Reforming the Energy Vision (REV)

Working Group II: Platform Technology

Table of Contents

Executive Summary **2**

Body of Report **4**

Subgroup: Existing Utility Distribution Systems and Capabilities 5

Iberdrola USA (NYSEG and RG&E) 5

National Grid 17

Central Hudson 27

Consolidated Edison 42

Subgroup: Platform Functionalities 56

Subgroup: Standards & Protocols 75

Subgroup: Technologies 110

Appendices: **127**

Appendix A: Full List of Working Group & Subgroup Members 128

Appendix B: Draft of Functions to Policy Mapping Tool – Preliminary in Nature 135

Appendix C: Draft Use Cases – Preliminary in Nature 138

Dynamic Electricity Production Forecasting 139

Direct Load Control 153

Volt VAR Optimization 197

Appendix D: P2030 Conceptual Architectural Diagrams 209

Appendix E: Draft of Technology Matrix Mapping Tool – Preliminary in Nature 222

Working Group II Platform Technology Executive Summary
July 8, 2014

I. Executive Summary

a. Who We Are:

Working Group II: Platform Technology was formed on May 12, 2014 at the Reforming the Energy Vision (REV) Collaborative Meeting. The Working Group consisted of over 70 organizations and approximately 140 individuals representing a broad cross section of interested parties and DPS Staff.[1] The Working Group Co-Convenors were Michael Rieder and Peggie Neville, DPS Staff; David Lovelady, Siemens PTI; Brian Horton, Consolidated Edison Company of NY; and Jim Gallagher, NY Smart Grid Consortium.

The Working Group identified four specific areas of focus. Volunteers from the full Working Group were sought to form these subgroups to research and compile information on the specific areas of focus and present back to the full Working Group. The Subgroups[2] and their respective leads were:

i. Existing Utility Distribution Systems and Capabilities, Brian Horton, Con Edison
ii. Platform Functionalities – Laney Brown, Iberdrola USA
iii. Standards & Protocols – David Lovelady, Siemens PTI
iv. Platform Technologies – John D'Aloia, DPS

The Working Group held 7 meetings from May 14 through June 25, with several subgroup meetings throughout this timeframe.

b. What we set out to do:

The objective of Working Group II: Platform Technology was to identify the infrastructure and technology needed to enable the Distributed System Platform Provider (DSPP) to integrate, monitor, and control Distributed Energy Resources (DER), while:

- Ensuring system reliability;
- Increasing system resiliency and efficiency;
- Maintaining system security;
- Maximizing energy efficiency;
- Promoting fuel diversity; and
- Empowering customer choice and third party participation in newly-formed markets.

c. Key Findings

i. The utilities have been planning and deploying technologies that will improve system visibility, enhance control and support analytics that can help achieve objectives described in REV.
ii. New York can build on advancements being made in advanced grid technology and the support of DER around the world by utilities and industry leaders.
iii. The REV process is an opportunity to align ongoing utility activity with a larger vision for New York.
iv. It is important to have clear 'line of sight' from policy goals to functionality to technology investments.

---

[1] A full listing of Working Group Members is included in Appendix A.
[2] A full listing of Subgroup Members is included in Appendix A.

v. The DSPP functionalities will evolve as technology and markets evolve and there is an increased penetration of DER.
vi. A number of well defined Standards and Protocols exist that will support the DSPP.
vii. Standards and Protocols support wide-scale DER integration, customer participation, market transactions and operational control.
viii. The data, security and integration complexity of a DSPP requires the rigor of a structured architecture.
ix. A number of technologies exist, in various stages of maturity, that can support anticipated functions of the DSPP. However, an 'off-the-shelf' comprehensive platform system does not currently exist.
x. Each DSPP will need to consider the existing utility distribution systems and capabilities in identifying the technologies needed to allow the DSPP to evolve.
xi. Defining and mapping the enabling technologies to the DSPP platform functions provides a common approach to assess the variety of evolving technologies while
    1. Creating a structure to identify functionalities and technology capabilities over time, and
    2. Identifying the technologies and gaps existing today.
xii. Key considerations for the development of DSPP platform technologies include:
    1. Designing in cyber security;
    2. Assuring interoperability and consistency across DSPPs; and
    3. Supporting future flexibility and scalability.

Body of Report

The full power points presented to the Working Group.

Existing Utility

Distribution Systems and Capabilities

Iberdrola USA (NYSEG and RG&E)

NYSEG & RGE Energy Control Systems

NYS DPS Platform Technology Working Group

May 28, 2014

IBERDROLA USA

Iberdrola USA Foundational Systems for the Modern Grid

Energy Control Systems

- Provides centralized real time control and monitor across the entire grid

Substations

- Remote engineering access and support for modernized, automated substations

AMI

- Enables real time visibility and control up to and beyond the meter with significantly greater granularity and frequency than today

NYSEG and RG&E Energy Control Systems

IBERDROLA USA

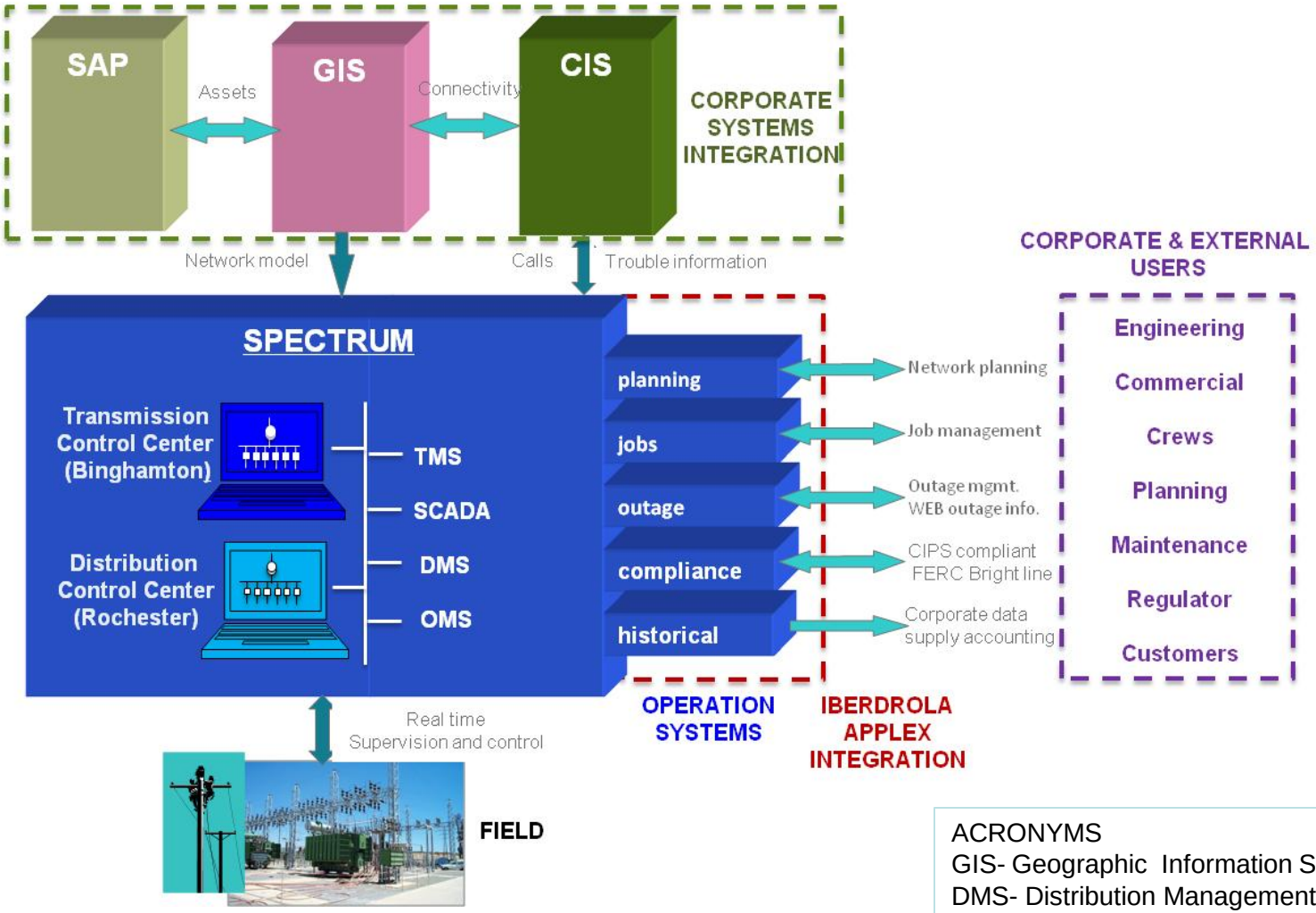
Integrated Control Solution for New York

- A single integrated control center platform for NYSEG and RG&E
- Alignment with IBERDROLA global standards & practices
- Full integration of key components (SAP, GIS, DMS, TMS, OMS)
- Full compliance with all FERC and NERC requirements
- Reengineering of systems and processes to become "Best in Class"
- Prepare for increased automation on the network
- Facilitate centralization of operations
- Provide customer facing services for outage management

ACRONYMS
GIS- Geographic Information System
DMS- Distribution Management System
TMS- Transmission Management System
OMS- Outage Management System

NYSEG and RG&E Energy Control Systems

Simplified System Design



ACRONYMS
GIS- Geographic Information System
DMS- Distribution Management System
TMS- Transmission Management System
OMS- Outage Management System

NYSEG and RG&E Energy Control Systems

The Integration of the EMS/SCADA system with the OMS provides real time transmission, substation, and distribution situational awareness.

Benefits OMS dispatchers and operators

- Improves the identification of interrupted equipment/circuits
- Decreases outage restoration times
- Improves accuracy of outage analysis engine
- Increases general public and utility crew safety

Supports substation and distribution automation

- Capability to monitor many more data points
- Simplifies new RTU additions

Corporate GIS Integration

- Outage maps on the internet
- Customer data available to OMS operators and dispatchers
- Decrease data entry errors and database reconciliation delays

Improved Efficiencies

- Single system upgrade covers both companies
- Accommodates FERC /NERC requirements

Iberdrola USA Forward Looking Approach for a Smarter Grid

Distribution Planning

- Criteria revised in 2013 to reflect Smart Grid approach to planning
- Policy of smart elements
- More emphasis on self-healing (automatic loop and sectionalizing schemes)
- N-1 planning to handle automatic v. manual tying (e.g., transformer & circuit capacity planning)

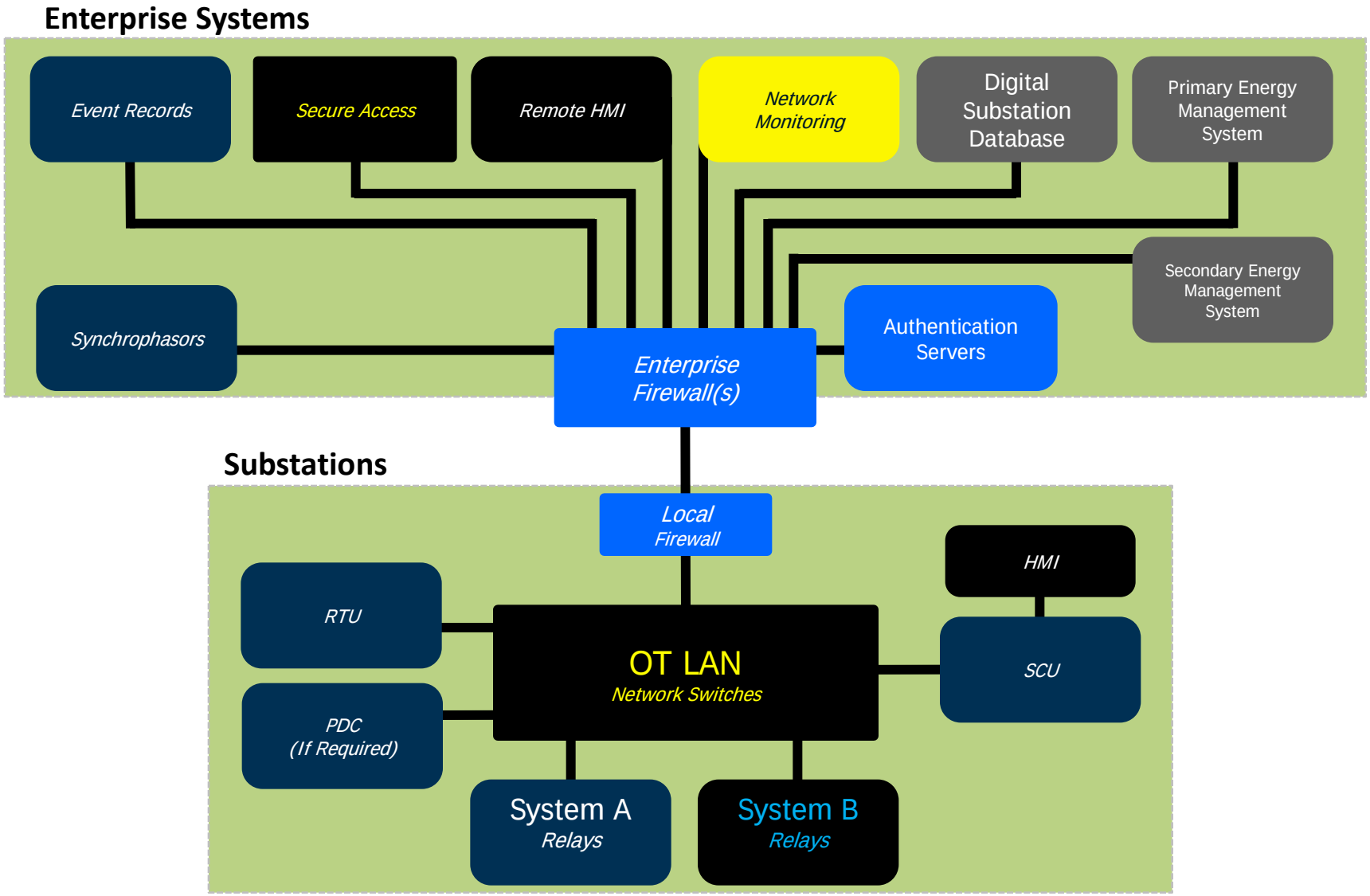
Substation Automation and Integration

- Utilizing IEC-61850 and goose messaging
- Looped and/or redundant networks within substations
- Leveraged with enterprise systems (remote HMI, network management, event records, etc.)

DER Integration Pilot Project

- Integrating Demand Response, Energy Efficiency and Distributed Generation (E.g. Boothbay Harbor ,ME Pilot)
- Dispatch Interface

IUSA Substation Automation & Integration Design



Central Maine Power's AMI – OMS Integration

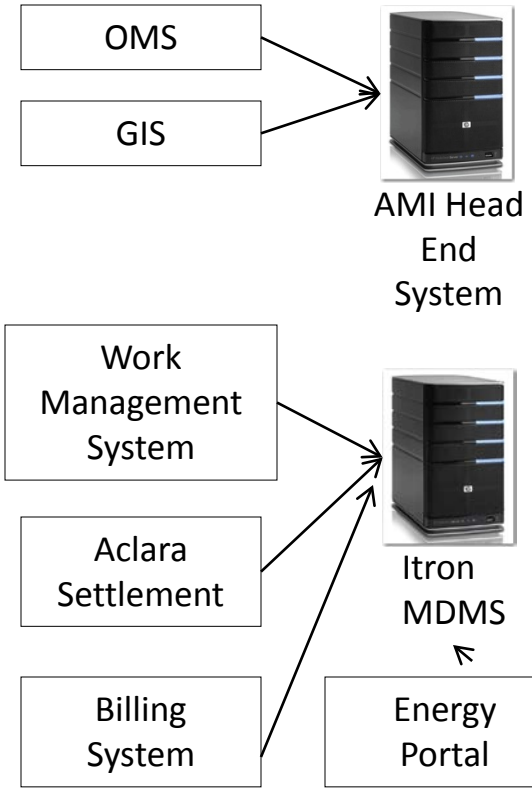
Increased outage visibility and restoration

- OMS captures and displays meter-level outage information in near real time
- Meter events clear outage work orders
- Meter 'pings' determine power status for efficient restoration efforts

Faster assessment and restoration

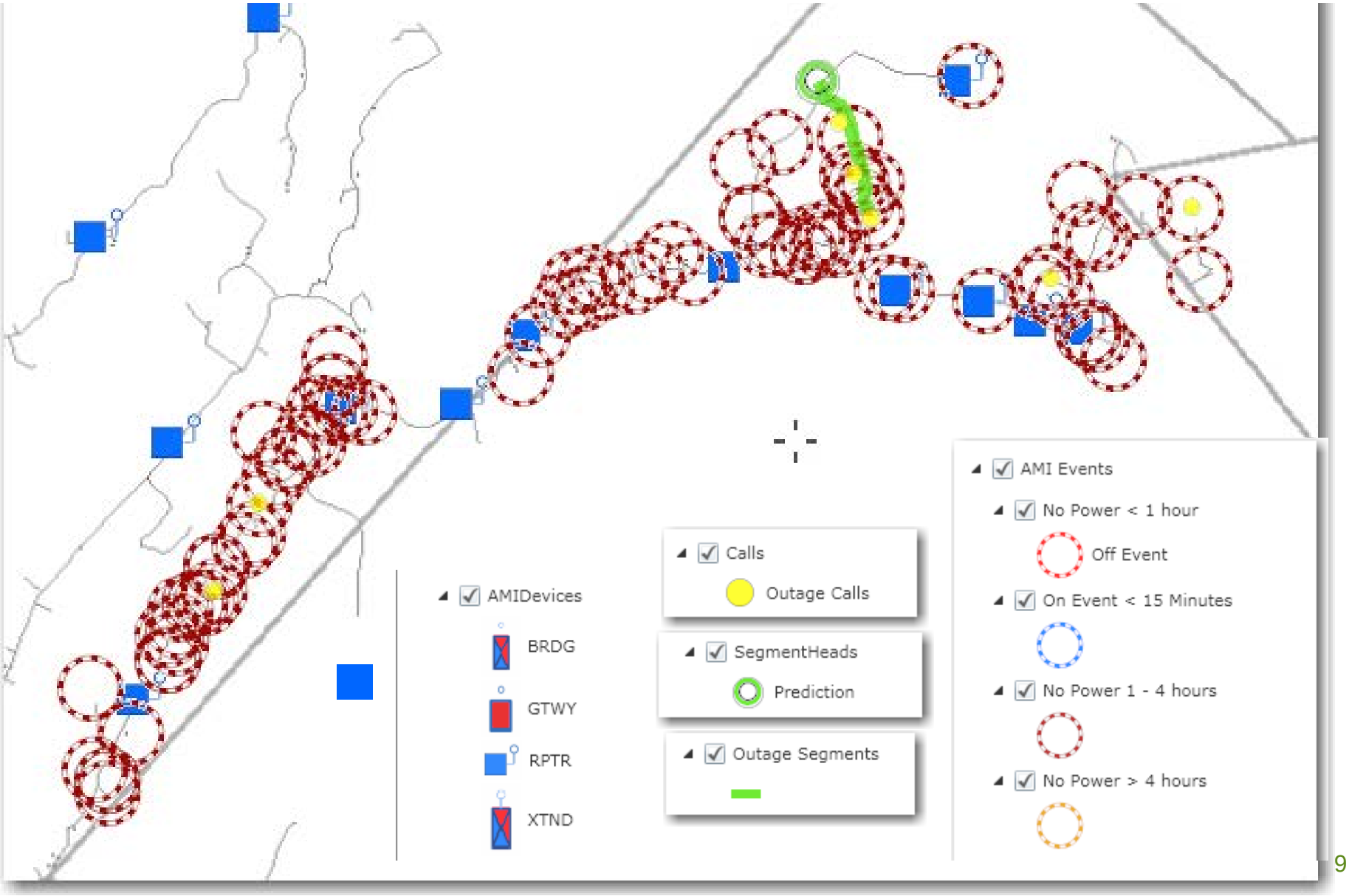
- 7 X more AMI events than customer calls for more accurate outage assessment
- On average, meter events come in 10 minutes faster than the first customer calls
- More efficient restoration to clear nested outages with meter pings

AMI Secure Mesh Network



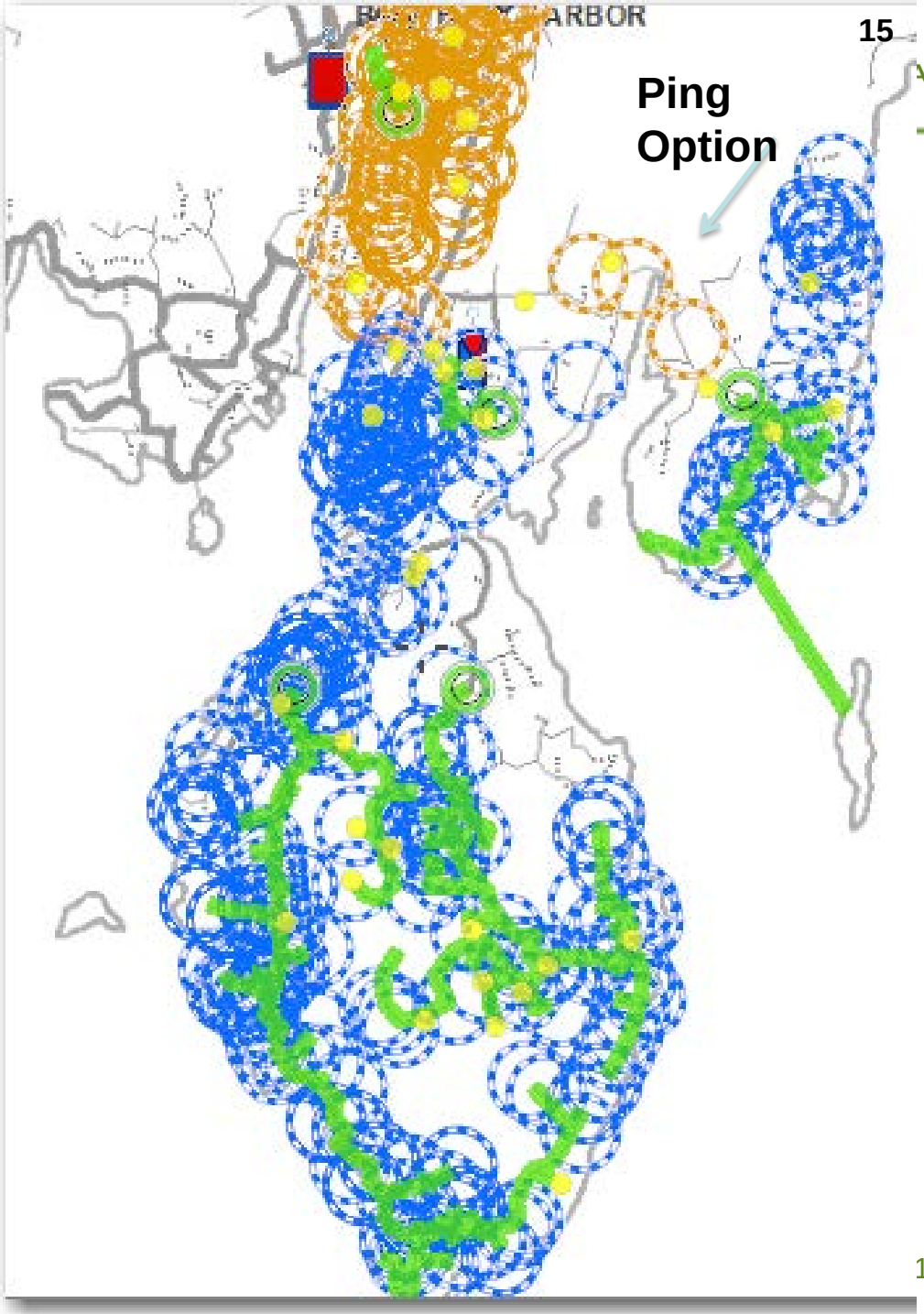
IBERDROLA USA

AMI Meter Off Events During an Outage



AMI Events and Power Restoration

- AMIDevices
  - BRDG
  - GTWY
  - RPTR
  - XTND
- Calls
  - Outage Calls
- SegmentHeads
  - Prediction
- Outage Segments
- AMI Events
  - No Power < 1 hour
    - Off Event
  - On Event < 15 Minutes
  - No Power 1 - 4 hours
  - No Power > 4 hours

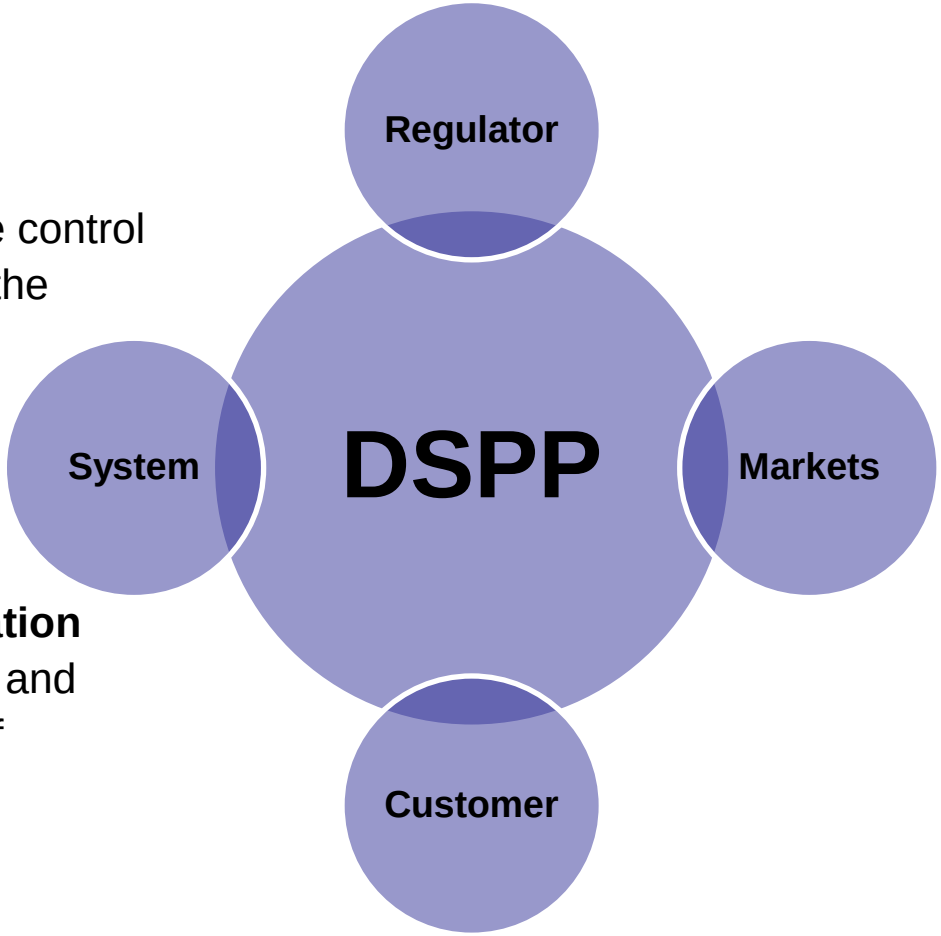


Iberdrola USA Support DSPP Foundations

The experience and the investments across Iberdrola USA will be foundational for the DSPP

NY Energy Control Systems
Centralized real time control and monitor across the entire grid

Maine's AMI System
Near real time visibility and control up to and beyond the meter



Substation Automation
Advanced operation and automated control of substation assets

Distribution Automation
Intelligence and control of distribution segments

Existing Utility

Distribution Systems and Capabilities

National Grid

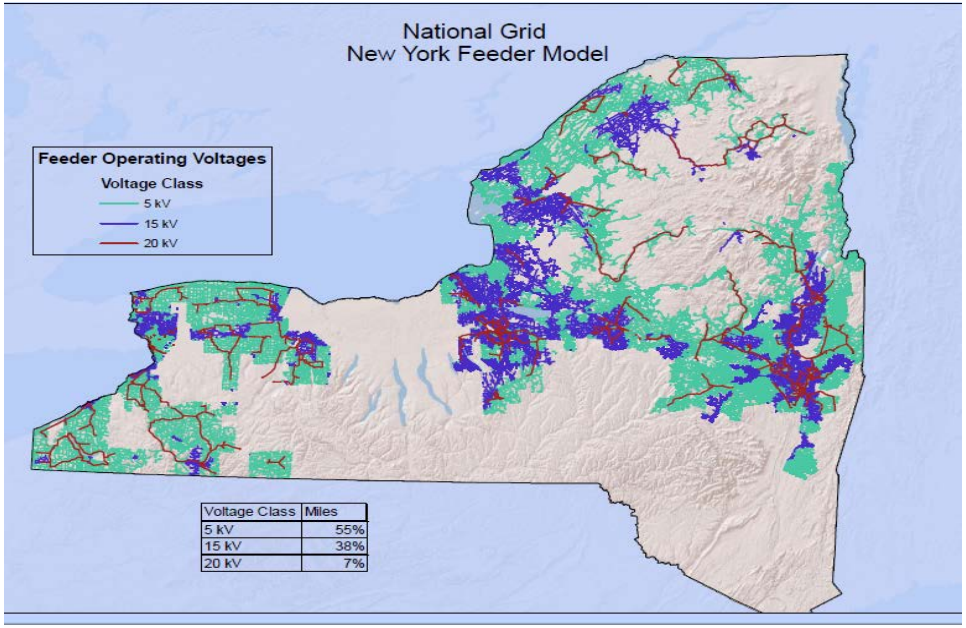
nationalgrid
HERE WITH YOU. HERE FOR YOU.

Progressing towards the DSPP

May 28, 2014

The Foundation for the Platform

nationalgrid
HERE WITH YOU. HERE FOR YOU.



- SCADA on only 52% of substations
- Areas of low customer density
  - > 50% of Distribution Line miles are 5kV
  - Radial design with limited Feeder Ties
- Limited communications to field devices.

Energy and Outage Management System (EMS & OMS)

nationalgrid
HERE WITH YOU. HERE FOR YOU.

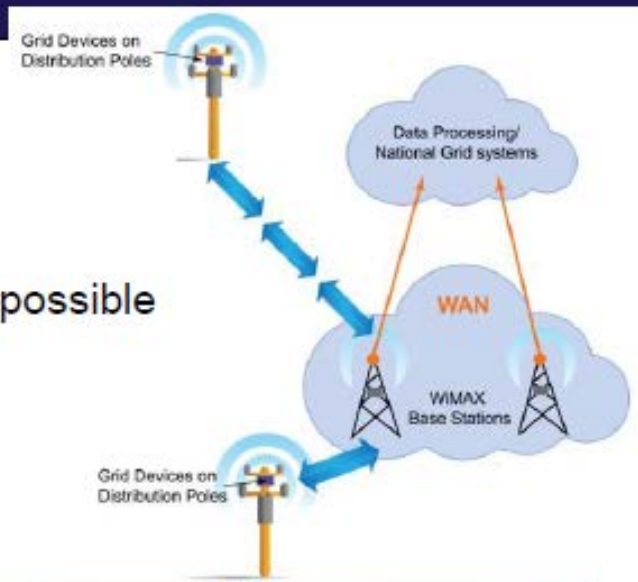
- **Upgrading existing EMS and OMS systems to ABB Network Manager**
  - **Initial benefits of the common Network Manager platform**:
    - Real time transfer of grid device status from EMS to OMS for optimization of outage prediction.
    - Integration of telemetered analog data from EMS to OMS to enhance situational awareness .
  - **Provides a common platform to leverage future capabilities.**
    - e.g., Volt VAR Optimization, Unbalanced Load Flow, Advanced Metering Infrastructure, Restoration Switching Analysis.
- Current forecasted go-live dates are:
  - NY EMS late 2014
  - NY OMS 2nd half 2015

Distribution System Initiatives

Smart Energy Solutions Program
Worcester, MA

nationalgrid
HERE WITH YOU. HERE FOR YOU.

- 15,000 Customers
- 11 – 13.8 kV Feeders
- 5 Substations
- Utilize as much existing equipment possible
- Advanced Distribution Automation
- Advanced Capacitor Control
- Advanced Grid Monitoring
- Fault Location Experiments



Customer Initiatives

Smart Energy Solutions Program
Worcester, MA

nationalgrid
HERE WITH YOU. HERE FOR YOU.

New Rates: Critical Peak Pricing (CPP) Peak Time Rebate (PTR)
Commercial and Residential

New Tools:

Level 1
- Advanced Smart Meter
- Phone, Internet, and/or Mobile Device Tools
- Education Materials

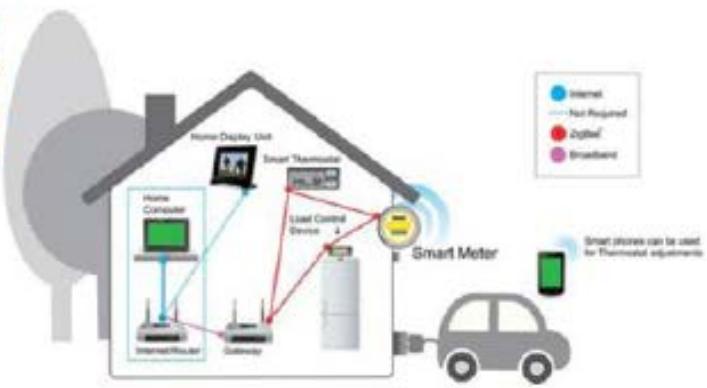
Level 2
- Advanced Smart Meter
- Phone, Internet, and/or Mobile Device Tools
- Education Materials
- Home Display Unit

Level 3
- Advanced Smart Meter
- Phone, Internet, and/or Mobile Device Tools
- Education Materials
- Smart Thermostat

Level 4
- Advanced Smart Meter
- Phone, Internet, and/or Mobile Device Tools
- Education Materials
- Home Display Unit
- Smart Thermostat
- Load Control

In Home Technology

Small Business: Level 2



Efficiency through Volt-Var Optimization

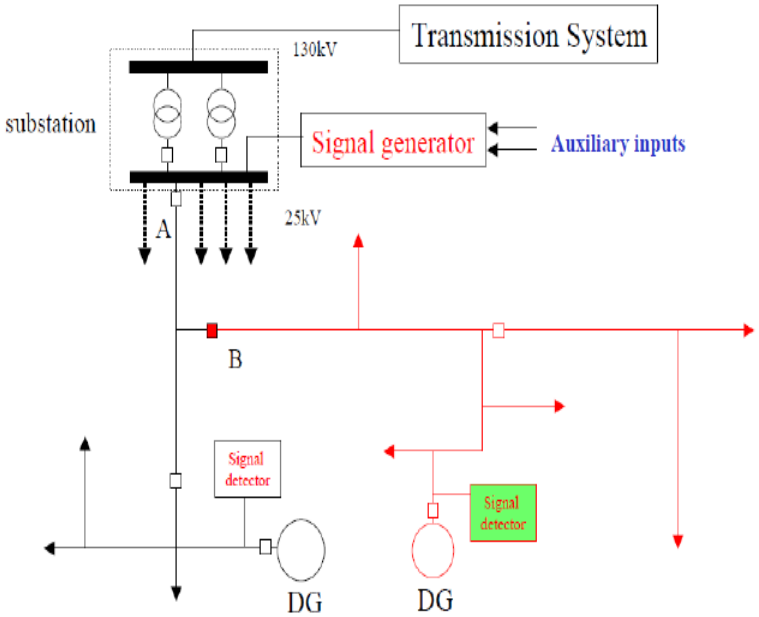
nationalgrid
HERE WITH YOU. HERE FOR YOU.

- To be demonstrated on 7 feeders in RI
- Primary System Monitoring
- Centralized control of reactive resources & voltage regulating equipment
  - Reduce Losses
  - Energy Use Reduction
  - Voltage Performance Improvement
  - Demand Reduction
  - Improved Flexibility in meeting NE ISO PF performance
  - Improve Planning & Operations with increased system performance monitoring
- Expected Benefits (provided by vendor)
  - 2.9% Energy reduction
  - 30% Less voltage regulator tap operations
  - Improved customer reliability through feeder monitoring

DG Interconnections

nationalgrid
HERE WITH YOU. HERE FOR YOU.

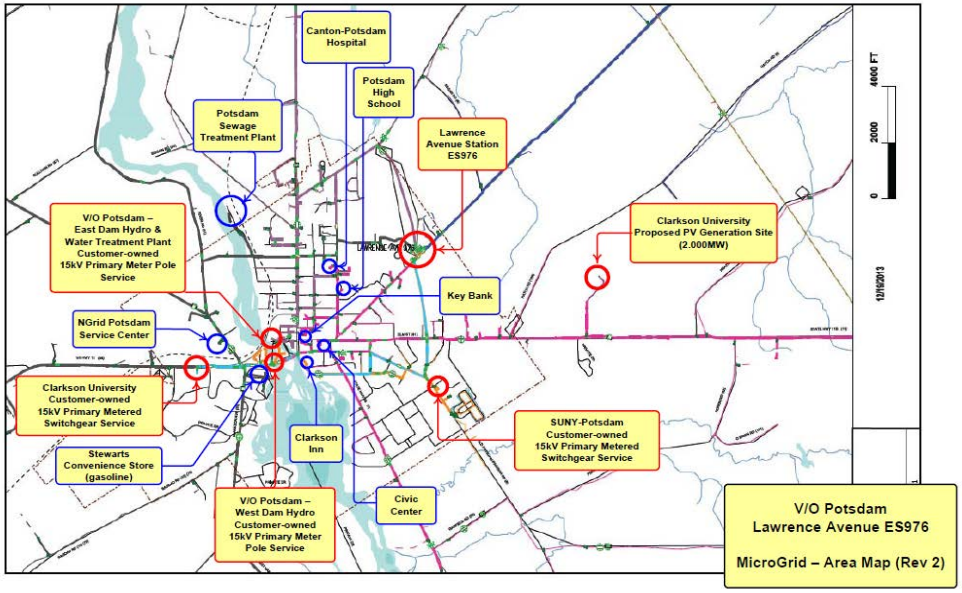
Power Line Carrier Technology



- DG applications are increasing and the MW size of requests are also increasing.
- Anti-islanding protection via Direct Transfer Trip can be expensive and restrictive for circuit re-configuration
- New technology being evaluated in Potsdam.
- Other enabling efforts:
  - The Fraunhofer Plug & Play Team
  - DOE-FOA-479 Smart-Grid Ready PV Inverter with Utility Communication

Microgrids

nationalgrid
HERE WITH YOU. HERE FOR YOU.



- Potsdam
  - Resiliency Based
  - Multiple generators
  - Multiple loads
  - Resilient UG interconnections
- Buffalo Niagara Medical Campus
  - Realistic optimization possibilities for power quality and energy efficiency will be identified throughout the power grid as well as within BNMC customer facilities.

Non-Wires Alternatives

nationalgrid
HERE WITH YOU. HERE FOR YOU.

- Consideration of DER as a deferral option to traditional utility infrastructure expansion.
- Custom Solutions: T&D Planning Engineers working closely with Customer EE and DR teams.
- Initial Efforts
  - Tiverton, RI
  - Nantucket, MA
  - Brockport, NY

Existing Utility

Distribution Systems and Capabilities

Central Hudson

People. Power. Possibilities.
Central Hudson
Gas & Electric Corporation

Smart Grid and Integrated Communication Strategy

Overall Goals/Key Strategic Components

Goals

Improve Grid Efficiency

Better Utilization of Existing Assets

Enhanced Resiliency

Allow for greater penetration of DER

Strategic Components

Distribution Management System (DMS/ADMS)

Intelligent devices/sensors

Integrated Communication System

Distribution Management System

- Key Objectives:
  - Develop an integrated near real time system model for the distribution system which enables 24/7/365 system optimization
  - Create an operator workstation to practically manage data
  - Integrate the transmission system to understand how the T&D systems are interrelated
  - Develop solar analysis tools
  - Further develop capabilities to model/integrate DER

People. Power. Possibilities. Central Hudson Gas & Electric Corporation

Integrated System Model developed for PON 1913 Pilot Area

GIS
GE via Red Planet

* **SCADA**
Telemetric

MV90
Large Cust Load

CIS
Small Cust kWHR

Load Research

Weather

* **EMS**
GE XA21

OMS
GE Small World OMS

GE Historian
EDNA

4 Distribution Circuits Modeled at High Falls Substation

Dew - ISM

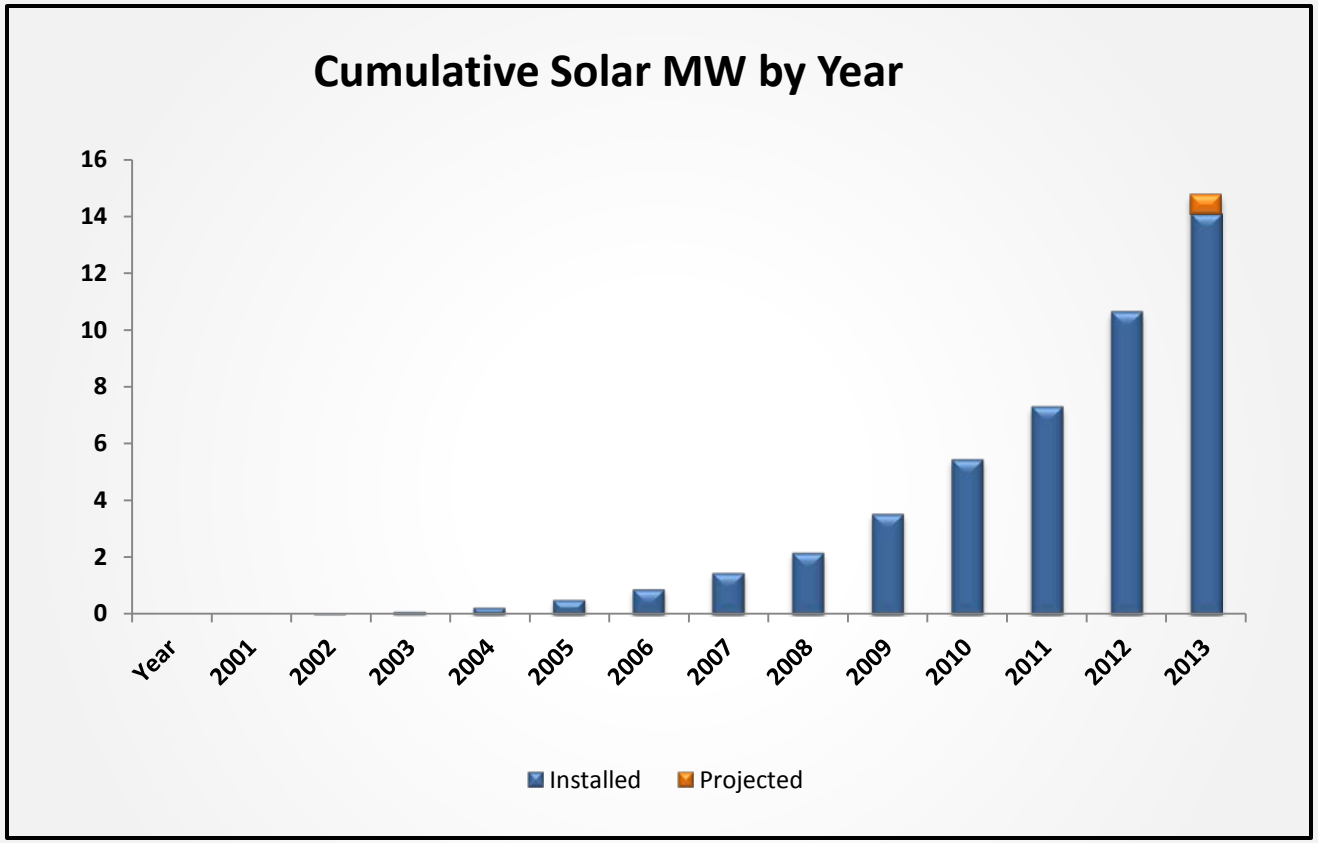
Dew Circuit Server
(Circuit Files)

Dew Data Base
(Part Definitions)
(Access, Oracle, etc.)

* Note EDNA includes SCADA Data

People. Power. Possibilities.
Central Hudson
Gas & Electric Corporation

Solar Analysis Tool becoming more Important



Metering (as of 10/23/13)	# Installations	MW
Completed	1532	14.1
Pending	269	6.2

People. Power. Possibilities.
Central Hudson
Gas & Electric Corporation

Automated/Intelligent Devices/Sensors

- Install intelligent devices capable of providing 2-way status and control
  - Electronic Reclosers/ Mid Point Ties
  - Switched Capacitors
  - Regulators
  - Voltage Monitors

- 2 Key Objectives:
  1. CVR/VVO
  2. FLISR/Automatic Load Transfer

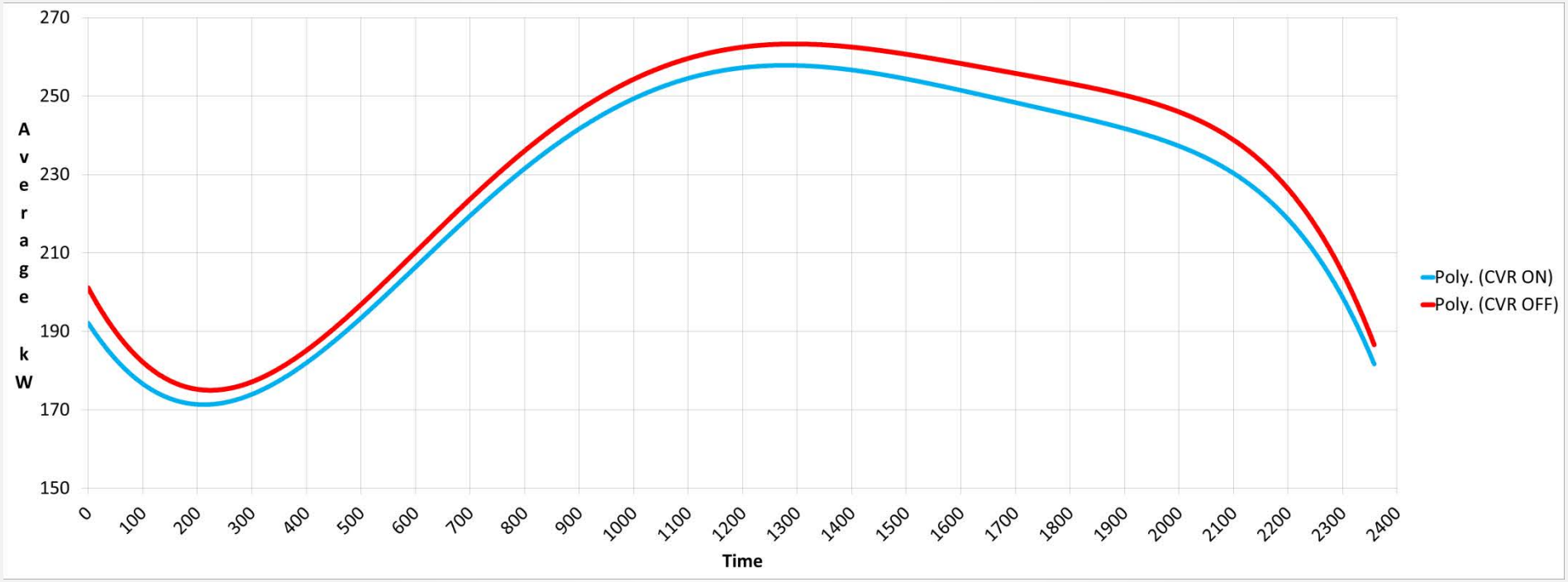
People. Power. Possibilities.
Central Hudson
Gas & Electric Corporation

CVR: Trial resulted in 2.50% kW reduction

- Trial Project: High Falls 3022 Circuit using a regulator feeding a resort
  - 3% voltage reduction → 2.50% kW reduction for the customer
  - 11 months of day on vs. day off testing
  - DEW also analyzed phase balancing and capacitor placement

- 2nd Trial began in May: Lincoln Park 2016
  - Good load mix
    - 1049 customers
    - 21 3-phase customers

CVR: Average Load Profile with and without



People. Power. Possibilities.
Central Hudson
Gas & Electric Corporation

CVR: Next Steps

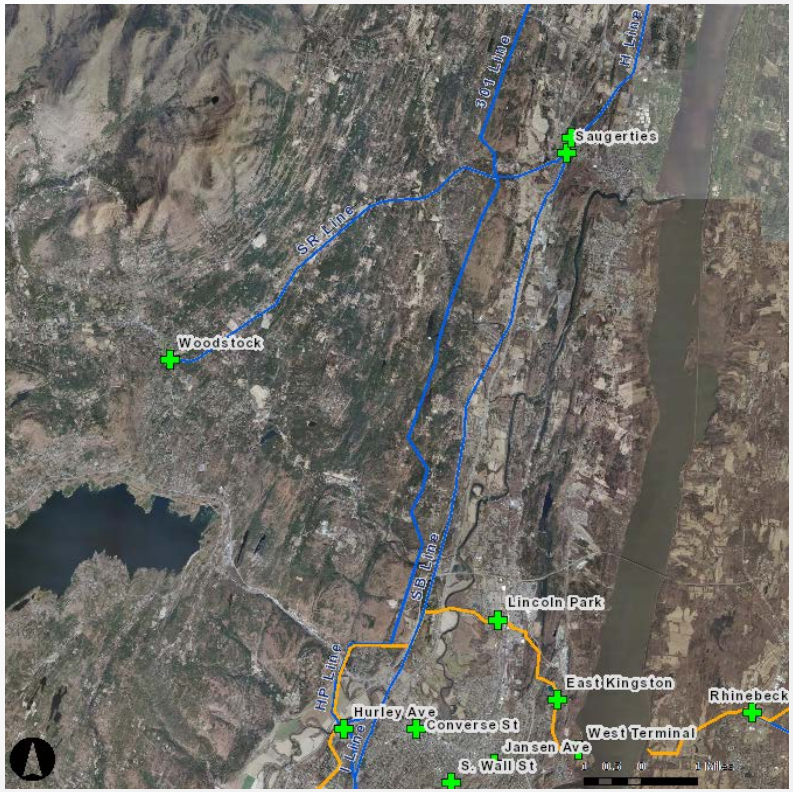
- Transition from testing feeder "Pockets" to testing CVR on entire feeder
  - 3 feeders are planned for CVR testing
  - Models will need to be created to determine if there will be any adverse customer impacts with a 3% voltage reduction
  - E.O.L. voltage monitors will be installed in order to insure we stay within ANSI standards

- Complete M&V on summer data to determine correlation between feeder composition and CVR factor

The New Automatic Load Transfer ("ALT")

- Radial 69 kV transmission feed in Woodstock, NY to 8,245 customers
- Automatic Transfer using electronic recloser loop schemes
- Demonstrate deferral of capital investments (Spend $1 million to defer $15 million)
- 2-way communications/control via the DMS (future)

- NYSERDA PON 2474



Integrated Communication Strategy

Cross-Functional Team Considered Benefits beyond DA

Distribution Automation

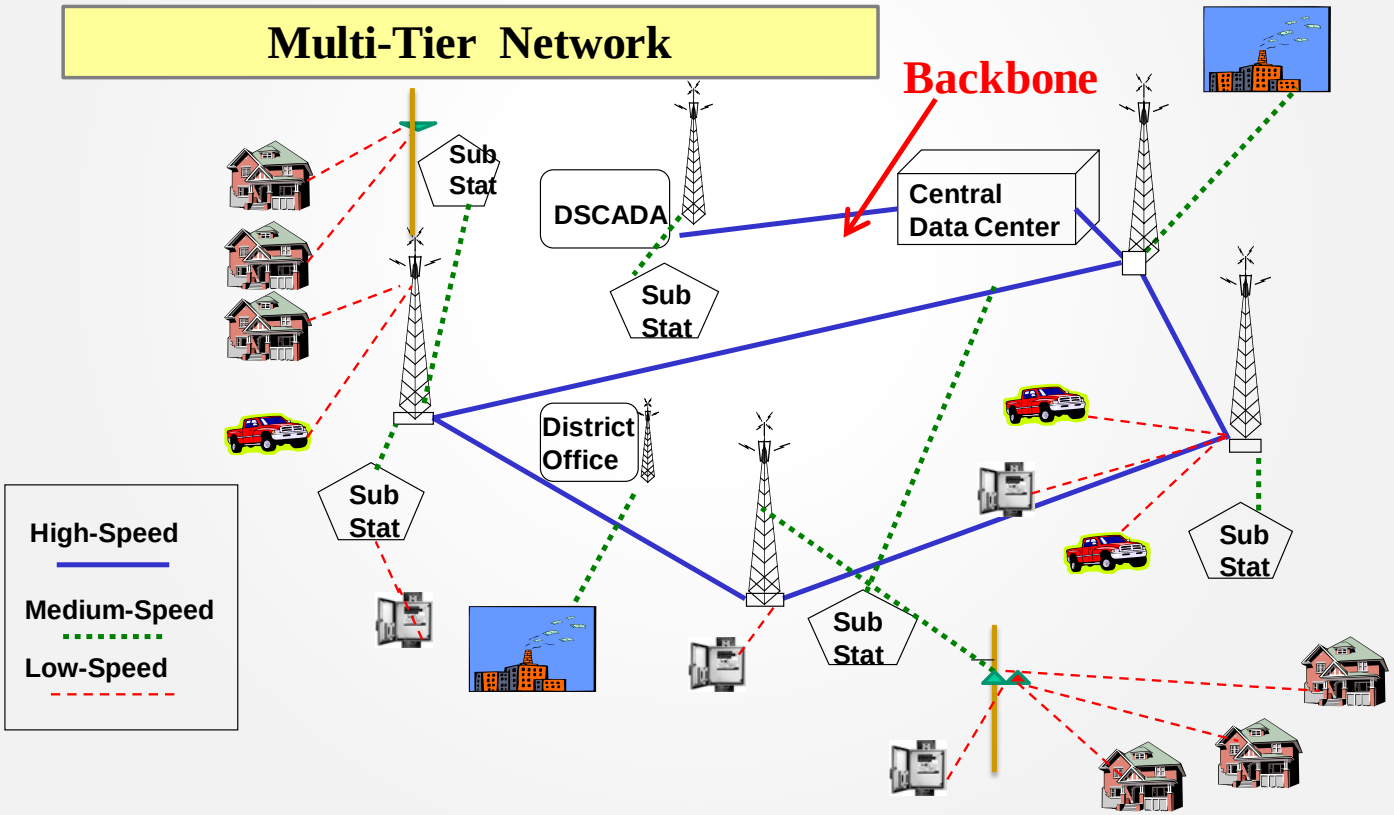
+

- SCADA
- Distribution Automation
- Meter Reading (large customer)
- Voice
- Data from field devices
- Transmission Line Protection
- Security (video and card access)
- Links to Radio Towers
- Meter Reading (residential – future)

People. Power. Possibilities.
Central Hudson
Gas & Electric Corporation

Integrated Communication System Diagram

Proposed Architecture



People. Power. Possibilities.
Central Hudson
Gas & Electric Corporation

Integrated Communication Strategy – Next Steps

1. Continue Research and Development Project to test feasibility of:
   - Tier 1 microwave
     - Test link between South Road and Hurley Avenue
       - Expected in-service Q3 2014
   - Tier 2 mesh network for DA applications
     - Deployment of the ABB Tropos network mesh solution of DA application in the Woodstock area

2. Develop business case for full-scale deployment

The Future Vision for Distribution: 2015 - 2020

- ESRI is the data center
- Centralized Distribution Automation through DMS
- Defer substation and transmission capital expenditures
  - Distribution infrastructure upgrades
  - Automated ties
  - Conservation Voltage Reduction
- Currently over 5-7 years

Existing Utility

Distribution Systems and Capabilities

Consolidated Edison

Con Edison Demonstration Project DE-OE0000197

Customer Sited Resource Management Tools

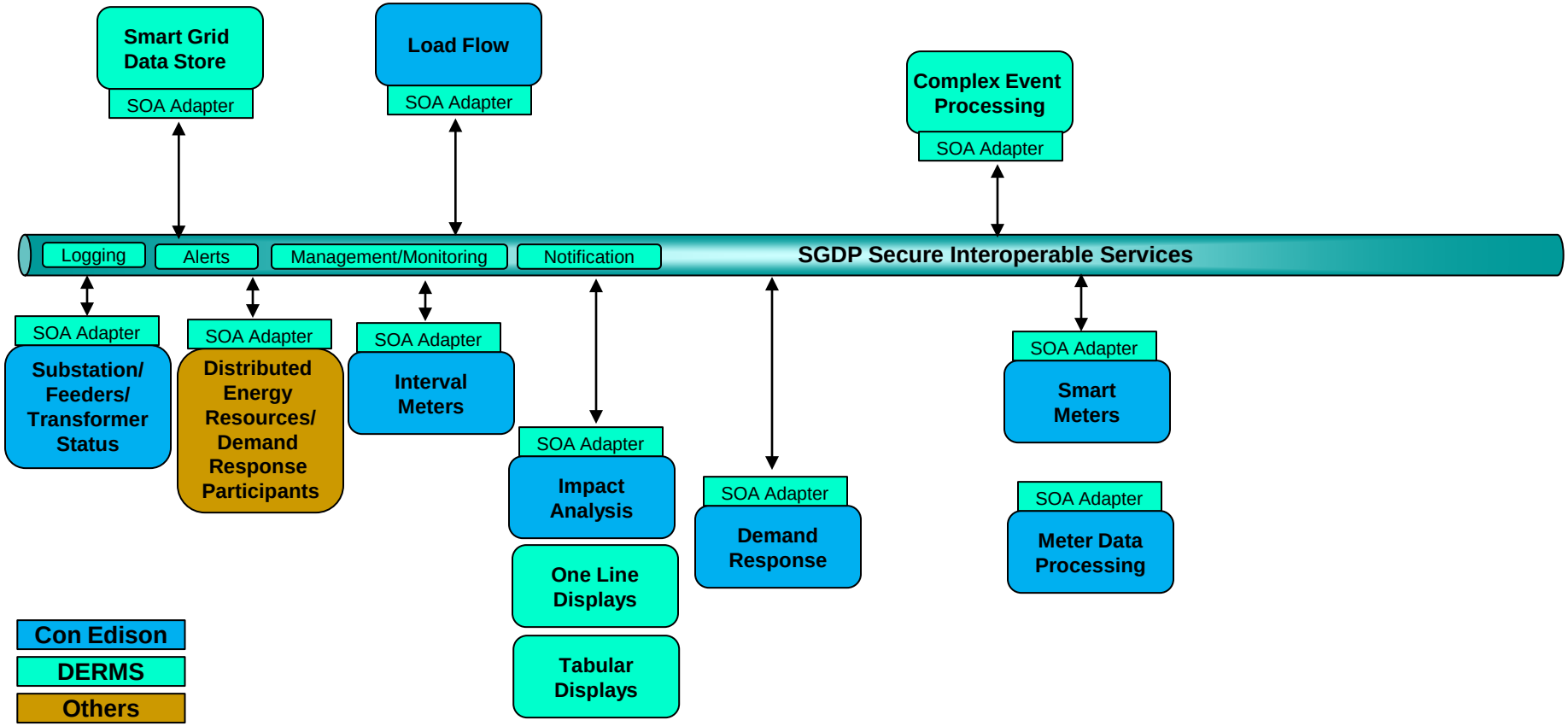
DERMS

- Distributed Energy Resource Management System – Siemens/TIBCO
- Demand Response & Distributed Generation resources integrated with distributed system
- Near real time status of DR and DG resources
- Control Capability: Demonstrated control of DR Resources via secure messages through NOC or directly to buildings (disabled initially)
- User Group – Distribution Engineering

DRMS

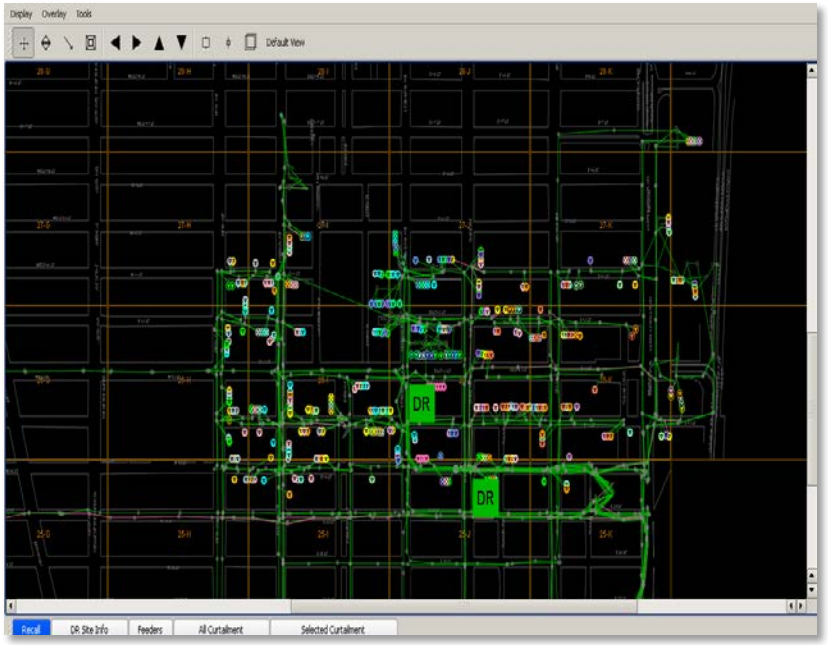
- Demand Response Management System
  - Alstom Grid
- Demand Response Program Management
  - Enroll
  - Event notification
  - CBL performance
  - Reporting
  - Settlement
- Near real time DR performance
- User Group – Energy Efficiency

Distributed Energy Resource Management System (DERMS)



Distributed Energy Resource Management System

- Con Edison Distributed System Status integrated with Customer Resources
- Targeted Demand Response from the following:
  - Building Management System (BMS)
  - Controller Connected to Standby Diesel Generator
  - Controller Connected to Electric Vehicle Charger with Standby Battery and PV Generation
  - ThinkEco Modlets



DR resource mapping

DERMS Resource Information

- Resource type
- Available Demand Response
- Current Generation
- Current Load Drawn
- Date / time of last status

SGDP - DR Resource Information - 2 - Windows Internet Explorer

Demand Response Summary■DR Resource Information - [PopUp]

DR - Resource

Resource ID:	SG4BG3I12030_BMS
Resource Type:	BMS
Resource Spec:	LC
Available Load for Demand Response (KW):	0
Available Generation for Demand Response (KW):	0
Current Generation (KW):	0
Current Load Drawn (KW):	0
Reactive Power (KVAR):	0
Resource Status:	Unavailable
Last Status Received:	07/02/2013 10:45

SGDP - PV Resource Information - 2 - Windows Internet Explorer

Demand Response Summary■PV Resource Information - [PopUp]

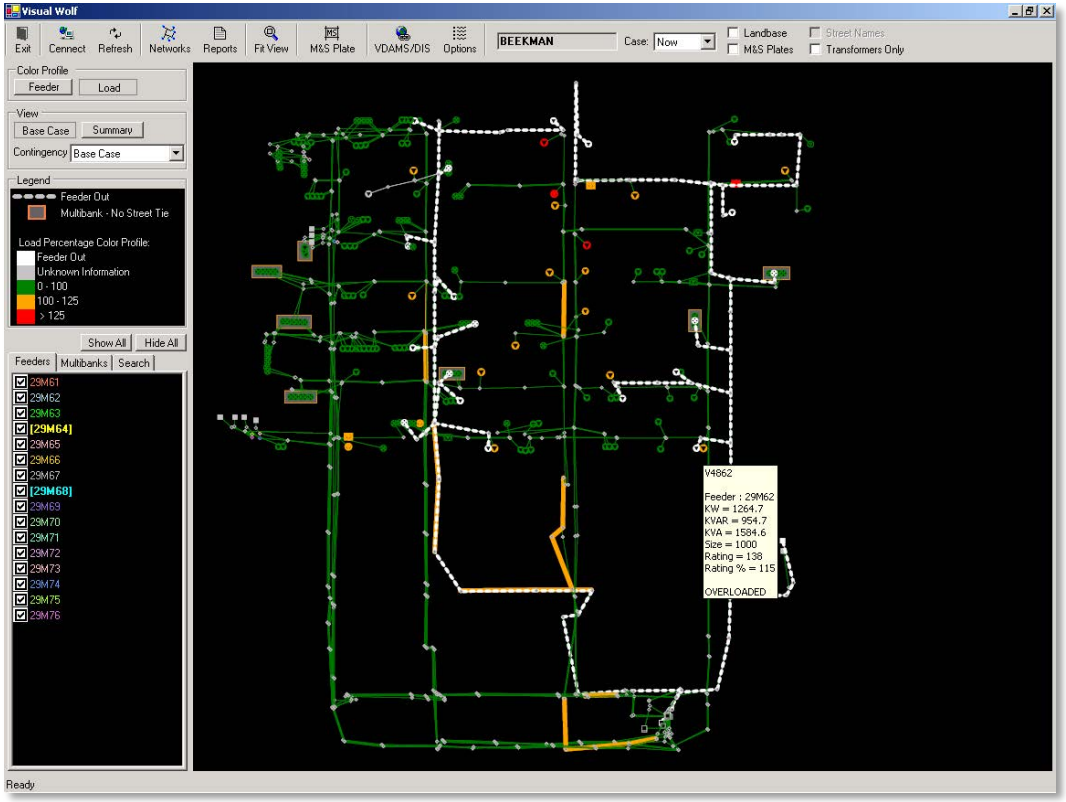
DR - Resource

PV Resource ID:	SO4BG4J12054_PV
Resource Type:	PV
Resource Spec:	PV
Available Load for Demand Response (KW):	0
Available Generation for Demand Response (KW):	0
Current Generation (KW):	5.3946666666666657
Current Load Drawn (KW):	
Reactive Power (KVAR):	0.212
Resource Status:	Unavailable
Last Status Received:	07/02/2013 10:40

PVL Decision Aid Integration into DERMS

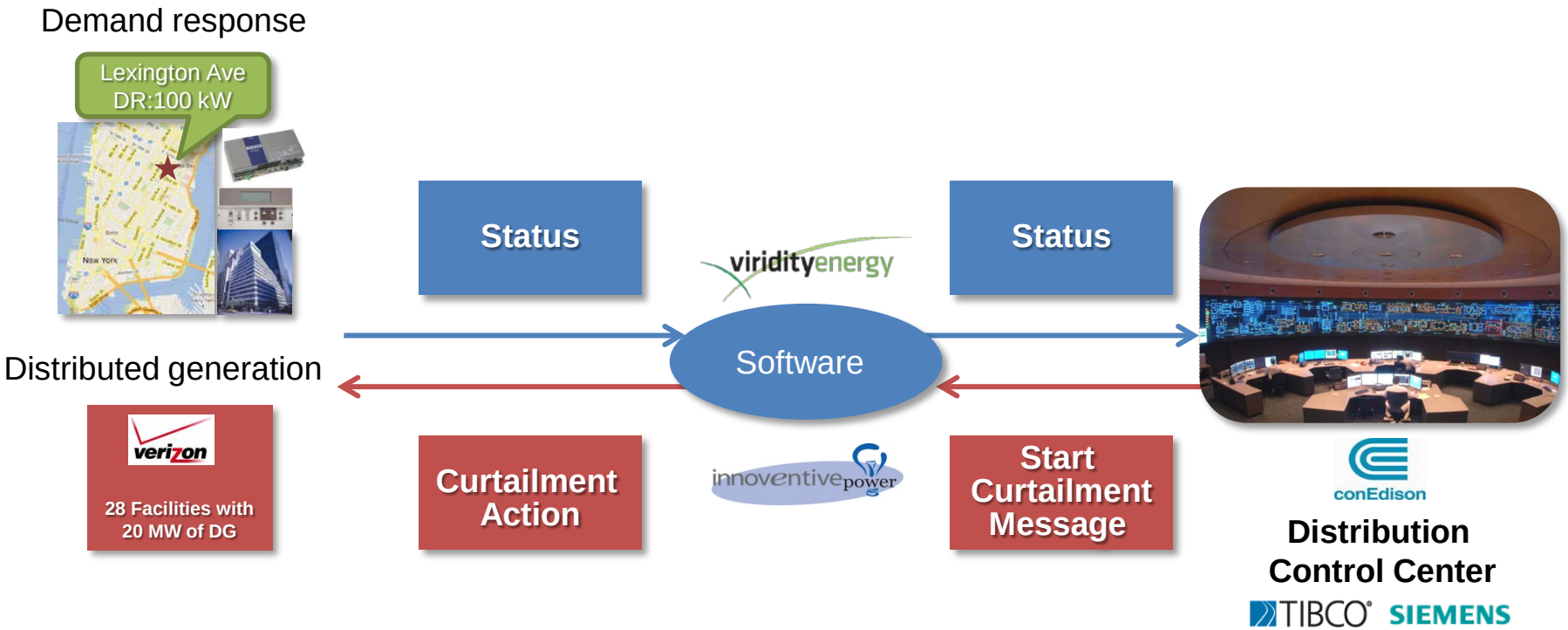
Prioritizes DR resources to alleviate overloaded Feeder Sections or Network Transformers

- Enables Targeted curtailment to alleviate overload on feeder or transformer
- Recommends DR resources to alleviate overload condition



SGDP Demand Response Diagram

SGDP Demand Response protocols provide better visibility and real-time dispatch of customer resources



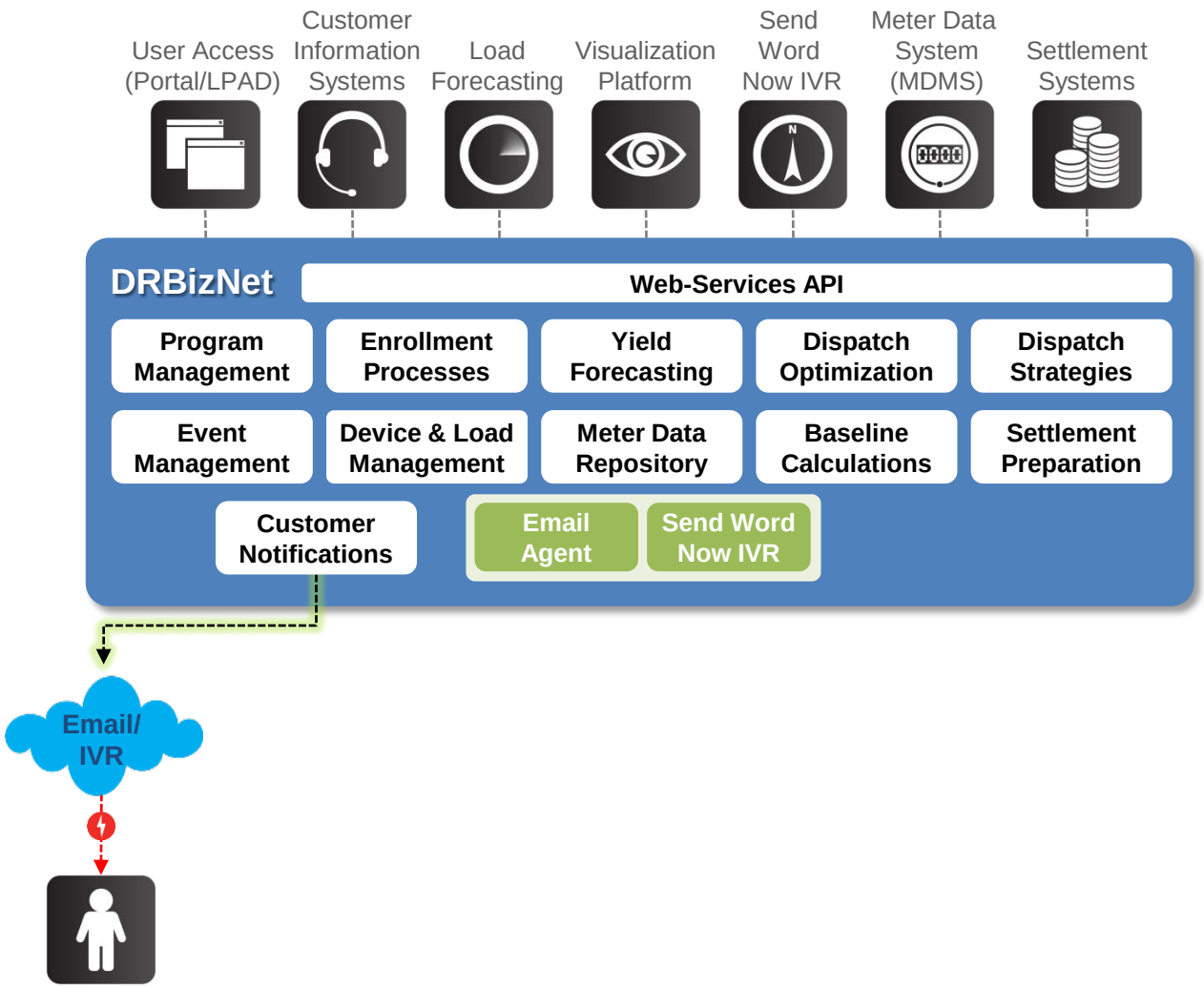
DERMS

- Distributed Energy Resource Management System – Siemens/TIBCO
- Demand Response & Distributed Generation resources integrated with distributed system
- Near real time status of DR and DG resources
- Control Capability: Demonstrated control of DR Resources via secure messages through NOC or directly to buildings (disabled initially)
- User Group – Distribution Engineering

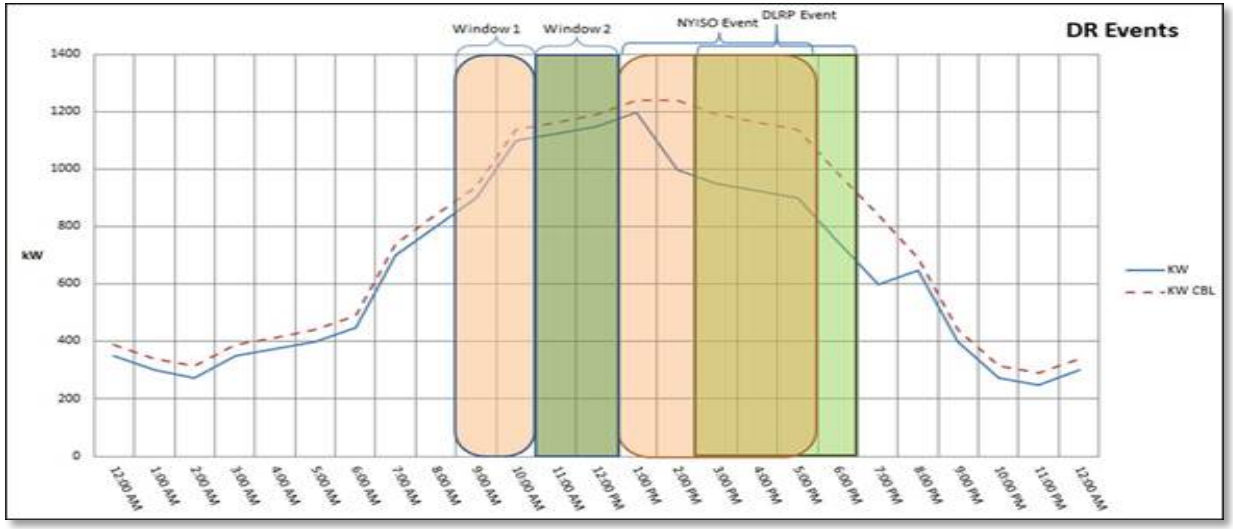
DRMS

- Demand Response Management System
  - Alstom Grid
- Demand Response Program Management
  - Enroll
  - Event notification
  - CBL performance
  - Reporting
  - Settlement
- Near real time DR performance
- User Group – Energy Efficiency

DRMS Implementation Architecture and Functionality



Baseline Calculations



Baseline Calculations Engine

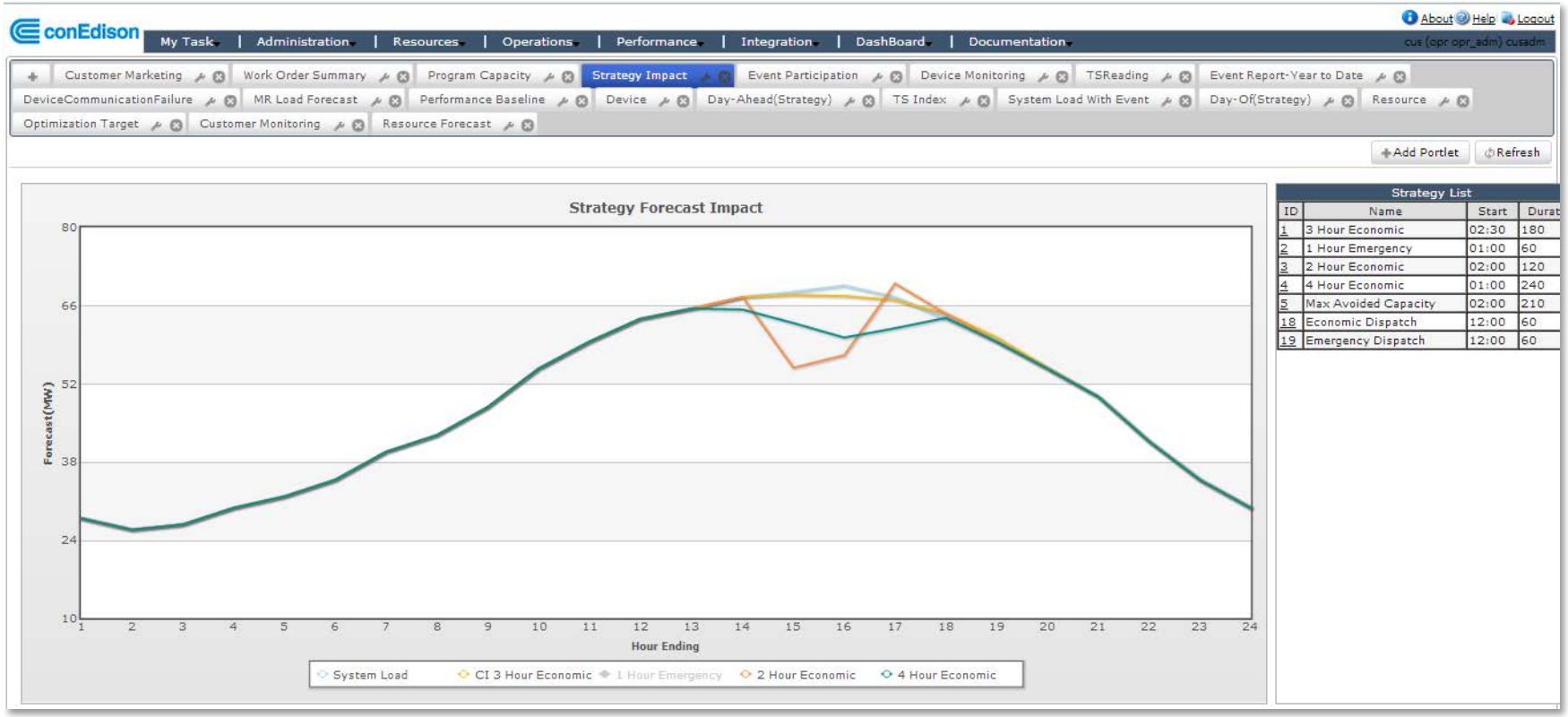
- Calculates recent historical usage to determine average usage prior to an event
- Calculates the actual performance during a DR event

Settlements Preparations Engine

- Calculates the payment due to a customer based upon their performance and the Program payment rules
- Calculates each hour / time segment separately
- Submits the credit/payment as a billing determinant to the Billing system

Visualization of Pre-defined Event Strategies

Impact shown against the system load



Optimization Module Modeling Dispatch Options

- Targeted DR Reduction
- Peak Load Shifting
- Economic Pricing/Profit

Con Edison Demonstration Project DE-OE0000197

Customer Sited Resource Management Tools

Platform Functionalities

New York State Department of Public Service

WG-2: Platform Technology Functionality

DRAFT 06-30-2014

Agenda

1. Development Approach
2. Definition, Scope and Role
3. High Level Functionality
4. Next Steps

Agenda

1 Development Approach

2 Definition, Scope and Role

3 High Level Functionality

4 Next Steps

Framework Components

- Ecosystem, Scope and Role
- Key Linkages
  - Policy objectives
  - Required functionality
  - Enabling technologies and infrastructure
  - Products, services and pricing
- Impacts/Outcomes
- Benefits

PTWG Guiding Principles

Technology Focused

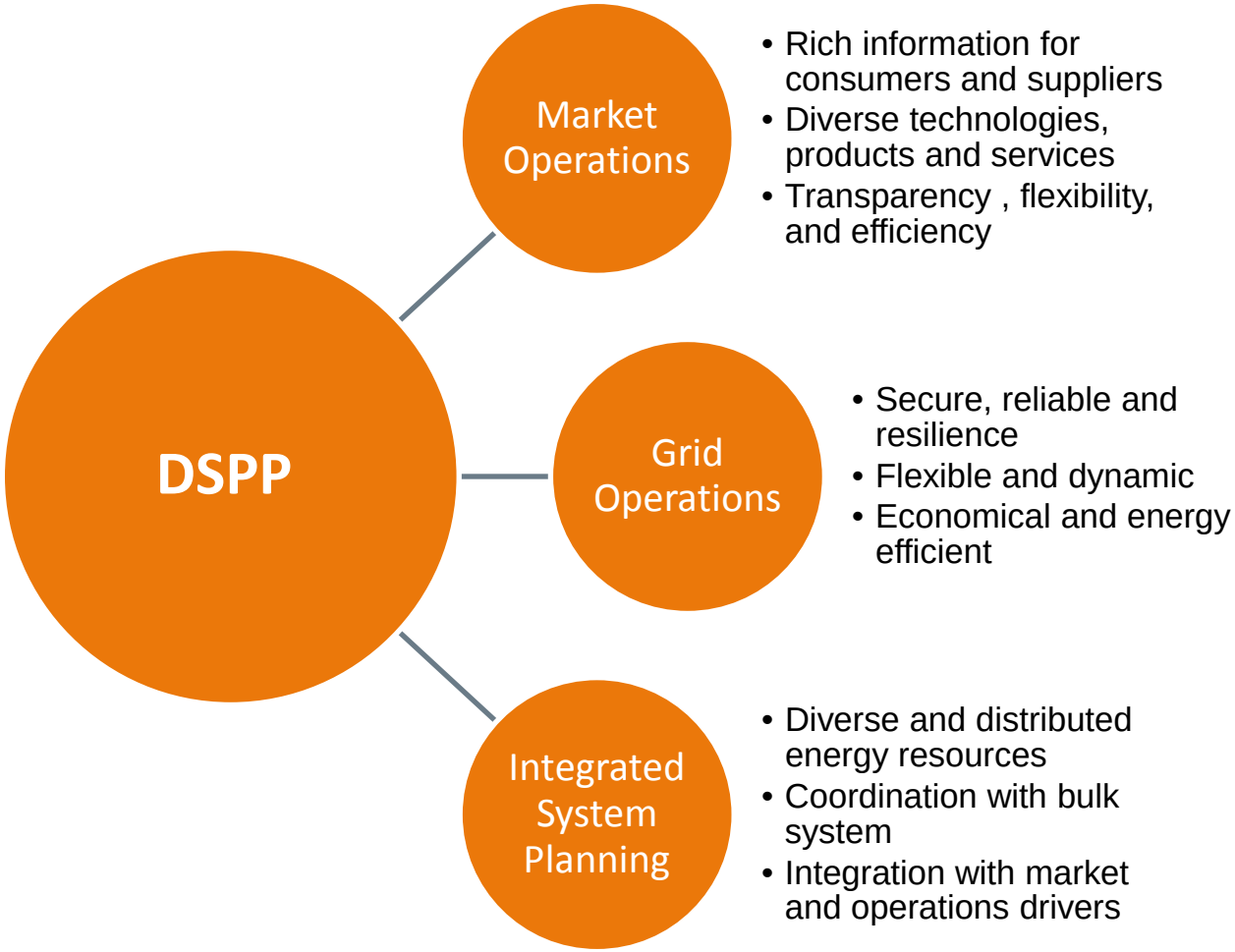
- Interoperable and standards based
- Consumer data privacy secured
- Meet /Exceed Federal & State Cyber Security requirements
- Enable transparent mechanism for technology updates through new regulatory tracking and accounting rules
- Promote greater visibility/control on the grid.
- Encourage open system architectures to maximize customer/third party participation (open architecture)
- Encourage platform standardization across utility service areas (standard interfaces)
- Achieve desired functionality while minimizing costs
- Minimize risk of obsolescence while optimizing new technologies/functionalities
- Employ scalable and flexible technologies

Policy Focused

- Enable significant expansion of customer facing energy services (all classes)
- Promote greater and more efficient use of DER including microgrids
- Maximize efficiency of existing utility infrastructure
- Enable transparent market based customer participation to grid reliability (Capacity) and differentiated energy delivery (Energy Source).
- Promote retail level markets and entry of new retail energy service providers
- Promote the development of net-zero and grid-integrated premises and develop mechanism to interact with them through the delivery of other services to them.
- Ensure continued system reliability, resilience, and security

Source: Working Outline, Platform Technology Working Group, June 2, 2014

Platform Functionalities
DSPP Objectives



Agenda

1 Development Approach

2 Definition, Scope and Role

3 High Level Functionality

4 Next Steps

Platform Functionalities
Working Definition of the DSPP

Working Definition of DSPP:

The DSPP operates an intelligent network platform that will provide safe, reliable and efficient electric services by integrating diverse resources to meet customers' and society's evolving needs. The DSPP fosters broad market activity by enabling active customer and third party engagement that is aligned with the wholesale market and bulk power system.

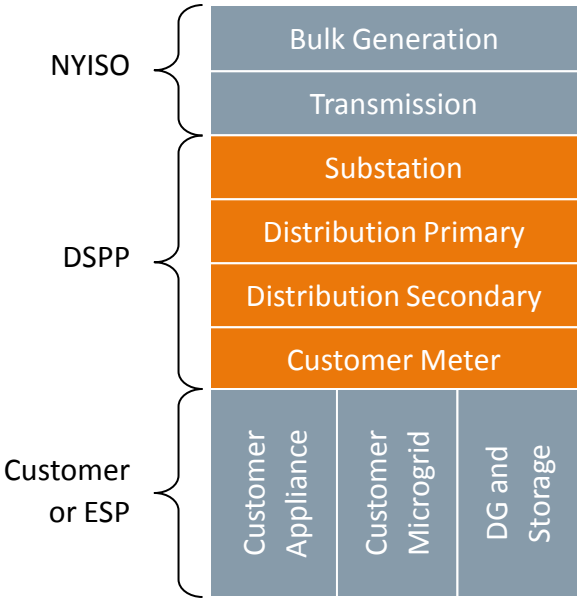
Platform Functionalities
Scope and Roles for Market Operations and Grid Operations

	NY ISO	DSPP	Customers
Market Operations	"Wholesale" Energy and Capacity	Basic and Value Added Services *	Direct Access (Individuals)
	"Wholesale" Ancillary Services	"Retail to Wholesale" Aggregation*	3rd Party Service Providers
	"Wholesale" Market Administration	"Retail" Market Administration	
Grid Operations	Wide Area View	Regional/Local View	"Premise" View
	Bulk Operations (115 kV and above)	T/D/Microgrid Ops (115 kV and below)	"Premise" or Microgrid Operations
	Central Generation Management	DER Management	DER Operations

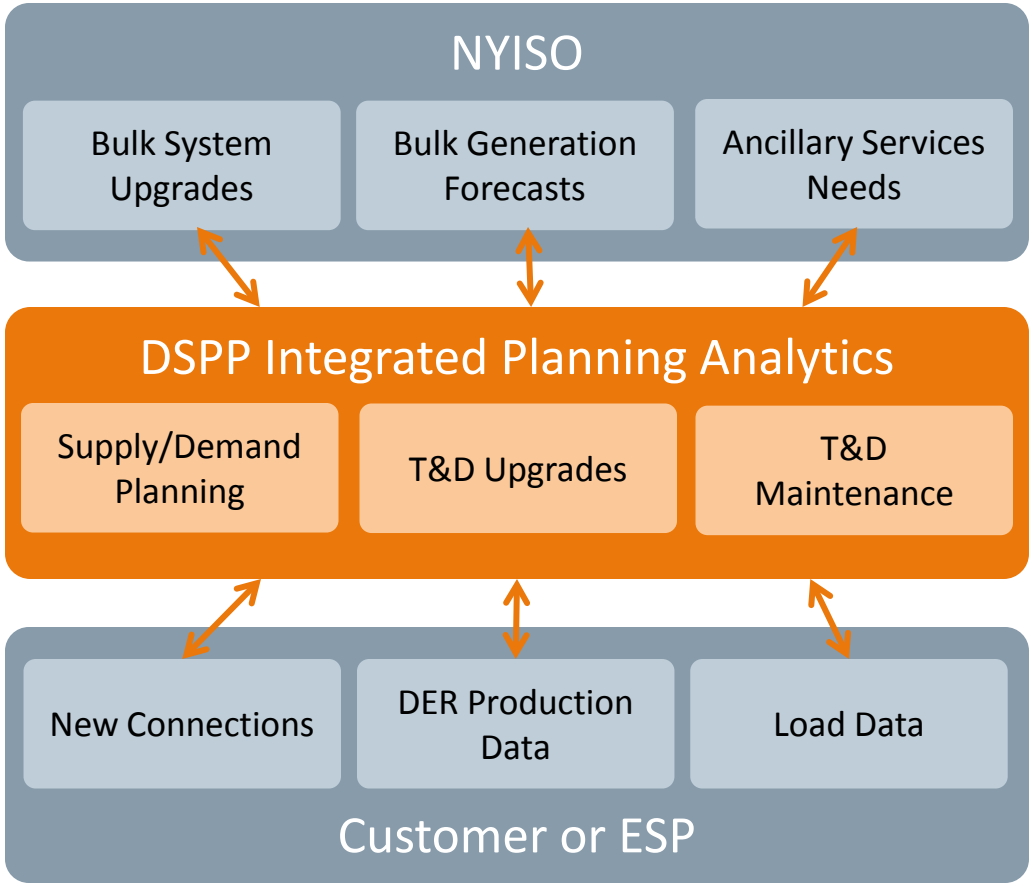
*Provide or enable

Platform Functionalities
DSPP Scope and Role for Integrated System Planning

Electric Network Levels



Integrated System Planning



Agenda

1 Development Approach

2 Definition, Scope and Role

3 High Level Functionality

4 Next Steps

Platform Functionalities
Preliminary DSPP functionalities in key areas

Grid

- Real-time load monitoring
- Real-time network monitoring
- Adaptive protection
- Enhanced fault detection/location
- Outage/restoration notification
- Automated feeder and line switching (FLISR/FDIR)
- Automated voltage and VAR control
- Real-time load transfer
- Dynamic capability rating
- Power flow control
- Automated islanding and reconnection (microgrid)
- Real time/predicted probabilistic based area substation, feeder, and customer level reliability metrics (MTTF/MTTR

Enable

Customer/DER/ Microgrid

- Direct load control
- DER power control
- DER power factor control
- Automated islanding and reconnection
- Algorithms and analytics for Customer/DER/Microgrid control and optimization

Market

- Dynamic event notification
- Dynamic pricing
- Market-based demand response
- Dynamic electricity production forecasting
- Dynamic electricity consumption forecasting
- M&V for producers and consumers (premise/appliance/resource)
- Participant registration and relationship management
- Confirmation and settlement
- Billing, receiving and cash management
- Free-market trading
- Algorithms and analytics for market information/ops

Platform Functionalities
DSPP Enablement of Policy Objectives

REV Policy Objective	DSPP Enables
Customer knowledge and tools that support effective management of their total energy bill	YES
Market animation and leverage of ratepayer contributions	YES
System wide efficiency	YES
Fuel and resource diversity	YES
System reliability and resiliency	YES
Reduction of carbon emissions	YES

Grid Example

Functionality	REV Policy Objectives						Domain		
	Customer knowledge and tools to manage bills	Market animation and leverage or ratepayer contributions	System wide efficiency	Fuel and resource diversity	System reliability and resiliency	CO2 reduction	Market Operations	Grid Operations	Integrated System Planning
Grid									
Real-time load monitoring									
Real-time network monitoring									
Adaptive protection									
Enhanced fault detection and location									
Outage and restoration notification									
Automated feeder and line switching (FLISR/FDIR)									
Automated Voltage and VAR control			Y	Y	Y	Y		Y	
Real-time load transfer									
Dynamic capability rating									
Diagnosis/notification of equipment condition									
Power flow control									

Customer/DER/Microgrid Example

Functionality	REV Policy Objectives						Domain		
	Customer knowledge and tools to manage bills	Market animation and leverage or ratepayer contributions	System wide efficiency	Fuel and resource diversity	System reliability and resiliency	CO2 reduction	Market Operations	Grid Operations	Integrated System Planning
Customer/DER/Microgrid									
Direct load control									
DER power control									
DER power factor control		Y	Y	Y	Y	Y		Y	Y
DER optimization									
Automated islanding and reconnection (microgrid)									
Electricity storage									

Market Functionality Example

Functionality	REV Policy Objectives						Domain		
	Customer knowledge and tools to manage bills	Market animation and leverage or ratepayer contributions	System wide efficiency	Fuel and resource diversity	System reliability and resiliency	CO2 reduction	Market Operations	Grid Operations	Integrated System Planning
Market									
Dynamic event notification									
Dynamic pricing									
Market-based demand response									
Dynamic electricity production forecasting	Y	Y	Y	Y	Y		Y	Y	Y
Dynamic electricity consumption forecasting									
Historical DER performance monitoring									
Historical load monitoring									
M&V for producers and consumers (premise/appliance/resource)									
Settlement, billing and payment transactions									

Agenda

1 Development Approach

2 Definition, Scope and Role

3 High Level Functionality

4 Next Steps

Next Steps

- Complete mapping of framework linkages including policy objectives, functional requirements, enabling technologies and infrastructure, impacts and benefits
- Complete high level technology architecture
- Align input from Products and Services working on platform functional requirements

Standards & Protocols

NYS DPS - Platform Technology Working Group

Standards and Protocols Subgroup

Members of the Working Subgroup

Subgroup Lead - David Lovelady (Siemens PTI), david.lovelady@siemens.com
Tony Abate (NYSERDA), awa@nyserda.ny.gov
Deana Dennis (NEMA), deana.dennis@nema.org
Jim Gallagher (Smart Grid Consortium), jgallagher@nyssmartgrid.com
Marty Uczen (Verizon), martin.uczen@verizon.com
Mike Williams (Staff), michael.williams@dps.ny.gov
Tom Herbst (Silver Springs), therbst@silverspringnet.com
David Locke (Verizon), david.w.locke@verizon.com
Michael Vecchi (Landis & Gyr), Michael.Vecchi@landisgyr.com
Dr Mani Vadari (NY State Consortium), mani.vadari@moderngridsolutions.com
Robert Sheridan (National Grid), robert.sheridan@nationalgrid.com

EPRI

Arindam Maitra, amaitra@epri.com
Tom Short, tshort@epri.com
Becky Wingenroth, Wingenroth@epri.com

Members of the Working Subgroup

LBNL

Girish Ghatikar, gghatikar@lbl.gov

Peter Cappers, pacappers@lbl.gov

Sila Kiliccote, skiliccote@lbl.gov

Staff

Michael Rieder, Michael.Rieder@dps.ny.gov

Peggie Neville, Peggie.Neville@dps.ny.gov

Contents

1. Introduction.
2. SP Background.
3. DSPP SP Framework.
4. Industry leading SP.
5. The current use of SP in NY.
6. Gaps in SP relevant to SP.
7. Conclusions & Suggestions.
8. References.

Introduction

The mains aim of this document is not to detail each and every SP relevant to the DSPP (although they are provided as an appendix) but instead highlight several topics this WG felt important for NYSPSC staff.

Please note, there are many SP that are not directly mentioned in this document and the discussion is based on the current knowledge of the limited number of working group members.

"Successful, market driven technologies will also require interoperability, connectivity and open standards" – REV

"An important step to encourage aggregation is for the Commission to establish protocols and standards for accessing and sharing customer information". - REV

As specified in REV, for successful implementation of the DSPP, SP will be very important in particular to ensure interoperability for the public benefit.

SP Background

- Smart grid SP are fragmented and confusing.

- Not only are there multiple named and numbered SP from multiple SP bodies (IEC, IEEE, ANSI, OAG, OpenSG and so on) dealing with the same issues, but there are also multiple SP bodies engaged in sometimes overlapping, sometimes complementary, efforts.

- In order to address some of the complexity NIST Smart Grid Interoperability Panel are charged with indentifying applicable standards, identifying gaps and driving new SP to cut across the current sea of SP.

SP Background Con't

- There are several layers of SP for example an SP for the data representation, a SP for the data structure with the IT system, a SP for the communication protocol and a SP for the hardware I/O (inputs & outputs).

- From history of other SP developments it is understood several industry SP will end up as popular solutions for each layer and to wait for completion of the optimal SP before implementing smart grid could be a very long wait.

- For SP development there is usually a race between vendor developed SP and committee SP, the winners will be determined by the industry as a whole over time.

Framework

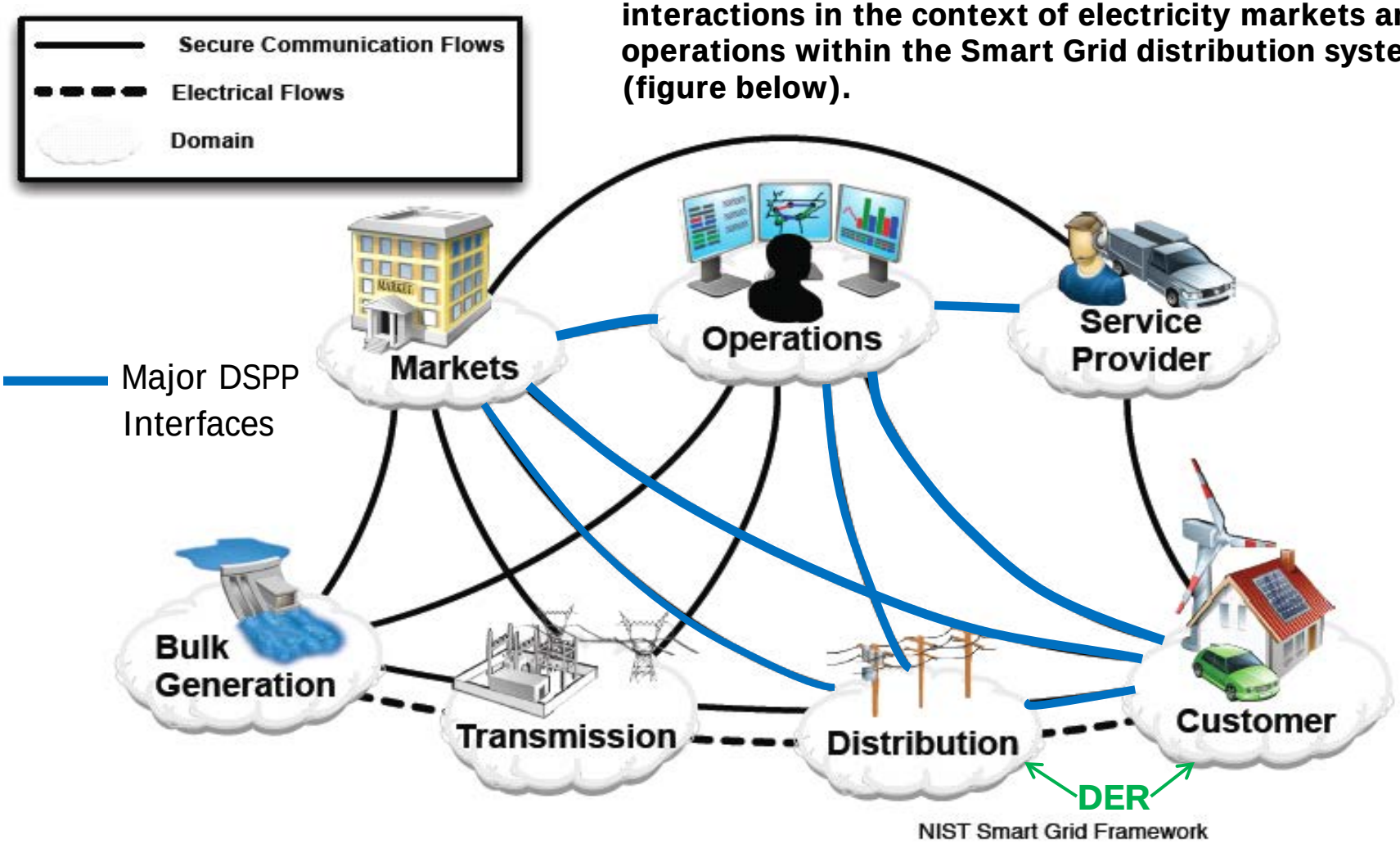
- To identify relevant industry Standards and Protocols (“SP”) applicable to the DSPP.

- Includes distributed and customer sited resources but not intra-building, DER technology specific, or internal operations of distribution or ISO operations.

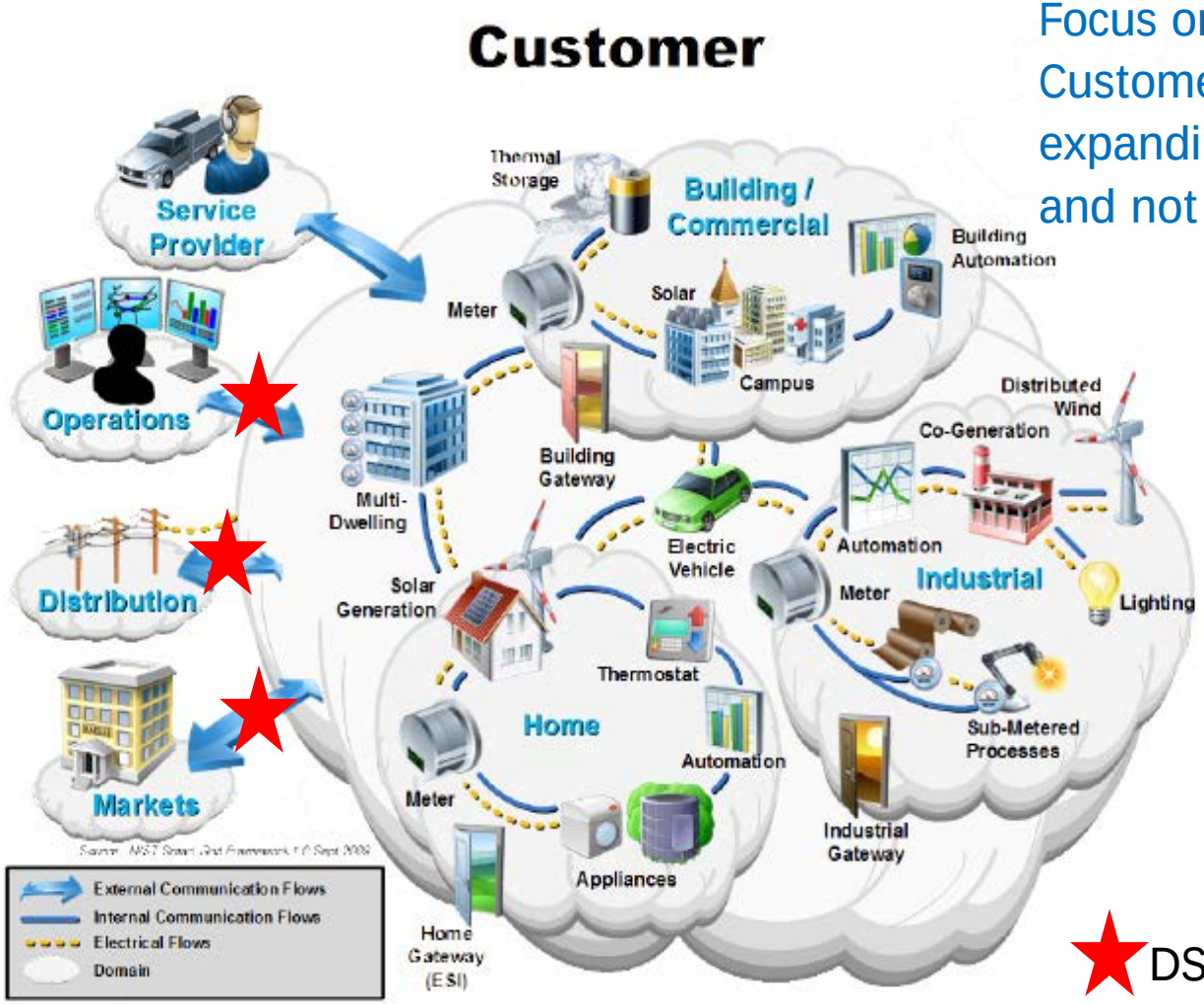
- The pertinent SP will support resources integration for program participation, transactions and operational control as necessary.

Framework - Smart Grid Conceptual Model (NIST & SGiP)

Domain focus on the customer and service providers' interactions in the context of electricity markets and operations within the Smart Grid distribution system (figure below).



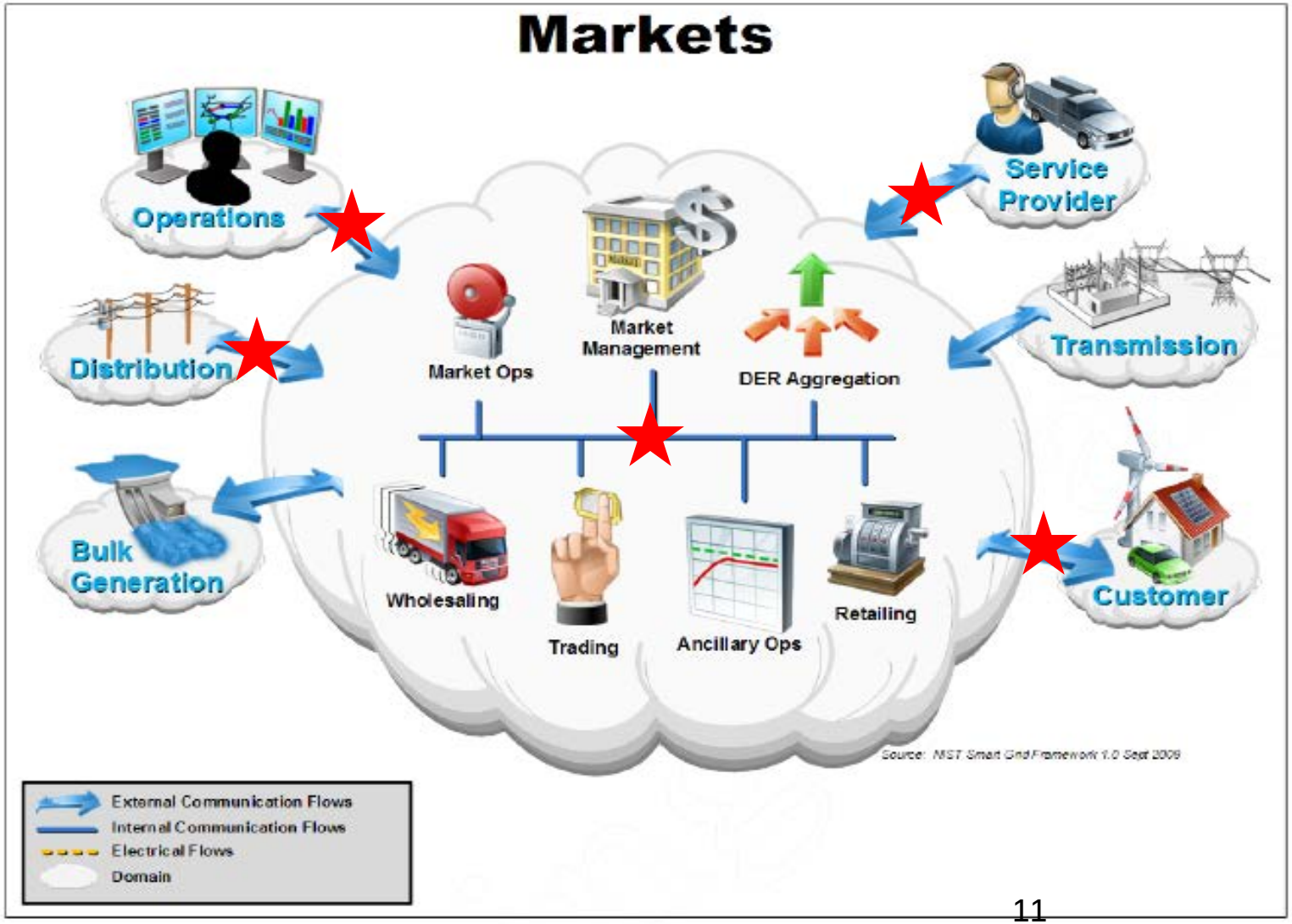
Framework Con't



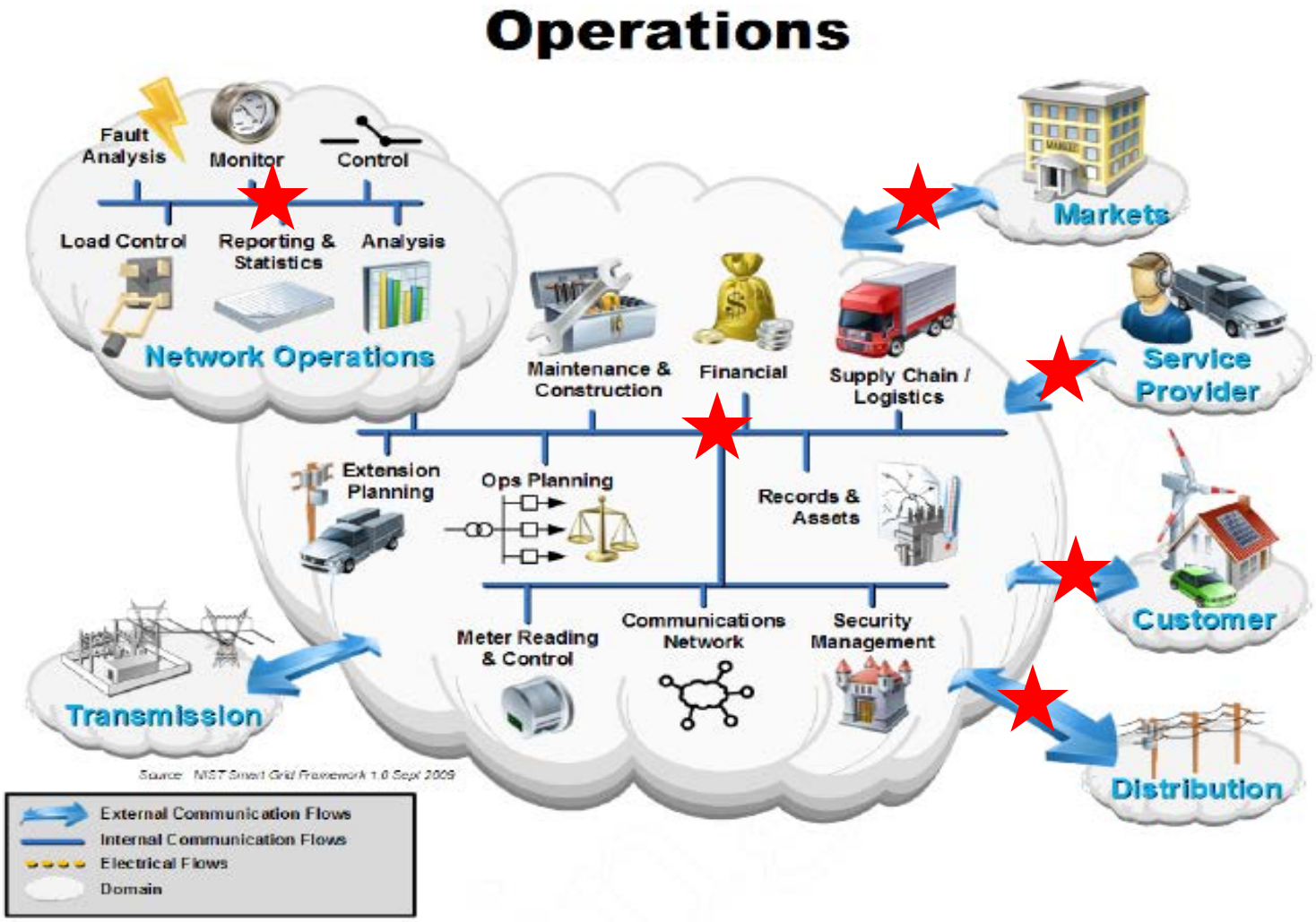
Focus on SP within Customer Domain that are expanding out to the Grid and not internal SP.

★ DSPP SP Interface Focus

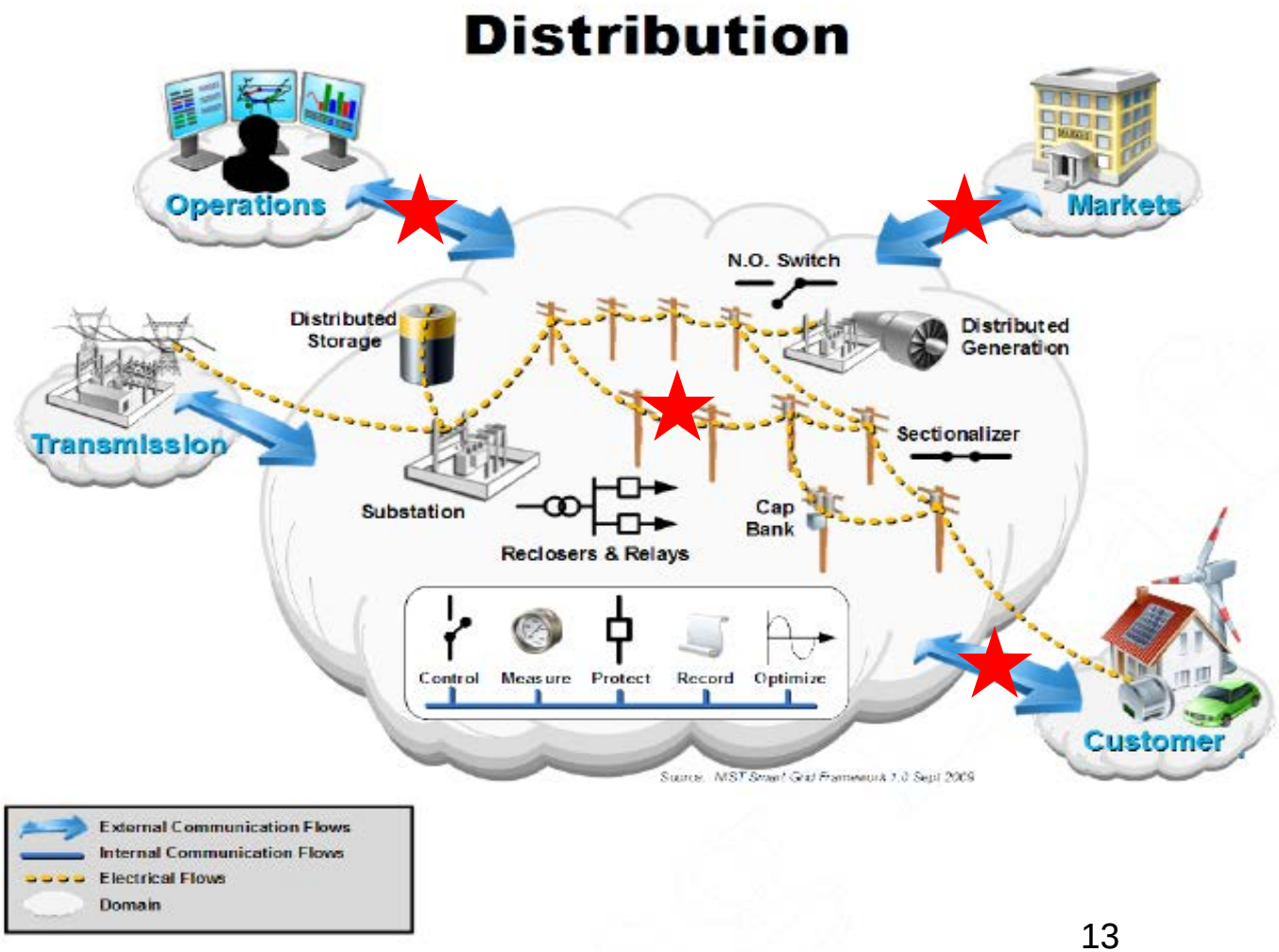
Framework Con't



Framework Con't



Framework Con't

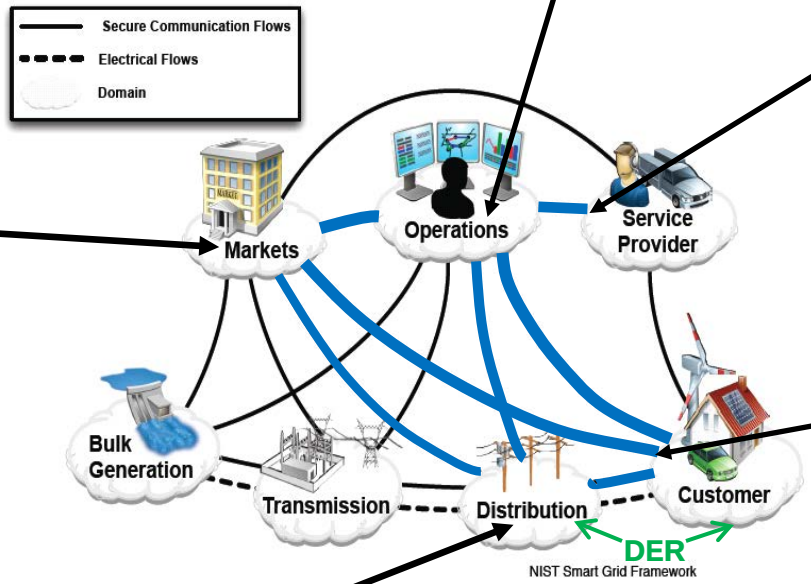


Industry leading SP

IEC 61968, 61970 (CIM)
NISTR 7628 (cyber security)

OpenADR
OCPP
IEC 61850-7-420
IEEE P2030.5
Sunspec
NIST 7628 (cyber security)

IEC 61968+61970 (CIM)
NISTR 7628 and IEC 62351 (cyber security)



OpenADR
OCPP
FSGIM
IEEE P2030.5
Sunspec
NEC
NIST 7628 (cyber security)

IEC 61850
DNP3
IEC 60870 (ICCP/TASE)
IEEE 1547
IEEE P2030.2
NISTR 7628 and IEC 62351 (cyber security)

Objective: Highlight the major SP currently leading the industry.

Industry leading SP Con't

SP Name	Brief Description
Markets & Operations	
IEC CIM (61968, 61970)	Deployed and increasingly used within the utility/system operator's enterprise systems.
Distribution	
IEC 68150 Suite	• Standard for the design of electrical substation automation. • Abstract data models defined in IEC 61850 can be mapped to a number of protocols. • IEC 61850-7-420 focuses on communications systems for Distributed Energy Resources (DER).
DNP3 (Distributed Network Protocol)	• Used by SCADA Master Stations, Remote Terminal Units (RTUs), and Intelligent Electronic Devices (IEDs). • Primarily used for communications between a master station and RTUs or IEDs.

Industry leading SP Con't

SP Name	Brief Description
Distribution Con't	
ICCP–IEC 60870-6 TASE.2	Developed to allow two or more utilities to exchange real-time data, schedule, and control commands.
IEEE 1547	• Standard for Interconnecting Distributed Resources with Electric Power Systems. • Provides a set of criteria and requirements for the interconnection of DG. • Many utilities follow the standard
IEEE P1547 Revision – in development	• Since the re-approval of 1547 in 2008 significant changes in DG space. • Interim amendment released May 2014, allows for limited voltage and frequency ride through and the ability to actively control voltage. • Full revision of the standard started April 2014, aim to release by 2018. • Main revisions are likely to include: • Wider frequency and voltage ride through. • Requirement for interoperability and communications interfaces. • Microgrids. • DG on secondary grid networks.

Industry leading SP Con't

SP Name	Brief Description
Distribution Con't	
IEEE P2030.2 – in development	• Guidelines for energy storage systems integrated with the grid. • Builds upon IEEE Std 2030 Guide • Provides guidance on technical characteristics, integration, compatibly, terminology, functional performance, operation, testing and application of energy storage systems.
Customers & Service Providers	
Open ADR	• A NIST Smart Grid data model standard. • Developed to facilitate one and 2-way price and demand response interactions between customers and the Smart Grid entities. • Not a prescriptive format, but flexible. • Presents a client-server architecture that is independent of the communication protocol. • Intended to enable automated response from smart buildings and devices be scalable, low-cost, non-propriety, industry supported, with a compliance path for interoperability certification.
Open Charge Point Protocol (OCPP):	• European communication protocol used to communicate charging session information and settlement with EVs and EVSEs. • Developing fast and being adopted around the world

Industry leading SP Con't

SP Name	Brief Description
Customers & Service Providers Con't	
FSGIM (NEMA & ASHRAE)	Create a common information model to enable management of residential commercial and industrial DER to response to communication with a smart electrical grid and electrical service providers.
IEC 61850-7-420	Communications systems for Distributed Energy Resources (DER)
IEEE 2030.5 – Smart Energy Profile 2.0 – in development	• Defines the application protocol to enable utility management of the end user energy environment • Will include demand response, load control, time of day pricing, management of distributed generation, electric vehicles, etc.
SunSpec	• Distributed energy industry participants, pursuing information standards to enable "plug & play" system interoperability. • Address operational aspects of PV power plants on the smart grid—including residential, commercial, and utility-scale systems.
NEC	• National Electrical Code is a standard that most if not all customers are subject to and are working to harmonize the smart grid with customers SP.

Industry leading SP Con't

SP Name	Brief Description
Overarching SP	
NIST & SGiP Framework	• Provides a national and international focus on smart grid. • Lists out all the main SP associated with SG. • Framework 3.0 is currently out for comments
IEEE P2030	• A Guide for Smart Grid Interoperability. • Based on NIST conceptual model. • Provides a methodology for developing a smart grid architecture based on three layers: Power, Communications and IT.
NIST-R 7628	Describes guidelines for cyber-security for the Smart Grid, considers NERC-CIP.
IPV6	• Latest Internet protocol is being discussed in the industry as potentially leading smart grid communications. The protocol is advertized as having the enhanced address space, routing and security that will be required for universal smart grid connectivity.

The current use of SP in NY

Objective: Highlight the major/most popular SP currently being used in NY that should be considered in the DSPP.

Demand-side Resources Integration with the NYISO

- NYISO networking, control and security SP apply to the sophisticated integration of DERs.

- Today, more than 100 MW of demand response (curtailment of large loads) is under NYISO automatic generator control (6 second control and telemetry signals) to provide grid reliability (synchronous reserves).

- The SP, commonly used for generators, initially presented a high-cost barrier.

- A combination of NYISO rule changes and technical innovation (NYSERDA project) enabled smaller resources to meet the same SP at a lower cost.

The current use of SP in NY Con't

In use today by Con Ed for utility device automation near 'edge of grid'

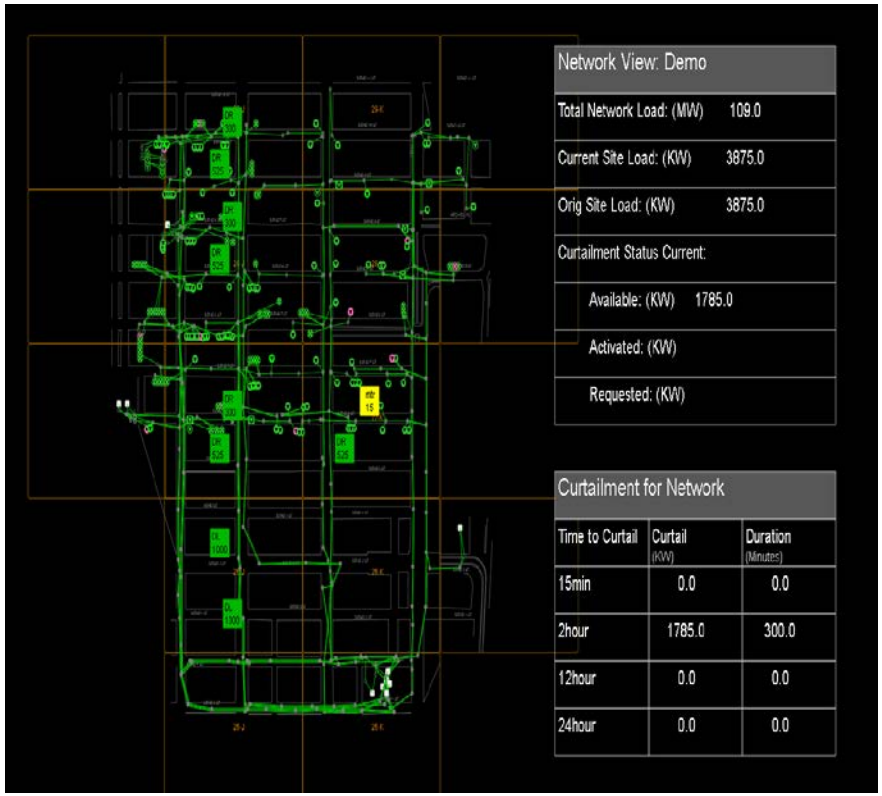
- DNP3.
- IEC 61850.
- IEEE 1547 – Interconnection w/ special methodology Con Ed for n-2
- ISA/IEC-62443 - cyber security management system utility control systems

National Grid

- Public available technical installation standards and guidelines for distributed generator integration with the utility – ESB 756.

The current use of SP in NY con't – DOE CONED DERMS

- Developed secure **interoperable** platform to monitor & control load and DER.
- Integrate legacy & smart grid data systems with established SP.
- Developed Secured Web Services for internal and external communication with third party providers.
- A blueprint for urban, underground smart grid deployment.



<u>SP Followed</u>

NIST 1108 – Smart Grid Frame Work

NIST 7628 – Smart Grid cyber security control

NIST 800.53 – Web Services (non-MPLS)

FIPS 199 - Federal Information Processing Standard for secure transmission

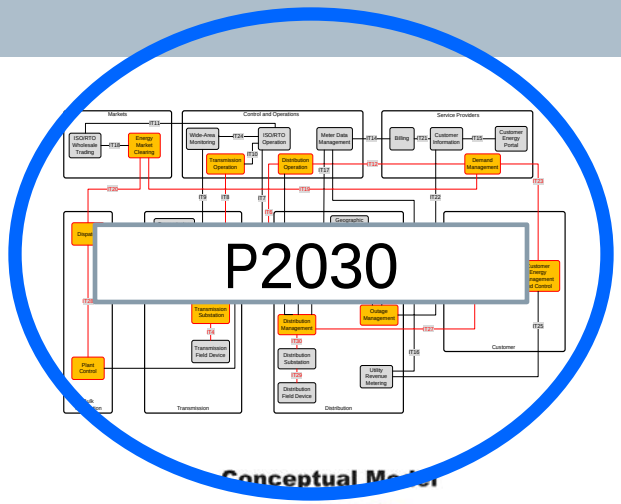
conEdison SIEMENS

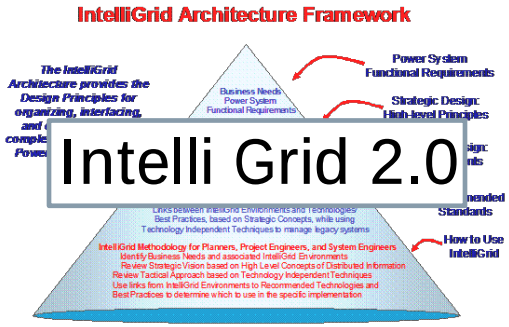
DSPP Architecture Benefits

Five key benefits for DSPP architecture development:

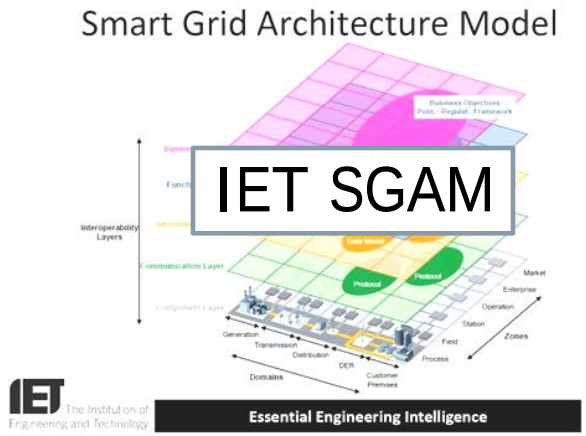
1. Architecture identifies gaps in technologies, and SP.
2. Architecture creates interoperability through the definition of domains, boundaries and terms.
3. A common NY DSPP architecture that all parties can understand and communicate with when developing something as complex as the DSPP.
4. Architecture can describe the evolution of DSPP functionality over time.
5. A common framework to show DSPP interactions.

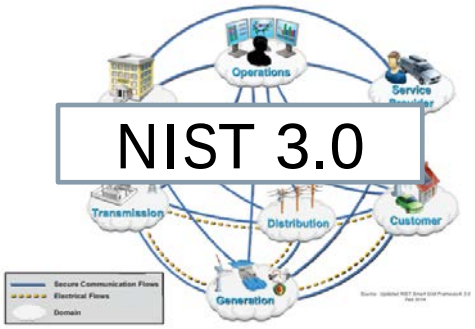
Architecture Standards

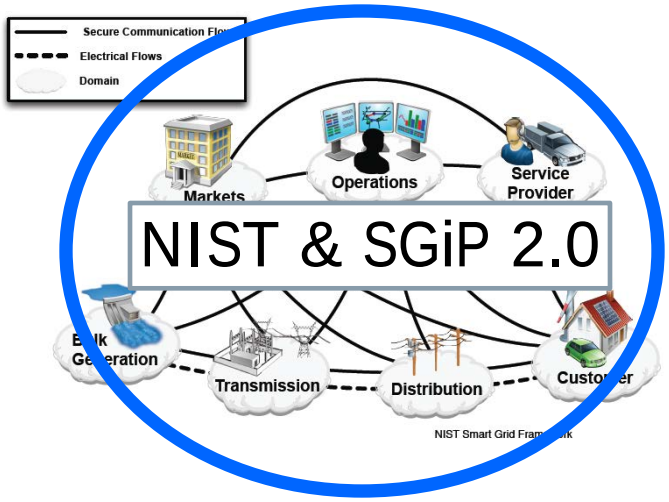


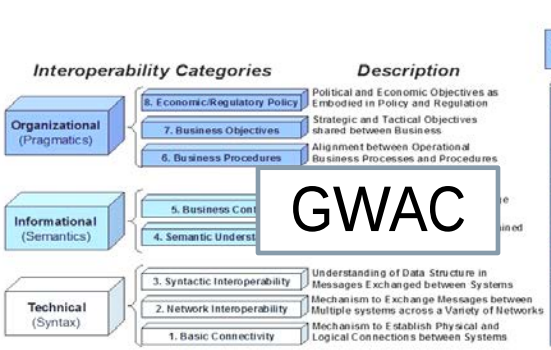


EPRI ELECTRIC POWER RESEARCH INSTITUTE



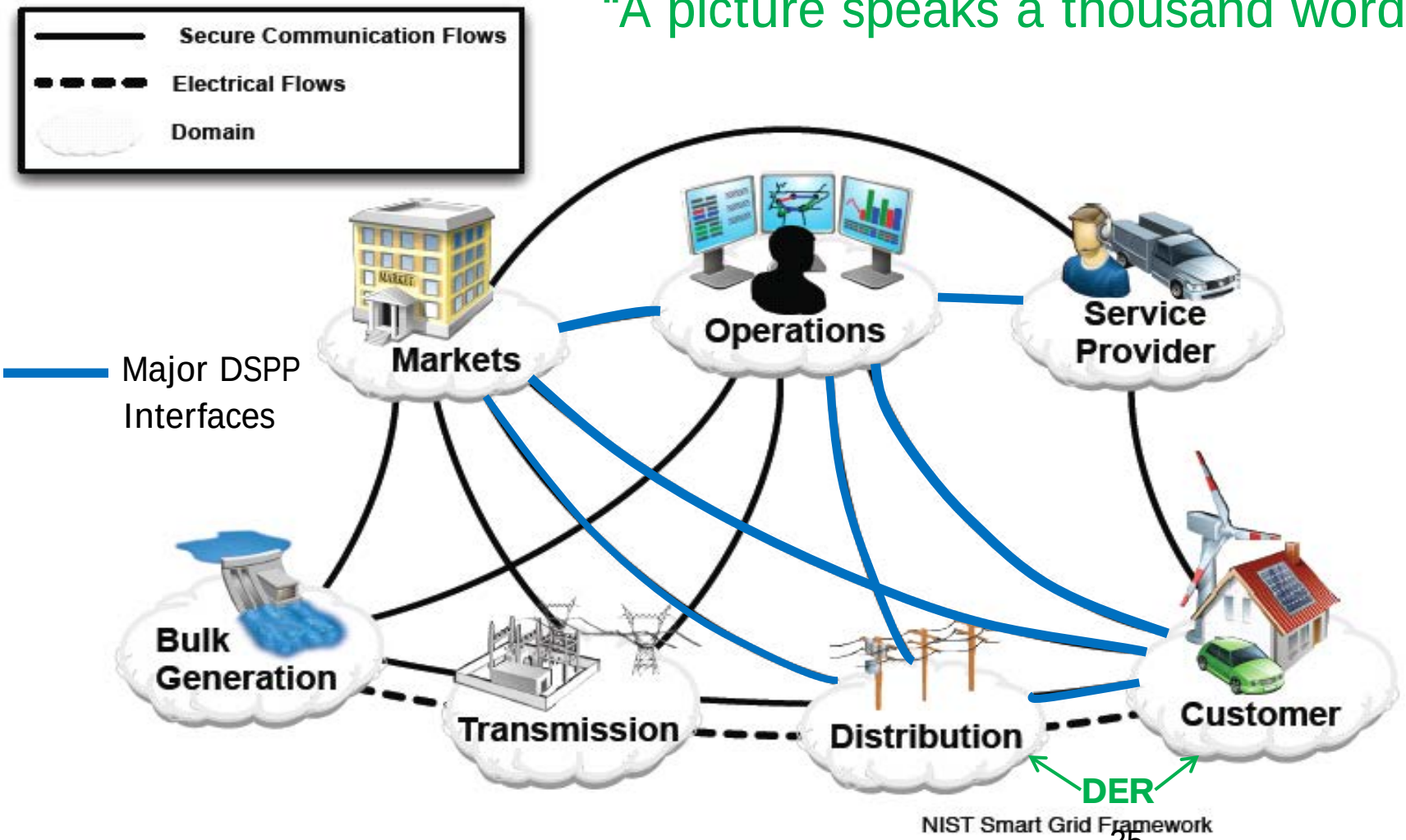




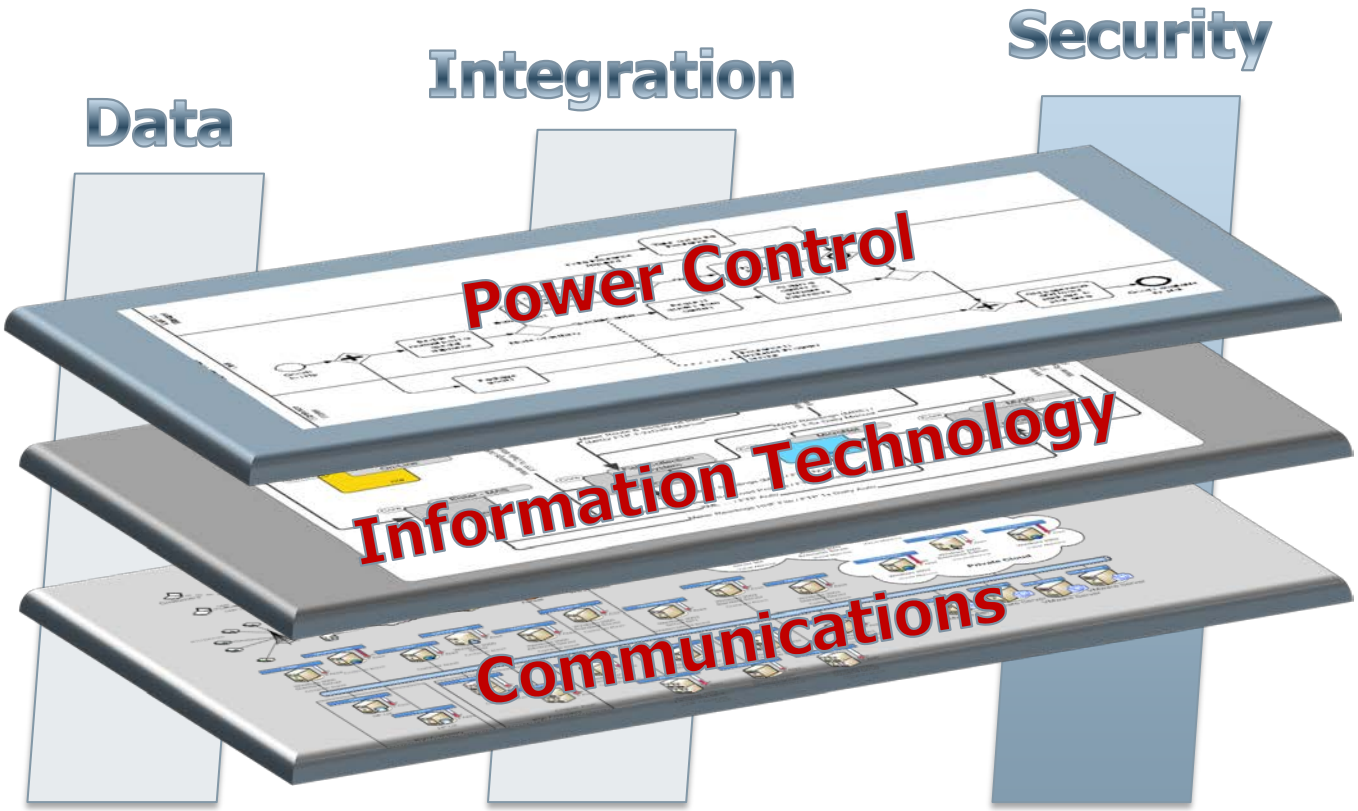


NIST 2.0 & SGiP

"A picture speaks a thousand words"



IEEE 2030 Architecture



Focus on key control and communications areas needed for DSPP

NIST Compliant National standard

Readily accepted and understood

IEEE is open to enhance as it matures

Most practical to use with initial WG and timeframe

Use Case - Dynamic Electricity Production forecasting

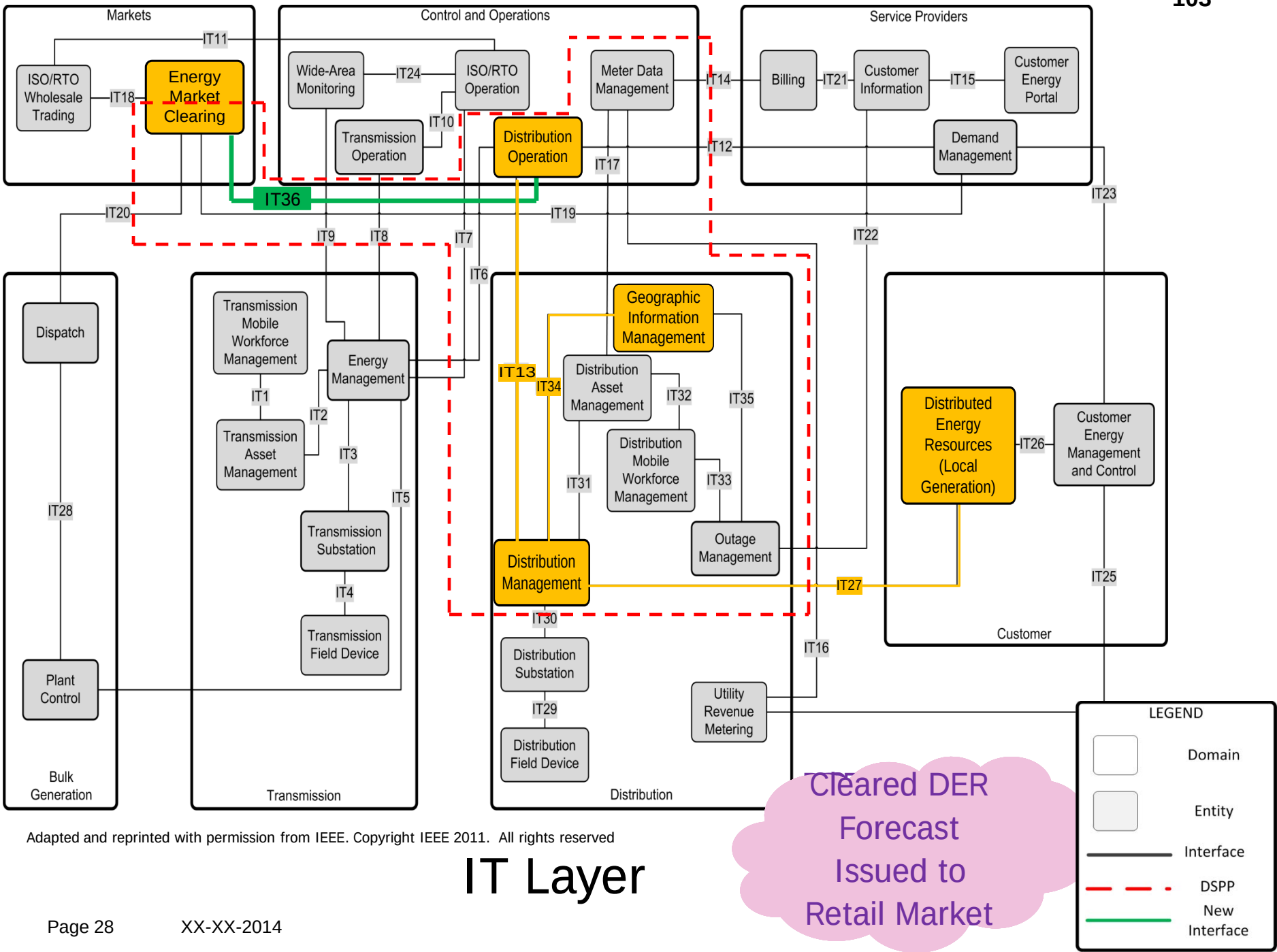
• Dynamic electricity production forecasting is the calculation and forecasting of electricity production from Distributed Energy Resources (DER).

• The forecasting is based on based on geography, forecasted fuel supply, solar isolation, wind speed and state of charge.

• The purpose of the forecasts would be to provide supply information to DSPP grid operations and planning, and to help set supply prices in the DSPP market.

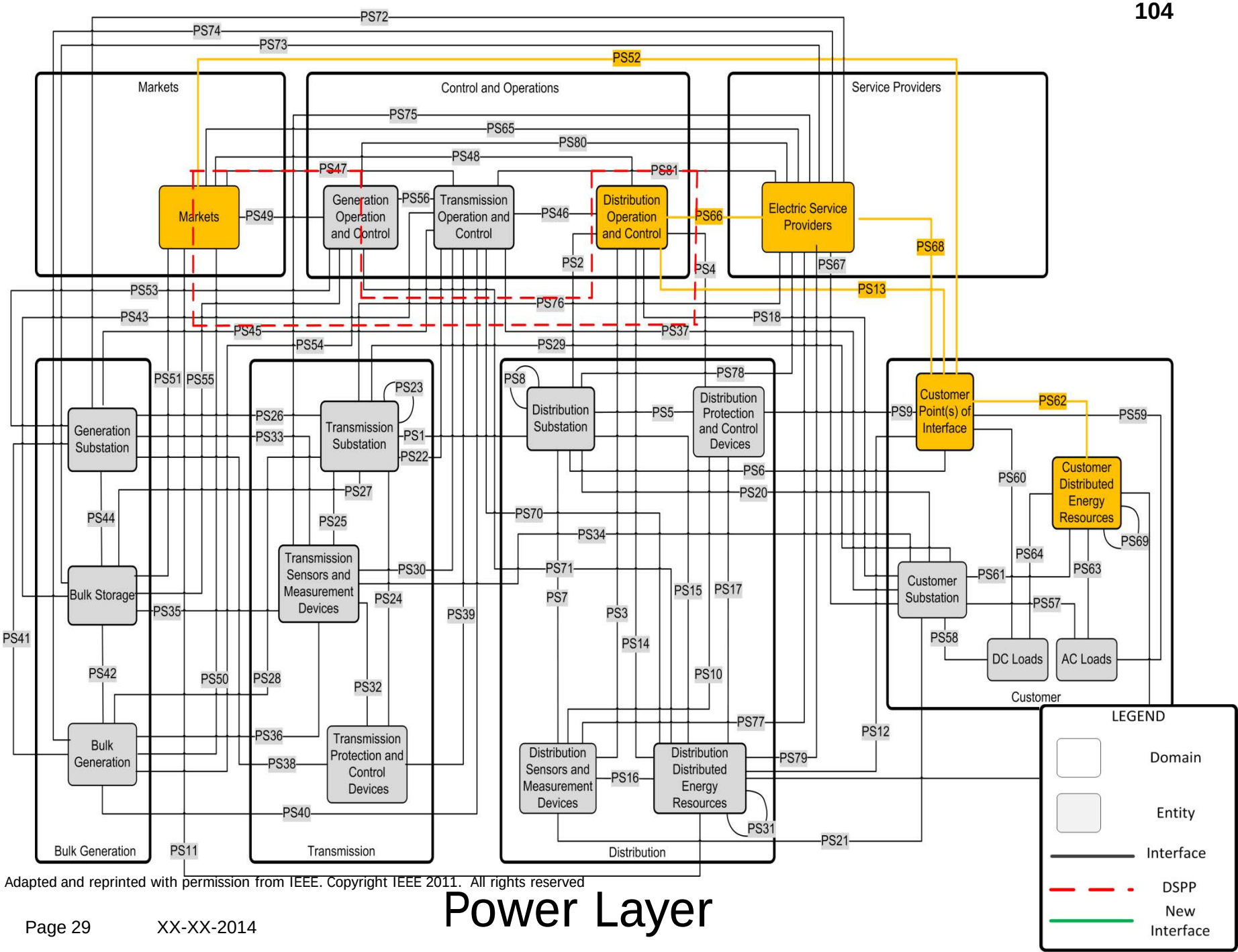
•The next few slides paint a story of the DSPP in action with the use of a conceptual architecture.

• Please note this is only an example an is subject to change.



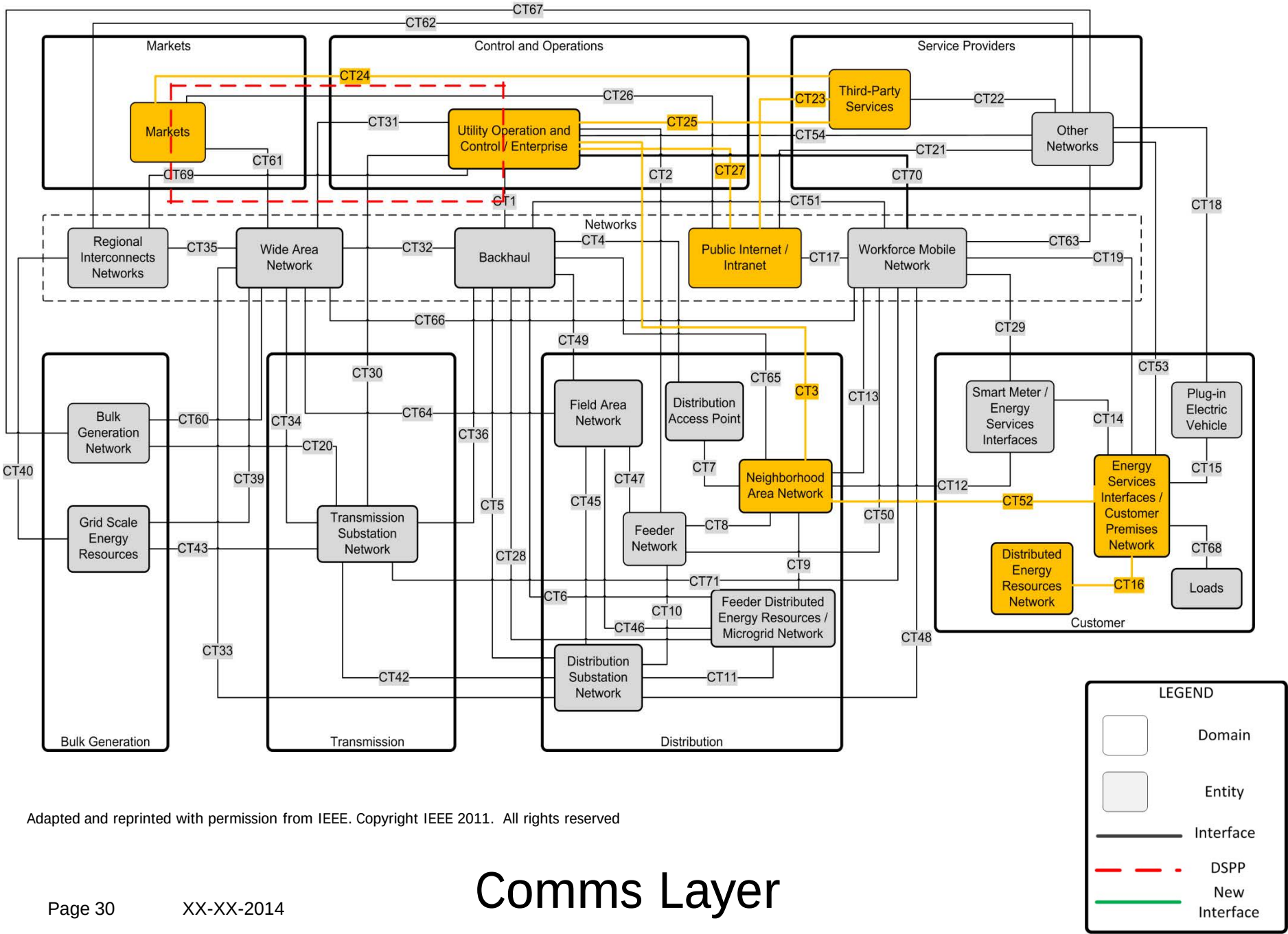
Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved

IT Layer



Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved

Power Layer



Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved

Comms Layer

Major Issues & Suggestions in SP for DSPP

Major Issues	Suggestions
Interoperability of SP for present and future	• Need harmonization of standards • Interoperability for DSPP has already begun and should be continued • Support testing and certification to ensure interoperability and accelerate their adoption • Encourage, support and incentivize SP interoperability, scalability and future proofing
SP are in various maturity levels & adoption rates	• Utilize existing adoption and industry-supported SP to scale and/or enhance support for additional services within the distribution system • Access SP maturity and adoption levels. • Don't wait for the most optimal SP
No acceptance of common cyber-security scheme	• Use secure standards-based protocols as basis for the communications models. • Investigate cyber security of open SP, in depth. • Cyber security should be integrated into the DSPP design not an add-on.
DSPP complexity and diversity	Need a rigorous architectural approach utilizing use case methodology.
How to maximize customer choice	Encourage SP that not only provides monitoring and control capabilities to the customers but also provides multiple pricing signals.
DSPP costs and market adoption.	• Encourage the use of national and open SP. • Interoperability and harmonization will commoditize equipment and thus increase customer and utility uptake.

References

http://smartgridstandardsmap.com/ - Online IEC tool to find SP.

http://www.nist.gov/smartgrid/upload/NIST_Framework_Release_2-0_corr.pdf - copy of approved NIST standards,

http://www.nist.gov/smartgrid/framework3.cfm - out for comments.

http://grouper.ieee.org/groups/scc21/ - P2030, 1547 and solar PV group of standards.

http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIPCoSStandardsInformationLibrary - SGiP table of standards.

https://www.oasis-open.org/ - OASIS website

References

http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group1_reference_architecture.pdf - SGAM (European Smart Grid Architecture Standards)

http://greenbuttondata.org/ - The list of companies currently adopt Green Button:

http://openadr.org/ - Companies supporting OpenADR Profile Specifications

http://www.nfpa.org/~/media/Files/Research/Research%20Foundation/Research%20Foundation%20reports/Electrical/rfsmartgridreport.pdf - NFPA harmonization of smart grid and customer standards.

:

Thank you for your attention!

David Lovelady – Working subgroup leader
Power Systems Consultant
Siemens PTI

400 State St, Schenectady, NY
12302

Phone: +518 395 5130

E-mail:
david.lovelady@siemens.com

Technologies

NYS DPS - Platform Technology Working Group

Technologies Subgroup

Current Thinking, June 18, 2014

Members of the Technologies Subgroup

Subgroup Lead - John D'Aloia (Staff)

Laney Brown (Iberdrola USA)
Stephanie Bailey (Con Edison)
Rob Sheridan (National Grid)
Ruben Brown (E Cubed)
Maria Seidler (Dominion)
Phil Powell (Dominion)
Forrest Small (Bridge Energy Group)
David O'Brien (Bridge Energy Group)
John Johnson (CALM Energy)
David Lovelady (Siemens)
Jim Gallagher (NY Smart Grid Consortium)
Dr. Mani Vadari (NY Smart Grid Consortium)
Maria Seidler (Dominion)
Marty Uczen (Verizon)
David Locke (Verizon)
Matt Anglin (NYISO)
John Cerveny (NY - Best)

Deana Dennis (NEMA)
Henrietta De Veer (Prime Solutions)
Laney Brown (Iberdrola USA)
Michael Barnett, Steve Snellers (Smart Cloud)
Phil Powell (Dominion)
Jeremy Tyree (Landis & Gyr)
Ward Camp (Landis & Gyr)
Michael Vecchi (Landis & Gyr)
Anthony Hawkins (Landis & Gyr)
Roy Pratt (Bridge Energy Group)
Hannah Polikov (Advanced Energy Economy)
Aminul Huque (EPRI)
Lindsey Rogers (EPRI)
Becky Wingenroth (EPRI)
Kelly Connell, Chris Graves, Brian Fisher (Staff)
Mike Rieder, Peggie Neville, Mike Williams (Staff)
Tony Abate, NYSERDA
Tom Mimnagh (Con Edison)
Brian Horton (Con Edison)

Subgroup Objectives

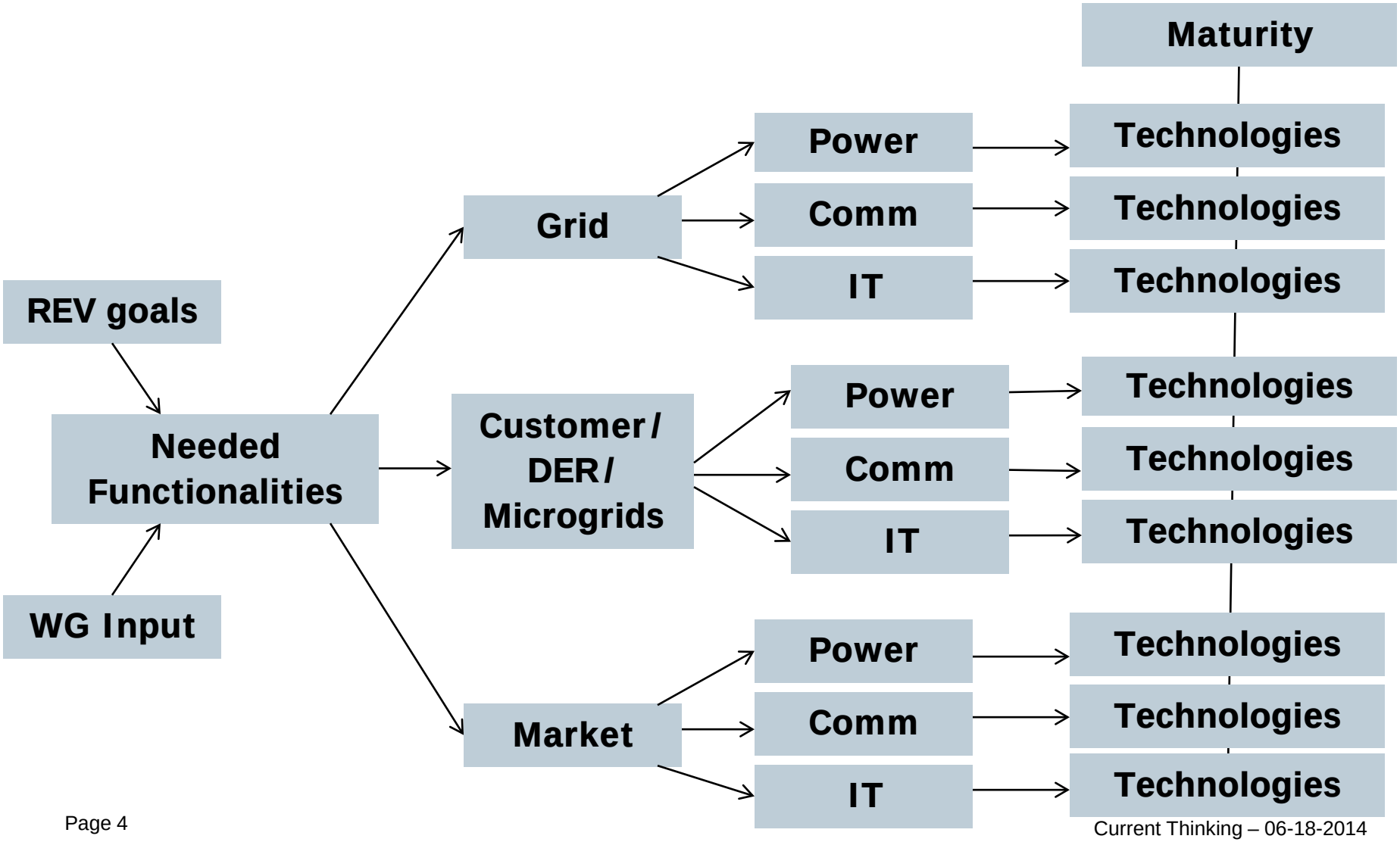
- **Map enabling technologies to DSPP platform functionalities**
  - Grid, Customer DER/ Microgrids, Market

- **Identify technologies that enable DSPP platform functionalities**
  - Power Systems, Communication Technology, Information Technology layers (IEEE P2030)
    - Hardware and software
    - Cyber-Security

- **Identify DSPP technology platform elements**
  - Maturity
  - Implementation Phases
  - Mandatory vs. Optional

- **Perform gap analysis**
  - Is the technology necessary for the DSPP platform available?
    - **YES,** can it be used to create platform?
    - **NO,** when will it be available? what is the platform road map?

Procedure/Approach



Functionalities

Grid

- Real-time load monitoring
- Real-time network monitoring
- Adaptive protection
- Enhanced fault detection and location
- Outage and restoration notification
- Automated feeder and line switching (FLISR/FDIR)
- Automated voltage and VAR control
- Real-time load transfer
- Dynamic capability rating
- Diagnosis and notification of equipment condition
- Power flow control
- Automated islanding and reconnection (microgrid)
- Electricity storage
- Algorithms for grid control and optimization

Customer/DER/ Microgrid

- Direct load control
- DER power control
- DER power factor control
- Automated islanding and reconnection
- Electricity storage
- Algorithms and analytics for Customer/DER/Microgrid control and optimization

Market

- Dynamic event notification
- Dynamic pricing
- Market-based demand response
- Dynamic electricity production forecasting
- Dynamic electricity consumption forecasting
- M&V for producers and consumers (premise/appliance/resource)
- Participant registration and relationship management
- Confirmation and settlement
- Billing, receiving and cash management
- Free-market trading
- Algorithms and analytics for market information and operations

Enabling Technologies- IEEE P2030 Layers

Enabling platform technologies were sorted by the 3 layers of the IEEE P2030 Interoperability Standard **Power System, Communication Technology, and Information Technology**

IEEE Std 2030-2011
IEEE Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), End-Use Applications, and Loads

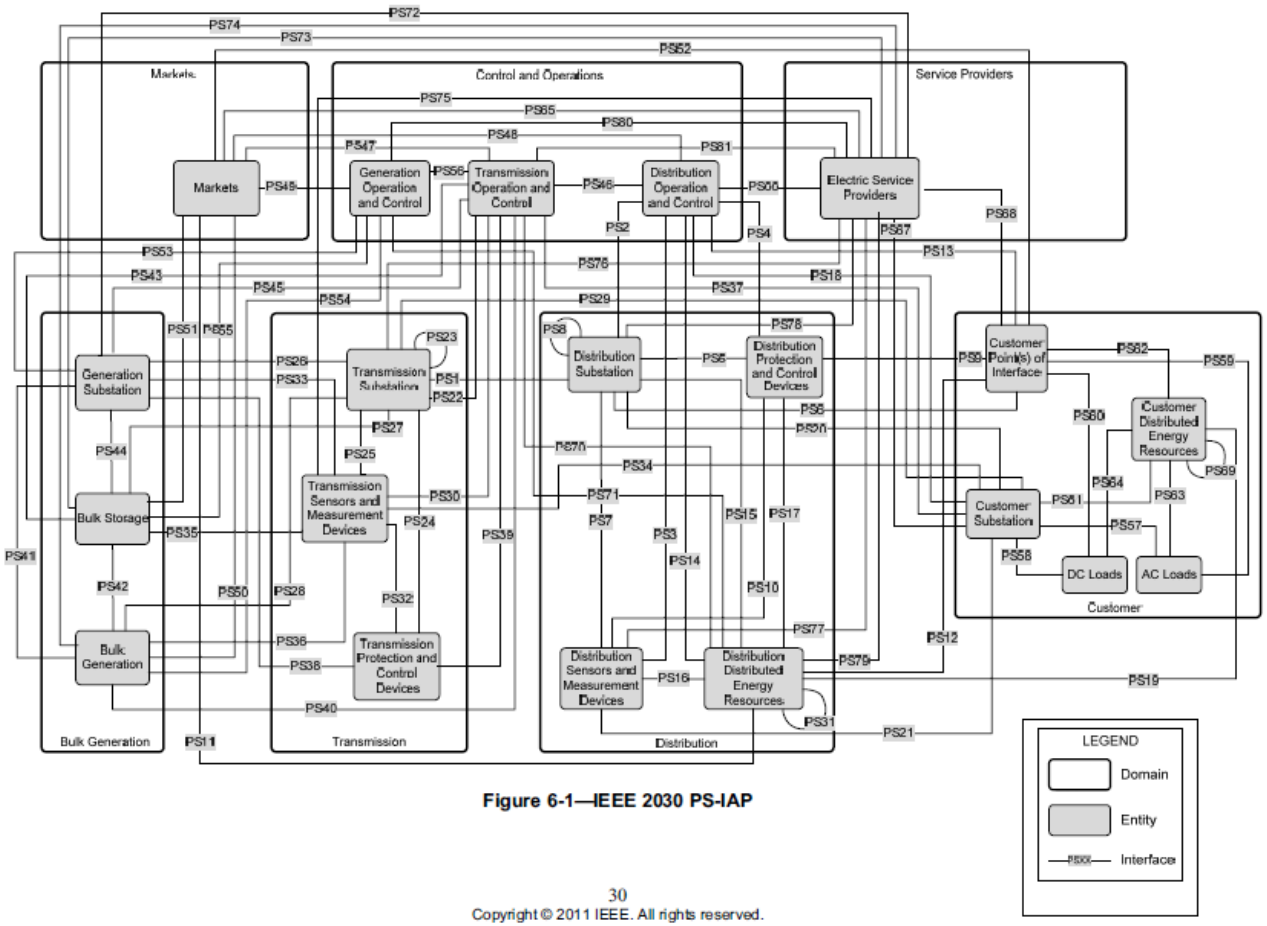


Figure 6-1—IEEE 2030 PS-IAP

This is a copyrighted IEEE Standard. For personal or standards development use only.

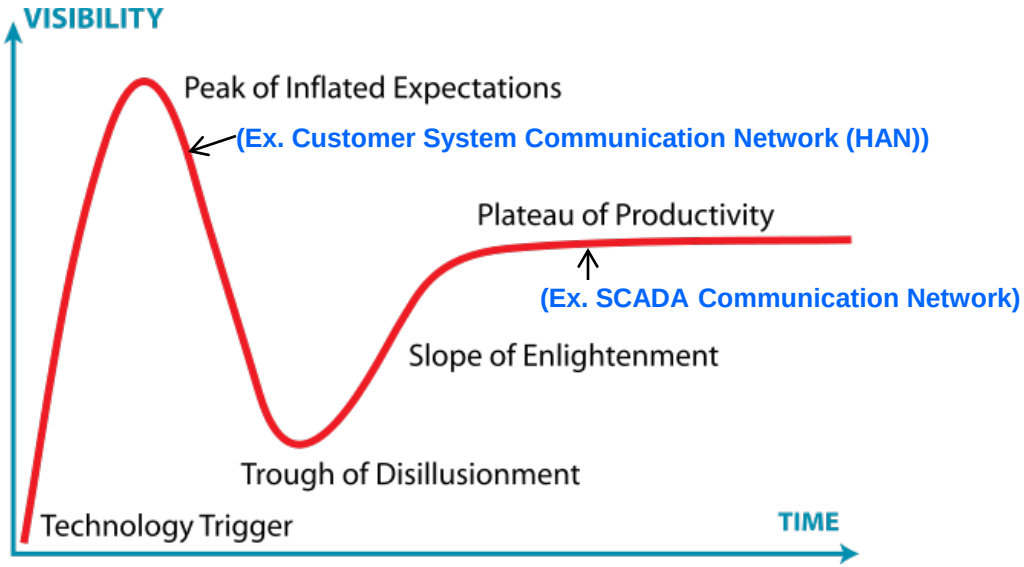
Copyright © 2011 IEEE. All rights reserved.

Enabling Technologies Matrix Mapping

- **Which technologies have a higher maturity level?**
  - Scale 1-5
- **Which technologies are foundational to the platform?**
  - Mandatory vs. Optional
- **Where does the technology fit in the DSPP phase implementation?**
  - Phase 1 – first 5 years
  - Phase 2 – Second 5 years
  - Phase 3 – ten years and beyond

Technology Maturity Level

The **Hype Cycle** is a branded graphical tool developed and used by IT research and advisory firm Gartner for representing the maturity, adoption and social application of specific technologies



Gartner Hype Cycle

https://www.gartner.com/login/loginInitAction.do?method=initialize&TARGET=http://www.gartner.com/document/709015

Matrix Key: Maturity Stage, Platform Need, DSPP Implementation Phase

Maturity (Gartner hype Cycle)		
Stage	**Gartner Description**	**Comments**
1	Innovation Trigger	Concept/Early R&D
2	Peak of Inflated Expectations	Mature R&D
3	Trough of Disillusionment	Pilot deployments some successful/some not.
4	Slope of Enlightenment	Multiple state deployment
5	Plateau of Productivity	Very mature and widely adopted

Technology Matrix Mapping Tool

Function-Technology Mapping Matrix

DRAFT Version 07-02-2014

"RT" - Required Technology "AA" - Alternatives Available

Functionalities

Technologies

DSPP Phase

Architecture layers

Maturity

Technology Classifiction (Device, Equipment, Software or Infrastructure)																
IEEE Architecture Layer	REV Sub-Category (Domain)	Technology	Phase for Tech	Maturity (1-5)	Real-time load monitoring	Real-time network monitoring	Adaptive protection	Enhanced fault detection and location	Outage and restoration notification	Automated feeder and switching (FLISR/FDIR)	Automated Voltage and VA control	Real-time load transfer	Dynamic capability rating	Diagnosis/notification of equipment condition	Power flow control	Algorithms and analytics for G control and optimization
Communications	Customer/Provider	Customer System Co ions Network (HAN)	2	2	AA						AA					
Communications	Grid	DSPP Backhaul C nications Network (DSPP WAN)	1	4	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
Communications	Grid	Distribution Automation Communications Network	1							RT	RT	RT		RT	RT	RT
Communications	Grid	Meter Communications Network (FAN)	1								AA					AA
Communications	Grid	SCADA Communications Network	1							AA	AA	RT	RT	AA	RT	AA
Communications	Grid	Synchrophasor Communications Network	1	4		AA	AA								AA	AA
Communications	Grid	DER Communictions Network	2		AA	AA	AA	AA	AA		AA	AA		AA	AA	AA
Communications	Market	Market Communications Network (Internet?)	3	3									AA			
IT/OT	Customer/Provider	Customer Web Portal	1	4	AA				AA							
IT/OT	Customer/Provider	In-Home Display	2	2	AA											
IT/OT	Customer/Provider	Customer Energy Management Device/System	2	2	AA						AA					
IT/OT	Customer/Provider	Settlement/Billing System	1	2												
IT/OT	Grid	Advanced T&D App - Advanced Analysis/Visualization	2	2		AA			AA					AA		AA
IT/OT		quency Monitoring	2	2		AA	AA				AA				AA	AA
IT/OT		State Estimation System	2	2	AA	AA							AA			AA
IT/OT		em Analysis Systems	2	2										AA		AA
IT/OT		Power System Restoration	2						AA							
IT/OT		Advanced Transmission App - Steady-State Model Benchmarking	2										AA		AA	AA
IT/OT	Grid	Advanced Transmission App - Voltage Stability Monitoring	2								AA					AA
IT/OT	Grid	Event Management System (and analytics)	1	2										AA		AA
IT/OT	Grid	Meter Data Management System	1	4					AA							AA
IT/OT	Grid	Meter Head-End System	1	4	RT	AA			AA							AA
IT/OT	Grid	Outage Management System	1	5	AA	AA			RT	AA						
IT/OT	Grid	Advanced Distribution Management System (ADMS)	1	3	AA	RT	RT	RT	AA	RT	RT	RT	AA	AA	RT	RT
IT/OT	Grid	Grid View Analytics	1	2										AA		RT
IT/OT	Grid	Grid Ops Analytics	1	2										AA		RT

Technology Matrix Map Features

- Version
- Maturity & Phase Key
- Function – Technology
- Function Descriptions
- Technology Descriptions

	Function	Category	Definition
5	Real-time load monitoring	Grid	Provides real-time measurement of energy consumption at the customer premise or device level. This could be accomplished using voltage and current sensors housed within a smart meter or other similarly capable sensor. The sensors would be connected to a communications network capable of delivering load measurements to a central monitoring system in intervals of one hour or less (more frequently).
6	Real-time network monitoring	Grid	Provides real-time measurement of voltage and current within the transmission and distribution network, including primary distribution feeders, laterals and line transformers. This monitoring can provide a high resolution view of voltage and load profiles throughout the network suitable for use in operations and real-time optimization algorithms. Sensors could be housed in T&D power equipment such as circuit breakers, reclosers, voltage regulators, capacitor banks, transformers, or other dedicated sensor hardware. The sensors would be connected to a communications network capable of delivering measurements to a central monitoring system in intervals of one hour or less
7	Adaptive protection	Grid	Adaptive protection uses adjustable protective relay settings (e.g., current, voltage, feeders, and equipment) in real time based on signals from local sensors or a central control system. This is particularly useful for feeder transfers and two-way power flow issues associated with high DER penetration.
8	Enhanced fault detection and location	Grid	Enhanced fault protection requires higher precision and greater discrimination of fault location and type with coordinated measurement among multiple devices. For distribution applications, these systems will detect and isolate faults without full-power re-closing, reducing the frequency of through-fault currents. Using high resolution sensors and fault signatures, these systems can better detect high impedance faults. For transmission applications, these systems will employ high speed communications between multiple elements (e.g., stations) to protect entire regions, rather than just single elements. They will also use the latest digital techniques to advance beyond conventional impedance
9	Outage and restoration notification	Grid	Provides power status information down to the customer service point. Upon loss of power or restoration of power, status sensors will send a notification message to a central monitoring system that can analyze and deliver the message to a reliability operator or system. Sensors should be capable of measuring load side power status and sending a notification message upon change of state or request from another system.
10	Automated feeder and line switching (FLISR/FDIR)	Grid	Automated feeder switching is realized through automatic isolation and reconfiguration of faulted segments of distribution feeders via sensors, controls, switches, and communications systems. These devices can operate autonomously in response to local events or in response to signals from a central control system.
11	Automated Voltage and VAR control	Grid	Automated voltage and VAR control requires coordinated operation of reactive power resources such as capacitor banks, voltage regulators, transformer load-tap changers, and distributed generation (DG) with sensors, controls, and communications systems. These devices could operate autonomously in response to local events or in response to signals
	Real-time load transfer	Grid	Real-time load transfer is achieved through real-time feeder reconfiguration and optimization to relieve load on equipment, improve asset utilization, improve distribution

Version | Maturity | Function-Tech Mapping | Function Descriptions | Technology Descriptions

Examples of Mandatory vs. Optional

Function-Technology Mapping Matrix

DRAFT Version 06-17-2014

"M" - mandatory "O" - optional

Technology Classifiction (Device, Equipment, Software or Infrastructure)					Grid Functionality								
IEEE Architecture Layer	REV Sub-Category (Domain)	Technology	Phase for Tech	Maturity (1-5)	Real-time load monitoring	Real-time network monitoring	Adaptive protection	Enhanced fault detection and location	Outage and restoration notification	Automated feeder and line switching (FLISR/FDIR)	Automated Voltage and VAR control	Real-time load transfer	Dynamic capability rating
Communications	Customer/Provider	Customer System Communications Network (HAN)	3	2	M								
Communications	Grid	DSPP Backhaul Communications Network (DSPP WAN)	2	4	M	M	M	M	M	M	M	M	M
Communications	Grid	Distribution Automation Communications Network		3		M	M	M	M	M	M	M	
Communications	Grid	Meter Communications Network (FAN)	2	4	M	O			O				
Communications	Grid	SCADA Communications Network	1	5			M	M	M	M	M	M	M
Communications	Grid	Synchrophasor Communications Network		3			O	O					
Communications	Grid	DER Communictions Network	2	2	M	O	O	M	M		M	O	
Communications	Market	Market Communications Network (Internet?)	3										O
IT/OT	Customer/Provider	Customer Web Portal	2	2	O				O				
IT/OT	Customer/Provider	In-Home Display	3	2	O								
IT/OT	Customer/Provider	Customer Energy Management Device/System	2	2	O								
IT/OT	Customer/Provider	Settlement/Billing System	1										
IT/OT	Grid	Advanced T&D App - Advanced Analysis/Visualization		2									
IT/OT	Grid	Advanced T&D App - Angle/Frequency Monitoring		2		O	O				O		
IT/OT	Grid	Advanced T&D App - Improved State Estimation System		2									O
IT/OT	Grid	Advanced T&D App - Post-mortem Analysis Systems		2									
IT/OT	Grid	Advanced Transmission App - Power System Restoration		3		O	O		M				
IT/OT	Grid	Advanced Transmission App - Steady-State Model Benchmarking		3									O
IT/OT	Grid	Advanced Transmission App - Voltage Stability Monitoring		3		O	O				O		
IT/OT	Grid	Event Management System (and analytics)	1	2		O							
IT/OT	Grid	Meter Data Management System	2	3	O				O				
IT/OT	Grid	Meter Head-End System	2	4	M	O			O				
IT/OT	Grid	Outage Management System	1	3		O			M	O			
IT/OT	Grid	Advanced Distribution Management System (ADMS)	2	3		M	M	M	O	M	M	M	O
IT/OT	Grid	Grid View Analytics	1	2									
IT/OT	Grid	Grid Ops Analytics	1	2									
IT/OT	Grid	Advanced Distribution Planning System (ADPS)	2	1								M	M
IT/OT	Grid	Fault Location, Isolation, and Service Restoration (FLISR) alg	1	3			O	M	O	M			
IT/OT	Market	Settlement System	1										
Power Equipment	Customer/Provider	Controllable/Regulating Inverter (DER)	2	1			O						
Power Equipment	Customer/Provider	Direct Load Control Device	3	5									
Power Equipment	Customer/Provider	Distributed Energy Resource Controller/interface	2	2	O	O	O				O	O	O

Examples of DSPP Phase Implementation

Technology Classifiction (Device, Equipment, Software or Infrastructure)				
IEEE Architecture Layer	REV Sub-Category (Domain)	Technology	Phase for Tech	Maturity (1-5)
Communications	Customer/Provider	Customer System Communications Network (HAN)	3	2
Communications	Grid	DSPP Backhaul Communications Network (DSPP WAN)	2	4
Communications	Grid	Distribution Automation Communications Network		3
Communications	Grid	Meter Communications Network (FAN)	2	4
Communications	Grid	SCADA Communications Network	1	5
Communications	Grid	Synchrophasor Communications Network		3
Communications	Grid	DER Communictions Network	2	2
Communications	Market	Market Communications Network (Internet?)	3	
IT/OT	Customer/Provider	Customer Web Portal	2	2
IT/OT	Customer/Provider	In-Home Display	3	2
IT/OT	Customer/Provider	Customer Energy Management Device/System	2	2
IT/OT	Customer/Provider	Settlement/Billing System	1	
IT/OT	Grid	Advanced T&D App - Advanced Analysis/Visualization		2
IT/OT	Grid	Advanced T&D App - Angle/Frequency Monitoring		2
IT/OT	Grid	Advanced T&D App - Improved State Estimation System		2
IT/OT	Grid	Advanced T&D App - Post-mortem Analysis Systems		2
IT/OT	Grid	Advanced Transmission App - Power System Restoration		3
IT/OT	Grid	Advanced Transmission App - Steady-State Model Benchmarking		3
IT/OT	Grid	Advanced Transmission App - Voltage Stability Monitoring		3
IT/OT	Grid	Event Management System (and analytics)	1	2
IT/OT	Grid	Meter Data Management System	2	3
IT/OT	Grid	Meter Head-End System	2	4
IT/OT	Grid	Outage Management System	1	3
IT/OT	Grid	Advanced Distribution Management System (ADMS)	2	3
IT/OT	Grid	Grid View Analytics	1	2
IT/OT	Grid	Grid Ops Analytics	1	2
IT/OT	Grid	Advanced Distribution Planning System (ADPS)	2	1
IT/OT	Grid	Fault Location, Isolation, and Service Restoration (FLISR) alg	1	3
IT/OT	Market	Settlement System	1	
Power Equipment	Customer/Provider	Controllable/Regulating Inverter (DER)	2	1
Power Equipment	Customer/Provider	Direct Load Control Device	3	5
Power Equipment	Customer/Provider	Distributed Energy Resource Controller/interface	2	2

Evolution of DSPP Capabilities

- An important REV goal is DSPP platform standardization, however, it is recognized that functionality and technologies will evolve over time.
- Current utility distribution data acquisition and control systems (i.e. SCADA) rely almost exclusively on in-house or privately designed networks.
- Third parties (i.e. aggregators) are increasingly providing services using public network connections.
- DSPP use of public networks will require cyber-security hardening.

Technology Adoption Lifecycle

Innovation, R&D, Custom Solutions

- DSPP/Third-parties: Demonstration systems

Premium Products & Services / Early Adopting Customers

- Third-parties: Commercial facility HVAC monitoring and control (premium services), high-end residential

Commoditized Products & Services / Fast Following Customers

- DSPP: Commercial facility HVAC monitoring and control (value-added option)
- Third-parties: Differentiated HVAC monitoring and control (premium services)

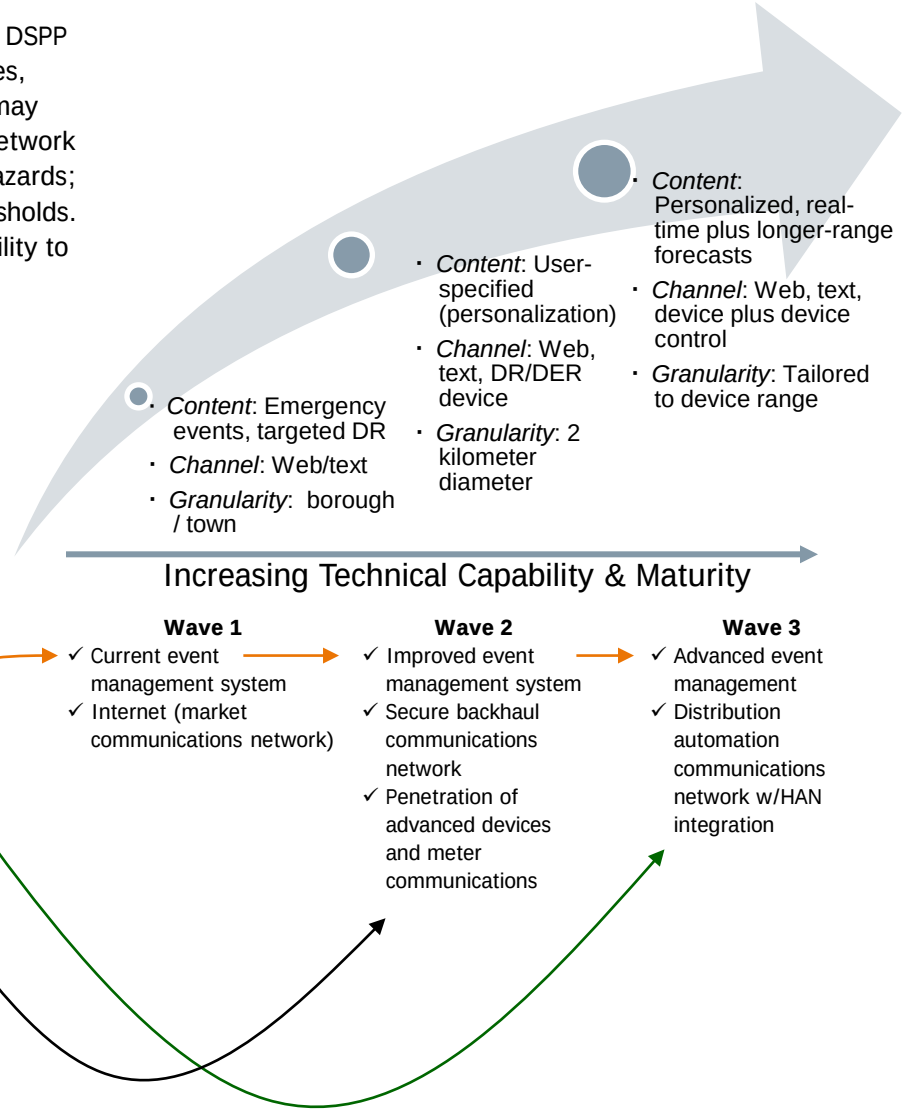
Standard Products & Services / Mass Market

- DSPP: Ubiquitous HVAC monitoring and control (low-cost or basic service)
- Third-parties: Differentiated HVAC monitoring and control

Evolution Example: Dynamic Event Notification

Dynamic Event Notification Definition: Automatic notification by the DSPP to market participants of events including, but not limited to: price changes, incentives, penalties, or special circumstances; events or conditions that may effect market operations; events or conditions that may effect electrical network performance or availability such as equipment failure, weather or other hazards; achieving or exceeding various production or consumption targets or thresholds. Such notification would be intended to provide market participants the ability to respond to important situations or conditions in a timely manner.

Technology	Phase for Tech
Customer System Communications Network (HAN)	3
DSPP Backhaul Communications Network (DSPP WAN)	2
Meter Communications Network (FAN)	2
DER Communictions Network	2
Market Communications Network (Internet?)	1
Customer Web Portal	2
Customer Energy Management Device/System	2
Event Management System (and analytics)	1
Meter Data Management System	2
Advanced Distribution Management System (ADMS)	2
Controllable/Regulating Inverter (DER)	2
Direct Load Control Device	3
Smart Thermostat	3



Observations/Recommendations

- **Defining and mapping the enabling technologies to the DSPP platform functions provides a common roadmap to assess the variety of evolving technologies**
  - Identifies the technologies existing today
  - Creates a structure to identify functionalities and technology capabilities over time
  - Identifies gaps in technologies

- **Cyber-security must take precedence in platform implementation**

- **Next Steps**
  - Subgroup recommends continuing to evolve the Matrix Map into a tool that could be used in implementation plans

Thank you for your attention!

John D'Aloia
NY Dept of Public Service Staff
3 Empire State Plaza
Albany, NY 12223
Phone: (518) 486-5210

E-mail:
john.daloia@dps.ny.gov

Appendices

Appendix A

Full List of Working Group

& Subgroup Members

Platform Technology Working Group - Full Member List

PARTICIPANT	COMPANY
Abate, Tony	NYSERDA
Acker, William	NY - Best
Andruski, Joel	Department of Public Service
Anglin, Matt	NYISO
Austen, Phil	National Grid
Bailey, Stephanie M.	Con Edison
Baldyea, Todd	NYSERDA
Ballard, Jeff	Iberdrola USA (NYSEG / RG&E)
Barnes, John	NYSDEC
Barnett, Michael	Smart Cloud, Inc.
Bashualdo, Hugo	Siemens
Bharadwaj, Aditya	Open Access Technology International, Inc.
Bishop, James	Maser Consulting P.A.
Bochenek, Scott	Iberdrola USA (NYSEG / RG&E)
Brown, Laney	Iberdrola USA (NYSEG / RG&E)
Brown, Ruben	ECubed
Bruno, Clarke	Anbaric Transmission
Camp, Ward	Landis & Gyr
Campbell, Greg	NYISO
Capers, Audrey	Department of Public Service
Cappers, Peter	Lawrence Berkeley National Laboratory (LBNL)
Carlesco, Adam	SEIA
Carter, Pamela	Department of Public Service
Cerbin, Andrea	Pace Energy & Climate Center
Cerveny, John	NY - Best
Christian, Rory	Environmental Defence Fund
Cinadr, Matt	ECubed
Collar, Gregg	DOS/Utility Intervention Unit/Div of Consumer Protection
Connell, Kelly	Department of Public Service
Crahen, Evan	National Fuel
Cross-Call, Dan	Rocky Mountain Institute
D'Aloia, John	Department of Public Service
Davidson, Gary	NYISO
DeBroff, Scott	Rhodes & Sinon LLP
Delurey, Dan	Assn. for Demand Response & Smart Grid
Dennis, Deana	National Electric Manufacturers Assn. (NEMA)
DeVeer, Henrietta	Prime Solutions, Inc. / Energy Engineering
Dodson, John	Thayer Gate Energy
Easton, Elliot	Lockheed Martin
Esposito, Allison	Department of Public Service
Evans, Debbie	Department of Public Service
Fisher, Brian	Department of Public Service
Fitzgerald, Brian	Cullen and Dykman LLP
Flory, John	The Alliance Risk Group
Freni, Charles	Central Hudson
Gallagher, James	NYS Smart Grid Consortium
Ghatikar, Girish	Lawrence Berkeley National Laboratory (LBNL)

PARTICIPANT	COMPANY
Gillespie, Susan H.	Citizens for Local Power
Graves, Christopher	Department of Public Service
Green, Manna Jo	Hudson River Sloop Clearwater, Inc.
Hagell, Suzanne	NYSDEC Office of Climate Change
Hanley, Ryan	Solar City
Harrison, Becky	Gridwise Alliance
Hawkins, Anthony	Landis & Gyr
Holtermann, Mark	Central Hudson
Horner, Randolph	Silicon Solution LLC
Horton, Brian	Con Edison
Huque, Aminul	Electric Power Research Institute (EPRI)
Husta, Bruce	Itron
Insogna, Martin	Department of Public Service
Isaac, Alexandrea	Starion Energy, Inc.
Johnson, John	CALM Energy, Inc.
Jolly, Margaret	Con Edison
Kallaher, Chris	Direct Energy
Kiddie, Ross	ICF International
Kiliccote, Sila	Lawrence Berkeley National Laboratory (LBNL)
Koda, Richard	Koda Consulting, Inc.
Kowalczyk, Ann	Verizon Communications
Krall, Timothy	Exelon Corporation
Kranz, Brad	NRG Energy, Inc.
Kristov, Lorenzo	California ISO
Kushman, Kevin	Blue Pillar, Inc.
Kwong, Lisa	Environmental Protection Bureau, NYS Office of the Attorney General
Lauckner, Kevin	Honeywell Smart Grid Solutions
Lindenfelzer, Paul	Smart Cloud, Inc.
Locke, David	Verizon Communications
Lovelady, David	Siemens PTI
Magee, Tom	Con Edison
Mager, Michael	Couch White, LLP
Maitra, Arindam	Electric Power Research Institute (EPRI)
Malkin, David	GE Energy Management
McAuliffe, Gary	Silver Spring Networks
McConnell, Erica	Keyes, Fox & Wiedman LLP
Mimnagh, Tom	Con Edison
Morris, Jackson	NRDC
Mullany, Sean	Department of Public Service
Murray, Frank	
Neville, Peggie	Department of Public Service
Nielsen, Matt	GE Global Research
O'Brien, David	BRIDGE Energy Group
O'Connor, Mark	NYPA
Panko, Danielle	DOS/Utility Intervention Unit/Div of Consumer Protection
Pearson, Arthur W.	Lockheed Martin
Phoenix, Phillip	NYISO
Polikov, Hannah	Advanced Energy Economy
Powell, Phil	Dominion Voltage Inc.

PARTICIPANT	COMPANY
Pratt, Roy	BRIDGE Energy Group
Pratt, William	Utilidata, Inc.
Quackenbush, Luke	Department of Public Service
Rieder, Michael	Department of Public Service
Rigberg, Saul	DOS/Utility Intervention Unit/Div of Consumer Protection
Rogers, Lindsey	Electric Power Research Institute (EPRI)
Ross, Valerie	Energy Technology Savings
Rothstein, Peter	New England Clean Energy Council
Rucinski, Randy	National Fuel
Ruotolo, Andrea	NYS Smart Grid Consortium
Salter, Raya	NRDC
Sandoval, Ronny	Environmental Defense Fund
Sartini, Monica	Rhodes & Sinon LLP
Schorr, Angela	Direct Energy
Seidler, Maria	Dominion Voltage Inc.
Sharif, Maryam	New York Power Authority
Sheridan, Robert	National Grid
Short, Tom	Electric Power Research Institute (EPRI)
Siskind, Esther	Solar One
Small, Forrest	BRIDGE Energy Group
Snellers, Steve	Smart Cloud, Inc.
Spilky, Rich	Integrys Energy
Strauss, Valerie	Ass'n for Energy Affordability, Inc.
Terry, Kandi	Just Energy
Thomson, Greg	Clean Coalition
Turner, Hal	Central Hudson
Twigg, GeoRG&E	Vermont Energy Investment Corporation
Tyree, Jeremy	Landis & Gyr
Uczen, Marty	Verizon Communications
Umoff, Rick	Solar Energy Industries Assn. (SEIA)
Vadari, Dr. Mani	NYS Smart Grid Consortium
Vecchi, Mike	Landis & Gyr
Vedhathiri, Arun	NYPA-Build Smart NY
Vercheak, Susan	Con Edison
Wallace, Matthew	Department of Public Service
Warner, Chet	Pareto Energy
Warshaw, Drew	NRG Energy, Inc.
Wentlent, Christopher	Constellation
Westman, David	Con Edison
Williams, Michael	Department of Public Service
Wilton, John	Sensus
Wingenroth, Rebecca	Electric Power Research Institute (EPRI)
Yakel, Joseph	Department of Public Service
Zhu, Penny	DOS/Utility Intervention Unit/Div of Consumer Protection

Platform Technology Working Group - Subgroups

Platform Functionalities Subgroup

PARTICIPANT	COMPANY
Brown, Laney (LEAD)	Iberdrola USA (NYSEG / RG&E)
Bailey, Stephanie	Con Edison
Brown, Ruben	E Cubed
Fisher, Brian	Department of Public Service
Johnson, John	CALM Energy
O'Brien, David	BRIDGE Energy Group
Powell, Phil	Dominion Voltage Inc.
Rob Sheridan	National Grid
Seidler, Maria	Dominion Voltage Inc.
Small, Forrest	BRIDGE Energy Group

Existing Utility Distribution Systems and Capabilities Subgroup

PARTICIPANT	COMPANY
Horton, Brian (LEAD)	Con Edison
Brown, Laney	Iberdrola USA (NYSEG / RG&E)
Holtermann, Mark	Central Hudson
Sheridan, Rob	National Grid

Standards and Protocols Subgroup

PARTICIPANT	COMPANY
Lovelady, David (LEAD)	Siemens PTI
Abate, Tony	NYSERDA
Cappers, Peter	Lawrence Berkeley National Laboratory (LBNL)
Dennis, Deana	National Electric Manufacturers Assn. (NEMA)
Gallagher, Jim	NYS Smart Grid Consortium
Ghatikar, Girish	Lawrence Berkeley National Laboratory (LBNL)
Herbst, Tom	Silver Springs
Kiliccote, Sila	Lawrence Berkeley National Laboratory (LBNL)
Locke, David	Verizon Communications
Maitra, Arindam	Electric Power Research Institute (EPRI)
Neville, Peggie	Department of Public Service
Rieder, Michael	Department of Public Service
Uczen, Marty	Verizon Communications
Vadari, Dr. Mani	NYS Smart Grid Consortium
Vecchi, Michael	Landis & Gyr
Williams, Mike	Department of Public Service
Wingenroth, Rebecca	Electric Power Research Institute (EPRI)

Technologies Subgroup

PARTICIPANT	COMPANY
D'Aloia, John (LEAD)	Department of Public Service
Abate, Tony	NYSERDA
Anglin, Matt	NYISO
Barnett, Michael	Smart Cloud, Inc.
Brown, Laney	Iberdrola USA (NYSEG / RG&E)
Camp, Ward	Landis & Gyr
Cerveny, John	NY - Best
Connell, Kelly	Department of Public Service
De Veer, Henrietta	Prime Solutions, Inc. / Energy Engineering
Dennis, Deana	National Electric Manufacturers Assn. (NEMA)
Fisher, Brian	Department of Public Service
Gallagher, Jim	NYS Smart Grid Consortium
Graves, Christopher	Department of Public Service
Hawkins, Anthony	Landis & Gyr
Horton, Brian	Con Edison
Huque, Aminul	Electric Power Research Institute (EPRI)
Kushman, Kevin	Blue Pillar
Locke, David	Verizon Communications
Lovelady, David	Siemens PTI
Mimnagh, Tom	Con Edison
Neville, Peggie	Department of Public Service
Polikov, Hannah	Advanced Energy Economy
Powell, Phil	Dominion
Pratt, Roy	BRIDGE Energy Group
Rieder, Michael	Department of Public Service
Rogers, Lindsey	Electric Power Research Institute (EPRI)
Seidler, Maria	Dominion Voltage Inc.
Snellers, Steve	Smart Cloud, Inc.
Tyree, Jeremy	Landis & Gyr
Uczen, Marty	Verizon Communications
Vadari, Dr. Mani	NYS Smart Grid Consortium
Vecchi, Michael	Landis & Gyr
Williams, Michael	Department of Public Service
Wingenroth, Becky	Electric Power Research Institute (EPRI)

Architecture Team

PARTICIPANT	COMPANY
Abate, Tony	NYSERDA
Brown, Laney	Iberdrola USA (NYSEG / RG&E)
Connell, Kelly	Department of Public Service
D'Aloia, John	Department of Public Service
Fisher, Brian	Department of Public Service
Gallagher, Jim	NYS Smart Grid Consortium
Horton, Brian	Con Edison
Lovelady, David	Siemens PTI
Mimnagh, Tom	Con Edison
Neville, Peggie	Department of Public Service
O'Brien, David	BRIDGE Energy Group
Pratt, Roy	BRIDGE Energy Group
Rieder, Michael	Department of Public Service
Small, Forrest	BRIDGE Energy Group
Vadari, Dr. Mani	NYS Smart Grid Consortium
Vecchi, Michael	Landis & Gyr

Appendix B

Draft of Functions to Policy Mapping Tool – Preliminary in Nature

The following two pages are only a screenshot of the tool. The tool has been filed electronically as “Appendix B” to this report.

Functionality	REV Policy Objectives						Domain		
	Customer knowledge and tools to manage bills	Market animation and leverage or ratepayer contributions	System wide efficiency	Fuel and resource diversity	System reliability and resiliency	CO2 reduction	Market Operations	Grid Operations	Integrated System Planning
Grid									
Real-time load monitoring	Y	Y	Y		Y		Y	Y	
Real-time network monitoring			Y		Y			Y	
Adaptive protection				Y	Y			Y	
Enhanced fault detection and location				Y	Y			Y	
Outage and restoration notification					Y			Y	
Automated feeder and line switching (FLISR/FDIR)					Y	Y		Y	
Automated Voltage and VAR control			Y	Y	Y	Y		Y	
Real-time load transfer			Y	Y		Y		Y	
Dynamic capability rating			Y	Y				Y	
Diagnosis/notification of equipment condition			Y		Y	Y		Y	
Power flow control			Y		Y	Y			
Algorithms and analytics for Grid control and optimization		Y	Y	Y	Y	Y			
Customer/DER/Microgrid									
Direct load control			Y				Y	Y	
DER power control	Y	Y	Y	Y	Y	Y		Y	
DER power factor control	Y	Y	Y	Y	Y	Y		Y	
DER optimization			Y			Y			
Automated islanding and reconnection (microgrid)					Y	Y		Y	
Electricity storage	Y	Y	Y	Y	Y	Y		Y	
Algorithms and analytics for Customer/DER/Microgrid control and optimization	Y	Y	Y	Y	Y	Y			

Market									
Dynamic event notification	Y	Y	Y		Y		Y	Y	
Dynamic pricing	Y	Y	Y				Y	Y	
Market-based demand response	Y	Y	Y		Y		Y	Y	
Dynamic electricity production forecasting	Y	Y					Y	Y	
Dynamic electricity consumption forecasting	Y	Y					Y	Y	
Historical DER performance monitoring	Y	Y							
Historical load monitoring	Y	Y							
M&V for producers and consumers (premise/appliance/resource)	Y	Y					Y		
Participant registration and relationship management	Y	Y							
Confirmation and settlement	Y	Y							
Billing, receiving and cash management	Y	Y							
Free-market trading	Y	Y							
Algorithms and analytics for Market Information and Operations	Y	Y							

Appendix C

Draft Use Cases – Preliminary in Nature

The Working Group used the IEEE P2030 standard as a starting point to develop an illustrative framework architecture of the DSPP. The following are a few examples of specific Use Cases out of hundreds of possible Use Cases that the DSPP may need to perform. The Use Cases are preliminary in nature and are for illustrative purposes only.

The Use Cases were adopted from the EPRI Smart Grid Resource Center – Use Case Repository and modified by Working Group Members.

Draft Use Cases – Preliminary in Nature

Dynamic Electricity Production Forecasting

Dynamic Electricity Production Forecasting (DEPF)

1 Descriptions of Function

1.1 Function Name

Dynamic Electricity Production Forecasting (DEPF)

1.2 Function ID

TBD

1.3 Brief Description

Dynamic electricity production forecasting is the calculation and forecasting of electricity production from Distributed Energy Resources (DER) based on geography, forecasted fuel supply, solar insolation, wind speed, electrical network conditions, or other factors that would affect the quantity and quality of electricity. Production forecasts would change with changes in input data. The purpose of the forecasts would be to provide supply information to DSPP grid operations and planning, and to help set supply prices in the DSPP market.

1.4 Narrative

The primary purpose of dynamic electricity production forecasting is to forecast the varying generation and energy production of Distributed Energy Resources for generation planning in the following time-frames:

- 15-minute
- Hour ahead
- Day ahead
- Weekly.

Input into the dynamic electricity production forecast include historical DER production and weather forecasts of temperature, humidity, wind speed and solar insolation.

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Results of dynamic electricity production forecasting and generation planning include dynamic generation forecasts and market price signals for price-sensitive distributed energy resources.

1.5 Actor (Stakeholder) Roles [Power System Architecture]

The Power System Architecture includes the following IEEE2030 Standard Domains and Entities:

- Markets
- Control and Operations
- Service Providers
- Customers

Power System information includes:

- DER generation
- DER energy production
- DER monitoring and control
- Market price signals.

Domain		*Domain Description*		
Markets		***The markets domain reflects market operations associated with electric utilities and regional entities. Markets are entities that signal changes in the operation of the system based on market economic variables.***		
Interface	*Entity 1*	*Entity 2*	*Comments*	*Use Case Example*
PS52	Markets	Customer Point(s) of Interface	Provides for optimization of distributed generation, storage, and load control (i.e., demand response) on the customer domain. Interfaces include those for control, monitoring, and reporting.	Price Signals Energy Production

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Domain		*Domain Description*		
Control and Operations		*The control and operations domain includes three distinctive operation and control entities. These entities control generation, transmission, and distribution.*		
Interface	*Entity 1*	*Entity 2*	*Comments*	*Use Case Example*
PS13	Distribution Operation and Control	Customer Point(s) of Interface	Provides information exchange and control of customer equipment by distribution operations and control. Interfaces include those for control and monitoring.	Generation Monitoring and Control
PS62	Customer Point(s) of Interface	Customer Distributed Energy Resources	Provides for information exchange and control of DERs by entities external to customer. Interfaces include those for protection, control, and monitoring.	

Domain		*Domain Description*		
Service Providers		*The service provider domain contains third parties and utilities that provide electrical power-related services. The service provider domain is the connection between the electric energy markets and the end users.*		
Interface	*Entity 1*	*Entity 2*	*Comments*	*Use Case Example*
PS66	Electric Service Providers	Distribution Operation and Control	Provides for information exchange of expected loading and aggregate control mechanisms. Interfaces include those for monitoring.	Electricity Production Forecasts Generation
PS68	Electric Service Provider	Customer Point(s) of Interface	Provides for monitoring information and control of customer generation, storage, and loads. Interfaces include those for monitoring and control.	Monitoring and Control

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Domain		*Domain Description*		
Service Providers		*The service provider domain contains third parties and utilities that provide electrical power-related services. The service provider domain is the connection between the electric energy markets and the end users.*		
Interface	*Entity 1*	*Entity 2*	*Comments*	*Use Case Example*
PS62	Customer Point(s) of Interface	Customer Distributed Energy Resources	Provides for information exchange and control of DERs by entities external to customer. Interfaces include those for protection, control, and monitoring.	

Domain		*Domain Description*		
Customer		*The customer domain includes many types of customers that are connected to the electrical distribution system or electrical transmission system.*		
Interface	*Entity 1*	*Entity 2*	*Comments*	*Use Case Example*
PS13	Customer Point(s) of Interface	Distribution Operation and Control	Provides information exchange and control of customer equipment by distribution operations and control. Interfaces include those for control and monitoring.	Generation Monitoring and Control
PS68	Customer Point(s) of Interface	Electric Service Provider	Provides for monitoring information and control of customer generation, storage, and loads. Interfaces include those for monitoring and control.	Generation Monitoring and Control
PS52	Customer Point(s) of Interface	Markets	Provides for optimization of distributed generation, storage, and load control (i.e., demand response) on the customer domain. Interfaces include those for control, monitoring, and reporting.	Price Signals Energy Production

1.6 Information Exchanged [Communications Architecture]

Information exchanged through the communications architecture includes:

- Control and Operations communications for:
  - Generation
  - Monitoring and Control
- Weather Forecasts to include:
  - Temperature
  - Humidity
  - Wind
  - Solar insolation
- Energy Production:
  - Energy Production
  - Historical Production calculation and storage
- Generation Production Forecasts:
  - 15-minute
  - Hour ahead
  - Day ahead
  - Weekly.

Interface	*Entity 1*	*Entity 2*	*Comments*	*Use Case Example*
CT3	Utility Operation and Control/ Enterprise	Neighborhood Area Network	This is a communications network that connects directly to the utility center. It is usually owned by the utility.	Generation Monitoring and Control
CT52	Neighborhood Area Network	Energy Services Interfaces/ Customer Premises	The ESI is the interface between NAN and HAN. Through ESI, NAN and HAN can communicate to each other even though they might use different communication technology.	

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Interface	*Entity 1*	*Entity 2*	*Comments*	*Use Case Example*
		Network		
CT16	Energy Services Interfaces/ Customer Premises Network	Distributed Energy Resources Network	This provides connectivity between the ESI (which may be a stand-alone device or could be integrated into the smart meter itself) and the DER network via the CPN to the DER in order to support functions such as charging, billing, load shedding, generation, and storage. Here (CT16), we only consider the case where the DER is capable of communication with the ESI.	
CT27	Public Internet/ Intranet	Utility Operation and Control/ Enterprise	It connects the utility control/operation/enterprise center to the third-party service provider, ISP, WSP, and other providers through the public Internet.	Weather Forecasts: • Temperature • Humidity • Wind • Solar insolation
CT23	Public Internet/ Intranet	Third-Party Services	It connects the third-party network (value-added service provider) to the public Internet.	
CT25	Utility Operation and Control/ Enterprise	Third-Party Services	It connects the third-party network (value-added service provider) to the utility control/operation/enterprise center. It is usually part of an open ADE data exchange arrangement where the third-party network accesses customer metering/billing and energy consumption information through the utility's data repositories. Other schemes involve third-party demand response and other services.	Generation Historical Production Electricity Production Forecasts
CT24	Markets	Third-Party Services	It connects the third-party network (value-added service provider) to the markets for energy/electricity price signaling information.	Price Signals Energy Production

1.7 Activities/Services [Information Technology Architecture]

These services provide systems and applications for Distribution Operations monitoring and control of the Distributed Energy Resources.

Interface	*Entity 1*	*Entity 2*	*Comments*	*Use Case Example*
IT13	Distribution Operation	Distribution Management	The information supports real-time monitoring and control of the distribution system.	Monitoring and Control
IT27	Distribution Management	Distributed Energy Resources (Local Generation)	Power system monitoring (capacity, availability, etc.) of distributed (customer) generation. Possible reactive power control.	

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

1.8 Contracts/Regulations

N/A

Identify any overall (human-initiated) contracts, regulations, policies, financial considerations, engineering constraints, pollution constraints, and other environmental quality issues that affect the design and requirements of the Function.

Contract/Regulation	*Impact of Contract/Regulation on Function*

Policy	*From Actor*	*May*	*Shall Not*	*Shall*	*Description (verb)*	*To Actor*
ProvideEnergy	ESP			X	Provide power on demand	Customer

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Constraint	*Type*	*Description*	*Applies to*

2 Step by Step Analysis of Function

N/A at this level of detail.

Describe steps that implement the function. If there is more than one set of steps that are relevant, make a copy of the following section grouping (Steps to implement function, Preconditions and Assumptions, Steps normal sequence, Post-conditions) and provide each copy with its own sequence name.

2.1 Steps to implement function – Name of Sequence

Name of this sequence.

2.1.1 Preconditions and Assumptions

Describe conditions that must exist prior to the initiation of the Function, such as prior state of the actors and activities

Identify any assumptions, such as what systems already exist, what contractual relations exist, and what configurations of systems are probably in place

Identify any initial states of information exchanged in the steps in the next section. For example, if a purchase order is exchanged in an activity, its precondition to the activity might be 'filled in but unapproved'.

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Actor/System/Information/Contract	*Preconditions or Assumptions*

2.1.2 Steps – Name of Sequence

Describe the normal sequence of events, focusing on steps that identify new types of information or new information exchanges or new interface issues to address. Should the sequence require detailed steps that are also used by other functions, consider creating a new "sub" function, then referring to that "subroutine" in this function. Remember that the focus should be less on the algorithms of the applications and more on the interactions and information flows between "entities", e.g. people, systems, applications, data bases, etc. There should be a direct link between the narrative and these steps.

The numbering of the sequence steps conveys the order and concurrency and iteration of the steps occur. Using a Dewey Decimal scheme, each level of nested procedure call is separated by a dot '.'. Within a level, the sequence number comprises an optional letter and an integer number. The letter specifies a concurrent sequence within the next higher level; all letter sequences are concurrent with other letter sequences. The number specifies the sequencing of messages in a given letter sequence. The absence of a letter is treated as a default 'main sequence' in parallel with the lettered sequences.

Sequence 1:

```
1.1 - Do step 1
1.2A.1 - In parallel to activity 2 B do step 1
1.2A.2 - In parallel to activity 2 B do step 2
1.2B.1 - In parallel to activity 2 A do step 1
1.2B.2 - In parallel to activity 2 A do step 2
1.3 - Do step 3
1.3.1 - nested step 3.1
1.3.2 - nested step 3.2
```

Sequence 2:

```
2.1 - Do step 1
2.2 – Do step 2
```


Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.*[1]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*

2.1.3 Post-conditions and Significant Results

Describe conditions that must exist at the conclusion of the Function. Identify significant items similar to that in the preconditions section.

Describe any significant results from the Function

Actor/Activity	*Post-conditions Description and Results*

2.2 Architectural Issues in Interactions

Elaborate on all architectural issues in each of the steps outlined in each of the sequences above. Reference the Step by number. Double click on the embedded excel file – record the changes and save the excel file (this updates the embedded attachment).

FUTURE USE

[1] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

2.3 Diagram

Refer to diagrams n IEEE 2030.

For clarification, draw (by hand, by Power Point, by UML diagram) the interactions, identifying the Steps where possible.

FUTURE USE

3 Auxiliary Issues

3.1 References and contacts

TBD

Documents and individuals or organizations used as background to the function described; other functions referenced by this function, or acting as "sub" functions; or other documentation that clarifies the requirements or activities described. All prior work (intellectual property of the company or individual) or proprietary (non-publicly available) work must be so noted.

FUTURE USE

ID	Title or contact	Reference or contact information
[1]		
[2]		

3.2 Action Item List

None at this time.

As the function is developed, identify issues that still need clarification, resolution, or other notice taken of them. This can act as an Action Item list.

FUTURE USE

ID	Description	Status
[1]		
[2]		

3.3 Revision History

TBD

For reference and tracking purposes, indicate who worked on describing this function, and what aspect they undertook.

FUTURE USE

No	Date	Author	Description
0.			

Draft Use Cases – Preliminary in Nature

Direct Load Control

Direct Load Control Event

5-6-2010

Version 3.0

1 Descriptions of Function

All prior work (intellectual property of the company or individual) or proprietary (non-publicly available) work should be so noted.

1.1 Function Name

Direct Load Control Event

1.2 Function ID

Identification number of the function

1.3 Brief Description

The DR solution shall provide the ability to manage direct load control programs. It accomplishes this by managing the transmission of direct load control actions to ***HAN devices***, shown as ***PEV***, Programmable Communicating Thermostat (***PCT***), ***load control switch*** and ***smart appliances***. This solution will also provide interactions with customers to convey direct load control information via in home display (***IHD***).

FERC states that further development of key standards around Demand Response will enhance interoperability and communications between system operators, demand response resources (also called curtailment resources), and the systems that support them. The following Use Cases on Demand Response supports DOE's request to identify use cases and relevant standards, particularly around dispatchable curtailment to address loss or unavailability of other resources or shifting consumption to non-peak times.

Demand Response is a temporary change in electricity consumption by demand control devices in response to market or reliability conditions. Demand control devices control loads capable of measurably and verifiably providing temporary changes in demand. Demand Response may be used to support electricity demand or supply management opportunities for reliability or economic reasons. By managing loads through Demand Response the opportunity exists to:

- Engage the consumer by allowing market participation and consumption/billing choices;
- Introduce new markets for aggregators, micro-grid operators, distributed generation;

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

- Control peak power conditions and limit or remove brownout/blackout instances;
- Flatten consumption curves or peaks and shift consumption times;
- Respond to temporary grid anomalies;
- Maximize use of available power and increase system efficiencies through time-of-use (TOU) and dynamic pricing models.

1.4 Narrative

There are three scenarios described in this use case. Scenario #1 details a Demand Response (DR) event using a meter centric approach. (DR via AMI. No EMS.) Scenario #2 details a DR event using an EMS centric approach with the AMI System. (DR signals travel through the Smart Meter to the EMS and back through the Smart Meter.) Scenario #3 details a DR Event using an EMS centric approach with Internet Gateway. (DR signals travel from the DR Application through the internet, to the internet gateway, to the EMS. The Information travels from the devices to the EMS, to the internet Gateway, through the internet, back to the DR Application.)

Scenario #1 - The Demand Response (DR) solution shall provide the ability to manage direct load control programs. It accomplishes this by managing the transmission of direct load control actions to ***PEV, load-control switch, HAN device,*** and ***smart appliances***. This solution will also provide interactions with customers to convey direct load control information using an ***In Home Display (IHD)***. The initiation of a DR event is triggered by the ***DR application*** (a module) of the AMI system, shown as logically separated. The ***AMI Head-End*** module sends the DR command/message through the ***AMI network*** to the ***smart meter*** where is it is transmitted through the Home Area Network (HAN) to the direct load control devices. These commands and messages can include:

- The DR profile which can include
    - Temperature change
    - On/off parameters
    - Pricing information (CPP, TOU)
    - Informational messages
- Curtailment requests (direct load control)

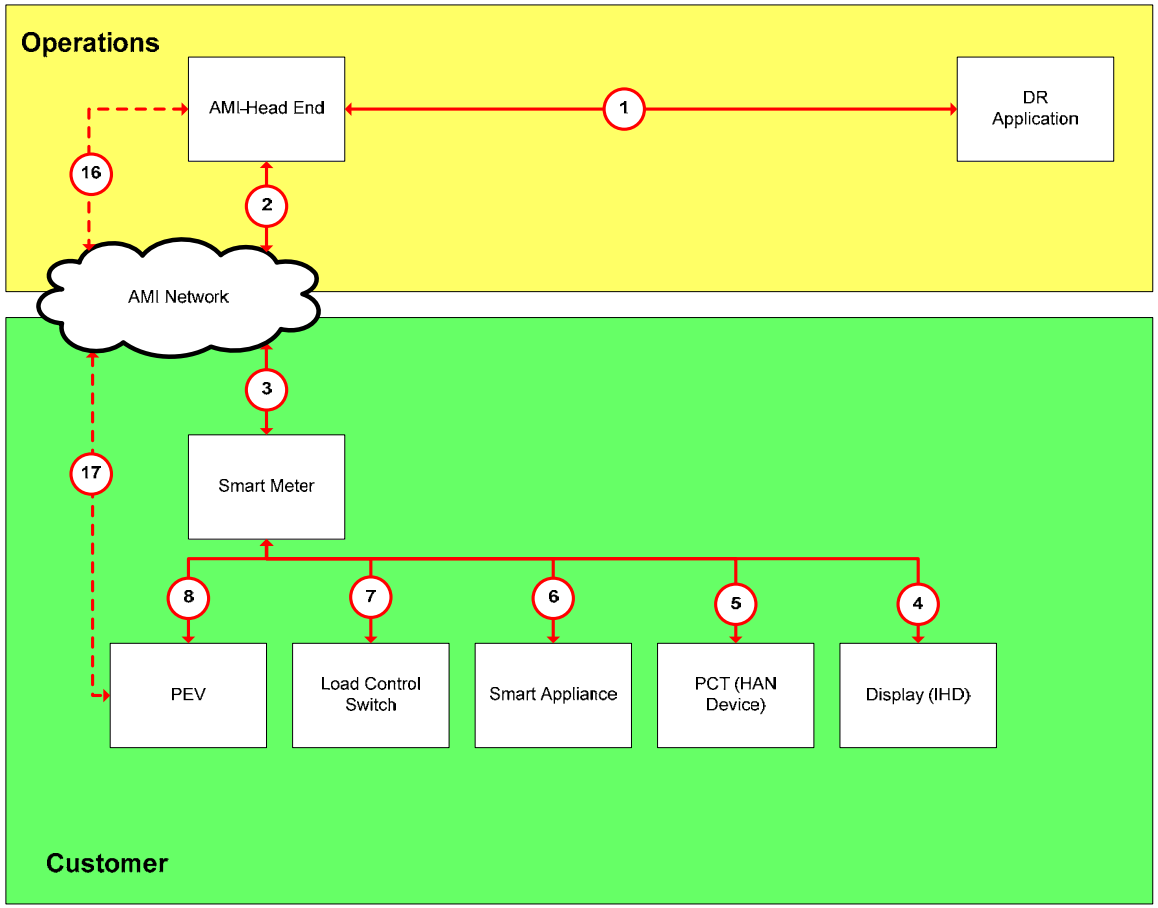


Figure 1-1
Context Diagram for DR Signal over AMI Network, Smart Meter Centric

Scenario #2 - The DR solution shall provide the ability to manage direct load control programs. It accomplishes this by managing the transmission of direct load control actions to ***PEV, load-control switch, HAN device,*** and ***smart appliances***. This solution will also provide interactions with customers to convey direct load control information using an ***IHD***. The initiation of a DR event is triggered by the ***DR application*** (a module) of the AMI system, shown as logically separated. The ***AMI head end*** module sends the DR command/message through the ***AMI network*** to the ***smart meter.*** The ***smart meter*** relays the information, needed by the home ***Energy Management System*** (***EMS***) which

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

acts as the home control center for electricity consumption. The ***EMS*** provides various facilities for the home owner to track his consumption verify trends and be savvier with his electricity consumption. The ***EMS*** transmits through the HAN to the direct load control devices. These commands and messages can include:

- The DR profile which can include
    - Temperature change
    - On/off parameters
    - Start & Duration
    - Pricing information (CPP, TOU)
    - Informational messages, other SEP1.0 DRLC cluster parameters
- Curtailment requests (direct load control)

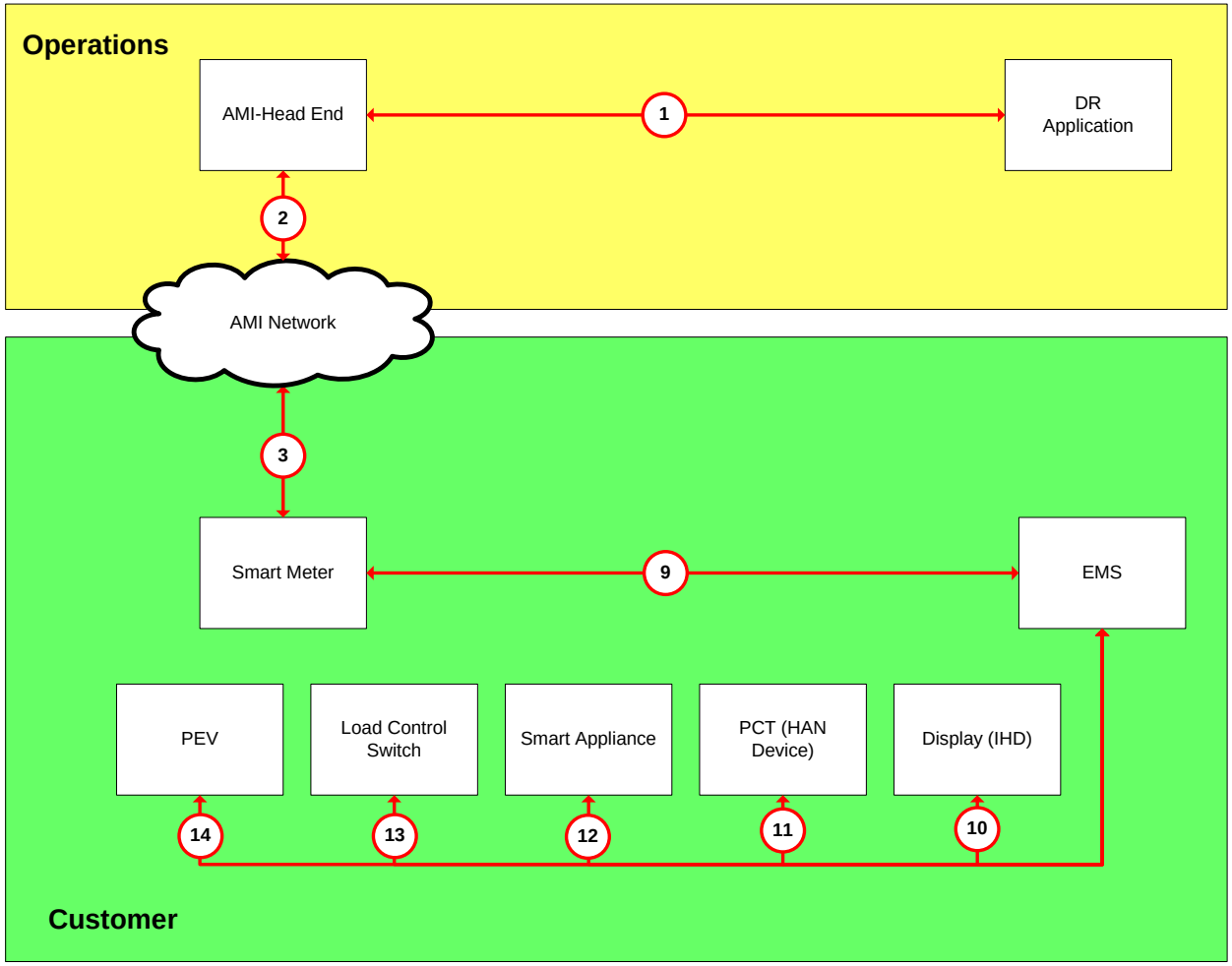


Figure 1-2
Context Diagram for DR Signal over AMI EMS Centric

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Scenario #3 - The DR solution shall provide the ability to manage direct load control programs. It accomplishes this by managing the transmission of direct load control actions to ***PEV, load-control switch, HAN device,*** and ***smart appliances***. This solution will also provide interactions with customers to convey direct load control information using an ***In Home Display IHD***. The initiation of a DR event is triggered by the ***DR application*** (a module) of the AMI system, shown as logically separated. The ***smart meter*** relays simple meter data needed by the home ***Energy Management System (EMS)***. The DR application, through the internet and ***internet gateway*** transmits DR commands to the ***EMS*** which acts as the home control center for electricity consumption. The ***EMS*** provides various facilities for the home owner to track their consumption verify trends and be savvier with his electricity consumption. The ***EMS*** transmits through the HAN to the direct load control devices. These commands and messages can include:

- The DR profile which can include
    - Temperature change
    - On/off parameters
    - Pricing information (CPP, TOU)
    - Informational messages
- Curtailment requests (direct load control)

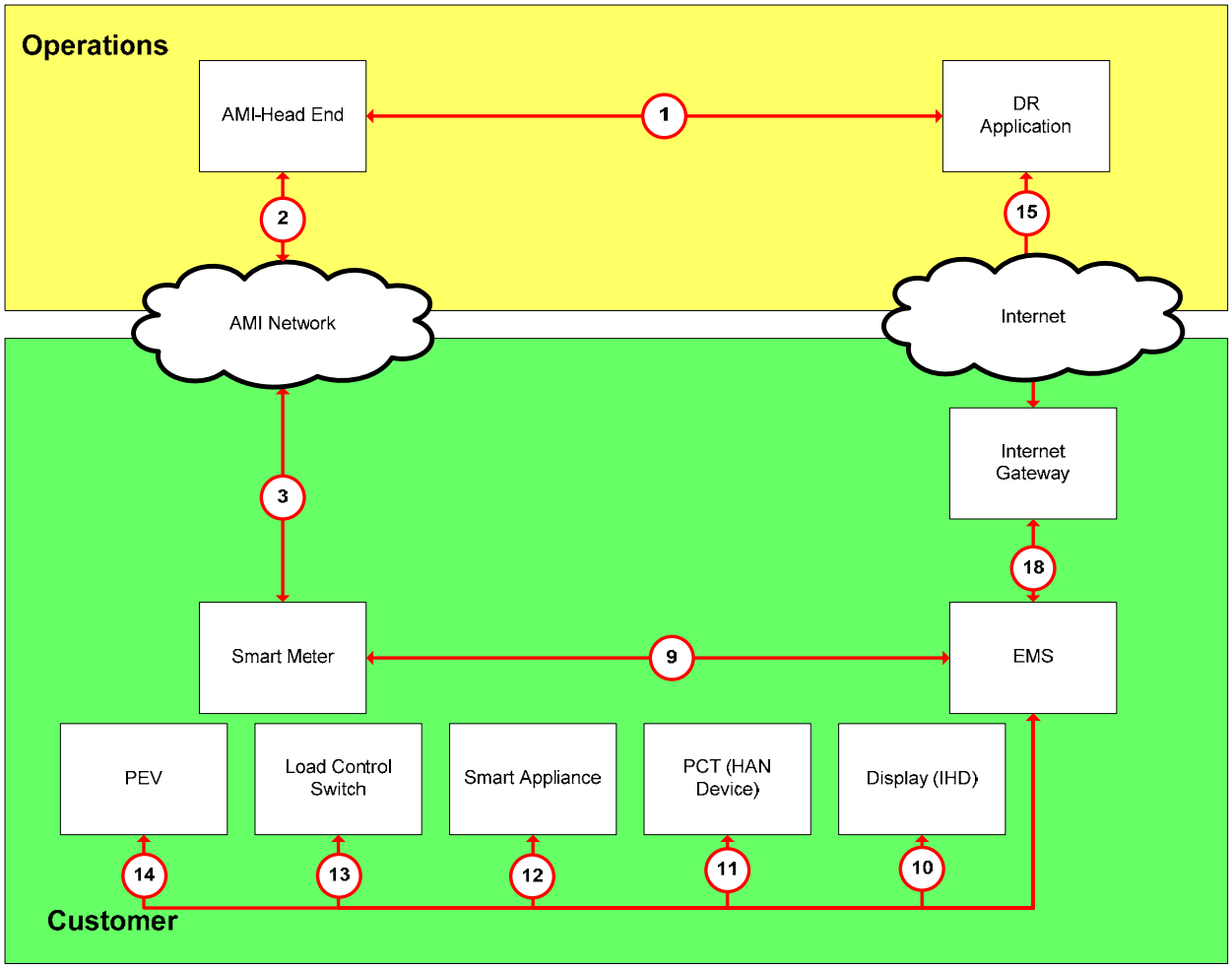


Figure 1-3
Context Diagram for DR Signal over Internet Gateway EMS Centric

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

1.5 Actor (Stakeholder) Roles

Grouping (Community)		*Group Description*
Actor Name	*Actor Type (person, organization, device, system, or subsystem)*	*Actor Description*
Access Point	Sub-System	The Access Point is a sub-system within the AMI system that performs high volume data transport capabilities.
The Utility's NOC/Human	Organization	The NOC is the Network Operations center for Telecom activities
AMI Head End	System	The AMI Head-End is the back office system than controls the Advanced Metering Infrastructure.
AMM Module	System	Automated Meter Management (predecessor to the DR module of the AMI Head-End)
Customer	Person	Customer of the Electric Service Provider. Contracts with the ESP to receive quality electrical service. Agrees to participate in Demand Response program. May or may not (at time of system operation) choose to participate
Customer Portal	System	Interactive Web-site that is accessible via the internet that enables the exchange and display of information for the customer.
Distribution Management	Organization	Organization within the utility in charge of the distribution of electricity.
Distribution Operations	Organization	Organizational Group within the utility responsible for the operations of the distribution system.
DR Application	Sub-System	Demand Response Application is a sub-system of the AMI System used to issue demand response commands.

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Grouping (Community)		*Group Description*
Actor Name	*Actor Type (person, organization, device, system, or subsystem)*	*Actor Description*
DR Service Provider	Organization	
EMS (customer)	Device	A logical or physical device typically located at the customer facility that acts as a home electricity control center. The EMS is typically connected to the HAN and sends/receives information from various communications means depending on the customer scenario.
EVSE (Electric Vehicle Supply Equipment)	Device	Electric Vehicle Supply Equipment manufacturers are delivering Smart charging stations for electric vehicles. These smart charging stations will typically be located at customers' premises, or at other private and public parking facilities.
EVSE Radio	Device	The radio within the EVSE that sends and receives information through the HAN
HAN	System	Home Area Network (Network of communicating energy consuming devices)
HAN Device	Device	Device owned by customer, utility or third party that is registered on the Home Area Network (HAN). It communicates in a secure way between other HAN devices.
IHD (In-Home Display)	Device	In-Home Display presents basic information to the customer such as consumption data, price information or demand response signals.
IHD Radio	Device	The radio with the IHD that receives and sends the data to the HAN.
Load Control	Device	Electric switch that can be remotely commanded to open or close.

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Grouping (Community)		*Group Description*
Actor Name	*Actor Type (person, organization, device, system, or subsystem)*	*Actor Description*
Switch (LCS)		
Load Control Switch Radio	Device	The radio that sends and receives data between the controller and the LCS
Meter	Device	A smart meter electronically tracks how much electricity is used and when it is used. The smart meter is also equipped to send and receive information from/to the AMI network and also from/to the HAN
Metering Department/Human	Organization	The Department within the utility in charge of metering electricity consumption
Metering System	System	Also called Advanced Metering Infrastructure it is the collection of devices (such as smart meters), systems (such as MDM) and sub-systems (such as relays or Access points) that enable the automated metering solution
NIC	Device	Network Interface Card within the meter that has 3 elements (NIC - ESI, NIC - ESP & Metrology board)
NIC - ESI	Device	HAN side of the Network Interface Card within the meter. (Energy Services Interface). Device and software that permits applications such as load control device or in-home display to receive information in a secure fashion.
NIC - ESP	Device	AMI side of the network interface card within the smart meter.
PCT (Programmable	Device	Device on the Home Area Network that is programmable and controllable.

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Grouping (Community)		*Group Description*
Actor Name	*Actor Type (person, organization, device, system, or subsystem)*	*Actor Description*
Communicating Thermostat)		
PCT Radio	Device	The radio that sends and receives data between the HAN and the PCT
PEV	Device	Plug-In Electric Vehicle
PEV Radio	Device	The radio with the PEV that sends and receives information through the HAN
Relay (AMI)	Device	A sub-system of the AMI system that typically relays the data using radio signals between the meters and the access points.
Smart Appliance	Device	Smart Appliances can react to remote management, whether to price, grid integrity, or other energy management signaling.
Smart Appliance Radio	Device	The radio that sends and receives data between the smart appliance and the HAN
Smart Meter	Device	A digital meter used in measuring watts, vars, var-hours, volt-amperes, or volt-ampere-hours. The Smart Meter is a 2-way communicating device that includes a NIC and is part of an advanced metering infrastructure (AMI). It is located on the customer premise and owned by the distributor or retail provider.

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

1.6 Information Exchanged

Information Object Name	*Information Object Description*
Inadequate generation resources	
Direct Load Control Event	
(1) Data elements to trigger for Direct Load Control	
(2) Data elements to trigger for Direct Load Control Event	
(3) Data elements concerning DR Event for In-Home Display	
Communications Acknowledgement	
Information for DR Event	
(4) Data elements to trigger for Direct Load Control Event	
Communications Acknowledgement	
(5) Data elements to trigger for Direct Load Control Event	
Communications Acknowledgement	
(6) Data elements to trigger for Direct Load Control Event	
Communications Acknowledgement	
(7) Data elements to trigger for Direct Load Control Event	

Information Object Name	*Information Object Description*
Communications Acknowledgement	
System Updates	

1.7 Activities/Services

Describe or list the activities and services involved in this Function (in the context of this Function).

Activity/Service Name	*Activities/Services Provided*

1.8 Contracts/Regulations

Identify any overall (human-initiated) contracts, regulations, policies, financial considerations, engineering constraints, pollution constraints, and other environmental quality issues that affect the design and requirements of the Function.

Contract/Regulation	*Impact of Contract/Regulation on Function*
Opt Out Clause	Customer may not exceed 5 hours a day

Policy	*From Actor*	*May*	*Shall Not*	*Shall*	*Description (verb)*	*To Actor*

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Constraint	*Type*	*Description*	*Applies to*

2 Step by Step Analysis of Function

Describe steps that implement the function. If there is more than one set of steps that are relevant, make a copy of the following section grouping (Steps to implement function, Preconditions and Assumptions, Steps normal sequence, Post-conditions) and provide each copy with its own sequence name.

2.1 Steps to implement function – Name of Sequence

Scenario #1 DR via AMI. No EMS.

2.1.1 Preconditions and Assumptions

Describe conditions that must exist prior to the initiation of the Function, such as prior state of the actors and activities.

Actor/System/Information/Contract	*Preconditions or Assumptions*
NIC - ESP	It is understood that the ESP is part of the Network Interface Card (NIC) inside the Smart Meter.
NIC - ESI	It is understood that the ESI is part of the Network Interface Card (NIC) inside the Smart Meter.

2.1.2 Steps – Name of Sequence

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.*[1]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section0.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section0.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section0.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
1.1	Energy Service Provider (ESP) determines that the available generation is inadequate to fulfill the system loads	ESP	ESP contacts Distribution Operations	ESP contacts Distribution Operations to report inadequate generation resources	ESP	Distribution Operations	Inadequate generation resources		
1.2		Distribution Operations	Direct Load Control Event Called	Distribution Operations calls a Direct Load Control Event using the Demand Response Application (demand response event).	Distribution Operations	Demand Response Application	Direct Load Control Event		

[1] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.3		Demand Response Application	Demand Response Application creates appropriate transactions	Demand Response Application creates appropriate transactions (to send to Customers and Customer's Devices) to send to the AMI Head End	Demand Response Application	AMI Head End	(1) Data elements to trigger for Direct Load Control	The AMI is ultimately passing data thru the meter to the HAN to the Controllable Devices	IEC 61968
1.4		AMI Head End	AMI Head End send data elements	AMI Head End sends Data elements to trigger for Direct Load Control Event to the NIC - ESP via the AMI Network	AMI Head End	NIC - ESP	(2) Data elements to trigger for Direct Load Control Event	Use AMI Network Use Case scenario AMI Head End to Smart Meter	
1.5		NIC - ESP	NIC - ESP send Data elements	NIC - ESP send Data elements to trigger for Direct Load Control Event to the NIC - ESI	NIC - ESP	NIC - ESI	(2) Data elements to trigger for Direct Load Control Event		
1.6 A.1		NIC - ESI	NIC - ESI sends Data elements	NIC - ESI sends Data elements concerning DR Event for IHD to IHD Radio	NIC - ESI	IHD Radio	(3) Data elements concerning DR Event for IHD		
1.6 A.1.1		IHD Radio	IHD Radio receives the signal	IHD Radio receives the signal and sends a Communications Acknowledgement to the NIC - ESI	IHD Radio	NIC - ESI	Communications Acknowledgement		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.6. A.2		IHD Radio	IHD Radio sends Data elements	IHD Radio sends Data elements concerning DR Event for IHD to IHD	IHD Radio	IHD (In-Home Display)	(3) Data elements concerning DR Event for IHD		
1.6 A.3		IHD (In-Home Display)	IHD displays information	IHD displays information for DR Event	IHD (In-Home Display)	IHD (In-Home Display)	Information for DR Event		
1.6 B.1		NIC - ESI	NIC - ESI sends Data elements	NIC - ESI sends Data elements to trigger for Direct Load Control Event to PCT Radio	NIC - ESI	PCT Radio	(4) Data elements to trigger for Direct Load Control Event		
1.6 B.1. 1		PCT Radio	PCT Radio receives the signal	PCT Radio receives the signal and sends a Communications Acknowledgement to the NIC - ESI	PCT Radio	NIC - ESI	Communications Acknowledgement		
1.6 B.2		PCT Radio	PCT Radio sends data elements	PCT Radio sends Data elements to trigger for Direct Load Control Event to the PCT Controller	PCT Radio	PCT Controller	(4) Data elements to trigger for Direct Load Control Event	Cycling vs. temperature control - ???	
1.6 B.3		PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat) functions	PCT (Programmable Communicating Thermostat) functions accordingly	PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.6 C.1		NIC - ESI	NIC - ESI sends Data elements	NIC - ESI sends Data elements to trigger for Direct Load Control Event to Smart Appliances Radio	NIC - ESI	Smart Appliances Radio	(5) Data elements to trigger for Direct Load Control Event		
1.6 C.1.1		Smart Appliances Radio	Smart Appliances Radio receives the signal	Smart Appliances Radio receives the signal and sends a Communications Acknowledgement to the NIC - ESI	Smart Appliances Radio	NIC - ESI	Communications Acknowledgement		
1.6 C.2		Smart Appliances Radio	Smart Appliances Radio sends data elements	Smart Appliances Radio sends Data elements to trigger for Direct Load Control Event to Smart Appliance Device Controller	Smart Appliances Radio	Smart Appliance Device Controller	(5) Data elements to trigger for Direct Load Control Event		
1.6 C.3		Smart Appliance	Smart Appliance responds	Smart Appliance responds accordingly	Smart Appliance Device Controller	Smart Appliance Device Controller	(5) Data elements to trigger for Direct Load Control Event		
1.6 D.1		NIC - ESI	NIC - ESI sends Data elements	NIC - ESI sends Data elements to trigger for Direct Load Control Event to the Load Control Switch Radio	NIC - ESI	Load Control Switch Radio	(6) Data elements to trigger for Direct Load Control Event		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.6 D.1.1		Load Control Switch Radio	Load Control Switch Radio receives the signal	Load Control Switch Radio receives the signal and sends a communications acknowledgement to the NIC - ESI	Load Control Switch Radio	NIC - ESI	Communications Acknowledgement		
1.6 D.2		Load Control Switch Radio	Load Control Switch Radio sends data elements	Load Control Switch Radio sends Data elements to trigger for Direct Load Control Event to Load Control Switch Device Controller	Load Control Switch Radio	Load Control Switch Device Controller	(6) Data elements to trigger for Direct Load Control Event		
1.6 D.3		Load Control Switch Device Radio	Load Control Switch Device Radio responds	Load Control Switch Device Radio responds accordingly	Load Control Switch Device Radio	Load Control Switch Device Radio	(6) Data elements to trigger for Direct Load Control Event		
1.6 E.1		NIC - ESI	NIC - ESI sends data elements	NIC - ESI sends Data elements to trigger for Direct Load Control Event to EVSE Radio	NIC - ESI	EVSE Radio	(7) Data elements to trigger for Direct Load Control Event		
1.6 E.1.1		EVSE Radio	EVSE Radio receives the signal	EVSE Radio receives the signal and sends a Communications Acknowledgement to the NIC - ESI	EVSE Radio	NIC - ESI	Communications Acknowledgement		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.6 E.2		EVSE Radio	EVSE Radio sends data elements	EVSE Radio sends Data elements to trigger for Direct Load Control Event to EVSE	EVSE Radio	EVSE	(7) Data elements to trigger for Direct Load Control Event		
1.6 E.3		EVSE	EVSE responds	EVSE responds accordingly	EVSE	EVSE	(7) Data elements to trigger for Direct Load Control Event		
1.7		NIC - ESI	NIC - ESI collects and delivers Communications Acknowledges	NIC - ESI collects and delivers Communications Acknowledges to NIC - ESP	NIC - ESI	NIC - ESP	Communications Acknowledgements		
1.8		NIC - ESI	NIC - ESP delivers Communications Acknowledgements	NIC - ESP delivers Communications Acknowledgements to the AMI Head End via the AMI Network	Smart ESP	AMI Head End	Communications Acknowledgements	Use AMI Network Use Case Scenario NIC - ESP to AMI Head End	
1.9		AMI Head End	AMI Head End delivers Communications Acknowledgements	AMI Head End delivers Communications Acknowledgements to the DR Application	AMI Head End	DR Application	Communications Acknowledgements		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.10		DR Application	DR Application displays updates	DR Application displays updates	DR Application	DR Application	System Updates		

2.1.3 *Post-conditions and* Significant Results

Actor/Activity	*Post-conditions Description and Results*
Distribution Operations	Load control event successfully implemented
Supplier of Demand Response Application	It is delivered as expected

2.2 Steps to implement function – Name of Sequence

DR signals travel through the Smart Meter to the EMS and back through the Smart Meter

2.2.1 Preconditions and Assumptions

Actor/System/Information/Contract	*Preconditions or Assumptions*
NIC - ESP	It is understood that the ESP is part of the Network Interface Card (NIC) inside the Smart Meter.
NIC - ESI	It is understood that the ESI is part of the Network Interface Card (NIC) inside the Smart Meter.
Internet Gateway	There is a functional Internet Gateway

2.2.2 Steps – Name of Sequence

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.*[2]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section0.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section0.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section0.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
2.1	Energy Service Provider determines that the available generation is inadequate to fulfill the system loads	ESP	ESP contacts Distribution Operations	ESP contacts Distribution Operations to report inadequate generation resources	ESP	Distribution Operations	Inadequate generation resources		
2.2		Distribution Operations	Direct Load Control Event Called	Distribution Operations calls a Direct Load Control Event using the Demand Response Application (demand response event).	Distribution Operations	Demand Response Application	Direct Load Control Event		

[2] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.3		Demand Response Application		Demand Response Application creates appropriate transactions (to send to Customers and Customer's Devices) to send to the AMI Head End	Demand Response Application	AMI Head End	(1) Data elements to trigger for Direct Load Control	The AMI is ultimately passing data thru the meter to the HAN to the Controllable Devices	IEC 61968
2.4		AMI Head End	AMI Head End sends transactions	AMI Head End sends Data elements to trigger for Direct Load Control Event to the NIC - ESP via the AMI Network	AMI Head End	NIC - ESP	(2) Data elements to trigger for Direct Load Control Event	Use AMI Network Use Case scenario AMI Head End to Smart Meter	
2.5		NIC - ESP	NIC - ESP send Data elements	NIC - ESP send Data elements to trigger for Direct Load Control Events to the NIC - ESI	NIC - ESP	NIC - ESI	(2) Data elements to trigger for Direct Load Control Event		
2.6		NIC - ESP	NIC - ESP send Data elements	NIC - ESI send Data elements to trigger for Direct Load Control Events to the EMS	NIC - ESI	EMS	(2) Data elements to trigger for Direct Load Control Event		
2.7 A.1		EMS	EMS sends Data elements	EMS sends Data elements concerning DR Event for IHD to IHD Radio	EMS	IHD Radio	(3) Data elements concerning DR Event for IHD		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.7 A.1.1		IHD Radio	IHD Radio receives the signal	IHD Radio receives the signal and sends a Communications Acknowledgement to the EMS	IHD Radio	EMS	Communications Acknowledgement		
2.7.A.2		IHD Radio	IHD Radio sends data elements	IHD Radio sends Data elements concerning DR Event for IHD to IHD	IHD Radio	IHD (In-Home Display)	(3) Data elements concerning DR Event for IHD		
2.7 A.3		IHD (In-Home Display)	IHD (In-Home Display) displays information	IHD (In-Home Display) displays information for DR Event	IHD (In-Home Display)	IHD (In-Home Display)	Information for DR Event		
2.7 B.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements to trigger for Direct Load Control Event to PCT Radio	EMS (customer)	PCT Radio	(4) Data elements to trigger for Direct Load Control Event		
2.7 B.1.1		PCT Radio	PCT Radio receives the signal	PCT Radio receives the signal and sends a Communications Acknowledgement to the EMS (customer)	PCT Radio	EMS	Communications Acknowledgement		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.7 B.2		PCT Radio	PCT Radio sends data elements	PCT Radio sends Data elements to trigger for Direct Load Control Event to the PCT (Programmable Communicating Thermostat)	PCT Radio	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event	Cycling vs. temperature control - ???	
2.7 B.3		PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)functions	PCT (Programmable Communicating Thermostat)functions accordingly	PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event		
2.7 C.1		EMS	EMS sends data elements	EMS sends Data elements to trigger for Direct Load Control Event to Smart Appliances Radio	EMS	Smart Appliances Radio	(5) Data elements to trigger for Direct Load Control Event		
2.7 C.1.1		Smart Appliances Radio	Smart Appliances Radio receives the signal	Smart Appliances Radio receives the signal and sends a Communications Acknowledgement to the EMS	Smart Appliances Radio	EMS	Communications Acknowledgement		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.7 C.2		Smart Appliances Radio	Smart Appliances Radio sends data elements	Smart Appliances Radio sends Data elements to trigger for Direct Load Control Event to Smart Appliance	Smart Appliances Radio	Smart Appliance	(5) Data elements to trigger for Direct Load Control Event		
2.7 C.3		Smart Appliance Device	Smart Appliance responds	Smart Appliance responds accordingly	Smart Appliance	Smart Appliance	(5) Data elements to trigger for Direct Load Control Event		
2.7 D.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements to trigger for Direct Load Control Event to the Load Control Switch Radio	EMS (customer)	Load Control Switch Radio	(6) Data elements to trigger for Direct Load Control Event		
2.7 D.1.1		Load Control Switch Radio	Load Control Switch Radio receives the signal	Load Control Switch Radio receives the signal and sends a Communications Acknowledgement to the EMS	Load Control Switch Radio	EMS (customer)	Communications Acknowledgement		
2.7 D.2		Load Control Switch Radio	Load Control Switch Radio sends data elements	Load Control Switch Radio sends Data elements to trigger for Direct Load Control Event to Load Control Switch Device Controller	Load Control Switch Radio	Load Control Switch Device Controller	(6) Data elements to trigger for Direct Load Control Event		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.7 D.3		Load Control Switch	Load Control Switch responds	Load Control Switch responds accordingly	Load Control Switch	Load Control Switch	(6) Data elements to trigger for Direct Load Control Event		
2.7 E.1		EMS (customer)	EMS (customer) sends data elements	EMS (customer) sends Data elements to trigger for Direct Load Control Event to EVSE Radio	EMS (customer)	EVSE Radio	(7) Data elements to trigger for Direct Load Control Event		
2.7 E.1. 1		EVSE Radio	EVSE Radio receives the signal	EVSE Radio receives the signal and sends a Communications Acknowledgement to the EMS	EVSE Radio	EMS (customer)	Communications Acknowledgeme nt		
2.7 E.2		EVSE Radio	EVSE Radio sends data elements	EVSE Radio sends Data elements to trigger for Direct Load Control Event to EVSE	PEV	EVSE	(7) Data elements to trigger for Direct Load Control Event		
2.7 E.3		EVSE	EVSE responds	EVSE responds accordingly	EVSE	EVSE	(7) Data elements to trigger for Direct Load Control Event		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.8		EMS (customer)	EMS (customer)delivers Communications Acknowledgements	EMS (customer)delivers Communications Acknowledgements to NIC - ESI	EMS (customer)	NIC - ESI	Communications Acknowledgements		
2.9		NIC - ESI	NIC - ESI collects and delivers Communications Acknowledgements	NIC - ESI collects and delivers Communications Acknowledgements to NIC - ESP	NIC - ESI	NIC - ESP	Communications Acknowledgements		
2.10		NIC - ESP	NIC - ESP delivers Communications Acknowledgements	NIC - ESP delivers Communications Acknowledgements to the AMI Head End via the AMI Network	NIC - ESP	AMI Head End	Communications Acknowledgements	Use AMI Network Use Case Scenario NIC - ESP to AMI Head End	
2.11		AMI Head End	AMI Head End delivers Communications Acknowledgements	AMI Head End delivers Communications Acknowledgements to the DR Application	AMI Head End	DR Application	Communications Acknowledgements		
2.12		DR Application	DR Application displays updates	DR Application displays updates	DR Application	DR Application	System Updates		

2.2.3 Post-conditions and Significant Results

Actor/Activity	*Post-conditions Description and Results*
Distribution Operations	Load control event successfully implemented
Supplier of Demand Response Application	It is delivered as expected

2.3 Steps to implement function – Name of Sequence

DR signals travel from the DR Application through the internet, to the internet gateway, to the EMS. The Information travels from the devices to the EMS, to the internet Gateway, through the internet, back to the DR Application

2.3.1 Preconditions and Assumptions

Actor/System/Information/Contract	*Preconditions or Assumptions*
NIC - ESP	It is understood that the ESP is part of the Network Interface Card (NIC) inside the Smart Meter.
NIC - ESI	It is understood that the ESI is part of the Network Interface Card (NIC) inside the Smart Meter.
Internet Gateway	There is a functional Internet Gateway

2.3.2 Steps – Name of Sequence

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.*[3]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section0.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section0.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section0.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
3.1	Energy Service Provider determines that the available generation is inadequate to fulfill the system loads	ESP	ESP contacts Distribution Operations	ESP contacts Distribution Operations to report inadequate generation resources	ESP	Distribution Operations	Inadequate generation resources		
3.2		Distribution Operations	Direct Load Control Event Called	Distribution Operations calls a direct load control or demand response event using the Demand Response Application.	Distribution Operations	Demand Response Application	Direct Load Control Event		

[3] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.3		Demand Response Application	Demand Response Application creates appropriate transactions	Demand Response Application creates appropriate transactions (to send to Customers and Customer's Devices) to send to the Internet Gateway via the internet	Demand Response Application	Internet Gateway	(1) Data elements to trigger for Direct Load Control	The AMI is ultimately passing data thru the meter to the HAN to the Controllable Devices	IEC 61968
3.4		Internet Gateway	Internet Gateway sends transactions	Internet Gateway sends transactions to the EMS (customer)	Internet Gateway	EMS (customer)	(2) Data elements to trigger for Direct Load Control Event		
3.5 A.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements concerning DR Event for IHD to IHD Radio	EMS (customer)	IHD Radio	(3) Data elements concerning DR Event for IHD		
3.5 A.1.1		IHD Radio	IHD Radio receives the signal and sends a Communications Acknowledgement	IHD Radio receives the signal and sends a Communications Acknowledgement to the EMS	IHD Radio	EMS	Communications Acknowledgement		
3.5 A.2		IHD (In-Home Display)	IHD Radio sends data elements	IHD Radio sends Data elements concerning DR Event for IHD to IHD	IHD Radio	IHD (In-Home Display)	(3) Data elements concerning DR Event for IHD		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.5 A.3		IHD (In-Home Display)	IHD (In-Home Display)displays information	IHD (In-Home Display)displays information for DR Event	IHD (In-Home Display)	IHD (In-Home Display)	Information for DR Event		
3.5 B.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements to trigger for Direct Load Control Event to PCT Radio	EMS (customer)	PCT Radio	(4) Data elements to trigger for Direct Load Control Event		
3.5 B.1.1		PCT Radio	PCT Radio receives the signal and sends a Communications Acknowledgement	PCT Radio receives the signal and sends a Communications Acknowledgement to the EMS	PCT Radio	EMS (customer)	Communications Acknowledgement		
3.5 B.2		PCT (Programmable Communicating Thermostat)	PCT Radio sends data elements	PCT Radio sends Data elements to trigger for Direct Load Control Event to the PCT (Programmable Communicating Thermostat)	PCT Radio	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event	Cycling vs. temperature control - ???	

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.5 B.3		PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)functions	PCT (Programmable Communicating Thermostat)functions accordingly	PCT (Programmable Communicating Thermostat)	PCT (Programmable Communicating Thermostat)	(4) Data elements to trigger for Direct Load Control Event		
3.5 C.1		EMS (customer)	EMS (customer)sends data elements	EMS (customer)sends Data elements to trigger for Direct Load Control Event to Smart Appliances Radio	EMS (customer)	Smart Appliances Radio	(5) Data elements to trigger for Direct Load Control Event		
3.5 C.1.1		Smart Appliances Radio	Smart Appliances Radio receives the signal	Smart Appliances Radio receives the signal and sends a Communications Acknowledgement to the EMS (customer)	Smart Appliances Radio	EMS (customer)	Communications Acknowledgement		
3.5 C.2		Smart Appliance Radio	Smart Appliances Radio sends data elements	Smart Appliances Radio sends Data elements to trigger for Direct Load Control Event to Smart Appliance	Smart Appliance Radio	Smart Appliance	(5) Data elements to trigger for Direct Load Control Event		
3.5 C.3		Smart Appliance	Smart Appliance responds	Smart Appliance responds accordingly	Smart Appliance	Smart Appliance	(5) Data elements to trigger for Direct Load Control Event		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.5 D.1		EMS (customer)	EMS (customer) sends data elements	EMS (customer) sends Data elements to trigger for Direct Load Control Event to the Load Control Switch Radio	EMS (customer)	Load Control Switch Radio	(6) Data elements to trigger for Direct Load Control Event		
3.5 D.1.1		Load Control Switch Radio	Load Control Switch Radio receives the signal and sends a Communications Acknowledgement	Load Control Switch Radio receives the signal and sends a Communications Acknowledgement to the EMS	Load Control Switch Radio	EMS	Communications Acknowledgement		
3.5 D.2		Load Control Switch Radio	Load Control Switch Radio sends data elements	Load Control Switch Radio sends Data elements to trigger for Direct Load Control Event to Load Control Switch	Load Control Switch Radio	Load Control Switch	(6) Data elements to trigger for Direct Load Control Event		
3.5 D.3		Load Control Switch	Load Control Controller responds	Load Control Switch responds accordingly	Load Control Switch	Load Control Switch	(6) Data elements to trigger for Direct Load Control Event		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.5 E.1		EMS (customer)	EMS (customer)sends data elements to trigger	EMS (customer)sends Data elements to trigger for Direct Load Control Event to EVSE Radio	EMS (customer)	EVSE Radio	(7) Data elements to trigger for Direct Load Control Event		
3.5 E.1.1		EVSE Radio	EVSE Radio receives the signal and sends a Communications Acknowledgement	EVSE Radio receives the signal and sends a Communications Acknowledgement to the EMS	EVSE Radio	EMS	Communications Acknowledgement		
3.5 E.2		EVSE Radio	EVSE Radio sends data elements	EVSE Radio sends Data elements to trigger for Direct Load Control Event to the EVSE	EVSE Radio	EVSE	(7) Data elements to trigger for Direct Load Control Event		
3.5 E.3		EVSE	EVSE responds	EVSE responds accordingly	EVSE	EVSE	(7) Data elements to trigger for Direct Load Control Event		

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
3.6		EMS (customer)	EMS (customer)collects and delivers Communication Acknowledgements	EMS (customer)collects and delivers Communication Acknowledgements to Internet Gateway	EMS (customer)	Internet Gateway	Communication Acknowledgements		
3.7		Internet Gateway	Internet Gateway delivers Communication Acknowledgements	Internet Gateway delivers Communication Acknowledgements to the DR Application via the Internet Gateway	Internet Gateway	DR Application	Communication Acknowledgements		
3.8		DR Application	DR Application displays updates	DR Application displays updates	DR Application	DR Application	System Updates		

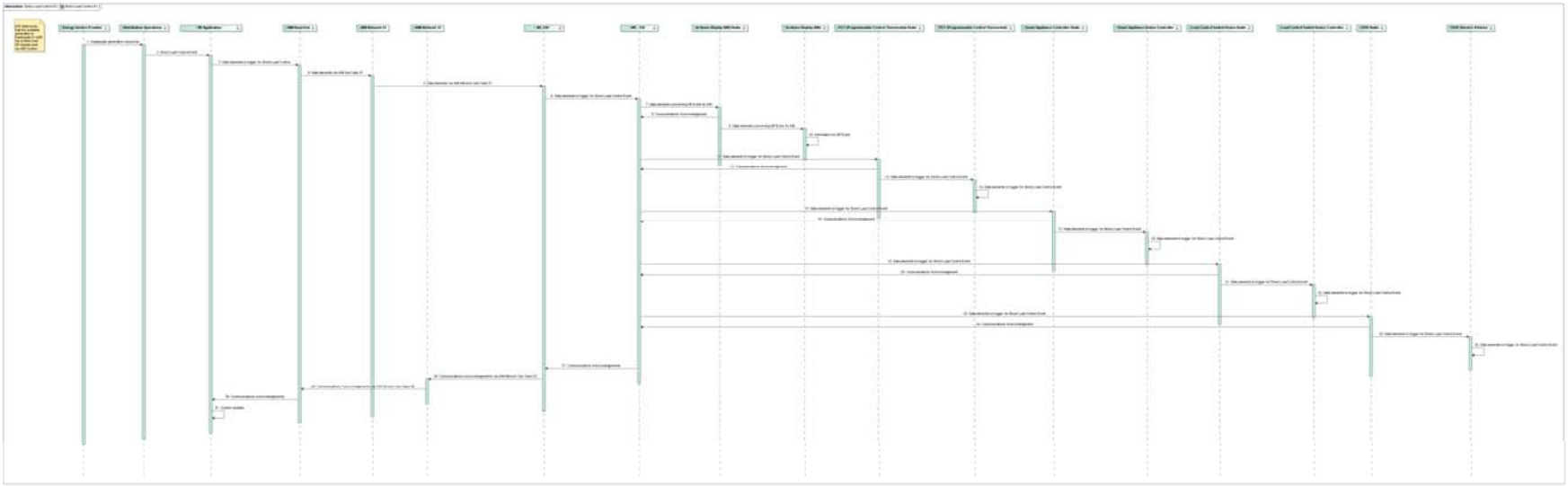
2.3.3 Post-conditions and Significant Results

Actor/Activity	*Post-conditions Description and Results*
Distribution Operations	Load control event successfully implemented
Supplier of Demand Response Application	It is delivered as expected

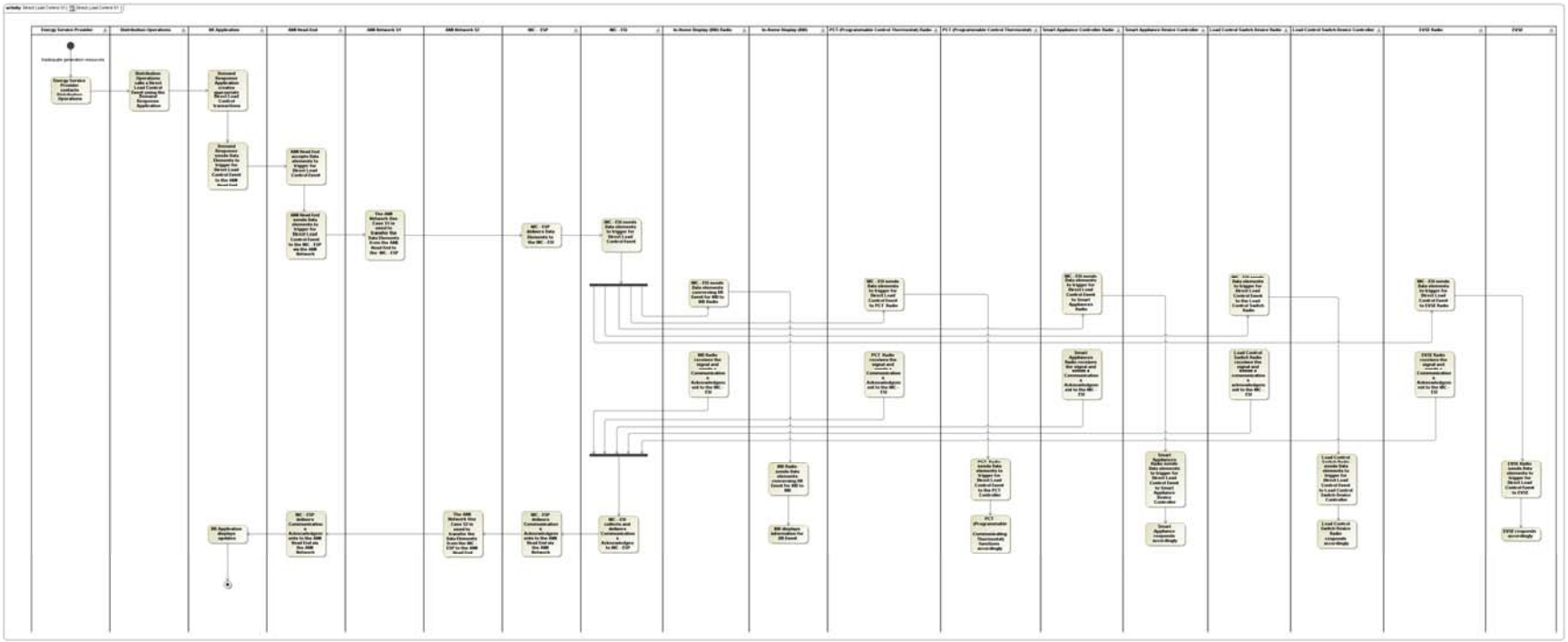
2.4 Architectural Issues in Interactions

Elaborate on all architectural issues in each of the steps outlined in each of the sequences above. Reference the Step by number.

2.5 Diagrams

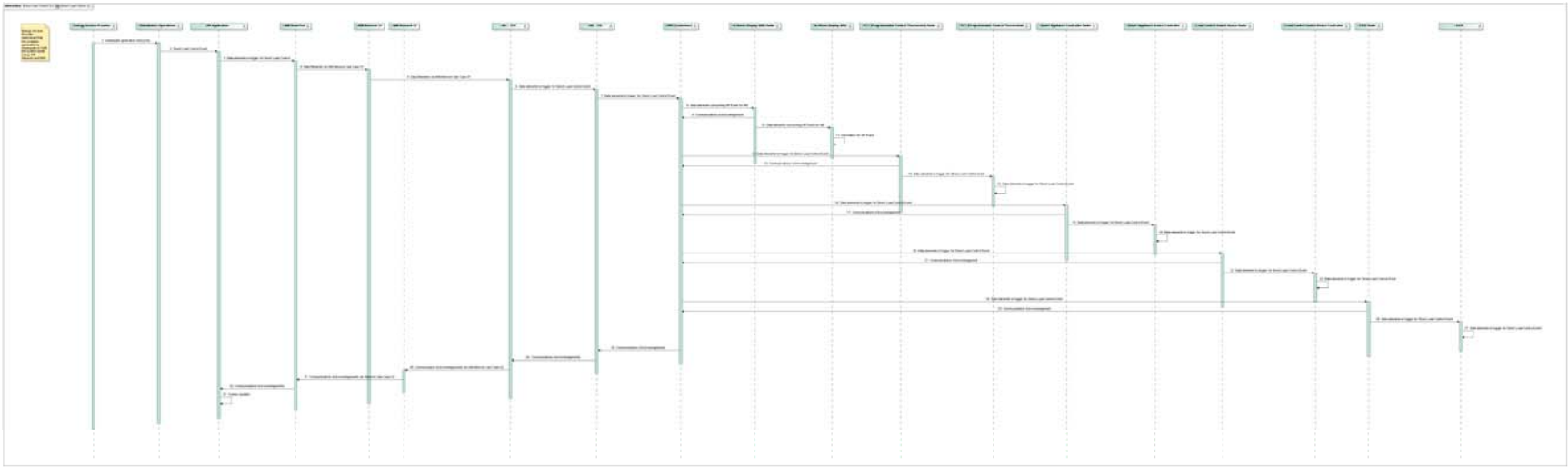


Direct Load Control Scenario 1 Sequence Diagram

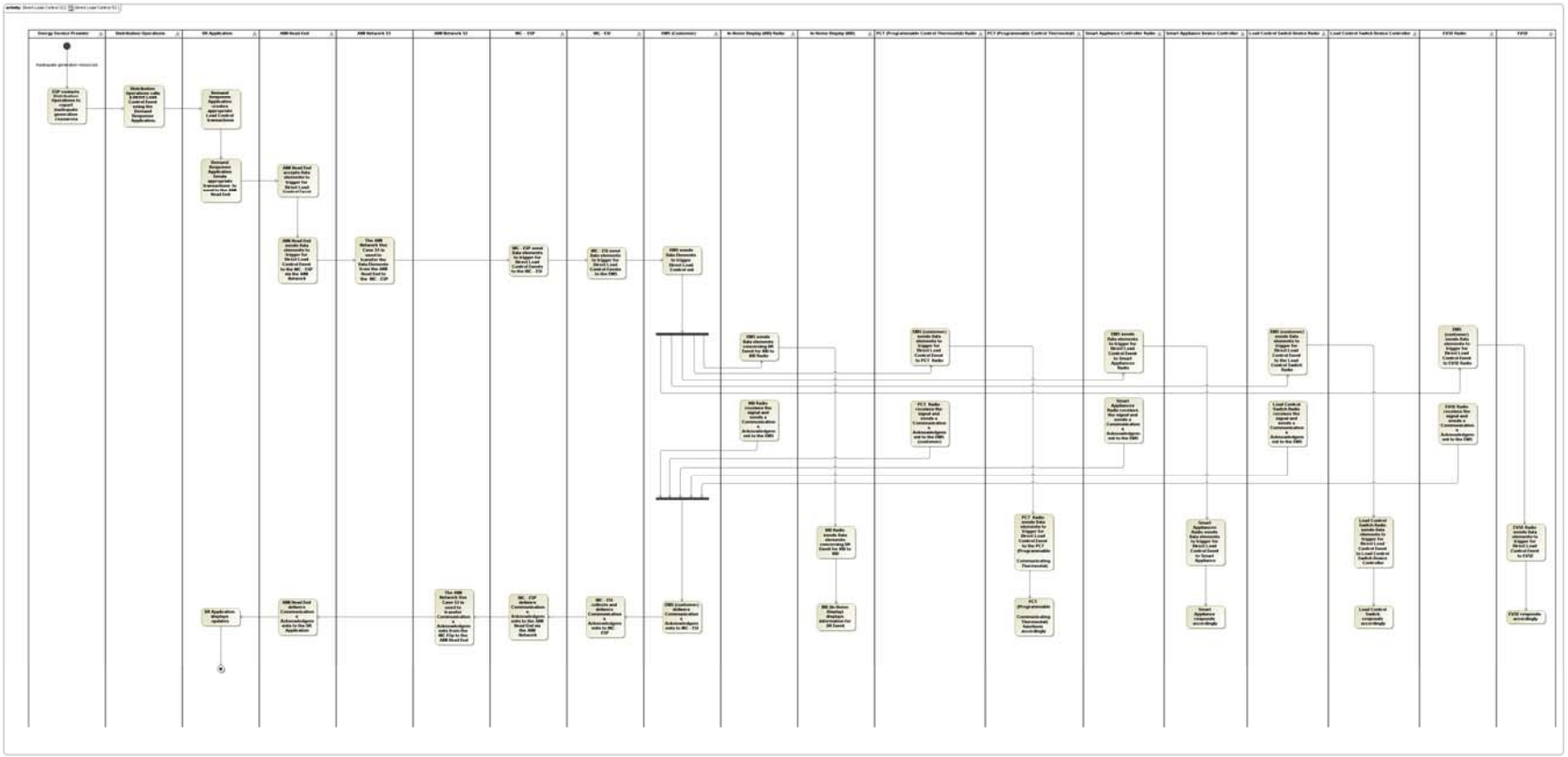


Direct Load Control Scenario 1 Activity Diagram

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

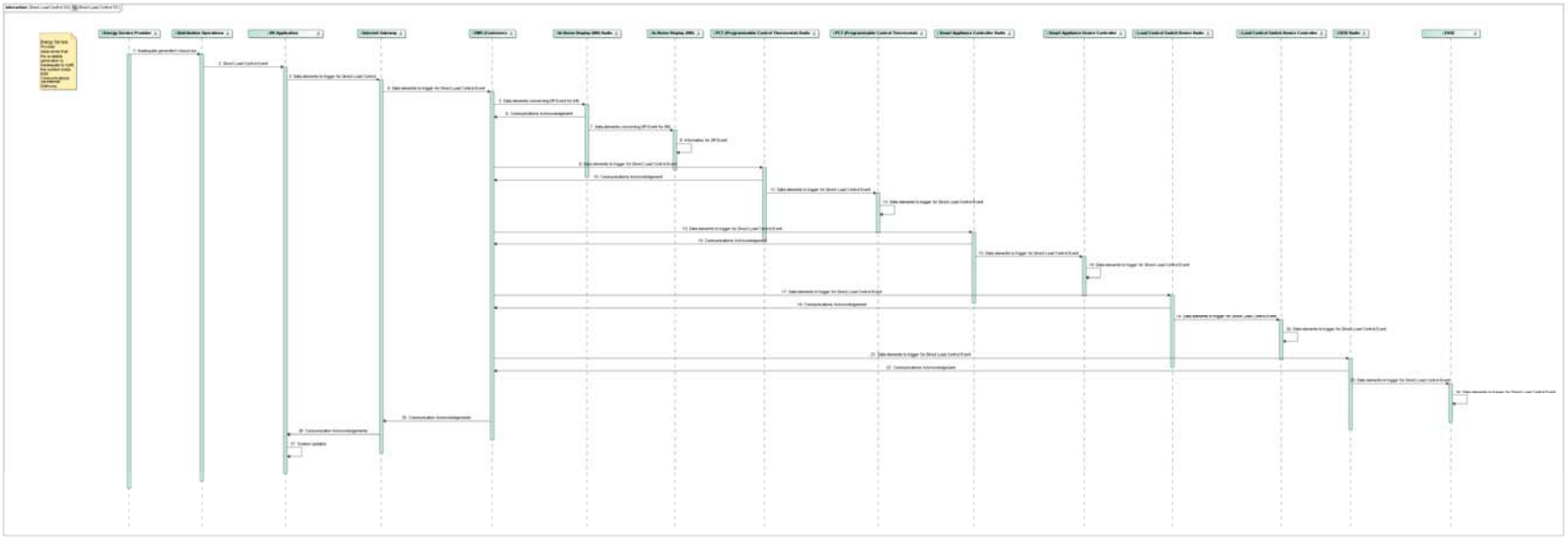


Direct Load Control Scenario 2 Sequence Diagram

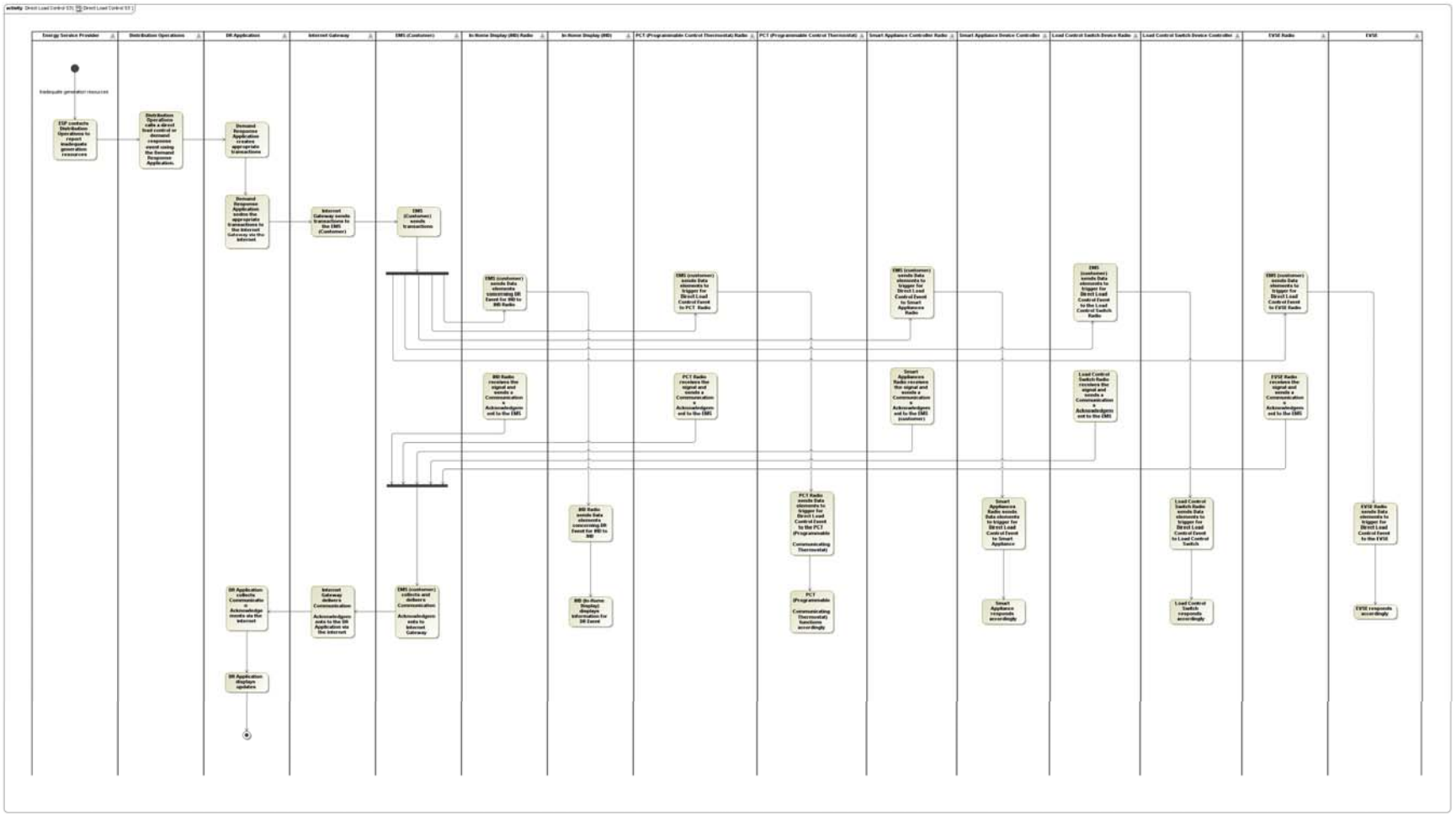


Direct load Control Scenario 2 Activity Diagram

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members



Direct Load Control Scenario 3 Sequence Diagram



Direct Load Control Scenario 3 Activity Diagram

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

3 Auxiliary Issues

3.1 References and contacts

Documents and individuals or organizations used as background to the function described; other functions referenced by this function, or acting as "sub" functions; or other documentation that clarifies the requirements or activities described. All prior work (intellectual property of the company or individual) or proprietary (non-publicly available) work must be so noted.

ID	Title or contact	Reference or contact information
[1]		

3.2 Action Item List

ID	Description	Status
[1]		

3.3 Revision History

No	Date	Author	Description
1.1	3/22/2010	Brian D. Green	Initial Use Case
1.2	3/24/2010	J.R. Cote	Actor Name Review
1.3	3/30/2010	Brian D. Green	Clean up Diagrams
2.0	4/11/2020	John J. Simmins	Fill in some blanks
3.0	5/6/2010	Brian D. Green	Minor Changes and add activity diagrams

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Draft Use Cases – Preliminary in Nature

Volt VAR Optimization

	American Electric Power	**4.3 Distribution Grid Management**	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

Integrated Volt VAR Control Centralized

"Acknowledgment: This material is based upon work supported by the Department of Energy under Award Number DE-OE0000193."

Disclaimer: "This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof."

Version History			
Rev.	Date	Author	Change description
A	09/16/2011	Brian D. Green	Initial Release
B	10/31/2011	Ron Cunningham	Final team review

Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	**4.3 Distribution Grid Management**	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

Summary:

The centralized Integrated Volt VAR Centralized (IVVC) system is an integral part of the Distribution SCADA (D-SCADA) environment. One central system manages and controls all Volt VAR Controller (VVC) devices on the regional distribution network.

Narrative:

The centralized ***Volt-VAR Controller (VVC)*** makes reference to the fact that in this centralized implementation, the ***VVC*** is completely integrated to ***Distribution SCADA (D-SCADA)*** and can only perform commands controlled by the ***D-SCADA*** system, (the intelligence of the Integrated Volt VAR Centralized (IVVC) lies within the ***D-SCADA*** system). The ***VVC*** devices inform the ***D-SCADA*** system of various measurements and statuses (including any Circuit Reconfiguration control area normal/abnormal state information associated with the Volt-VAR Control area), and the ***D-SCADA*** systems aggregate this information with ***Distribution RTU*** data it acquired from the field. The ***Powerflow Module*** acquires its necessary loadflow information and passes it on to the ***D-SCADA***. ***D-SCADA*** then computes and prepares commands and sequences that it sends to the ***Distribution RTUs***. The ***Distribution RTUs*** then interacts with various feeder line devices (***Capacitor Bank Controller(s), Voltage Regulator Controller(s)***, and ***End-of-Line Voltage Monitor(s)*** (***EOL Volt Monitors)***) to pass configuration information and current state information that optimizes power distribution and minimizes loss. The ***D-SCADA*** system passes the information to the ***Distribution Historian*** environment for future analysis.

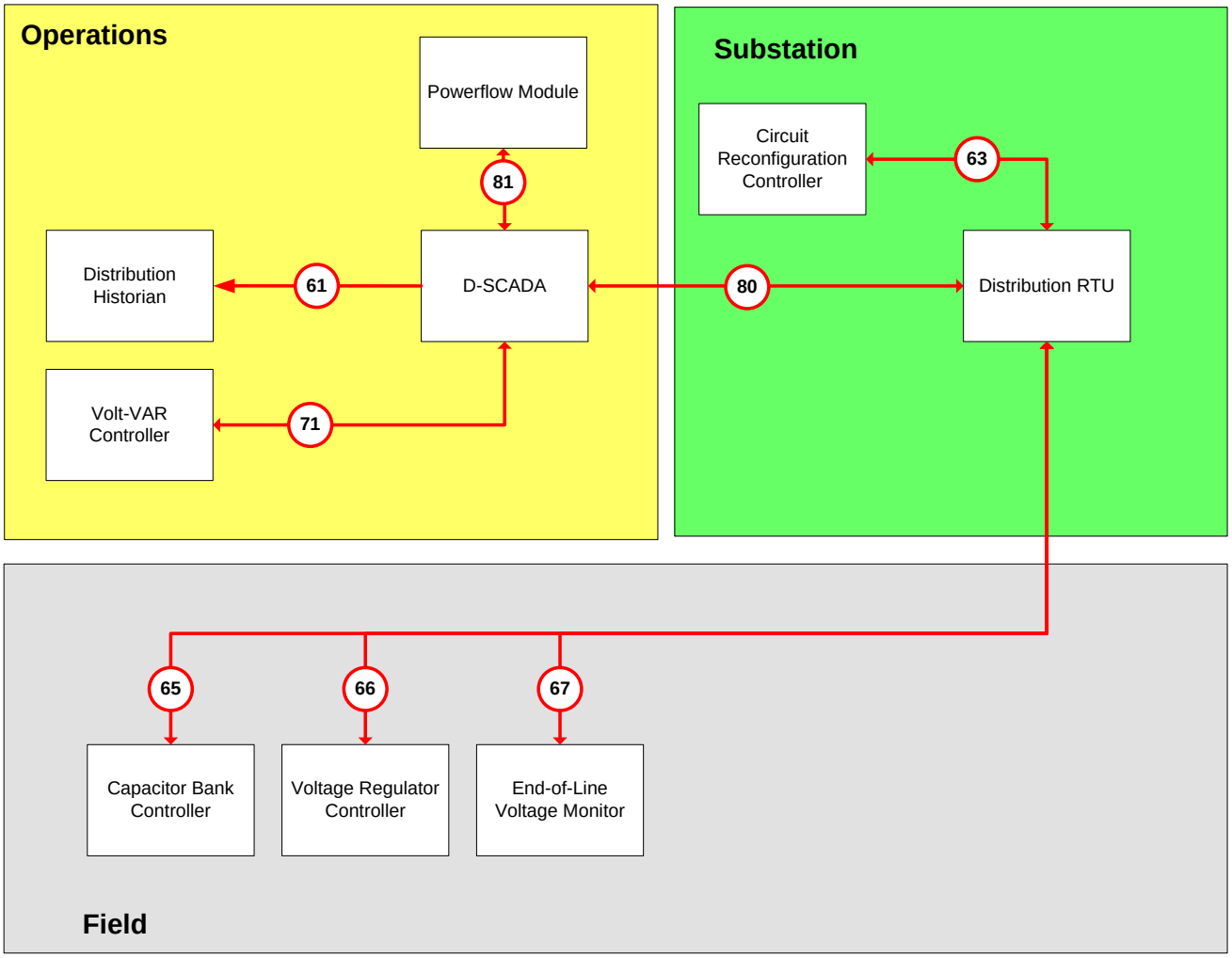
 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	4.3 Distribution Grid Management	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

Interface Diagram:



Note(s):

Specific Feeder Line Devices include Capacitor Bank Controller, Voltage Regulator Controller and End-of-Line Voltage Monitor.

 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	4.3 Distribution Grid Management	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

Actor(s):

The list of the actors and the roles that are participating in this use case described in the table below.

Name	Role description
Capacitor Bank Controller	Controller for the capacitor banks
Circuit Reconfiguration Controller	Controller for the circuit reconfiguration system (logic and application)
Distribution Historian	Data Historian for the distribution system
Distribution RTU	Distribution RTU
D-SCADA	Distribution SCADA
End-of-Line Voltage Monitor	Voltage monitors for endpoints at the end of the line.
Powerfow Module	Loadflow calculation engine
Volt VAR Controller	Controller for Volt VAR operation
Voltage Regulator Controller	Controller for the voltage regulators

Participating Business Functions:

The participating business function, its acronym and what they provide in this use case are detailed in the table below.

Acronym	Business Function/Abstract Component	Services or Information Provided
VVC	Volt-VAR Controller, controls Volt VAR operations for the field equipment	Controls Volt VAR operations by initiating operational commands for field devices
CRC	Circuit Reconfiguration Controller, controls fault isolation and circuit reconfiguration for the substation circuits	Circuit Reconfiguration control logic and application, initiating operational commands for fault isolation and reconfiguration devices

 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	4.3 Distribution Grid Management	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

Assumptions / Design Considerations:

- Standard International Electrotechnical Commission (IEC) 61968 Message Definition format will be followed to provide the Header, Request, Reply, and payload used when defining the messages for the design specifications. For the purpose of this use case, no IEC 61968 or 61850 protocol messages are specified.
- Interoperability between AMI and real time grid management is challenged. Currently, metering standards and DNP3 are not compatible and AMI performance does not meet requirements of real time grid management.
- Work is still underway to see if the communications will be synchronous or asynchronous.
- This use case will portray the communications as asynchronous. It may need to be changed at a later date.
- Powerflow Module is up to date with the current as operated system configuration.
- Integrated Volt-VAR Control documented in this use case requires that the Circuit Reconfiguration control area (circuits) that the Integrated Volt-VAR Control circuit devices operate in, is in the normal circuit configuration state.
- This use case does not currently document the scenario of Integrated Volt-VAR Control being disabled (revert VVC controlled devices to their normal baseline state) upon recent of a Circuit Reconfiguration control area in abnormal state for those circuits with Integrated Volt-VAR Control nor the return to normal Volt-VAR Control operations.

Normal Sequence:

The sequences of events, showing the order in which they ocurr during the typical progression of this use case are provided in the table below. The Sequence Diagram that graphically depicts the events is presented immediately following the table.

Use Case Step	Triggering Event	Description Of Process	Information To Be Exchanged	Producer	Receiver	Message Type
1	Predetermined and/or variable D-SCADA polling frequency	D-SCADA on a predetermined and or variable frequency will poll the Distribution RTU of specified Feeder Devices	Poll of Distribution RTU	D-SCADA	Distribution RTU	DNP3
2		On a predetermined frequency Distribution RTU will Poll of specified Feeder Devices	Poll of specified Feeder Devices	Distribution RTU	Feeder Device	DNP3

 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	4.3 Distribution Grid Management	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

Use Case Step	Triggering Event	Description Of Process	Information To Be Exchanged	Producer	Receiver	Message Type
3	Receipt of Poll Request or Time Trigger	Voltage Regulator Controller sends System Monitoring Data to Distribution RTU	System Monitoring Data	Voltage Regulator Controller	Distribution RTU	DNP3
4	Receipt of Poll Request or Time Trigger	Capacitor Bank Controller sends System Monitoring Data to D-RTU Distribution RTU	System Monitoring Data	Capacitor Bank Controller	Distribution RTU	DNP3
5	Receipt of Poll Request or Time Trigger	End–of-Line Voltage Monitor sends System Monitoring Data to Distribution RTU	System Monitoring Data	End-of-Line Voltage Monitor	Distribution RTU	DNP3
6	Change of State	Circuit Reconfiguration Controller sends Normal/Abnormal Status to Distribution RTU	Circuit Reconfiguration Control area Normal /Abnormal Status	Circuit Reconfiguration Controller	Distribution RTU	DNP3
7		Distribution RTU sends System Monitoring Data and CRC State Change to D-SCADA	System Monitoring Data & CRC Normal/Abnormal Status	Distribution RTU	D-SCADA	DNP3
8		D-SCADA sends System Monitoring Data to Volt-VAR Controller	System Monitoring Data from D-SCADA	D-SCADA	VVC	DNP3
9		D-SCADA sends System Data to Distribution Historian on predetermined interval	System Data	D-SCADA	Distribution Historian	Proprietary
10	Powerflow Module receives instruction to perform loadflow	Powerflow Module exchanges System Data with D-SCADA	System Data	Powerflow Module	D-SCADA	DNP3

 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	4.3 Distribution Grid Management	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

Use Case Step	Triggering Event	Description Of Process	Information To Be Exchanged	Producer	Receiver	Message Type
11		Powerflow Module exchanges System Data with VVC via D-SCADA	System Data	Powerflo w Module	D-SCADA	Proprietary
12		D-SCADA exchanges Powerflow Module System Data with VVC	System Data	D-SCADA	VVC	DNP3
13	Receives loadflow and device status information	VVC calculates an Optimal Volt-VAR Configuration for the circuit and commands sequence (excluding circuit switching operations) to be initiated	Optimal Volt-VAR Configuration	VVC	Internal	Proprietary
14	VVC determines feeder line device operations needed	VVC issues Device Control/Commands to D-SCADA.	Device Control /Commands	VVC	D-SCADA	DNP3
15		D-SCADA sends Device Control /Commands to Distribution RTU	Device Control /Commands	D-SCADA	Distributi on RTU	DNP3
16		Distribution RTU issues Device Control /Commands to Voltage Regulator Controller.	Device Control /Commands	Distributi on RTU	VVC	DNP3
17	Receipt of control commands	Voltage Regulator Controller functions accordingly	Device Control /Commands	Voltage Regulato r Controlle r	Internal	Proprietary

 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	4.3 Distribution Grid Management	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

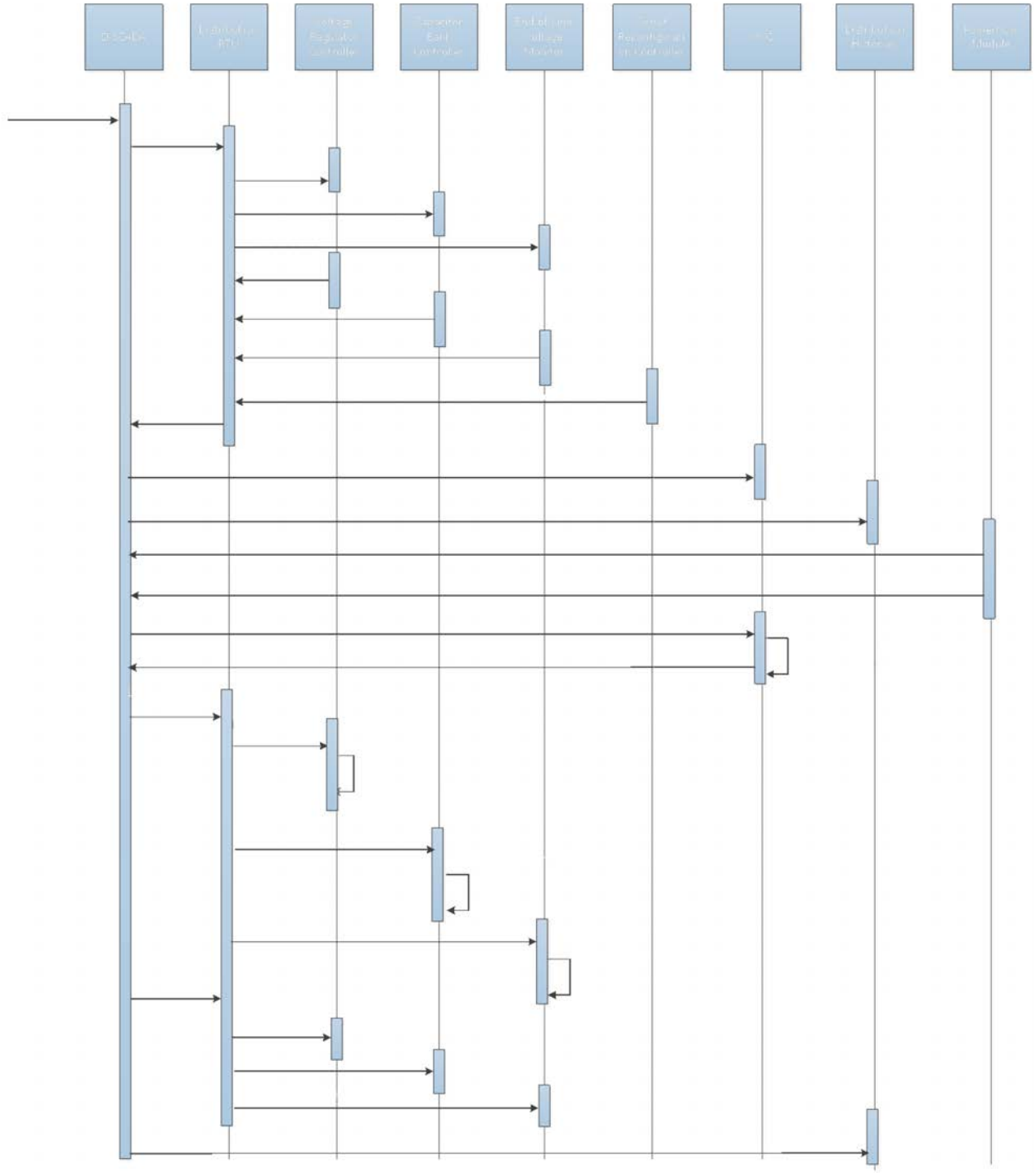
Use Case Step	Triggering Event	Description Of Process	Information To Be Exchanged	Producer	Receiver	Message Type
18		Distribution RTU issues Device Control /Commands to Capacitor Bank Controller	Device Control /Commands	Distribution RTU	Capacitor Bank Controller	DNP3
19	Receipt of control commands	Capacitor Bank Controller functions accordingly	Device Control /Commands	Capacitor Bank Controller	Internal	Proprietary
20		Distribution RTU issues Device Control /Commands to End-of-Line Voltage Monitor	Device Control /Commands	Distribution RTU	End-of-Line Voltage Monitor	DNP3
21	Receipt of control commands	End-of-Line Voltage Monitor function accordingly	Device Control /Commands	End-of-Line Voltage Monitor	Internal	Proprietary
22		D-SCADA on a predetermined and/or variable frequency will poll the Distribution RTUs of specified Feeder Devices	Poll of Distribution RTU	D-SCADA	Distribution RTU	DNP3
23		On a predetermined frequency Distribution RTUs will Poll of specified Feeder Devices	Poll of Specified Feeder Devices	Distribution RTU	Feeder Device	DNP3
24		D-SCADA sends System Data to Distribution Historian on predetermined interval	System Data	D-SCADA	Distribution Historian	Proprietary

 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	4.3 Distribution Grid Management	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham



 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	4.3 Distribution Grid Management	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

Integration Scenarios:

The following are the points of integration that must be tested for this use case. Other non-CIM message interfaces may be testable in this use case.

Actor	Interface Points
D-SCADA	• Distribution RTU • Circuit Reconfiguration Controller • Volt-VAR Controller • Distribtuion Historian • Powerflow Module
Distribtuion RTU	• Voltage Regulator Controller • Capacitor Bank Controller • End-of-Line Voltage Monitor

Pre-conditions: None

Post-conditions: None

Exceptions / Alternate Sequences:

There are no exceptions, unusual events or alternate sequences defined for this use case.

Use Case Step	Triggering Event	Description Of Process	Information To Be Exchanged	Producer	Receiver	Message Type

Message Type(s) Diagram: None

An XML Schema Definition (XSD) diagram shows the normative and informative parts of the message. Not all of the International Electrotechnical Commission's (IEC) – CIM message optional elements must or will be used in the use of IEC – CIM for this specific use case.

 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

	American Electric Power	4.3 Distribution Grid Management	Document ID: **Use case # 3.1**
	Title: **Integrated Volt VAR Control Centralized**		

Subject Matter Expert:	Author:	Reviewed by:
Ron Cunningham	Brian D. Green	Ron Cunningham

References:

Use Cases or other documentation referenced by this use case include:

- **20100625 AEP Ohio Interoperability Plan V1.docx:** Section 4.3.2 (Centralized Integrated Volt/Var Control)
- **20100625 Use Cases EPRI Report_V2.4.docx: Section 3.1 (IVVC Centralized)**

Issues: None

ID	Description	Status

Miscellaneous Notes: None

 Copyright © 2011 American Electric Power Company

Use Case adopted from EPRI Smart Grid Resource Center - Use Case Repository and modified by Working Group Members

Appendix D

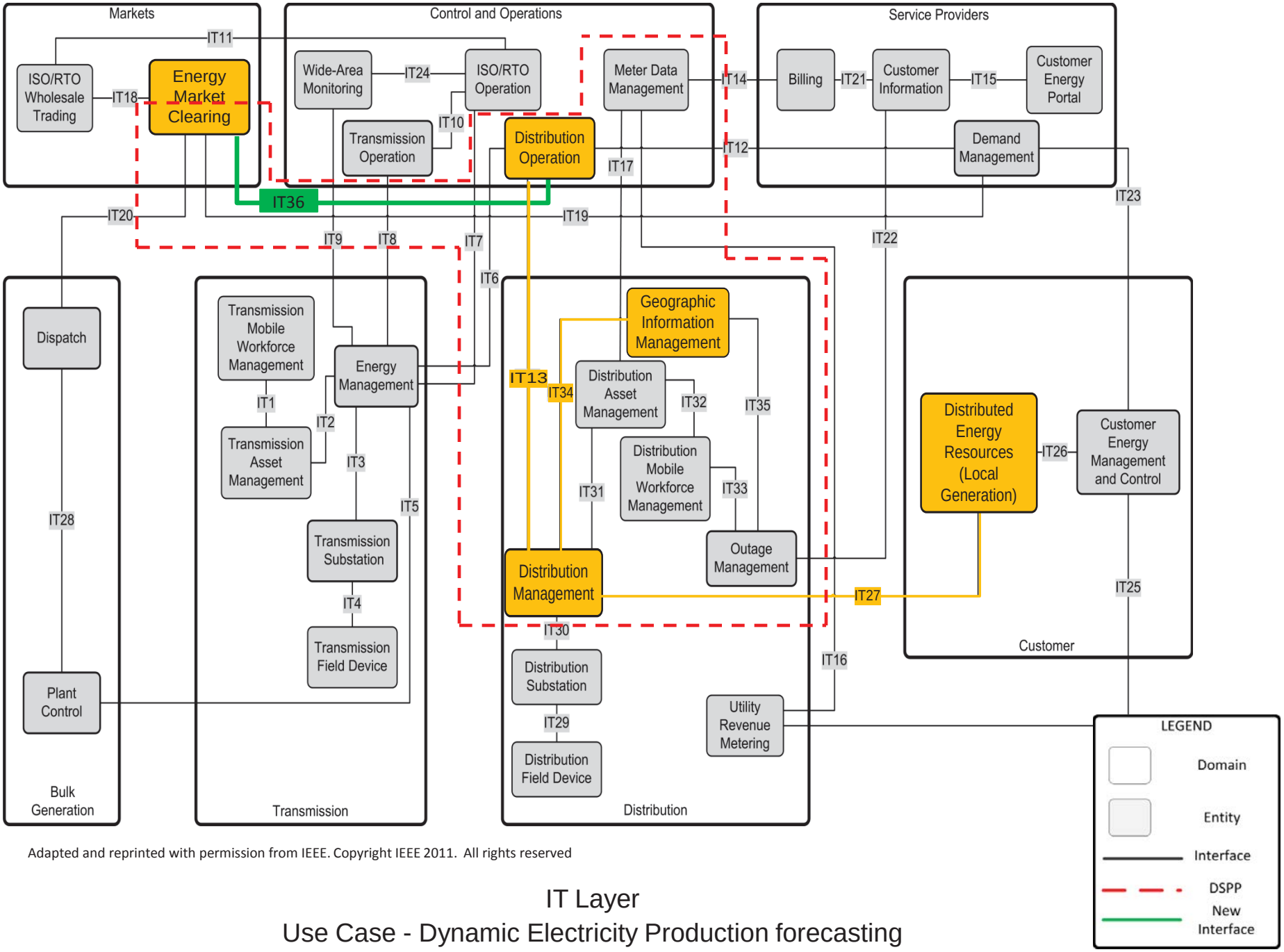
P2030 Conceptual Architectural Diagrams

The IEEE P2030 Smart Grid Interoperability Standard architectural diagram was used as a way to conceptualize the DSPP. The integration and interfaces of energy technologies, information technologies, and communication technologies are necessary to achieve seamless distributed grid operations and market functions. The standard covers all major areas of the DSPP; Power Control, Information Technology, and Communications with cross-cutting elements of data, integration, and security.

The following diagrams are examples of use cases, e.g., functions, which the DSPP could facilitate. The entities and interfaces required to facilitate these DSPP functions for the specific use case are highlighted in yellow. All examples are preliminary in nature and are for illustrative purposes only.

All materials are adapted and reprinted with permission from IEEE.

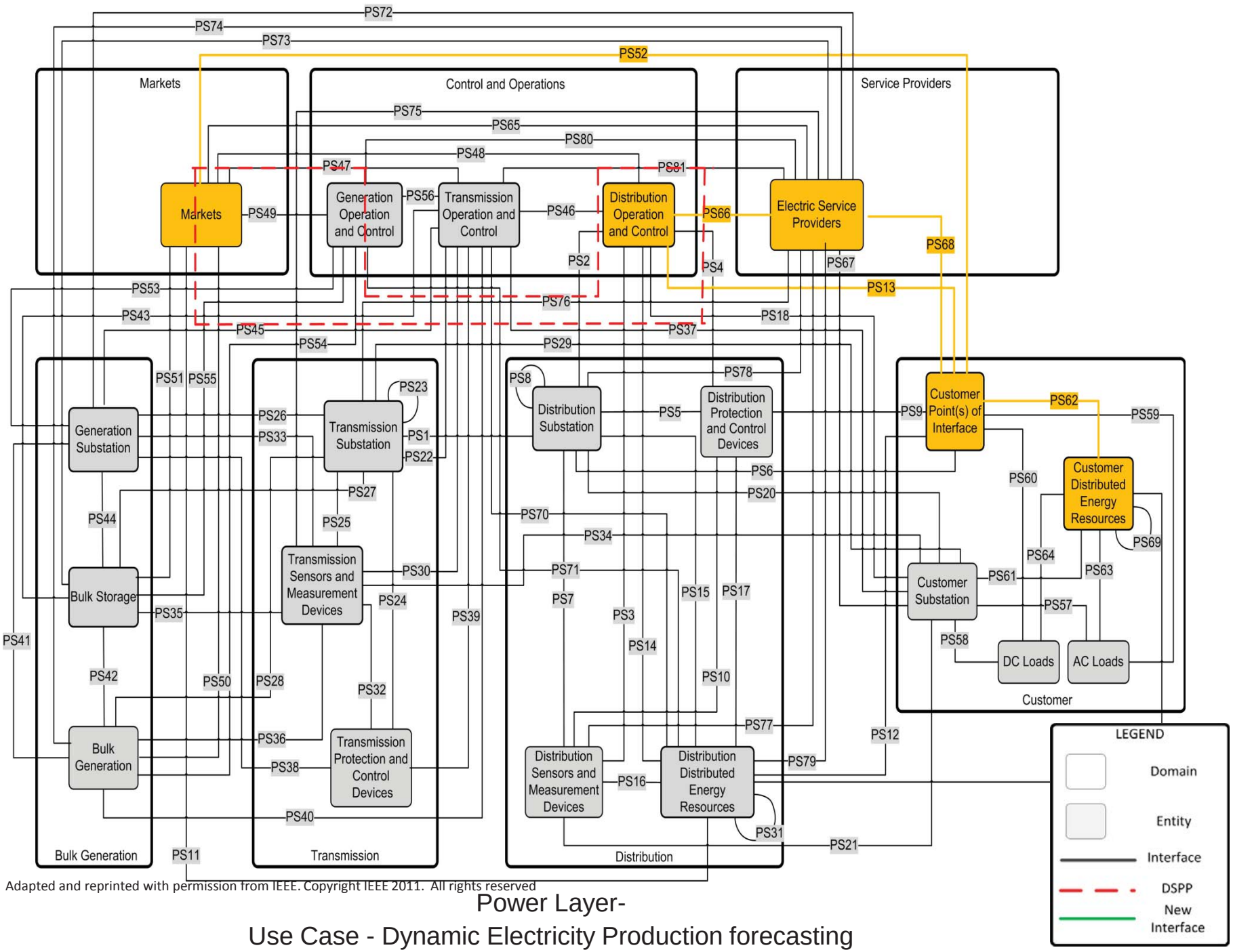
Dynamic Electricity Production Forecasting



Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved

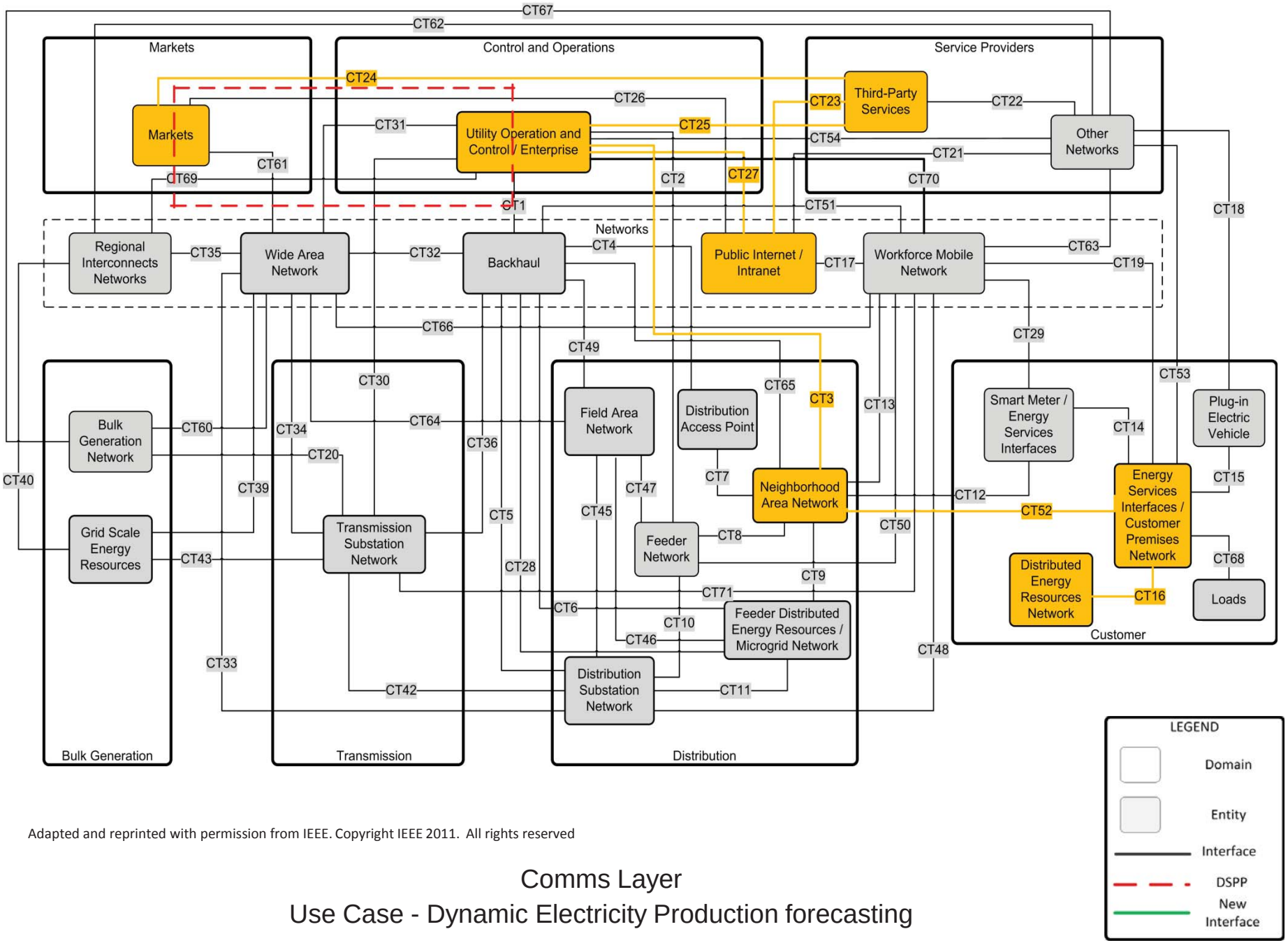
IT Layer

Use Case - Dynamic Electricity Production forecasting



Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved

Power Layer-
Use Case - Dynamic Electricity Production forecasting

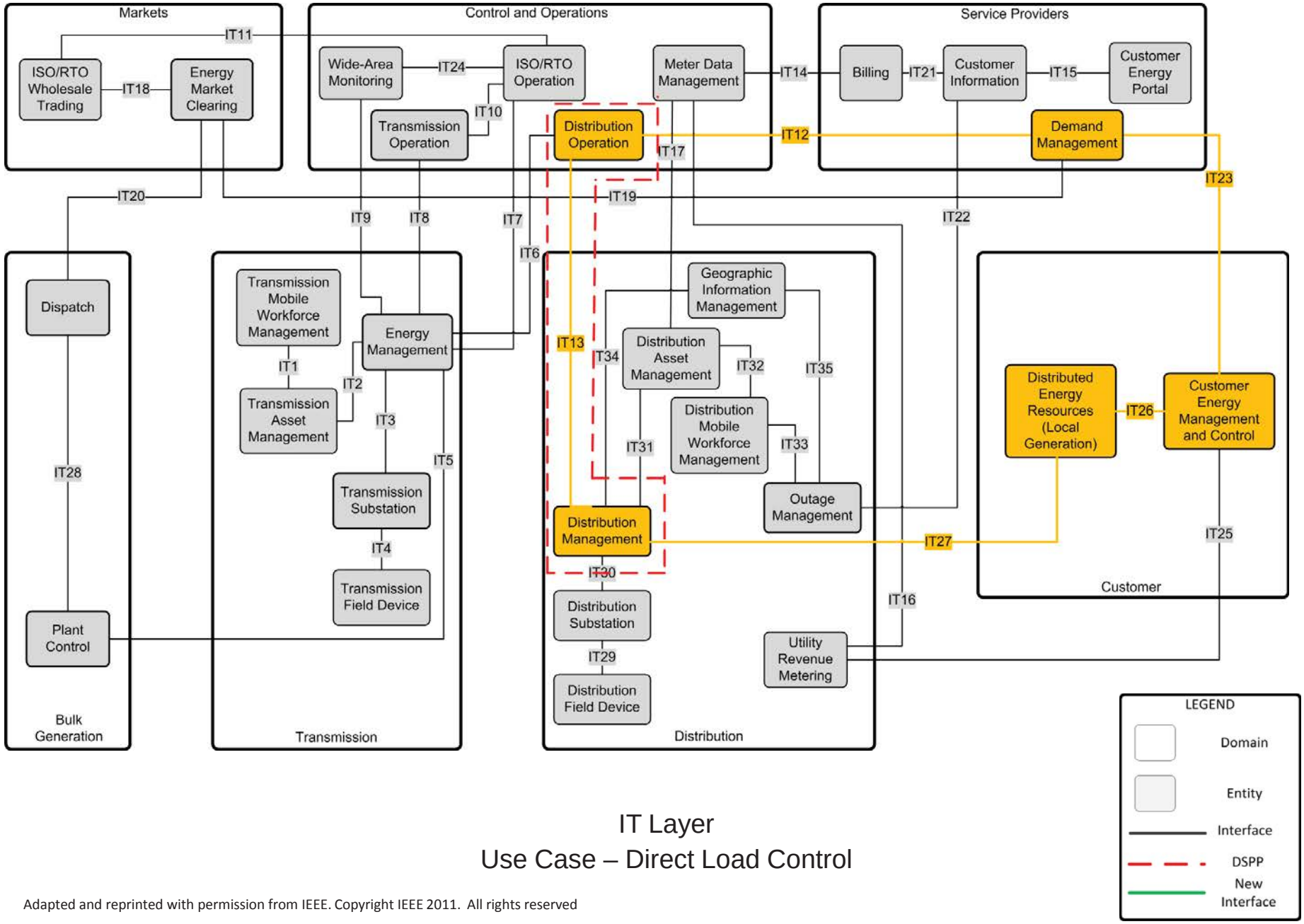


Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved

Comms Layer

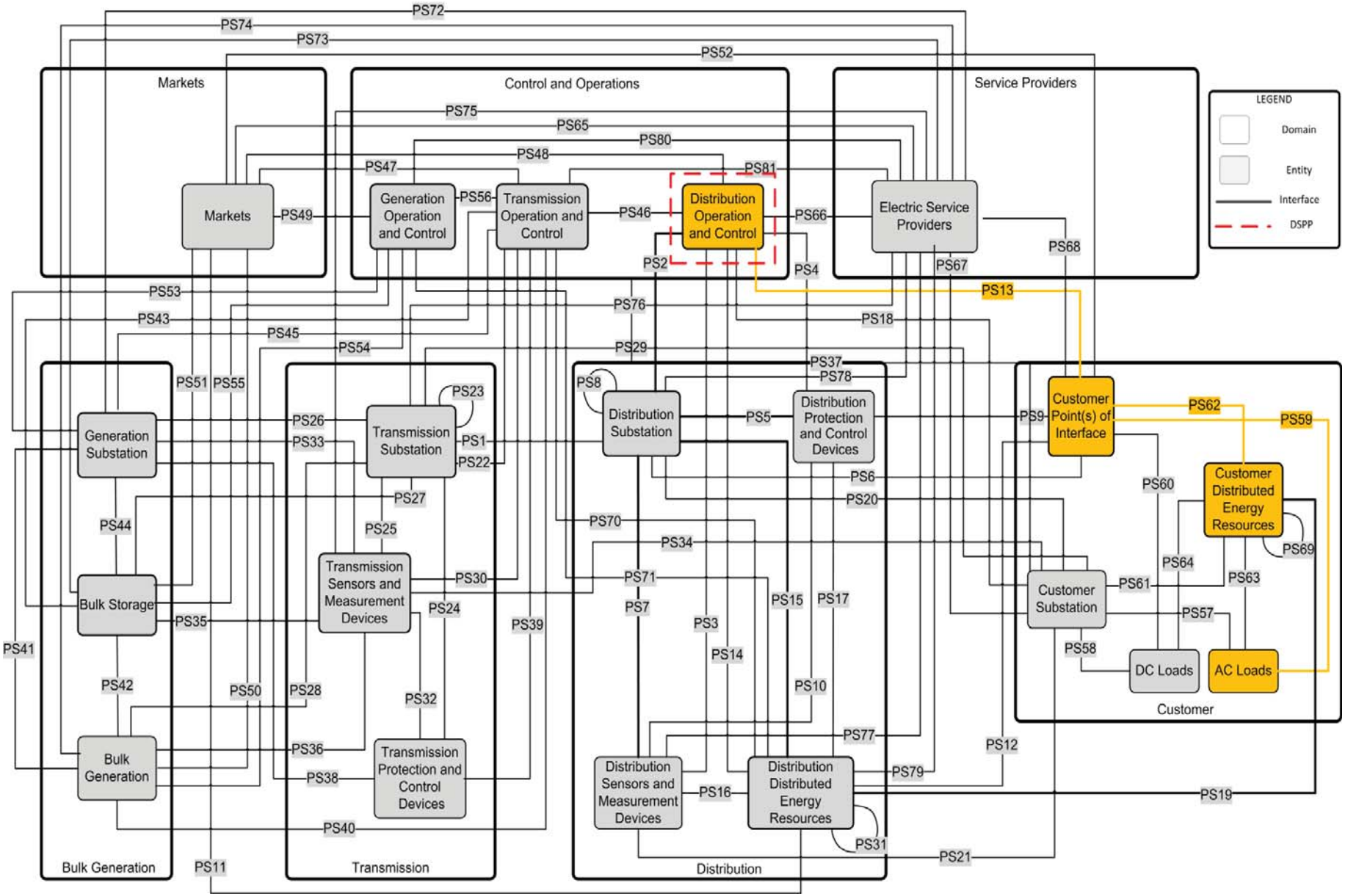
Use Case - Dynamic Electricity Production forecasting

Direct Load Control



IT Layer
Use Case – Direct Load Control

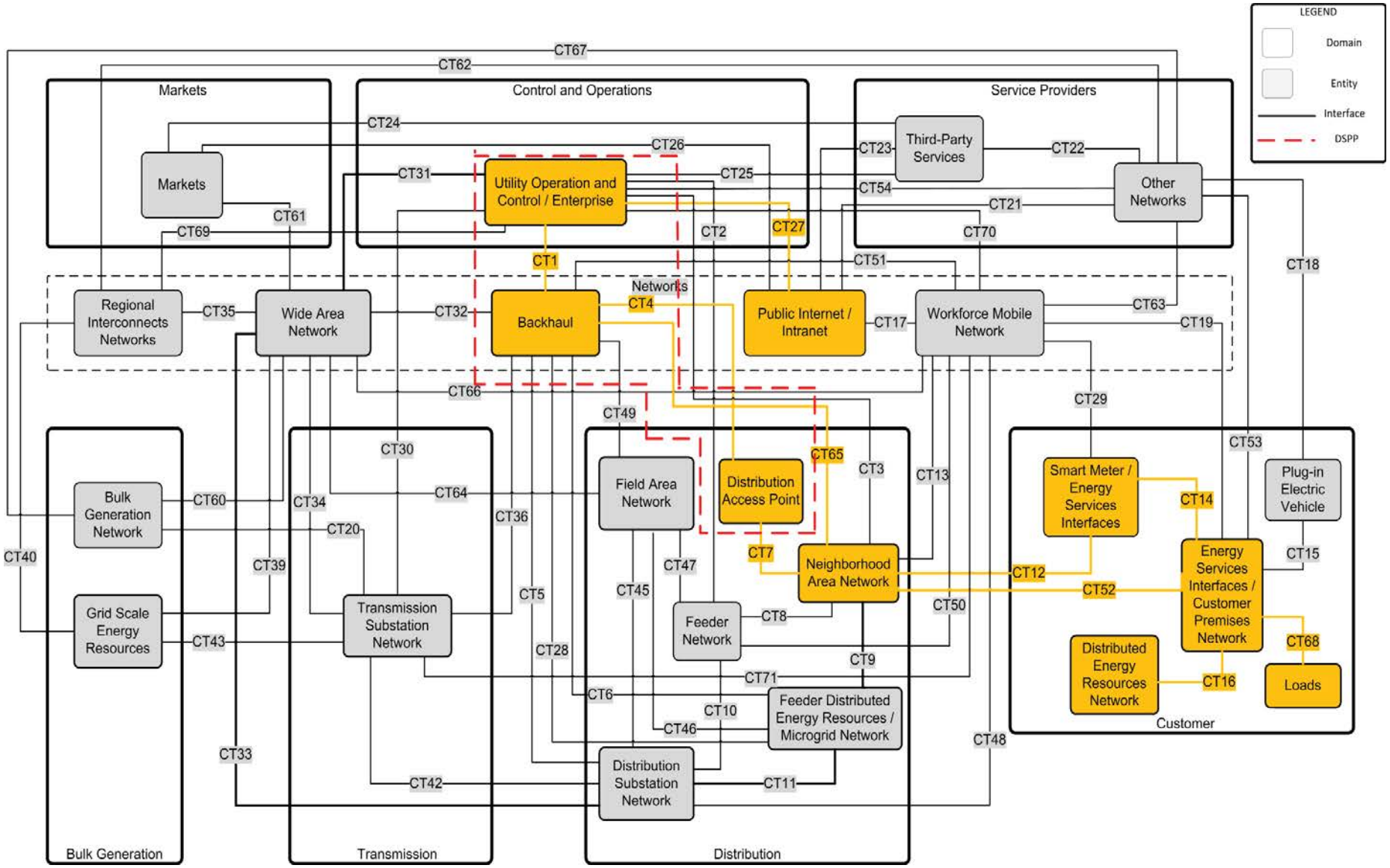
Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved



Power Layer

Use Case – Direct Load Control

Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved

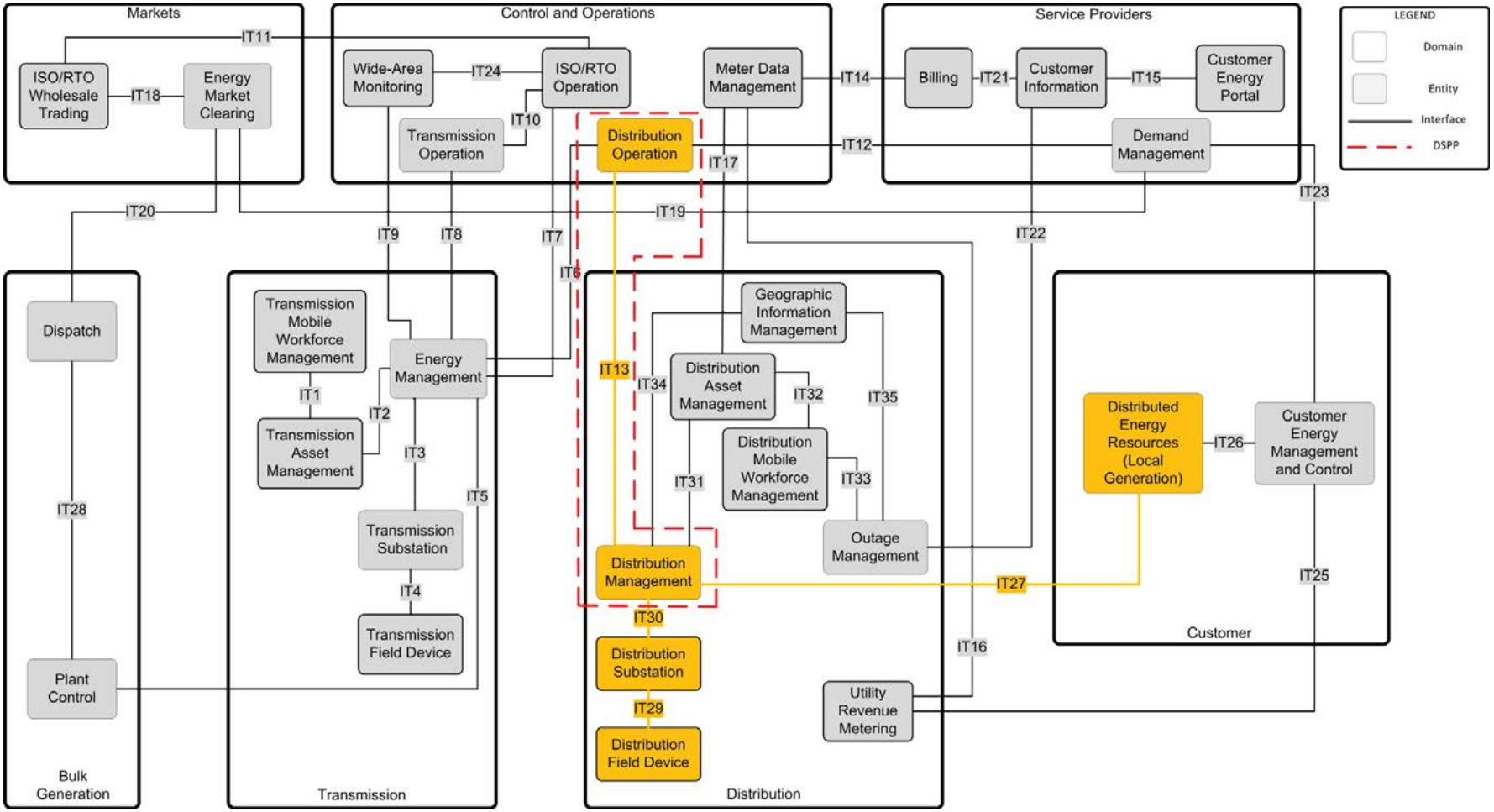


Comms Layer

Use Case – Direct Load Control

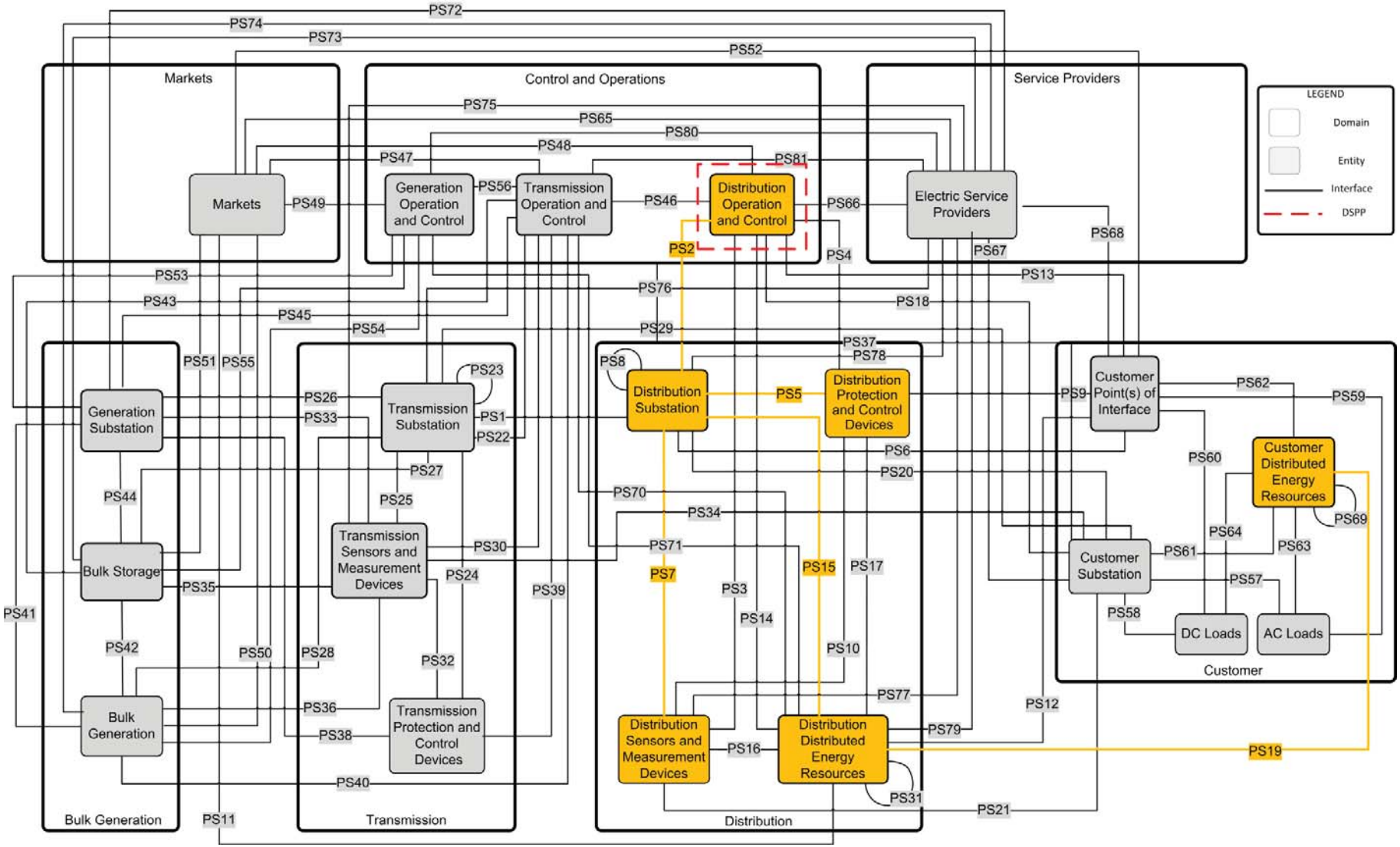
Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved

Volt VAR Optimization



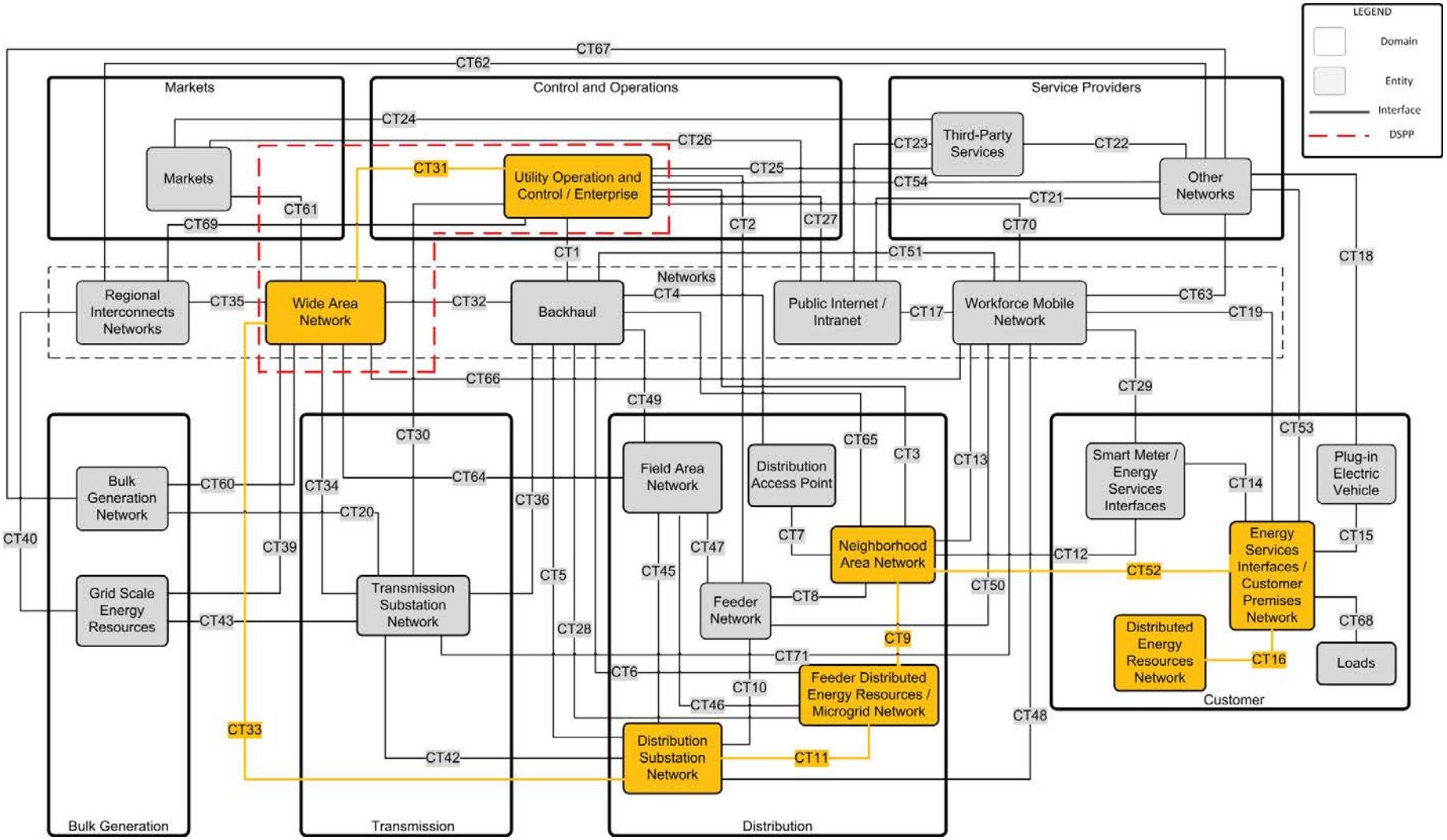
IT Layer
Use Case – VVO (Volt VAR Optimization)

Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved



Power Layer
Use Case – VVO (Volt VAR Optimization)

Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved



Comm Layer
Use Case – VVO (Volt VAR Optimization)

Adapted and reprinted with permission from IEEE. Copyright IEEE 2011. All rights reserved

Appendix E

Draft of Technology Matrix Mapping Tool – Preliminary in Nature

See excel workbook titled “Appendix E”.