Utility Telecom Track

Examining the implications of a more interconnected and secure regional energy system for private utility telecom network roll out plans

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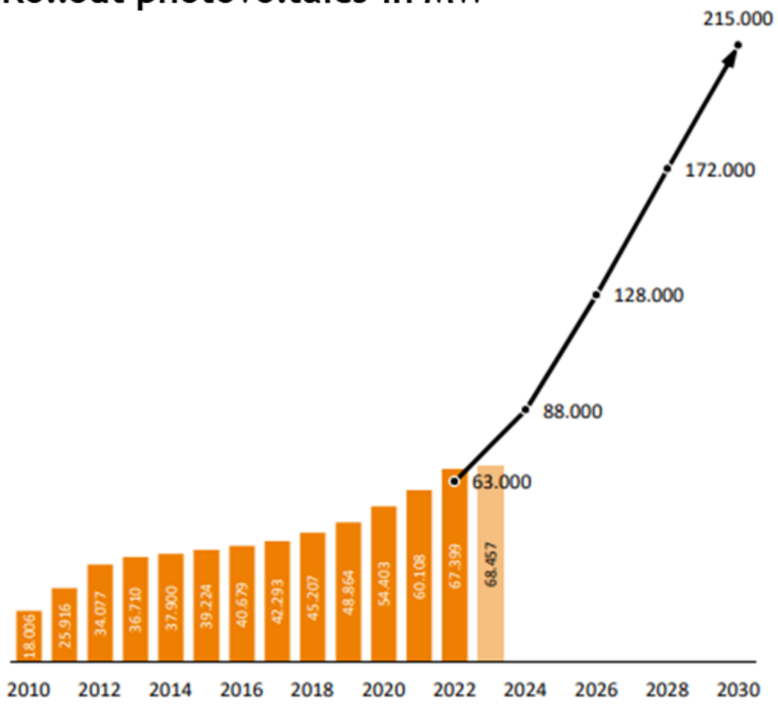
SMART GRID FORUMS | SGTech Week 2023

Agenda

- Challenges for energy systems due to electrification and renewals
- Degree of digitalization of the energy network
- Options for communication technologies in low- and medium voltage networks
- Use of existing electrical infrastructure assets for telecommunication
- Standardization of Broadband Powerline in ITU-T

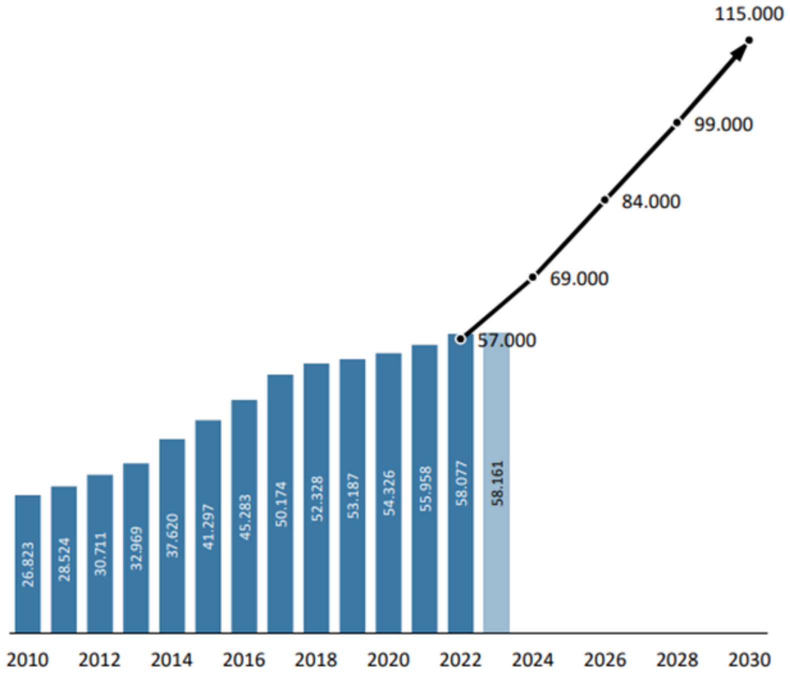
Increasing demand of renewal energy sources to meet European CO_2 targets (Germany)

Rollout photovoltaics in MW



Source: EE-Statistik MaStR BNetzA

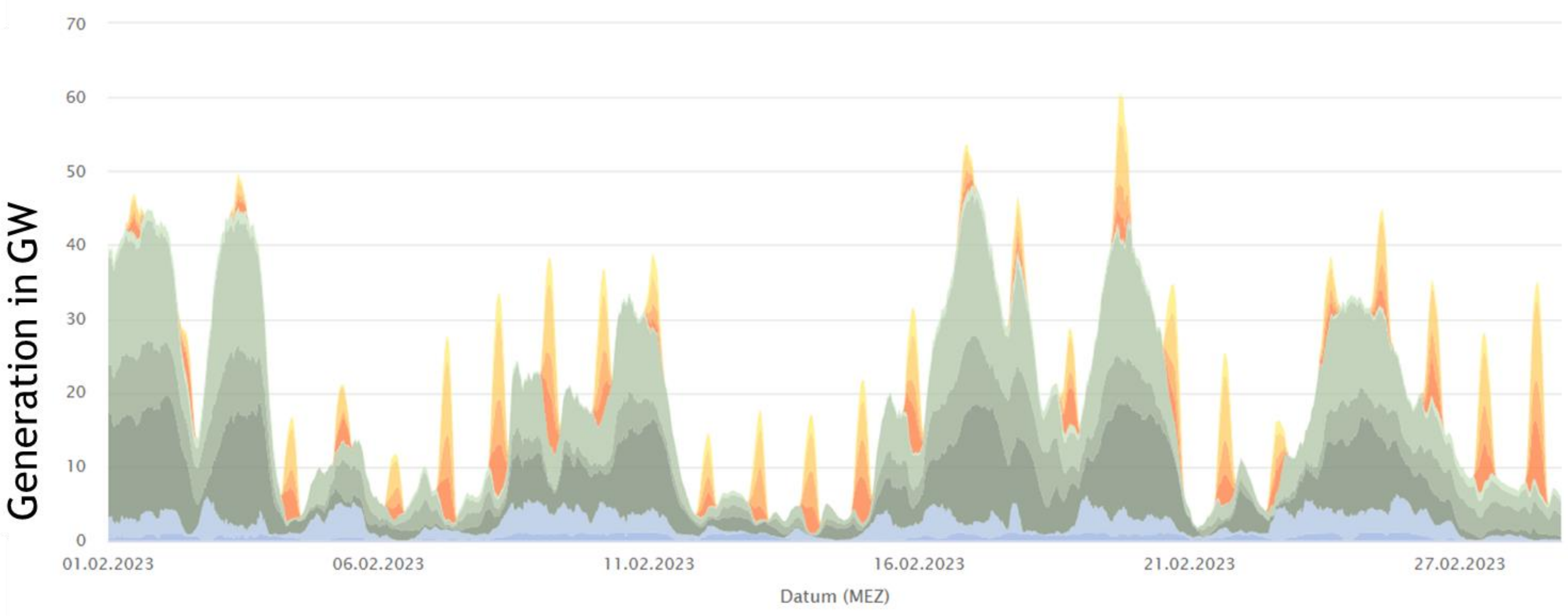
Rollout wind onshore in MW



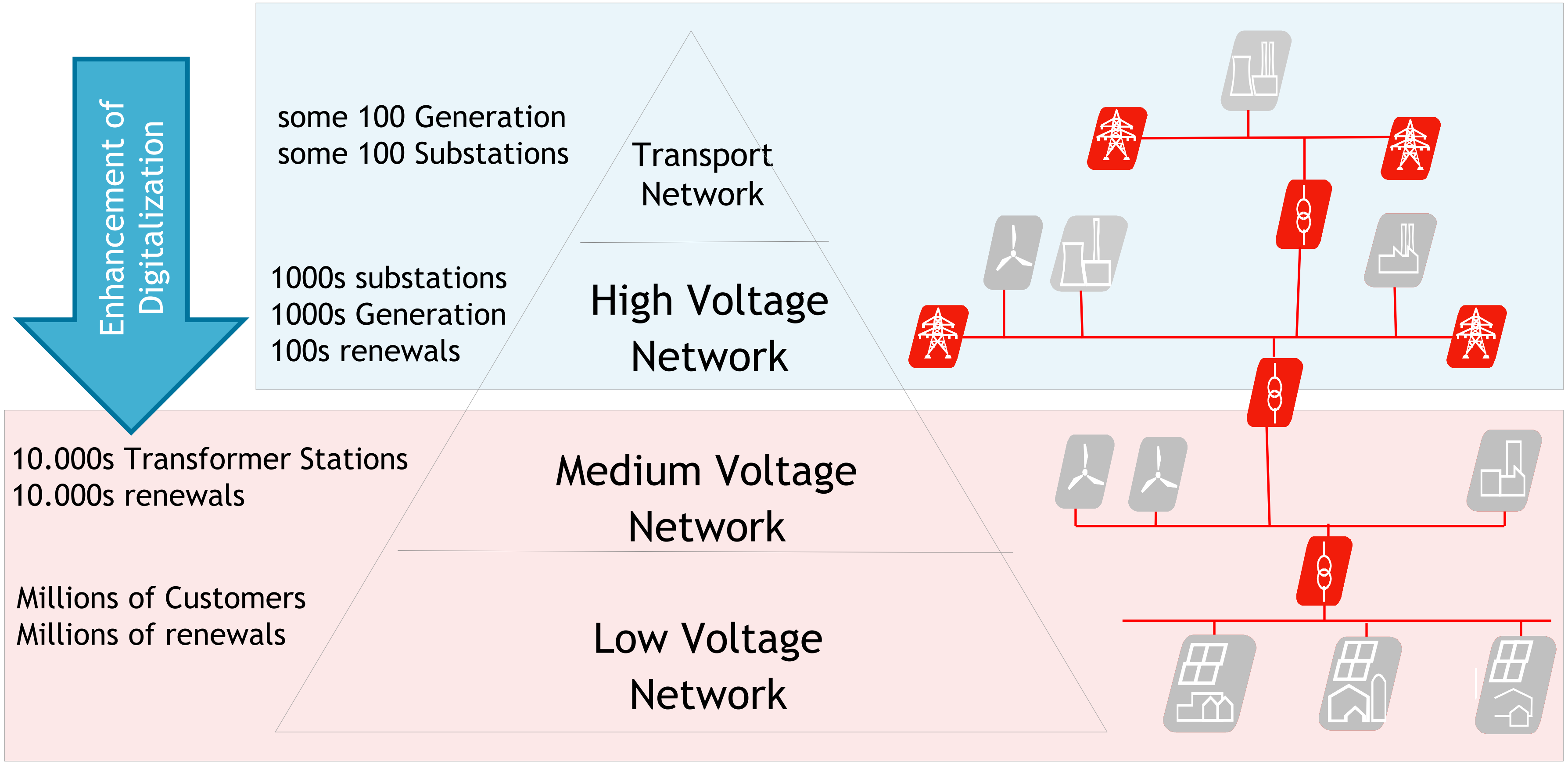
Source: EE-Statistik MaStR BNetzA

Fluctuating renewal energy generation

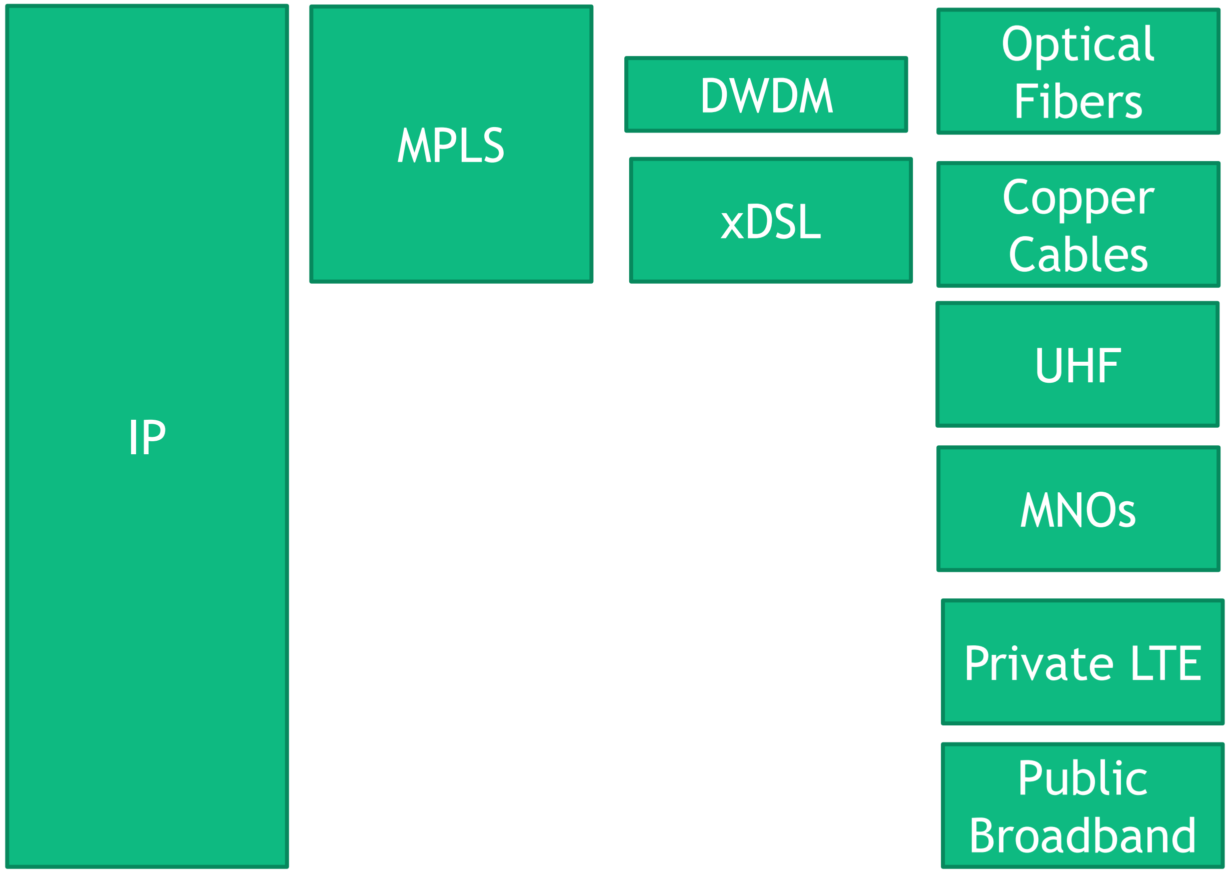
(example February 2023 Germany)



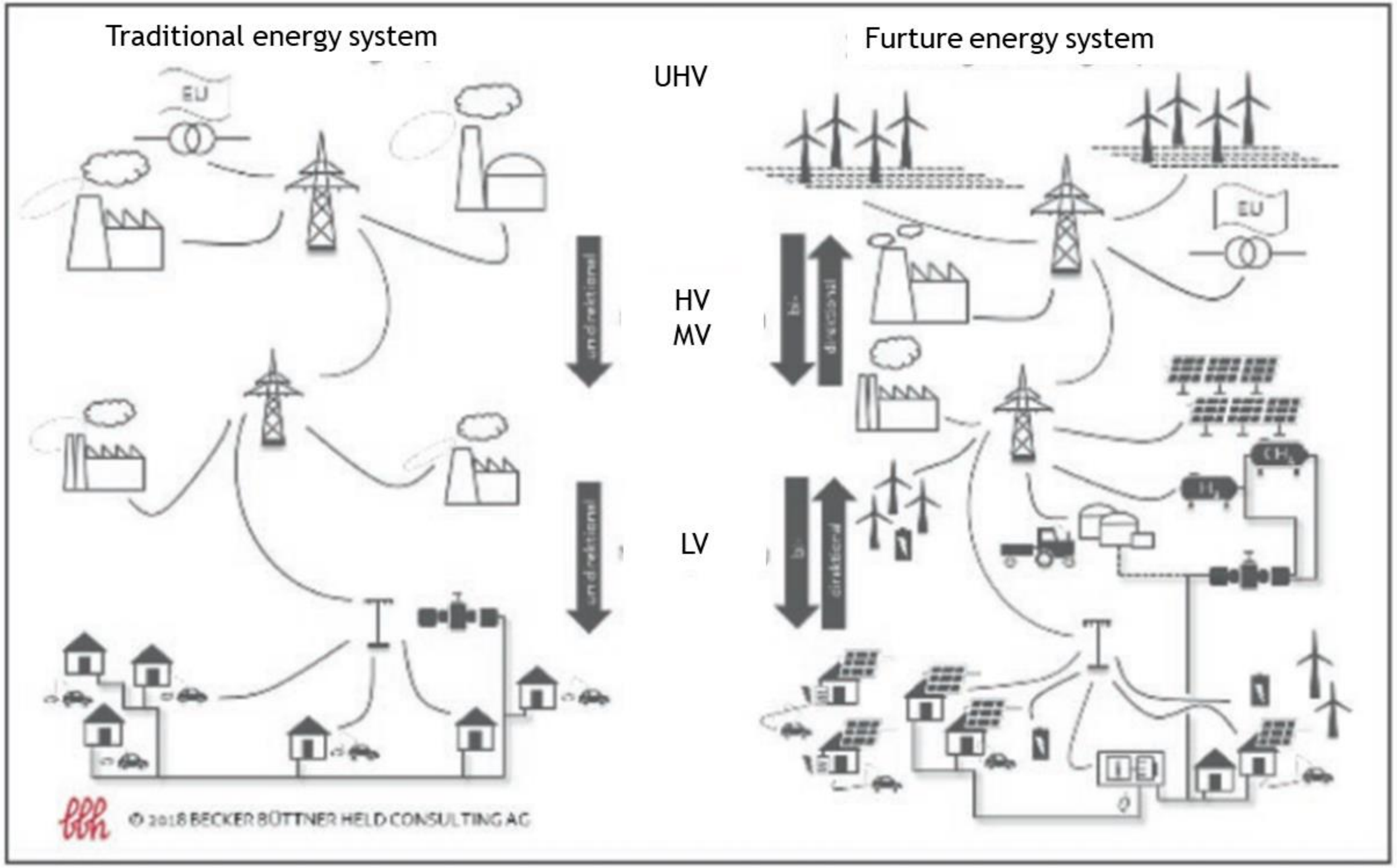
Degree of digitalization energy networks today



Common telecommunication architecture for utilities today

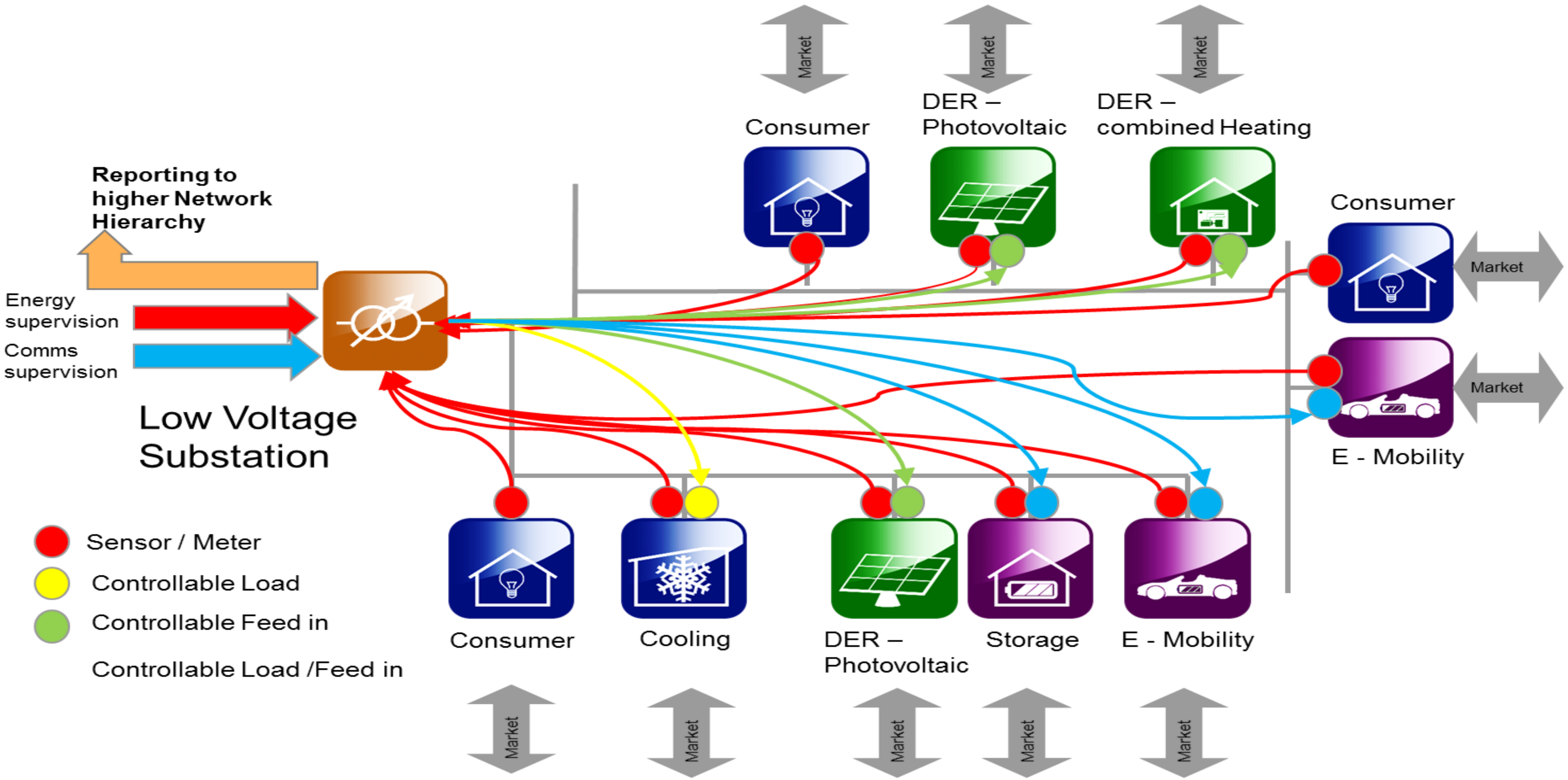


Vision of a cellular energy system

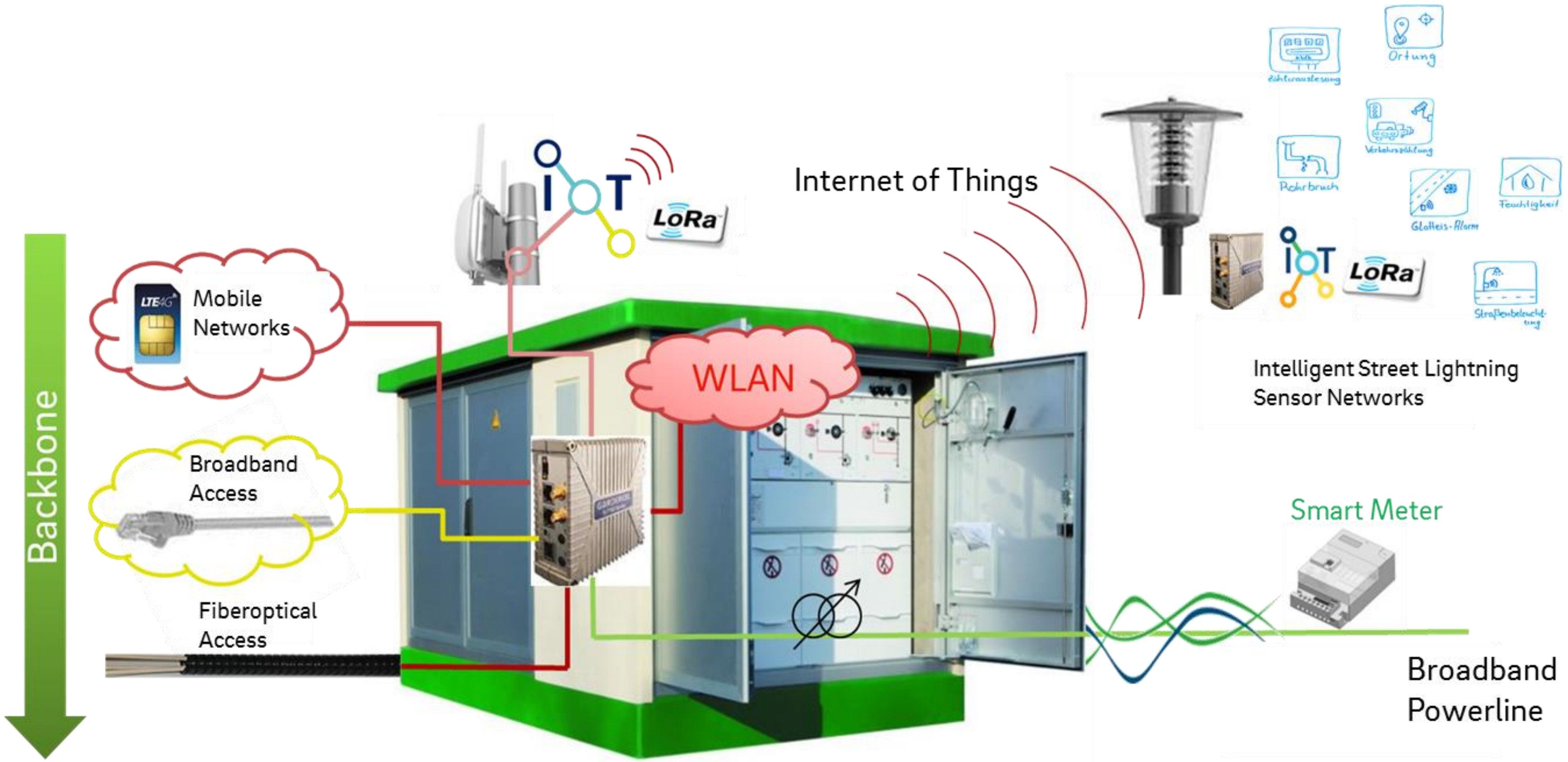


Source: Zellulares Energiesystem VDE May 2019

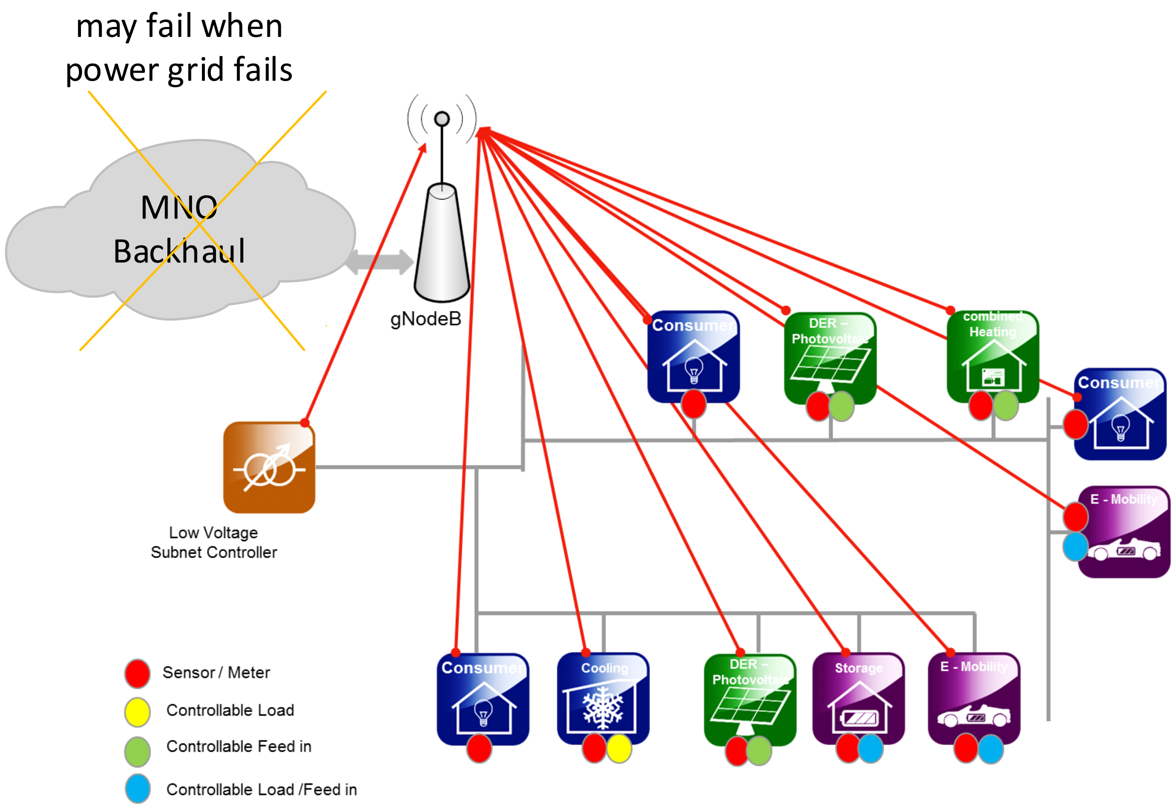
Communication requirements in LV networks



Low voltage substation as a digital hub



Mobile networks as backhaul for smart grids



Requirement an telecommunication for smart grids

Future Smart Grids require local Peer to Peer communication

Future Smart Grids require black start capabilities and blackout resilience

Future Smart Grids require islanding capabilities

Future Smart Grids require a high degree of inherent IT security

Future Smart Grids require broadband

→ Why not using the electrical grid for communiction?

Standardization in ITU – T – study groups

SG2 - Operational aspects

- About SG2

SG3 - Economic & policy issues

- About SG3

SG5 - Environment, EMF & circular economy

- About SG5

SG9 - Broadband cable & TV

- About SG9

SG11 - Protocols, testing & combating counterfeiting

- About SG11

SG12 - Performance, QoS & QoE

- About SG12

SG13 - Future networks

- About SG13

SG15 - Transport, access & home

- About SG15

SG16 - Multimedia & digital technologies

- About SG16

SG17 - Security

- About SG17

SG20 - IoT, smart cities & communities

- About SG20

Standardization of Powerline Communiction

Using the electrical infrastructure as transport media for telecommunication ITU-T Technical Paper

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Technical Paper

(09/2020)

GSTP-HNSG
Technical paper on the use of G.hn technology for smart grid

Use cases for broadband powerline systems in smart grids

Smart Meter Access

High number of active nodes in domain
Low bandwidth requirements
Medium latency requirements
Medium availability requirements

Smart Meter Gateway

Medium number of active nodes in domain
High bandwidth requirements
High latency requirements
High availability requirements

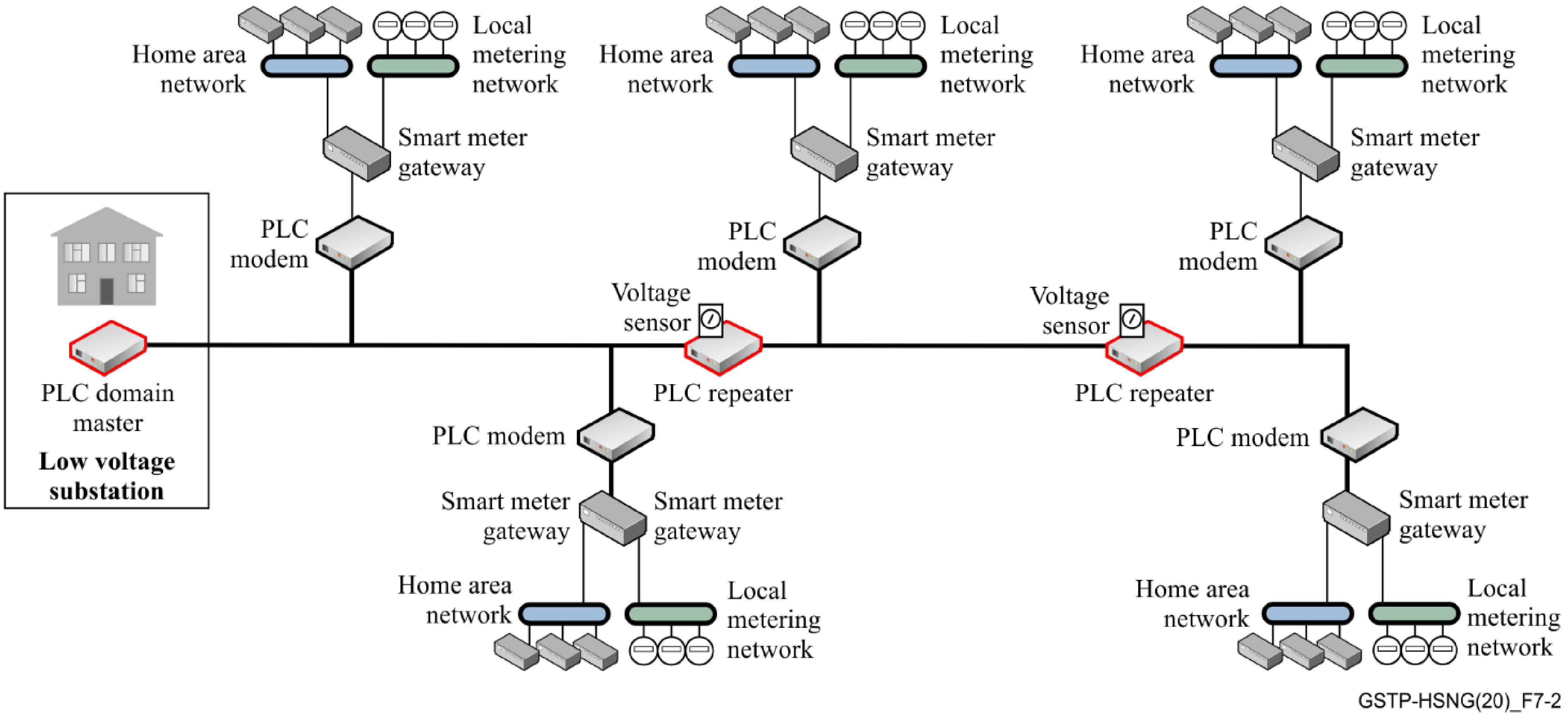
Smart Meter Concentrator

Medium number of active nodes in domain
High bandwidth requirements
High latency requirements
High availability requirements

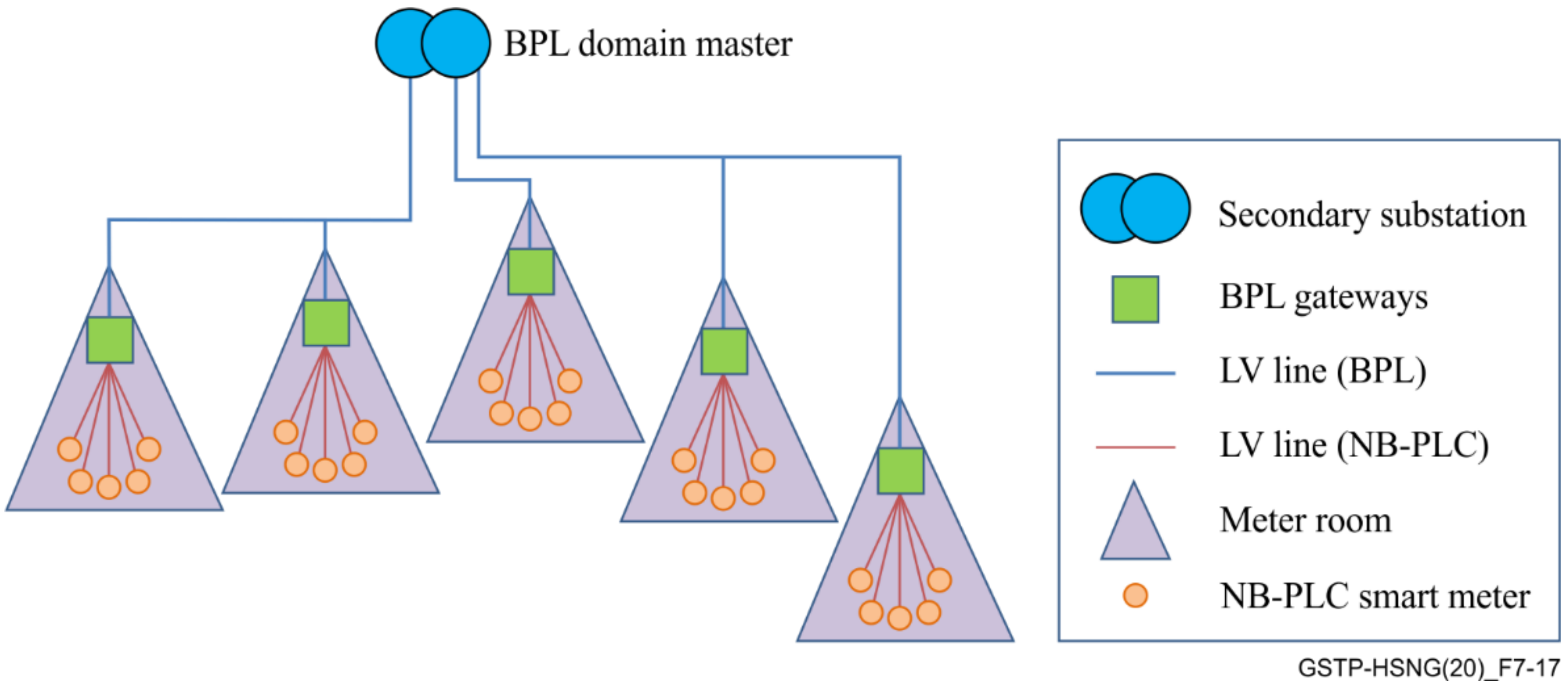
Medium Voltage BB

Low number of active nodes in domain
High bandwidth requirements
High latency requirements
High availability requirements

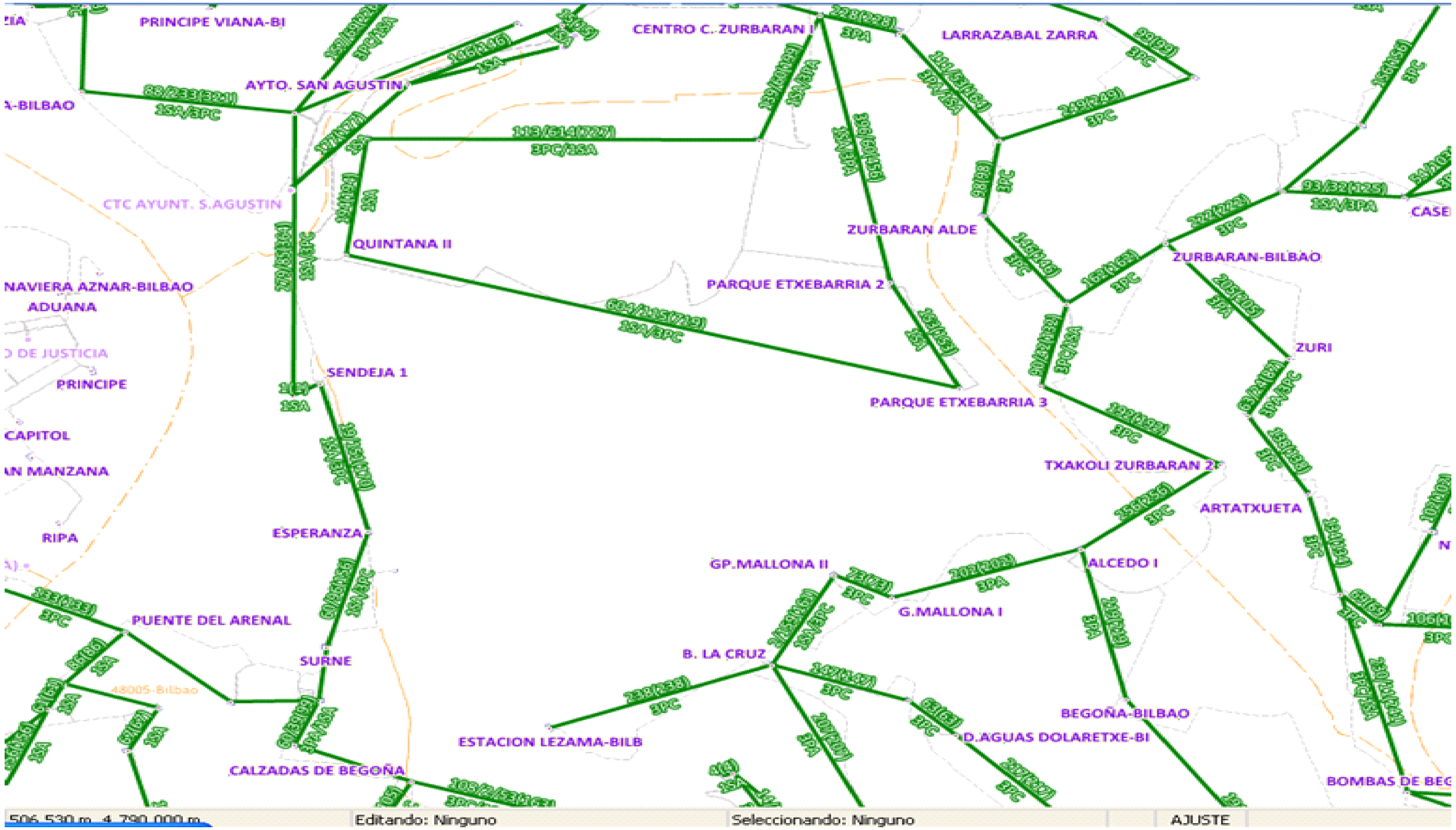
Use case Smart Meter Gateway



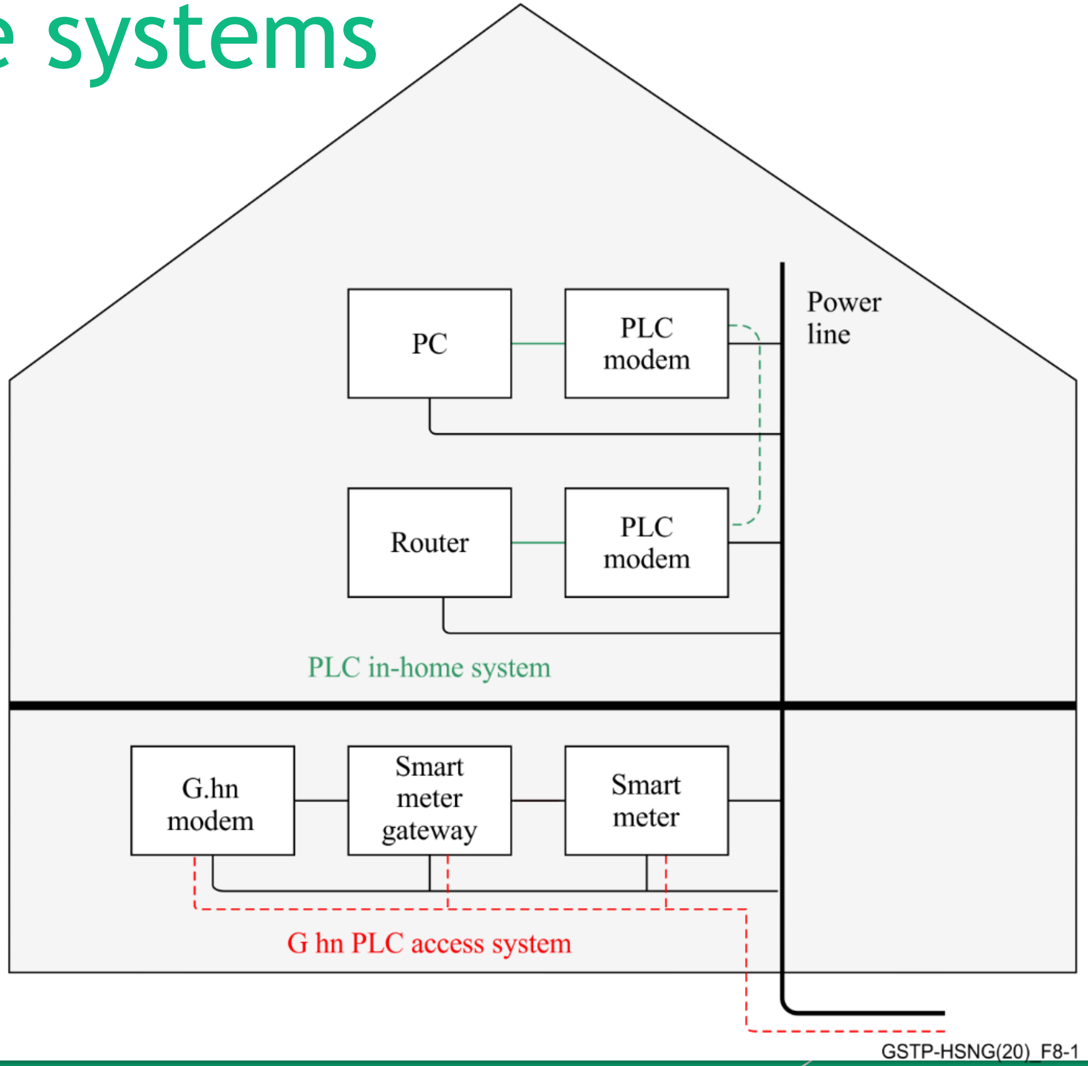
Use case narrow Band Meter Concentrator



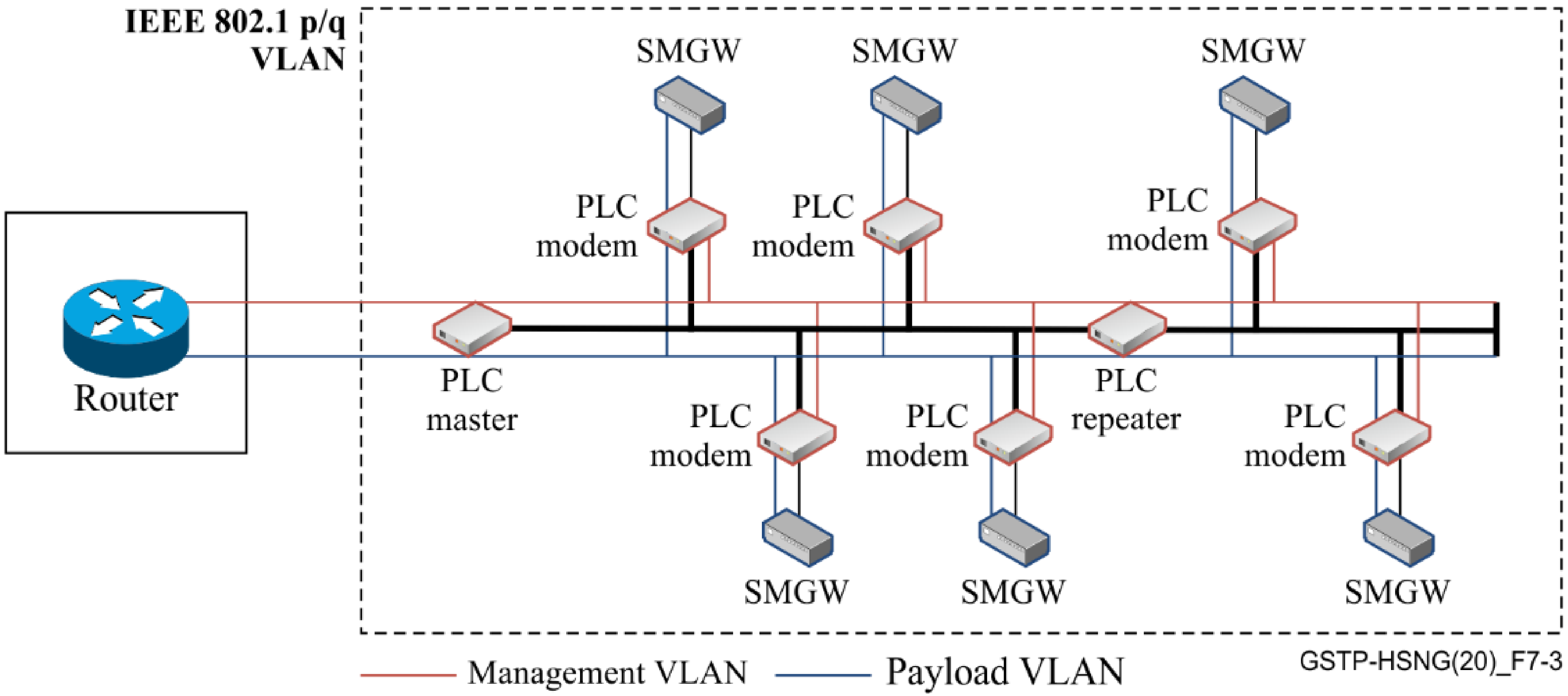
Use case Medium Voltage Backbone



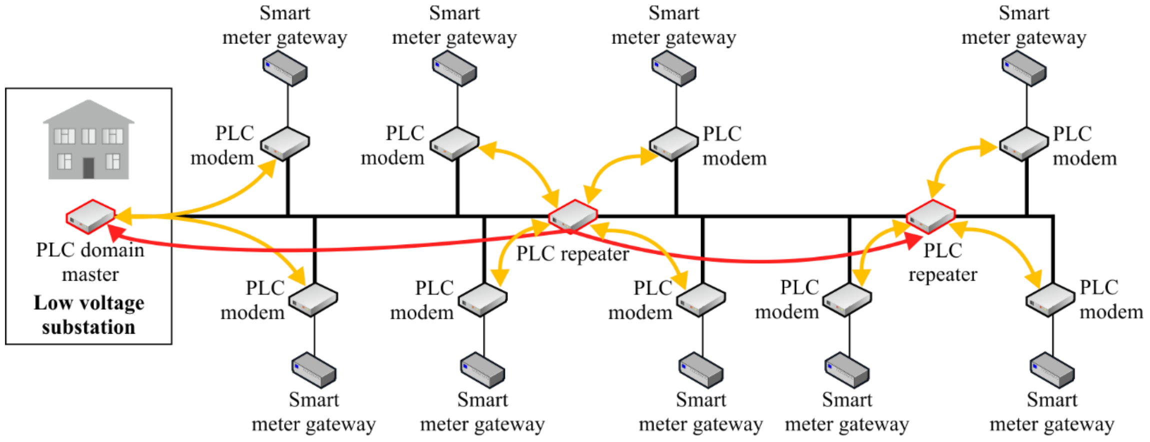
Coexistence between G.hn smart grid system and PLC in- home systems



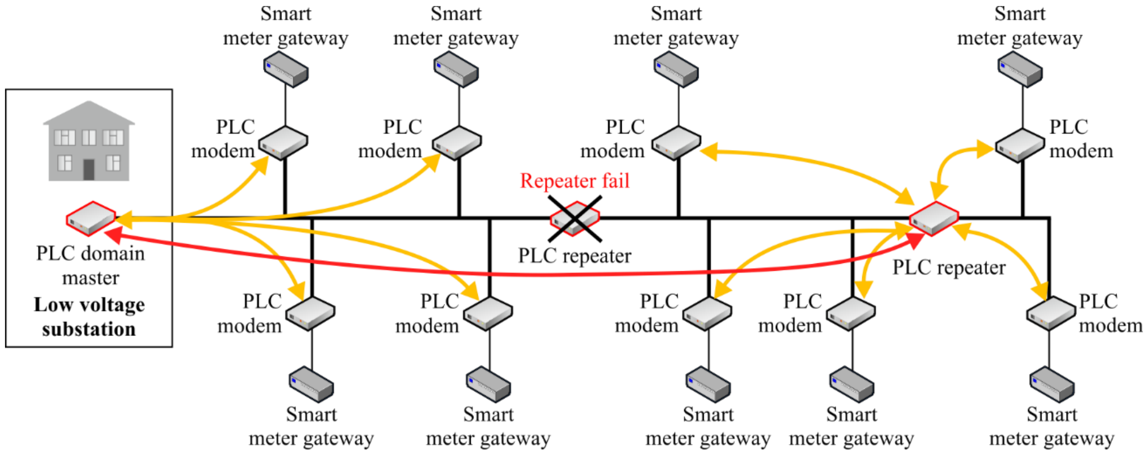
Using VLANs in Powerline Communication



Self configuration of topology

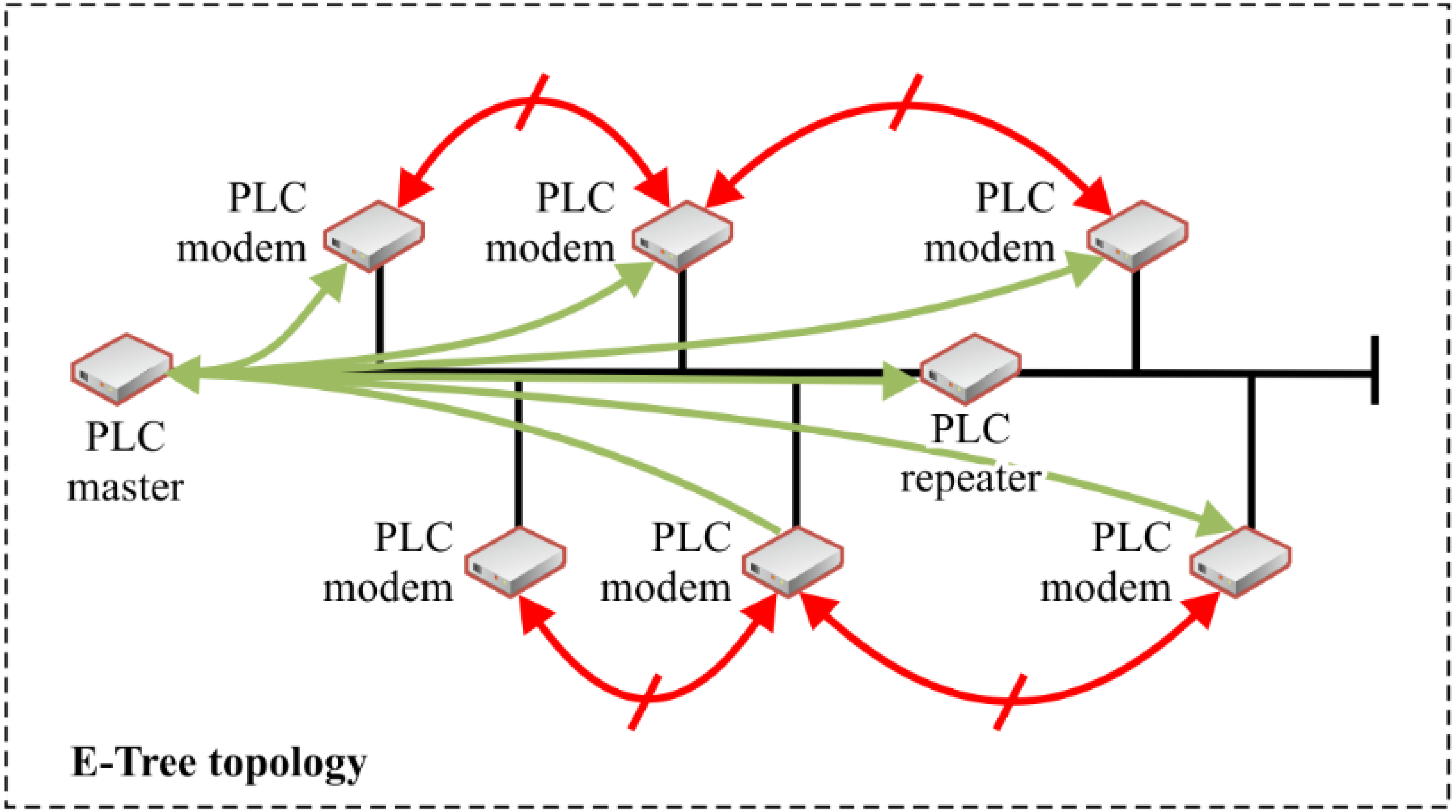


GSTP-HSNG(20)_F7-5



GSTP-HSNG(20)_F7-6

Security option – support of E-tree



GSTP-HSNG(20)_F7-4

Security option – support IEEE 802.1x

Only authenticated and authorized devices shall have access to the powerline – network. Therefore a centralized AAA shall be used.

The authentication process is done using IEEE 802.1x and follows the process described in Annex D of [ITU-T G.9961].

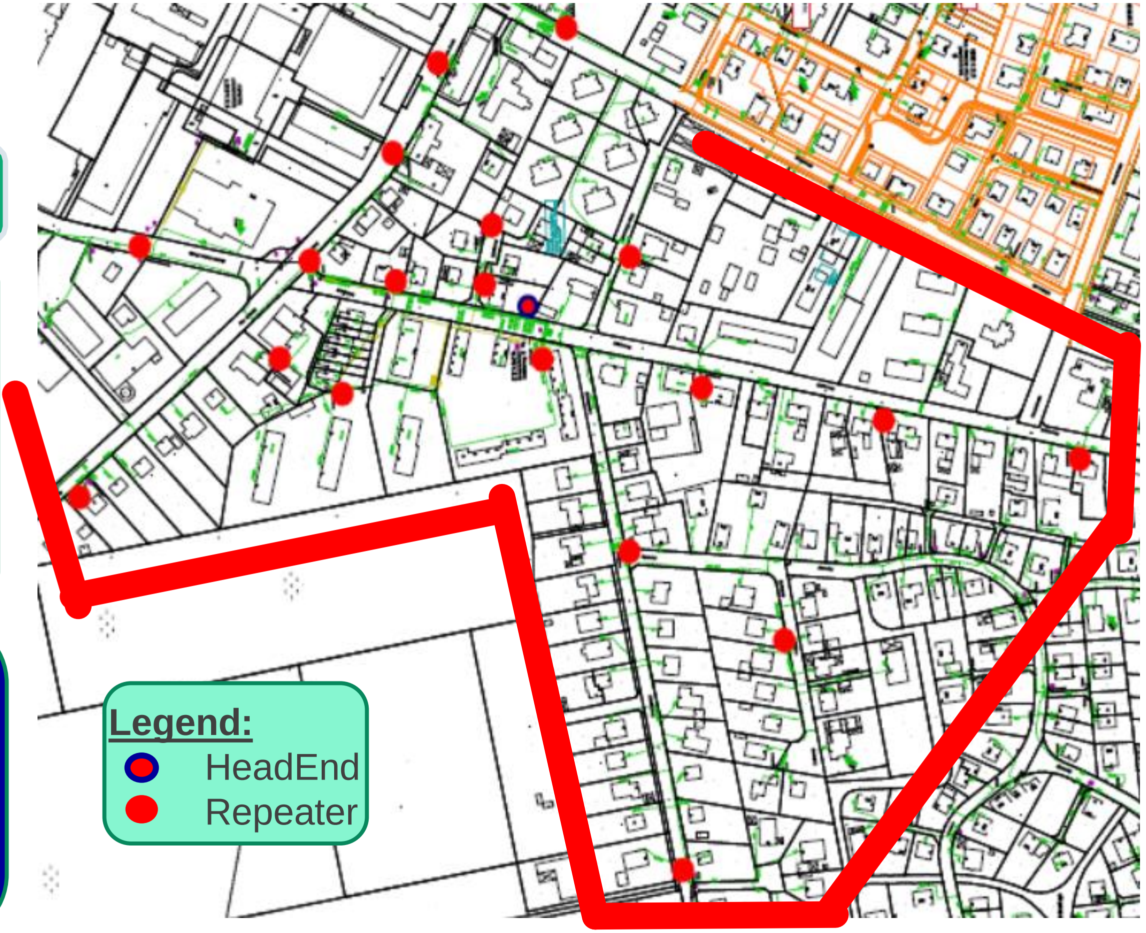
G.hn devices use cryptographic encryption as described in clause 9 of [ITU-T G.9961]. The generation of cryptographic keys shall use procedures as described in IEEE 802.11

Typical performance data in live networks

Availability and Functionality

- 92/91 MBit/s PHY-rate performance, and 100% Availability

Area ≈ 0.36 km²
Covered with 19 repeaters
Distance B/W nodes: Up to 230m
Node Density = 55.5 Node/km²
Same density in both locations

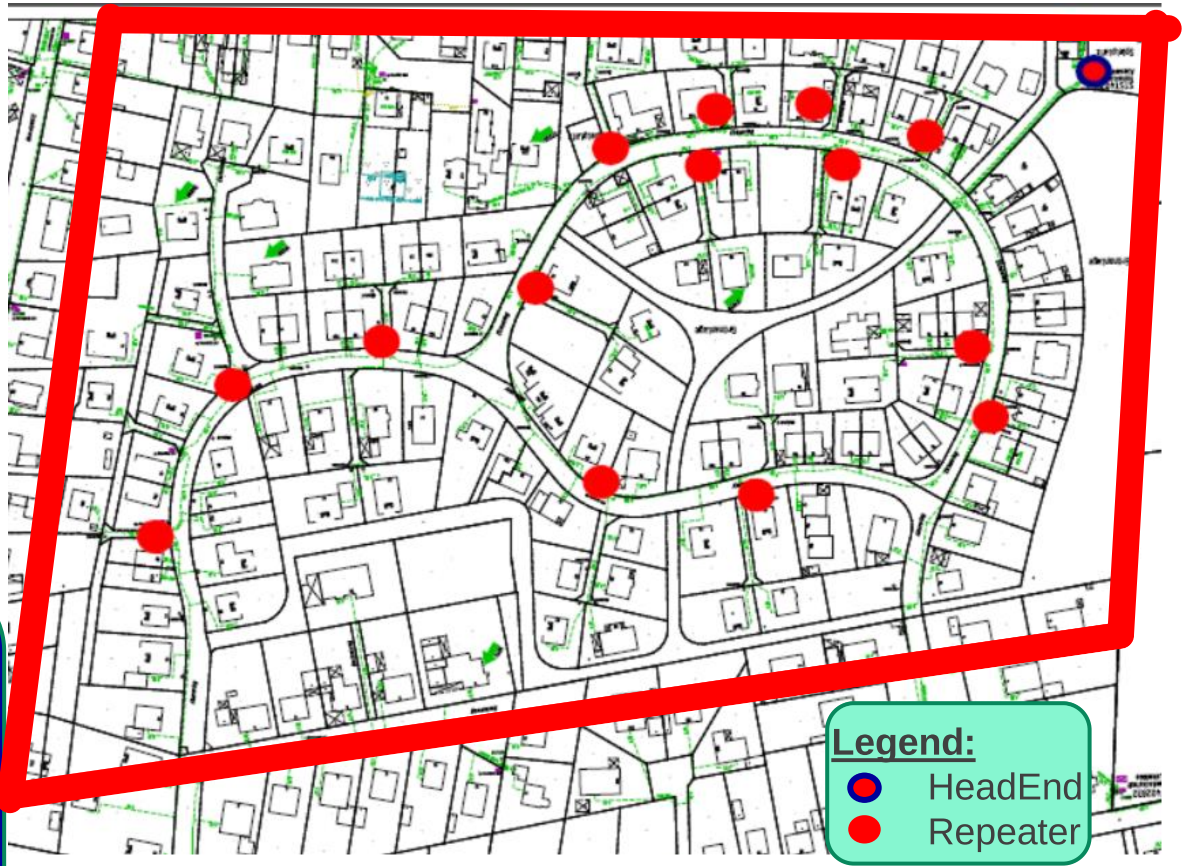


Typical performance data in live networks

Availability and Functionality

68/81 MBit/s PHY-rate performance, and 99% Availability

Area ≈ 0.27 km²
Covered with 14 repeaters
Distance B/W nodes: Up to 160m
Node Density = 55.5 Node/ km²
Same density in both locations



Typical performance data in live networks

Distance to adjacent (m)	Uplink (MBit/s)	Downlink (MBit/s)	Availability
145	76.56	97.63	98.65%
45	179.49	273.54	100.00%
150	30.06	41.44	100.00%
70	67.48	103.34	100.00%
95	72.65	76.98	97.98%
125	4.26	4.3	100.00%
205	59.68	50.98	100.00%
220	3.29	15.89	100.00%
95	71.59	49.94	100.00%
55	80.96	100.84	100.00%
125	45.41	70.27	100.00%
65	153.26	221.5	100.00%
55	89.36	136.03	100.00%
55	99.01	105.25	100.00%
155	38.14	47.7	100.00%
110	31.87	49.43	100.00%
50	102.97	123.66	100.00%
90	225.9	250.49	100.00%
105	42.2	55.87	100.00%