Synchrophasors Data Analytics at Dominion Energy

Presented by

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Dominion Energy

Looking Back Over 10+ Years

- **2009** – Kicked off synchrophasor initiative; DOE SGIG Kickoff
- **2012** – Began standardized Relay-PMU sensor deployment
- **2013** – DOE SGIG Demonstration
  - Linear State Estimator v1.0 released as OSS
- **2014** – CERTS Synchrophasor Data Conditioning and Validation Project
- **2015** – DOE FOA970 Kickoff
- **2017** – DOE FOA970 Demonstration
  - Linear State Estimator v2.0
- **2017** – DFR PMU Conversion Begins
  - Towards total transmission system coverage
- **2018** – Analytics Journey Begins
  - High performance sandbox for use case development
- **2019** – Go-Live of Cloud-Hosted PingThings' Platform
- **2020** – Leaning into Data Analytics

A Path Forward for Synchrophasors

We must drive down the cost of working with data!

THE RIGHT TOOL FOR THE JOB

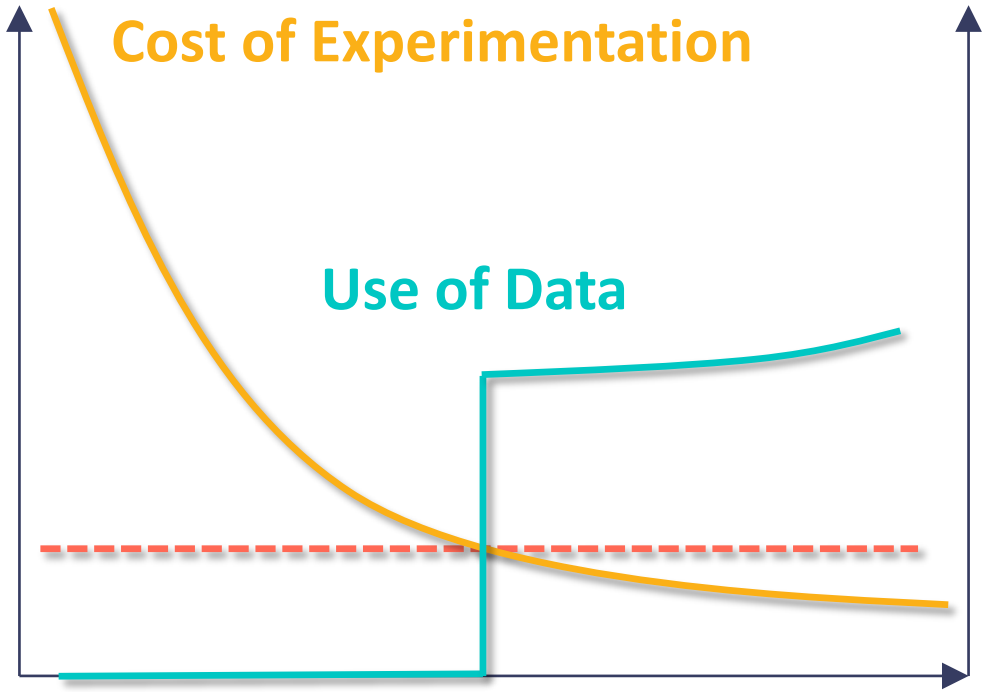
High resolution time series (e.g. synchrophasors) is a special comp. sci problem • Big Data technologies evolved towards specialization • Not all time-series DBs are equal • Historians make data history • Data at rest stays at rest

NO SINGULAR "KILLER APP"; ENSEMBLE INSTEAD

The literature is full (10^3s) of proposed applications • Each utility may have niche use cases • Value prop. of individual use cases is myopic

ANALYTIC EXPERIMENTATION >> A PRIORI "GUESSES"

We need to use lean methodologies, not guesses that play out over years, to arrive at our highest valued use cases



A Fork in the Road. . .

Technology

- First-Principles Approach
- Platform vs Siloed Applications
- Cloud vs On-Prem

Engineering vs Real-time Operations

- Rapid prototyping & integration
- Quicker ROI for synchrophasors

Capital vs O&M

- Larger company/societal impact

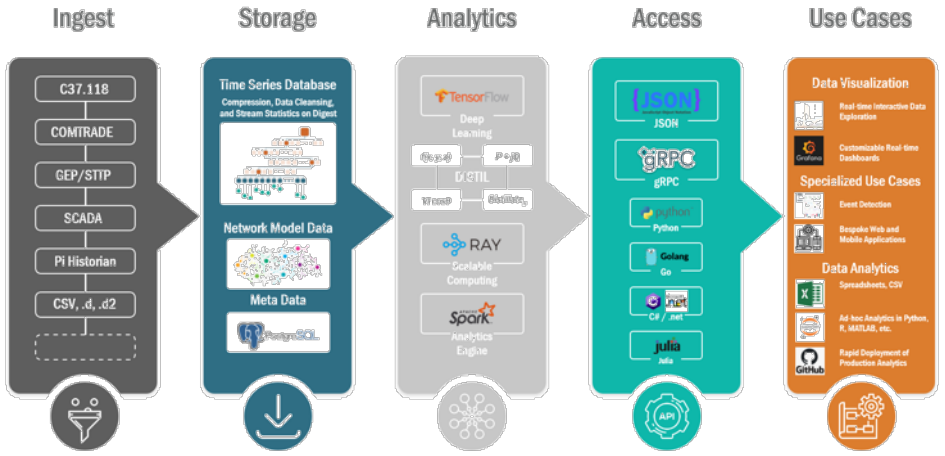
PingThings` PredictiveGrid Platform

PREDICTIVEGRID IS A PLATFORM-AS-A-SERVICE

This means we pay an annual subscription as an *all-in-cost* for:

- All Platform Features
- Infrastructure
- Maintenance
- Scheduled Upgrades
- Security
- Services

The combination of best-in-class tech, hosted in the cloud, and supported by a world-class team allows us to achieve at a scale and pace that would be otherwise impossible.

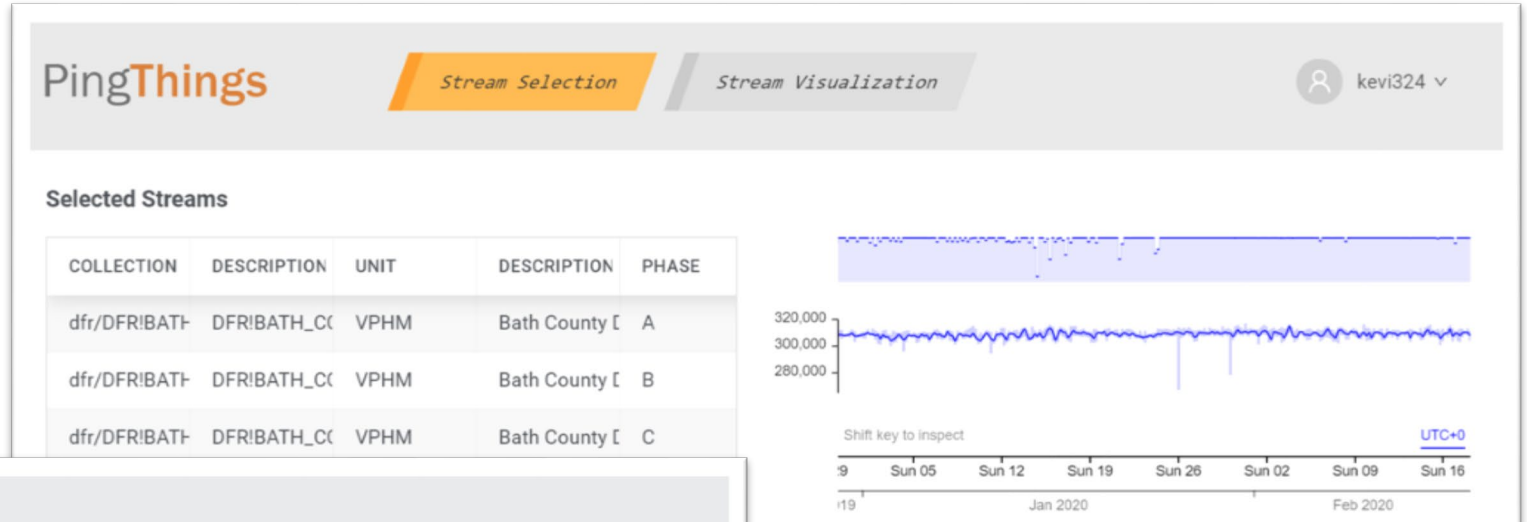


Zero to streaming data in under 4 months. We can do more with less [people, time, and resources] with PingThings & PredictiveGrid.

Human-Scale Data Exploration

YOU MUST LOOK AT YOUR DATA!

Any data,
at your fingertips,
instantly, fluidly.

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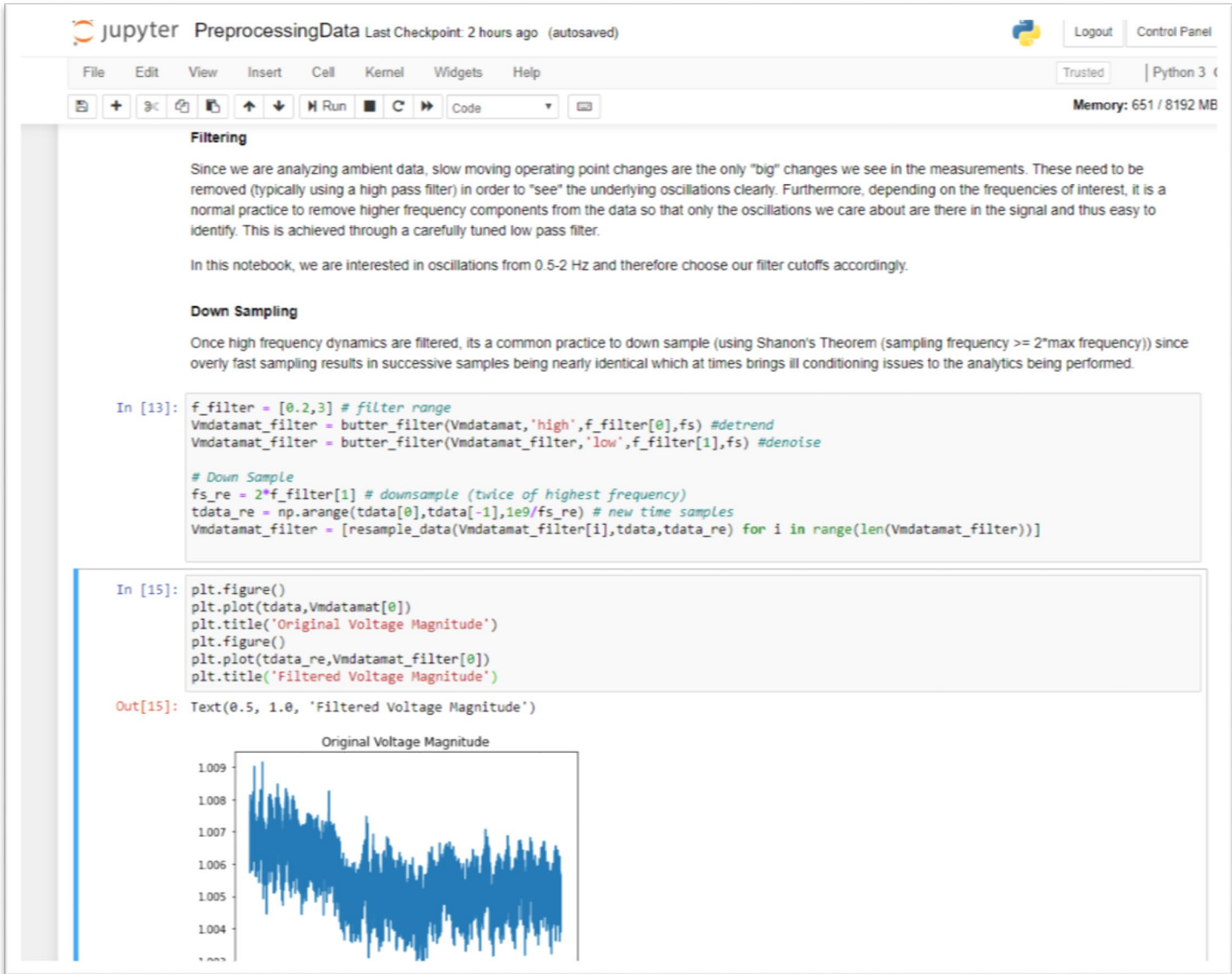
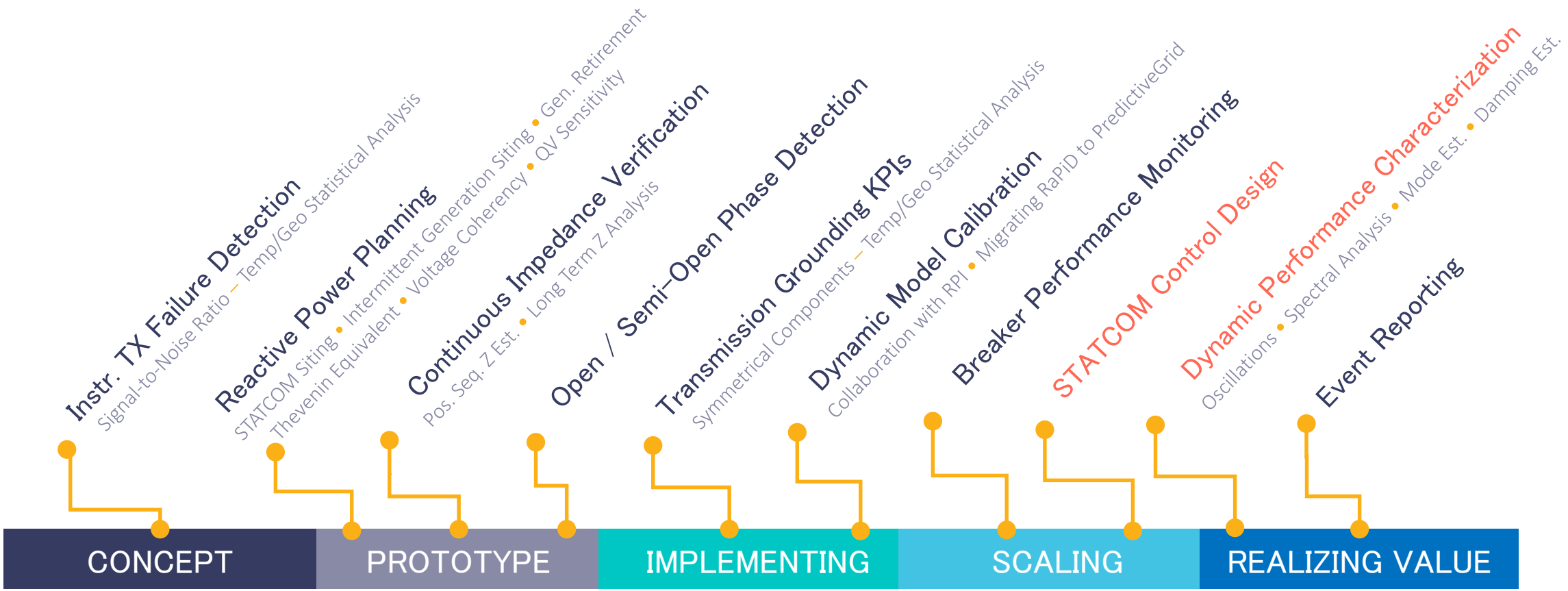
Rich, Programmatic Access

PREDICTIVEGRID DRIVES DOWN THE COST OF ANALYTIC DEVELOPMENT

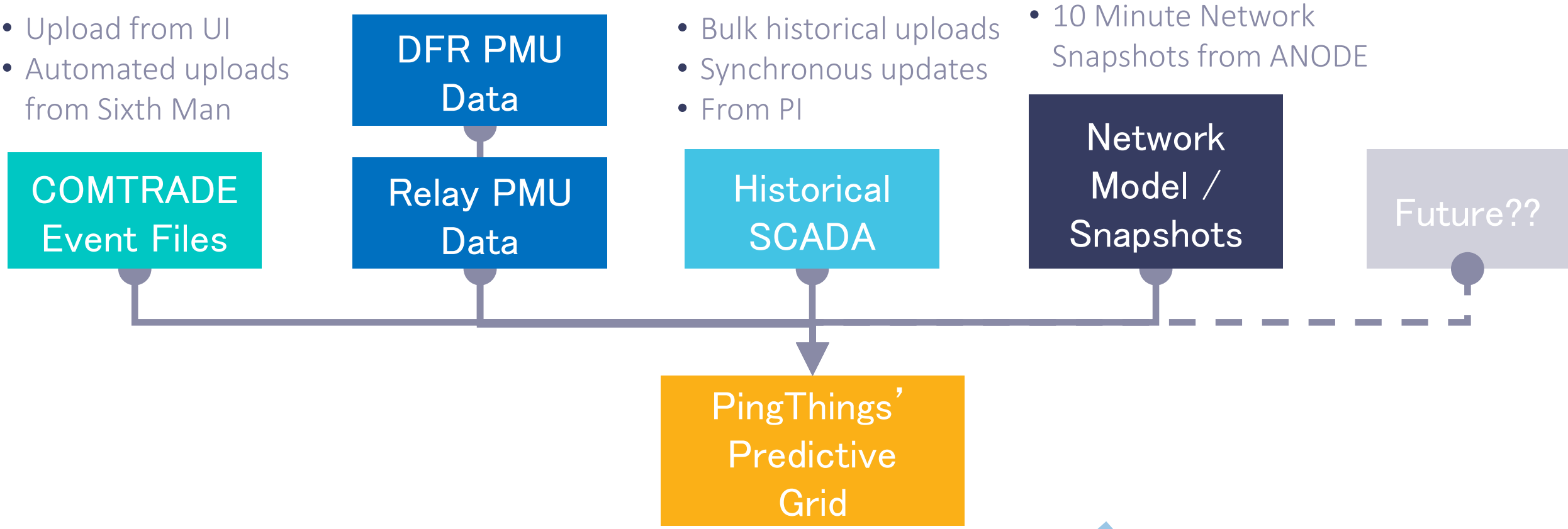
- Ad-hoc Analytics & Experimentation
  - *Exploration*
- Rapid & Targeted Use Case Development
  - *Exploitation*
- Great for Exploration and Exploitation.
- Great for beginner, intermediate, and advanced users.



Promising Use Cases

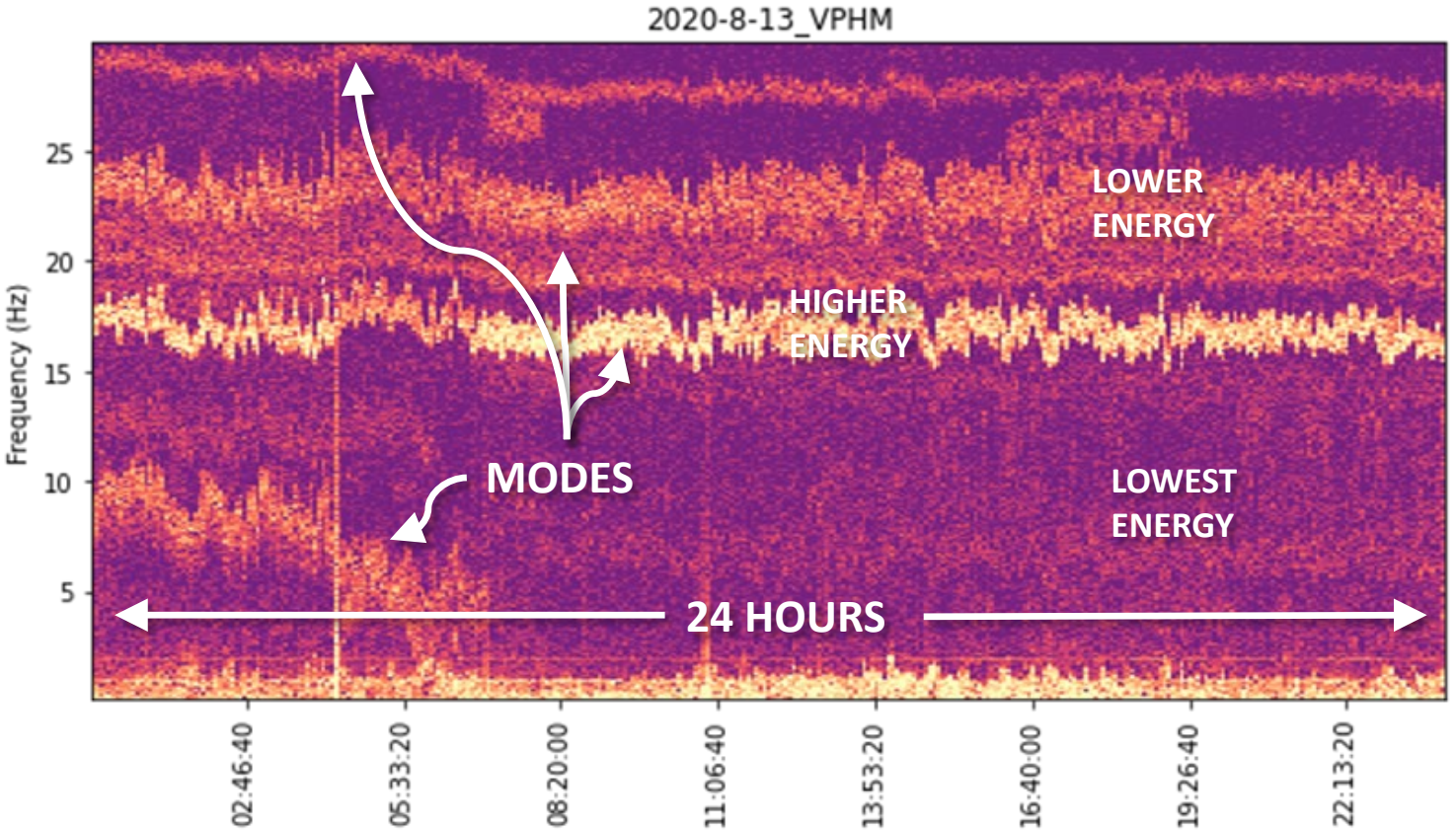


Beyond Synchrophasors



Today: Small Signal Analysis Case Studies

- Richness of ambient data
- Our homegrown toolbox is growing; dozens of techniques
- Must consider system level behaviors under all operating conditions across months of history
- This analysis requires working at a scale only made possible by PingThings` PredictiveGrid



Today: Small Signal Analysis Case Studies

1. Regional Industrial Load Dynamics ← *Improving Grid Models*
2. Regional Solar Dynamics ← *Improving Grid Models & Interconnection Analyses*
3. STATCOM Controller Dynamics ←*Improving Existing Controller Design*
4. STATCOM Controller Testing ← *In-Vivo Testing of Controller Changes*
5. STATCOM Controller Interactions ← *Improving Existing Controller Design*
6. SVC Dynamics ← *Performance Assessment of FACTS*
7. Hydro Plant Dynamics ← *Data + Models for Diagnostics*
8. Impacts of Arc Furnace ← *Data Wrangling & Power Quality*
9. Nuclear & Gas Gen Dynamics ← *Beyond Synchrophasors: Point-on-Wave*

Why Does This Matter?

Consider a future where. . .

INCREASED RENEWABLES

Exponentially increases the likelihood of undesirable device interactions.

INCREASED DYNAMIC COMPENSATION DEVICES

As a key enabler of renewable integration, design must consider actual small signal characteristics.

LIMITATIONS ON TRADITIONAL SOLUTIONS

New technologies will be required, data analytics can compensate for uncertainty.

NEED FOR MULTI-MODAL INVESTMENT JUSTIFICATION

Data will become a necessary part of the simulation/model-based investment proposal process.

GROWING WORKFORCE OF TECH-SAVVY ENGINEERS

Talent will be available to build data teams

Thank you!

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