



# SEESGEN-ICT

## 4° GENERAL WORKSHOP

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**Matthias Stifter (AIT):**  
*ICT Requirements, solutions and needs  
for the priority applications*



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# 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
- Reliability
- 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
<b>Inject energy surplus into the grid</b>	✗	✗	✗	✗	✗
<b>Produce maximum power</b>	✗	✗	✗	✗	✗
<b>Peak shaving (generation curtailment)</b>	✓	✓✓	✓	✓	✓
<b>Anti-islanding</b>	✗	✓✓	✓✓	✓✓	✓✓
<b>Voltage and reactive power regulation</b>	✓	✓	✓✓	✓	✓
<b>Support island operation</b>	✓	✓✓	✓✓	✓✓	✓✓
<b>Ensure correct operation of power system</b>	✓	✓✓	✓✓	✓✓	✓✓



# General ICT requirements

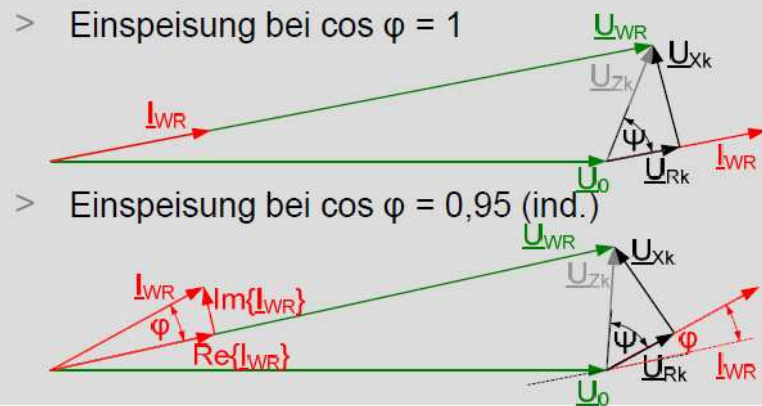
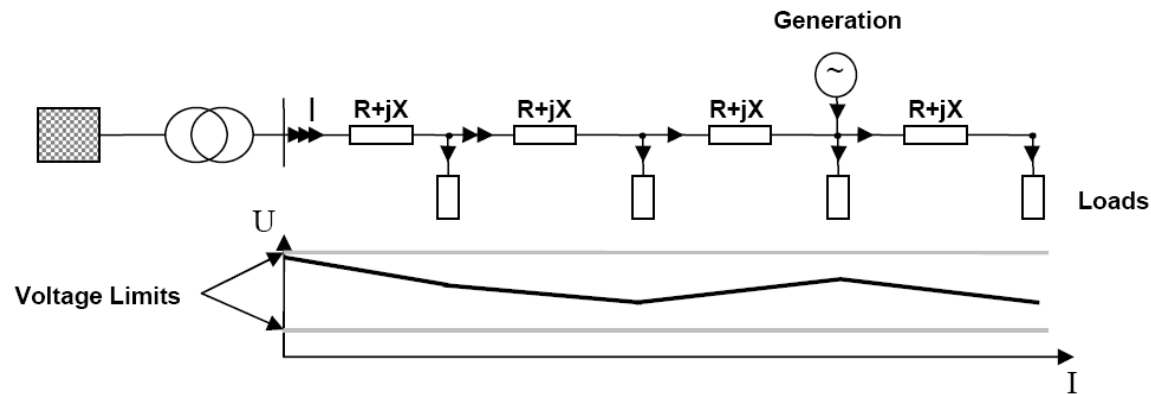
Data delivery time required

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



# Voltage control

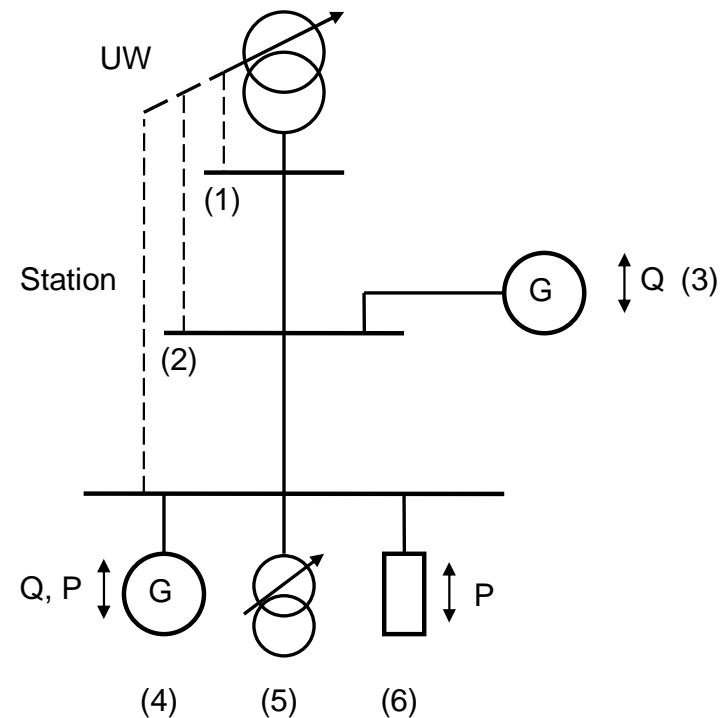
- Keep voltage between limits





## 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

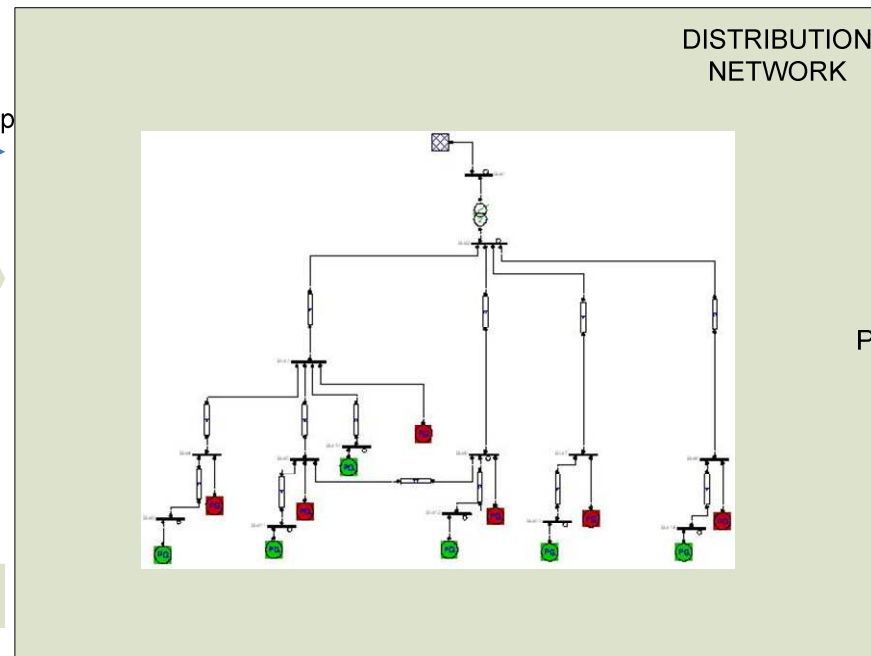
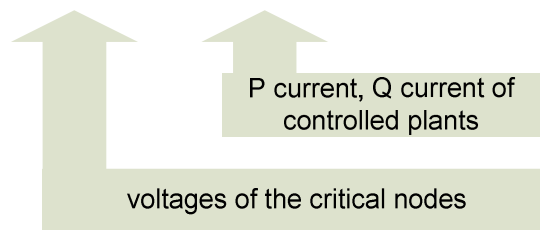
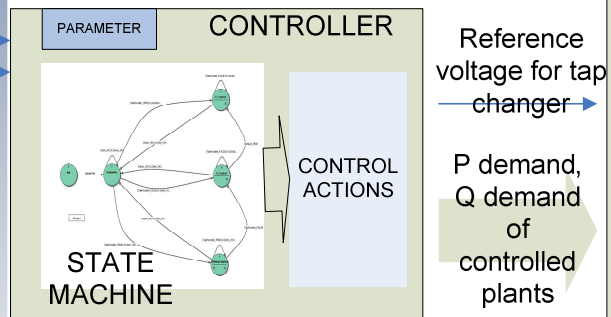
Option	Advantage	Disadvantages
Modem dial-up / dedicated line	easy to install medium costs	not always available (or expensive) long time for dial-up external provider
GSM/UMTS	highly available (continuous connection) easy to install low costs	not 100% reliable external provider security problem due to 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

U upper = 1.03 p.u.  
U lower = 0.94 p.u.





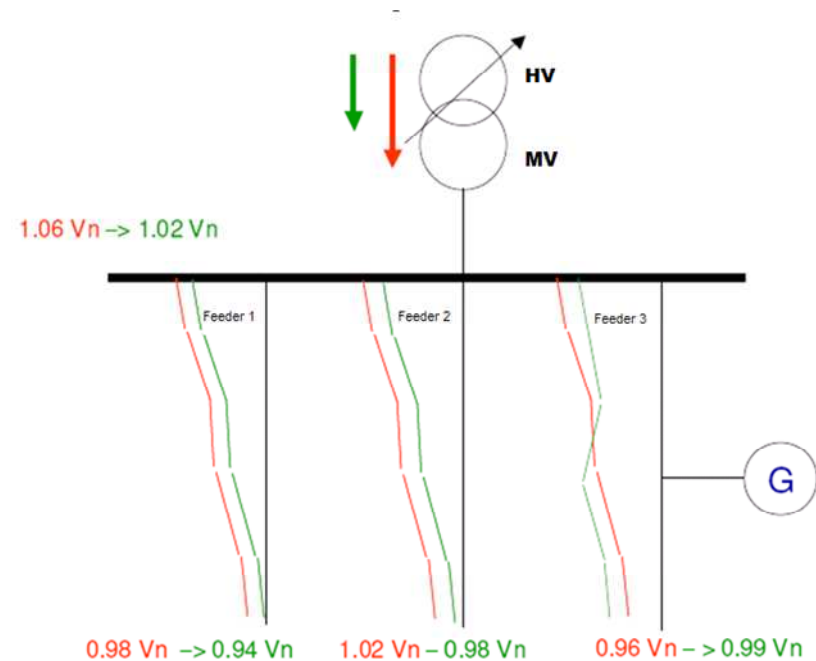
# Voltage control (5)

## ■ ENEL experience

- Voltage control at the tap changer (MV bus bar)
- No communication with the DG

## ■ Future voltage control

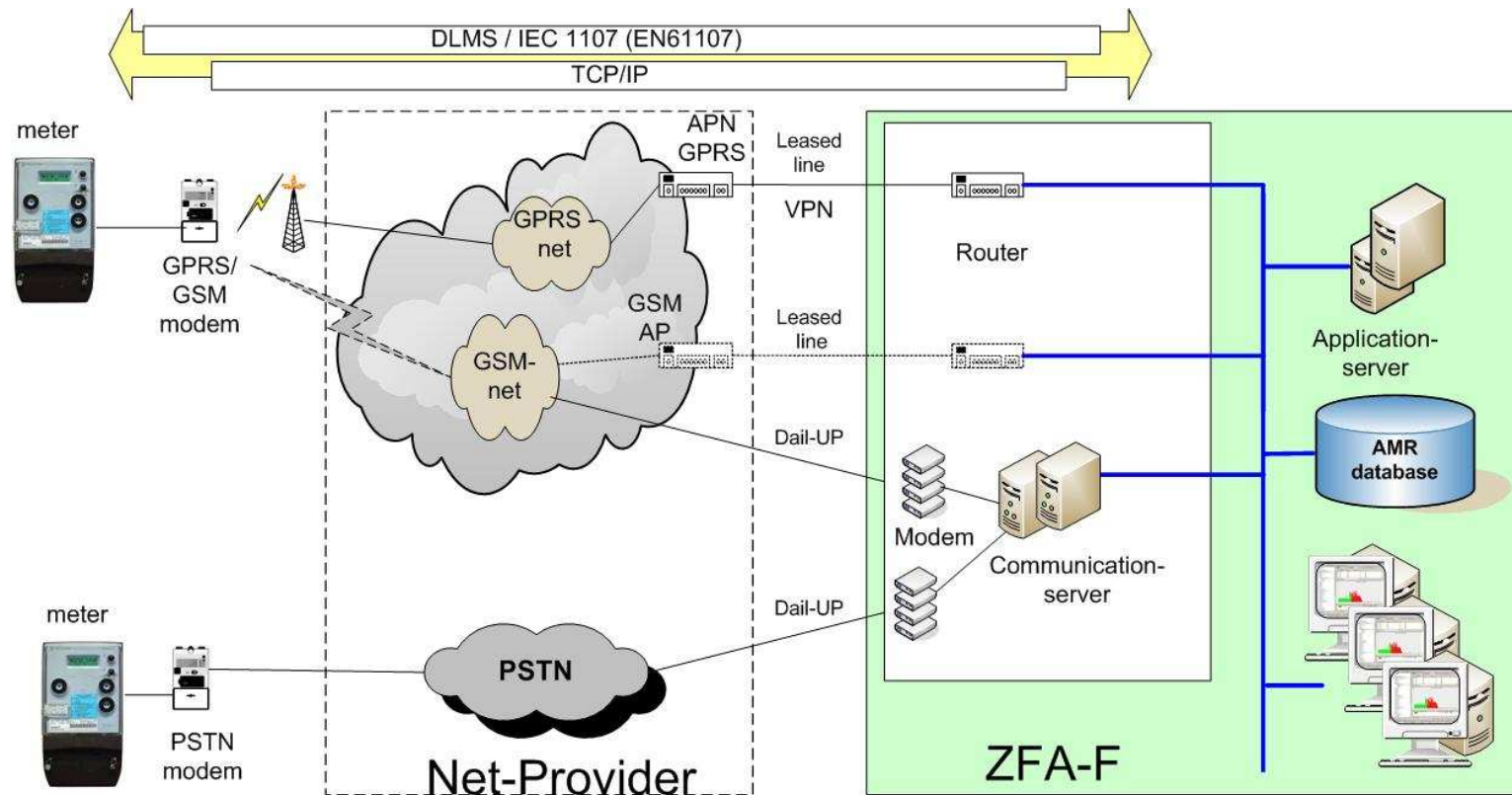
- Control single nodes
- Communication
  - highly reliable
  - secure
  - real time





# Voltage control (6)

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



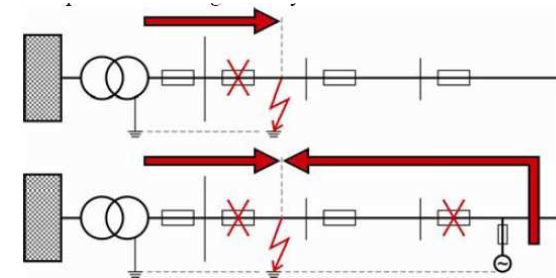


# Adaptive protection

■ 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

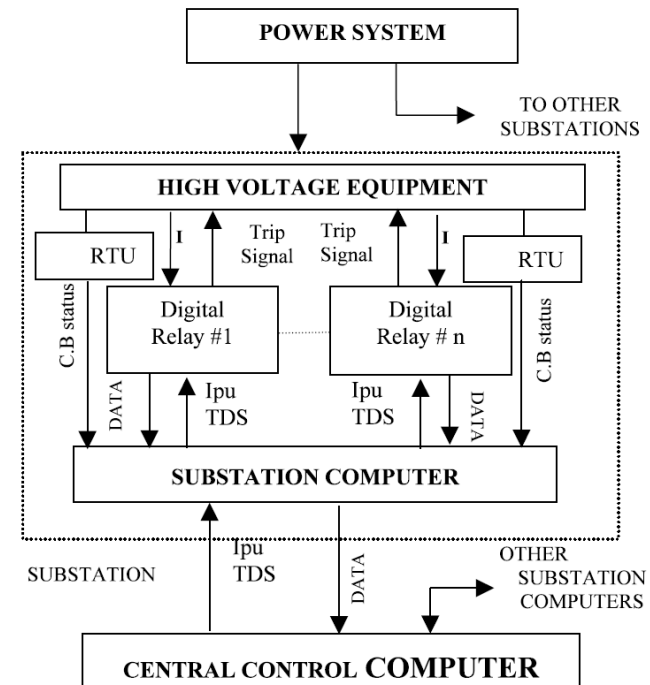


# Adaptive protection (2)

## ■ 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 !!!

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