# PMU ANALYTICS

## Archiving Strategies

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NASPI Work Group Meeting
San Diego, CA
April 15-17, 2019

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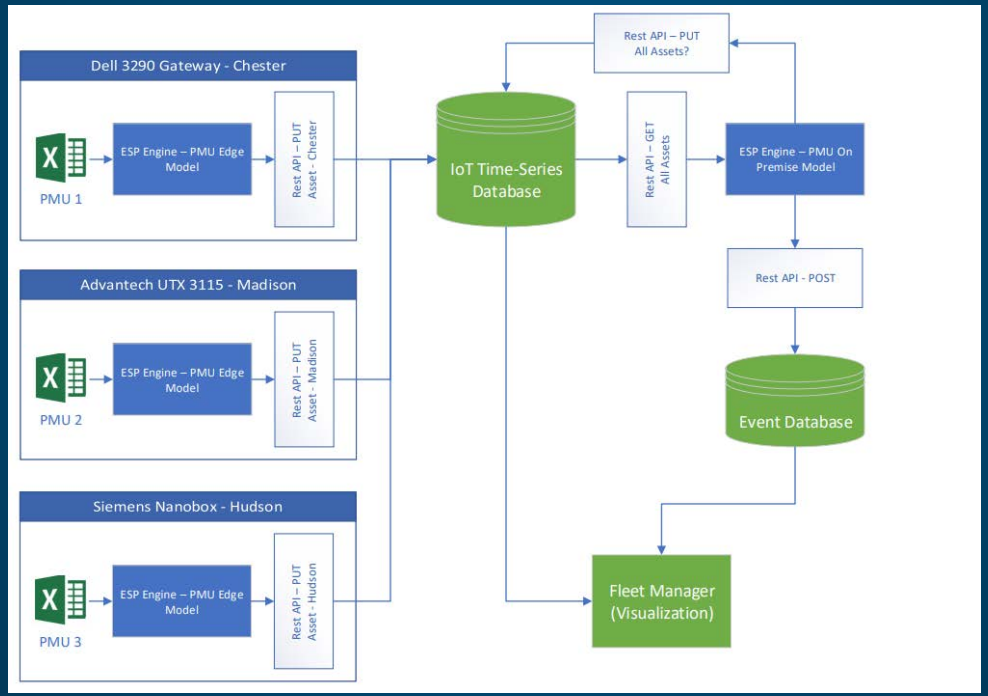
# Archiving Strategy

## Archiving Time Series and Events

Edge Devices

On Premise/On Cloud

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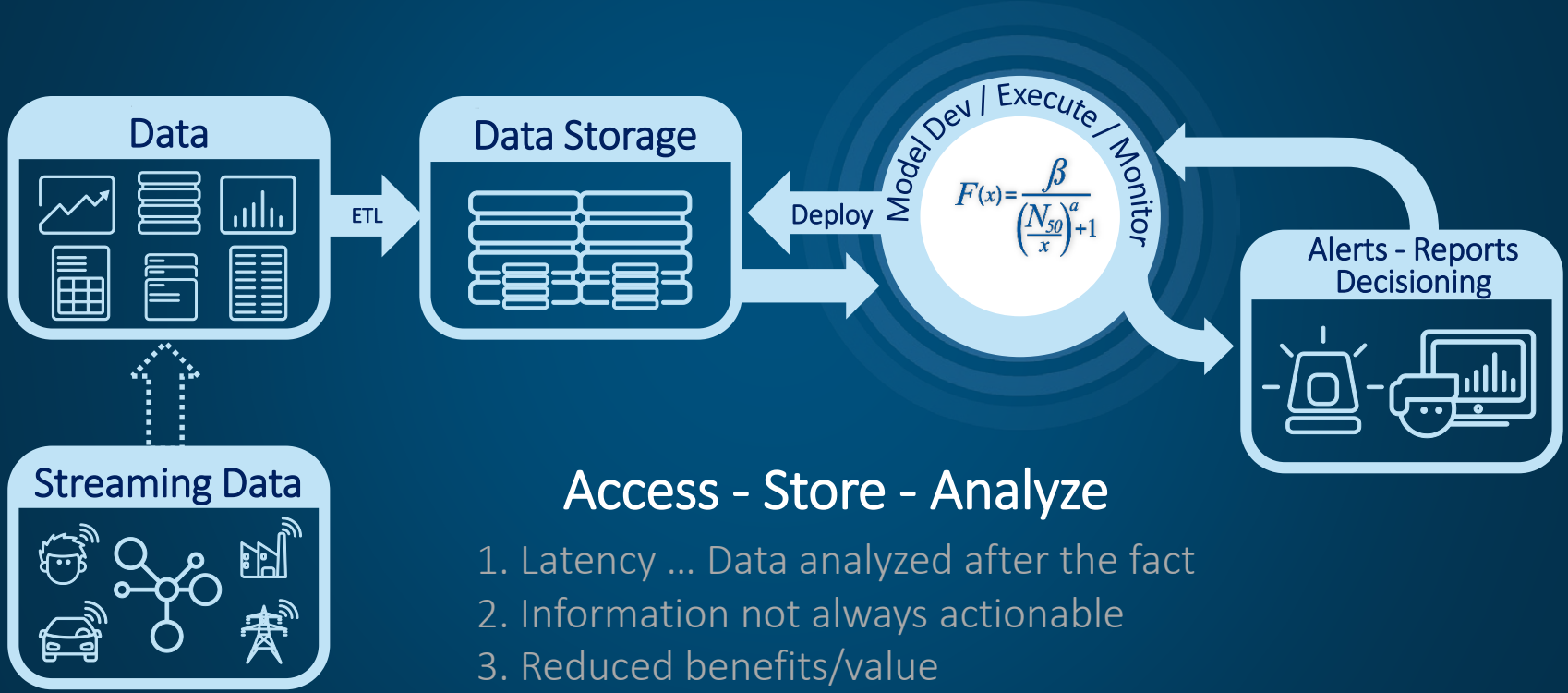
# Analytics Lifecycle

## Traditional Analytics Lifecycle




## Access - Store - Analyze

1. Latency … Data analyzed after the fact
2. Information not always actionable
3. Reduced benefits/value

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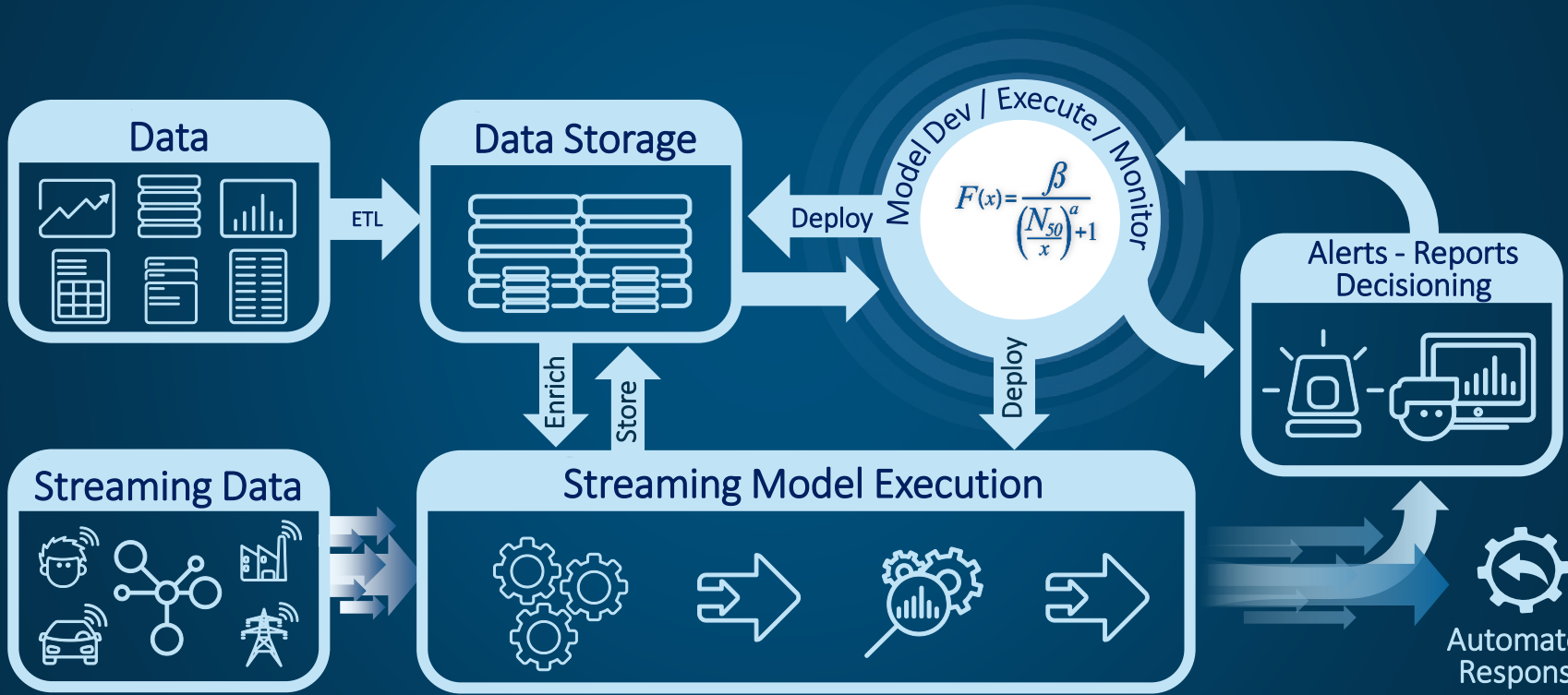
# Analytics Lifecycle

## IoT Analytics Lifecycle

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# Archiving PMUs

## Key Points

**Fast** – Millions of events/second – sub-millisecond latency on commodity hardware

**Agile** – From lightweight embedded technology to cloud distributed architecture

**Flexible** – Flow Based Modeling for fast adaptation to change

**High End Analytics** – SAS® most advanced analytics and machine learning

**Analytics at the Edge** – Brings analytics closest to the event source.

**Enterprise Class** – Seamless integration with existing IT architecture and open source

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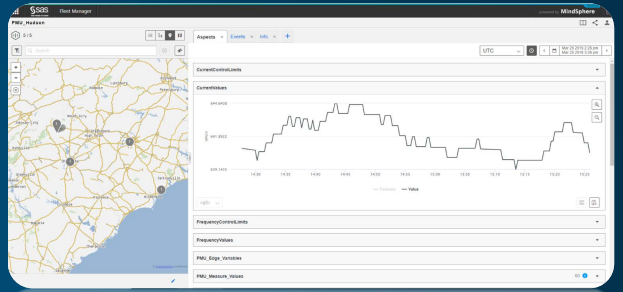
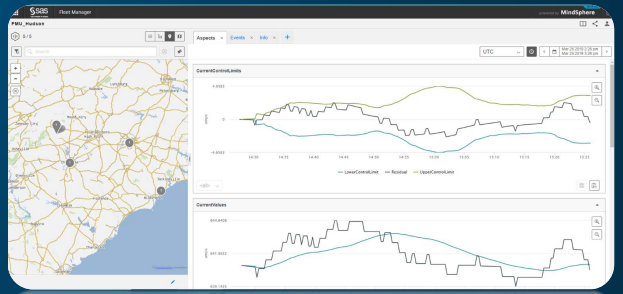
# Architecting Streaming Analytics

## Processing PMU High Speed Data

- Challenge:
  - SOC center SCADA observability versus PMU measures at edge
    - Samples per second (PMU 30-120 samples per sec)
    - Time Synchronization (GPS)
    - Measured Aspects (SCADA – Magnitudes ; PMU – Magnitudes and phase angles)
  - Detection of events that occur within engineering specs
    - Frequency varies within engineering specs
    - Data points are highly auto-correlated
- Solution:
  - Real-time forecast of expected values and detect deviations
    - Expected value based on time series model
    - Residual differences from expected values with Upper & Lower Spec limits





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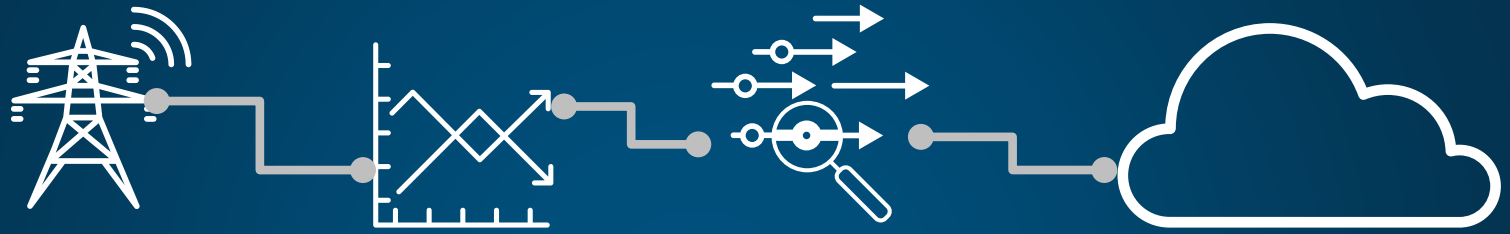
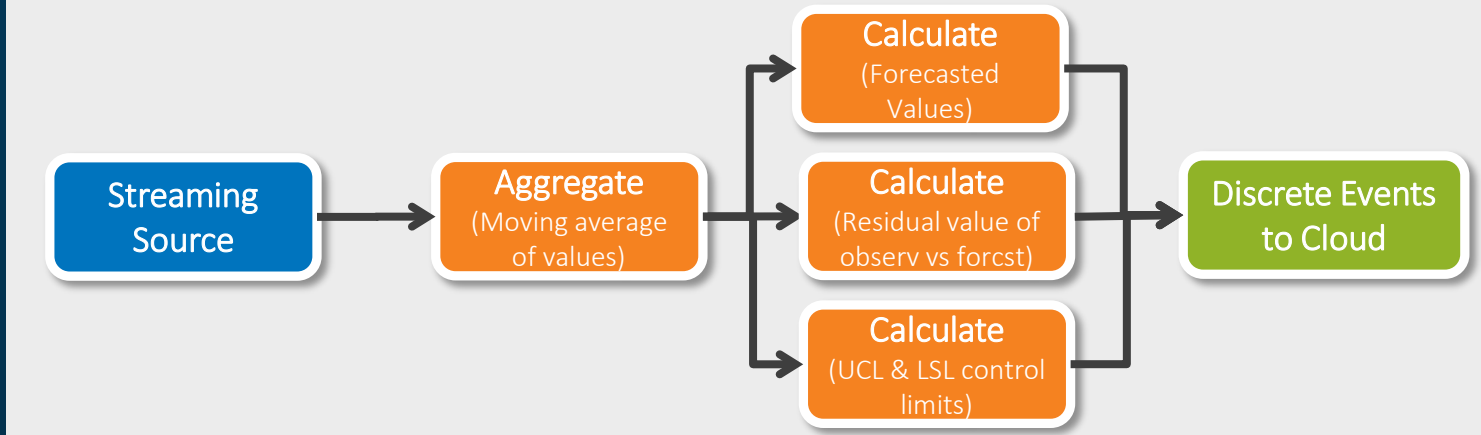
# Edge Streaming Analytics

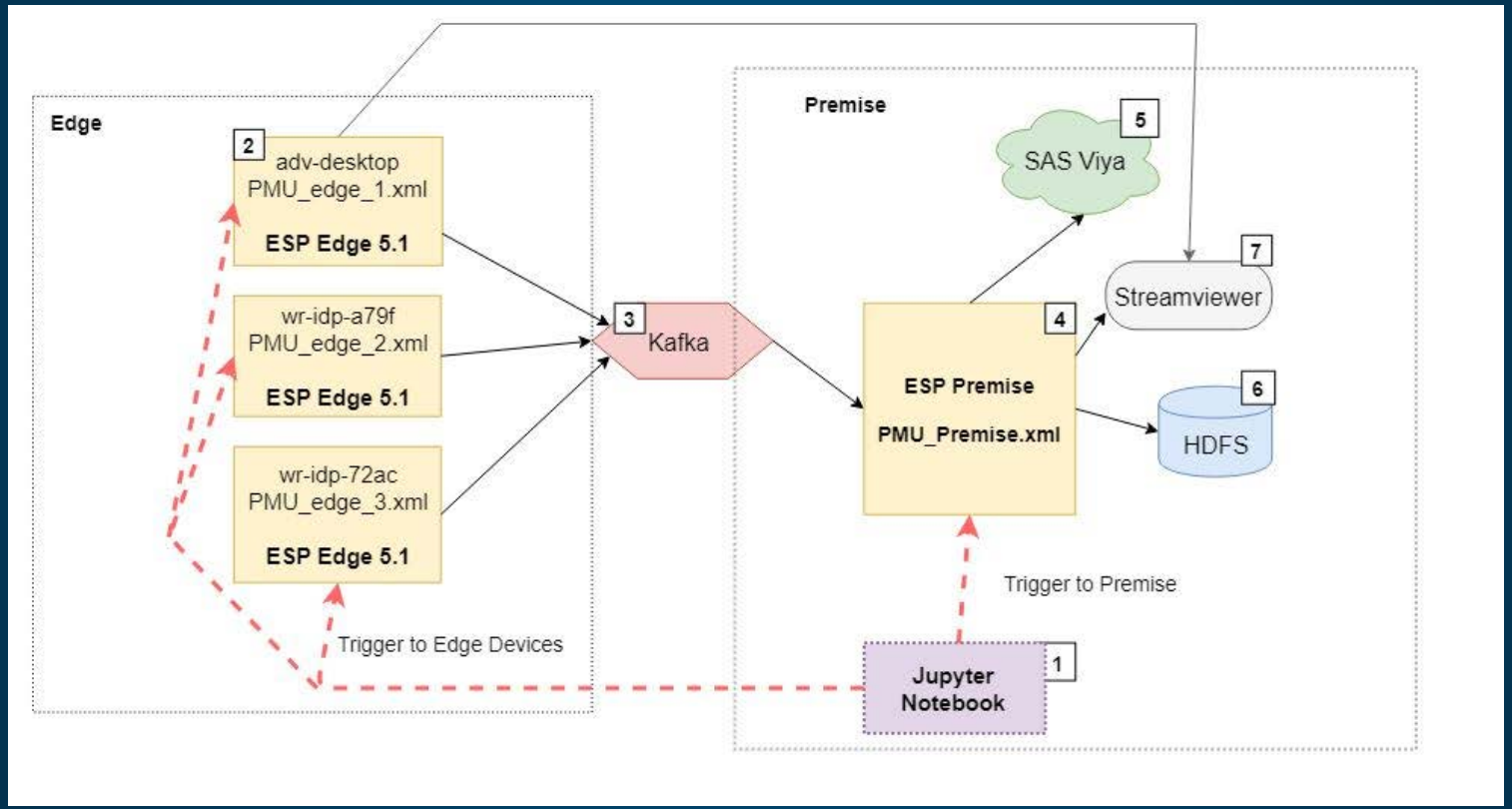
## Processing PMU High Speed Data





# Edge Streaming Analytics

## Architecture Overview

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# Grid Stability Design Example

## Archiving Time Series and Events

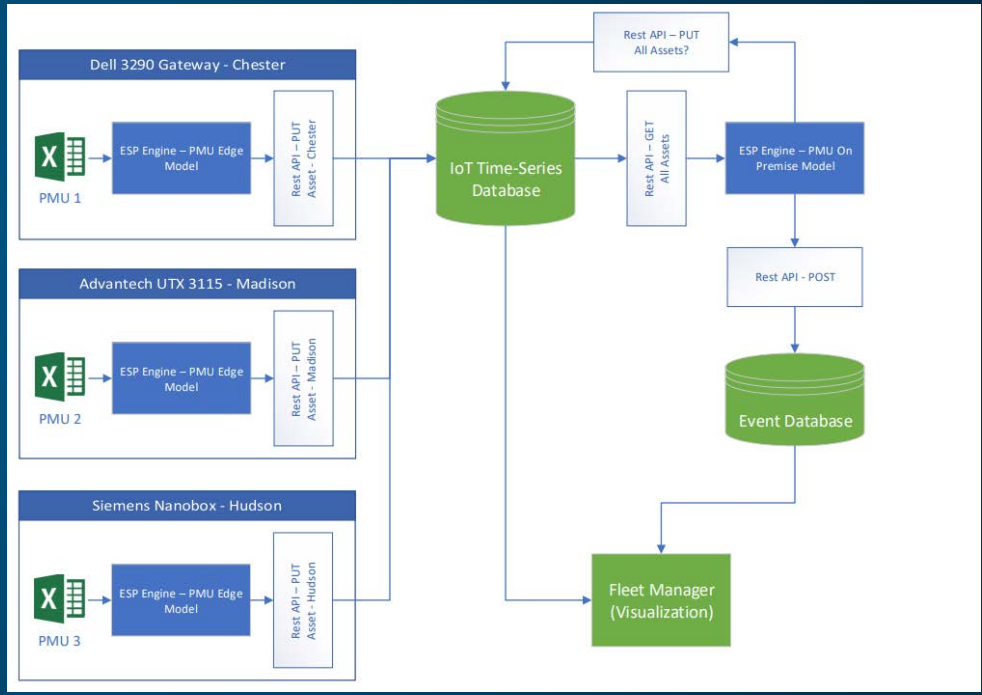
### Edge-to-Enterprise IoT Solution using SAS Event Stream Processing (ESP)

### Edge Devices

- Historical data captured for Phasor Monitor Units (PMUs) at different locations
  - Data captured includes Frequency, Current, Voltage on Grid
- ESP Model enriches the data to send back into On-Premise Model

### On-Premise / Cloud

- All PMU data sources are analyzed to determine abnormalities within grid
  - SPC processing determines individual excursion of signal
  - Clustering technique (DBSCANS) processes excursions to see if a sudden occurrence of events happened in short time period
- Outputs both events and time-series data

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# Thank You

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