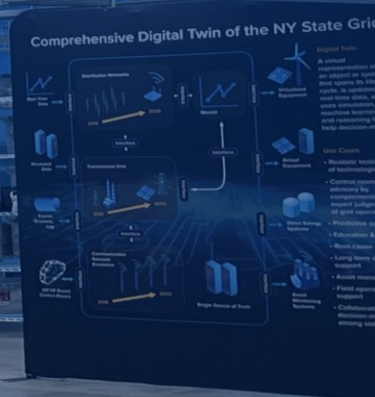


# Electromagnetic Transient (EMT) Modeling for Large-Scale Power Systems

## A Utility Perspective

Reza Pourramezan

Manager, Advanced Grid Innovation Laboratory for energy (AGILE)



# New York Power Authority (NYPA)

- Largest state-owned electric utility in the United States

**17**

Generating  
Facilities

**1,550**

Circuit-Miles of  
Transmission

**1,000+**

Public-Sector  
Customers

## Major Development Initiatives

**6 GW**

Renewable  
Generation  
(in development)

**1 GW**

Advanced  
Nuclear  
(announced)



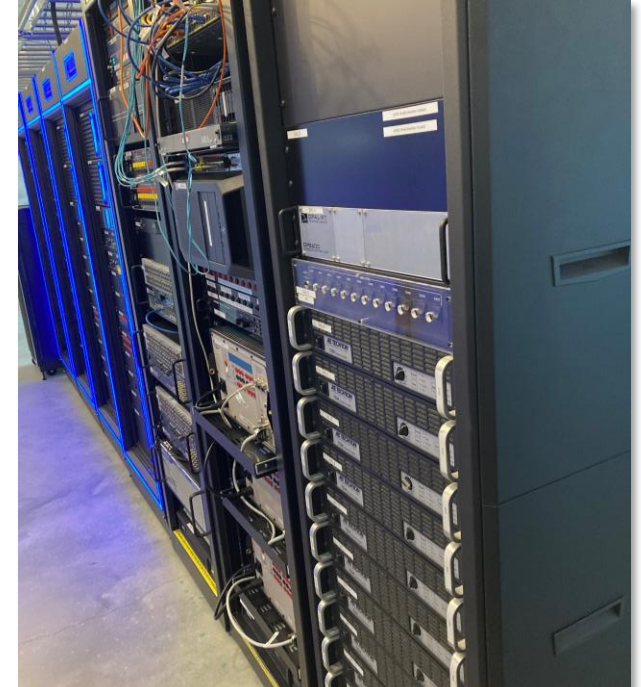
# Advanced Grid Innovation Lab for Energy (AGILE)

Enabling an Affordable, Reliable, Low-Carbon Future



Grid of the Future

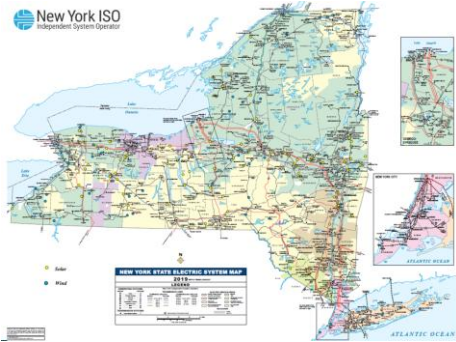
- Need a platform to evaluate the grid of the future
- Need a facility to prototype solutions
- Need a platform to safely and realistically test and demonstrate **grid-scale** solutions



AGILE

A state-of-the-art power systems laboratory to enable an affordable, reliable, low-carbon future power grid by providing a close-to-real testing environment that facilitates identifying and solving grid related challenges

# Evolution of NYS EMT Grid Models at AGILE



## 2019

- Full NYS transmission
- Phasor-domain transient (PDT)
- ~6000 bus
- ePHASORSIM

## 2022

- Multi-regional EMT
- $\geq 34.5$  kV
- RSCAD & HYPERSIM

## 2018

- Transmission EMT model
- 500 bus
- $\geq 230$  kV
- RSCAD & HYPERSIM

## 2021

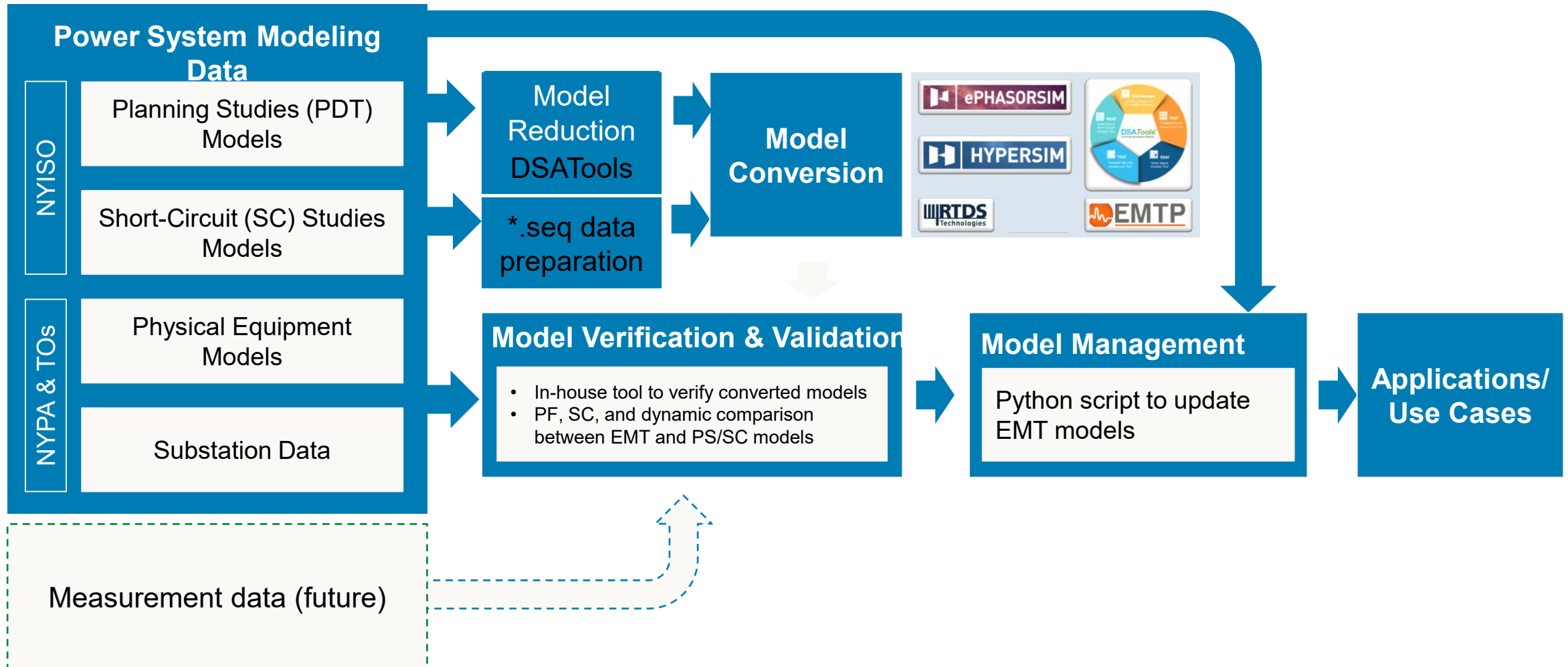
- Regional EMT models
- Regional EMT-PDT hybrid
- $\geq 34.5$  kV
- RSCAD & HYPERSIM

## 2025

- Digital twin of NYS Grid
- Full NYS Transmission EMT
- Eastern Interconnection + NYS in EMT-PDT hybrid



# Transmission EMT Model Development

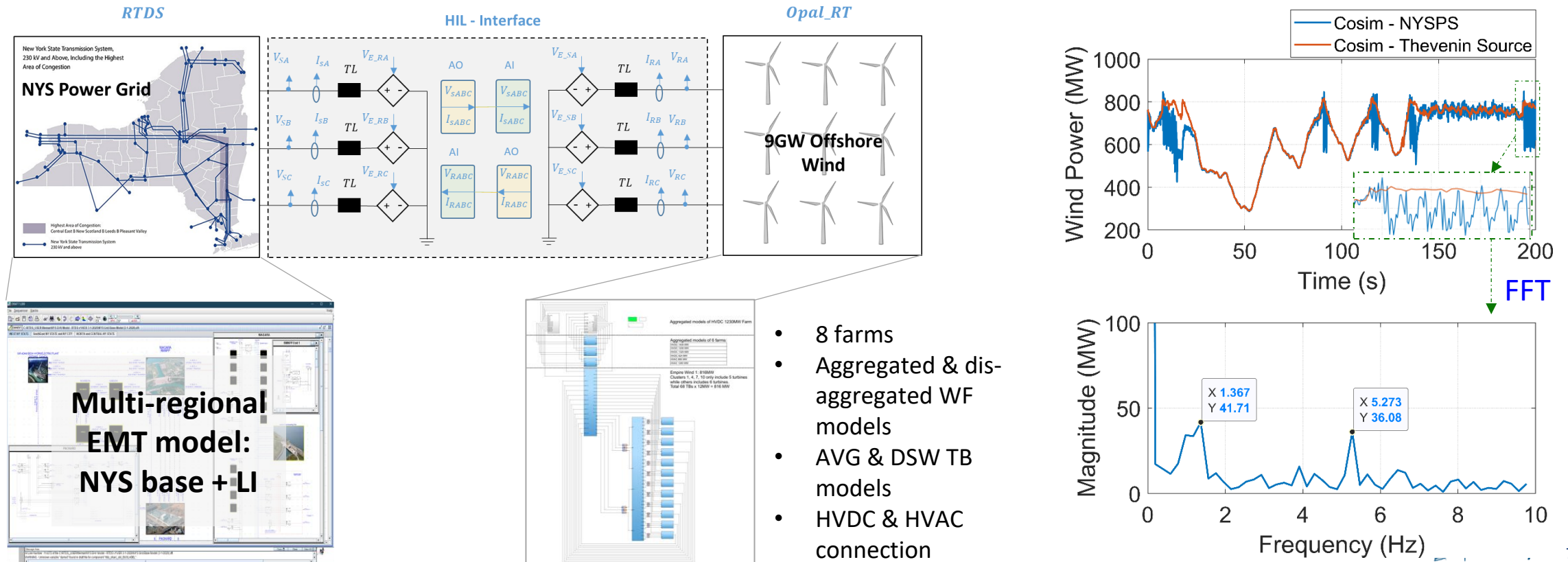




# Use Case

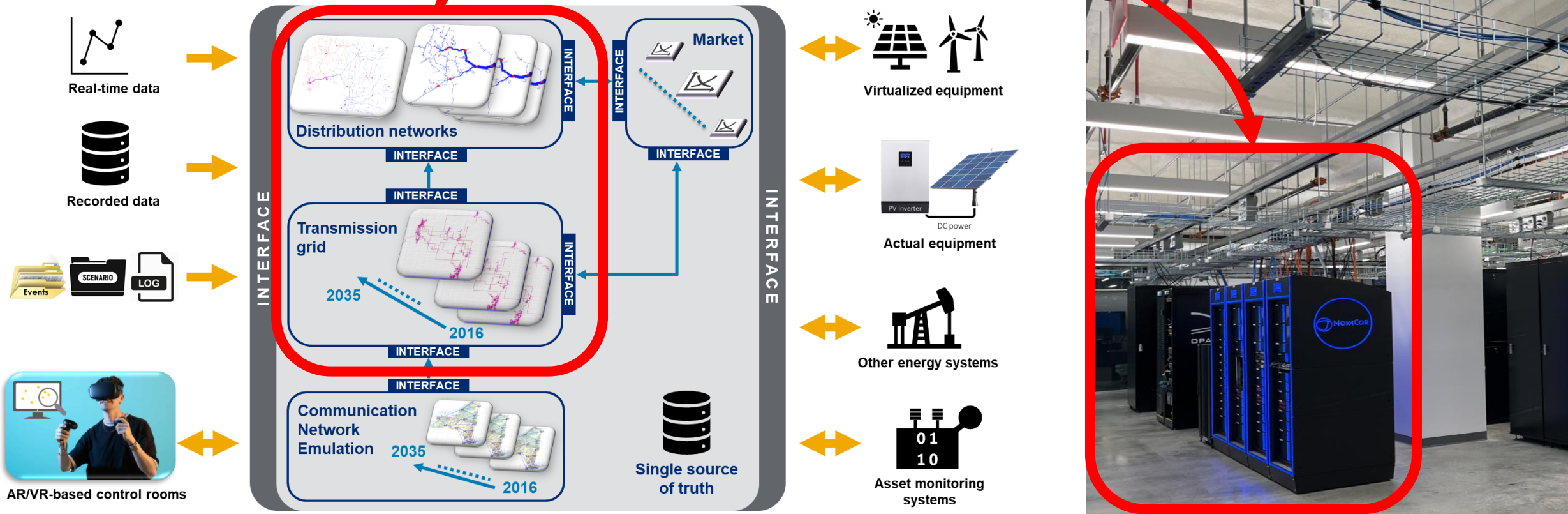
## Real-Time Interconnection Studies and Control of NYS Offshore Wind

- Joint research project by Clarkson University and NYPA, funded by NYSERDA.
- Full EMT modeling and simulation: NYS power grid on RTDS and 9 GW offshore wind on Opal-RT
- Reveal SSO risk when performing full EMT simulation (Entire NYS power grid & wind farms).



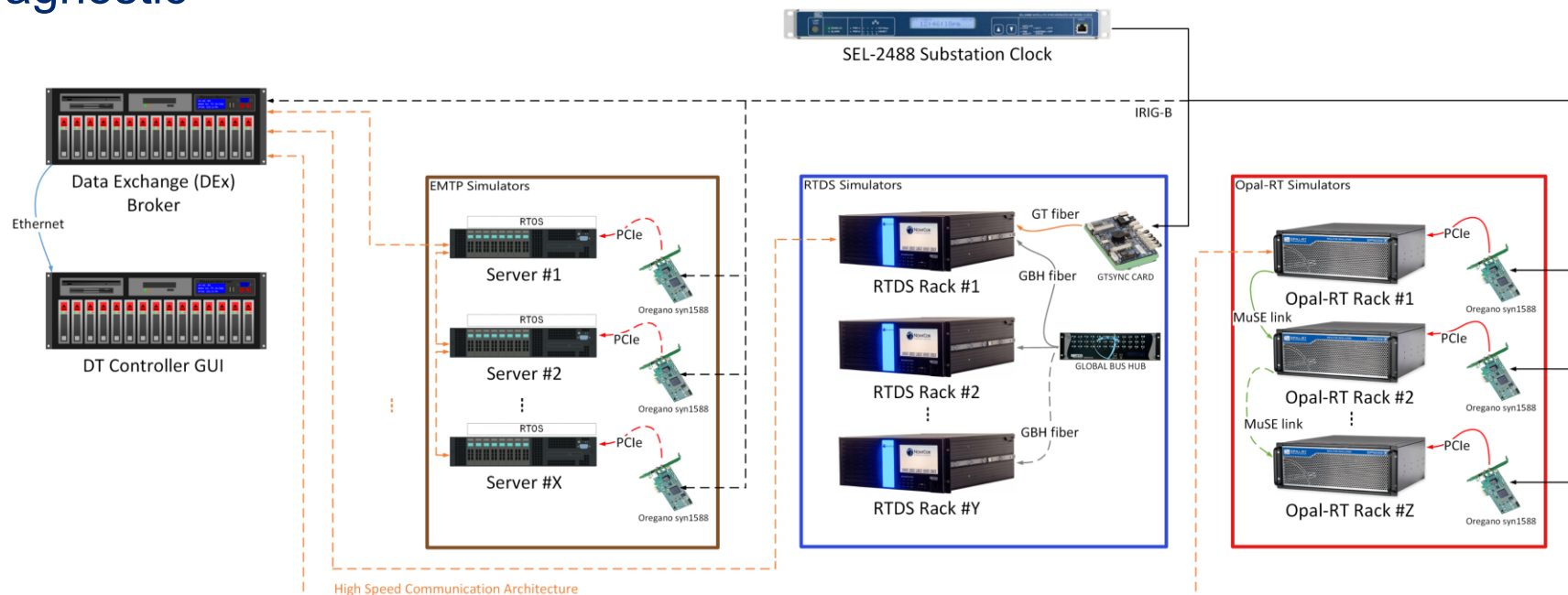
# Digital Twin of NYS Grid

*Computationally intensive*



# Hardware Architecture for EMT Model of NYS Grid

- ❑ A new architecture using high speed low latency data exchange brokers (DEx) to interface multiple simulators
- ❑ Works differently than high-performance computing architectures
- ❑ Vendor agnostic
- ❑ Servers will run EMTP models faster than realtime
- ❑ Allows models to stay in their native platforms
- ❑ Upgradable

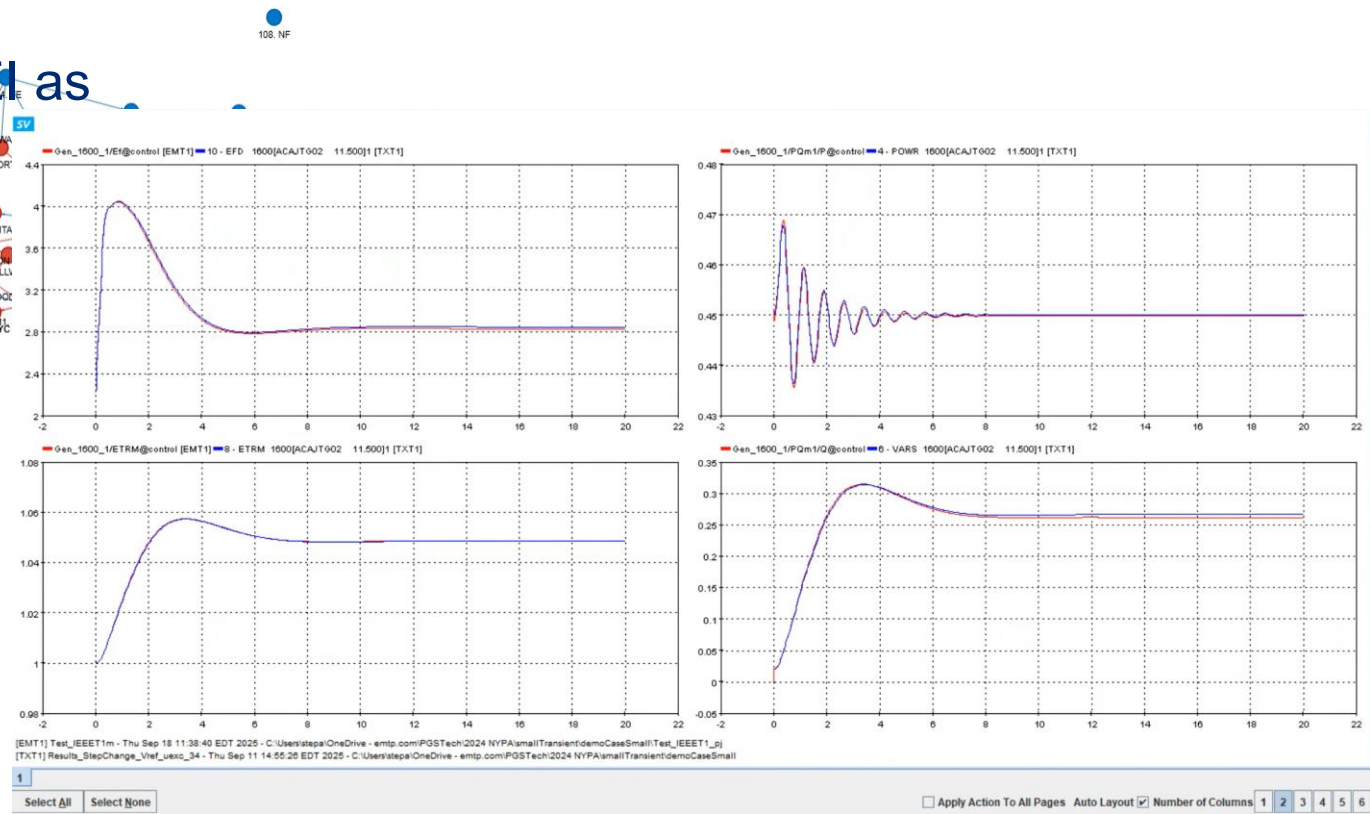
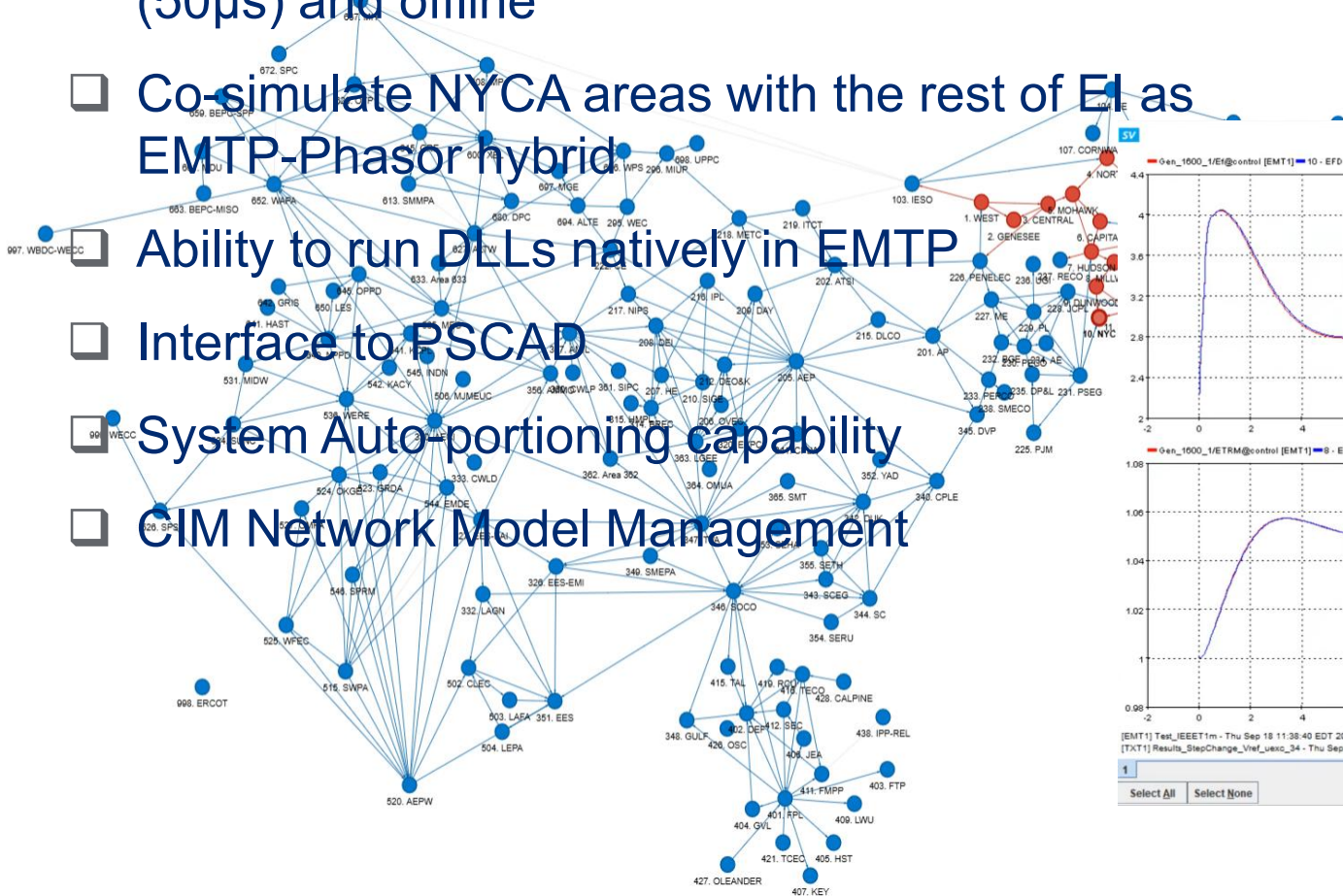






# EMT Model of NYS Grid

- ❑ Multiple "as-found system" cases covering SUM, WIN, and SLL from 2023 to 2033
- ❑ EMT model of NYCA areas running in real-time (50µs) and offline
- ❑ Co-simulate NYCA areas with the rest of EIA as EMT-Phasor hybrid
- ❑ Ability to run DLLs natively in EMT
- ❑ Interface to PSCAD
- ❑ System Auto-portioning capability
- ❑ CIM Network Model Management





# Thank You

