

IEEE 1547 Standard & Conformity Assessment

Ravi Subramaniam

Conformity Assessment Program Director

April 28th, 2015

Global Reach

426,000+
Members



160+
Countries



1,600+
Annual Conferences



Technical Breadth

39 Technical Societies
6 Technical Councils



3,500,000
Technical Documents



180+
Top-cited Periodicals



- Aerospace and Electronic Systems
- Antennas and Propagation
- Biometrics Council
- Broadcast Technology
- Circuits and Systems
- Communications
- Components, Packaging, and Manufacturing Technology
- Computational Intelligence
- Computer
- Consumer Electronics
- Control Systems
- Council on Electronic Design Automation
- Council on Superconductivity
- Dielectrics and Electrical Insulation

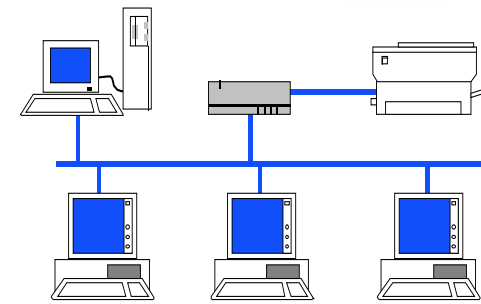
- Education
- Electron Devices
- Electromagnetic Compatibility
- Engineering in Medicine and Biology
- Geoscience and Remote Sensing
- Industrial Electronics
- Industry Applications
- Information Theory
- Instrumentation and Measurement
- Intelligent Transportation Systems
- Magnetics
- Microwave Theory and Techniques
- Nanotechnology Council
- Nuclear and Plasma Sciences
- Oceanic Engineering
- Photonics

- Power Electronics
- Power & Energy
- Product Safety Engineering
- Professional Communications
- Reliability
- Robotics and Automation
- Sensors Council
- Signal Processing
- Social Implications of Technology
- Solid-State Circuits
- Systems, Man, and Cybernetics
- Systems Council
- Technology and Engineering Management
- Ultrasonics, Ferroelectrics, and Frequency Control
- Vehicular Technology

Standards

Some Areas Covered

- Interoperability
- Networking and Communications
(including the home)
- Cyber Security
- Substations Automation
- Distribution Automation
- Renewables
- AMI
- Power Quality and Energy Efficiency
- Electric Vehicles



Complete Business Lifecycle



IEEE-SA provides industry a framework of solutions to ensure rapid introduction of new technologies to market

Enabling Consumer Connectivity Through Consensus Building

Smart Grid into Home
Devices Standards
IEEE 1675 / IEEE 1775
IEEE 2030 / IEEE P2030.1
IEEE 1901 / IEEE P1901.2

Home Networking Standards
IEEE 802
IEEE 1901
IEEE P1901.2
IEEE 1815

Smart Metering
Standards
IEEE P1377
IEEE 1701
IEEE 1702
IEEE P1703
IEEE P1704
IEEE P1705

Smart Grid into
Home Devices Standards
IEEE 1547 Series
(Distributed Energy Interconnection
Solar, Wind, Storage, etc.)
IEEE 2030

Home Networking Standards
IEEE 802 / IEEE 1901
IEEE P1901.2 / IEEE P1905.1
(Communication Inside
the Home)

Electric Vehicle Standards
IEEE 802 Series / IEEE 1901
IEEE P1901.2 / IEEE 1609 Series
(Vehicular Communications)
IEEE 2030 / IEEE P2030.1

IEEE 1547 Standards for Integration of Distributed Energy Resources (DER)

SCC21 Chair and P1547 Chair: Thomas (Tom) Basso*

*National Renewable Energy Laboratory

Distributed Energy Resources Interconnection

Distributed Energy Resources



Fuel Cell



PV



Microturbine



Wind



Energy Storage



PHEV;
V2G



Generator

Interconnection Technologies



Inverter



Switchgear,
Relays, &
Controls

Functions

- Power Conversion
- Power Conditioning
- Power Quality
- Protection
- DER and Load Control
- Ancillary Services
- Communications
- Metering

Electric Power Systems



Utility System



Microgrids

Loads

Local Load Simulators



Interconnection & Interoperability Standards

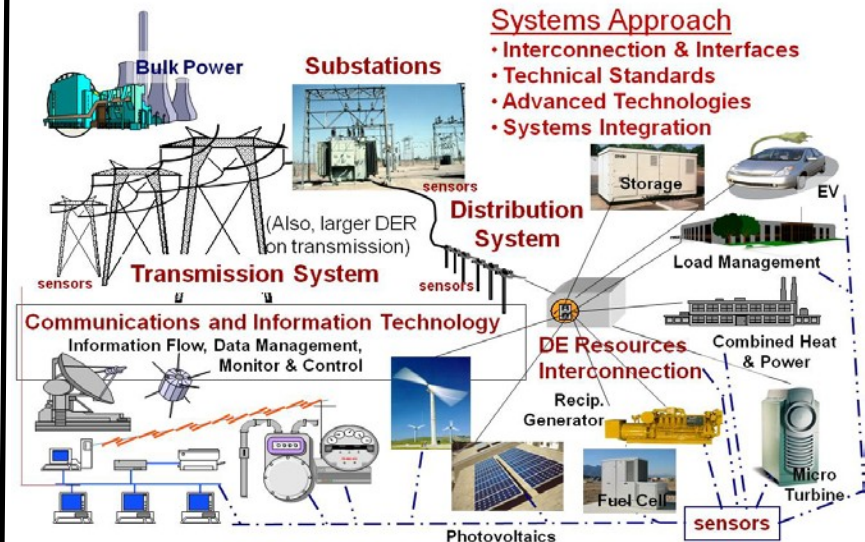
(NREL Work funded by U.S. DOE)

Objective

Facilitate evolution of the electric power system infrastructure to a smarter grid including integration of renewable energy resources by supporting the development of standards and best practices.

Approach

Provide leadership to accelerate distributed energy resources (DER) interconnection, interoperability, and integration standards and validation. E.g., IEEE SCC21 1547 & 2030 standards, the NEC, and UL 1741,



For background see www.nrel.gov ;
Technical report: NREL/5D00-63157;
Standards for DER -- IEEE 1547
(Interconnection) and IEEE 2030
(Interoperability); Basso, T.;

Nov. 2014

IEEE Std 1547™(2003 and 2014 Amendment 1) Standard for Interconnecting Distributed Resources with Electric Power Systems

IEEE SCC21 1547 Series of Standards

IEEE Std P1547™(full revision) Draft **Standard** for Interconnection and **Interoperability** of Distributed **Energy** Resources with **Associated** Electric Power Systems **Interfaces**

IEEE Std 1547.1™(2005 and 2015 Amendment 1) Standard for Conformance Tests Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

IEEE Std P1547.1 (full revision) Draft **Standard** for Conformance Tests Procedures for Equipment Interconnecting Distributed **Energy** Resources with Electric Power Systems **and Associated Interfaces**

Note:

IEEE Std 2030.2
was published
Jun 2015

IEEE Std 1547.2™(2008) Application Guide for IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

IEEE Std 1547.3™(2007) Guide for Monitoring Information Exchange, and Control of Distributed Resources with Electric Power Systems

IEEE Std 1547.4™(2011) Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power Systems

IEEE Std 1547.6™(2011) Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks

IEEE Std 1547.7™ (2013) Guide to Conducting Distribution Impact Studies for Distributed Resource Interconnection

IEEE Std P1547.8™ Draft Recommended Practice for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE Std 1547-2003

MicroGrid >>

Two-Levels SG System Architecture

1547™-2003


IEEE Standards

1547™

IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems

Standards Coordinating Committee 21

Sponsored by the
Standards Coordinating Committee 21 on
Fuel Cells, Photovoltaics, Dispersed Generation, and Energy Storage

 **IEEE**

Published by
The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

28 July 2003

Print: SH95144
PDF: SS95144

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4.0 Interconnection Technical Specifications and Requirements:

- . General Requirements
- . Response to Area EPS Abnormal Conditions
- . Power Quality
- . Islanding

5.0 Test Specifications and Requirements:

- . Type Test/Safety Listing
- . Production Tests
- . **Commissioning Tests**
- . **Periodic Interconnection Tests**

IEEE Std 1547a – Amendment 1, May 2014

(Amendment 1: revisions to 4.1.1, 4.2.3, and 4.2.4)

4.1.1 Voltage Regulation

... DER allowed to change its output of active and reactive power.

3. *(Response to abnormal grid ...)* Voltage

.... DER allowed to “ride through” abnormalities of grid voltage;

... grid and DER operators can mutually agree to other voltage trip and clearing time settings

4. *(Response to abnormal grid ...)* Frequency

... DER allowed to provide modulated power output as a function of frequency

... ... grid and DER operators can mutually agree to other frequency trip and clearing time settings

IEEE1547.1 CASC Key Focus

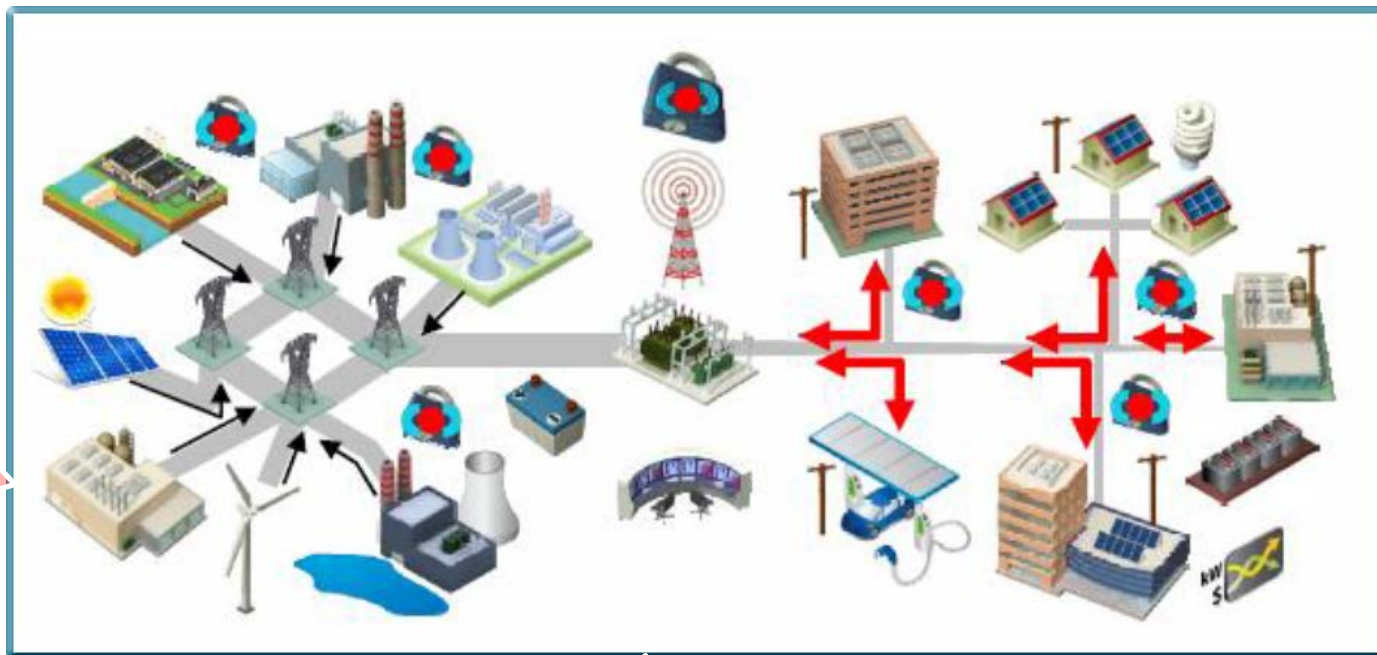
The following constitute the key goals and activity focus of the 1547.1 CASC:

- Converge on program structure (methods, sequence, documentation) for the certification of DER for safe and controlled interconnection with the Area EPS.
- Act as advisors on test methods and interpretation of standards,
- Define the Test Lab requirements and audit processes,
- Test Tool Validation, Validate Test Report template,
- Determine and stimulate demand drivers that will rapidly mature the commercial processes, Communicate and collaborate with industry.
- Leverage and harmonize with other industry standards for DER integration initiatives, e.g. IEEE 2030, SAE2847, UL1741, SGIP PAP24, IEC61850, etc.

IEEE 1547.1 CASC Consortium Logic

"How Do We Align Mutual Interests?"

OEM Providers Utility Industry
(Wholesale, Retail) Gov't Policy/Regulation



Test Labs

University R&D



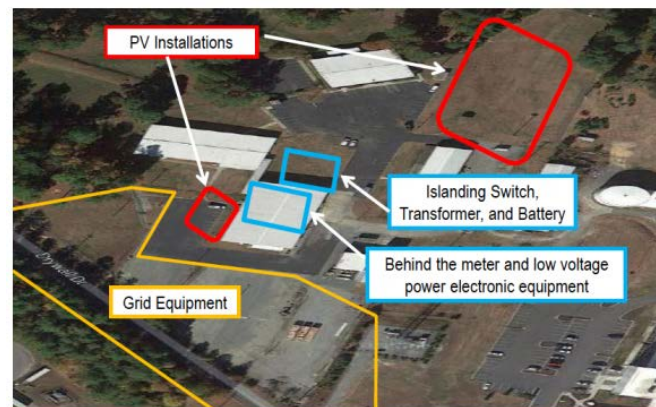
Adobe Acrobat
Document

IEEE 1547.1 CASCADE

- IEEE-SA is developing and implementing the Conformity Assessment program for its sponsored **IEEE 1547** Standard, providing certification of applicable Distributed Energy Resource (DER) designs and implementations that utilize Point of Common Coupling (PCC) interconnection to the local utility's electric distribution system
- The standard applies to those DER subsystems that are normally connected to the utility electric distribution system and may be decoupled (i.e. islanded) or otherwise managed as energy resources behind a micro grid.
- This IEEE 1547 standard development initiative is utilizing a **Conformity Assessment Steering Committee – Accelerated Deployment Effort (CASCADE)** with the purpose of enabling more effective translation of evolving standards requirements into actionable test methods, which will reduce industry uncertainty and raise adoption of DER.

IEEE 1547.1 CASCADE Pilot: Raleigh NC

"How Do Pursue Agile Conformity Testing?"



Duke's long-range hopes for this grand experiment in multi-vendor interoperability are twofold, he said. "The first goal is to promote interoperability between devices. The second is for Duke to find out if we can potentially offer microgrid services in the future."

1547.1 CASCADE Prototype Readiness:

System Setup

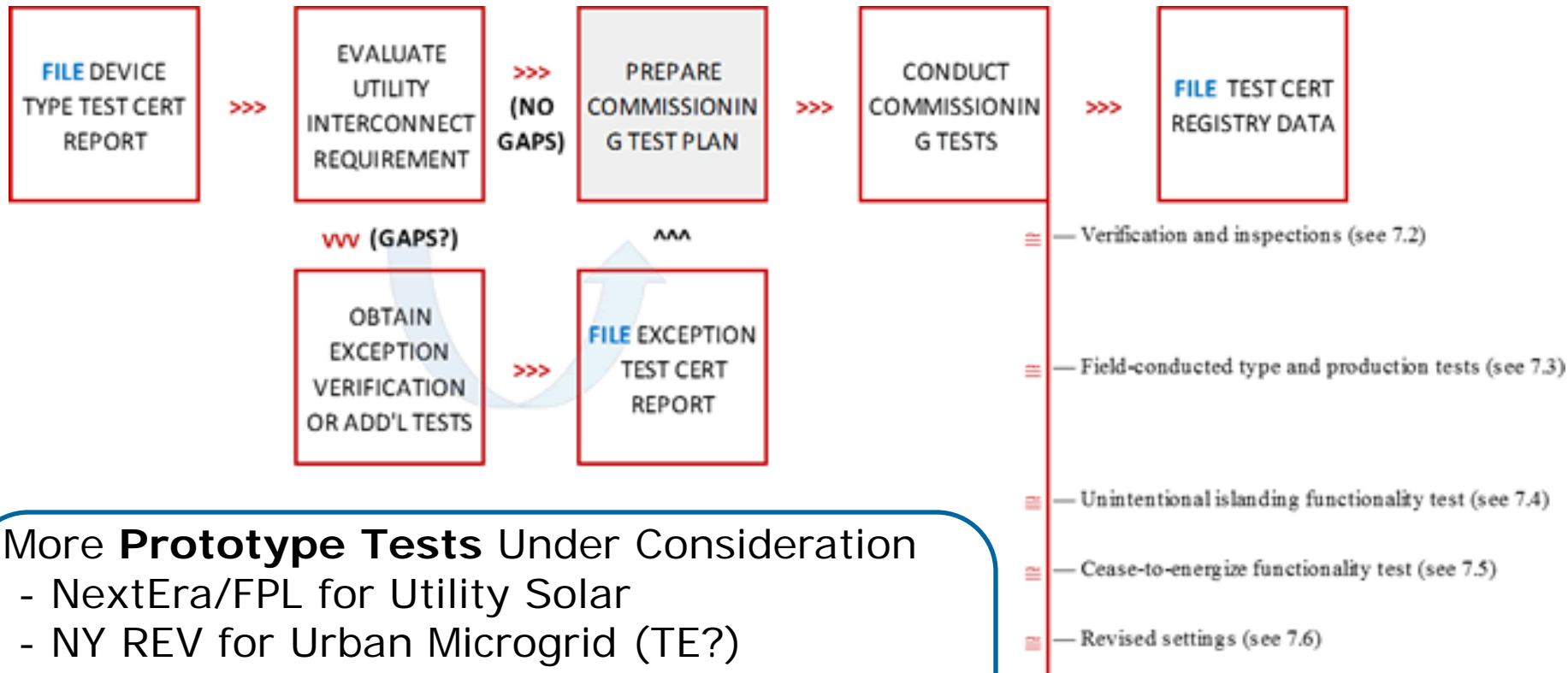
- ✓ Agreements Signed
- ✓ Inverters Selected
- ✓ Inverters Installed
- ✓ Software Installed
- Circuits and Sensors Activated

Test Plan

- ✓ 1547.1 Document Distributed
- ✓ Pilot Scenarios defined
- ✓ Test Plan compiled
- Testing scheduled
- ✓ Witness Engineer Resource
- Reporting format established

CASCADE Prototypes seeks to align synergistic partners from the Utility, OEM, Academic and Testing communities to build facilities which will allow execution of developing test protocols that can verify conformance to substantial portions of the IEEE1547 standard.

IEEE 1547.1 CASCADE Test Plan



More **Prototype Tests** Under Consideration

- NextEra/FPL for Utility Solar
- NY REV for Urban Microgrid (TE?)
- PGE for Transactive Energy
- DC ??
- International? (Korea, India, EU...)

Emerging “App”: Transactive Energy

<http://www.nist.gov/smartgrid/techallenge.cfm>

The screenshot shows the NIST SmartGrid website. The header includes the NIST logo and navigation links: NIST Time, NIST Home, About NIST, Contact Us, and A-Z Site Index. A search bar is also present. Below the header, there's a section for 'SmartGrid' with links to About Smart Grid, Publications, Topic/Subject Areas, News/Multimedia, and Programs and Projects. The main content area is titled 'NIST Transactive Energy Modeling and Simulation Challenge for the Smart Grid'. It describes the challenge as a system of economic and control mechanisms that allows the dynamic balance of supply and demand across the entire electrical infrastructure using value as a key operational parameter. The challenge aims to bring researchers and companies with simulation tools together with utilities, developers, and other grid stakeholders to create and demonstrate modeling and simulation while applying TE approaches to real grid problems. The products of the challenge will help better understand the potential for TE and create a path for real-world trial implementations. The challenge was initiated by the National Institute of Standards and Technology in collaboration with federal partners and industry. It formally started with a September 10-11, 2015 Kickoff event. There will then be an Interim Coordination and Team Building Meeting in December, 2015 to encourage team progress and build new teams, and then Summits in Spring and Fall of 2016. The Summits will allow teams to present their work and success.

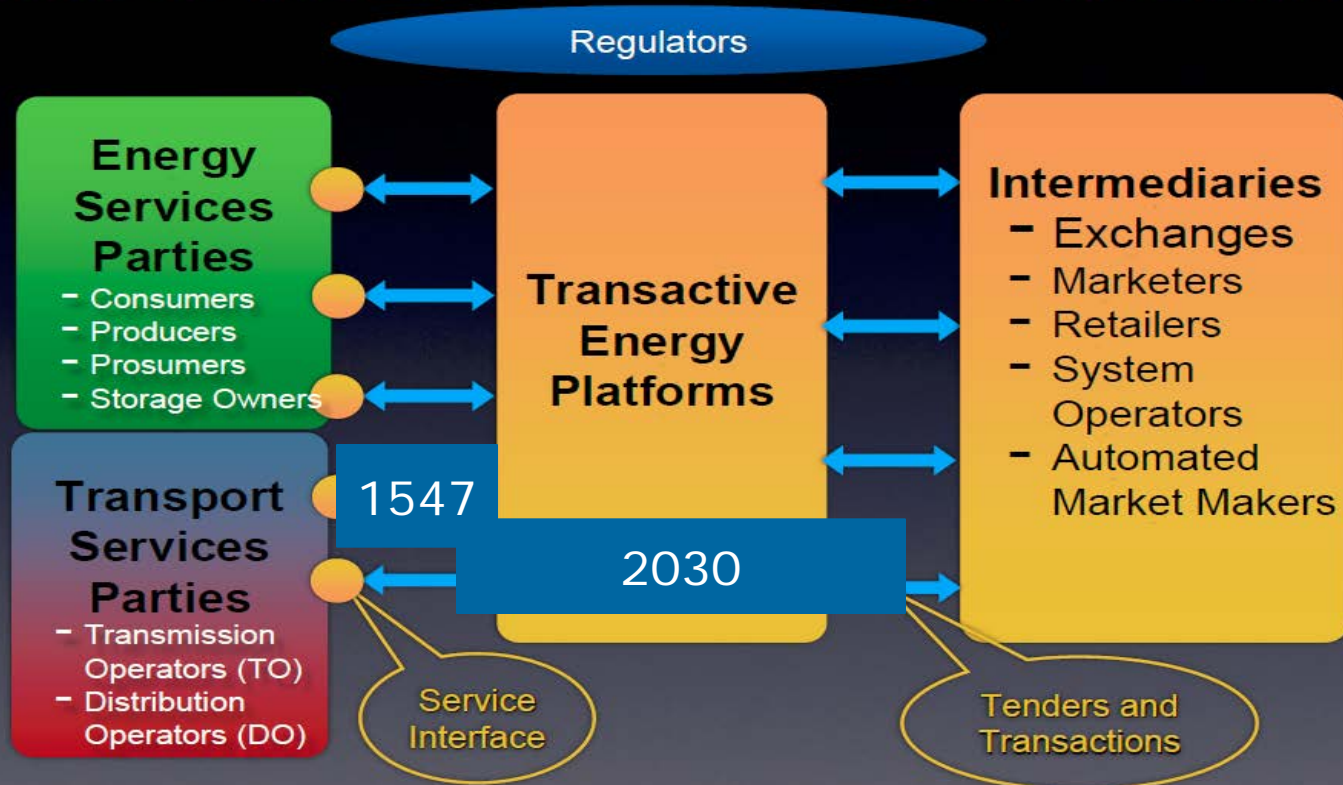
On the right side of the page, there are social media sharing options (SHARE, Facebook, Twitter, Email) and a language selection dropdown menu. Below the main content, there are two blue boxes with the text 'Apps' and '2030'.

On the left side of the page, there is a sidebar with the following sections:

- Of Interest**
 - NIST and the Smart Grid
 - Research at NIST
 - Smart Grid Interoperability Panel (SGIP)
 - International Coordination
 - Smart Grid Advisory Committee
 - NIST Smart Grid Collaboration Wiki
 - Green Button Initiative
 - Call for Participation
- Related Links**
 - Simulation Challenge for the Smart Grid (TE) Kick-Off
 - FAQ/ Latest Information
 - Modeling and simulation Tool Chest

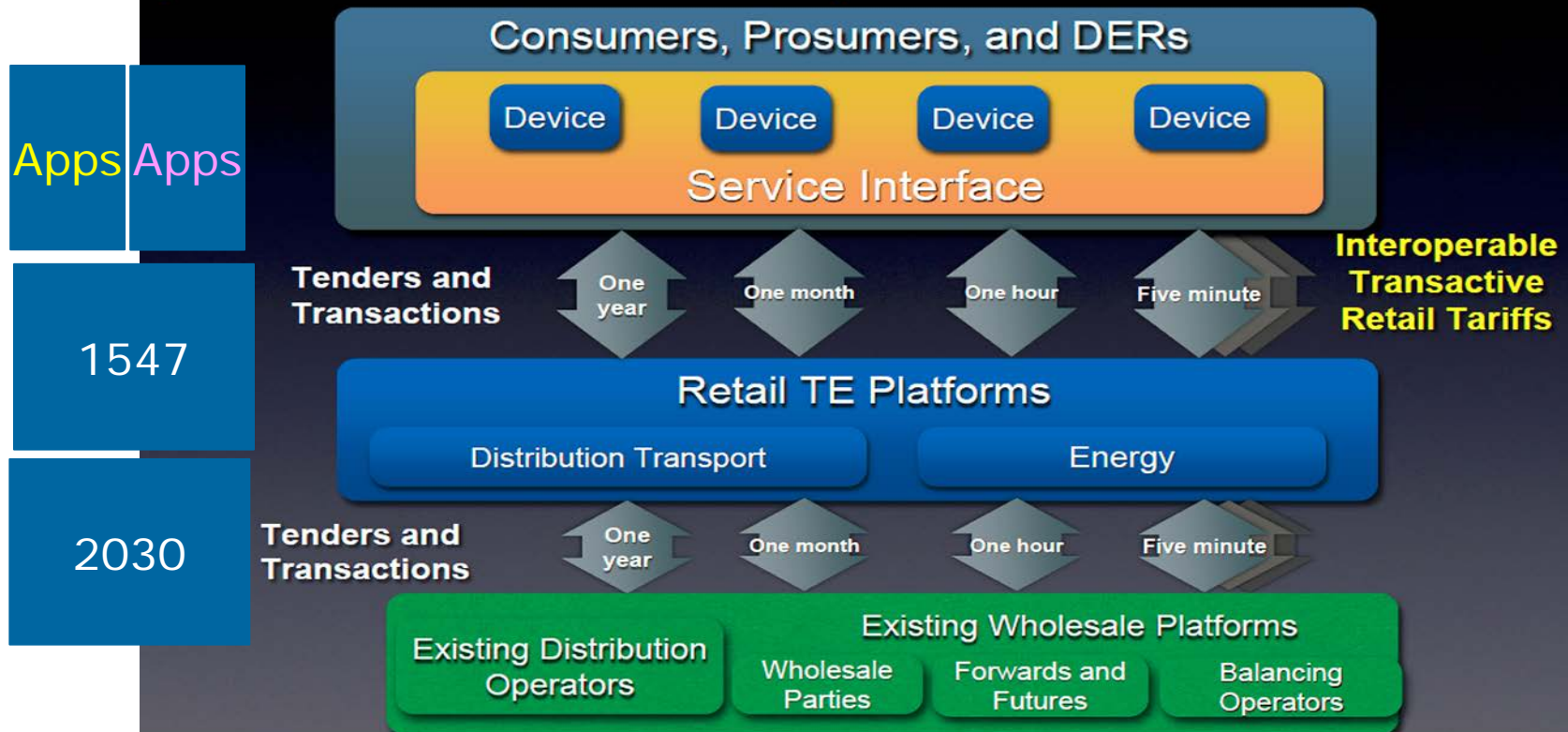
Design Concept: Transactive Energy

Vision: The “grid of people” who manage the “grid of things”



Implementation: Transactive Energy

Retail platforms and tariffs work with current wholesale platforms and distribution operators.



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Thank You!

IEEE Standards Association

<http://standards.ieee.org/>

w.ash@ieee.org

Bill handles all of the Smart
Grid related standards
development initiatives

r.subramaniam@ieee.org

Ravi handles the Conformity
Assessment certification process
for applicable IEEE standards