



SEESGEN-ICT

4th GENERAL WORKSHOP

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WP7: Supporting Best Practices through Experiences in Test Facilities

**Requirements and classification criteria of Test
Facilities for validation of ICT solutions in Smartgrids**





Objectives

To produce recommendations for policies/actions/strategies to improve the EU testing capacity and trustworthy, related to the experimentation and validation of ICT solutions and best practices needed to support Smart Grid evolution

- To identify the conditions for the best deployment of the existing Test Facilities complementarities, maximizing the synergies and optimizing the quality and completeness of the results***
- To recognize and characterize the gap of the existing TF to the needs***





Compliance and impact

EU initiatives:

- FP7 Research Infrastructures Programme:
 - e.g. DERri Project (www.der-ri.net)
- EERA (European Energy Research Alliance) initiative
<http://setis.ec.europa.eu/initiatives/technology-roadmap/european-energy-research-alliance-eera>
- Other Networking initiatives: e.g. DERlab (www.der-lab.net)
- Demonstration Projects in FP7: e.g. Grid4EU

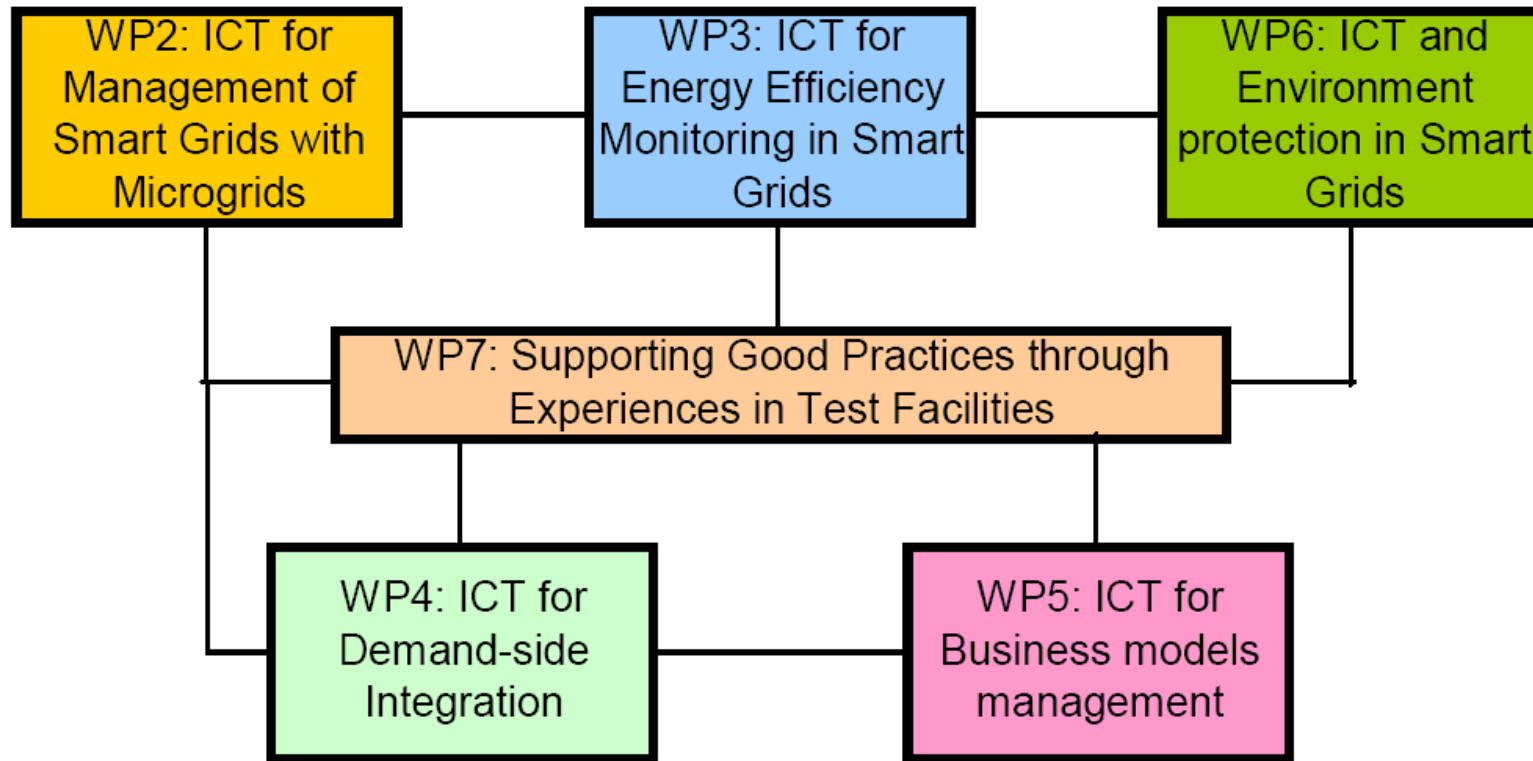
Impact:

- Address investments in Test Facilities
- Improve experimental dotation for research/industry to:
 - Proper validation of ICT solutions/technologies/Best practices
 - Validate Business Models
 - Enable new services in the market
 - Supporting standardization





Requirements to be tested

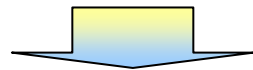




Analysis of Use Cases from WPs

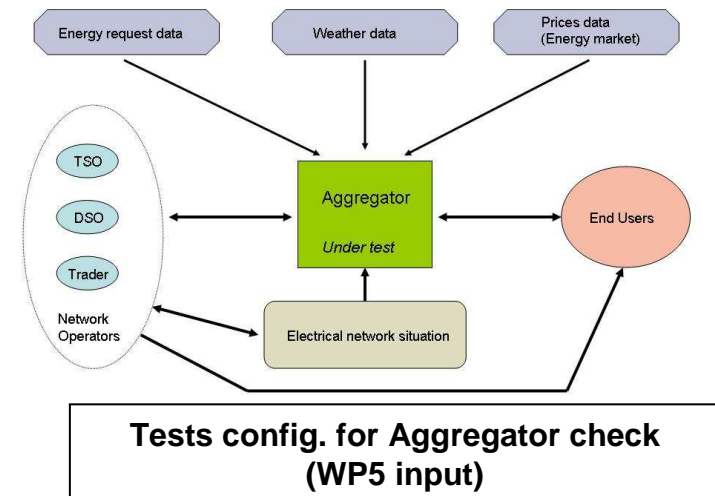
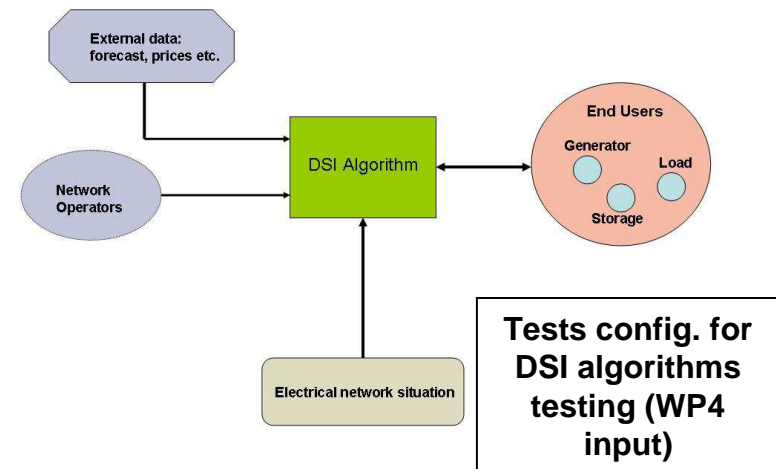
Requirements to be checked (from WPs analysis), e.g.:

- What results to be assessed
- Time horizon to be explored
- Scalability constraints
- Interfaces to be represented
- Interactions to be reproduced
- Technologies to be considered



Needed Test Facilities Features, e.g.:

- Simulated environment
- Real experimental needs
- Physical technologies to be included





Test Facilities classification

- A limited number of Test Facilities, ideally equipped, can carry out any verification
- A first result of WP7 has been the identification and description of these TFs, taking into account the state-of-the-art and best practises
- Obviously, not all the capabilities are implemented in each Test Facility, then the classification is important as a mean able to recognize the range covered and the gaps between requirements and real possibilities



Real and simulated aspects (1)

- **A distinction:**
 - **Test Range**, employing physical equipments normally deployed in the electrical infrastructure (generators, storage devices, loads, etc.), at prototypical or commercial stage, normally including hardware and software
 - **Simulation environment**, a software capability able to implement physical components models and therefore simulate their (steady-state or dynamic) behaviour.
- In some situation, both aspects are present in the same Test Facility (a part is realized with real devices and another part with simulation tools), or, sometimes, in the same device



Real and simulated aspects (2)

- The two approaches are often quite complementary:
 - Test Range is the only option when it is required to verify response times, not due interactions, troubles and noises, that is all the phenomena strictly related to real interconnections and not completely predictable;
 - Simulation environment is essential to simulate a great number of interconnections and elements, unfeasible in a Test Range, or to explore a large number of different working conditions.



Best Practices and Policies

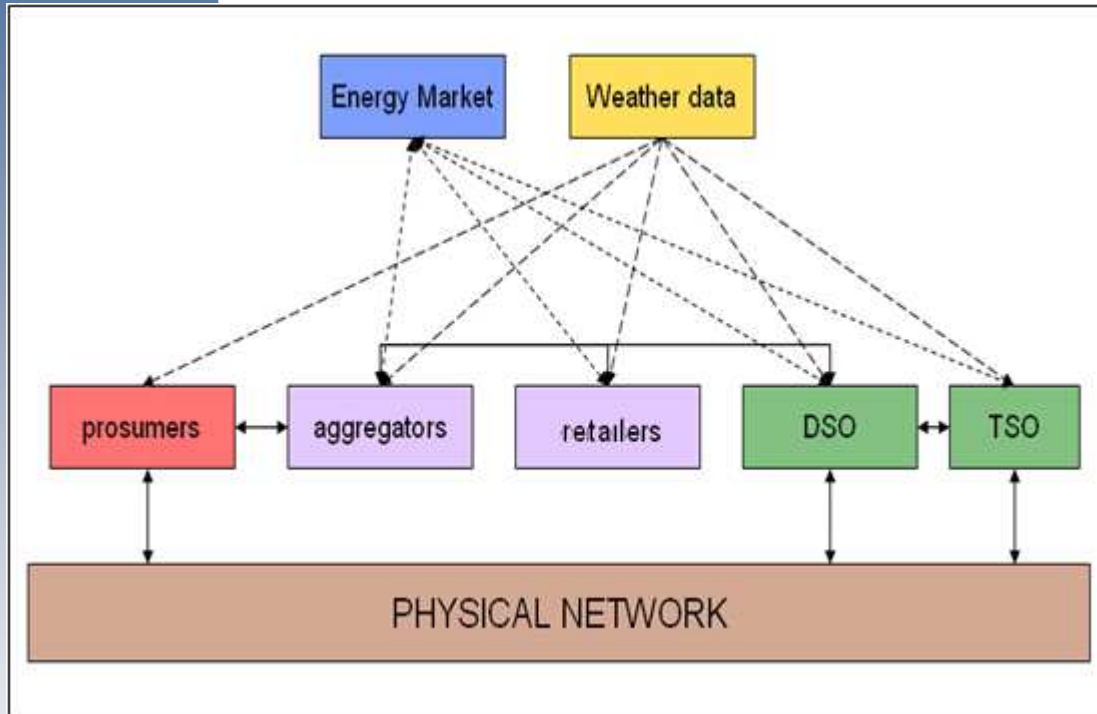
- Different layers, in order to separate the problems to be checked
- Accurate definition of the limits due to the hardware configuration of the Test Facility
- Accurate definition of the limits due to the software simulation aspects
- Environmental conditions
- Scalability
- Repeatability and Reproducibility
- Archiving and Logging
- Quality assurance



The different types of TFs

- Simulation Environment
- Test Range
- Performance Benchmark

Simulation environment

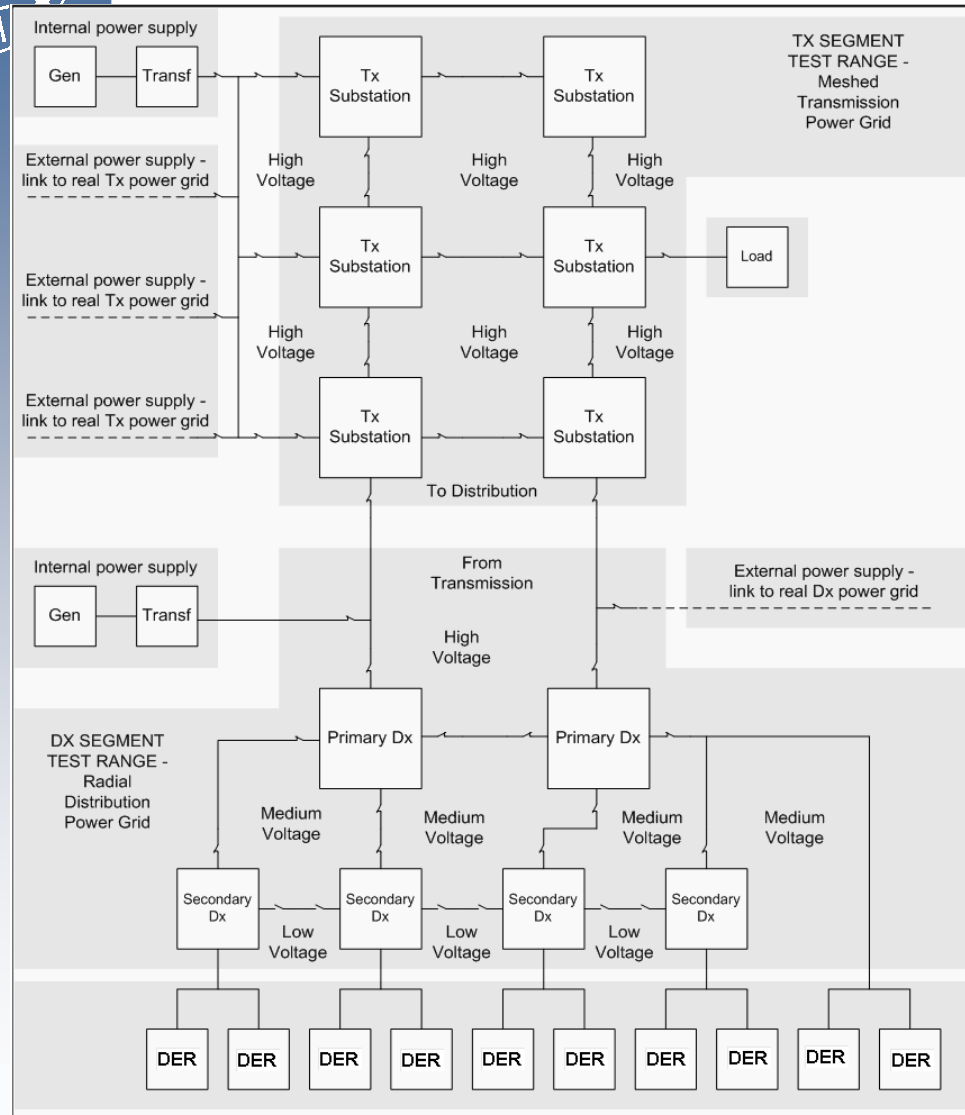


- the physical network, simulated or emulated
- the players: prosumers, aggregators, retailers, DSO and TSO
- the external world: energy market and weather data

SE -- Simulation Environment		
LAYER	ID	ASSET
Physical network	SE_1	Simulation of electrical power system / network
	SE_2	Real Time power system simulators
	SE_3	Change simulation topologies
	SE_4	Interface commercial power simulators
	SE_5	Controllable load and generators
Players	SE_6	Simulate prosumers (single entity)
	SE_7	Simulate prosumers (aggregated entity)
	SE_8	Metering services
	SE_9	Business logic (profile clustering, algorithms, SLAs, etc.)
	SE_10	SCADA
	SE_11	EMS - Energy Management Systems
	SE_12	State Estimator
	SE_13	Business Management Systems
	SE_14	Human Machine Interface
	SE_15	Communication infrastructure protocols
	SE_16	Administrative data (as for billing)
External world	SE_17	Energy market module
	SE_18	Real Energy market data for simulation
	SE_19	Weather module
Logging and results	SE_20	Real weather data for simulation
	SE_21	Logging feature of performance and results
	SE_22	Logging interfaces physical and market layer
	SE_23	Logging of messages and numerical simulation data
	SE_24	Metrics extraction from (database stored) logging data

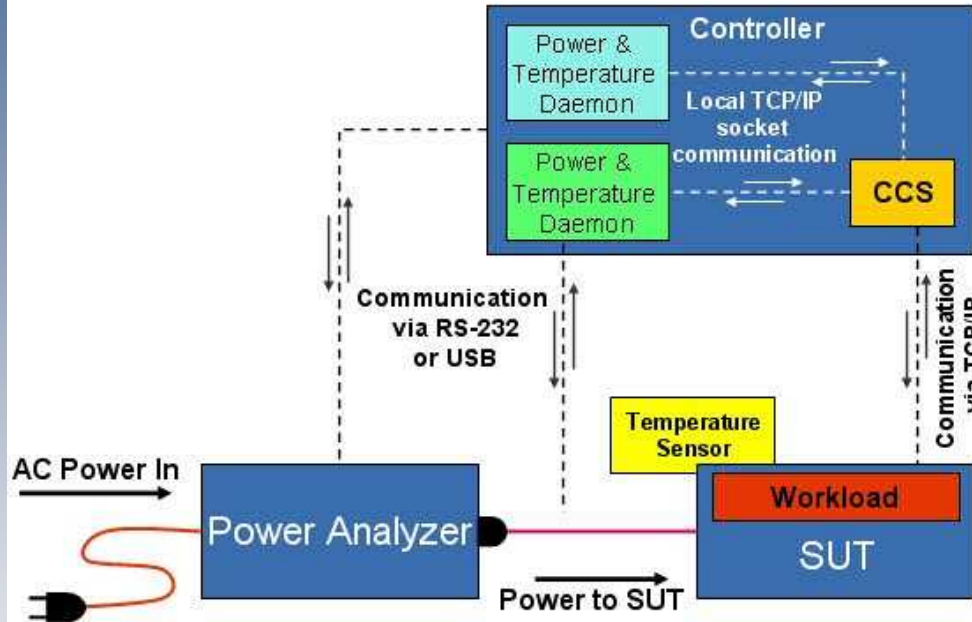


Test range



TR – Test Range		
LAYER	ID	ASSET
Power layer	TR_1	Real electrical power system / network
	TR_2	Generators / power plants
	TR_3	Electrical energy storage systems
	TR_4	Flexible connection and configuration
	TR_5	Electrical measurements and safe switchgear
	TR_6	Controllable Load (consumers)
	TR_7	Transmission network / High voltage
	TR_8	Double switches for isolation of feeders / networks
	TR_9	Distribution with radial power grid
	TR_10	Transmission lines
	TR_11	Independent power supply from external / high voltage
	TR_12	Primary distribution substation / medium voltage
	TR_13	Secondary distribution substation / low voltage
	TR_14	Controllable power loads
	TR_15	Full configurability of grid topology / medium voltage
	TR_16	Full configurability of grid topology / low voltage
Communication/monitoring layer	TR_17	Electrical measurement equipments and SCADA
	TR_18	Data archive
	TR_19	Communication system technologies

Performance Benchmark



Benchmark for assessing IT equipment performances:

- the System Under Test (SUT), a PC or any programmable HW
- a Controller, to change and monitor the workload of the system
- a power measurement device
- environmental sensors, to monitor the working conditions

PB – Performance Benchmark		
LAYER	ID	ASSET
Workload controller	PB_1	External or internal performance benchmark controller
	PB_2	Start and stop sequence / phase of benchmark
	PB_3	Control workload demands
	PB_4	Start and stop collection of power data
	PB_5	Store log files / information
	PB_6	Convert and validate data
	PB_7	Environmental data and throughput performance info
	PB_8	Maximum workload record
	PB_9	Benchmark intermediate workload curves
	PB_10	Minimum workload record (idle)
	PB_11	Variability in performance workload
Power Environmental measurements	PB_12	External measurement of power usage
	PB_13	Power related information
	PB_14	Start and stop power measurement meter
	PB_15	Automatically upload power meas results
	PB_16	Power analyzer
	PB_17	Average power characteristics (once per second)
	PB_18	Temperature / environment measurement device



Further steps

- On the basis of the proposed classification → a first directory of the main TFs in Europe
- Singling out the main gaps in Europe
- Recommendations to eliminate the gaps