



QUANTA
TECHNOLOGY

Deploying Synchrophasor Systems for Real-Time Control Room Operations



IEEE 2021 International Conference
on Smart Grid Synchronized
Measurements and Analytics
May 25, 2021

Quanta Technology

Who:

- Trusted advisors with global utility experience
- Industry recognized thought leaders
- A team drawn from diversity in all forms
- Our team's experience base spans the entire lifecycle – planning to implementation and support.

Why:

- Independent, objective, practical advice and solutions
- Unique business, regulatory, and technical expertise coupled with best practice know-how
- Technology Savvy: Testing, commissioning, integration, and post-installation evaluations of technologies
- Ability to engage in a variety of roles, including staff augmentation

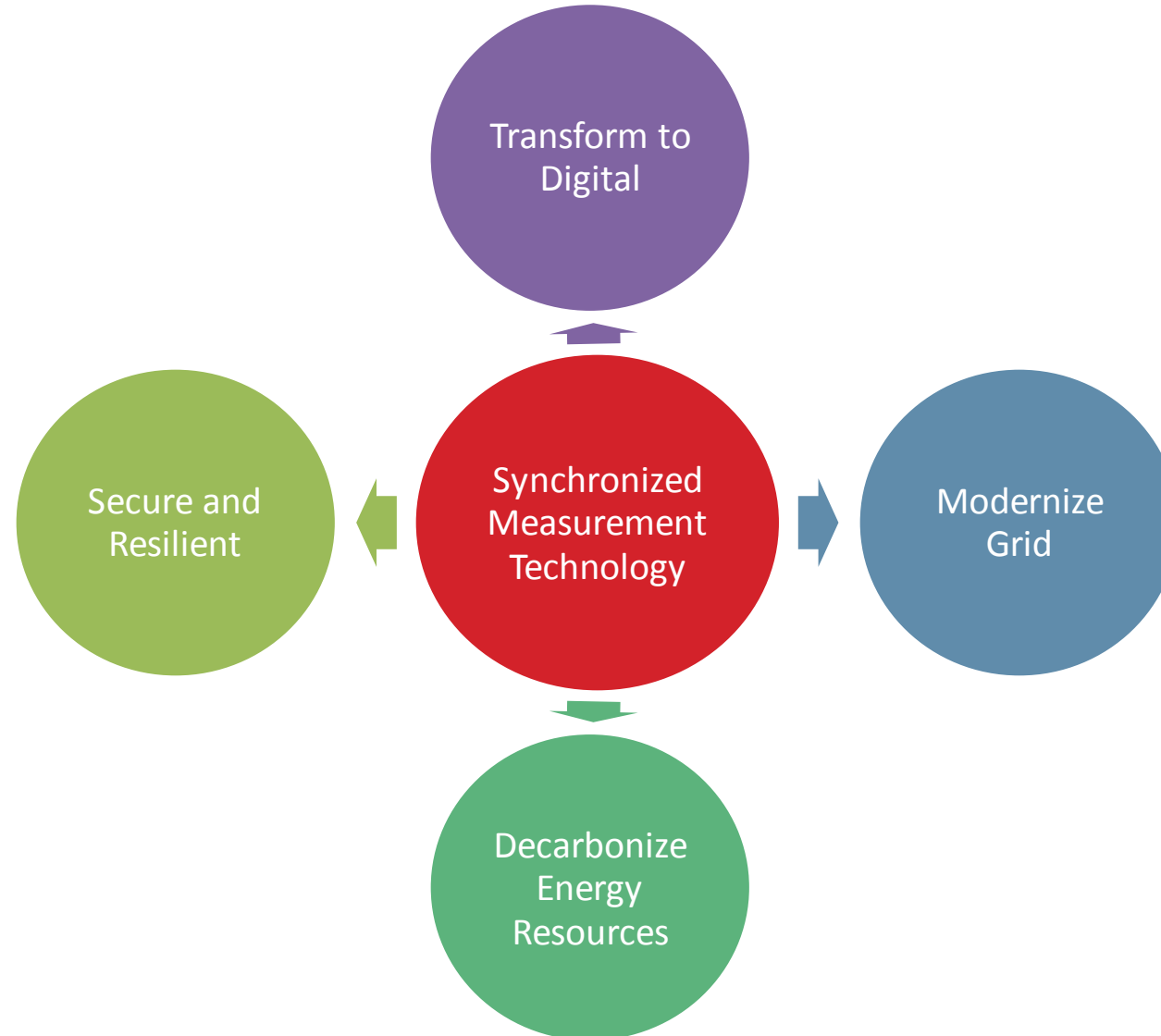
Quanta Technology End-to-End Capabilities

Strategic Capabilities: From Concept to Reality



Our mission is to enable your success with industry-best technical and business expertise, holistic and practical advice, and industry thought leadership.

Synchronized Measurement Technology



Quanta Technology and The Synchronized Measurement Technology

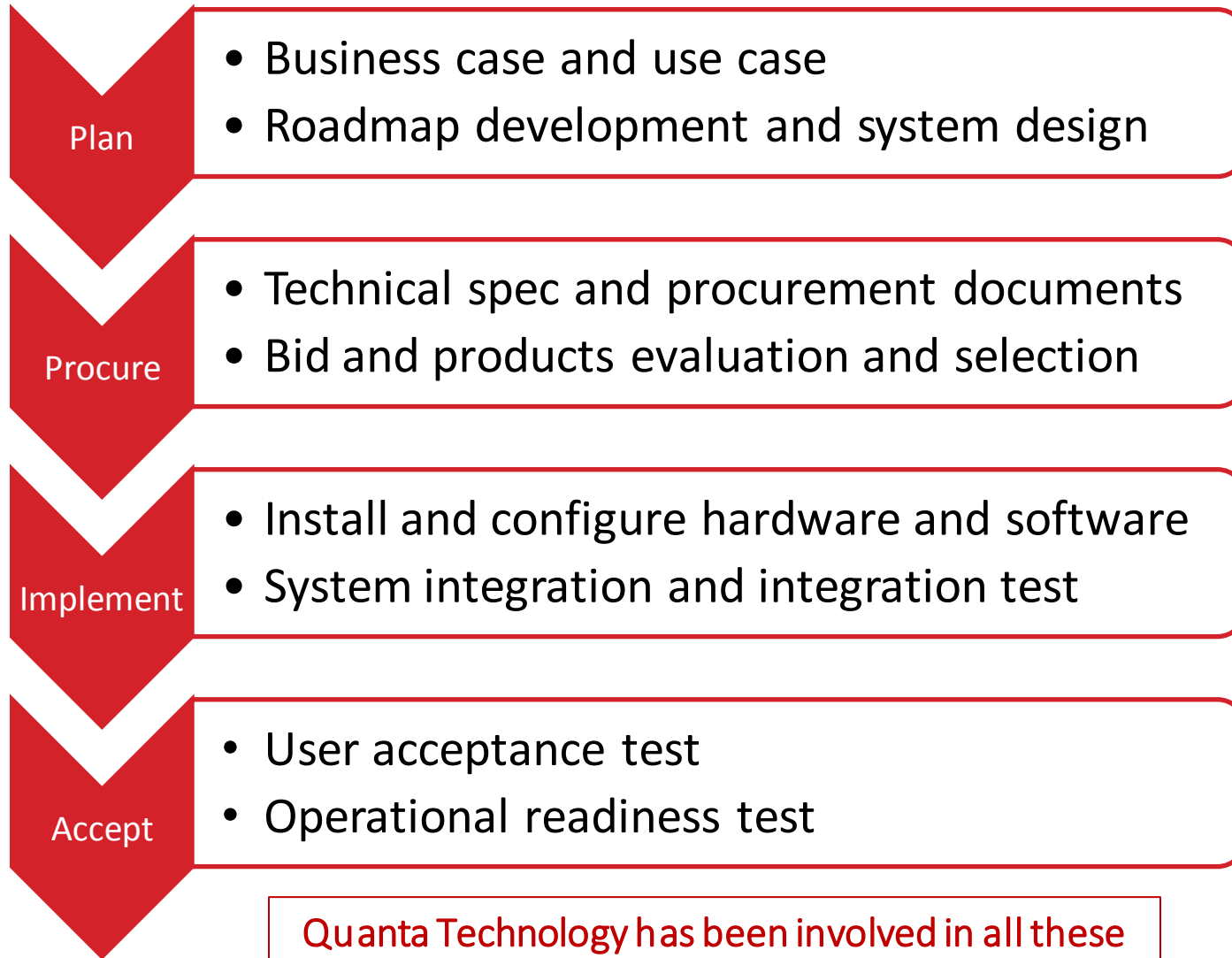
- Involved with many large utility deployment projects



- Active participants of and contributors to synchronized technology related activities such as R&D and standards, guides, and reports development



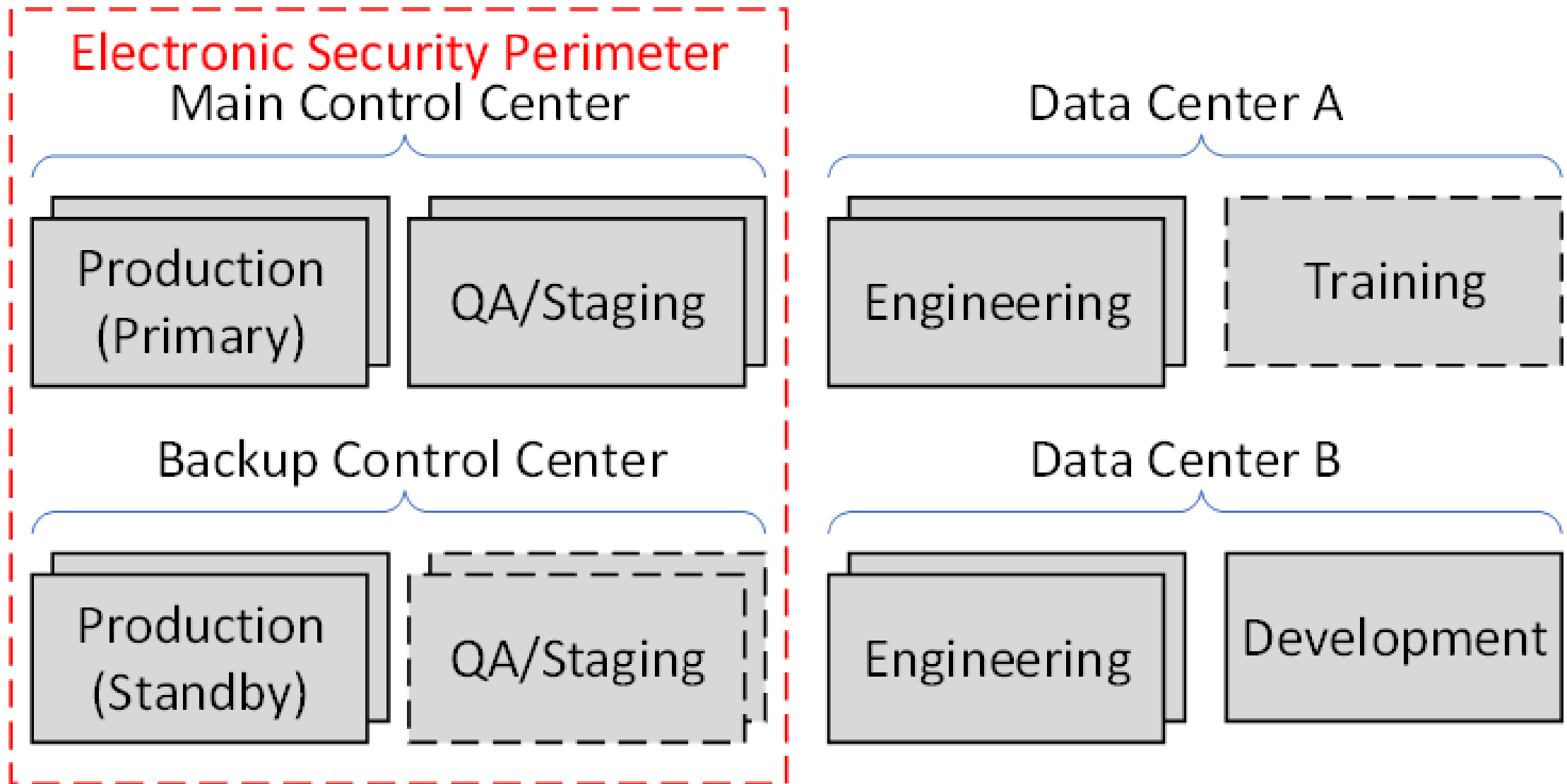
Deploying A Large Synchrophasor System for Control Room Real-Time Operations



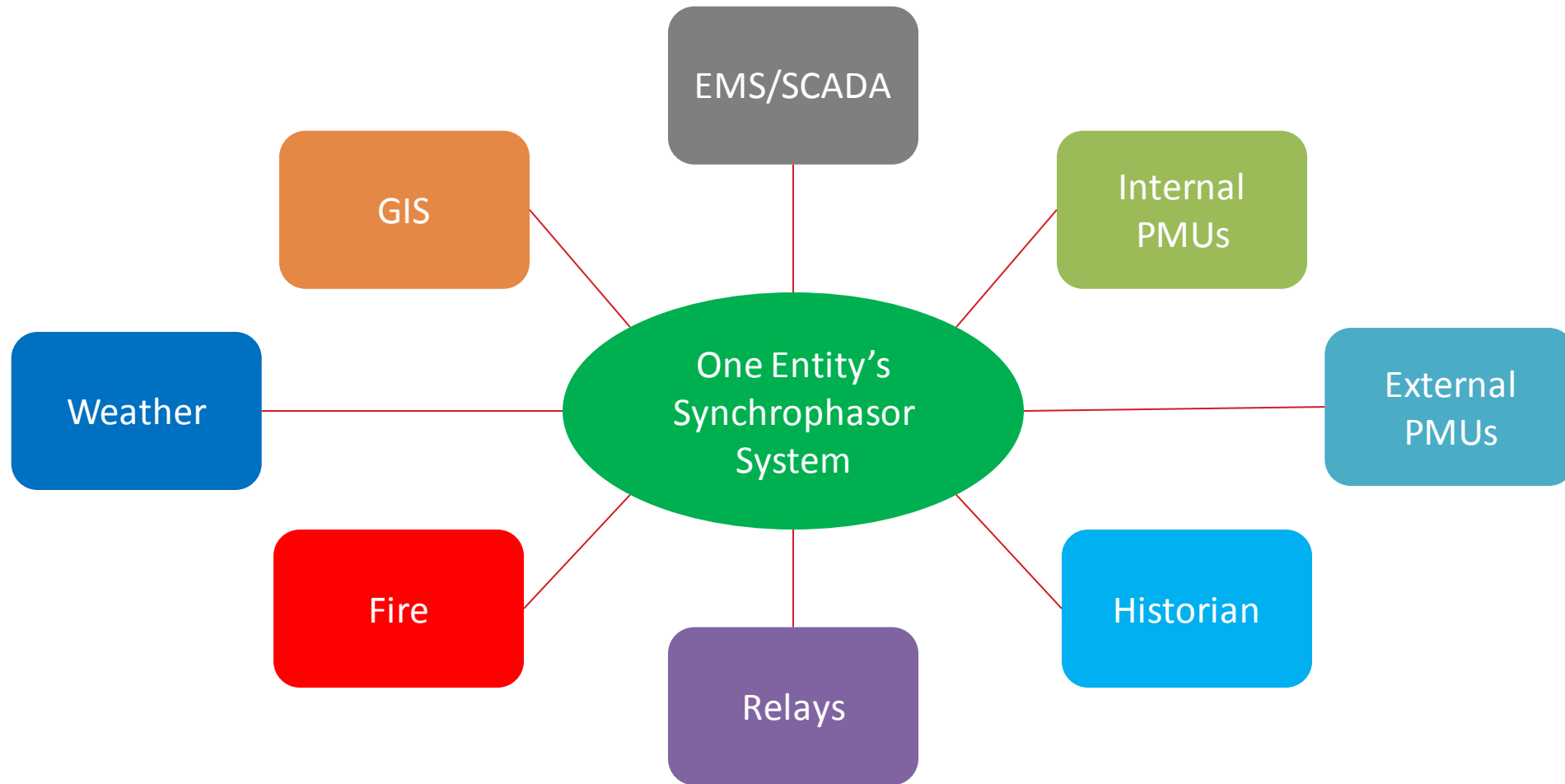
Quanta Technology has been involved in all these phases and the post-deployment support

- Support a wide-range applications
 - Measurement and model based
 - Combine the use of synchrophasor with other types of data
- Have much higher requirements for the system
 - Availability
 - Data quality
 - Performance
 - Usability
 - Support
- Require major deployment effort and investment
 - A multi-year effort
 - Multi-million to tens of millions of US dollars

Synchrophasor System for Control Room Real-Time Operations



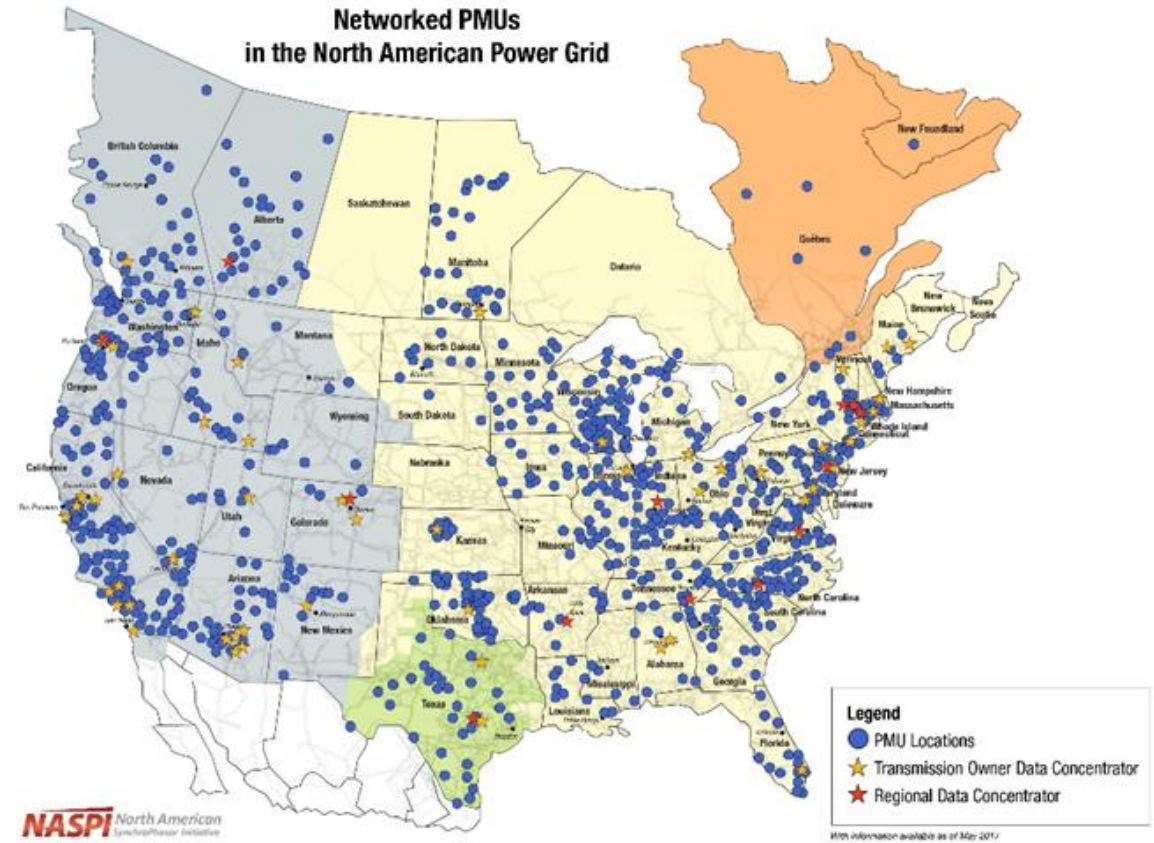
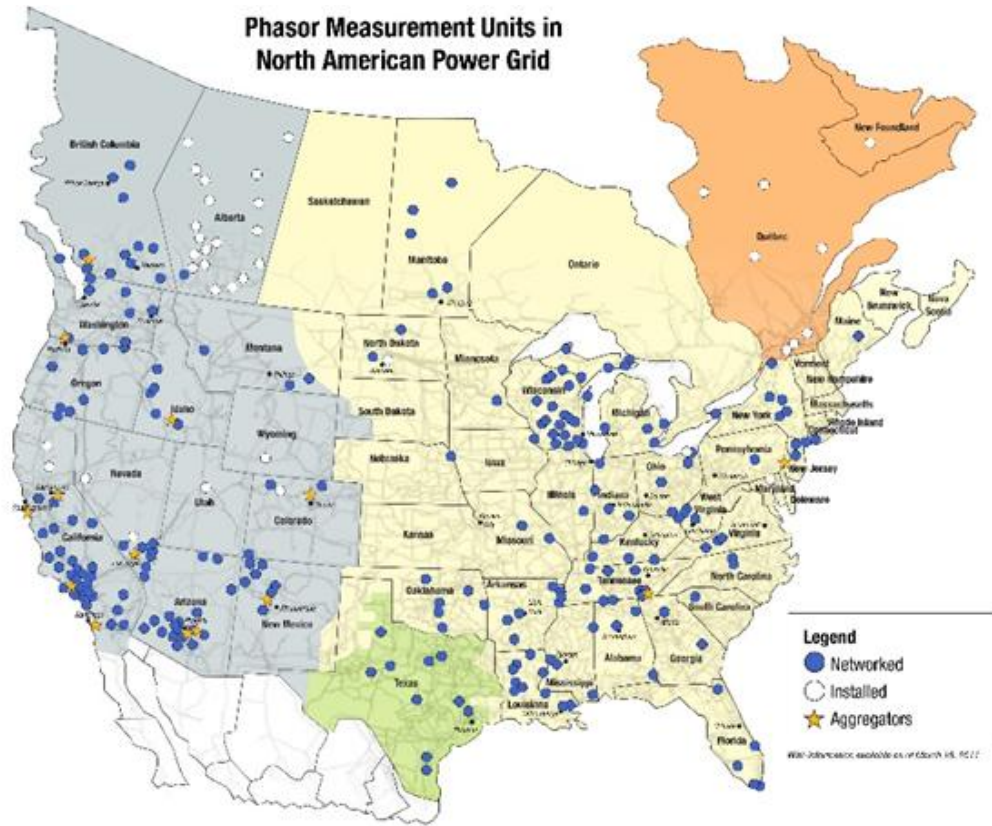
A Major System Integration Task



Number of Installed and Connected PMUs in North America

2011

2017



Impact of Increased Number of PMUs

- Increased PMU installation in US is driven by meeting
 - NERC PRC-002-2 requirements
 - ISOs/RCs required PMU installations at new or existing lines and generators
 - Utility's own drive to reach full observability of its transmission grid
- Enable more and more advanced synchrophasor applications to be implemented → More benefits can be realized
- Increased deployment challenges
 - Data transfer and sharing – bandwidth (1 to 1, or 1 to many)
 - Data archiving and retrieving – storage space and read/write performance
 - Data processing and analytics – performance of real-time and offline analytics applications
 - Information and data visualization – effectiveness and ease of navigation

Post-Deployment Addition/Integration of New/Advanced Applications

Closed System

- Limited by original supplier's ability to develop and supply
- Major integration efforts involved for any third-party applications

Open System

- Application quality control is a major concern
- Could still have major issues in application integration

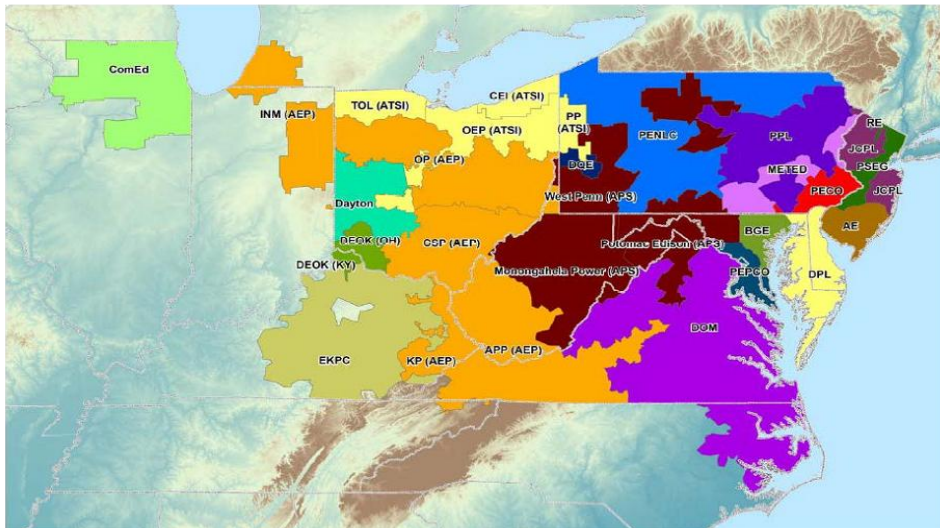
Controlled Open System

- Good application quality control
- Minimal effort in integrating third-party applications

Example 1: ComEd/Exelon Synchronphasor Technology Deployment

- ComEd – One of the Exelon Companies (others include PECO, BGE, and Pepco)
 - Serving 4+ million customers, approx. 23,500 MW in Northern Illinois, US
 - Transmission: 5,800 circuit miles of transmission at 138kV and 345kV
 - Member of PJM since 2004

PJM Footprint and Locational Deliverability Areas



Source: US FERC

- ComEd
 - Installed 9 PMUs as a pilot in US DOE co-funded Smart Grid Investment Grant project led by PJM
 - Decided to expand after good experience with the pilot
 - Developed business cases and a comprehensive roadmap for bringing the technology into transmission control room real-time operations and for distribution system applications
 - Has commissioned 125 PMUs in 52 substations, and deployed a Wide-Area Situational Awareness System (WASAS) and a Wide-Area Monitoring System (WAMS) for transmission
 - Piloted in several selected distribution feeders with over 100 PMUs installed
- Other Exelon companies
 - Will deploy the same WASAS and WAMS as ComEd

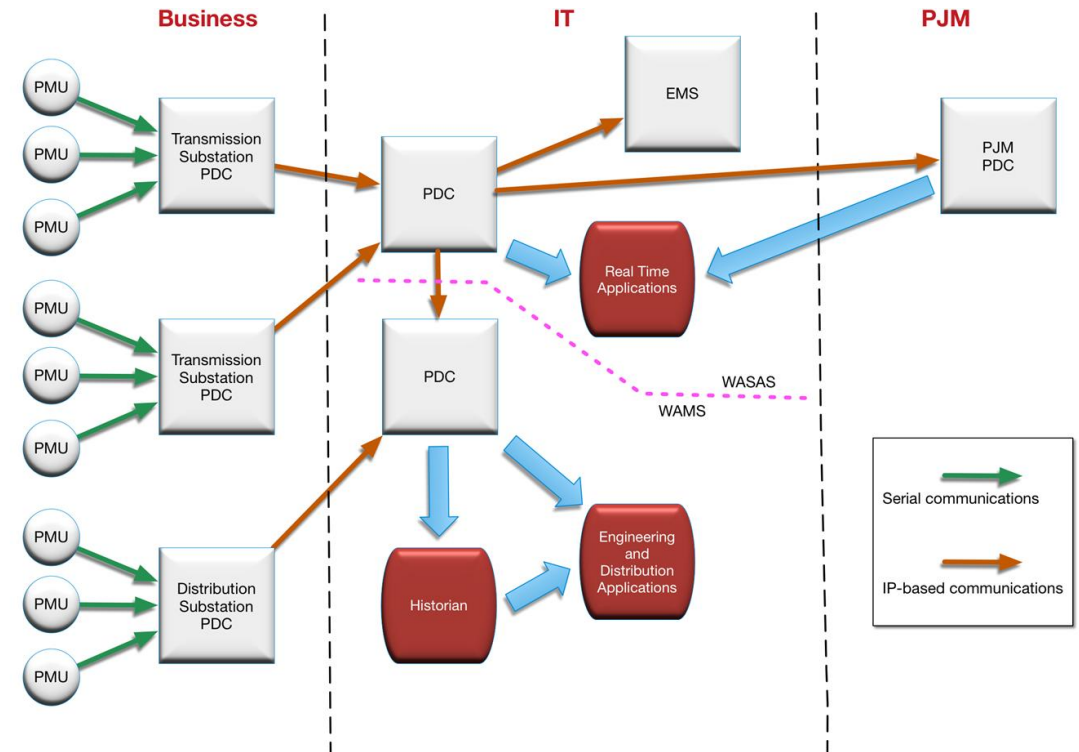
ComEd Transmission Synchrophasor Technology Deployment Roadmap



Source: ComEd

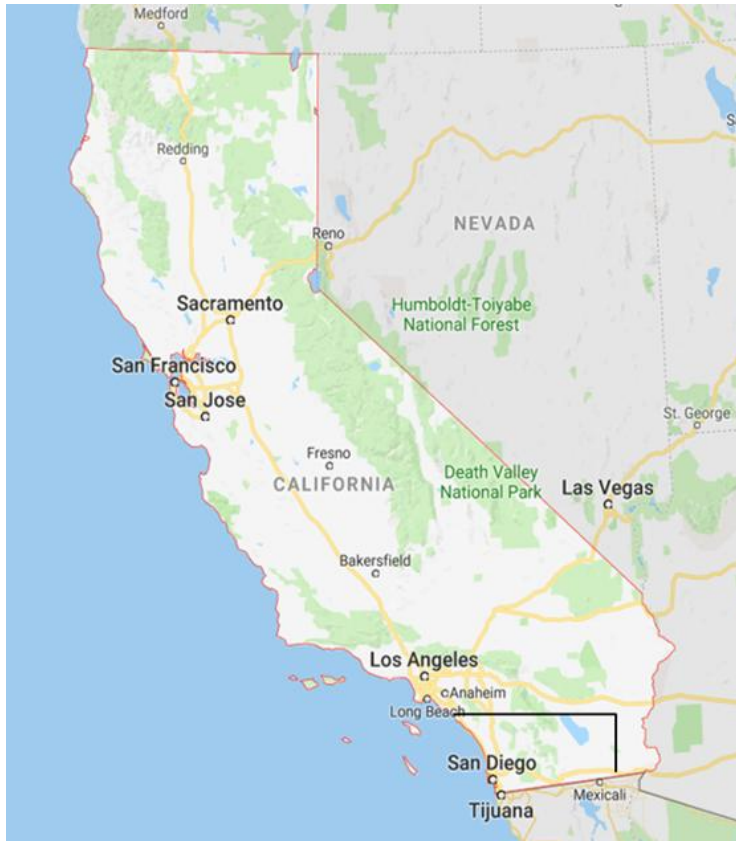
Deployed ComEd WASAS and WAMS for Transmission Control Room Operations

- Full redundant system design and implementation
 - The WASAS and WAMS are duplicated in two data centers – Substation PDCs send data to both data centers
 - Each PDC in the data center has local failover capability – A role server keeps the configurations consistent between the failover machines
 - The high availability historian for WAMS is duplicated in the two data centers – makes switching historians seamless
 - Data center WASAS PDC also send synchrophasor data to EMS and PJM
- WASAS is deployed to meet CIP requirements while WAMS is not



Source: ComEd

Example 2: San Diego Gas & Electric® Synchrophasor Technology Deployment



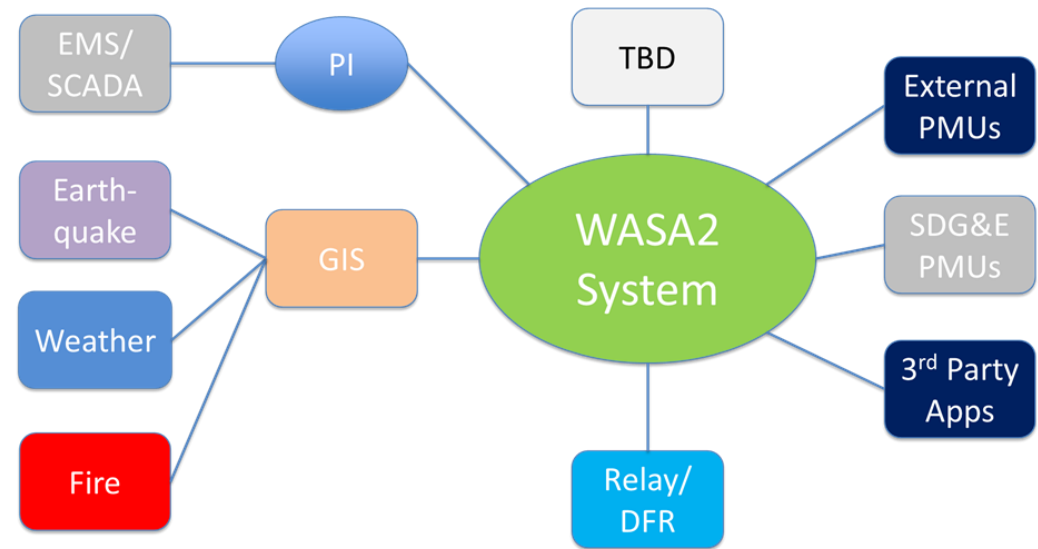
- Servicing 3.6 million people through 1.46 million electric and 889,000 natural gas meters span an area 4,100 square miles
- Approx. 43% electric load are supplied by renewable energy resources now, 60% by 2030 and 100% by 2045

- 2011-2020 SDG&E Smart Grid Deployment Plan: “Integrate Synchrophasor Technology into SDG&E’s electrical grid, improve system performance and coordination with ISO and neighboring utilities, and participate in the Smart Grid Initiative”
 - Integrate the Technology into SDG&E’s Bulk Power Electric System
 - Develop Applications to Aid in System Operations and System Protection
 - Share Data with CAISO, Reliability Coordinator, and Neighboring Systems
 - Support meet NERC requirements for Oscillography and Disturbance Monitoring and Reporting



SDG&E Wide-Area Situational Awareness (WASA) System Deployment

- Transmission PMUs
 - Installation started in 2005
 - Covered all 500 kV and 230 kV tie lines, and is expanding installation in 138 kV and 69 kV
- 1st generation WASA system was a success and well received by operators
- In process of finishing the 2nd generation of WASA system deployment by end of 2021
 - Based on the business requirement document
 - Conducted a rigorous procurement process with detailed technical specifications
 - Near completion of visualization software acceptance
 - Will release to Grid Operations once site integration test, site acceptance test, and operational readiness test are completed
- Already sharing data with BPA, PG&E, SCE, APS, and SRP



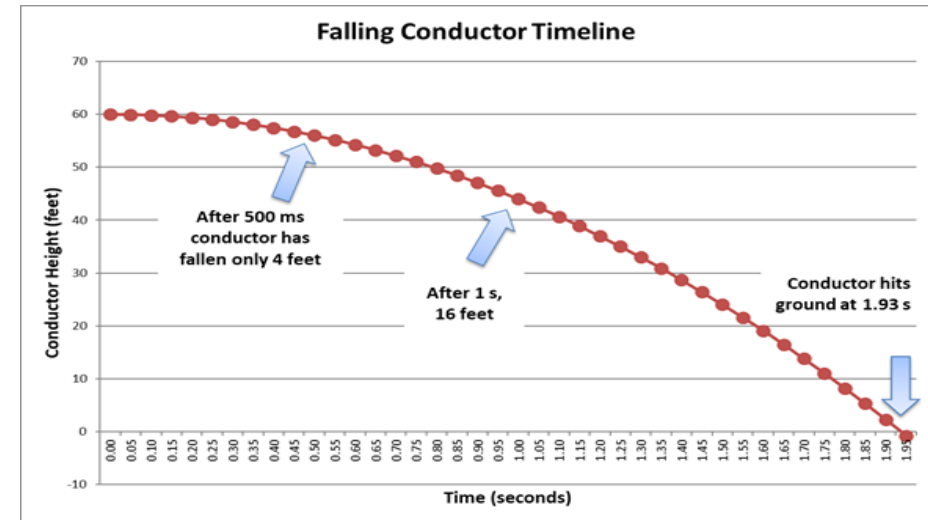
The Visualization Software System of the 2nd generation WASA system (WASA2)

- Provide single GUI for all information visualization and navigation
- Serve as a system integration platform for third-party applications and external systems and data sources

SDG&E Next Step Transmission Deployment Activities

- WASA system expansion and enhancement
 - Continue PMU installation to reach full observability of the SDG&E transmission grid
 - Add third-party applications, such as
 - Linear State Estimator
 - Oscillation detection, source location, and alarming
 - Advanced voltage stability management with both measurement-based and model-based applications
 - AI/ML empowered applications
 - And many more
 - Share synchrophasor data with more utilities for improved wide area situational awareness
- Work toward a next generation EMS

- Evolve WASA system into a Wide-Area Monitoring, Protection, Automation, and Control (WAMPAC) system
 - Transmission falling conductor protection
 - Wide-area backup protection
 - Adaptive islanding and islanding operation
 - Real-time fault detection and fault location
 - System integrity protection schemes

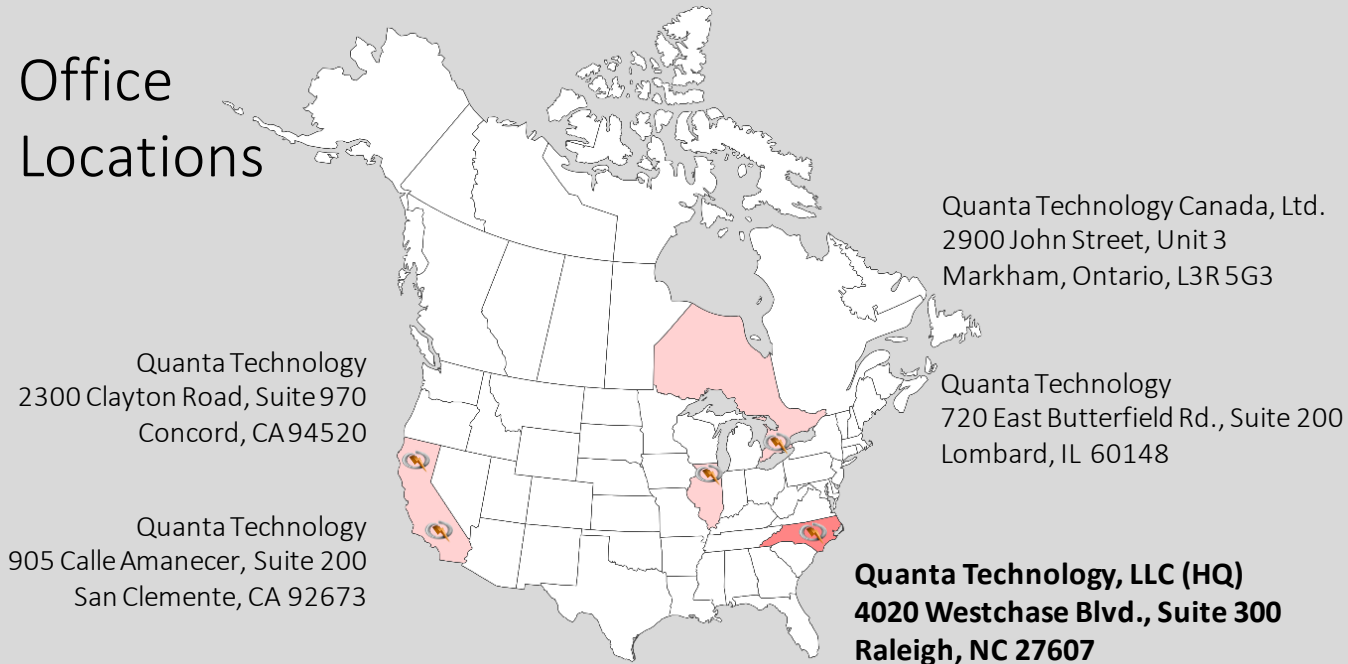


Concluding Remarks

- Synchronized measurement technology will play an increasingly important role in a rapidly-transitioning power system
- Deploying production-grade synchrophasor systems for control room real-time operation use requires major investment and efforts to meet the high system requirements
- Planning and executing with proven approaches are critical aspects for a successful deployment of a production-grade synchrophasor system for control room real-time operation use
- Start early before there is an urgent need – it will take many years to gain working familiarity and to fully deploy a synchrophasor system for control room real-time operation use

Thank you!

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