SEESGEN-ICT

4° GENERAL WORKSHOP

Paris - SAP Office, April 14th – 15th 2011

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ICT Requirements, solutions and needs for the priority applications

ICT and Intra-grid management

- **Introduction**
- **Functionalities of DG**
- **Characteristics of communication**
- **ICT requirements**
  - Voltage control
  - Adaptive protection
  - reconfiguration

Need for ICT to manage DER/DG

- **DG** brings **operational challenges**:
  - volatility
  - voltage rise
  - power quality
  - protection
  - stability
- Need for **secure**, **reliable** and **economical** operation:
  - Centralized vs. decentralized approach for control and coordination of DERs
  - Bidirectional communication

Functionalities of DG/DER

DG benefits and problems:

- Local generation → surplus
- peak power, peak shaving
- (Anti-) islanding
- Volt/Var (reactive power management)
- Network stability
- Fault behaviour
- Security of supply
- Energy

Communication characteristics

Features of a communication connection

- Data transfer rate / data volume
- Response time latency
- Application priority
- Reliablity
- Availability
- Security (and privacy)

General ICT requirements

ICT Requirements based on the function assigned to units DG
(✓✓ High, ✓ Medium, × Low)

	Transfer rate	Latency	Priority	Reliability	Availability
Inject energy surplus into the grid	×	×	×	×	×
Produce maximum power	×	×	×	×	×
Peak shaving (generation curtailment)	✓	✓✓	✓	✓	✓
Anti-islanding	×	✓✓	✓✓	✓✓	✓✓
Voltage and reactive power regulation	✓	✓	✓✓	✓	✓
Support island operation	✓	✓✓	✓✓	✓✓	✓✓
Ensure correct operation of power system	✓	✓✓	✓✓	✓✓	✓✓

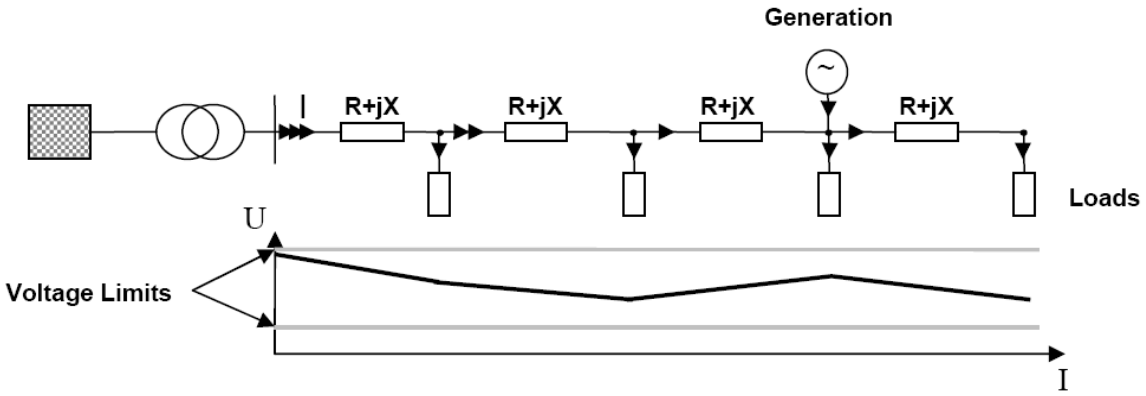
General ICT requirements

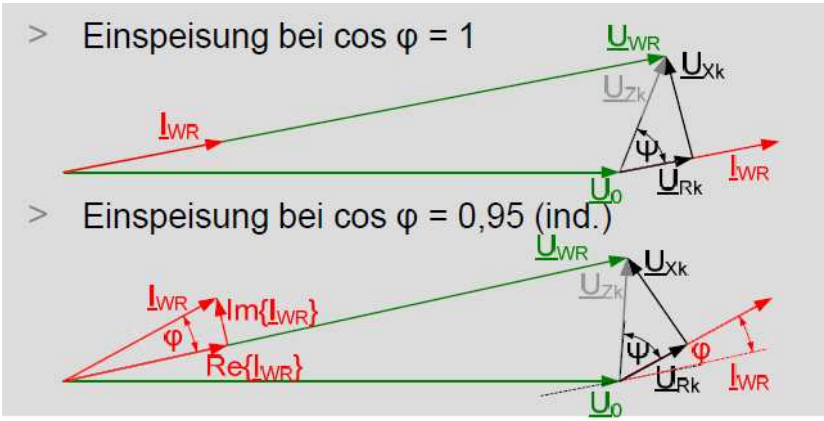
Data delivery time required

Information Types	Internal to Substation	External to Substation
Protection information, high speed	¼ cycle	8-12 ms
Monitoring and control information, medium speed	16 ms	1 s
Operations and maintenance, low speed	1 s	10 s
Text strings	2 s	10 s
Processed data files	10 s	30 s
Program files	60 s	10 min
Image files	10 s	60 s
Audio and video data streams	1 s	1 s

Voltage control

- Keep voltage between limits





Voltage control (2)

(1) Control with **on load tap change** transformers due to the **voltage of the transformer station**

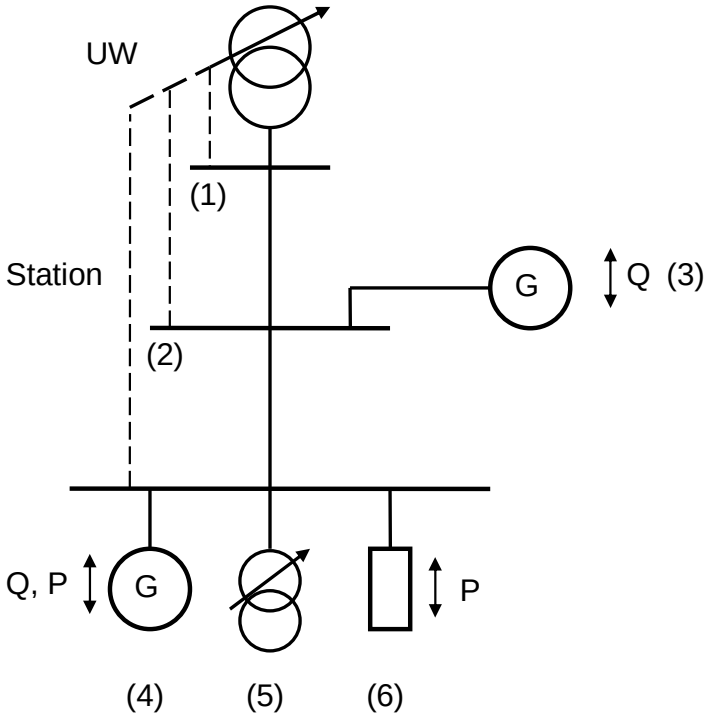
(2) Control with **on load tap change** transformers due to the **metered value** of critical nodes

(3) Local voltage control at critical nodes with **reactive power control** at generation units

(4) Local voltage regulation at critical hubs with **active power** at **generators**

(5) Readjustment with **adjustable transformers** (MV/MV)

(6) Local voltage control at critical nodes with **load management**



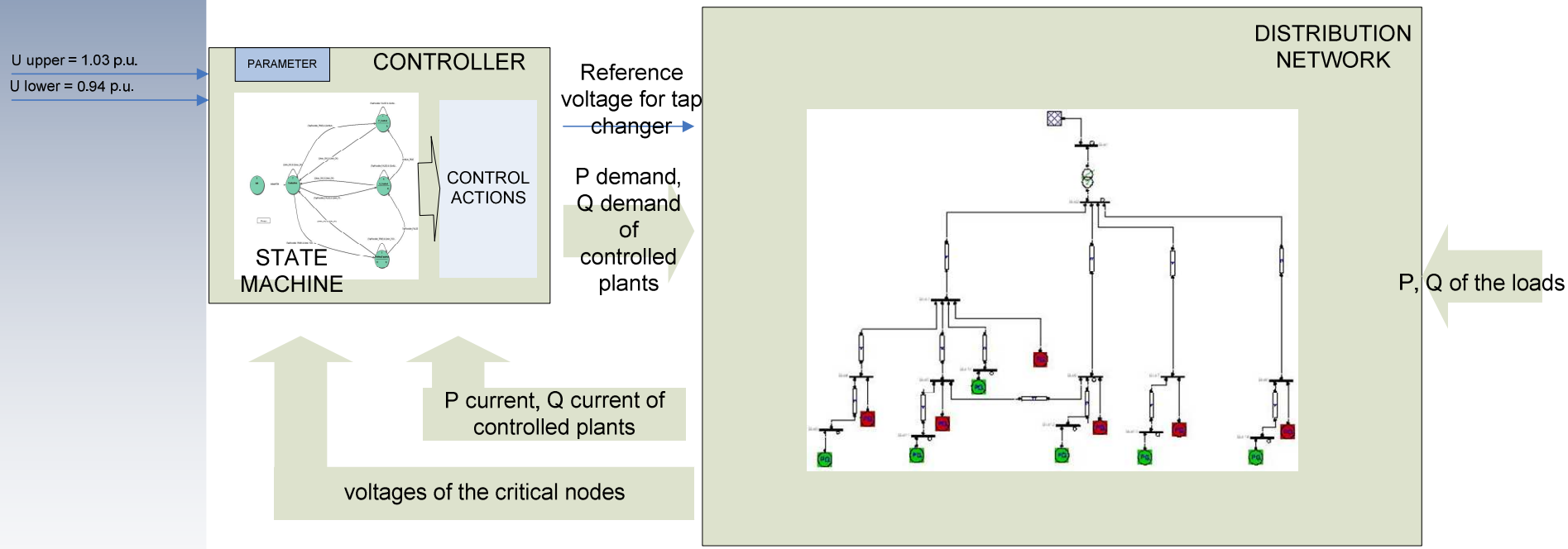
Voltage control (3)

General communication options for voltage regulation in the MV grid

Option	Advantage	Disadvantages
Modem dial-up / dedicated line	easy to install medium costs	not always available (or expensive) long time for dial-up external provider
GSM/UMTS	highly available (continuous connection) easy to install low costs	not 100% reliable external provider security problem due to internet tunneling
Distribution line carrier (DLC)	belongs to DSO medium costs	problem of attenuation due to high number of stations in the communication channel problem of radiation (if high bandwidth)
Radio link	easy to install belongs to the DSO medium costs	limited range dependence of topographical conditions wave band has to be licensed
Glass fiber	very high availability high bandwidth low latency belongs to DSO	high installation efforts high costs

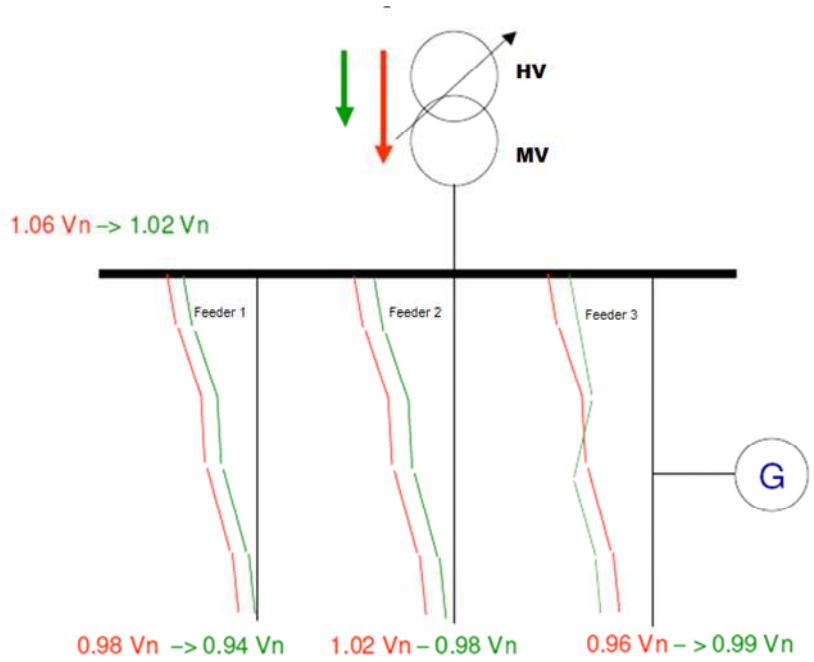
Voltage control (4)

- **DG DemoNet**



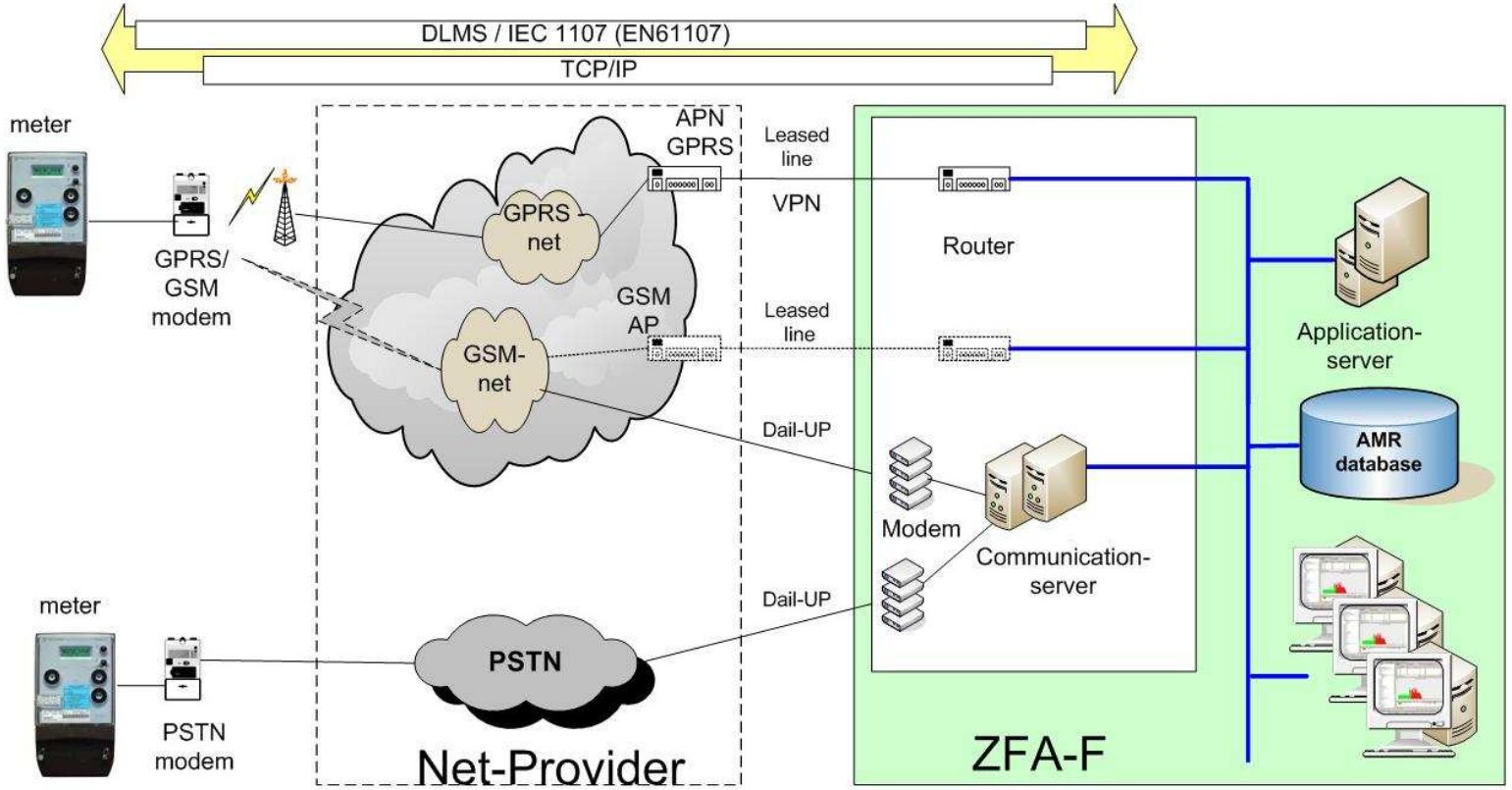
Voltage control (5)

- **ENEL** experience
  - Voltage control at the tap changer (MV bus bar)
  - No communication with the DG
- Future voltage control
  - Control single nodes
  - Communicaton
    - highly reliable
    - secure
    - real time



Voltage control (6)

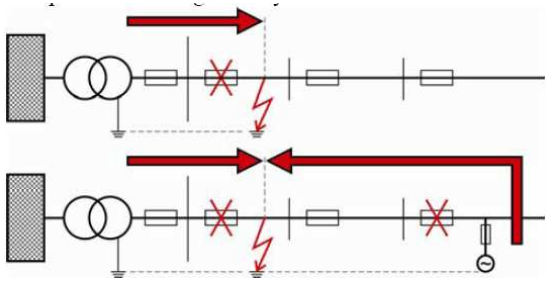
AMR and Energy data management system for MV customers (Larissa Project – PPC)



Adaptive protection

- Directional overcurrent relaying commonly used

- Need arises because:
  - Guards against „heavy loading“
  - Responds to failure events
  - Prevent emergency situations

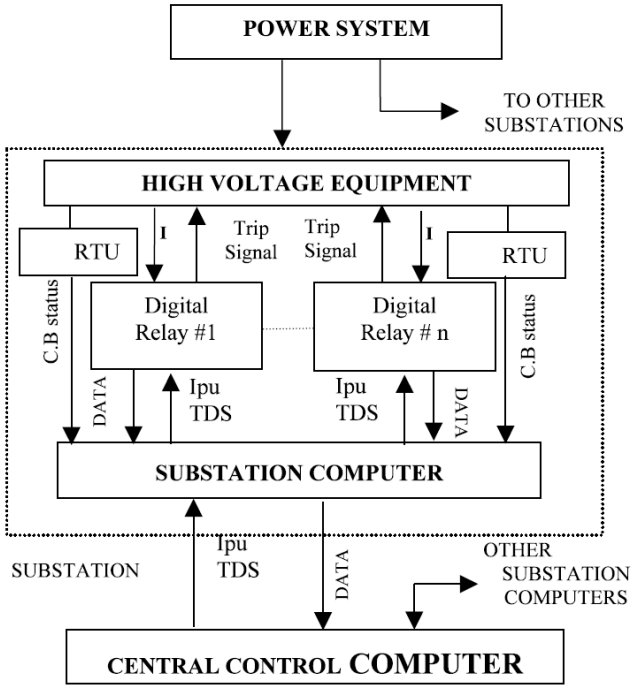


- Difficulties in **relay coordination** in multi-loop and multi-source networks

→ **change characteristics** of the relays adaptively

Adaptive protection (2)

- Strong requirements on ICT
- **Integral** project:
  - Fault distance computation with FIs results for fault location
  - Determine degree of fault state



Reconfiguration

- **Change topology** of the network
  - Optimize power flow and losses, minimize stress on assets (pro-actively)
  - Safe operations (re-actively)

- Restore supply:
  - manually, remotely, automated

→ Real time measurements and fault alarms required
  - Circuit and switchgear information
  - Fault information
  - Protection settings

Conclusion

- Suitable communication required
  - Bidirectional, fast, reliable, secure, economical
- Voltage control needs beside communication controllable DG units, OLTC and a (central) controller
- AMR based on wireless hotspots in MV is fast and flexible enough to enable intra-grid load management
- Protection and reconfiguration require
  - high number of monitoring, time synchronization, efficient processing

THANKS to the WP2 Team !!!

- **Geert Deconinck** (KUL)
- **Parvathy Chittur Ramaswamy** (KUL)
- Jianzhong Wu (CU)
- Jerzy S. Zielinski (UL)
- Rune Gustavsson (BTH)
- Marina Lombardi (ENEL)
- Fritz Schwarzlaender (SAP)
- Sotirios Hadjimichael (PPC)
- Matthias Stifter (AIT)
- Jochen Koszescha (ECPE)
- Giorgio Franchioni (ERSE)
- Maher Chebbo (SAP)