Communications Requirements for Smart Grids and Active Demand

ADDRESS INTERNATIONAL WORKSHOP
ACTIVE DEMAND: THE FUTURE OF ELECTRICITY

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communication

address interactive energy

Official Partner

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Outline

Goals & Methodology
- Survey on Future requirements of Smart Grids
- Architecture Design Methodology

Survey Results
- Key requirements
- Service Oriented Architecture / Web Services

Draft Architecture
- Actor interactions
- Service & Connectivity
- Traffic Matrix

Goals

In the project, the Communications workpackage has the goal of providing

- A guideline to designing a communications architecture that will enable active demand
- A guide to testing that the implemented communications system is sufficient to operate a smart grid with active demand
- Tested prototypes and a design for the field tests

The aim of the first communication activity was to:

"Identify, describe and specify the main requirements on the communication infrastructure – data transmission architecture, and data service requirements – in order to enable active demand"

Methodology

Survey

- Partners and members of the GUS will be surveyed regarding:
  - Status of the current communications system
  - Expected developments
  - Specific Smart Grids requirements

Use Case Analysis

- Based on the Use Cases of Deliverable D1.1, the interactions between actors are analyzed down to the individual links to determine the communications requirements

Survey on future Smart Grids Communications

19 entities answered the survey:

- ABB, Alcatel-Lucent, Consentec, Current Technologies International (CTI), Elektrizitätswerke des Kantons Zürich (EKZ), ENEL Distribuzione, ENEL Produzione, Electric Power Research Institute (EPRI), Ericsson, Iberdrola, Instituto Tecnológico de la Energía (ITE), KEMA, Landis+Gyr, LABEIN Tecnalia, Vattenfall, Vlaamse Instelling voor Technologisch Onderzoek (VITO), VTT and ZIV

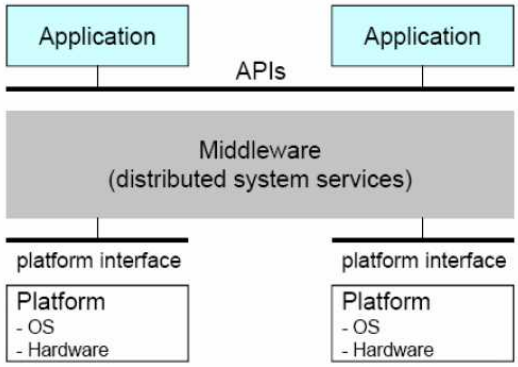
They provided details regarding:

- Interoperability, PHY Media, Scalability, Regulatory Issues, Standardisation, Performance: business / technical, Robustness/availability, Plug & Play, Management, Upgrades, Security, CAPEX & OPEX

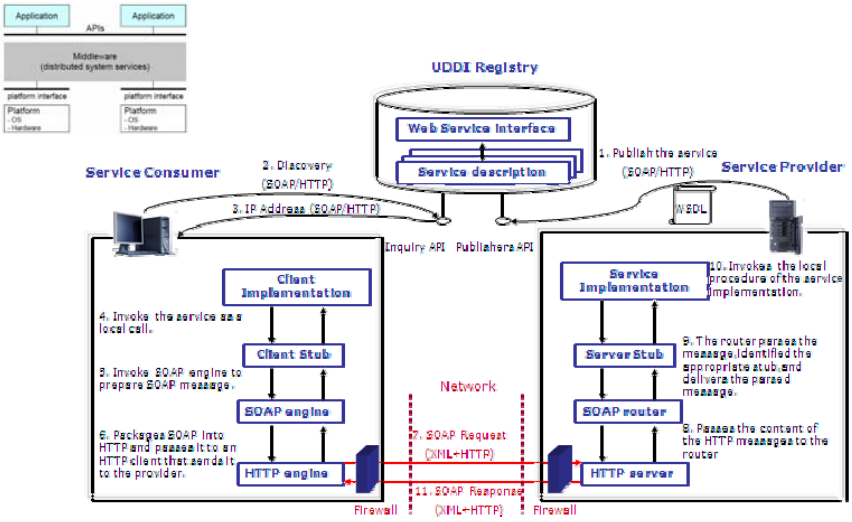
Key Results / Communications Requirements

- Flexibility with respect to physical media
  - Last mile likely to be PLC, wireless, or re-routed via Public TeleCom
- Full interoperability for all network elements
  - To be guaranteed by XML based messaging & CIM standards
- Secure remote access to all elements of the network
- Implementation to be compatible with TCP/IP and Web Services
  - Technical & business performance requirements
- Communication performance should be independent of grid state
- At Aggregator & E-Box level the network should be self-configuring
- Network management: Visualization & remote configuration

Communications Architecture
Basis: Service Oriented Architecture



Communications Architecture
Basis: Service Oriented Architecture & Web Services

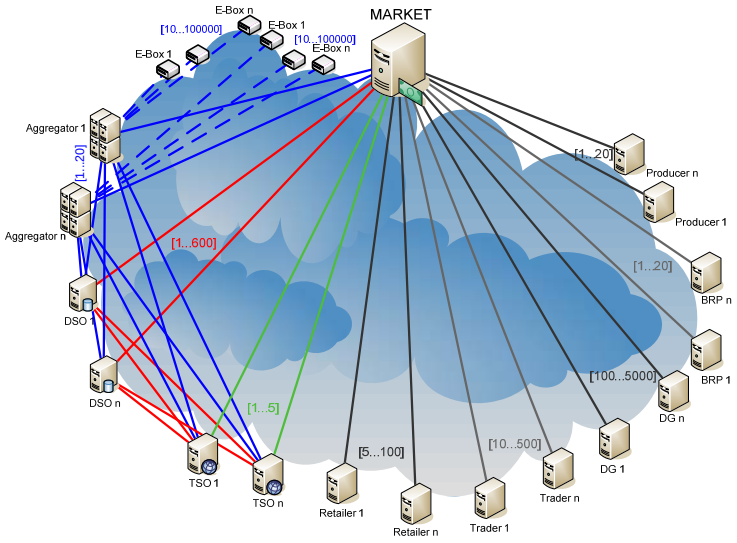


Architecture Design Methodology

Based on the requirements & use cases from D1.1

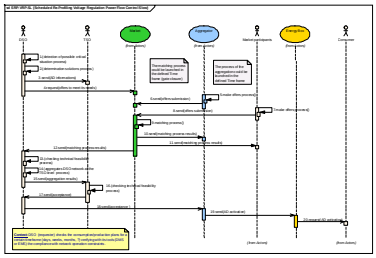
- Step 0: Identify the Logical Communication Entities
- Step 1: Identify the Logical Architecture
  - Analyze the interactions to determine the required Services
  - Determine cardinality, addressing & partitioning
- Step 2: Map Logical to Physical Architecture
  - Consider Geographical Span & Technologies
  - Consider Performance Issues
  - Determine the resulting network
- Step 3: Determine completeness
  - Otherwise iterate Steps 1 & 2

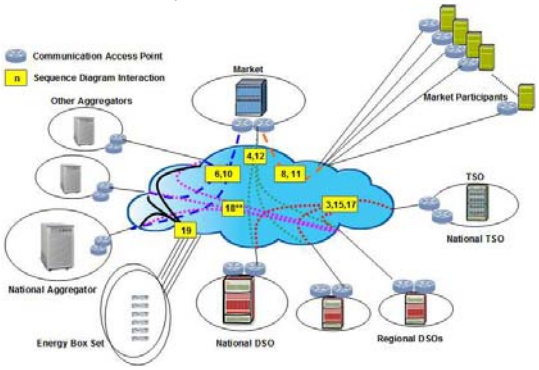
Abstract Communications Architecture



Service and Connectivity

Starting from the service description in (D1.1) and some initial general assumptions concerning the network, draft a generic architecture describing the logical end to end connection needed for the implementation of each specific service.

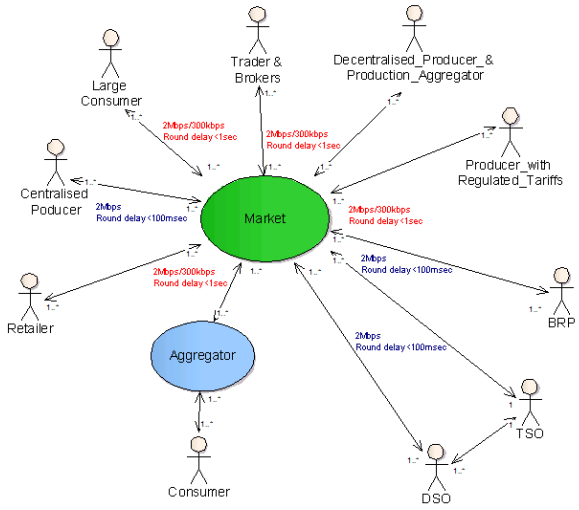




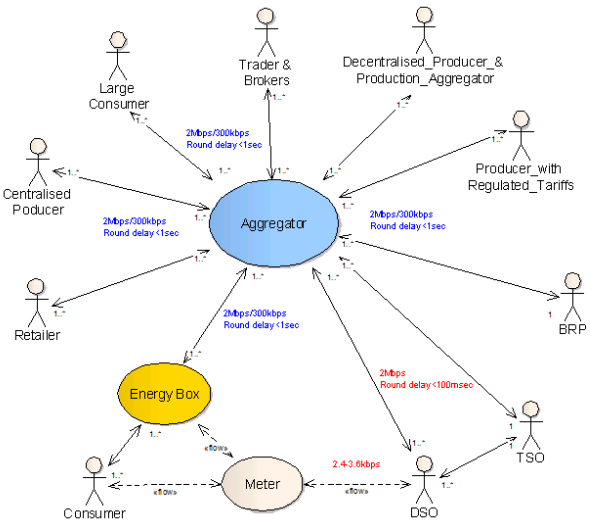
Traffic Matrix

TSOack	**Message Payload Short Description**		
From → To (n:m)	TSO → DSO (1:6)	Note:	
Payload (Application Layer)	Data	Lenght (bit)	Note
	Parameter	256	XML Message Description
	TimeStamp	64	Standard Reference
	Sender ID	32	*Example:*
	Total	**352**	
Traffic	(60;60)	(Frequency Periodicity in second; Max Round Trip Time including channel and Telecommunication Interfaces in seconds)	
Priority	L		Low; High

Performance: business



Performance: technical

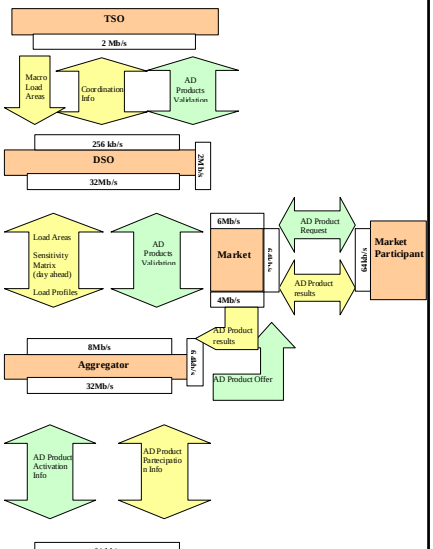


ADDRESS Scenario & Traffic Matrix Sample

Using WEB Services will have big impact on the traffic matrix while assuring the highest level of interoperability

Scenario	
TSO	1-5
DSOs	1-600
Aggregators	1-20
Market Participants	1000-10000
Market	1
E-boxes	100000-1000000

SRP Request	Message Payload Short Description		
From → To (ncm)	Market Participant → Market (1000:1)	Note: Request - from different buyers - for a SRP Product	
Payload (Application Layer)	Data	Lenght (bit)	Note
	Parameter	256	Description
	TimeStamp	64	Standard Reference
	Sender ID	32	Description
	Service ID	32	Description
	Service requested/supplied	16	Status
	Service negotiation gate closure	64	Time Reference
	Minimum volume	64	Power reference
	Requested/supplied power or power curve shape	256	Description
	Price structure	256	Description
	Macro Load Areas or Load Areas involved	256	Description
	Other conditions	256	Description
Traffic	**Total** (Before Market gate closure;60)	... (Frequency Periodicity in second; Max Round Trip Time including channel and Telecommunication Interfaces in seconds)	
Priority	L	Low; High	



Conclusions & next steps

The requirements on the ADDRESS communications infrastructure have been identified by:

- A survey on the needs of the communications infrastructure
- An initial analysis of the use cases

A service oriented architecture based on web services and standardized XML messages forms the basis for ADDRESS communications

The Traffic matrix has been introduced as a tool for estimating & representing the overall performance requirements for a specific scenario

Next steps:

- Communications media will be identified
- Specific solutions will be developed
- The requirements and architecture will be refined
- Communications architectures for the field tests will be developed

THANK YOU

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