G3-PLC 500 kHz for Smart Metering

Dr. Michael Koch

Vice President Strategic Positioning

devolo

The Network Innovation

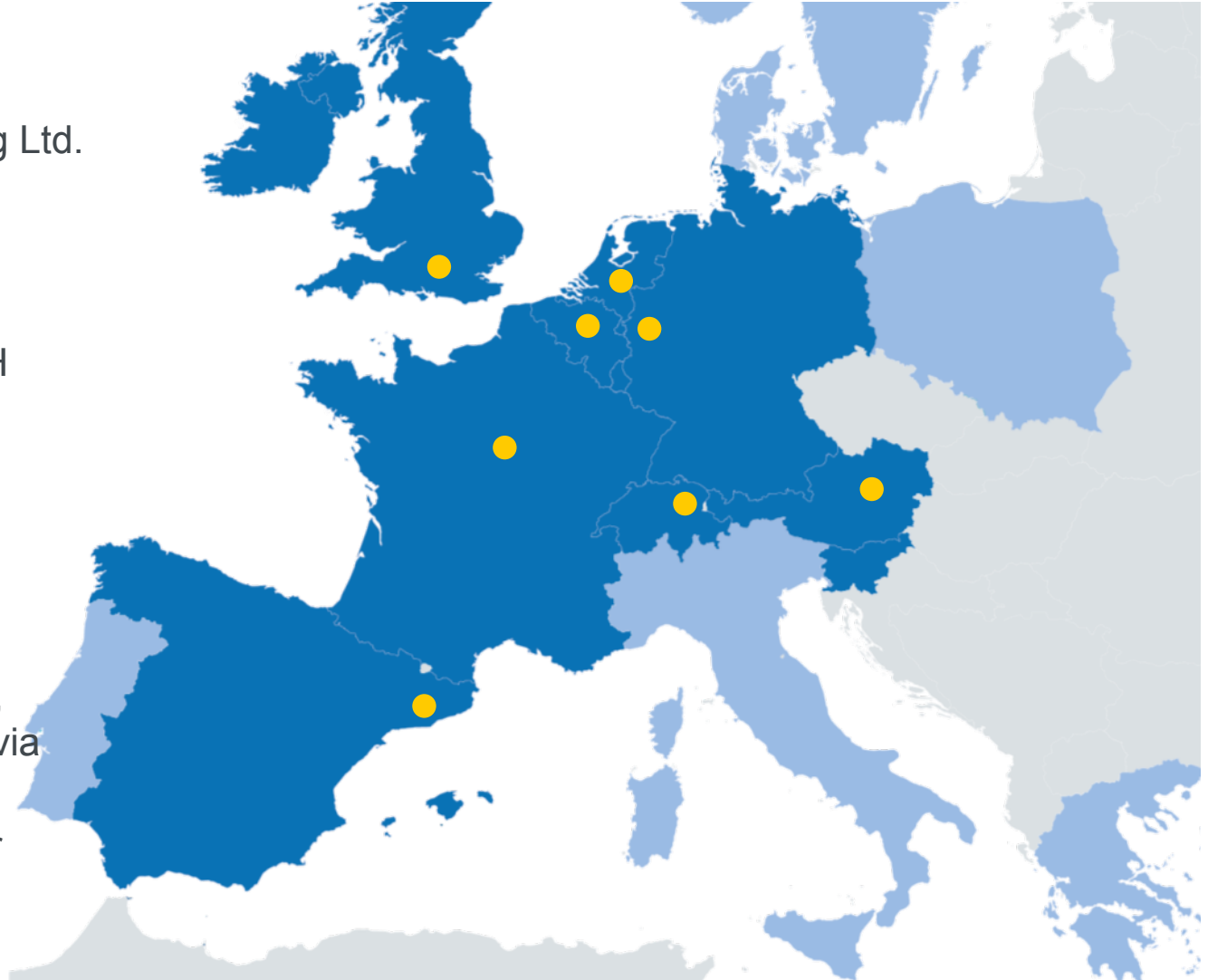# From the startup to the worldwide market leader in powerline solutions

devolo AG, Germany – subsidiaries

- devolo Asia Consulting Ltd.
- devolo Austria GmbH
- devolo Benelux bvba
- devolo France SARL
- devolo Schweiz GmbH
- devolo Spain SL
- devolo UK Ltd.

Further focused sales areas

- Italy, Portugal, Poland, Greece and Scandinavia (SE, NO, FI, DK, IS)
- Others currently under development

Three business units for the future

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2013   2014   2015
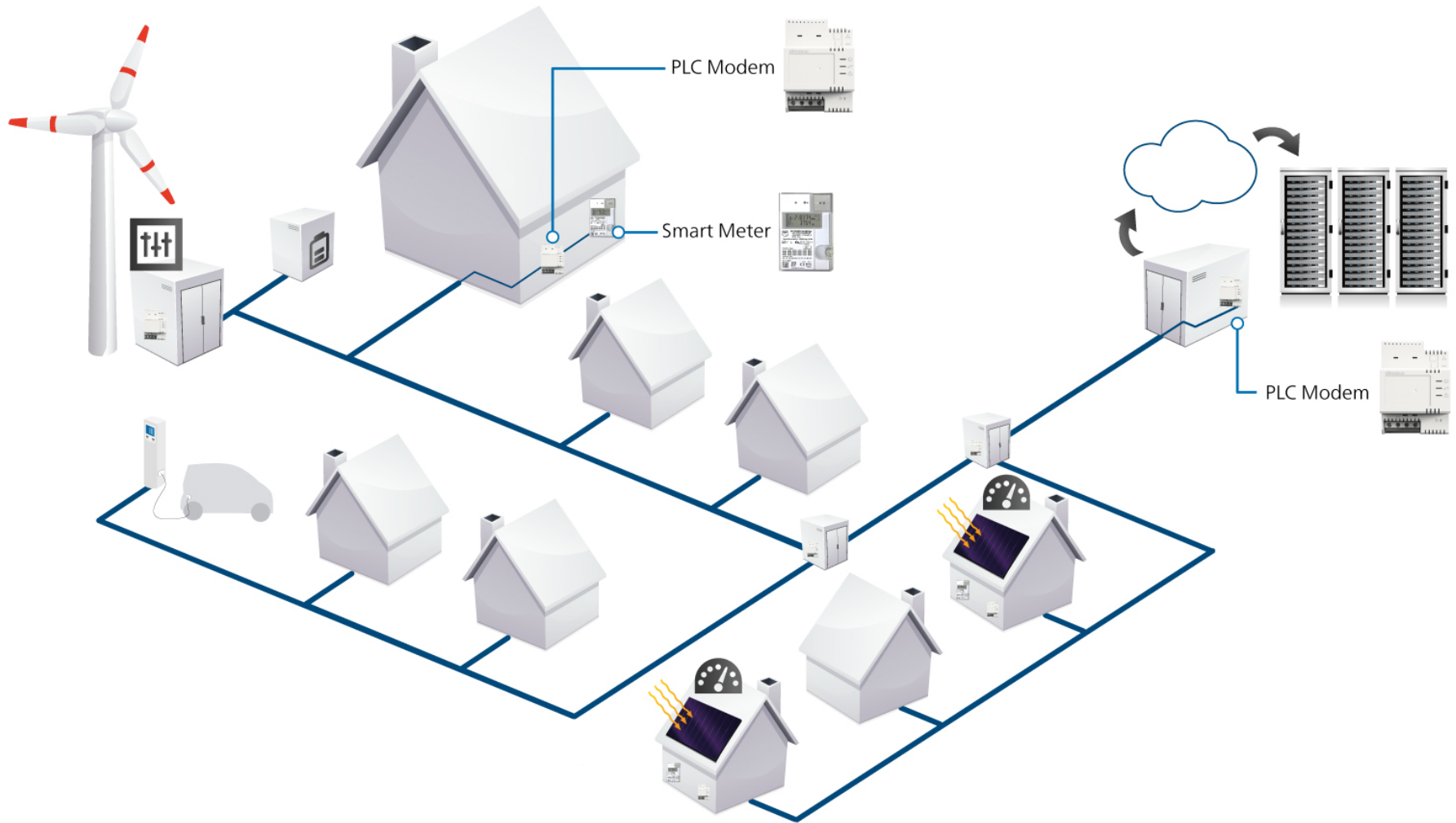
Smart Grid
B2B

Home Control
B2C / B2B

Home Networking
B2C / B2B
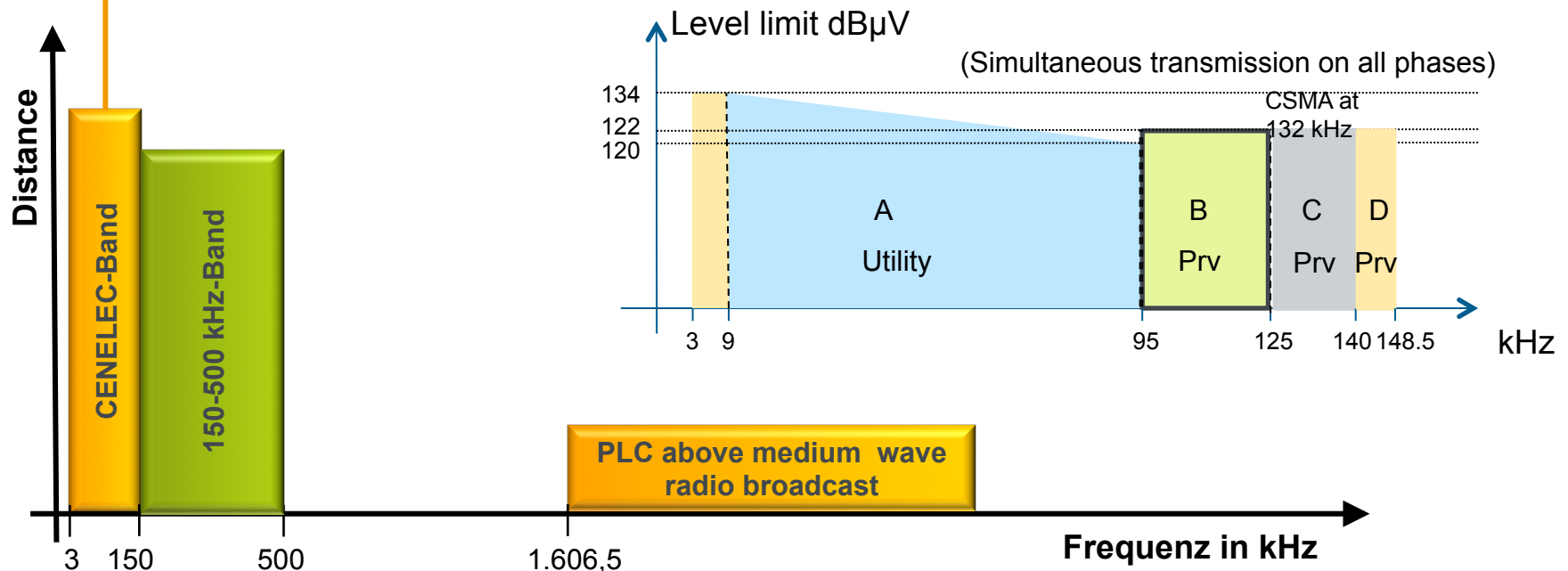
Smart Metering Szenario

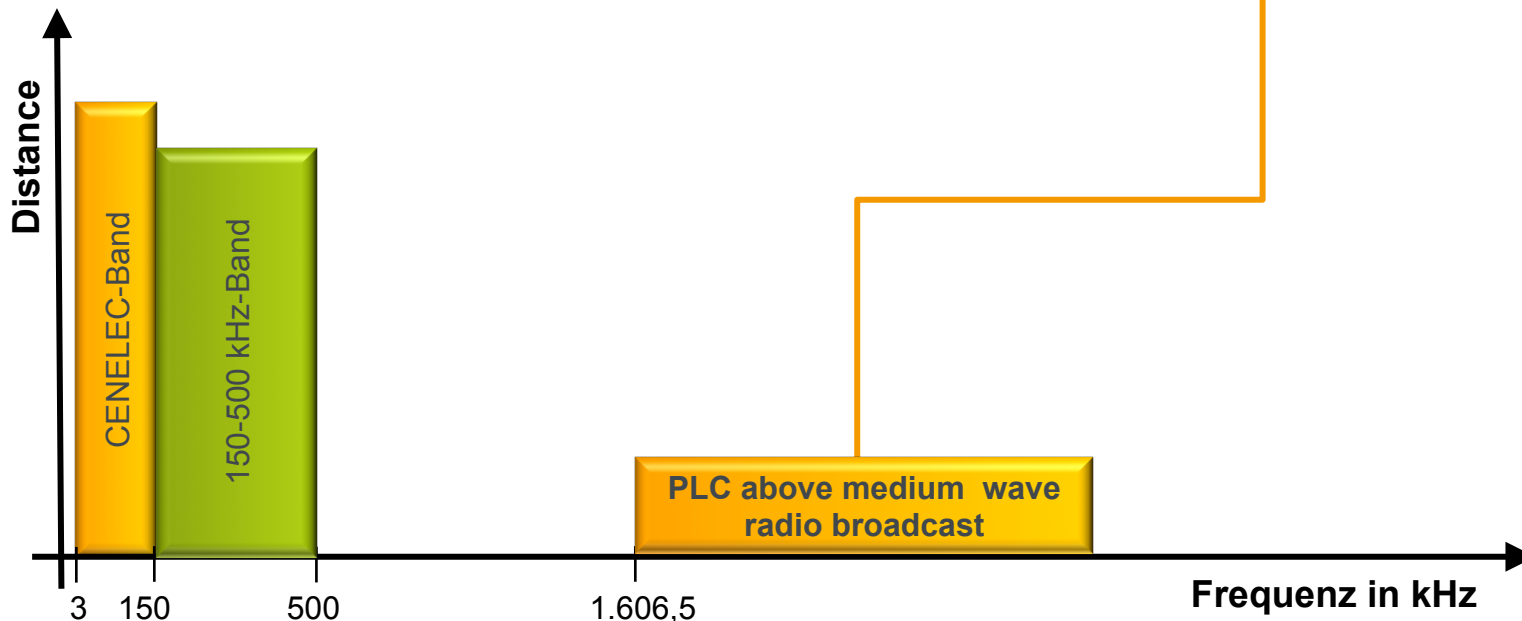Typical application of the Access PLC for the Smart Grid Scenarios
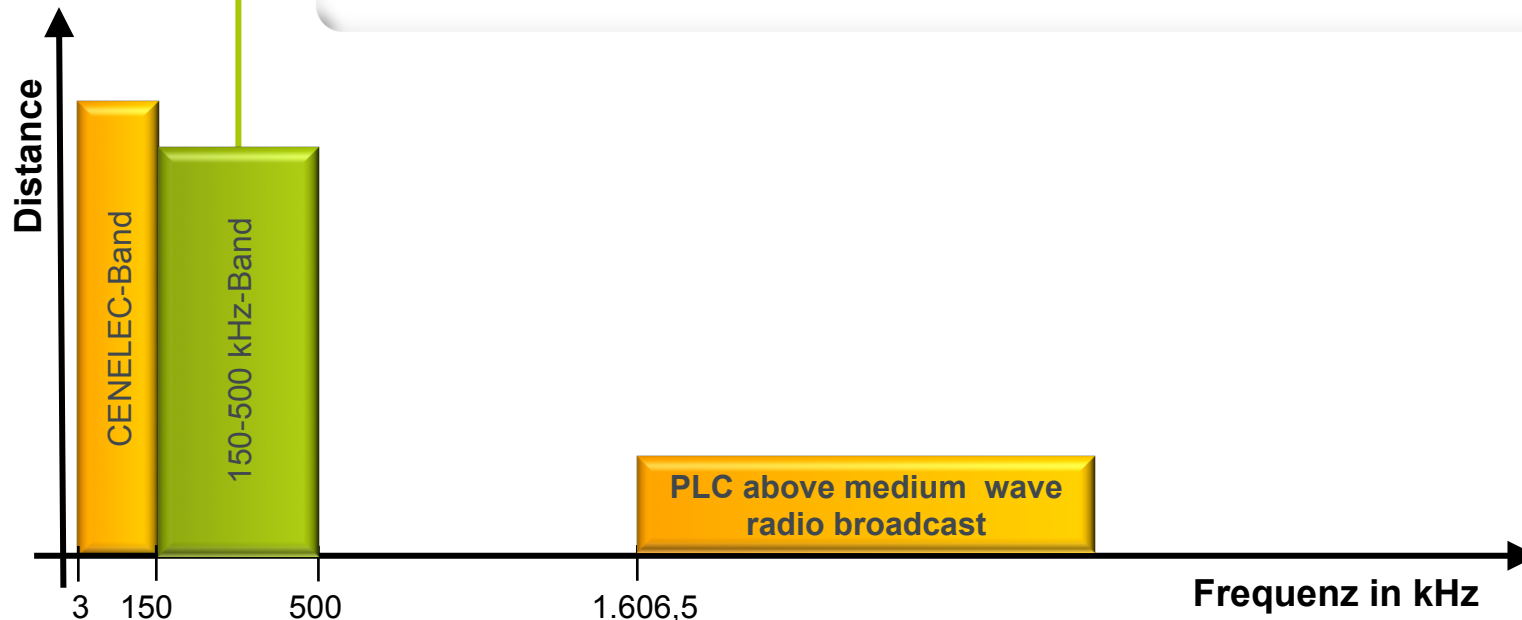
Comparison of PLC Technologies

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+ already available as PLC EMC standard: EN 50065
+ separate frequency band for energy supply company and private use

- low data rates
    - small frequency spectrum for PLC transmission
    - poor transmission channels as general EMC filtering is only above 150 kHz
- interaction with other devices, such as e.g. inverters and capacitive switches

Distance

CENELEC-Band

150-500 kHz-Band

PLC above medium wave radio broadcast

Level limit dBµV

(Simultaneous transmission on all phases)

CSMA at 132 kHz

134
122
120

A
Utility

B
Prv

C
Prv

D
Prv

3 9   95   125   140 148.5   kHz

3 150   500   1.606,5

Frequenz in kHz

Comparison of PLC Technologies

devolo

+ high data rates

- range ideal for in-house transmission, insufficient in the access area
- the need for repeaters harms business plans

→ devolo's concept for in-house PLC

Distance

CENELEC-Band

150-500 kHz-Band

PLC above medium wave radio broadcast

3   150   500   1.606,5

Frequenz in kHz

Comparison of PLC Technologies

devolo

+ high coverage and long range: longest transmission distance 1.7 km
  (measured in field tests; limited by infrastructure)
+ significantly higher data rate compared to CENELEC band, but lower than
  in the band above medium wave radio broadcast

→ devolo's concept for IP-based communication in PLC Access
  Networks/Smart Grid applications

Distance

CENELEC-Band

150-500 kHz-Band

PLC above medium wave radio broadcast

3   150   500   1.606,5

Frequenz in kHz

G3-PLC road to an international standard

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G3-PLC Alliance

2008 2009
- May 2008: International contest for the design of G3-PLC (Launched by ERDF)
- Oct 2009: G3-PLC first field tests on 5 nodes – Presentation of the results at Metering Barcelona

2010 2011
- Sep 2011: Creation of the G3-PLC Alliance with 12 founding members
- Dec 2011: G3-PLC ITU standard – G9955 and G9956
- Successful interoperability tests

2012 2013
- G3-PLC ITU T standard – New version G 9903 (Cenelec A, FCC, ARIB)
- Clarifications and enhancement brought by IOT
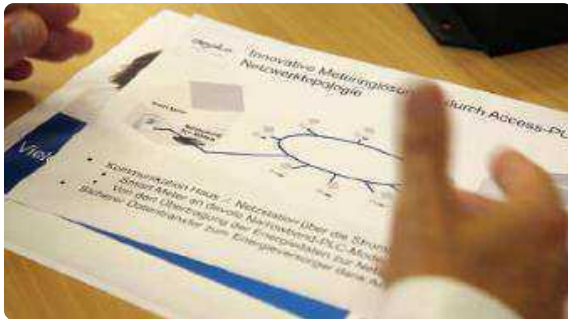- Development of the certification processes

2014
- Feb 2014: First interim certificates, Arib band
- Apr 2014: G3-PLC ITU Standard (Cenelec A, FCC, ARIB)
- Aug 2014: Official certification

Source: **G3-PLC** Alliance

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IP-Access Powerline for Smart Grids

Field trials by Vattenfall and devolo in Hamburg and Berlin

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VATTENFALL

- IP-based PLC in real time
- High- speed with long distances by usage 150- 500 kHz
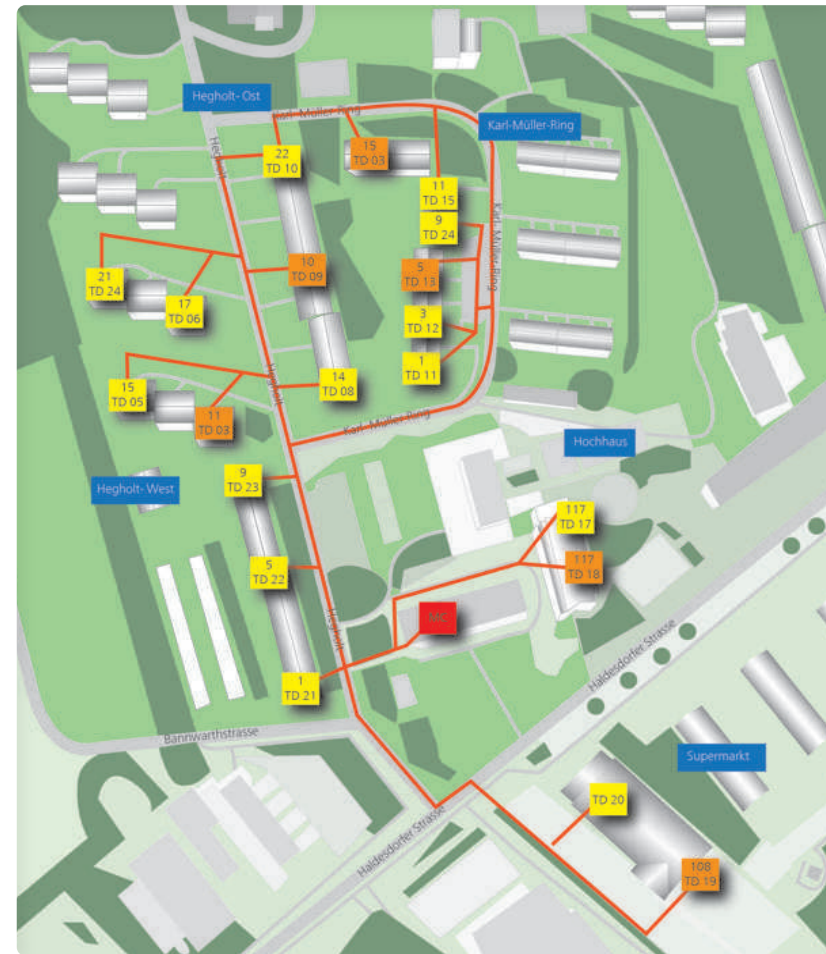- Fast, reliable performance

Field Trial in Hamburg Bramfeld

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GOALS OF TEST

VATTENFALL

- Determination of round trip delay time
- Determination of bandwidth in the physical layer
- Calculation of bandwidth in the application layer
- Accessibility of the nodes
- Channel measurement
- Analysis of the lead time for parametrizing and firmware upload to the meters
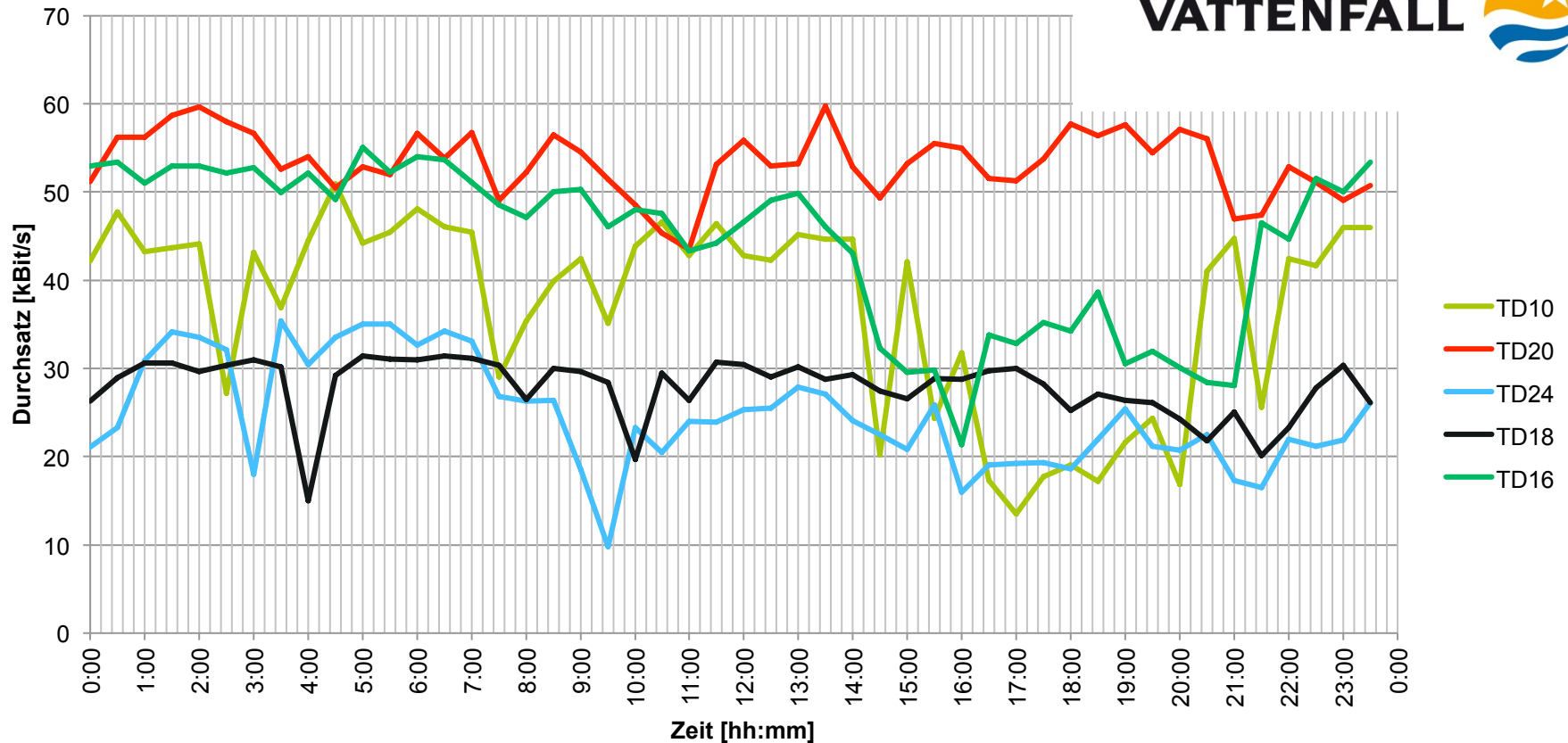
DESCRIPTION OF ENVIRONMENT

- Typical environment of urban grid
- High concentrated grid
- Distance between the nodes: min. 200 m
- Installation of one access point in a substation
- Installation of 22 nodes at costumers' premises
- Test only with synthetic data

Performance Test Results

PLEASE NOTE:
Achieved data rates are on application layer - physical layer data rates are nominally much higher.

G3-PLC based Fieldtrials with Vattenfall

Berlin Trials

- Aim
  Evaluation of data rates, distances and channel characterization of G3-PLC 500k in areas where CENELEC-PLC failed due to difficult power grid conditions.

- Locations
  - Berlin, Märkisches Viertel: Extensive domestic complex.
  - Berlin, Hohenschönhausen: Multi dwelling unit
  - Berlin, Kaulsdorf: Low voltage overhead wire.

Märkisches Viertel

Hohenschönhausen

Kaulsdorf

- Results
  - Stable communication connections
  - Data rates of up to 70 kBit/s payload UDP
  - The achieved distances were by far longer than expected.

Next step: >1000 industrialized products will be tested in the biggest two cities of Germany (Berlin, Hamburg)!

G3-PLC based Fieldtrials with Vattenfall – Berlin Results

Flat buildings with 20 floors

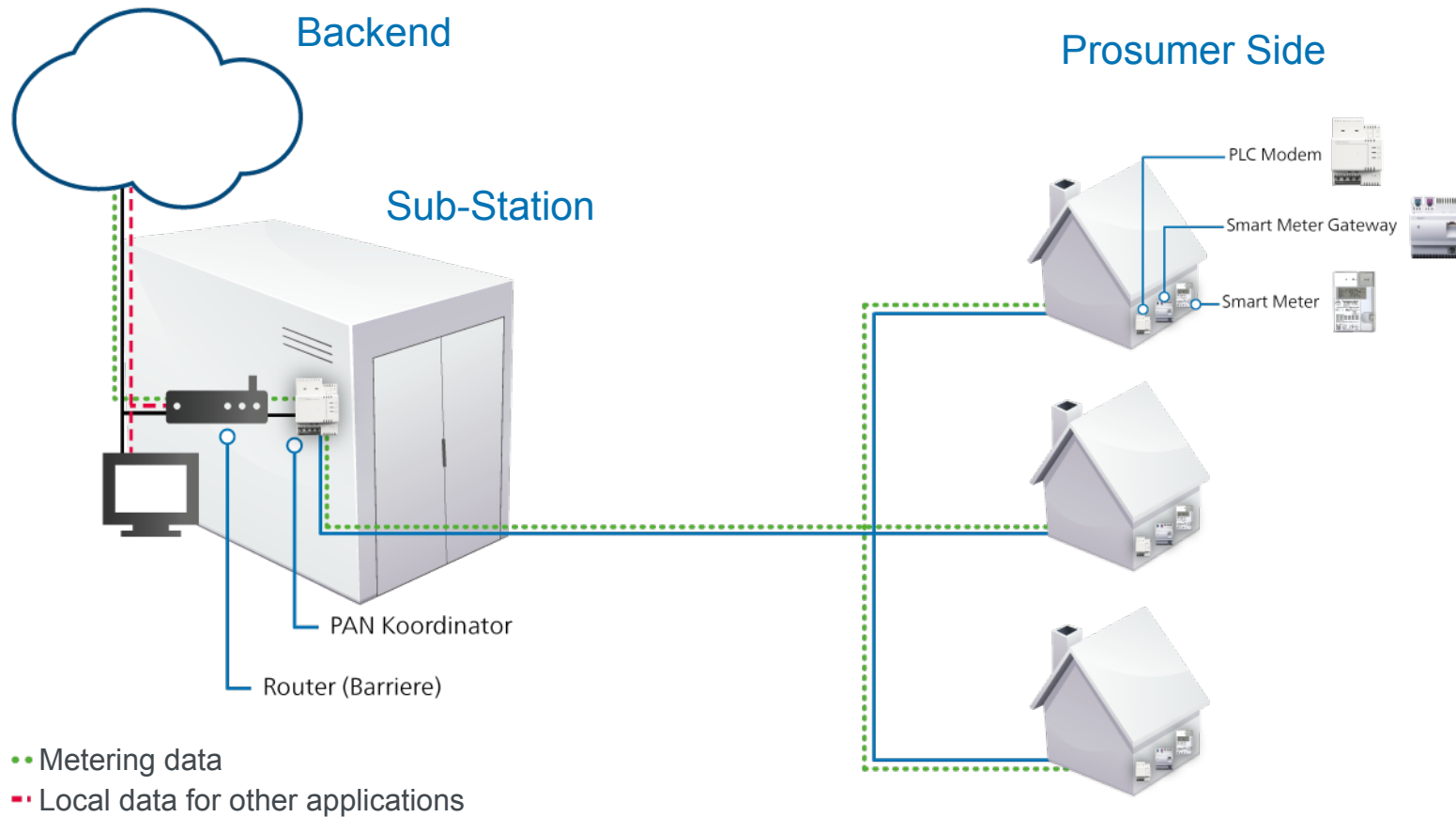|		Meter 1	Meter 2	Meter 3	Meter 4	Meter 5	Meter 6
Throughput [kBit/s]	max:	84	83	82	79	81	82
	avg:	79	81	76	73	53	77
	min:	60	74	56	45	22	59
Round Trip Delay [ms]	max:	513	469	474	503	1267	574
	avg:	433	426	437	448	650	441
	min:	418	417	427	426	490	419

System requirements of the Commission

Recommendation of 9.3.2012, C(2012) 1342 on preparations for the roll out of smart metering systems

- (10) *Data protection and information security features should be built into smart metering systems before they are rolled out and used extensively.* Such features can effectively improve consumers' control over the processing of personal data.

- (11) … to stimulate and support introduction of the '*security and data protection by design*' principle at an early stage in the development of smart grids, particularly *for the roll-out of smart metering systems*.

- (15) *An assessment of the data protection impact carried out by the operator* and stakeholders prior to the roll-out of smart metering systems will provide the information necessary in order to take appropriate protective measures. Such measures should *be monitored and reviewed throughout the lifetime of the smart meter*.

→ **German concept: Introduction of a Smart Meter Gateway (SMGW)**

Overview of Smart Metering System in Germany

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Backend

Sub-Station

Prosumer Side

PLC Modem

Smart Meter Gateway

Smart Meter

PAN Koordinator

Router (Barriere)

- - Metering data
- - Local data for other applications

Security and Privacy are ensured by the Smart Meter Gateway
- Protection of confidentiality, authentication, integrity of data
- End-to-End Security
- Information flow control

→ Requirement for higher data rates than without security/protection

Conclusion

- devolo's access technology approach based on G3-PLC 150-500 kHz has a very high potential as communication infrastructure for smart metering systems and other Smart Grid applications

  - Support of IP-traffic
  - Data rates observed during the field trials are typically higher than 50 kBit/s (payload TCP)
  - This is above present estimations for data rates requirements for metering systems and Smart Grid application.
  - With it's coverage and the observed distances, repeaters are generally not necessary.
  - Data transmission is robust against interferences on the power grid.
  - No interferences have been observed against other systems.

- System requirements on security and data protections increase data rates requirements.
  - CENELEC PLC systems cannot meet these requirements.

Next step: >1000 industrialized products will be tested in the biggest two cities of Germany (Berlin, Hamburg)!

devolo G3-PLC Modem 500k

Reliable data transmission in Smart Grids

G3-Powerline technology for efficient communication on smart grids.

G3-PLC uses your existing power grid to transmit data from smart meters, infeed renewable energy sources and grid status measurement.

Powerline is the essential technology to build up a smart grid in your municipality.

„We have extensively tested devolo's G3-PLC Modem 500k prototype. Our expectations have been greatly surpassed. That's why we run a large field test with devolo's serial product."

Jan-Philipp Blenk
Project Manager Vattenfall Europe Metering GmbH

Thank you very much for your attention.

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