
NIST Briefing on Smart Grid Standards Harmonization

Opportunities for International Collaboration

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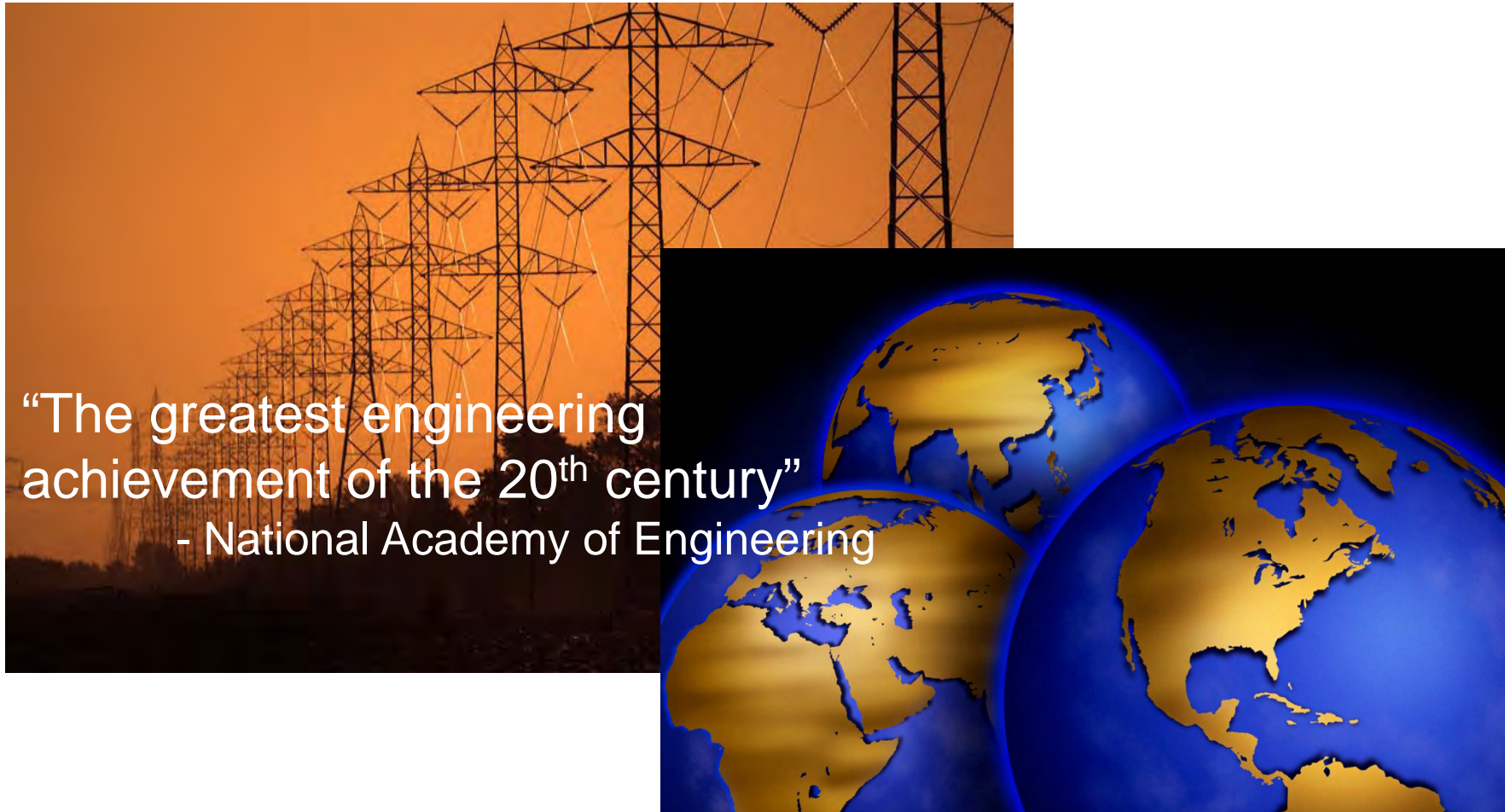


Outline

- Drivers for Smart Grid Interoperability Standards
 - U.S. Government Agencies and Roles
- NIST's Three Phase Plan
- Smart Grid Framework and Conceptual Model
- Smart Grid Stakeholders
 - Smart Grid Interoperability Panel
- Priority Action Plans
- International Coordination and Engagement
- Testing and Certification
- Open Discussion

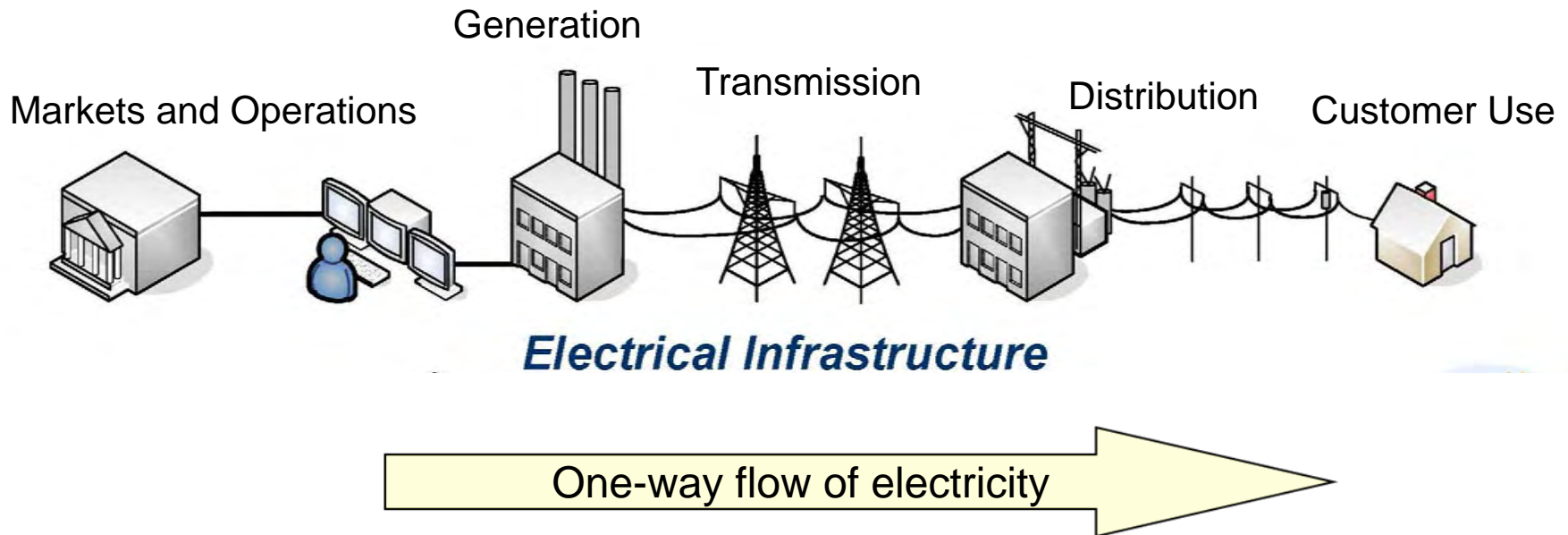
The Electric Grid

One of the largest, most complex infrastructures ever built



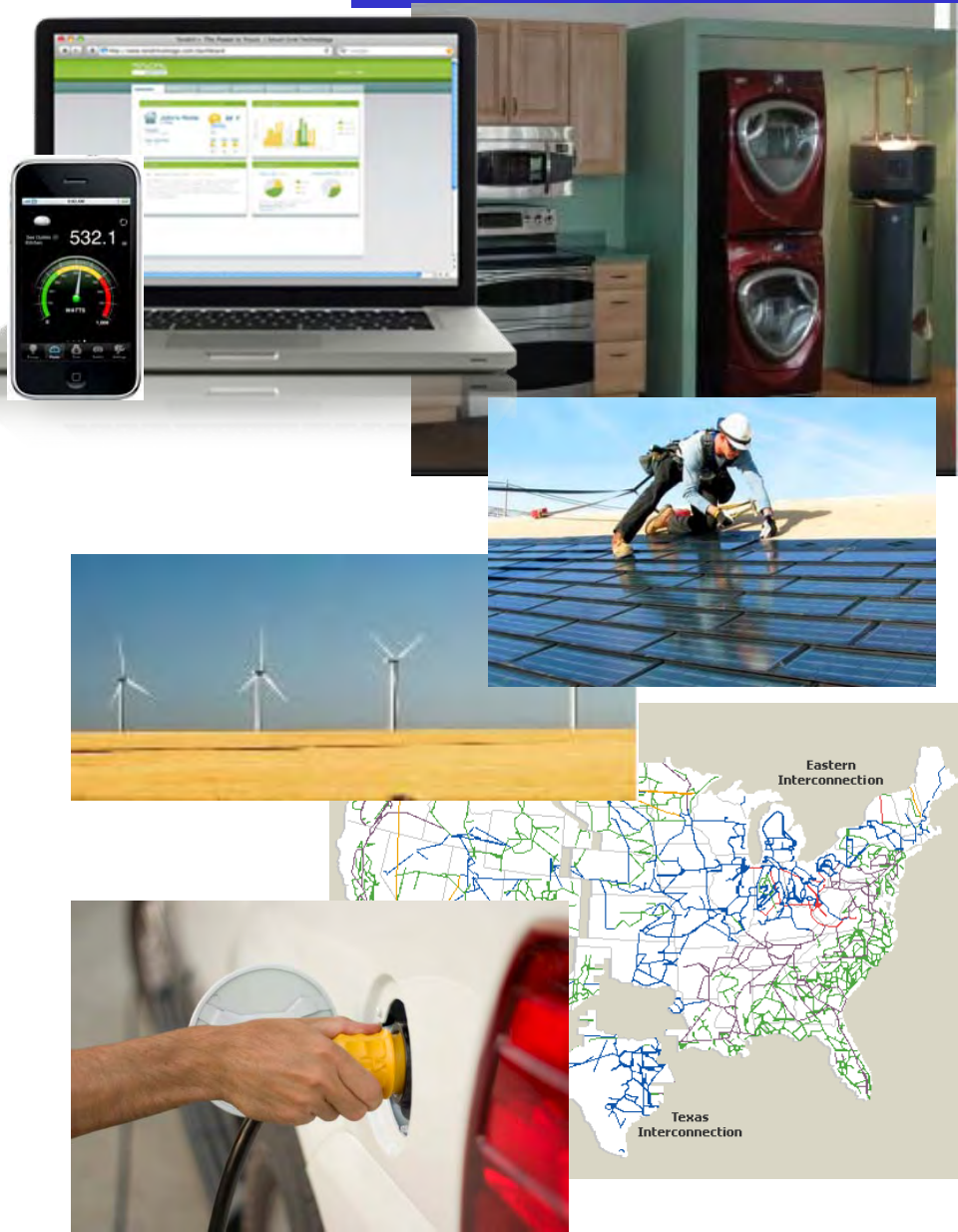
“The greatest engineering achievement of the 20th century”
- National Academy of Engineering

Today's Electric Grid



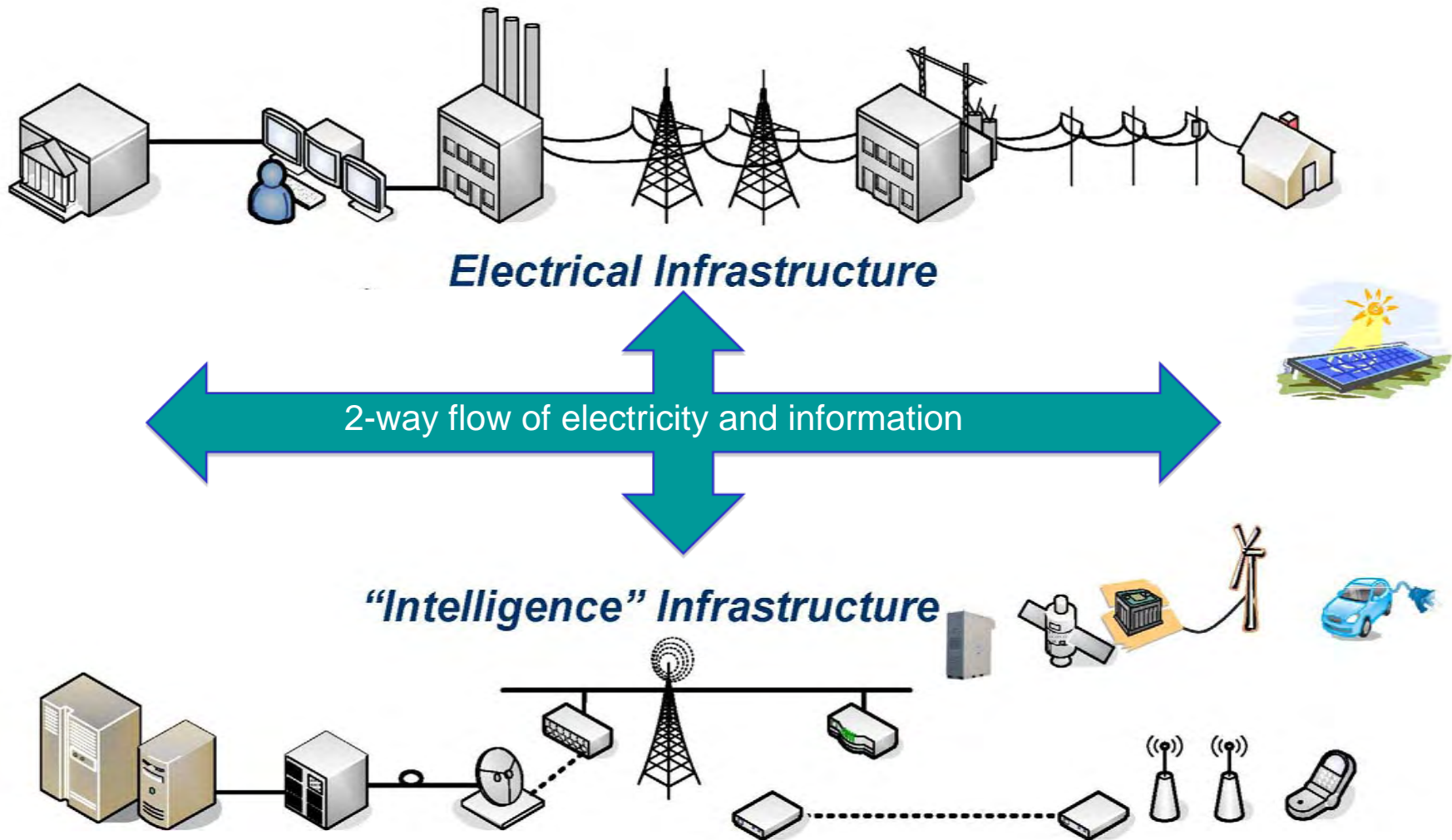
- *Centralized, bulk generation, mainly coal and natural gas*
- *Responsible for 40% of human-caused CO₂ production*
- *Controllable generation and predictable loads*
- *Limited automation and situational awareness*
- *Lots of customized proprietary systems*
- *Lack of customer-side data to manage and reduce energy use*

Smart Grid Goals



- Enable consumers to manage and reduce energy use
- Increase use of renewable sources
- Improve reliability and security
- Facilitate infrastructure for electric vehicles

Smart Grid: The “Energy Internet”



Standards Provide a Critical Foundation

What Will the Smart Grid Look Like?

- High use of renewables – some jurisdictions as high as 35% by 2020
- Distributed generation and microgrids
- Bidirectional metering – selling local power into the grid
- Distributed storage
- Smart meters that provide near-real time usage data
- Time of use and dynamic pricing
- Ubiquitous smart appliances communicating with the grid
- Energy management systems in homes as well as commercial and industrial facilities linked to the grid
- Growing use of plug-in electric vehicles
- Networked sensors and automated controls throughout the grid

Smart Grid – A National Priority

- “We’ll fund a better, smarter electricity grid and train workers to build it...” President Obama
- “To meet the energy challenge and create a 21st century energy economy, we need a 21st century electric grid...”
Secretary of Energy Steven Chu
- “A smart electricity grid will revolutionize the way we use energy, but we need standards ...”
Secretary of Commerce Gary Locke

Smart Grid Enables:

- Higher Penetration of Renewables
- Smart Charging of Electric Vehicles
- Consumers to Control Energy Bills
- Efficient Grid Operations & Reduced Losses
- Reduced Distribution Outages
- Improved System Reliability & Security



US Government Roles in Smart Grid

Federal



Office of Science & Technology
Policy; National Economic Council;
& Council on Environmental Quality



Smart Grid Task Force /
National Science &
Technology Council
Smart Grid
Subcommittee

Other Federal
Agencies (ITA, ...)

NIST
National Institute of
Standards and Technology
U.S. Department of Commerce



Federal
Energy
Regulatory
Commission



State

FERC – NARUC
Smart Response Collaborative

Public Utility Commissions

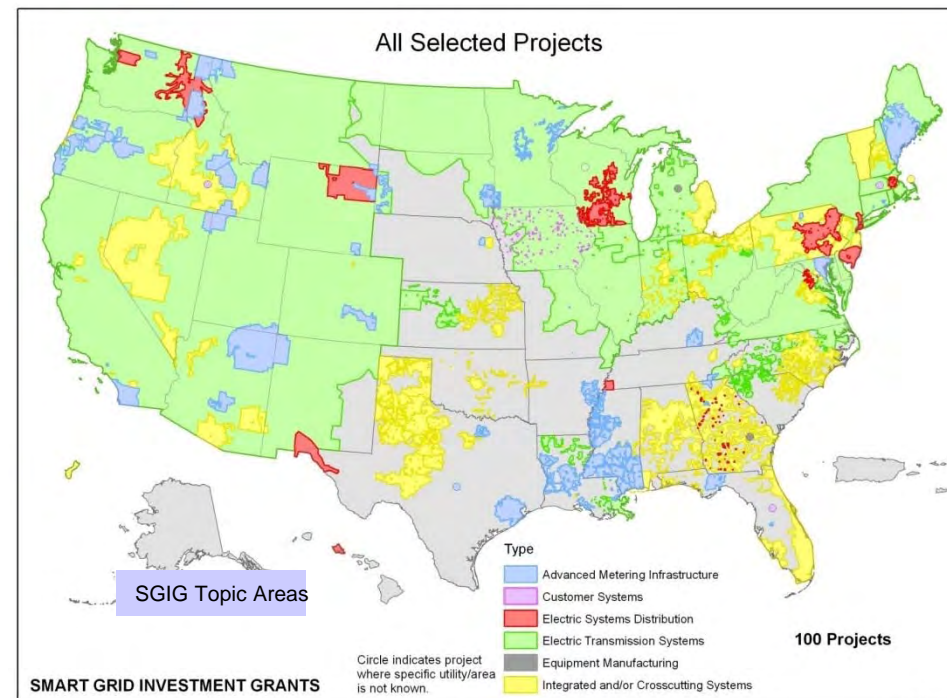


US Smart Grid Investment Grants

Category	\$ Million
Integrated/Crosscutting	2,150
AMI	818
Distribution	254
Transmission	148
Customer Systems	32
Manufacturing	26
Total	3,429

18 million smart meters
1.2 million in-home display units
206,000 smart transformers
177,000 load control devices
170,000 smart thermostats
877 networked phasor measurement units
671 automated substations
100 PEV charging stations

Geographic Coverage of Selected Projects



Oct 21, 2009

NIST Role: Coordination of Interoperability Standards

- Under Title XIII, Section 1305 of the Energy Independence and Security Act (EISA), NIST has
 - “primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems...”*
- Input to Federal Energy Regulatory Commission (and State Public Utility Commissions)
 - “...after [NIST]’s work has led to sufficient consensus in [FERC]’s judgment, [FERC] shall institute a rulemaking proceeding to adopt such standards and protocols...”*
- Use of these standards is a criteria for Department of Energy Smart Grid Investment Grants

Benefits of Interoperability Standards

- Make it easy for consumers to use smart devices regardless of location & provider
- Protect privacy while enabling consumers to securely access information on their own energy consumption
- Prevent premature obsolescence, facilitate future upgrades, & ensure systems can be scaled up for larger deployments
- Provide for backward compatibility, integrating new investments with existing equipment
- Expand product markets & promote vendor competition: reducing costs, accelerating innovation, & increasing choice
- Ensure the security & enhance the reliability of the power grid

NIST Three Phase Plan

PHASE 1

Identify an initial set of existing consensus standards and develop a roadmap to fill gaps

PHASE 2

Establish public/private Interoperability Panel to provide ongoing recommendations for new/revised standards

PHASE 3

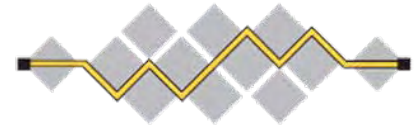
Testing and Certification Framework

March 2009 September 2010



Standards Come from Many Developers

International



I E T F[®]



SAE *International*[™]

Global
Consortia



OGC[®]
Open Geospatial Consortium, Inc.

OASIS 

Regional and
National



NEMA

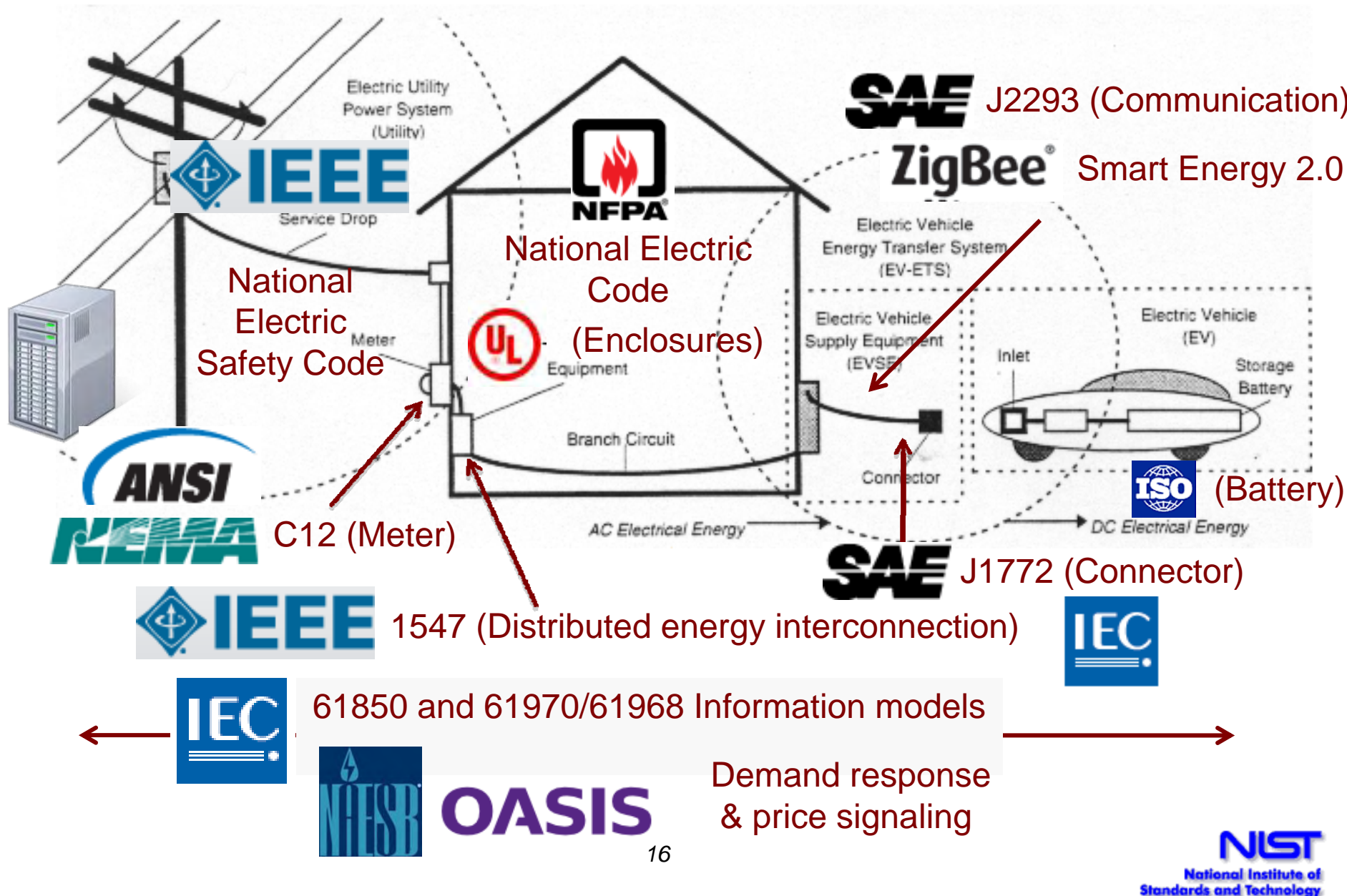
NIST
National Institute of
Standards and Technology

Priorities for Standardization

- Demand Response and Consumer Energy Efficiency
- Wide Area Situational Awareness
- Electric Storage
- Electric Transportation
- Advanced Metering Infrastructure
- Distribution Grid Management
- Cyber Security
- Network Communications



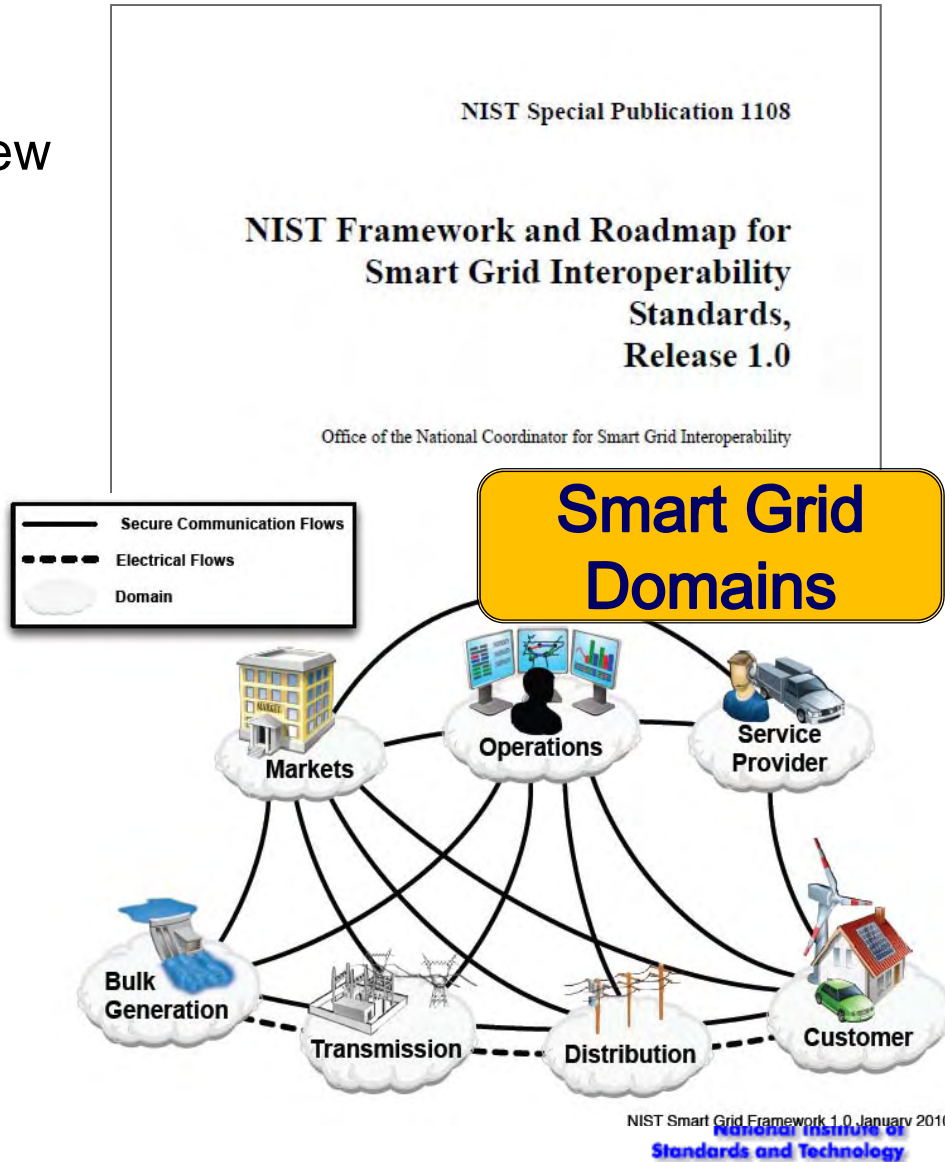
Example: Electric Vehicles Require Many Standards



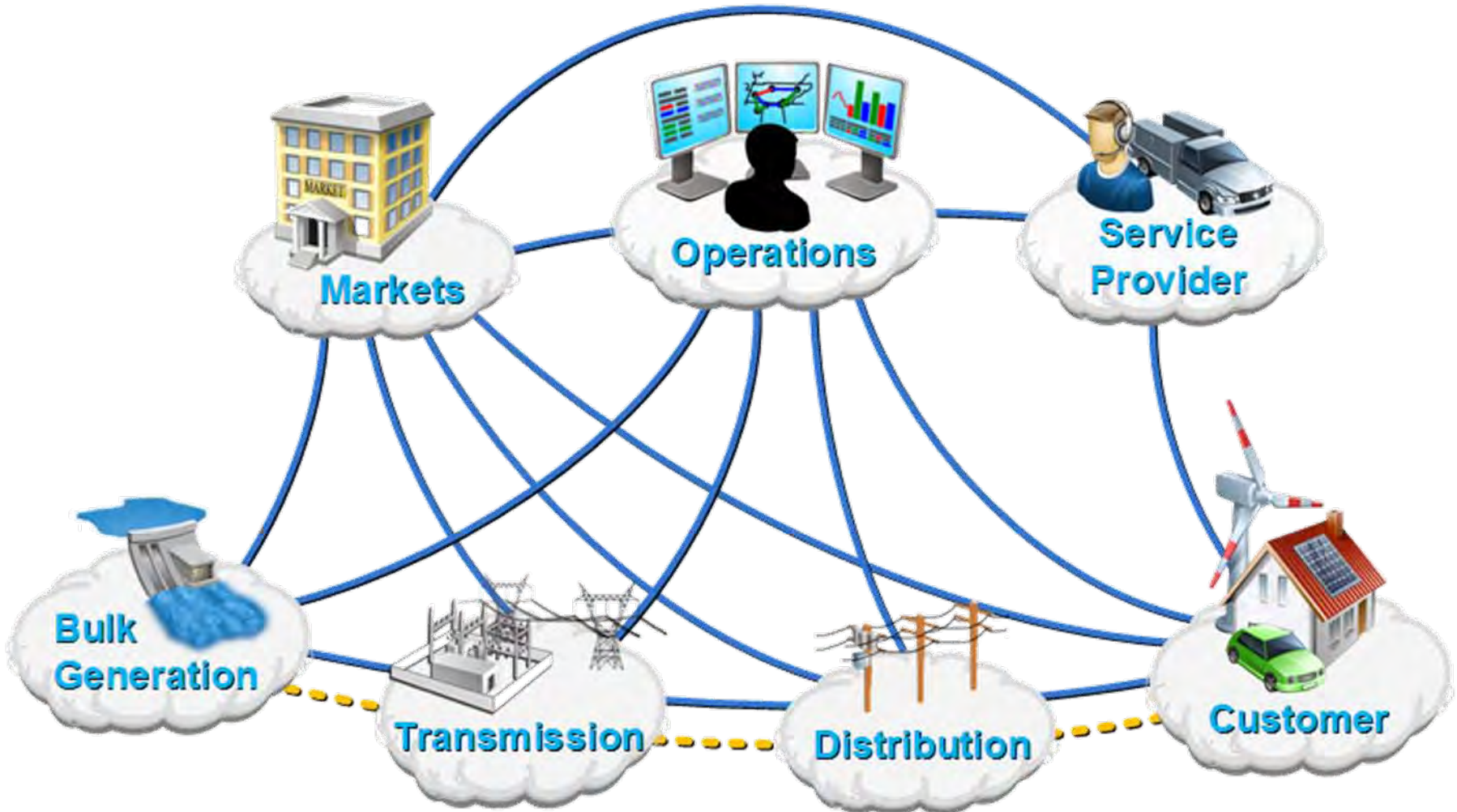
NIST Smart Grid Framework and Roadmap 1.0

- Published January 2010
 - Extensive public input and review
 - Completed in Less than 1 year
- Smart Grid Vision & Reference Model
- Identified 75 existing standards
- 16 Priority Action Plan Projects are filling key gaps
- Companion Cyber Security Strategy

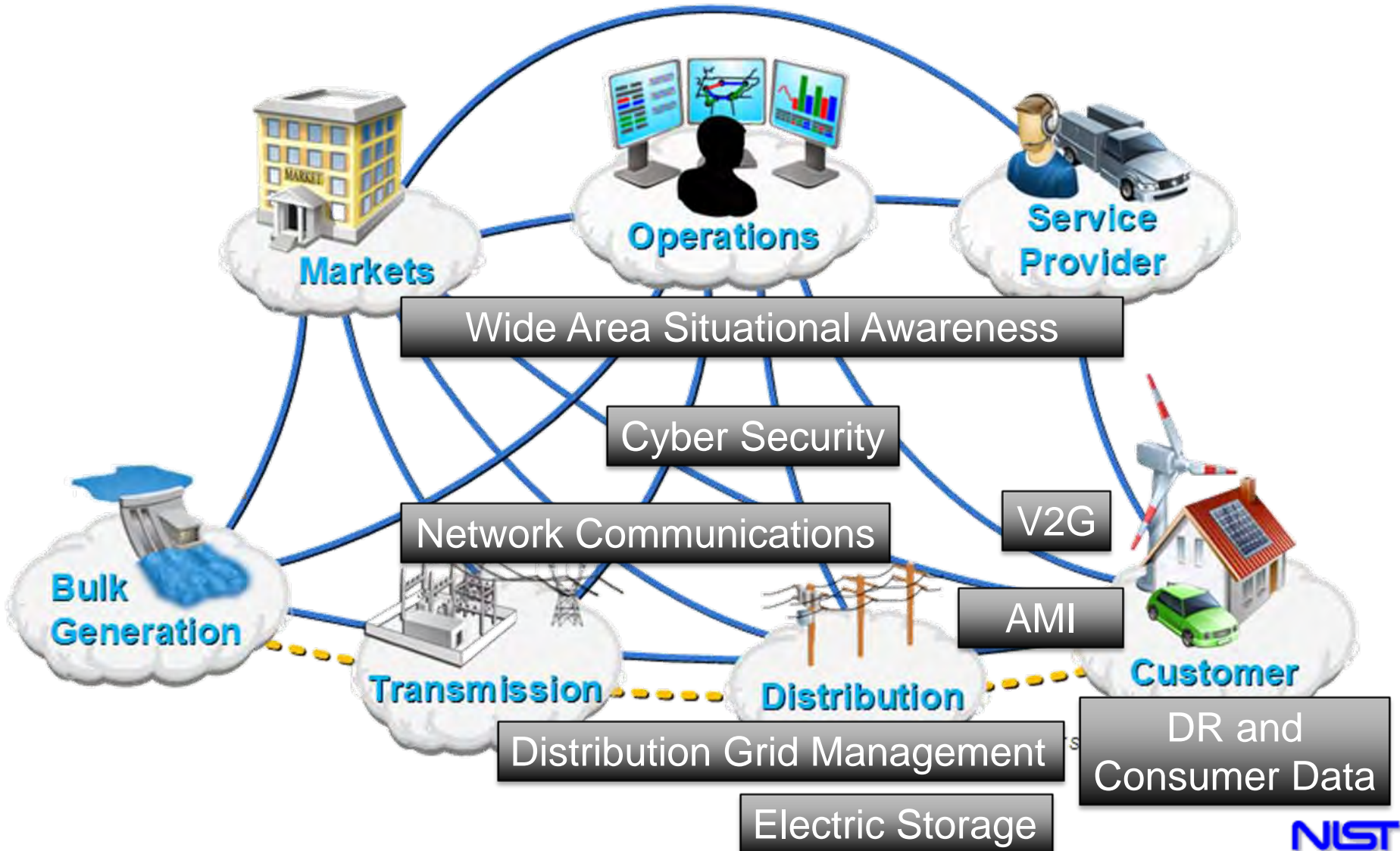
<http://www.nist.gov/smartgrid/>



NIST Smart Grid Conceptual Model

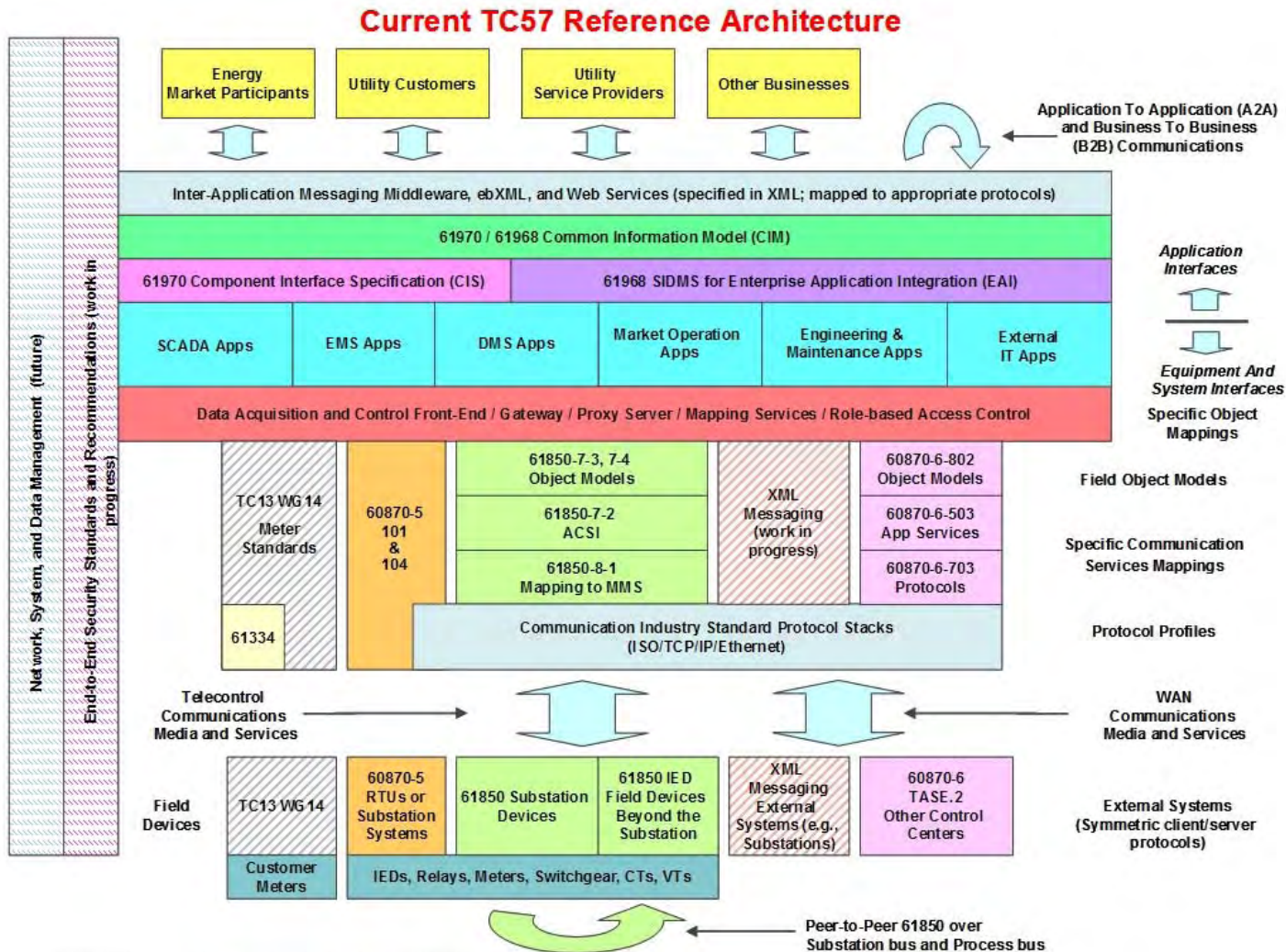


The Standards Address...



NIST-identified Foundational Standards

“Ready for Consideration by Regulators”



- IEC 61970/61968 Common Information Model for Transmission and Distribution
- IEC 61850 Common data format for substation automation
- IEC 60870-6 Inter-control center communication
- IEC 62351 Cybersecurity

*Notes: 1) Solid colors correlate different parts of protocols within the architecture.

2) Non-solid patterns represent areas that are future work, or work in progress, or related work provided by another IEC TC.



NIST Smart Grid Interoperability Panel

- Public-private partnership created in Nov. 2009
- Over 600 member organizations
- Open, public process with international participation
- Coordinates standards developed by Standards Development Organizations (SDOs)
 - Identifies Requirements
 - Prioritizes standards development programs
 - Works with over 20 SDOs including IEC, ISO, ITU, IEEE, ...
- Web-based participation



SGIP Twiki:
<http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIP>

Stakeholders categories in the NIST SGIP

1	Appliance and consumer electronics providers	12	Power equipment manufacturers and vendors
2	Commercial and industrial equipment manufacturers and automation vendors	13	Professional societies, users groups, and industry consortia
3	Consumers – Residential, commercial, and industrial	14	R&D organizations and academia
4	Electric transportation industry Stakeholders	15	Relevant Government Agencies
5	Electric utility companies – Investor Owned Utilities (IOU)	16	Renewable Power Producers
6	Electric utility companies - Municipal (MUNI)	17	Retail Service Providers
7	Electric utility companies - Rural Electric Association (REA)	18	Standard and specification development organizations (SDOs)
8	Electricity and financial market traders (includes aggregators)	19	State and local regulators
9	Independent power producers	20	Testing and Certification Vendors
10	Information and communication technologies (ICT) Infrastructure and Service Providers	21	Transmission Operators and Independent System Operators
11	Information technology (IT) application developers and integrators	22	Venture Capital



NIST SGiP Organization

Governing
Board

SGiP
Officers

NIST

SGiP Administrator

Test & Certification
Committee
(SGTCC)

Architecture
Committee
(SGAC)

Cyber Security
Working Group
(CSWG)

Standing Committees &
Working Groups

Program
Mgmt
Office
(PMO)

Comm.
Marketing
Education
(CME)

Bylaws &
Operating
Procedures
(BOP)

Coordination Functions

PAP 1

PAP 2

PAP 3

PAP 4

PAP ...

PAP 17

Priority Action Plan Teams

BnP

H2G

B2G

TnD

I2G

PEV2G

Electromagnetic
Interoperability Issues

Domain Expert Working Groups

SGiP Membership



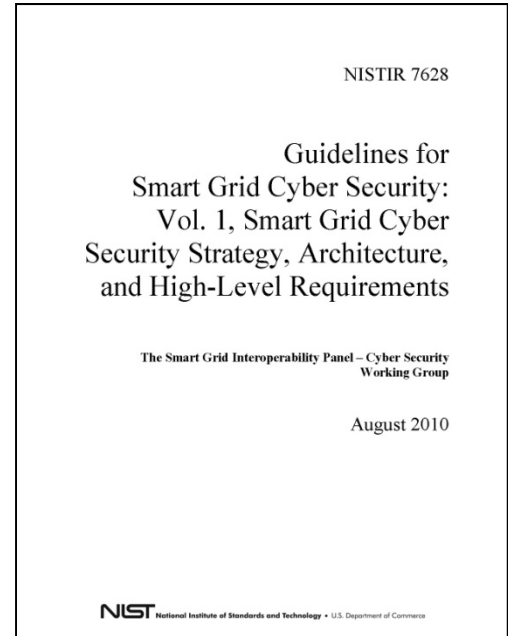
NIST SGiP Standing Committees

- Smart Grid Architecture Committee (SGAC)
 - Creates & refines SG Conceptual Reference Model, including input to lists of the standards and profiles necessary to implement the Smart Grid.
 - Testing & Certification Committee (SGTCC)
 - Creates and maintains the documentation and organizational framework for compliance, interoperability and cyber security testing and certification related to Smart Grid standards
 - Develops & implements certification criteria by which compliance can be verified through testing of vendor products and services
-
- Cyber Security Working Group (permanent working group)



Cyber Security Working Group

- Building cyber security in from the start has been a paramount concern
- Permanent Working Group
 - Over 460 public and private sector participants
- August 2010 NIST publishes: *Guidelines for Smart Grid Cyber Security*
 - Reflects Comments on Sept 2009 and Feb 2010 Draft *Smart Grid Cyber Security Strategy and Requirements*
- Guideline includes:
 - Risk assessment guidance for implementers
 - Recommended security requirements
 - Privacy recommendations





Filling Gaps in the Standards

- Priority Action Plans (led by NIST staff)

#	Priority Action Plan	#	Priority Action Plan
0	Meter Upgradeability Standard	9	Standard DR and DER Signals
1	Role of IP in the Smart Grid	10	Standard Energy Usage Information
2	Wireless Communication for the Smart Grid	11	Common Object Models for Electric Transportation
3	Common Price Communication Model	12	IEC 61850 Objects/DNP3 Mapping
4	Common Scheduling Mechanism	13	Time Synchronization, IEC 61850 Objects/ IEEE C37.118 Harmonization
5	Standard Meter Data Profiles	14	Transmission and Distribution Power Systems Model Mapping
6	Common Semantic Model for Meter Data tables	15	Harmonize Power Line Carrier Standards for Appliance Communications in the Home
7	Electric Storage Interconnection Guidelines	16	Wind Plant Communications
8	CIM for Distribution Grid Management	17	Facility Smart Grid Information

PAP 07: ENERGY STORAGE INTERCONNECTION GUIDELINES

- Objective

- Develop a series of coordinated and consistent electrical interconnection standards, communication standards, and implementation guidelines for energy storage devices (ES), power-electronics-connected distributed energy resources (DER), hybrid generation-storage systems (ES-DER), and the ES-DER aspects of plug-in electric vehicles (PEV)

- Impact

- Will allow for increased penetration of intermittent renewable energy resources and will improve overall electrical power system performance
- Broad set of stakeholders must agree on the electrical interconnection standards

- Outcome

- Increased penetration of intermittent renewable energy resources

- Status

- PAP WG has provided requirements to IEEE and IEC and are awaiting Standards from them

- Leadership and Participating Organizations

- Al Hefner (NIST) & Frances Cleveland (EnerNex)
- IEEE 1547 series, IEC TC57, UL 1741

- Projected Completion Date

- Q4, 2011



PAP 10: STANDARD ENERGY USAGE INFORMATION

- Objective

- To set up a standardized information model of energy usage to allow customers and other authorized entities to access such information easily and rapidly, in order to make decisions based on that information

- Impact

- Easier access to monthly usage information, including near-real-time information as smart meters and other devices are deployed
- The standards will enable innovation by third-party service and software providers in providing novel ways to help consumers and operations manage their energy usage

- Outcome

- Standardized information model which facilitates access to information

- Status

- NAESB formal comment period complete. Now in executive committee. Next step is NAESB member ratification, then PAP team will review for requirements one final time.

- Leadership and Participating Organizations

- David Wollman (NIST) & Marty Burns (EnerNex)
- NAESB, EIS Alliance, UCAIug

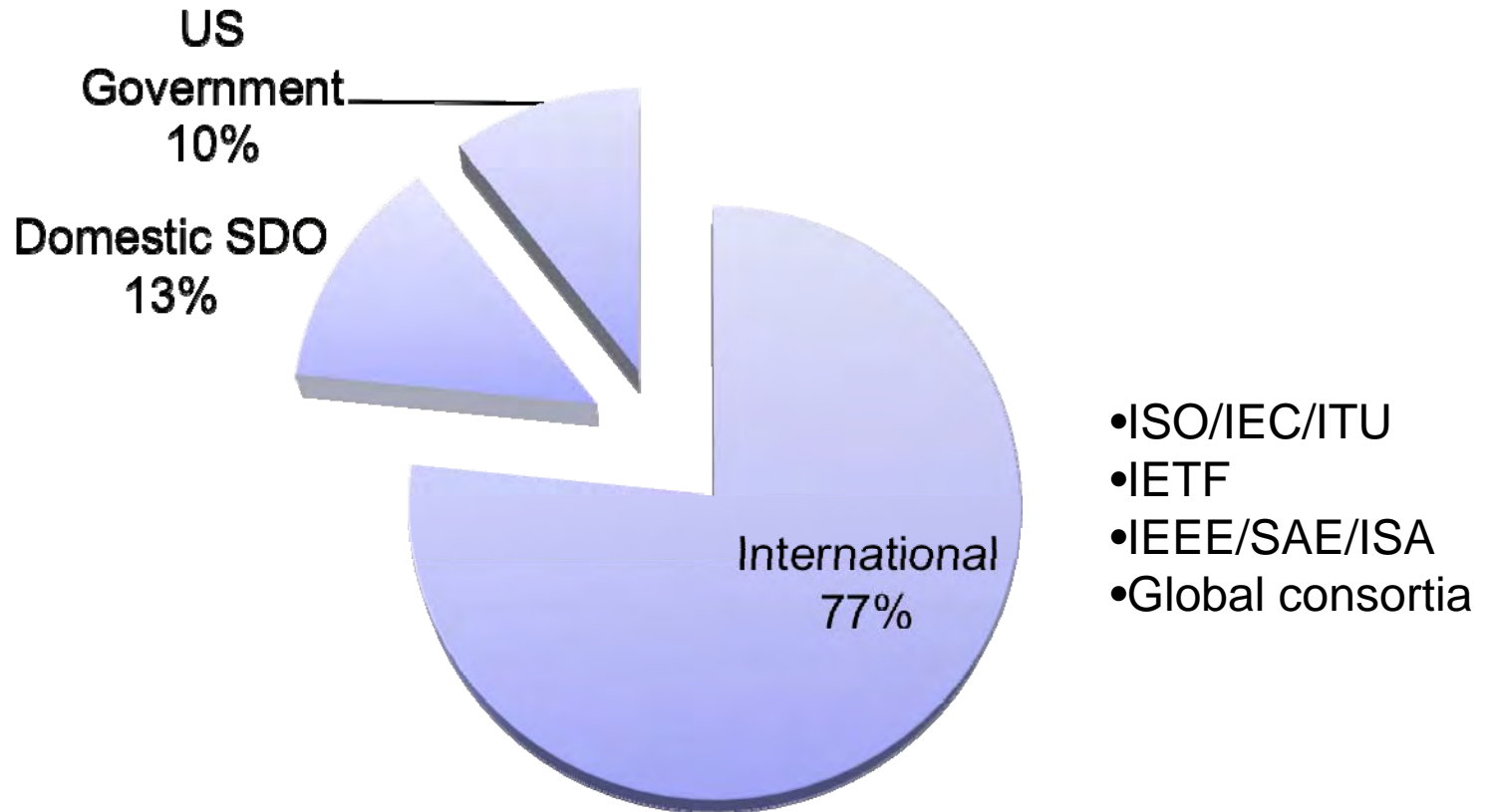
- Projected Completion Date

- Q1, 2011



Smart Grid Will Use International Standards

Source of Standards in NIST Roadmap



Benefits of Global Standards

- Avoid unnecessary adaptations for different markets
- Promote supplier competition
- Encourage innovation
- Lower costs for suppliers
- Lower costs for utilities
- Lower costs to end customers

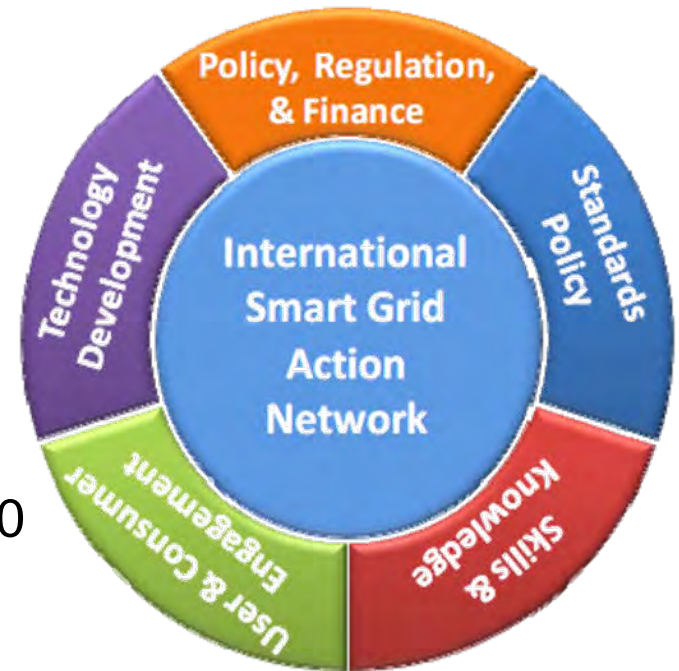


International Smart Grid Action Network



Purpose: To accelerate development and deployment of smarter electric grids around the world

- Announced at the first meeting of the Clean Energy Ministerial (CEM) in July 2010



Further Information

- Web portal: <http://www.nist.gov/smartgrid>
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