

May 2010



SG Network TF Overview

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SG-Network Overview

- Previously started as AMI-Network with a focus on network management.
- Scope and Charter for SG-Network within UCAiug
 - NIST PAP 2 (Wireless standards for the Smart Grid)
 - Supply functional requirements for Smart Grid Networks from a utility perspective
 - Define functional domains within the Smart Grid
 - Create a System Requirements Specification
 - Provide information to SDO's (e.g., IEEE P2030)
- Participation
 - Utilities, Academia, Vendors





SG-Network Overview Continued

- Deliverables
 - Communications Requirements
 - Latency, How Often, Payload size, etc
 - Database for using the requirements
 - System Requirements Specification
 - Pulls all of the work together
 - Reference Architecture Diagram





SG-Network Output

- Progress to date:
 - System Requirements Specification V5.1 complete
 - Key stats:
 - 19 payload-groupings (usecases)
 - 204 payloads
 - 500 payload-parent-sets
 - 7854 requirement rows (including parents)
 - Database matches requirements capture V5.1





SG Network Requirements

- Use Cases
- Asymmetric payloads (with attributes, security LIC – CIA values)
- Payload requirement sets with:
- Actors (from/to pairs) for original source and consuming actors, + intermediary comm-path actor to actor flows
- Business focused requirements & architectural non-functional rqmts (network volumetrics e.g. how-often, reliability, latency, app-payload size)
technology agnostics





SG Network Requirements (cont'd)

- Optional deployment scenarios per payload requirement set
- Commonly found/anticipated deployment profiles for AMI, Distr Apps, combinations
- Instructions for how to consume the requirements as documented by SG Network TF



Rqmt Ref	Row Type (P - Parent, c - child)	Data Flow Ref (min set that includes opts) - SG-Network TF Diag r5.1	Data Flow from Actor	Data Flow to Actor	Use Case Ref	Requirements (assumed electric unless noted otherwise)	Payload Name - Specific Data/Mesg (Logical - info content the same)	Payload Type [cmd , ack, resp-data, comm-err, cmd-err, alarm, alert]
MR-001	P	1Aa	CIS/Billing - Utility	MDMS	Meter Reading	CIS/Billing - Utility shall be able to send bulk meter read information requests to MDMS	bulk_Mtr-read_cmd	cmd
MR-005	P	1B	MDMS	AMI Head-End(j)	Meter Reading	MDMS shall be able to send bulk meter read information requests to AMI Head-End(j)	bulk_Mtr-read_cmd	cmd
MR-006	P	1Aa	MDMS	CIS/Billing - Utility	Meter Reading	MDMS shall be able to process & send bulk meter read information data to CIS/Billing - Utility	bulk_Mtr-read_resp-data	resp-data
MR-013	P	1B	AMI Head-End(j)	MDMS	Meter Reading	AMI Head-End(j) shall be able to process & forward on-demand meter read data to MDMS	bulk_Mtr-read_resp-data	resp-data
MR-036	P	[1Dg or (16Ga + 5Ba) or (16Gb + 5Bb)] + [1Ca or (1Cb + 1Cba) or (1Cc + 1Cba)]	2-Way Meter - Gas C/I	AMI Head-End(j)	Meter Reading	2-Way Meter - Gas C/I shall be able to send multi interval-data meter reads data to AMI Head-End(j)	Mtr-read_multi-interval-data_resp-data	resp-data
MR-032	c	1Dg	2-Way Meter - Gas C/I	DAPjm	Meter Reading	2-Way Meter - Gas C/I shall be able to send multi interval-data meter reads data to DAPjm	Mtr-read_multi-interval-data_resp-data	resp-data
MR-106	c	16Ga	2-Way Meter - Gas C/I	ESI - In Meter	Meter Reading	2-Way Meter - Gas C/I shall be able to send multi interval-data meter reads data to ESI - In Meter	Mtr-read_multi-interval-data_resp-data	resp-data
MR-107	c	5Ba	ESI - In Meter	DAPjm	Meter Reading	ESI - In Meter shall be able to send multi interval-data meter reads data to DAPjm	Mtr-read_multi-interval-data_resp-data	resp-data

Rqmt Ref	Payload Name - Specific Data/Mesg (Logical - info content the same)	Payload Type [cmd , ack, resp-data, comm-err, cmd-err, alarm, alert]	Daily Clock Periods of Primary Occurrence	How Often	Reliability	Latency (response time one direction) Rqmts	App Payload Size - bytes
MR-001	bulk_Mtr-read_cmd	cmd	6PM - 6AM	x per Utl per day (batches of y Mtrs)	> 99.5%	< 1 hr	25
MR-005	bulk_Mtr-read_cmd	cmd	6PM - 6AM	x per Utl per day (batches of y Mtrs)	> 99.5%	< 1 hr	25
MR-006	bulk_Mtr-read_resp-data	resp-data	6PM - 6AM	x per Utl per day (batches of y Mtrs)	> 99.5%	< 1 hr	xMB
MR-013	bulk_Mtr-read_resp-data	resp-data	6PM - 6AM	x per Utl per day (batches of y Mtrs)	> 99.5%	< 1 hr	xMB
MR-036	Mtr-read_multi-interval-data_resp-data	resp-data	24x7	1-6 per GasC/IMtr per day (may have 15 min vs 1hr interval data)	90% success every 4-6 hr, 98% success over 1 day, > 99.5% over 2 day	< 4 hr (expected window of data delivery)	1600 for 4hr of data - 2400 for 6hr of data
MR-032	Mtr-read_multi-interval-data_resp-data	resp-data	24x7	1-6 per DAPjm-GasC/IMtr per day (may have 15 min vs 1hr interval data)	90% success every 4-6 hr, 98% success over 1 day, > 99.5% over 2 day	< 4 hr (expected window of data delivery)	1600 for 4hr of data - 2400 for 6hr of data
MR-106	Mtr-read_multi-interval-data_resp-data	resp-data	24x7	1-6 per ESInMtr-GasC/IMtr per day (may have 15 min vs 1hr interval data)	90% success every 4-6 hr, 98% success over 1 day, > 99.5% over 2 day	< 4 hr (expected window of data delivery)	1600 for 4hr of data - 2400 for 6hr of data
MR-107	Mtr-read_multi-interval-data_resp-data	resp-data	24x7	1-6 per DAPjm-ESInMtr-GasC/IMtr per day (may have 15 min vs 1hr interval data)	90% success every 4-6 hr, 98% success over 1 day, > 99.5% over 2 day	< 4 hr (expected window of data delivery)	1600 for 4hr of data - 2400 for 6hr of data



Payload Name	Payload Type	Description	Application Payload-attributes (excludes comm packet fields), date-time-stamps assumed for all payloads	Security LICs - NISTIR 7628 - associated to Payloads	Non-Functional Application Payload C-I-A	Non-Functional Application Payload C-I-A Risk Values (and/or LIC) - Rational & Comments
bulk_Mtr-read_cmd	cmd	CIS/Billing - Utility requests several large files (batches) of Utility meter information from MDMS per day	group(cycle)ID, data-elements-groups, data-date	7	L-M-M	C - none to minimal harm to customer or organization for access to/disclosure of payload data; I - inaccurate command parameters associated to a batch of meters may lead to an incorrect next workflow process execution that may lead to a partial rebuild of stored data or a reprocessing (e.g. re-billing) for that batch of meters; A - not receiving the response payload to this command would create missing data for a batch of meters and would trigger an immediate retry or retry at next file transfer period to satisfy next workflow processing steps (e.g. billing);
bulk_Mtr-read_resp-data	resp-data	MDMS sends several large files (batches) per day of Utility meter information to CIS/Billing - Utility	group(cycle)ID, data-elements-group ID (e.g. Meter ID, Register Readings, Interval Data, program-opt-outs, Voltage), data-date,	7	M-M-M	C - serious harm to organization for not showing good stewardship (unauthorized access to/disclosure) of large amounts of meter payload data, with minimal to harm to customer for unauthorized access to/disclosure of payload data; I - inaccurate positive command parameters associated to a batch of meters may lead to an incorrect next workflow process execution that may lead to a partial rebuild of stored data or a reprocessing (e.g. re-billing) for that batch of meters; A - not receiving the payload would create missing data for a batch of meters and would trigger an immediate retry or retry at next file transfer period to satisfy next workflow processing steps (e.g. billing);
Mtr-read_multi-interval-data_cmd	cmd	Operations e.g. MDMS actor sends command requesting a specific interval of meter consumption information for a specific period from 2-Way Meter (Electr or Gas). Meter is not a electric grid critical infrastructure component. This payload is not used primarily for disturbance analysis	device ID, period of time to be reported, reading type	13	M-M-L	C - minimal harm to customer or organization for access to/disclosure of payload data as the payload data is tagged to a Meter ID not a customer account, but made lead to serious impact to Utility if in-scale I - inaccurate Meter ID, reading period and reading type can lead to billing errors and customer complaints leading to serious harm to utility (if in-scale) A - not receiving the payload would create missing meter data and would trigger an immediate retry or retry at next file transfer period to satisfy next workflow processing steps (e.g. billing);





AEP/CIM Message Payload

Payload Name	Payload Type	Description	Application Payload-attributes (excludes comm packet fields), date-time-stamps assumed for all payloads	CIM Mapping	CIM comments
on-demand_Mtr-read_cmd_comm_err	comm-err	IHD or Cust EMS or DAP or AMI Head-End sends message to MDMS, NMS, and/or CIS/Billing - Utility of issue with adhoc meter read request. Even though Meter is not a electric grid critical infrastructure component, this payload may be used in performing meter and telecomm network diagnostics.	Meter ID, failure code, sending device ID		
ReplyMeterReading	fault message			Result = FAILED, reply code = CIM extension	The Reply code does not exist in the individual tables so this will be an extension.





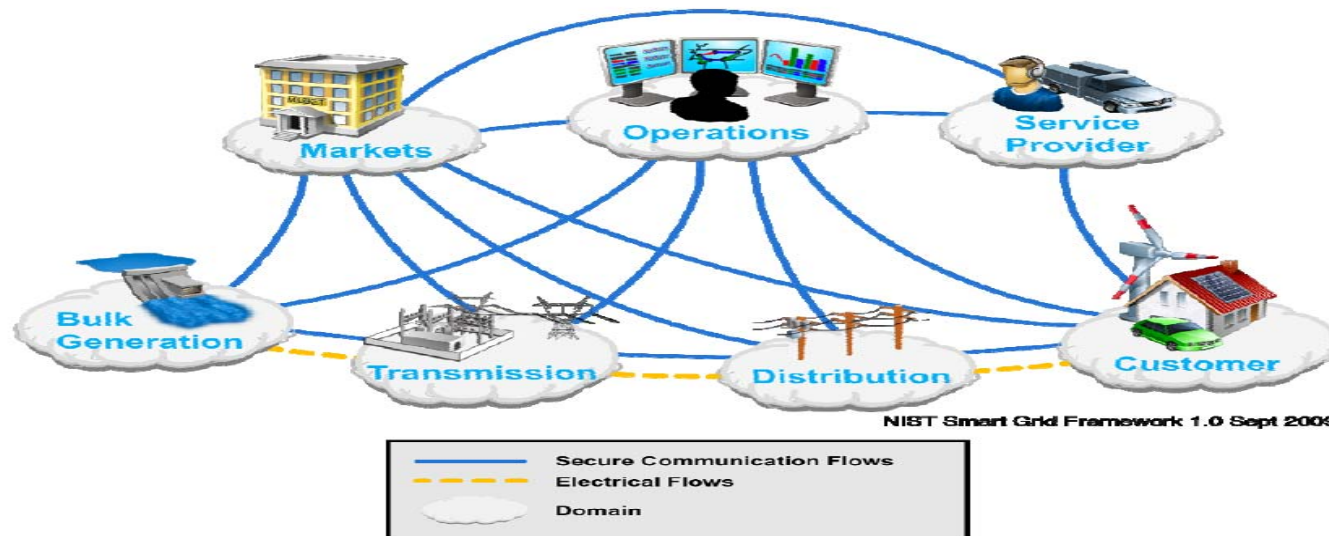
Payload_Source-Actor_Consuming-Actor Patterns

- The 500 Parent Payload Rqmts Sets are decomposed into ~1525 unique from-to-Actor_payload triplets
- Pivoting on the ~1525 record-set for the from-to actor pairs results in ~300 unique pairs used across subsets of the payloads
- Pivoting on the ~1525 record-set for the from-to-actor_reliability_latency quads results in ~520 unique occurrences across subsets of the payloads

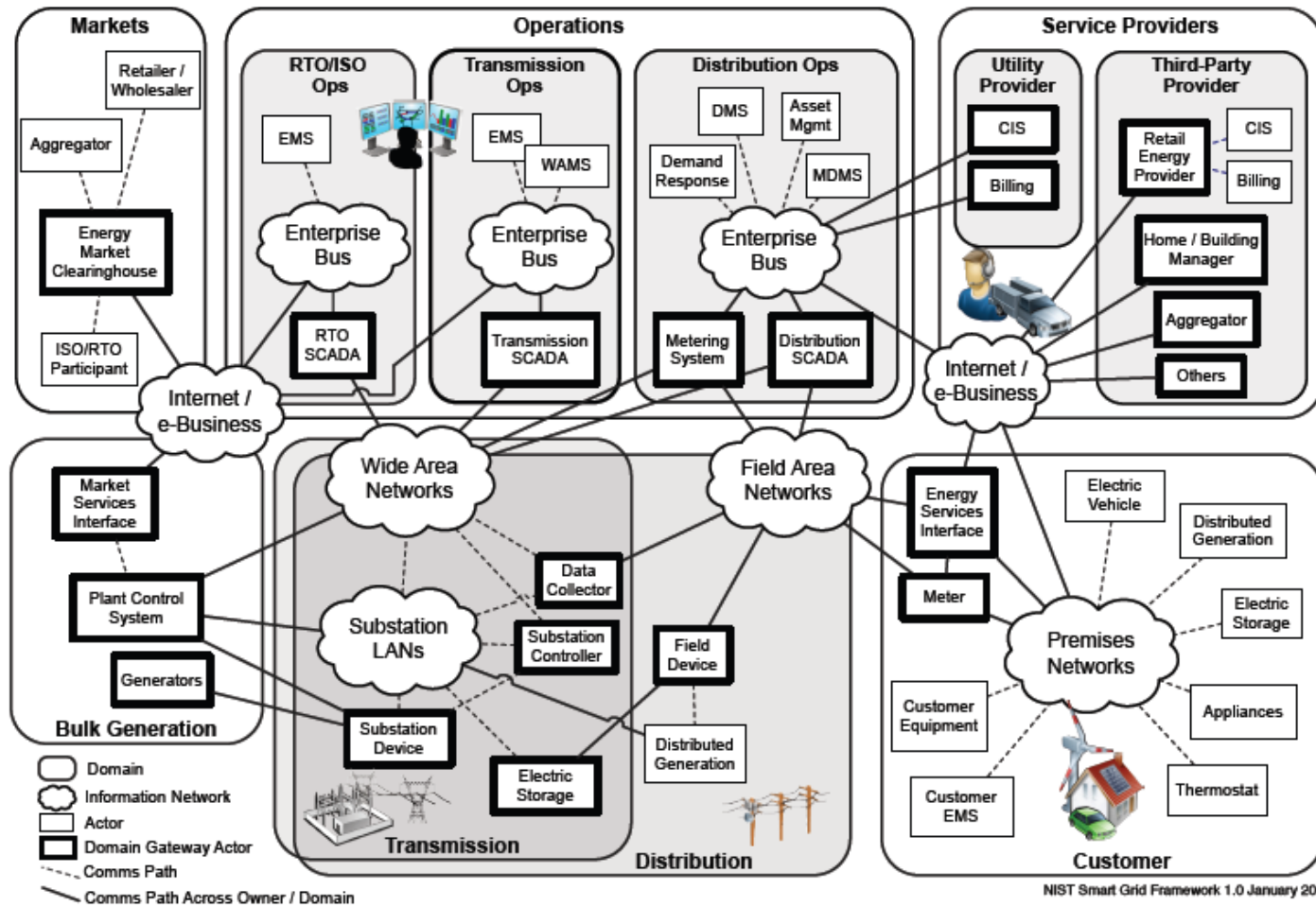
How does this map up to an abstracted view of the to other architectures, EIM, and other semantic models? Good Question

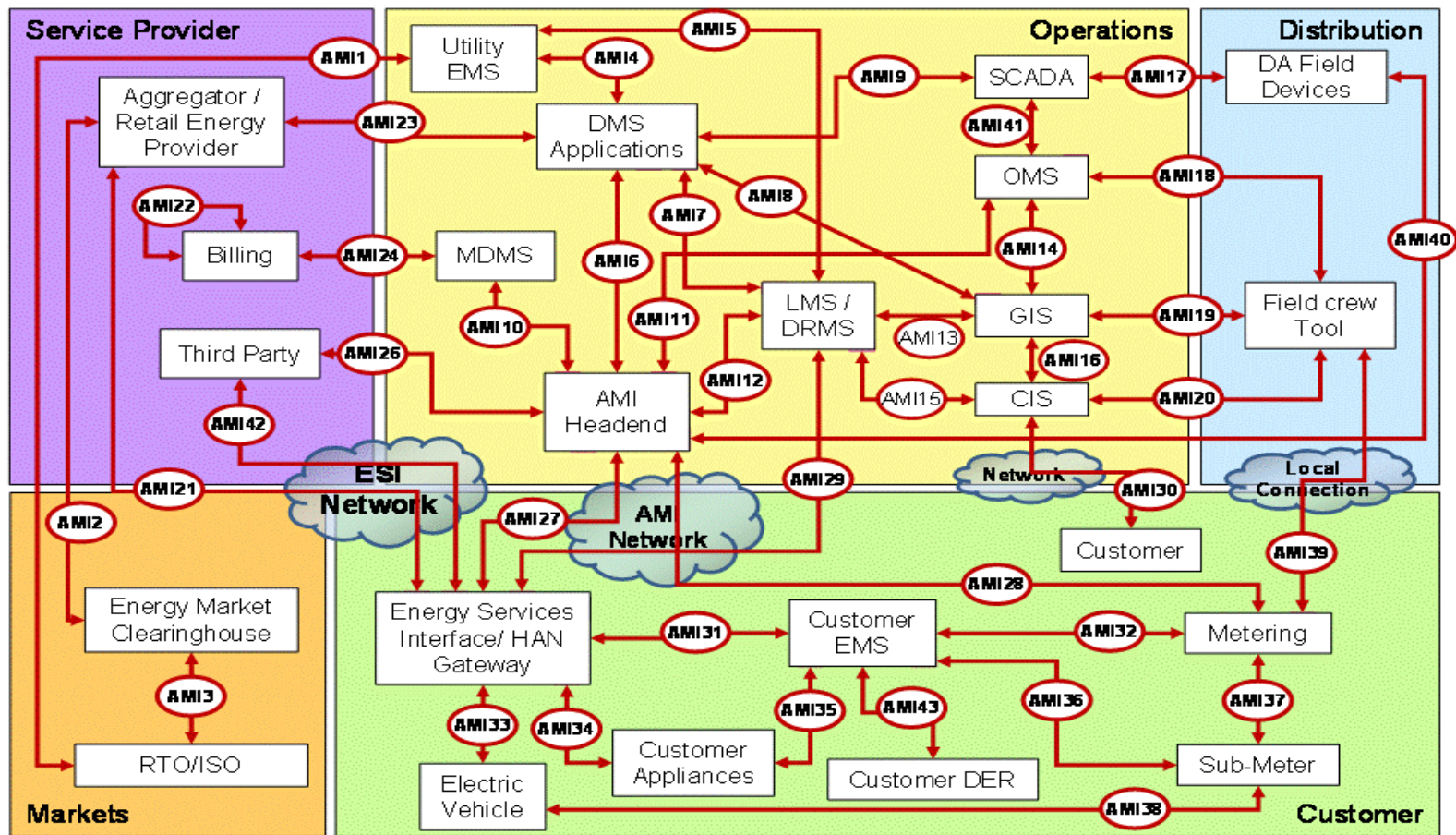


NIST Conceptual Model



NIST Conceptual Ref Diagram





AM Systems Use Cases: Actors, Logical Interfaces, and Networks

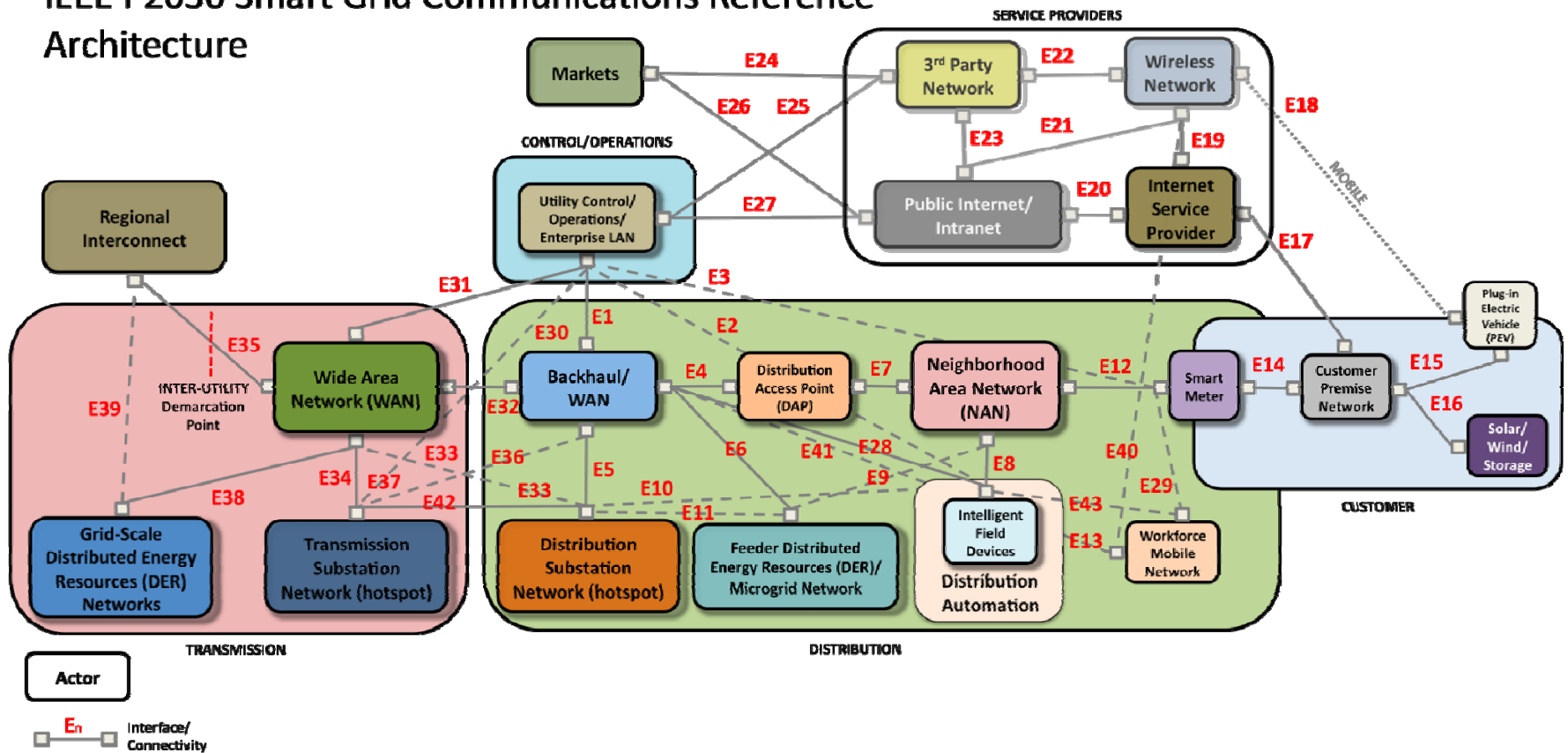
AMI: Advanced Metering Infrastructure
 CIS: Customer Information System
 DMS: Distribution Management System
 DRMS: Demand Response Management System
 EMS: Energy Management System
 GIS: Geographic Information System

HAN: Home Area Network
 ISO: Independent System Operator
 LMS: Load Management System
 OMS: Outage Management System
 RTO: Regional Transmission Operator



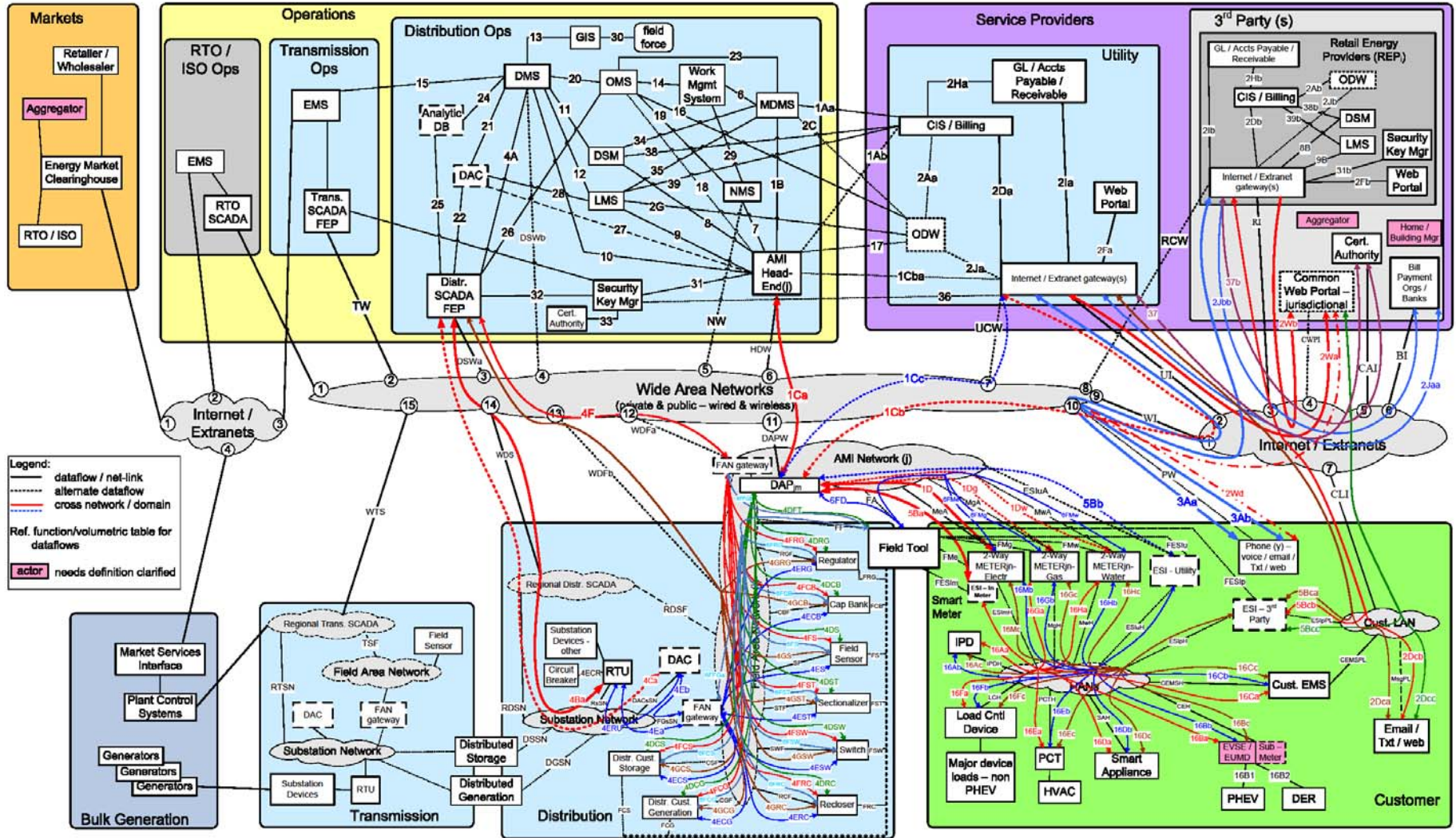
P2030 Smart Grid Comms Reference Architecture

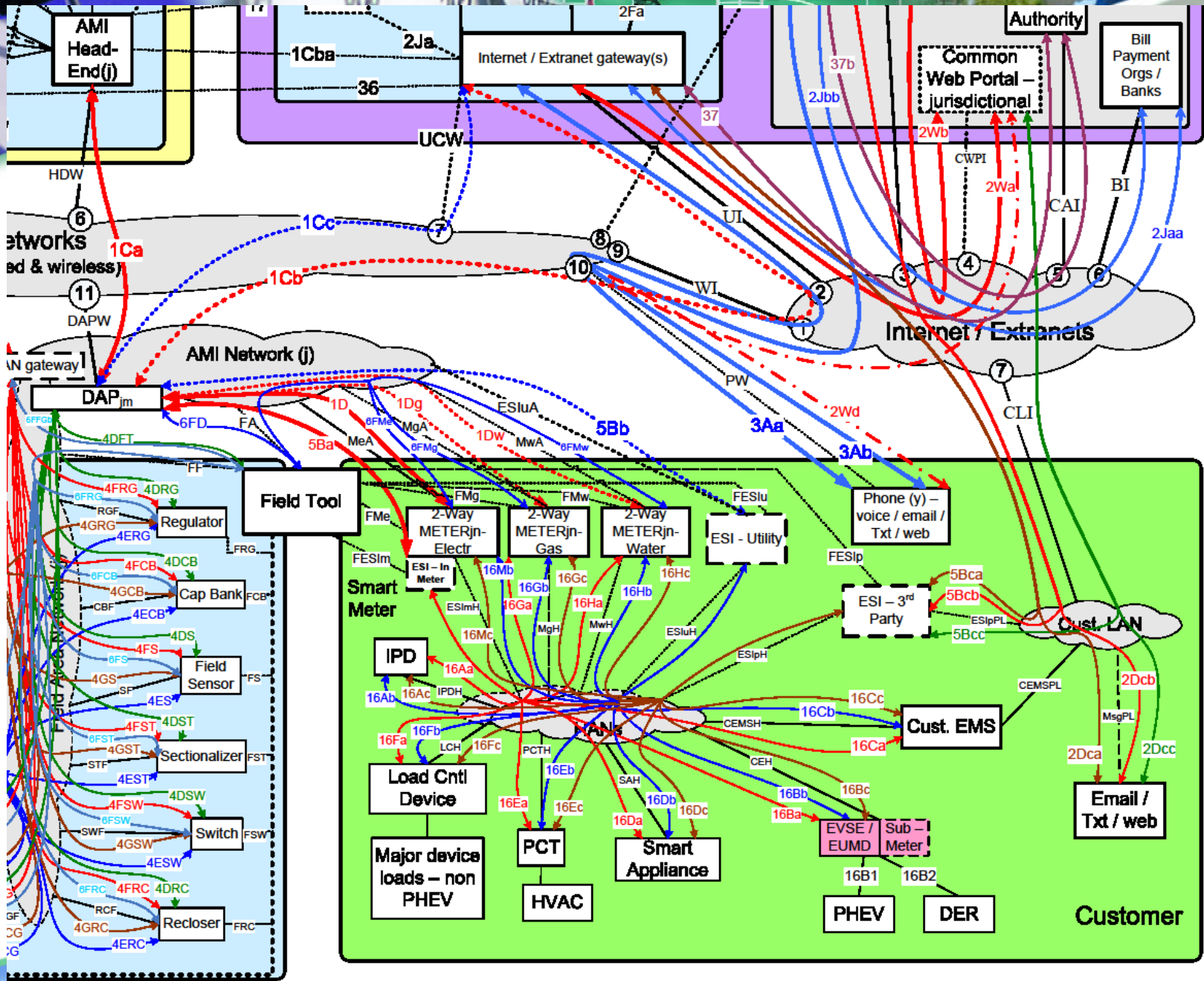
IEEE P2030 Smart Grid Communications Reference Architecture



Smart Grid Conceptual Actors / Data Flow Diagram – Cross Domain Network Focused – OpenSG / SG-Network TF

DRAFT 14Feb2012
 Base – file SG-NET-diagram-r5.1.vsd
 page size: ANSI-D







Deliverables

- Interim Release 1.0 was published in December 2009
 - Requirements and some volumetric and latency requirements
- Interim Release 2.0 was published in February 2010
 - Requirements, volumetric, latency requirements, security, implications and more use cases
 - Reference Architecture Diagram first published
 - System requirements specification published
- Interim Release 3.0 was published in May 2010
 - Addition of the following use cases: Pre-Payment, Meter Events, DA and Outage Management
 - System requirements specification updates
- Interim Release 4.0 was published in June 2010
 - Addition of the following use cases: DRLC, DA fault isolation and reconfiguration
- Interim Release 5.0 was published in October 2011
 - Addition of following use cases: Price
 - Additional payload reqmts sets in especially: DR-DLC, DSDR, Field DA Maint, Firmware/Prog update, Premise Network Admin, PrePay, Volt/Var Cntl
 - Revised How-Often syntax
- Interim Release 5.1 was published in March 2012



SG Communications / SG Network TF SG Requirements Release 5.1 Document/File Set
 Shared Documents Folder => http://osgug.ucaing.org/UtiliComm/Shared%20Documents/Latest_Release_Deliverables

Item	File Name	SubFolder wrt URL Above	Comments
Rqmts Table - clean	SG Network System Requirements Specification v5.1.xls		Clean version, based on vetted draft candidate
Rqmts Table – with editing since previous released version	SG Network System Requirements Specification v5.1-draft1b.zip		Contains all the edit changes from previous release, plus vetting formulas, VBA macros
Documenting Rqmts Instructions	<ul style="list-style-type: none"> rqmts-documentation-instructions-r1.4-clean-draft.doc rqmts-documentation-instructions-r1.4-clean-draft.pdf 		Clean version of instructions of how to create and/or interpret SG Requirements Table row and column content
Ref Diag – Source	SG-NET-diagram-r5.1.vsd	Diagrams	Microsoft Vision™ 2003 source file of the Reference Diagram (ANSI D size)
Ref Diag – base pdfs	<ul style="list-style-type: none"> SG-NET-diagram-r5.1D.pdf SG-NET-diagram-r5.1D-with-Xflows.pdf 	Diagrams	Filtered print image of the domains, actors, interfaces and the domains, actors, interfaces and cross domain-network data flows
Ref Diag – use case set pdfs	SG-NET-diagram-r5.1D-use-case-set.pdf	Diagrams	Use case filtered print images of domains, actors, interfaces, and cross domain-network data flows, currently contains 12 of 19 use cases as categorized in the Rqmts Table
Comm-path decisions - source	SG-Net-comm-path-decisions-r0.4.vsd	Diagrams	Compilation and pseudo code for major deployment profile and comm-path decisions
Comm.-path scenarios - source	SG-Net-comm-path-scenarios-r0.9.vsd	Diagrams	Compilation of major alternative comm-path sets
Rqmts database	SGNet-2012mod-5.1.zip	Rqmts_Database	Refreshed using clean r5.1 Rqmt Table and updated db refresh instructions for Microsoft Access™ 2003
Rqmts database – refresh steps	<ul style="list-style-type: none"> RqmtsDatabase-Refresh-of-RqmtsTable-data-r0.5.doc RqmtsDatabase-Refresh-of-RqmtsTable-data-r0.5.odt 	Rqmts_Database	Updated to reflect r5.1 Rqmt Table content and worksheet (tabs)
Rqmts db – overview & use instructions	<ul style="list-style-type: none"> SG-Network-Rqmts-DB-use-doc-r5.1-clean-draft.doc SG-Network-Rqmts-DB-use-doc-r5.1-clean-draft.pdf 	Rqmts_Database	Updated overview and use instructions for: r5.1 Rqmt Table content/format; merges in the db refresh steps and parsing section, and clarifies other section content