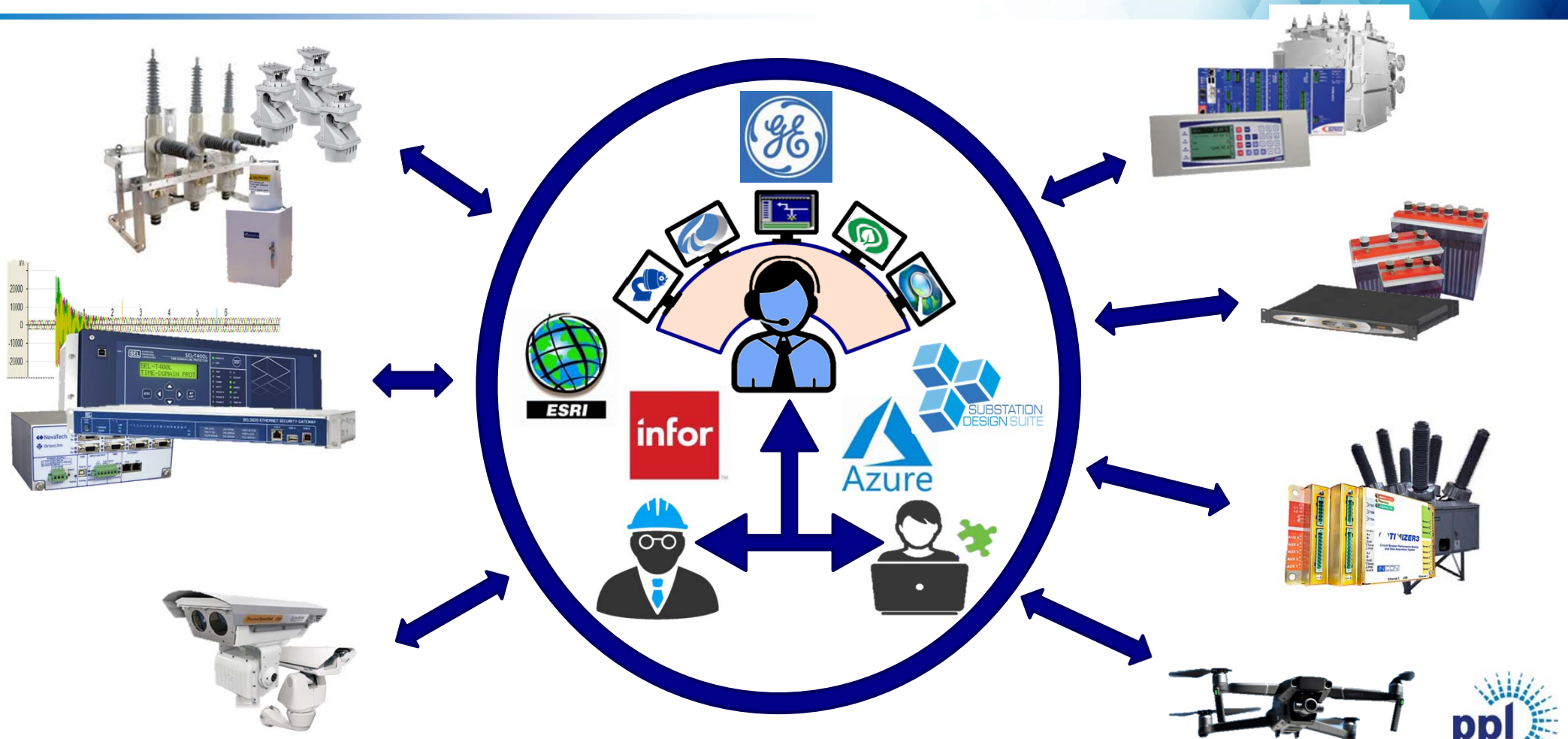
Elements of the Future Transmission Grid

- 100% smart relays & devices
- Single connectivity, geo-spatial, & engineering model
- Predict all failures before they occur
- Automated operations based on real-time data feeds into TMS
- Grid-enhancing technologies
  - Smart Wires
  - Asset Health Monitoring on every asset class
    - *Dynamic Line Monitoring*
  - Traveling Wave Relays



High Resolution Waveform Data

Enabler: Centralized Platforms



What is DLR?

System of line sensors installed to measure conductor and environmental real time data. The data can then be used for asset health algorithms and real-time operation for determining a real time rating for the line.

Static Line Ratings

Assumes:

- Wind speed
- Ambient Temp
- Solar Radiation
- 2 Seasons (Summer & Winter)

Conservatively Calculates Ratings

No way to trend field conditions or health

Dynamic Line Ratings

Measures:

- Wind Speed
- Ambient Temp
- Conductor Temp
- Conductor Sag

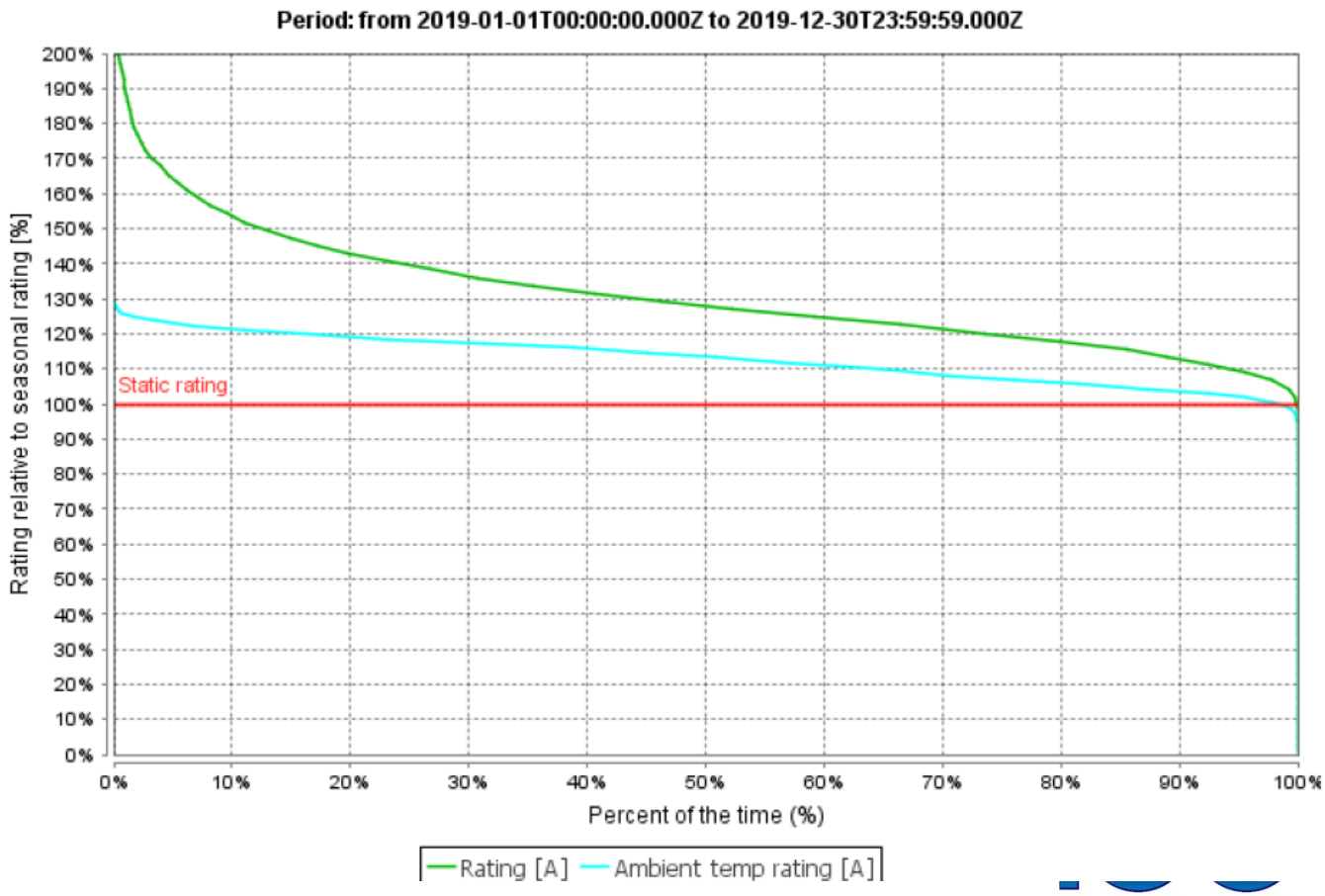
Provides Accurate Real Time Ratings

Allows for Forecasted Ratings

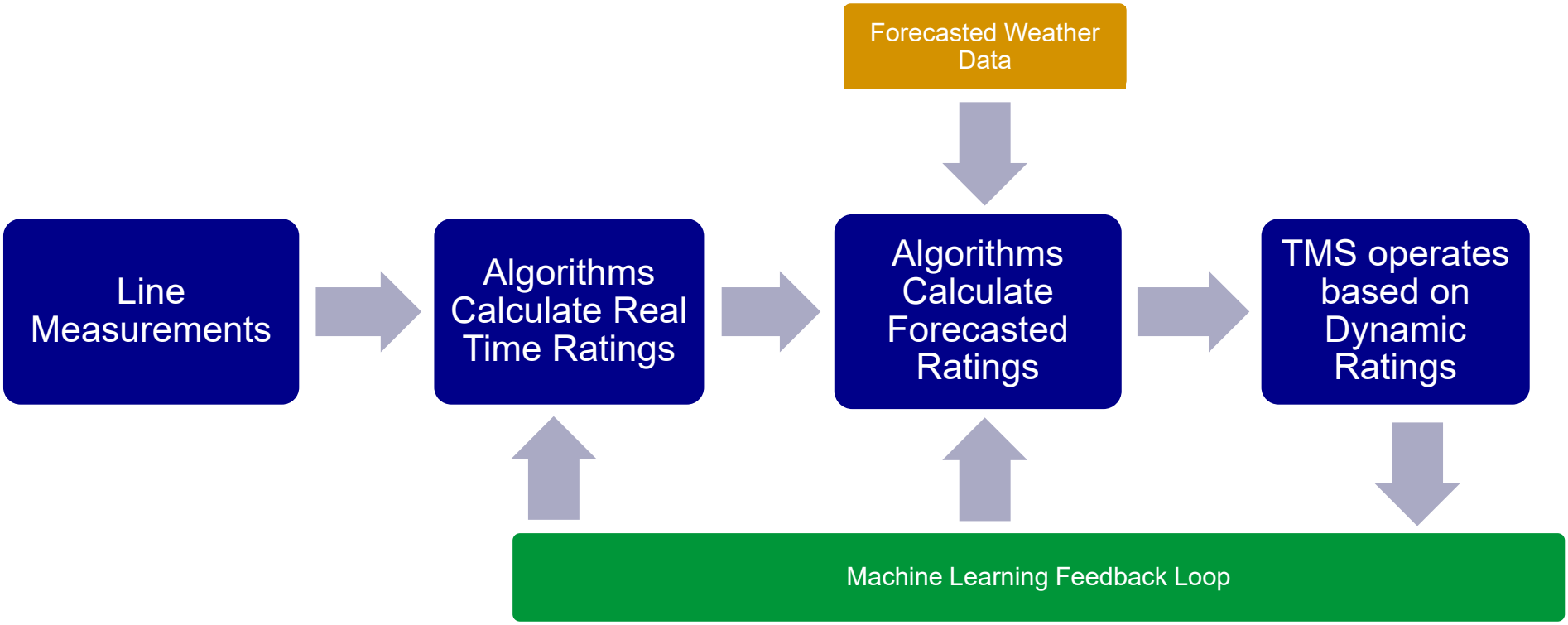
Measures Conductor Health

Potential Ratings Gain

- Used historical temperature and wind speed to estimate the impact of the dynamic lines ratings system
- Based on calculated conductor temperature
- Expected average ratings gain of almost 30%
- Actual rating increase incorporating the real time conductor data is expected to be greater than the estimated ratings using historical data



Dynamic Line Ratings Process



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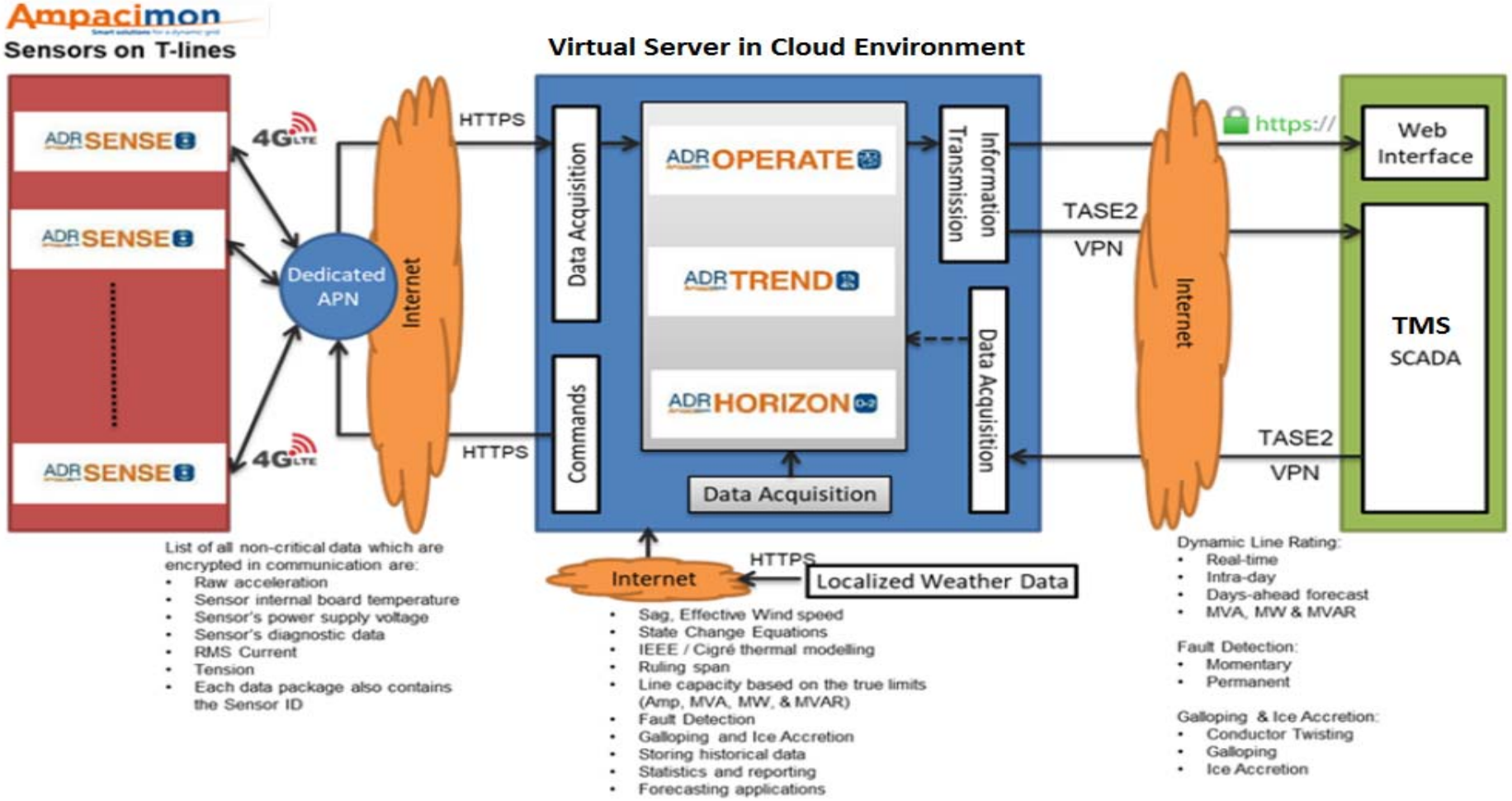
System Overview



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Next Steps

- Deploying DLR on Juniata-Cumberland & Harwood-Susquehanna lines. We consider the installation of the sensors as permanent for the life of the line.
- Work with PJM to fully utilize available line capacity
- Continue to seek additional lines to install the technology on