SG Network System Requirements Specification
Interim Release 3

5/17/2010

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Document History

Revision History

Revision Number	Revision Date	Revision By	Summary of Changes	Changes marked
1.01			Documented shell created	N
1.02	2/16/10	MKG	Result from 2/16/10 conference call	N
1.03	2/16/10	Armes/MKG	Cleaned up definitions and acronyms	N
1.04	2/16/10	MKG	Added TOC and Draft Preface	N
1.05	2/22/10	MKG	Added Requirements specification info	N
1.06	2/22/10	MKG	Clerical updates to links to work	N
2	2/22/10	MKG	Updated version number for release	N
3 rc1	4/17/10	MKG/RTC	Updated Use case flow charts and diagrams	N
3 rc3	4/17/10	RTC	Added links to documentation instructions	Y
3 rc5	4/18/10	MKG	Added acknowledgements and minor edits. Made images/illustrations portrait versus landscape	N

Preface

This document has been created to support NIST Smart Grid Interoperability Priority Action Plans (PAP) 1 & 2 and provide Utilities, Vendors and Standard Development Organizations a system requirements specification for Smart Grid Communication.

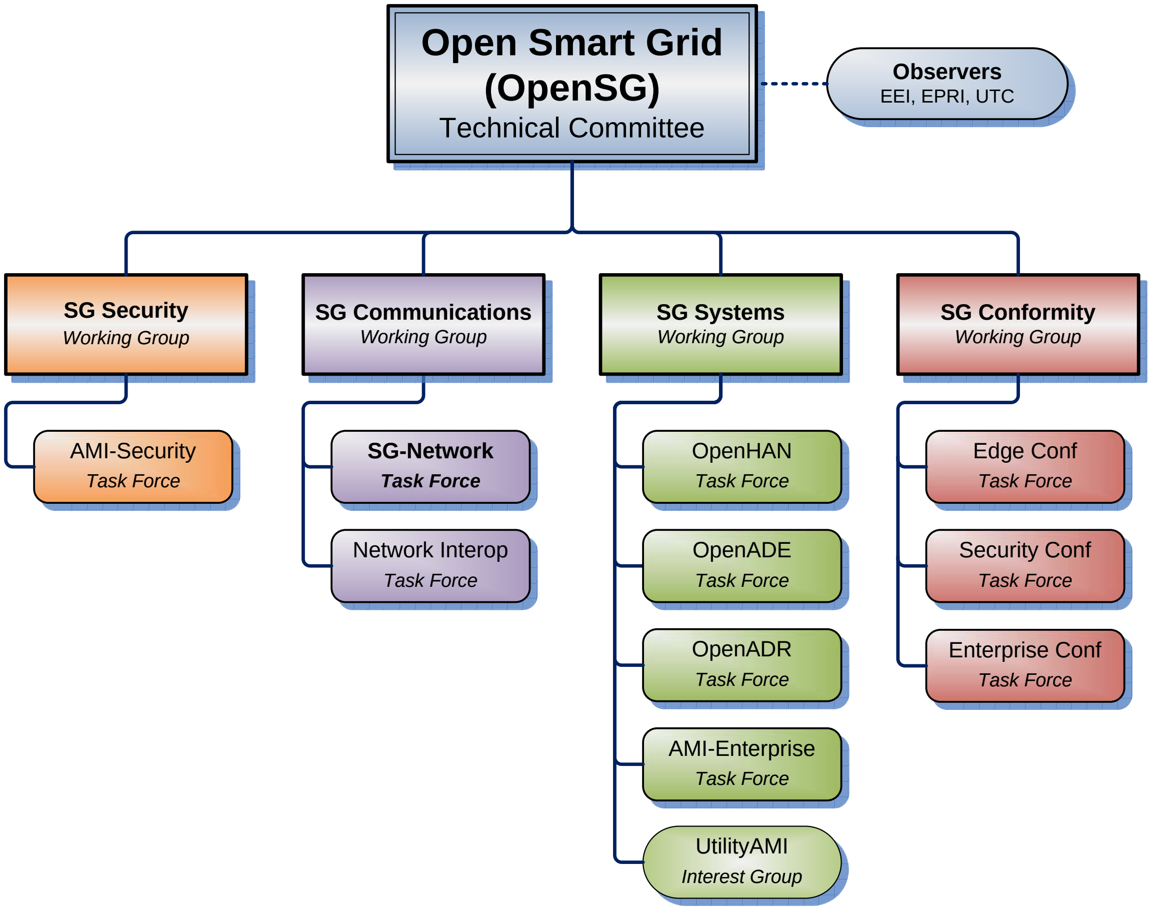
For PAP 1 the tasks assigned to UCAiug (SG-Network) are as follows:

> Task 1: Develop a set of requirements for different Smart Grid applications

For PAP 2 the tasks assigned to UCAiug (SG Network) are as follows:

> Task 1: Segment the smart grid and wireless environments into a minimal set of categories for which individual wireless requirements can be identified.
>
> Task 3: Compile & communicate use cases and develop requirements for all smart grid domains in terms that all parties can understand.
>
> Task 4: Compile and communicate a list of capabilities, performance metrics, etc. in a way that all parties can understand. - Not quantifying any standard, just defining the set of metrics.

To accomplish these assignments, the UCAiug Open Smart Grid (OpenSG) has assigned these tasks to a task force within the SG Communications working group called SG Network to formally work on these tasks.


Open Smart Grid
(OpenSG)
Technical Committee
Observers
EEI, EPRI, UTC
SG Security
Working Group
AMI-Security
Task Force
SG Communications
Working Group
SG-Network
Task Force
Network Interop
Task Force
SG Systems
Working Group
OpenHAN
Task Force
OpenADE
Task Force
OpenADR
Task Force
AMI-Enterprise
Task Force
UtilityAMI
Interest Group
SG Conformity
Working Group
Edge Conf
Task Force
Security Conf
Task Force
Enterprise Conf
Task Force

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Acronyms and Abbreviations

AC	Alternating Current
AMI	Advanced Metering Infrastructure
AMS	Asset management system
ASAP-SG	Advanced Security Acceleration Project-Smart Grid
B2B	Business to Business
BAN	Business Area Network
CIM	Common Information Model.
CIP	Critical Infrastructure Protection
CSWG	Cyber Security Working Group
DA	Distribution Automation
DAP	Data Aggregation Point
DER	Distributed Energy Resources
DHS	Department of Homeland Security
DMS	Distribution Management System
DNP	Distributed Network Protocol
DOE	Department of Energy
DOMA	Distribution Operations Model and Analysis
DR	Demand Response
DSDR	Distribution Systems Demand Response
DSM	Demand Side Management
EMS	Energy Management System
EPRI	Electric Power Research Institute
ES	Electric Storage
ESB	Enterprise Service Bus
ESI	Energy Services Interface
ET	Electric Transportation
EUMD	End Use Measurement Device
EV/PHEV	Electric Vehicle/Plug-in Hybrid Electric Vehicles
EVSE	Electric Vehicle Service Element
FAN	Field Area Network
FEP	Front End Processor
FERC	Federal Energy Regulatory Commission
FIPS	Federal Information Processing Standard Document
FLIR	Fault Location, Isolation, Restoration
G&T	Generations and Transmission
GAPP	Generally Accepted Privacy Principles.
GIS	Geographic Information System
GPRS	General Packet Radio Service
HAN	Home Area Network
HMI	Human-Machine Interface

HVAC	Heating, Ventilating, and air conditioning (shown in figure)
I2G	Industry to Grid
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IHD	In-home Display
ISA	International Society of Automation
ISO	Independent System Operator
ISO/IEC27001	International Organization for Standardization/International Electrotechnical Commission Standard 27001.
IT	Information Technology
LAN	Local Area Network
LMS	Load management system
LMS/DRMS	Load Management System/ Distribution Resource Management System
LV	Low voltage (in definition)
MDMS	Meter Data Management System
MFR	Multi-Feeder Reconnection
MSW	Meter service switch
MV	Medium voltage (in definition)
NAN	Neighborhood Area Network
NERC	North American Electric Reliability Corporation
NIPP	National Infrastructure Protection Plan
NIST	National Institute of Standards and Technology
NISTIR	NIST Interagency Report
NMS	Network Management system
OMS	Outage Management System
OWASP	Open Web Application Security Project
PAP	Priority Action Plan
PCT	Programmable Communicating Thermostat
PEV	Plug-In Electric Vehicle
PI	Process Information
PIA	Privacy Impact Assessment. .
PII	Personally Identifying Information
R&D	Research and Development
RTO	Regional Transmission Operator
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SCE	Southern California Edison
SGIP	Smart Grid Interoperability Panel
SGIP-CSWG	SGIP – Cyber Security Working Group
SP	Special Publication
SSP	Sector-Specific Plans
T/FLA	Three/Four Letter Acronym
VAR	Volt-Amperes Reactive

VVWS	Volt-VAR-Watt System
WAMS	Wide-Area Measurement System
WAN	Wide Area Network
WASA	Wide Area Situational Awareness
WLAN	Wireless Local Area Network
WMS	Work Management System

Definitions

Actor	A generic name for devices, systems, or programs that make decisions and exchange information necessary for performing applications: smart meters, solar generators, and control systems represent examples of devices and systems.
Anonymize	A process of transformation or elimination of PII for purposes of sharing data
Aggregation	Practice of summarizing certain data and presenting it as a total without any PII identifiers
Aggregator	SEE FERC OPERATION MODEL
Applications	Tasks performed by one or more actors within a domain.
Asset Management System	A system(s) of record for assets managed in the Smart Grid. Management context may change(e.g. financial, network)
Capacitor Bank	This is a device used to add capacitance as needed at strategic points in a distribution grid to better control and manage VARs and thus the Power Factor and they will also affect voltage levels.
Common Information Model	A structured set of definitions that allows different Smart Grid domain representatives to communicate important concepts and exchange information easily and effectively.
Common Web Portal	Web interface for Regional Transmission Operator, customers, retail electric providers and transmission distribution service provider to function as a clearing house for energy information. Commonly used in deregulated markets.
Data Collector	See Substation Controller
Data Aggregation Point	This device is a logical actor that represents a transition in most AMI networks between Wide Area Networks and Neighborhood Area Networks. (e.g. Collector, Cell Relay, Base Station, Access Point, etc)
De-identify	A form of anonymization that does not attempt to control the data once it has had PII identifiers removed, so it is at risk of re-identification.
Demand Side Management	A system that co-ordinates demand response / load shedding messages indirectly to devices (e.g. Set point adjustment)
Distribution Management System	A system that monitors, manages and controls the electric distribution system.
Distribution Systems Demand Response	A system used to reduce load during peak demand. Strictly used for Distribution systems only.
Electric Vehicle/Plug-in Hybrid Electric Vehicles	Cars or other vehicles that draw electricity from batteries to power an electric motor. PHEVs also contain an internal combustion engine.
Energy Services Interface	Provides security and, often, coordination functions that enable secure interactions between relevant Home Area Network Devices and the Utility. Permits applications such as remote load control, monitoring and control of distributed generation, in-home display of customer usage, reading of non-energy meters, and integration with building management systems. Also provides auditing/logging functions that record transactions to and from Home Area Networking Devices.

Enterprise Service Bus	The Enterprise Service Bus consists of a software architecture used to construct integration services for complex event-driven and standards-based messaging to exchange meter or grid data. The ESB is not limited to a specific tool set rather it is a defined set of integration services.
Fault Detector	A device used to sense a fault condition and can be used to provide an indication of the fault.
Field Force	Employee working in the service territory that may be working with Smart Grid devices.
GAPP	Generally Accepted Privacy Principles. Privacy principles and criteria developed and updated by the AICPA and Canadian Institute of Chartered Accountants to assist organizations in the design and implementation of sound privacy practices and policies.
Home Area Network	A network of energy management devices, digital consumer electronics, signal-controlled or enabled appliances, and applications within a home environment that is on the home side of the electric meter.
Intelligent Fault Detector	A device that can sense a fault and can provide more detailed information on the nature of the fault, such as capturing an oscillography trace.
ISO/IEC27001	An auditable international standard that specifies the requirements for establishing, implementing, operating, monitoring, reviewing, maintaining and improving a documented Information Security Management System within the context of the organization's overall business risks. It uses a process approach for protection of critical information
Last Gasp	Concept of an energized device within the Smart Grid detecting power loss and sending a broadcast message of the event.
Load Management System	System that controls load by sending messages directly to device (e.g. On/Off)
Low Voltage Sensor	A device used to measure and report electrical properties (such as voltage, current, phase angle or power factor, etc.) at a low voltage customer delivery point.
Medium Voltage Sensor	A device used to measure and report electrical properties (such as voltage, current, phase angle or power factor, etc.) on a medium voltage distribution line.
Motorized Switch	A device under remote control that can be used to open or close a circuit.
Neighborhood Area Network	A network comprised of all communicating components within a distribution domain.
Network Management System	A system that manages Fault, Configuration, Auditing/Accounting, Performance and Security of the communication. This system is exclusive from the electrical network.
Outage Management System	A system that receives out power system outage notifications and correlates where the power outage occurred

Personal Information	Information that reveals details, either explicitly or implicitly, about a specific individual's household dwelling or other type of premises. This is expanded beyond the normal "individual" component because there are serious privacy impacts for all individuals living in one dwelling or premise. This can include items such as energy use patterns or other types of activities. The pattern can become unique to a household or premises just as a fingerprint or DNA is unique to an individual.
Phase Measuring Unit	A device capable of measuring the phase of the voltage or current waveform relative to a reference.
Power Factor	A dimensionless quantity that relates to efficiency of the electrical delivery system for delivering real power to the load. Numerically, it is the Cosine of the phase angle between the voltage and current waveforms. The closer the power factor is to unity the better the inductive and capacitive elements of the circuit are balanced and the more efficient the system is for delivering real power to the load(s).
Privacy Impact Assessment	A process used to evaluate the possible privacy risks to personal information, in all forms, collected, transmitted, shared, stored, disposed of, and accessed in any other way, along with the mitigation of those risks at the beginning of and throughout the life cycle of the associated process, program or system
Programmable Communicating Thermostat	A device within the premise that has communication capabilities and controls heating, ventilation and cooling systems.
Recloser (non-Team)	A device used to sense fault conditions on a distribution line and trip open to provide protection. It is typically programmed to automatically close (re-close) after a period of time to test if the fault has cleared. After several attempts of reclosing it can be programmed to trip open and stop trying to reclose until reset either locally or under remote control.
Recloser (Team)	A device that can sense fault conditions on a distribution line and to communicate with other related reclosers (the team) to sectionalize the fault and provide a coordinated open/close arrangement to minimize the effect of the fault.
Regional Transmission Operator	A Regional Transmission Organization (RTO) is an organization that is established with the purpose of promoting efficiency and reliability in the operation and planning of the electric transmission grid and ensuring non-discrimination in the provision of electric transmission services based on the following required/demonstrable characteristics and functions.
Remote Terminal Unit	Aggregator of multiple serialized devices to a common communications interface
Sub Meter	Premise based meter used for Distributed Energy Resources and PHEV. This device may be revenue grade.
Substation Controller	Distributed processing device that has supervisory control or coordinates information exchanges from devices within a substation from a head end system.
Transformer (MV-to-LV)	A standard point of delivery transformer. In the Smart Grid context is it assumed there will be a need to measure some electrical or physical characteristics of this transformer such as voltage (high and/or low side) current, MV load, temperature, etc.

Use Case	Use cases are a systems engineering tool for defining a system's behavior from the perspective of users. In effect, a use case is a story told in structure and detailed steps—scenarios for specifying required usages of a system, including how a component, subsystem, or system should respond to a request that originates elsewhere.
Voltage Regulator	This device is in effect an adjustable ratio transformer sitioned at strategic points in a distribution grid and is utilized to better manage and control the voltage as it changes along the distribution feeder.
VAR – Volt-Amperes Reactive;	In an AC power system the voltage and current measured at a point along the delivery system will often be out of phase with each other as a result the combined effects of the resistive and reactive (i.e. the capacitance and inductive) characteristics of the delivery system components and the load. The phase angle difference at a point along the delivery system is an indication of how well the inductive and capacitive effects are balanced at that point. The real power passing that point is the product of the magnitude of the Voltage and Current and the Cosine of the angle between the two. The VAR parameter is the product of the magnitude of the Voltage and Current and the Sine of the angle between the two. The magnitude of the VAR parameter is an indication of the phase imbalance between the voltage and current waveforms.
Web Portal	Interface between energy customers and the system provider. Could be the utility or third party

SG-Network Requirements Gathering process

The SG-Network task force derived functional requirements from the following process:

- Listing of pertinent use cases
- Identification of Actors within use cases
- Gap analysis by mapping actors to use cases
- Defining Functional Requirements
    - Requirement actor to actor
    - Estimated payload
    - Expected latency
    - Expected Reliability
    - Security Requirements
        - Low, Medium, High per NISTIR 7628
    - Implications of failure

- Smart Grid Domain, Actor, Interface reference diagram
    - Illustrative diagram of requirements

Listing of pertinent use cases

In order to create a list of functional requirements for the Smart Grid, an exercise was performed to list all pertinent use cases that involve network communication. Sources for this information include the Southern California Edison Use Cases, Grid Wise Architectural Console use cases, EPRI and others. Use cases from all of these sources were selected based upon a network requirements basis. From this research the following high level use cases have been identified.

Smart Grid Use Case	Requirements Derived	Requirements included in release 3.0
Meter Read	Yes	Yes
Direct load control	In progress	No
Service Switch	Yes	Yes
PHEV	Yes	Yes
System updates	In progress	No
Distributed GEN	In progress	No
Distributed Storage	Draft	No
Outage Events	Yes	Yes
Tamper Events	Draft	No
Meter Events	Draft	No
Demand Response	Draft	No
Pre-Pay Metering	Yes	Yes
Field Force tools	Not started	No
Distribution automation support	Yes	Yes
Transmission automation support	Not started	No
Pricing TOU / RTP/ CPP	in progress	No
Configuration mgmt	in progress	No
Accounting Mgmt	in progress	No
Performance Mgmt	in progress	No
Security mgmt	in progress	No
Fault mgmt	in progress	No
Volt/VAR Management	Yes	Yes

The “Requirements Derived” Column of the above table shows that requirements have been produced for the use case. However the requirements will not be submitted for wider audiences until they have been fully vetted. Requirements that are fully vetted have a “Yes” in the “Requirements Fully Vetted” column.

Identification of Actors within Use Cases

After the use cases were identified. Members of SG Network reviewed the existing use cases from the industry and defined the actors. While doing this exercise the actors were also added to architectural domains:

Actor	Domain
Meter Data Management System	Operations
Asset Management System	Operations
Energy Management System	Operations
Demand Side Management System	Operations
Event / OMS System	Operations
Distribution Management System	Operations
Load Management System	Operations
Supervisory Control and Data Acquisition System	Operations
Geospatial Information System	Operations
Network Management System	Operations
Head End System	Operations
Capacitor Bank	Distribution
Voltage Regulator	Distribution
Meduim Voltage Sensor	Distribution
Recloser Teamed	Distribution
Recloser Not Teamed	Distribution
Phase Measuring Unit	Distribution
Fault Detector	Distribution
Data Aggregation Point	Transmission and Distribution
Smart Meter	Customer
Energy Services Interface	Customer
In Home Display	Customer
Customer Information System	Service Provider
Customer Information System 3rd Party	Service Provider

Gap analysis by mapping actors to use cases

Having collected a list of actors and use cases, the gab analysis was conducted by mapping actors to use cases. The exercise involved a review of each selected use case and mapping which actors apply. Below is an example of this process for Meter Reading.

Actor	Domain	Use Case: Meter Reading
Meter Data Management System	Operations	Yes
Asset Management System	Operations	No
Energy Management System	Operations	No
Demand Side Management System	Operations	No
Event / OMS System	Operations	No
Distribution Management System	Operations	No
Load Management System	Operations	No
Supervisory Control and Data Acquisition System	Operations	No
Geospatial Information System	Operations	No
Network Management System	Operations	No
Head End System	Operations	Yes
Capacitor Bank	Distribution	No
Voltage Regulator	Distribution	No
Medium Voltage Sensor	Distribution	No
Recloser Teamed	Distribution	No
Recloser Not Teamed	Distribution	No
Phase Measuring Unit	Distribution	No
Fault Detector	Distribution	No
Data Aggregation Point	Transmission and Distribution	Yes
Smart Meter	Customer	Yes
Energy Services Interface	Customer	Yes
In Home Display	Customer	Yes
Customer Information System	Service Provider	Yes
Customer Information System 3rd Party	Service Provider	Yes

Defining Functional Requirements

The process of requirements gathering has been evolutionary in nature. The SG Network task force has defined over 800 functional requirements while reviewing the use cases identified previously. The group intends to release versions of requirements over time in order to keep scope and focus attainable yet giving consumers of this information something to work with and provide feed back.

The requirements have been captured in a spreadsheet that matches the version of this document. A partial description of the spreadsheet and its columns are below. For a more complete description, refer to the latest version of the "Requirements Documentation Instructions" located in the SG-Network Task Force webpage folder

http://osgug.ucaiug.org/UtiliComm/Shared%20Documents/Interium_Release_3/

Rqmt Ref – This column is a reference to the original worksheet line number the requirement originally defined

Data-Flow Ref – This column is a reference to the architectural reference models lines between actors shown illustratively in this document and attached to this work as a separate file

Data Flow From Actor – This column indicates the actor that is considered the sender of information noted in the Requirements Column

Data Flow to Actor – This column indicates the actor that is considered the desired recipient of the information noted in the Requirements Column

Requirements – This column is the actual application requirement. Words like "shall" in this column are to be considered required, while words like "may" should be considered optional

Payload Name – This column explains the scenario type of the requirement derived from the use case. (e.g. Bulk, On Demand for meter reading)

Candidate NIST LIC – Derived and mapped to the NISTIR document 7628

Security Confidentiality – Derived and mapped to the NISTIR document 7628

Security Integrity – Derived and mapped to the NISTIR document 7628

Security Availability – Derived and mapped to the NISTIR document 7628

Latency - Summation of the node processing time and network time from the originating payload actor to the consuming actor

Reliability - The probability that an operation will complete without failure over a specific period or amount of time.

Payload Size Type – This column indicates whether the payload is native (encoded in a compact format), intgrt (encoded in an API or web service format) or Display (encoded in a format for a user interface)

App Payload Size – This column is an estimation of how many bytes are needed for the requirement as actual payload.

Implications – This column is an attempt to explain the impacts of the requirements not being met for the operator of the system.

Smart Grid Domain, Actor, Interface Reference Model

In these section a few illustrative diagrams are included to help the reader of this document to understand the content. These files are also available for reference at the following location:

The reference model diagrams locations are in the SG-Network TF webpage folder:
http://osgug.ucaiug.org/UtiliComm/Shared%20Documents/Interium_Release_3/Diagrams

The SG-Network functional requirements table location is:

http://osgug.ucaiug.org/UtiliComm/Shared%20Documents/Interium_Release_3/SG-Net_TF_%20funct-volumteric-reqs_v3.xls

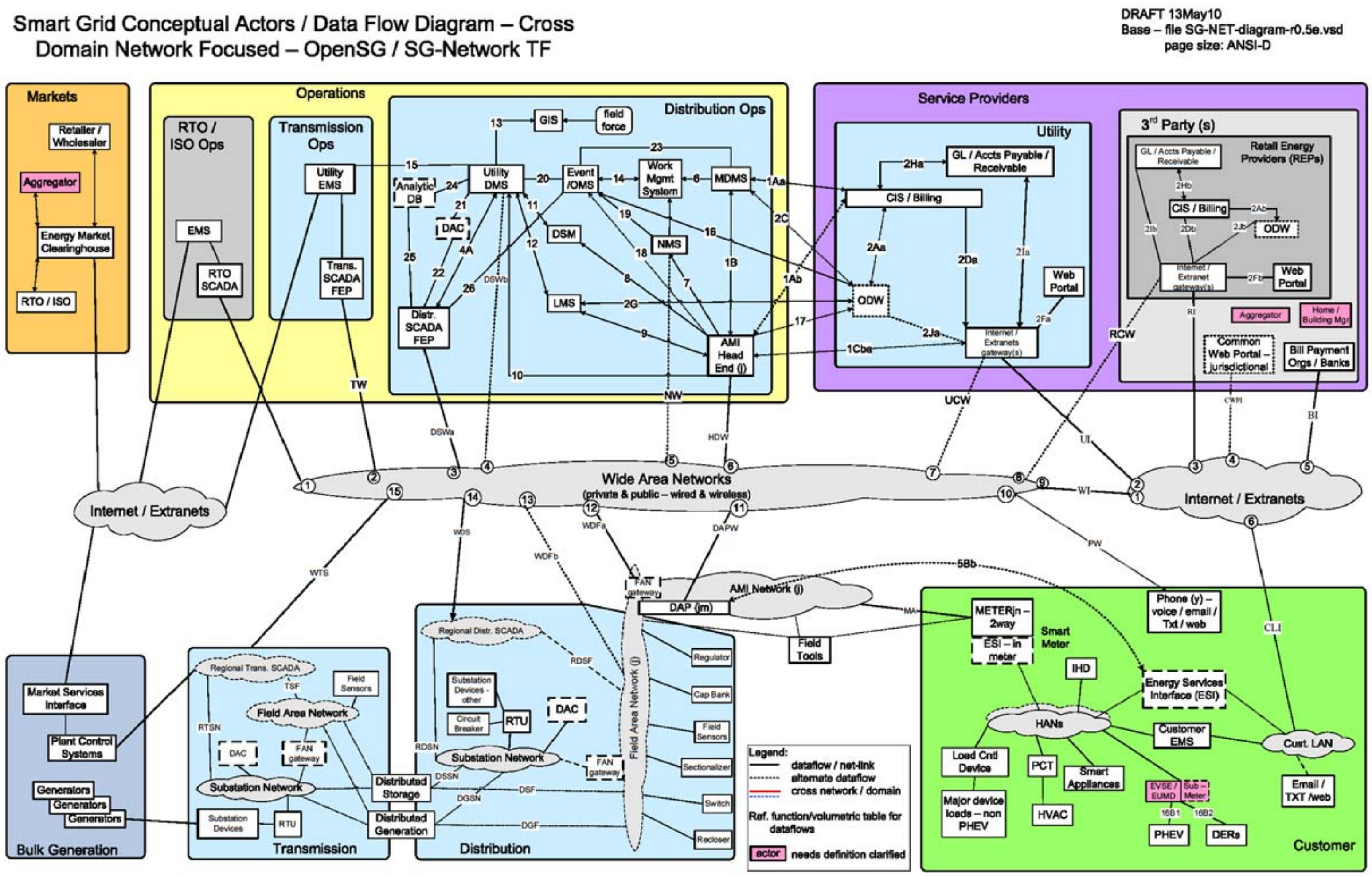


Diagram 1 – Baseline Diagram Without Cross Domain & Network

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

DRAFT 13May10
Base – file SG-NET-diagram-r0.5e.vsd
page size: ANSI-D

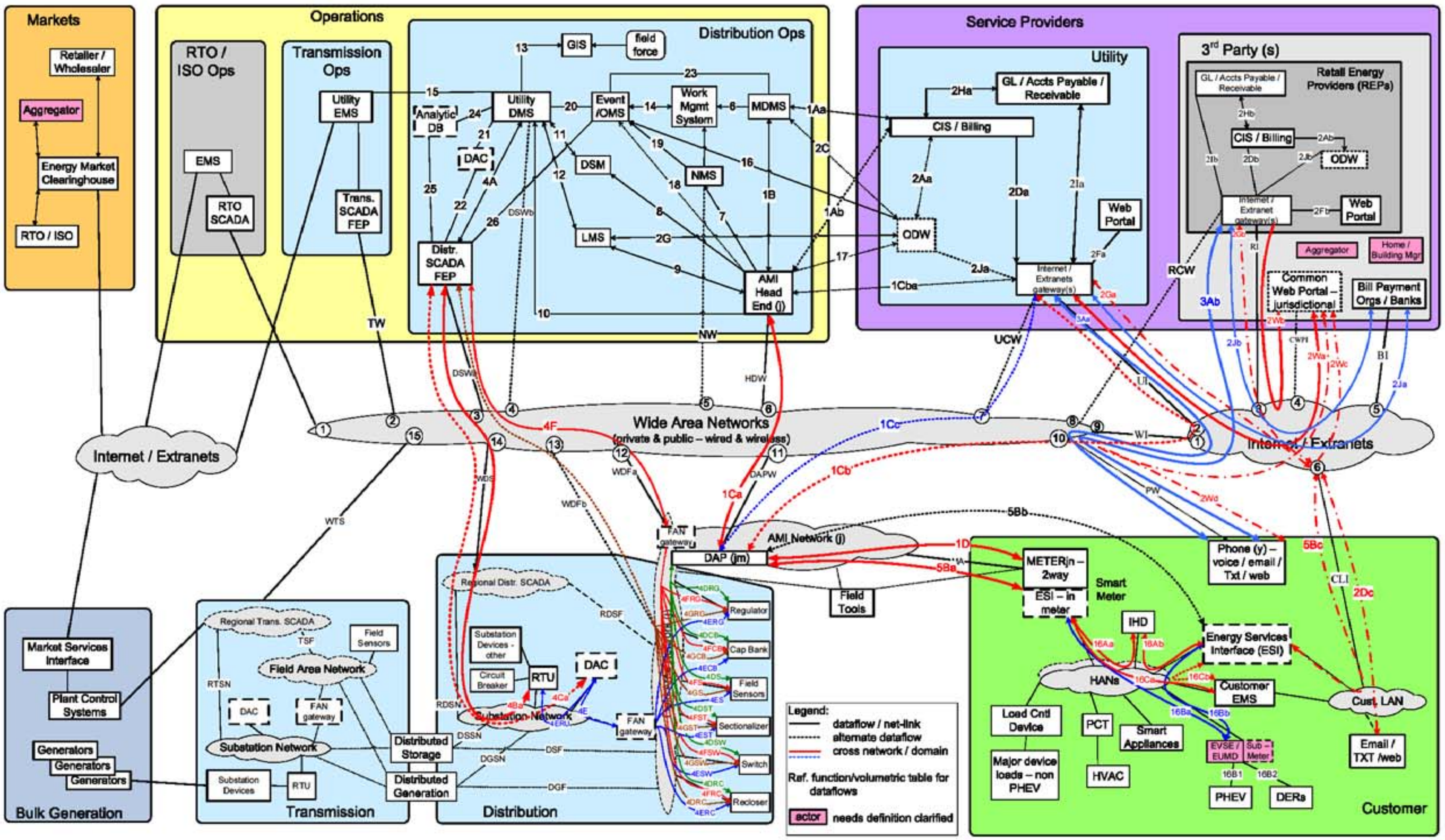


Diagram 2 – Baseline Diagram With Cross Domain & Network flows

Rqmt Ref	Row Type (P - Parent, else null)	Data Flow Ref (min set that includes opts) - SG-Net Diag r0.5d	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)	Daily Clock Periods of Primary Occurance	How Often	Reliability	Latency (response time one direction) Rqmts	Candidate NIST LIC	Security Confidentiality (L, M, H)	Security Integrity (L, M, H)	Security Availability (L, M, H)	Payload Size Type (native, Intgrt, display)	App Payload Size - bytes	Implication (sys critical, low importance)
MR-2	**P**	**[(1Aa + 1B) or 1Ab] + [1Ca or (1Cba + 1Cb) or (1Cba + 1Cc)] + 1D**	**CIS/Billing - Utility**	**Smart Meter**	**Meter reading**	**CIS - Utility shall be able to send on-demand meter read request to the Smart Meter via the Head-End**	on-demand_Mr-read_cmd	**cmd**	**7AM - 10PM**	**25 trans per 1000 mtrs per day**	**> 98%**	**< 15s**	**3a, 10a, 10b, 11**	**L**	**M**	**L**	**Intgrt**	**25**	**May need to estimate or manually read, Not system critical**
MR-3		1Aa	CIS/Billing - Utility	MDMS	Meter reading	CIS - Utility may be able to send on-demand meter read request to MDMS	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 mtrs per day	> 99.5%	< 5s	3a	L	M	L	Intgrt	25	May need to estimate or manually read, Not system critical
MR-4		1Ab	CIS/Billing - Utility	AMI Head-End	Meter reading	CIS - Utility may be able to send on-demand meter read request to AMI Head-End	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 mtrs per day	> 99.5%	< 5s	3a	L	M	L	Intgrt	25	May need to estimate or manually read, Not system critical
MR-9		1B	MDMS	AMI Head-End	Meter reading	MDMS shall be able to process & forward on-demand meter read request to AMI Head End, as maybe received from CIS - Utility	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 mtrs per day	> 99.5%	< 5s	3a	L	M	L	Intgrt	25	May need to retry, Not system critical
MR-16		1Ca	AMI Head End	DAP	Meter reading	Head End shall be able to process & forward on-demand meter read requests to DAP	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 mtrs per day	> 99%	< 5s	10a, 10b	L	M	L	Native or Intgrt	25	May need to retry, Not system critical
MR-76		1Cba	AMI Head End	Internet / Extranet gateway(s) - Utility	Meter reading	Head End shall be able to process & forward on-demand meter read requests as routed throug Internet / Extranet gateways(s) - Utility	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 mtrs per day	> 99.5%	< 5s	10a, 10b	L	M	L	Native or Intgrt	25	May need to retry, Not system critical
MR-77		1Cb	Internet. Extranet gateway(s) - Utility	DAP	Meter reading	Internet / Extranet gateway(s) - Utility shall be able to inspect & forward on-demand meter read requests to DAP	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 mtrs per day	> 99%	< 5s	10a, 10b	L	M	L	Native or Intgrt	25	May need to retry, Not system critical
MR-78		1Cc	Internet. Extranet gateway(s) - Utility	DAP	Meter reading	Internet / Extranet gateway(s) - Utility shall be able to inspect & forward on-demand meter read requests to DAP	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 mtrs per day	> 99%	< 5s	10a, 10b	L	M	L	Native or Intgrt	25	May need to retry, Not system critical
MR-27		1D	DAP	Smart Meter	Meter reading	DAP shall be able to process & forward on-demand meter read requests to the Smart Meter (Electric or Gas, Residential or Commerical/Industrial)	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 DAP]m-mtrs per day	> 98%	< 5s	10a, 10b	L	M	L	Native or Intgrt	25	May need to retry, Not system critical
MR-100	**P**	**[16Aa or (1D + 5Bb + 16Ab)]**	**IHD**	**Smart Meter**	**Meter reading**	**IHD shall be able to send on-demand meter reading request to Smart Meter**	on-demand_Mr-read_cmd	**cmd**	**7AM - 10PM**	**1-10 trans per day per customer with IHD**	**> 99%**	**< 5s**	**11**	**L**	**M**	**L**	**Intgrt**	**25**	**Customer Frustration, Not system critical**
MR-52		16Aa	IHD	Smart Meter	Meter reading	IHD shall be able to send on-demand meter reading request to Smart Meter via Smart Meter ESI	on-demand_Mr-read_cmd	cmd	7AM - 10PM	1-10 trans per day per customer with IHD	> 99%	< 5s	11	L	M	L	Intgrt	25	Customer Frustration, Not system critical
MR-53		16Ab	IHD	ESI - non-Smart Meter - Utility	Meter reading	IHD shall be able to send on-demand meter reading request to non Smart Meter ESI - Utility	on-demand_Mr-read_cmd	cmd	7AM - 10PM	1-10 trans per day per customer with IHD	> 98%	< 5s	11	L	M	L	Intgrt	25	Customer Frustration, Not system critical
MR-101		5Bb	ESI - non-Smart Meter - Utility	DAP	Meter reading	ESI - nob-Smart Meter - Utility shall be able to send on-demand meter reading request to DAP	on-demand_Mr-read_cmd	cmd	7AM - 10PM	1-10 trans per day per customer with IHD	> 98%	< 5s	11	L	M	L	Intgrt	25	Customer Frustration, Not system critical
MR-102		1D	DAP	2-Way Meter	Meter reading	ESI - nob-Smart Meter - Utility shall be able to send on-demand meter reading request to 2Way Meter	on-demand_Mr-read_cmd	cmd	7AM - 10PM	1-10 trans per day per customer with IHD	> 99%	< 5s	11	L	M	L	Intgrt	25	Customer Frustration, Not system critical
MR-103	**P**	**[16Ca + (1D + 5Bb + 16Cb)]**	**Cust. EMS**	**Smart Meter**	**Meter reading**	**Customer EMS shall be able to send on-demand meter reading request to Smart Meter**	on-demand_Mr-read_cmd	**cmd**	**7AM - 10PM**	**1-10 trans per day per customer with Cust. EMS**	**> 99%**	**< 5s**	**11**	**L**	**M**	**L**	**Intgrt**	**25**	**Customer Frustration, Not system critical**
MR-55		16Ca	Cust. EMS	Smart Meter	Meter reading	Customer EMS shall be able to send on-demand meter reading request to Smart Meter via non Smart Meter ESI	on-demand_Mr-read_cmd	cmd	7AM - 10PM	1-10 trans per day per customer with Cust. EMS	> 99%	< 5s	11	L	M	L	Intgrt	25	Customer Frustration, Not system critical
MR-56		16Ab	Cust. EMS	ESI - non-Smart Meter - Utility	Meter reading	Customer EMS shall be able to send on-demand meter reading request to non Smart Meter ESI	on-demand_Mr-read_cmd	cmd	7AM - 10PM	1-10 trans per day per customer with Cust. EMS	> 98%	< 5s	11	L	M	L	Intgrt	25	Customer Frustration, Not system critical
MR-104		5Bb	ESI - non-Smart Meter - Utility	DAP	Meter reading	ESI - nob-Smart Meter - Utility shall be able to send on-demand meter reading request to DAP	on-demand_Mr-read_cmd	cmd	7AM - 10PM	1-10 trans per day per customer with Cust. EMS	> 98%	< 5s	11	L	M	L	Intgrt	25	Customer Frustration, Not system critical
MR-105		1D	DAP	2-Way Meter	Meter reading	ESI - nob-Smart Meter - Utility shall be able to send on-demand meter reading request to 2Way Meter	on-demand_Mr-read_cmd	cmd	7AM - 10PM	1-10 trans per day per customer with Cust. EMS	> 99%	< 5s	11	L	M	L	Intgrt	25	Customer Frustration, Not system critical
PP-198	**P**	**[(1Aa + 1B) or 1Ab] + [1Ca or (1Cba + 1Cb) or (1Cba + 1Cc)] + 1D**	**CIS/Billing - Utility**	**Smart Meter**	**PrePay**	**CIS - Utility shall be able to send on-demand meter read request to the Smart Meter via the Head-End**	on-demand_Mr-read_cmd	**cmd**	**7AM - 10PM**	**25 trans per 1000 PrePay mtrs per day**	**> 98%**	**< 15s**	**3a, 10a, 10b, 11**	**L**	**M**	**L**	**Intgrt**	**25**	**May need to estimate or manually read, Not system critical**
PP-199		1Aa	CIS/Billing - Utility	MDMS	PrePay	CIS - Utility may be able to send on-demand meter read request to MDMS	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 PrePay mtrs per day	> 99.5%	< 5s	3a	L	M	L	Intgrt	25	May need to estimate or manually read, Not system critical
PP-200		1Ab	CIS/Billing - Utility	AMI Head-End	PrePay	CIS - Utility may be able to send on-demand meter read request to AMI Head-End	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 PrePay mtrs per day	> 99.5%	< 5s	3a	L	M	L	Intgrt	25	May need to estimate or manually read, Not system critical
PP-201		1B	MDMS	AMI Head-End	PrePay	MDMS shall be able to process & forward on-demand meter read request to AMI Head End, as maybe received from CIS	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 PrePay mtrs per day	> 99.5%	< 5s	3a	L	M	L	Intgrt	25	May need to retry, Not system critical
PP-202		1Ca	AMI Head End	DAP	PrePay	Head End shall be able to process & forward on-demand meter read requests to DAP	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 PrePay mtrs per day	> 99%	< 5s	10a, 10b	L	M	L	Native or Intgrt	25	May need to retry, Not system critical
PP-203		1Cba	AMI Head End	Internet / Extranet gateway(s) - Utility	PrePay	Head End shall be able to process & forward on-demand meter read requests as routed through Internet / Extranet gateways(s) - Utility	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 PrePay mtrs per day	> 99.5%	< 5s	10a, 10b	L	M	L	Native or Intgrt	25	May need to retry, Not system critical
PP-204		1Cb	Internet. Extranet gateway(s) - Utility	DAP	PrePay	Internet / Extranet gateway(s) - Utility shall be able to inspect & forward on-demand meter read requests to DAP	on-demand_Mr-read_cmd	cmd	7AM - 10PM	25 trans per 1000 PrePay mtrs per day	> 99%	< 5s	10a, 10b	L	M	L	Native or Intgrt	25	May need to retry, Not system critical

Table 1 – Smart Grid Functional & Volumetric Business Requirements

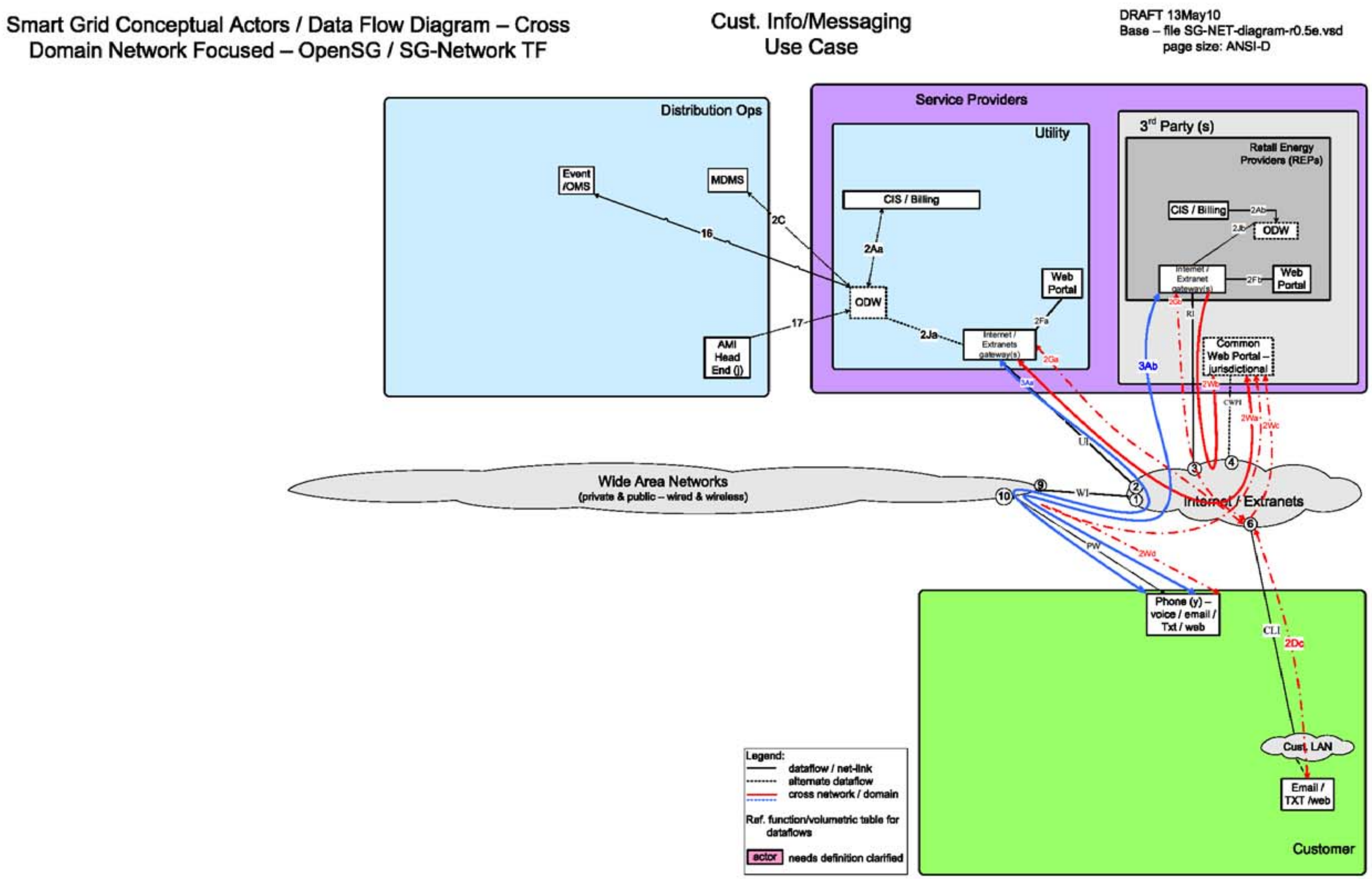


Diagram 3 – Customer Information / Messaging Use Case

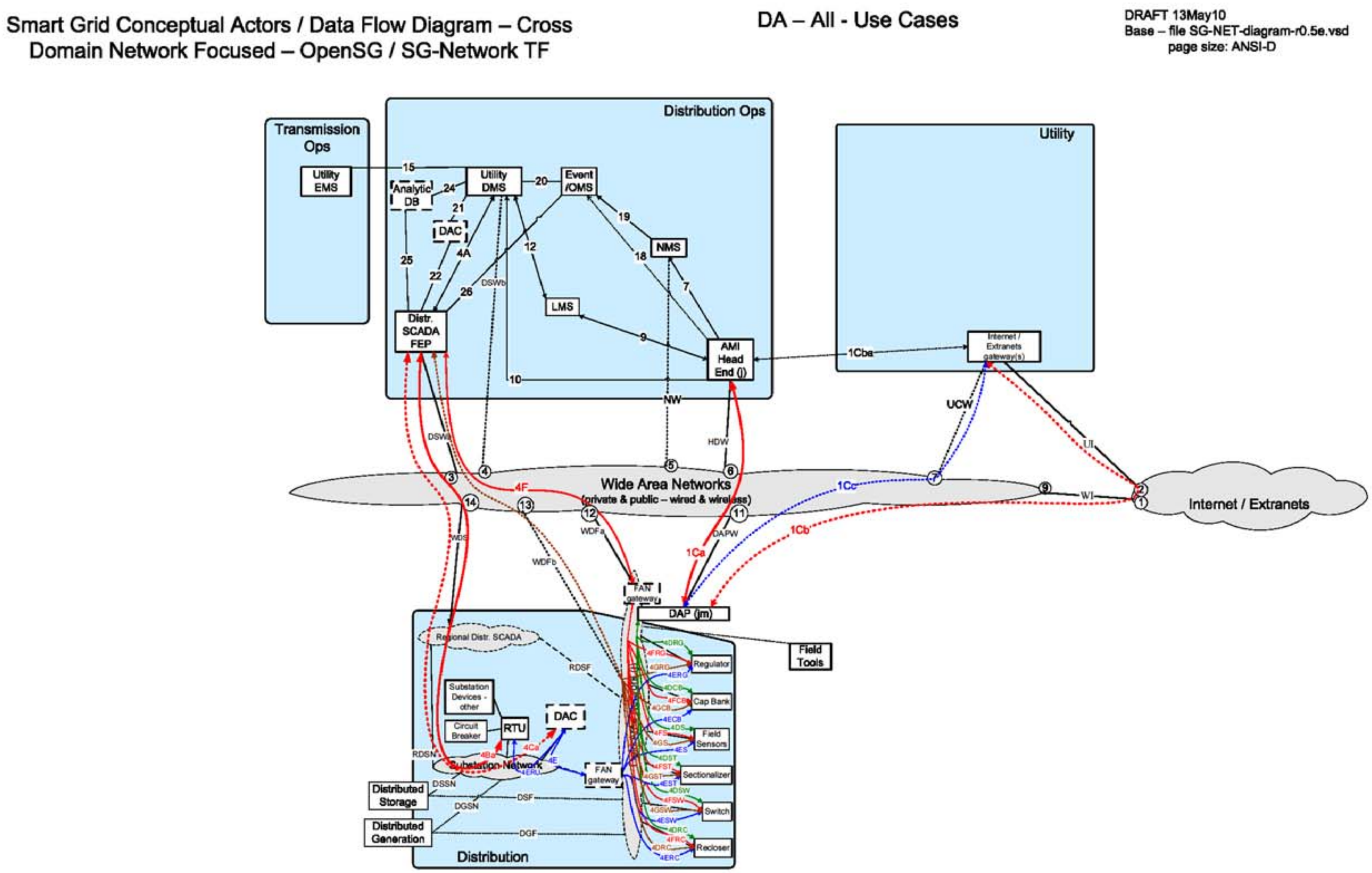


Diagram 4 – Distribution Automation Use Case

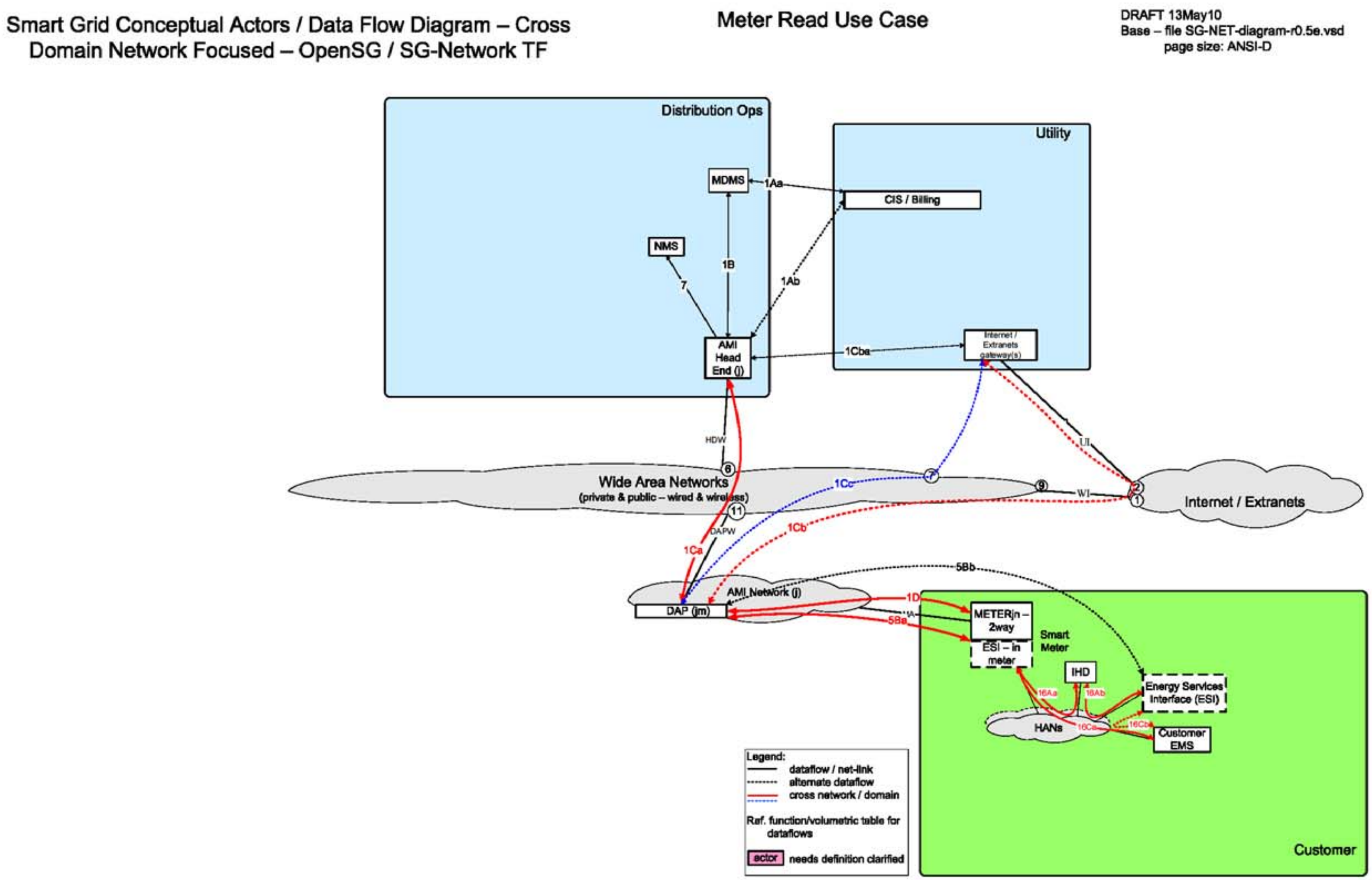


Diagram 5 – Meter Read Use Case

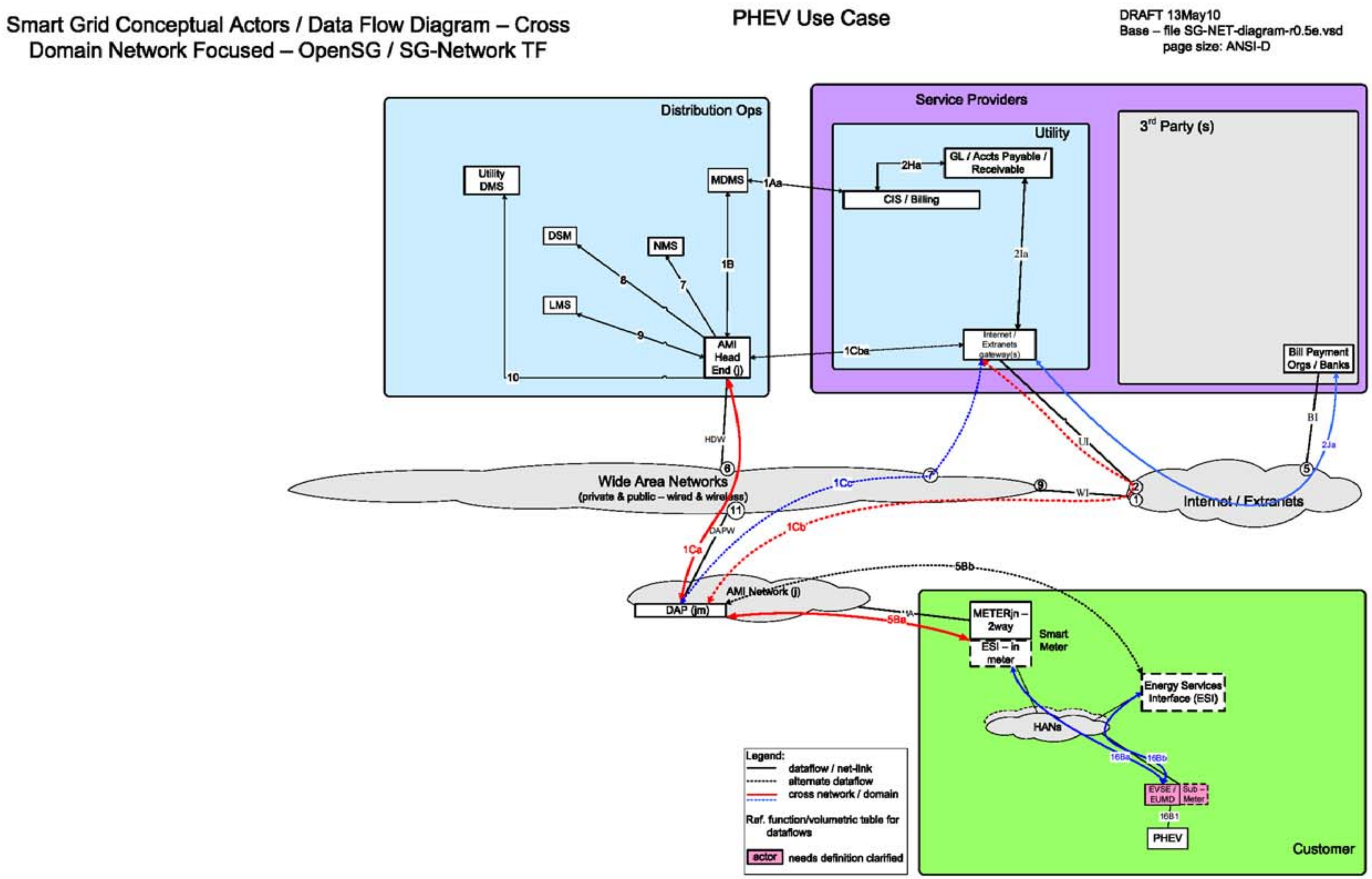


Diagram 6 – PHEV Use Case

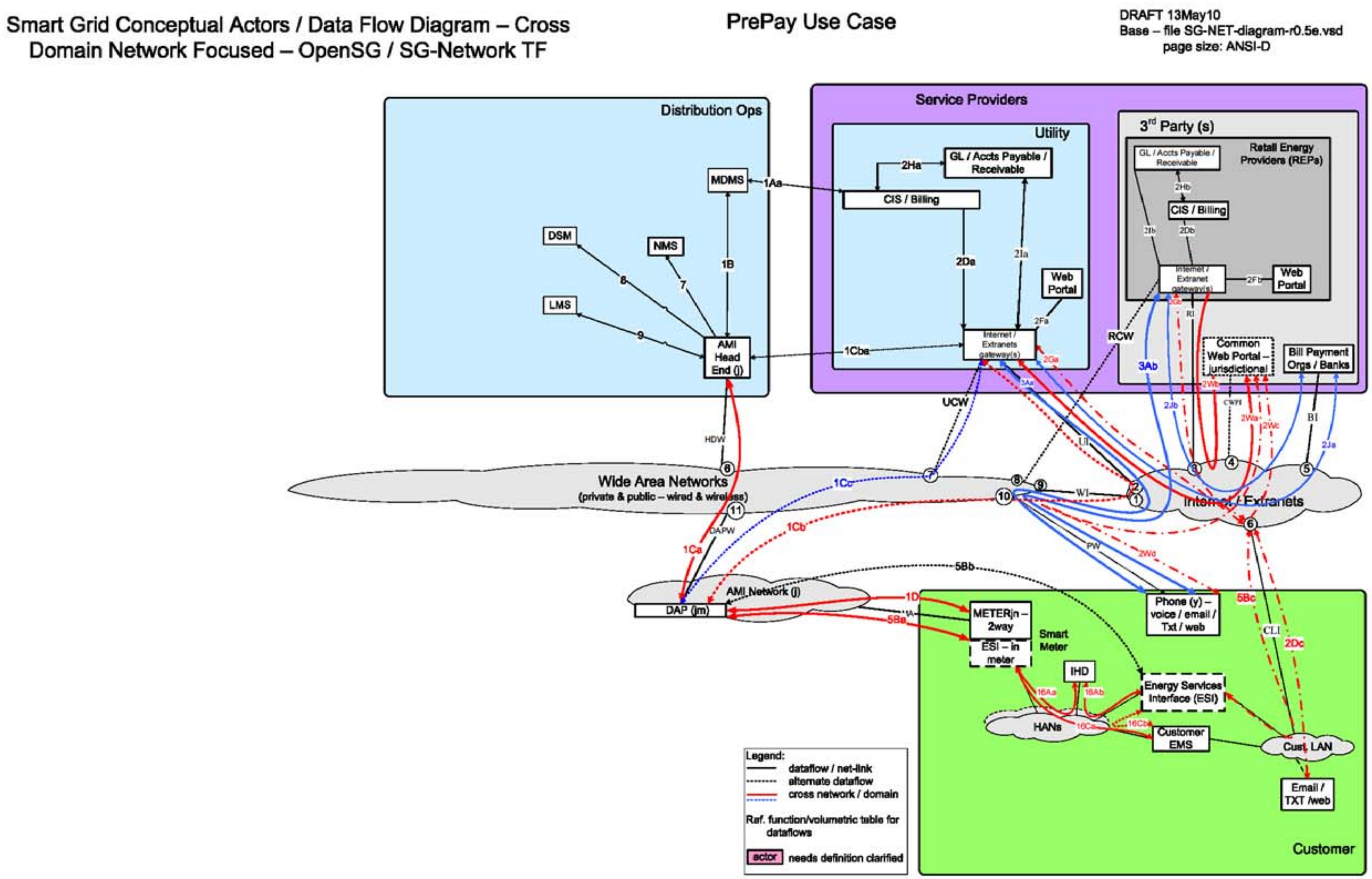


Diagram 7 – PrePay Use Case

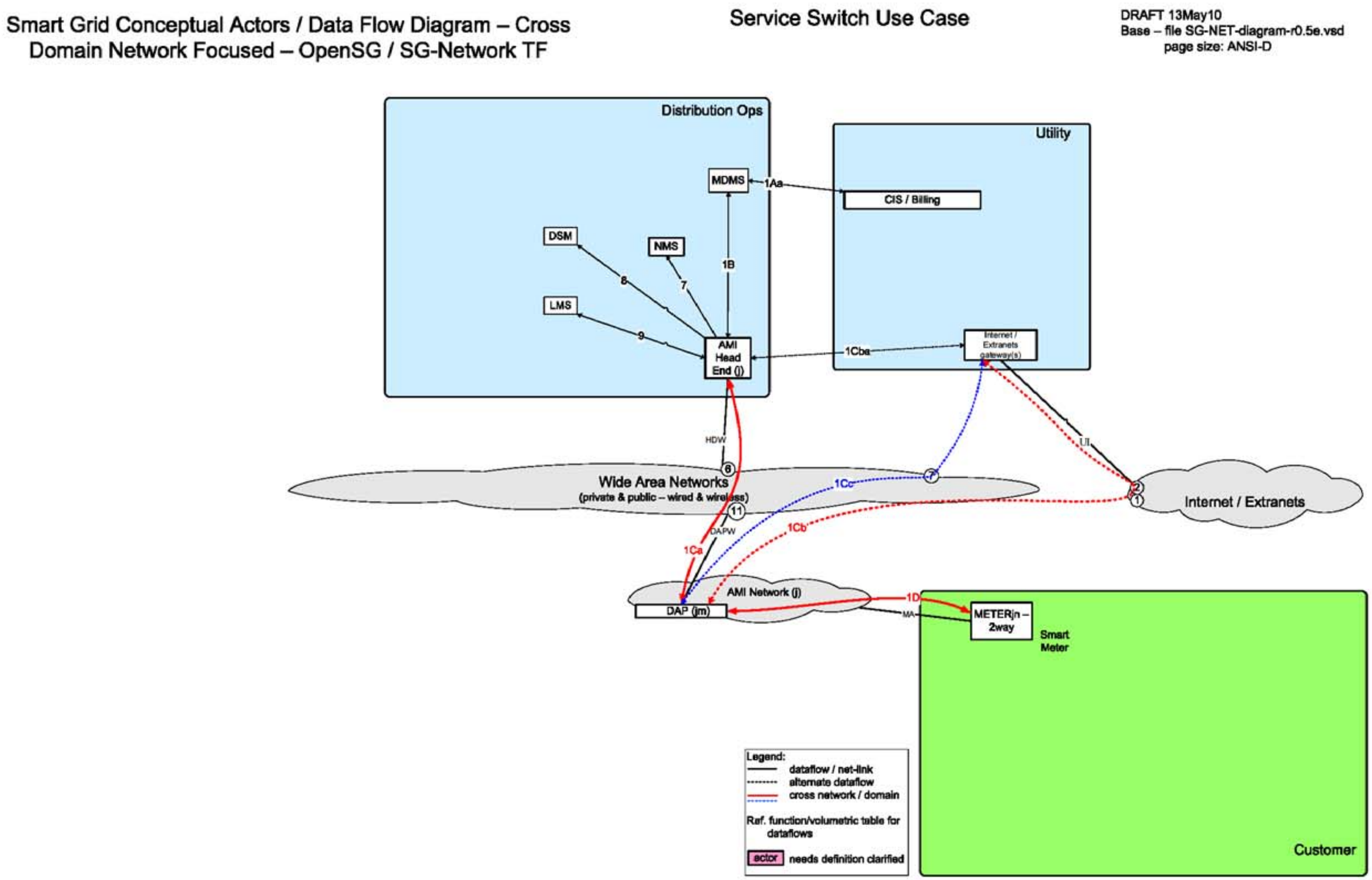
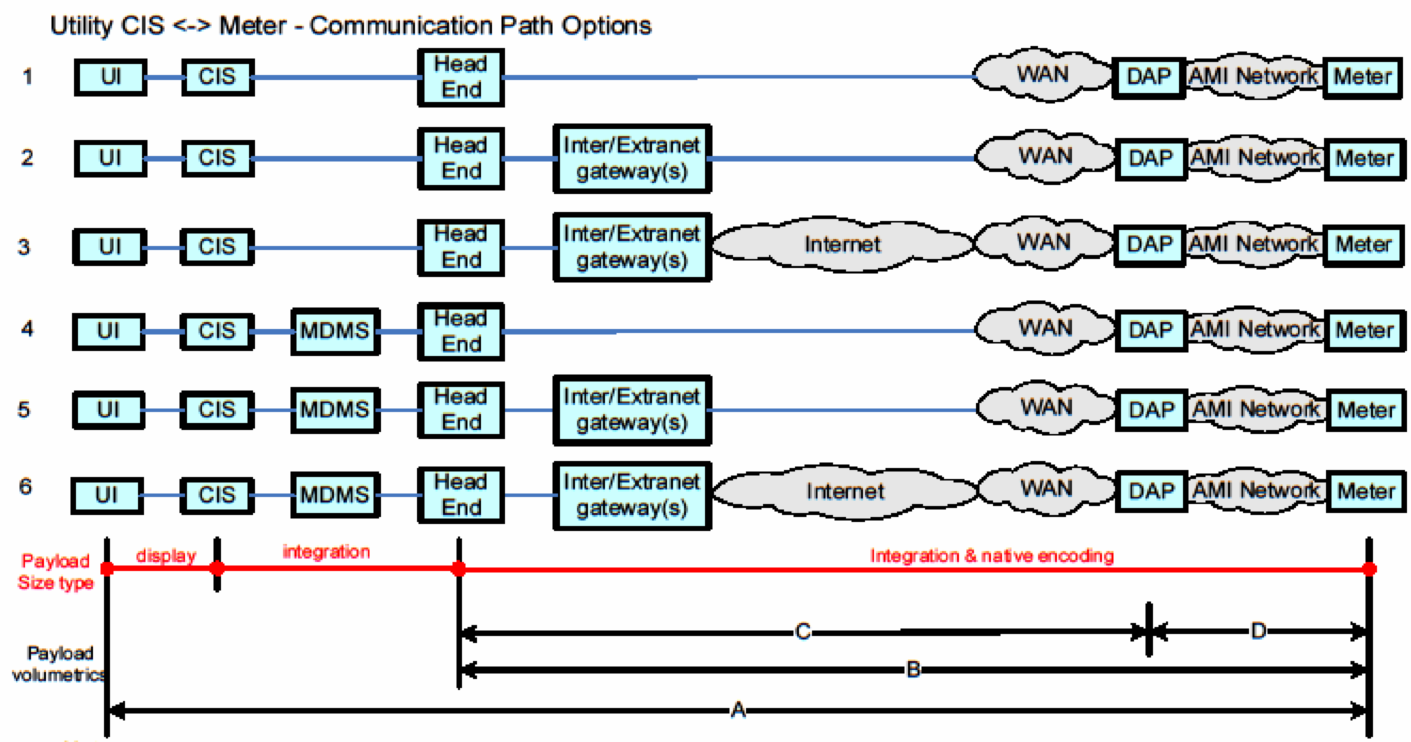


Diagram 8 – Service Switch



Notes:

1) Business volumetric requirements are being documented for the application payloads between specific actors for specific communications paths. Typically it is easier to document these volumetric requirements for the dataflows (ref boundary points above), in the following order: A, C, B or D.
2) Most volumetrics for dataflows for the same payload, MUST NOT be relaxed more than the their parents volumetrics requirements. E.G.: a) the latency for dataflow B, MUST be < A's; b) C + D latency MUST be < B's; HOWEVER, the total amount of payloads per dataflow will diminish as one traverses towards a singular endpoint, e.g. specific payload qtys for CIS & HeadEnd probably will be equal, HeadEnd = sum of DAPs; a specific DAP = sum of meters that the specific DAP has been designed/deployed to handle.
3) For the CIS <-> Meter comm paths, several payloads will concurrently traverse, each with different business volumetric reqmts. E.G.: a) on-demand meter reads, b) meter read of multiple interval data time blocks, c) service switch ops & status, d) demand resets, e) meter last-gasp, f) and this same common path used to pass HAN, prepay, load control, type messages to HAN devices

Diagram 9 – Utility CIS <-> Meter Communication Path Scenarios

Meter Reading Use Case, functional, volumetric requirements – documentation needs

Documenting the various sets of "Meter Reading" use case Comm Path Options, results in the following:
(6) options for CIS <-> Meter (see CIS-Mtr page)
(2) options for IHD <-> Meter (this page)
(2) options for Cust. EMS <-> Meter (this page)

2) Each of the various meter read payloads have different volumetrics across the set of different source and consumer actors. The intent is to document up all of these volumetric requirements (ref notes on "CIS-MTR" page and communicate the dataflows visually.

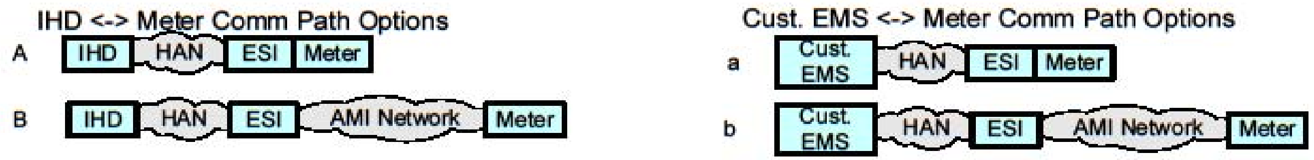


Diagram 10 – IPD & Cust. EMS <-> Meter Communication Path Scenarios

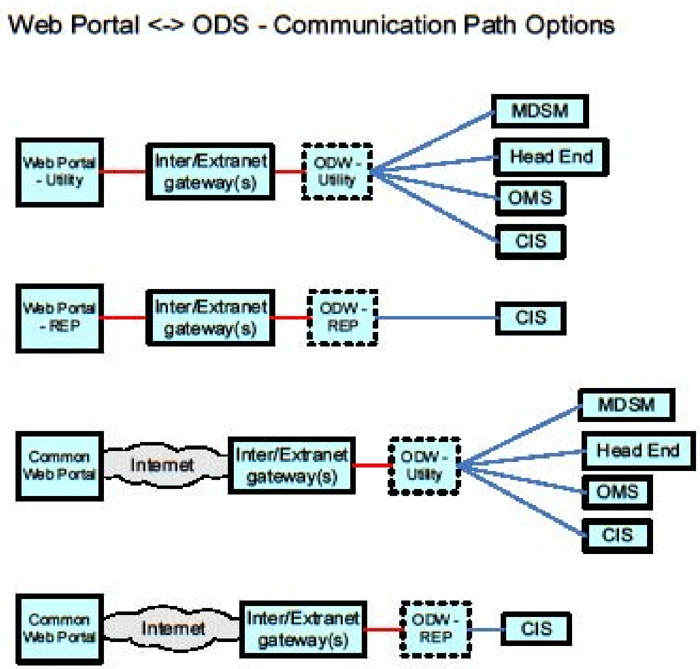


Diagram 11 – Web Portal <-> ODS Communication Path Scenarios

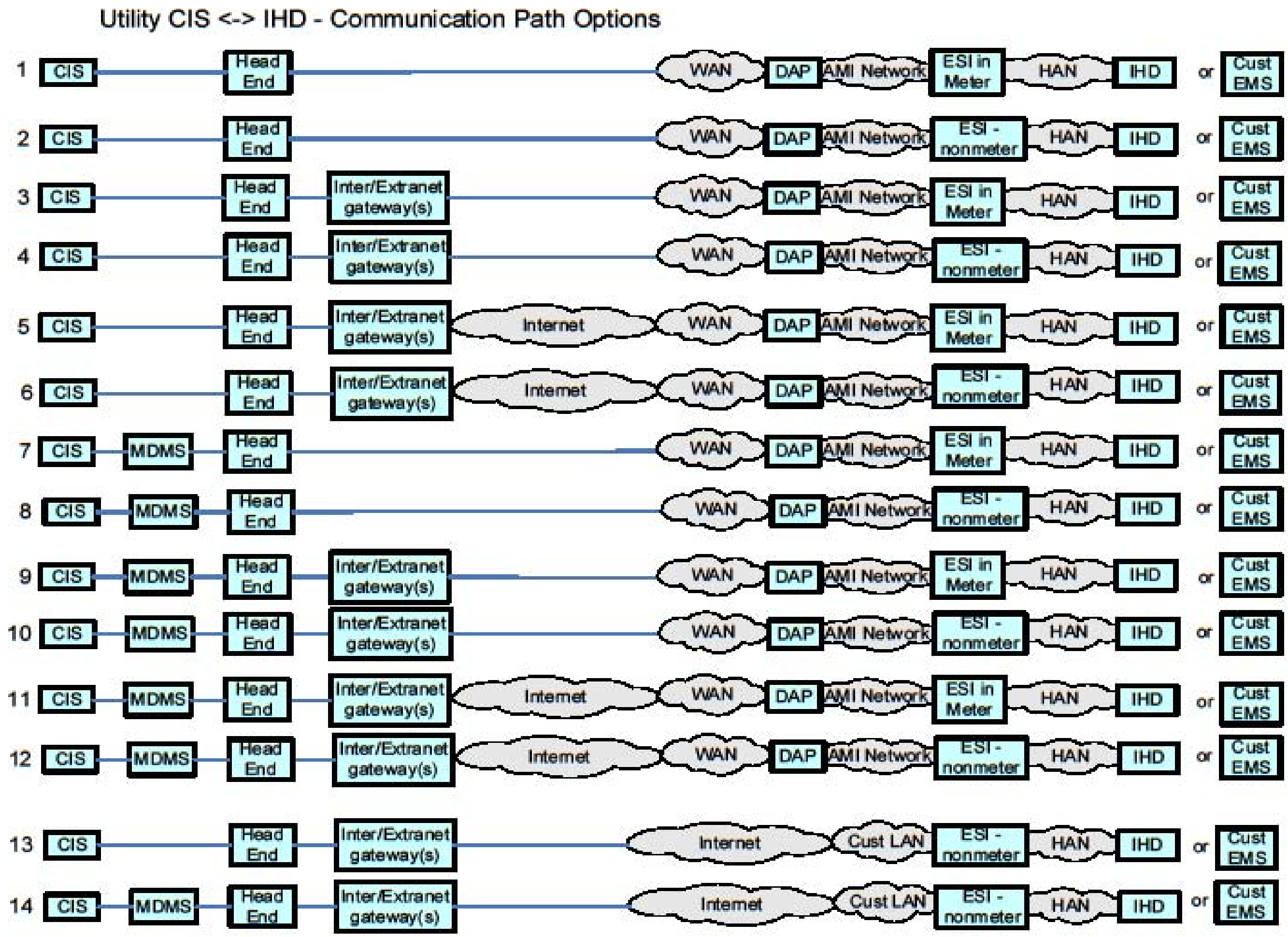


Diagram 12 – Utility CIS <-> IPD Communication Path Scenarios

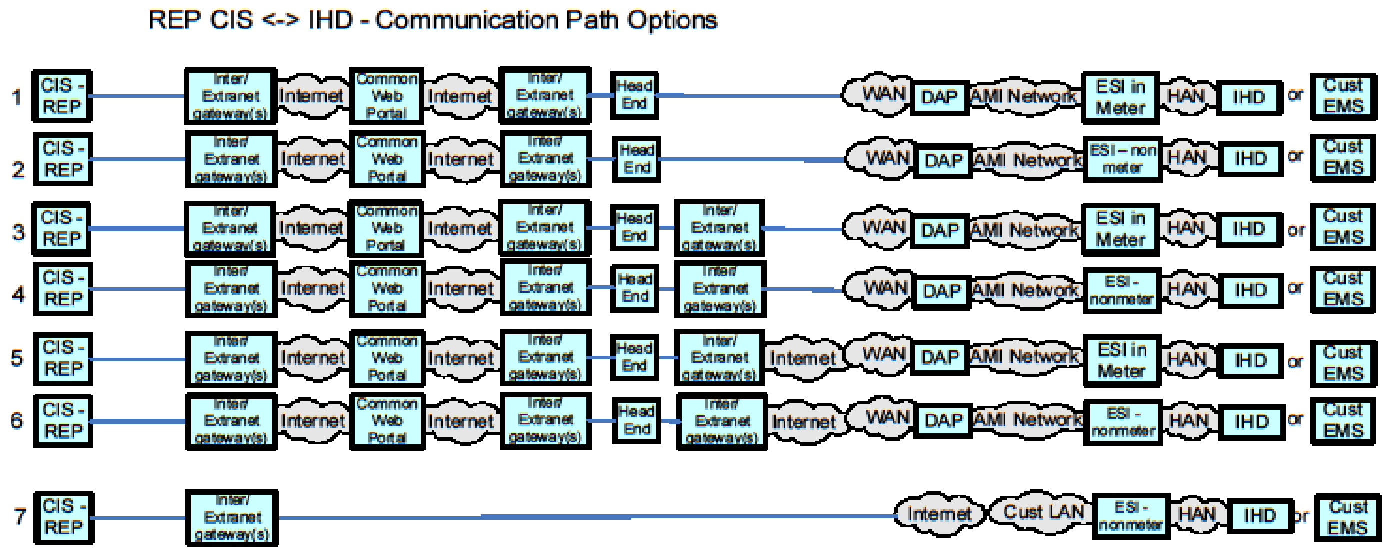


Diagram 13 – REP CIS <-> IPD Communication Path Scenarios

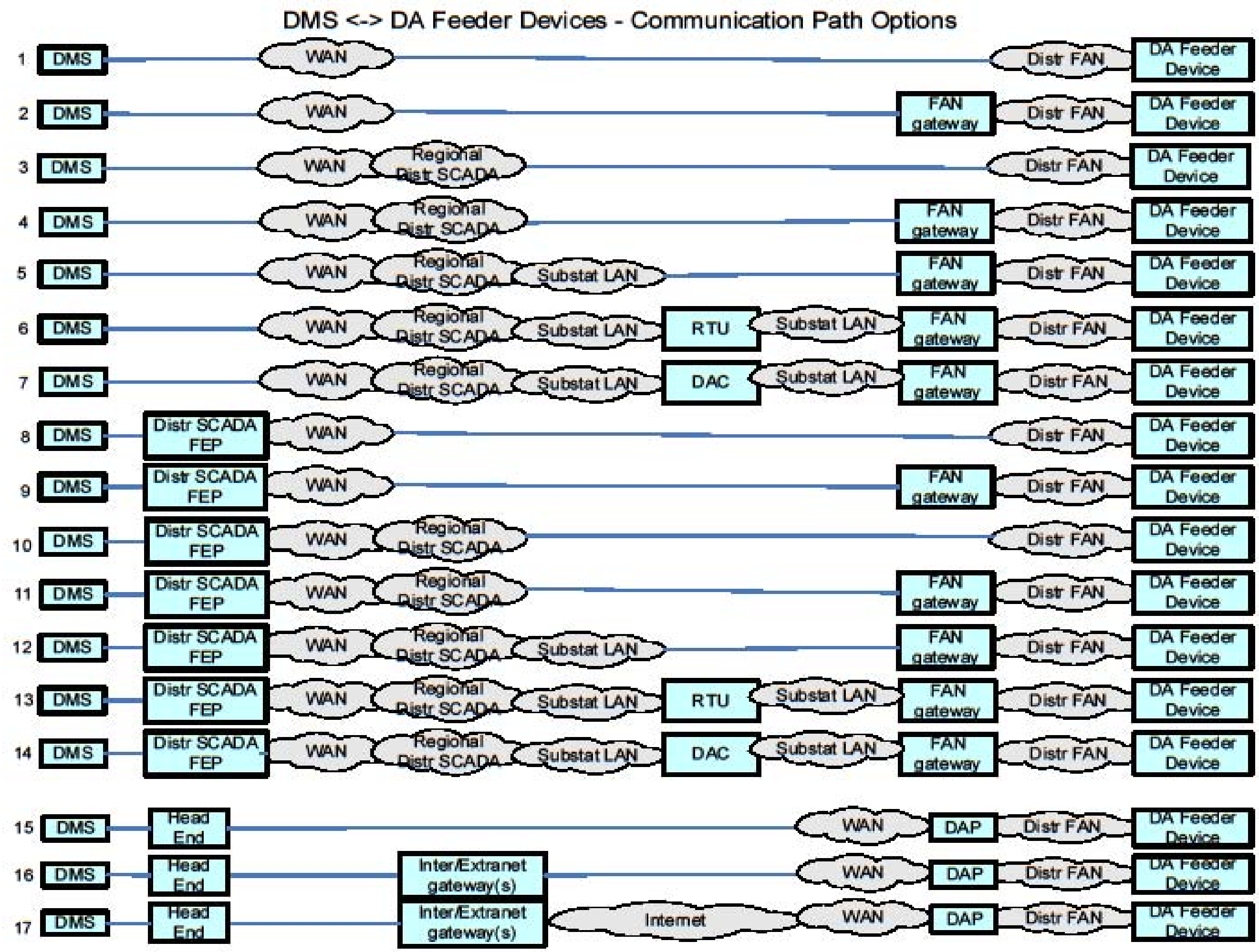


Diagram 14 – DMS <-> DA Feeder Devices Communication Path Scenarios

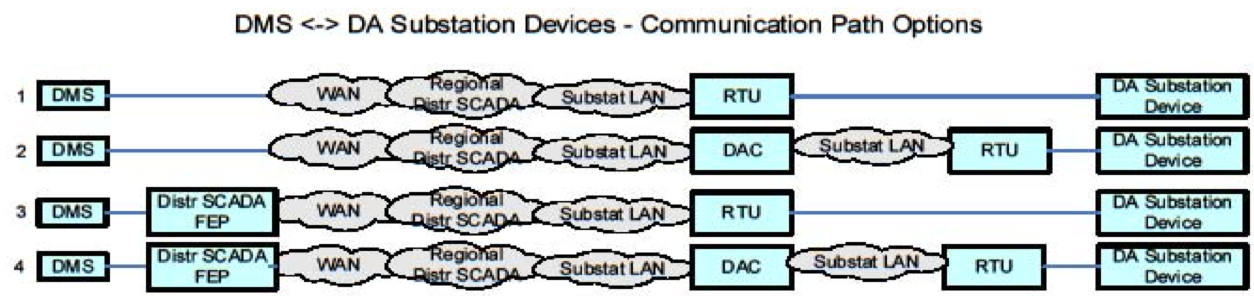


Diagram 15 – DMS <-> DA Substation Devices Communication Path Scenarios