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For any questions, comments or concerns, please email
Project Manager Angelique Rajski Parashis at a.rajski@ieee.org

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IEEE Smart Energy

Presented by:
Robby Simpson, PhD, GE Grid Solutions
Mike Bourton, Kitu Co-Founder
Steve Kang, VP Engineering, QualityLogic
James Mater, GM Smart Grid, QualityLogic

7 June 2017

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Welcome from Moderator

Rudi Schubert, IEEE Standards Association (IEEE-SA) – Director – New Initiatives

Director Smart Grid Labs and Principal Consultant, EnerNex
Director – Conformity Assessment, IEEE Industry Standards and Technology Organization (ISTO)
Program Director – Network & Product Integrity, Telcordia Technologies
BS and MS, Stevens Institute of Technology

We will be taking questions at the end of our presentations. Please feel free to chat your questions throughout the webinar and we'll take them in the order they were received.

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Today's Speakers

Robby Simpson, PhD, GE Grid Solutions
System Architect for GE Grid Solutions
Vice Chair of IEEE 2030.5 Working Group
Vice Chair of IEEE-SA CAG
Member of ANSI, IEC, IETF, SEPA (Vice Chair of OpenFMB), and ZigBee Alliance
BS Computer Engineering, Clemson; PhD ECE, Georgia Tech

Mike Bourton, Kitu Co-Founder
More than 25 years of experience in the telecommunications industry
VP and GM for Agilent Technologies – telecom test equipment
VP and GM for Acterna Corporation – test solutions for telecomm and cable
BS in Communication Engineering from Plymouth University, UK

Steve Kang, VP Engineering, QualityLogic
Contributor to CSEP IEEE 2030.5 PICS and Test Specification
Contributor to CSIP IEEE 2030.5 Implementation Guide
Developer of QualityLogic IEEE 2030.5 Test Tools
MS Computer Science from USC and MBA from UCLA

James Mater, GM Smart Grid, QualityLogic
Organizer of OpenADR/EPRI DER Protocol Workshop
Organizer of two IEEE 2030.5 Symposiums
Member GWAC; Past Chair Smart Grid NW
BA Physics Reed College and MBA University of Pennsylvania Wharton School

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Agenda

- **Welcome**
- **Speaker Introductions**
- **IEEE 2030.5 Background/Technical Update**
  - Short history
  - Overview of IEEE 2030.5
  - Standard Update
- **Update on IEEE 2030.5 Adoption**
  - Research projects
  - CA Rule 21
  - Deployments
  - IEEE 1547.1™
  - Test and certification
- **Resources for Implementing IEEE 2030.5 Products**
- **Open Q&A with Audience**
- **End**

IEEE 2030.5 HISTORY

Robby Simpson

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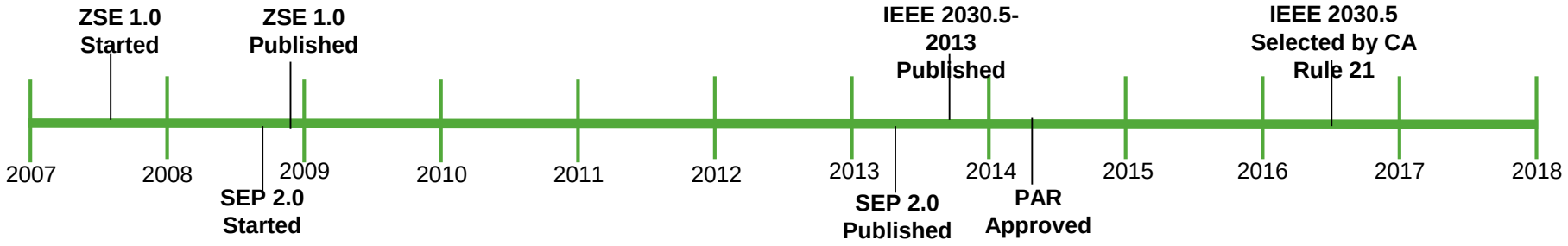
IEEE 2030.5 History

Evolution of ZigBee Smart Energy 1.x

- A widely deployed standard for the Smart Grid HAN
- IEEE 2030.5-2013 incorporates all of the application functionality of ZSE 1.x with several additions (including DER and EV support)
- Robust testing and certification program with a certification mark
- 60+ million meters currently deployed or under contract, from a variety of manufacturers
- ~550 Certified Products
- However, limited to the ZigBee PRO technology (IEEE 802.15.4™ at 2.4 GHz running the ZigBee PRO stack)



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IEEE 2030.5 History

- ZigBee Smart Energy Profile 2 initiated in 2008
  - Requirements defined by utilities
  - Designed to use widely-adopted technologies
- Consortium for SEP 2 Interoperability (CSEP) formed in 2012
  - Founded by HomePlug, Wi-Fi and ZigBee
  - Completed V1.0 PICS and Test Spec in December 2013
- Standard completed and adopted as IEEE 2030.5 in 2013 (IEEE 2030.5-2013)
- Added to SGIP Catalog of Standards in 2013
- First Test Harness approved in February 2015
  - First Conformance tests by UL in 2015
- Selected as the “default protocol” for California Rule 21 in 2016

IEEE 2030.5 OVERVIEW

Steve Kang

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IEEE 2030.5 Design

- Leverages open standards for communication and data formats
- Integrates energy devices into the smart grid based upon demand response events, price signals, and DER requirements
- Transport Layer Agnostic – relies on HTTP/XML
  - TCP/IP based – Wi-Fi®, BlueTooth, Zigbee IP, WiSUN, HomePlug, etc
- Subscription or Polling method determined by end device
- Data compression optional for end devices
- Zero configuration networking – use of mdns
- 7 years test specification and certification tool development

Function Sets

- 5 Mandatory FSs required in all IEEE 2030.5 devices – enables secure message exchanges
  - Certificates (CERT)
  - Device Capabilities (DCAP)
  - Discovery (DNS)
  - Secured HTTP (TLS)
  - Time Synchronization (TM)
- To do anything useful requires additional Function Sets such as
  - DER Program
  - Metering
  - Demand Response Load Control
  - Total of over 30 Function Sets
- Simple operations require numerous function sets to execute

Function Sets and Conformance Tests

Core

Optional

Phase 1 Function Sets	Client Tests	Server Tests
CERT - Certificates	1	1
DCAP - Device Capabilities	0	1
DNS – Discovery	1	3
TLS – Secured HTTP	5	4
TM - Time	2	3
APPS – App Support	1	3
COM – Common Functionality	15	3
DER – DER Information	0	5
DERP – DER Program	3	4
DSGN – Design Pattern	2	8
DRLC – Demand Response	9	4
EDEV – End Device	1	2
FRQ – Flow Reservation Request	4	0
RSPS - Response	1	2
TP – Pricing	4	7
UPT - Metering	0	2
Totals	49	52

Function Sets = Toolsets

EV Charging Reservations

Security

Pricing

Demand Response and Load Control

Time Synchronization

Device Capabilities

Smart Inverter Settings

Why IEEE 2030.5 for DER?

- DER Functionality:
  - Supports the CA Rule 21 SIWG Phase 1 functions
  - Full Metering data support
  - Monitoring/alarms for situational awareness and Measurement/Verification
  - Controls provide support for DER advanced functionality - Autonomous controls and Curves
  - Ability to group and target groups or individual devices based upon the utility network design
- Architecture:
  - RESTful HTTP & use of IP enables interactions with existing technologies & communications (IOT devices, internet/aggregators, routers, etc.)
  - Security: Strong security profile (TLS 1.2, Certificates for authentication, Access control) meets NIST requirements
  - Open standard: –No proprietary advantage- IEEE 2030.5 an open standard
  - DER information model based on 61850 and SunSpec
  - IEEE 2030.5 systems can support many types of programs and classes of customers (Residential, C&I, EV, Storage, Aggregators, Tariffs, DR, M&V, Monitoring, etc.)

IEEE 2030.5 STANDARD UPDATE

Robby Simpson

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IEEE 2030.5 Ongoing Updates

- Maintenance PAR opened in 2014
  - Address feedback from implementation and field experience
  - Address feedback from California Rule 21 needs
  - Address feedback from IEEE 1547 revisions
- Have received 212 comments, addressed all as a group, now editing
- Expected publication 4Q17

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IEEE 2030.5 RESEARCH PROJECTS

James Mater

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US Research Projects

- **“Standard Communication Interface and Certification Test Program for Smart Inverters”** June 2016
  - CA Solar Initiative funded project
  - EPRI, SunSpec, Sandia, UL, Kitu, Fronius, SMA, QualityLogic, SMUD and SCE
  - Demonstrated communicating using SunSpec and IEEE 2030.5 and OpenADR
- **“Certified Open-Source Software to Support the Interconnection Compliance of DER”**, in process
  - CA Energy Commission funded project
  - EPRI, SunSpec, Xanthus, QualityLogic, EnPhase
  - Demonstration of CA Rule 21 CSIP IEEE 2030.5 Requirements
  - Development of IEEE 2030.5 DER Test and Certification Program

US Research Projects

- **"Impact Assessment & Secure Implementation of CA Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration"** in process
  - CEC funded
  - EPRI, SunSpec, UCSD, Sunrun
  - Comprehensive assessment of the California Rule 21 Phase 3 functions.
  - To assess cyber security and to deploy the digital certificate infrastructure needed to support the IEEE 2030.5 requirements identified in Phase 2
- **"VOLLTRON Common Data Model"** in process
  - US DOE Funded as part of Grid Modernization Lab Call
  - SLAC and Kisensum
  - Developing an Open Source DER Management System Using Voltron and IEEE 2030.5
  - Adding IEEE 2030.5 support and Demand Response and DER function sets to Voltron

US Research Projects

- DOE GMLC DER Interconnection and Interoperability Project
  - NREL, PNNL, LBNL, SNL, ANL, ORNL, INL
  - IEEE 2030.5 DER Gap Analysis followed by test procedure development
  - Looking beyond current IEEE 1547 to include controllable loads
  - April 2016 – Mar 2019

Korea Research Projects

- Government funded IEEE 2030.5 Research Projects Conformance Tested Products
  - INSCOBEE IEEE 2030.5 Server for an “Energy Demand Response System for Smart Home”
  - KERI (Korea Electrotechnology Research Institute) IEEE 2030.5 Demand Response Client for an “energy grid response system technology”
  - KETI (Korea Electronics Technology Institute) IEEE 2030.5 Client in a Home Energy Management System
  - Nestfield Co IEEE 2030.5 Server for Demand Response applications
  - TIS Co Smart EMS IEEE 2030.5 Client for a “100kW Demonstration for Economic Dispatch Microgrid PV System” using the IEEE 2030.5 pricing function set
  - WIZnet Co IEEE 2030.5 Demand response Server for an “Energy Demand Response System for Smart Home”
- Development of an Adapter for Conversion of OpenADR messages into IEEE 2030.5 instructions, KERI

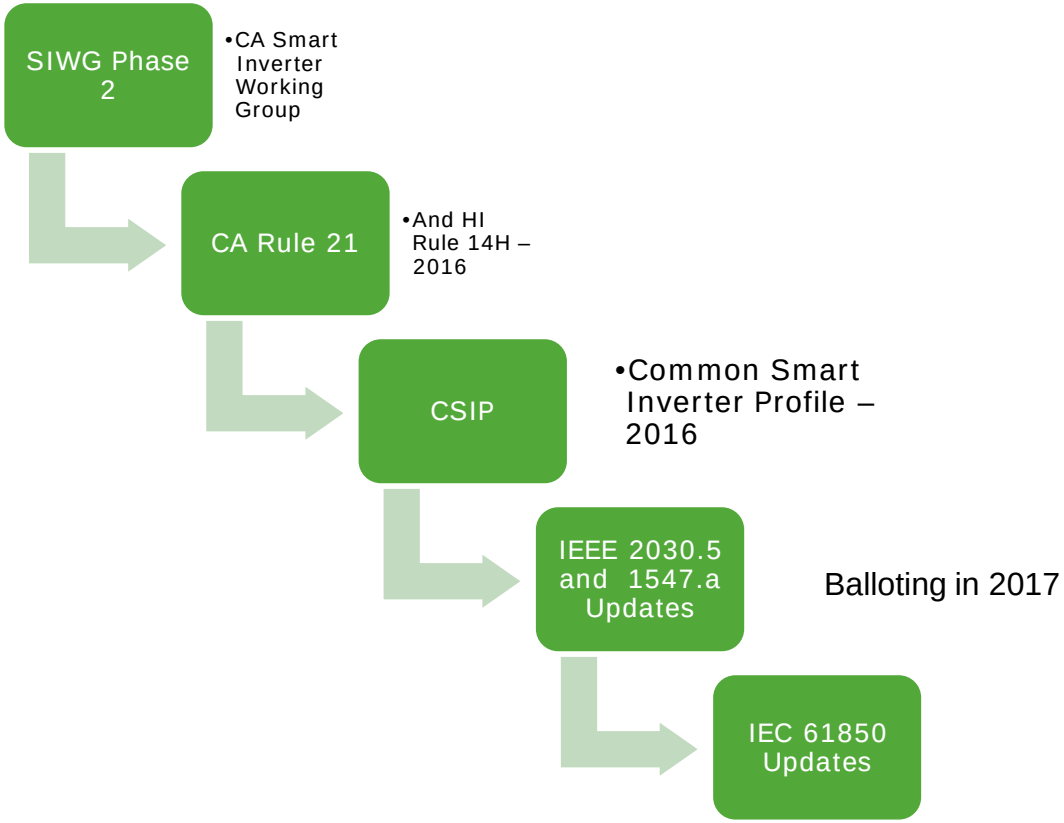
CA RULE 21 UPDATE

Mike Bourton

Background

- Standardizing functionality and communications with smart inverters for all DER
- Phase 2, “Recommendations for Utility Communications with Distributed Energy Resources (DER) Systems with Smart Inverters”, approved June 23, 2016
- Specifies requirements for interconnection including:
  - “The default Application Level protocol shall be the IEEE 2030.5.”
  - Latest utility filings propose that IEEE 2030.5 “…become mandatory for generating facilities utilizing inverter-based technologies…on or after the later of (a) March 1, 2018 or (b) nine months after the release of the SunSpec Alliance communication protocol certification test standard or the release of another industry-recognized communication protocol certification test standard.”

Standardizing Smart Inverter Communications – Phase 2



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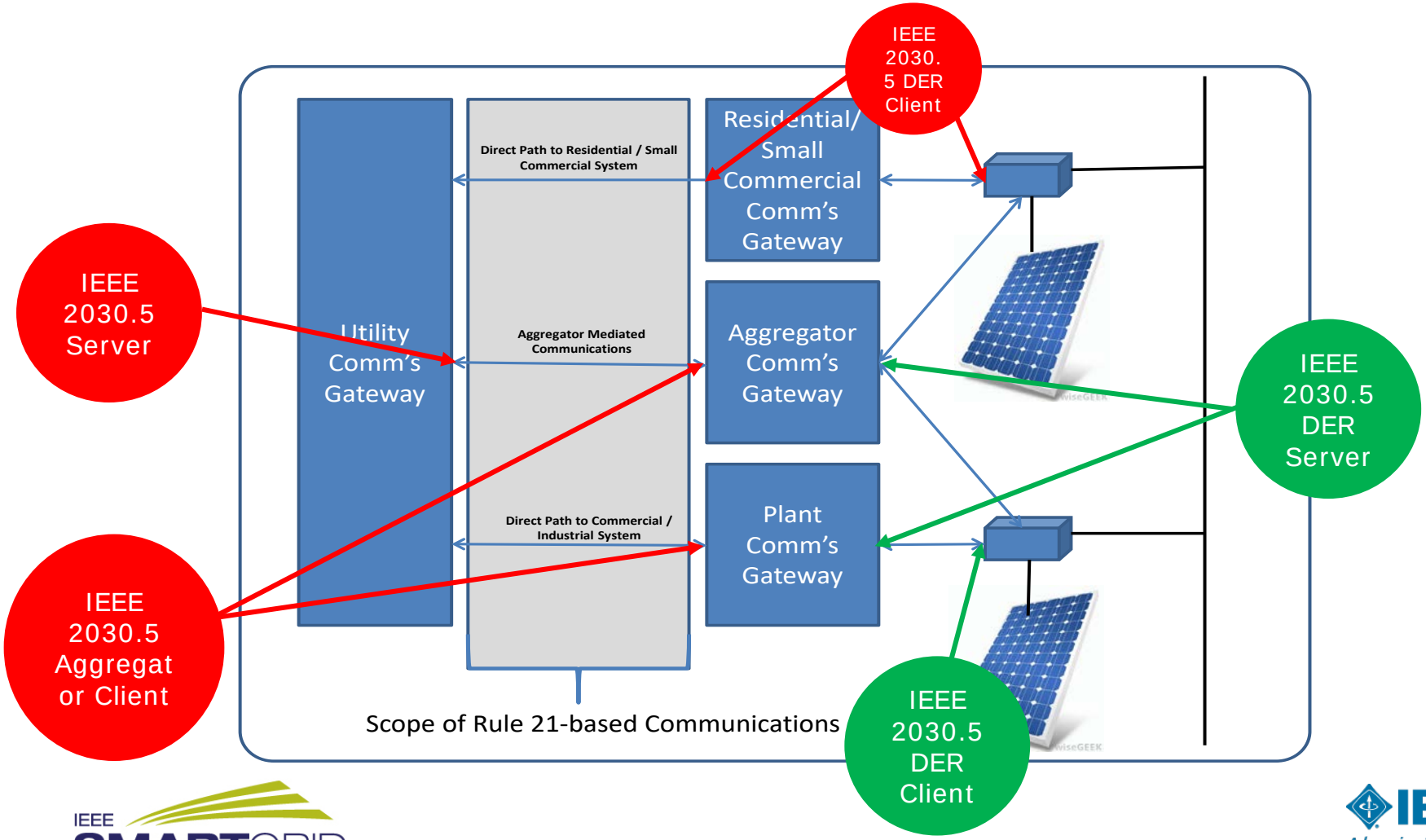
Rule 21 Communications Key Requirements and Principles

- Single default mandatory communications profile.
- All inverter-based DER systems shall be capable of communications.
- Not intended for sub-second interactions and protection.
- The Transport Level protocol shall be TCP/IP.
- The default Application Level protocol shall be the IEEE 2030.5.
- The details of the IEEE 2030.5 profile are defined in the California IEEE 2030.5 Implementation Guide.
- A common test harness and 3rd party certification processes are preferred
- Other Application Level protocols may be used by mutual agreement, including IEEE 1815/DNP3 for SCADA real-time monitoring and control and IEC 61850.

DER Use Cases in CA Rule 21



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IEEE 2030.5 DEPLOYMENTS

Mike Bourton

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Deployments

- Utilities
  - A CA IoU is deploying a test system and is in procurement of an IEEE 2030.5 Production System
  - Field testing with Aggregator planned this year
  - Another CA IoU has field tested with an Aggregator and next steps is a production System
  - Another CA IoU is testing a different deployment method
- Aggregators
  - Several developments under way combined with inverter monitoring
- Smart Inverters (Solar and Battery)
  - Several Manufacturers have completed development and testing with Utilities

IEEE 1547 UPDATE

James Mater

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IEEE 1547-rev201x in Balloting

- Both CA Rule 21 and IEEE 2030.5 will follow IEEE 1547.1™ lead in smart inverter functions
- Draft to ballot May 2017. Approval in 2017 (depending on comments)
  - New standard published in late 2017/early 2018
- New smart inverter functions:
  - Required VAR capacity and capabilities
  - Required ride through of disturbances
  - Revised testing requirements
  - ***Requires support of at least one communications protocol: IEEE 1815 (DNP3), IEEE 2030.5 (SEP2) or SunSpec***
- Next up in 2018-19: IEEE 1547.1 rev to define interoperability and testing requirements

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IEEE 2030.5 TEST AND CERTIFICATION UPDATE

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Certification and Testing

- QualityLogic with UL and TTA provide Conformance Testing of IEEE 2030.5 products today – 9 products tested to date
- CA IOU's Advice Letter for implementing new Rule 21 Communications requirements approved by CPUC 5 April 2017
- CA PUC will require certifications 9-12 months after an industry CA Rule 21 program is available – scheduled for later 2017
- The Wi-SUN Alliance is organizing IEEE 2030.5 certification programs worldwide
  - Wi-SUN Alliance is negotiating security certificates
- The SunSpec Alliance is working on DER 2030.5 certification program (scheduled for Q4 2017)
  - Working with QualityLogic/UL to design/implement the test program

SunSpec CA Rule 21 IEEE 2030.5 Certification Test Standard Plan

Program Element	Description and Notes	Planned Delivery
PICS template	“Protocol Information Conformance Statement” template allowing implementers to declare how products comply to the IEEE 2030.5 standard for DER and CSIP requirements.	Q3 2017
Communication protocol certification test standard draft	First review draft of test procedures sufficient to evaluate and certify DER systems for IEEE 2030.5 compliance.	Q3 2017
Communication protocol certification test standard final	Royalty-free test procedures sufficient to evaluate and certify DER systems for IEEE 2030.5 compliance. Starts clock for CA Rule 21 Phase 2.	Q4 2017

IEEE 2030.5 RESOURCES FOR IMPLEMENTERS

Rudi Schubert

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Further Information on IEEE 2030.5

- Learn about working group participation
  - https://standards.ieee.org/develop/wg/SEP2.html
- Obtaining the IEEE 2030.5 standard
  - http://www.techstreet.com/ieee/standards/ieee-2030-5-2013?gateway_code=ieee&vendor_id=5666&product_id=1860492
- Educational webinar – Robby Simpson for IEEE Smart Grid
  - http://resourcecenter.smartgrid.ieee.org/sg/product/education/SGWEB0043
- Presentations from IEEE-SA 2016 Symposium on IEEE 2030.5
  - http://standards.ieee.org/events/2030_5/presentations.html

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