



Synchronized Measurements in the Utility Control Center at San Diego Gas & Electric

Tariq Rahman
Principal Engineer
System Protection, Automation & Control
Engineering

IEEE 2021 International Conference on Smart Grid Synchronized
Measurements and Analytics
SGSMA
May 25TH – 27TH 2021



Synchrowave Operations

Deployment objectives

- Accelerated adoption of synchrophasor measurements and PMU data over the last decade
- Since 2011, SDG&E[®] has improved reliability performance and operational response by integrating synchrophasor data for wide area situational awareness (WASA)
- PMU installations continue since 2013, supported by improvements in communications and data archiving infrastructure
- PMUs cover all 500 and 230 kV tie lines, with penetration into 138 and 69 kV
- Currently sharing data with external utilities for tie-line phase angle delta calculations and improved WASA



A Sempra Energy utility[®]



Synchrophasor Success

- Participated in WECC Peak Reliability Synchrophasor Project (PRSP)
- Early adopter of the Grid Protection Alliance Gateway Exchange Protocol
- Participated in the DOE Advanced Synchrophasor Protocol (ASP) development and demonstration project
- Developed and deployed falling conductor system using synchrophasor data on feeders; now adapting the falling conductor system to transmission lines
- Committed to using synchrophasor data for decision making in the control room
- Developed and deployed in-house WASA application using synchrophasor data
- Now developing new state-of-the-art multifunction synchrophasor application with vendor for operations deployment in Q2 2021



A Sempra Energy utility®

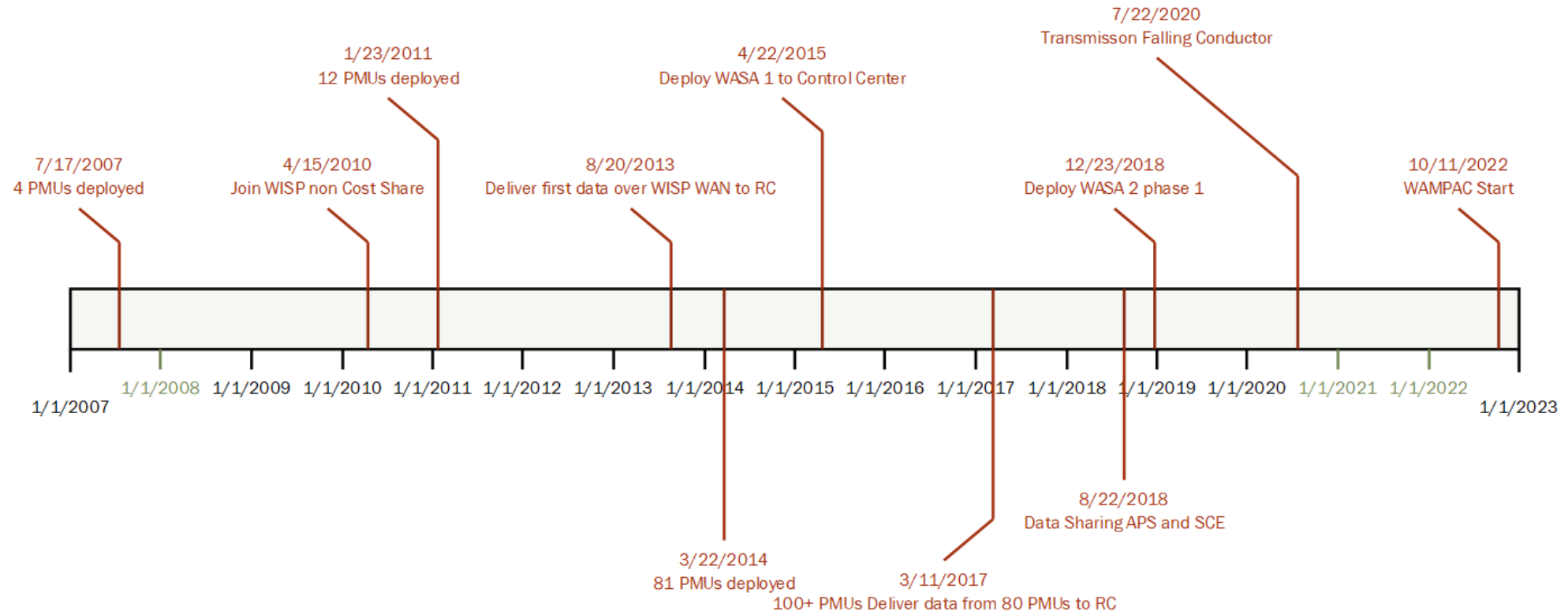


WASA Deployment Roadmap



A Sempra Energy utility®

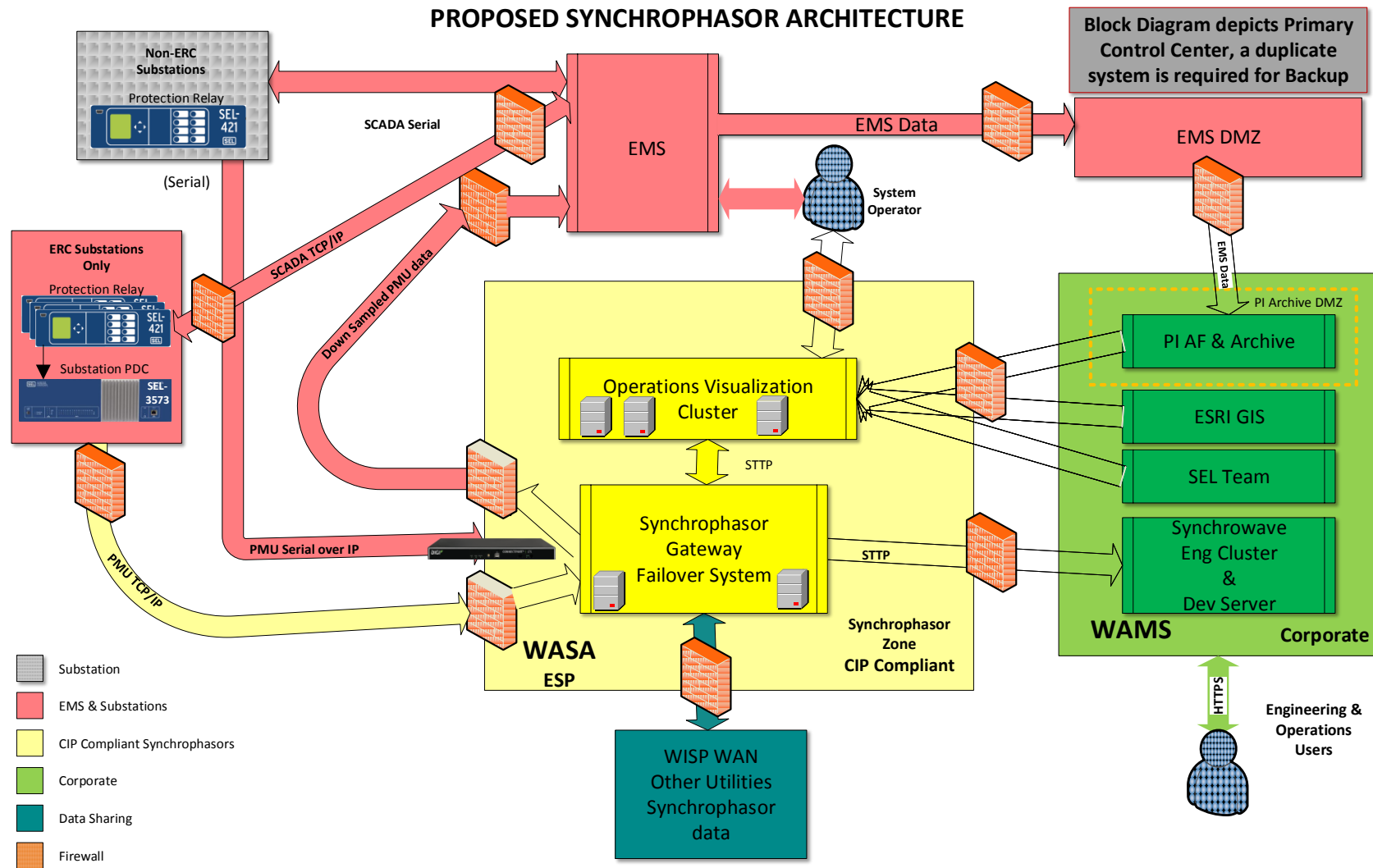
- Continuous additions of PMUs and PDCs
- Transition from serial to MPLS Ethernet communications
- Development of new functions including advanced operational client, fire risk reduction, and system protection



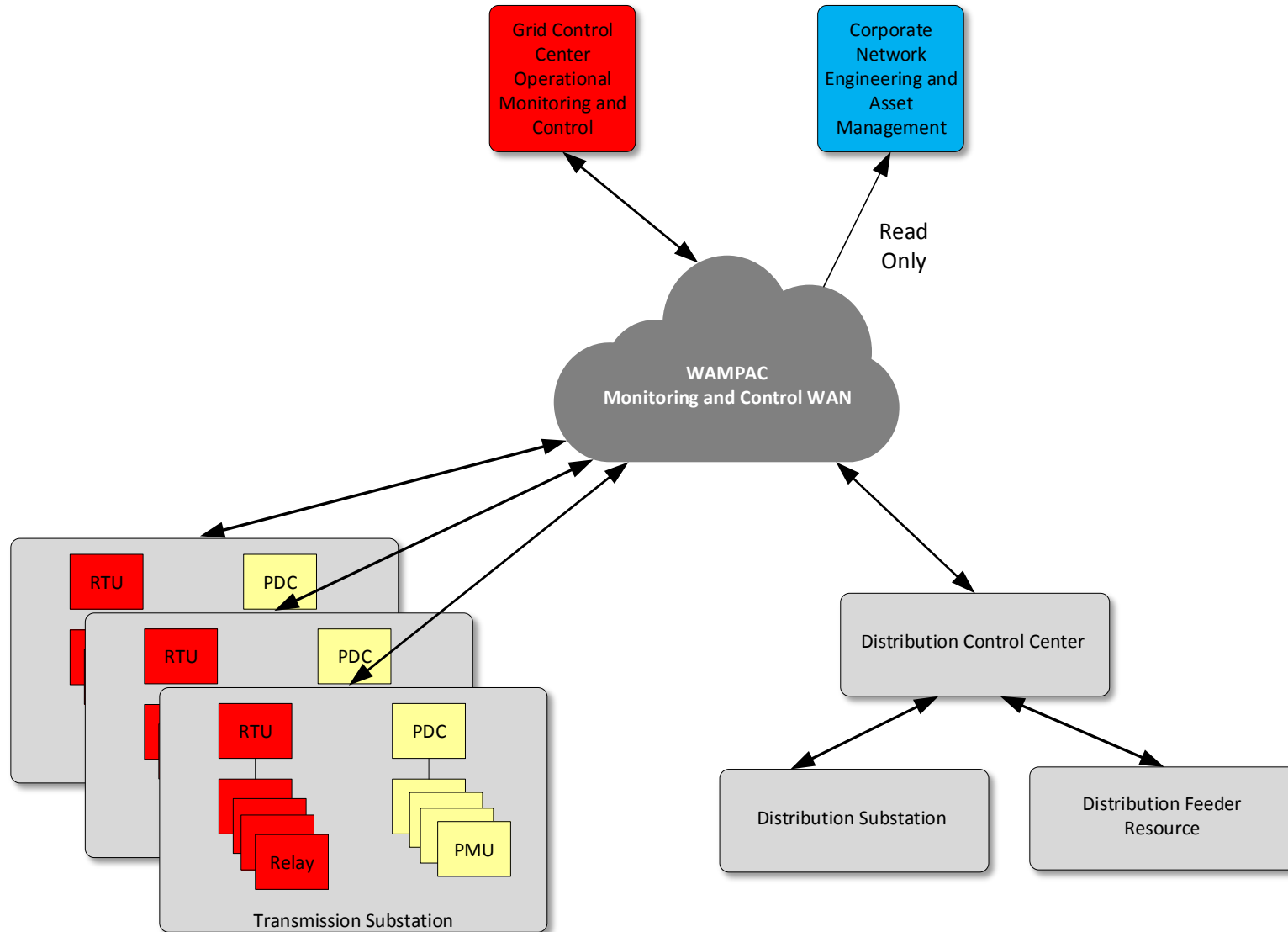
WASA System Architecture



A Sempra Energy utility®



PMU System Architecture

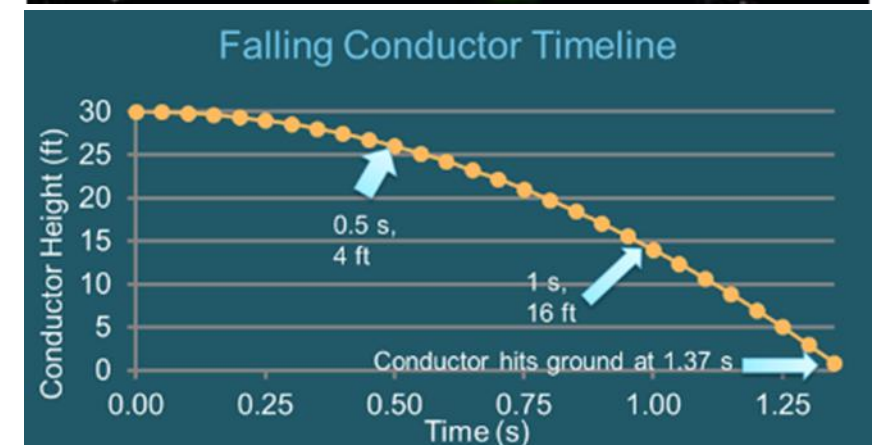


Fire and Hazard Risk Reduction



A Sempra Energy utility®

- Developed and patented FCP for Distribution (DFCP)
 - In service in 2016 and presently in text mode
 - Installations in Fire Risk Mitigation locations and seven circuits transitioned into production in 2019
- Trips failed circuit section in 150-350 ms when broken conductor has fallen only a few feet
- Conductor lands dead – no fault, no arcing, no high-impedance fault detection needed
- Transmission FCP is different from Distribution FCP:
 - Based on current synchrophasor measurement streams
 - Current differential comparison detects open conductors
 - Supplement with voltage phasors and algorithms
 - Uses existing relay/PMU types and TCRI MPLS or legacy SONET communications
 - No Ethernet field radios needed; the largest DFCEP cost



WASA and WAMPAC Functions

System operator situational awareness

- Voltage, current, phase profiles and variations
- Voltage and angular stability warnings
- Normal versus unusual flow patterns

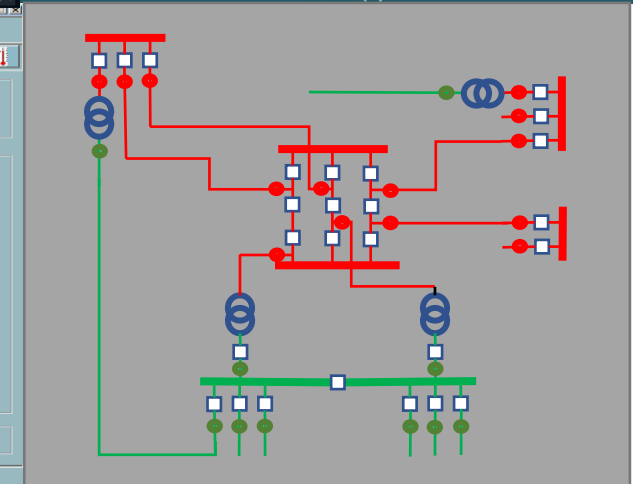
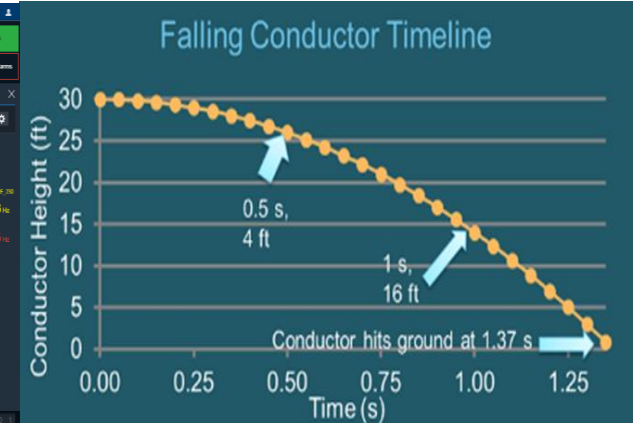
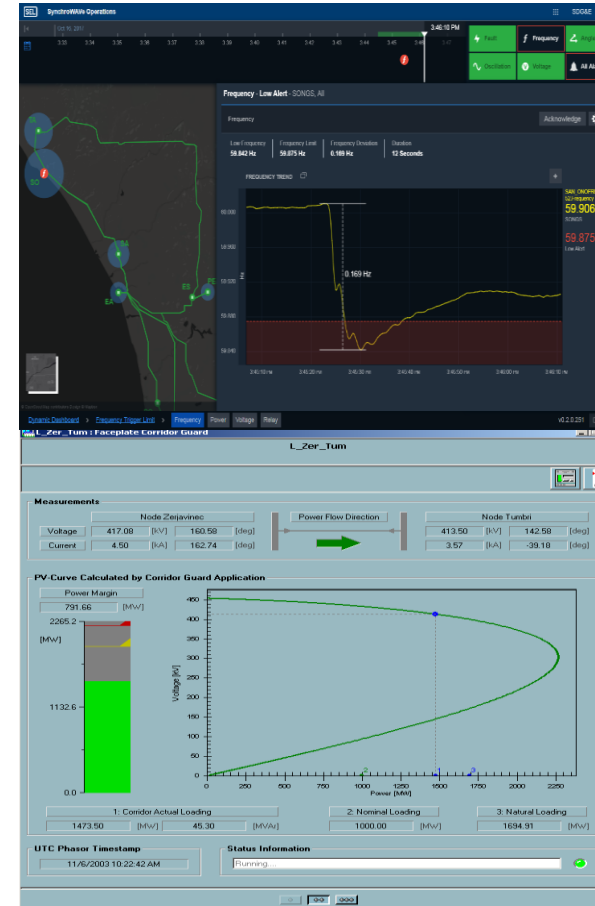


WASA and WAMPAC Functions



A Sempra Energy utility®

- Disturbance monitoring and analysis
- System state and condition monitoring
- Wide-area RAS and SIPS
 - Distribution Falling Conductor Protection
 - Transmission Falling Conductor Protection
- Wide-area Fault and swing protection
- Wide-area voltage stability management
- Wide-area Control



Disturbance monitoring and analysis

- PMU system data storage and presentation for disturbance monitoring per DME requirements of NERC PRC-002-2
- Stable measurements of F and ROCOF included
- High-rate data shows oscillations, swings, event propagation not visible in SCADA data
- Use real system responses to known events to tune models (automated tools coming)

System state and condition monitoring

- Improve conventional state estimation with accurate and redundant measurements
- Holistically assess power apparatus and electrical measurements for state estimation and alarming of failures
- Present actionable diagnostic information for field corrective maintenance of power and measurement apparatus

WASA and WAMPAC Functions

SCADA and EMS support

- WASA has been separate from SCADA and EMS, but...
 - Dense PMU deployments are covering the entire transmission system
 - PMU data at 30-60-120 accurate measurements per second is the vastly better data gathering platform for all SCADA and EMS functions that depended on RTU or data concentrator values every 1-5 seconds
 - We can improve EMS functions and add new functions with phase angles across system and beyond, sequence values, F, ROCOF, redundant and derived backup measurements
 - Some EMS now integrate down-sampled PMU data



Synchronized Measurements in the Utility Control Center at San Diego Gas & Electric

Questions?

Tariq Rahman
trahman@sdge.com

Acknowledgements:

Special Thank You to:

Eric Udren, Quanta Tech for his contribution to this presentation

