



From Smart Metering to Smart Grids: PLC Technology evolutions

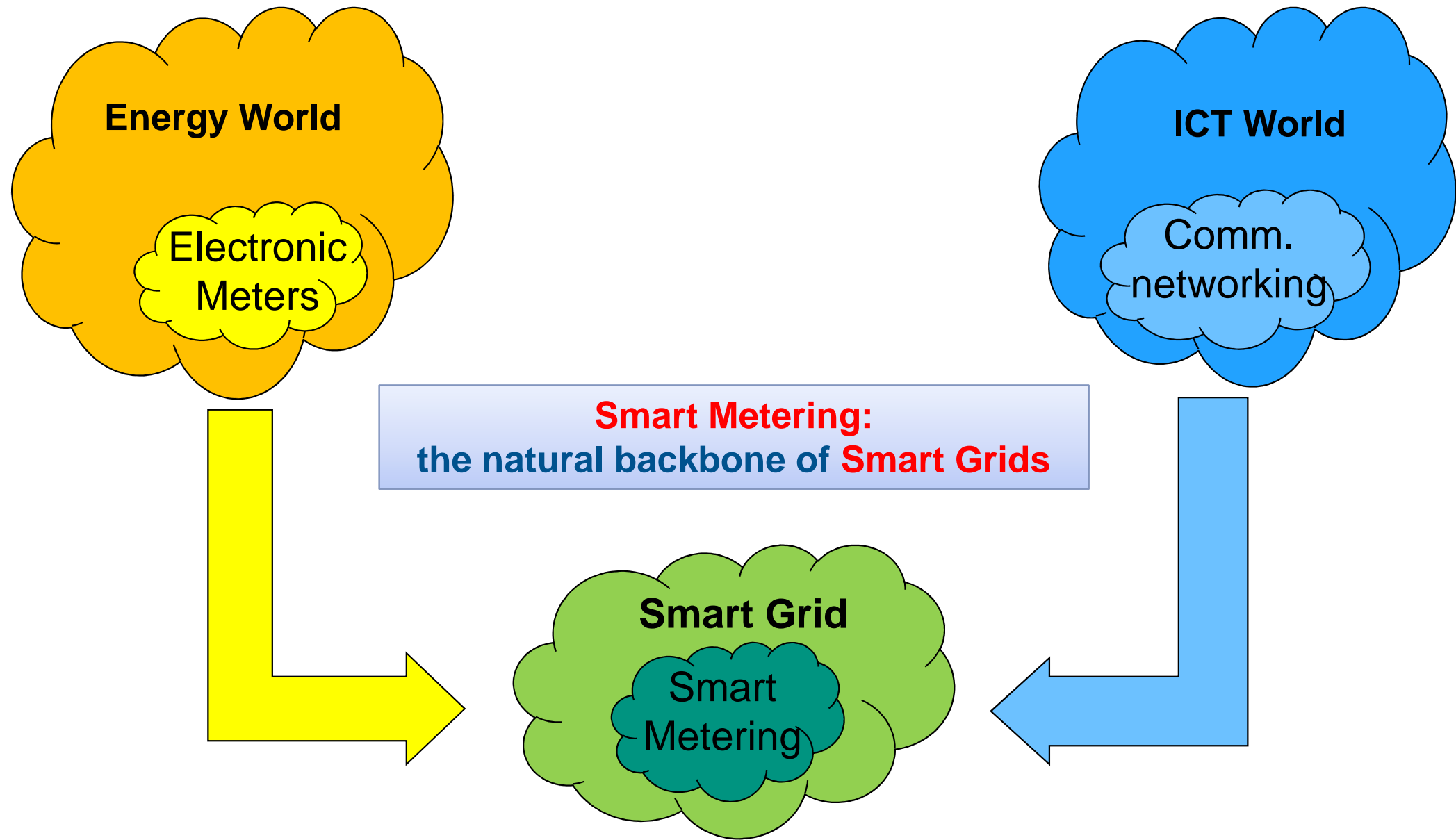
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ISPLC 2011
Udine, 5th April 2011

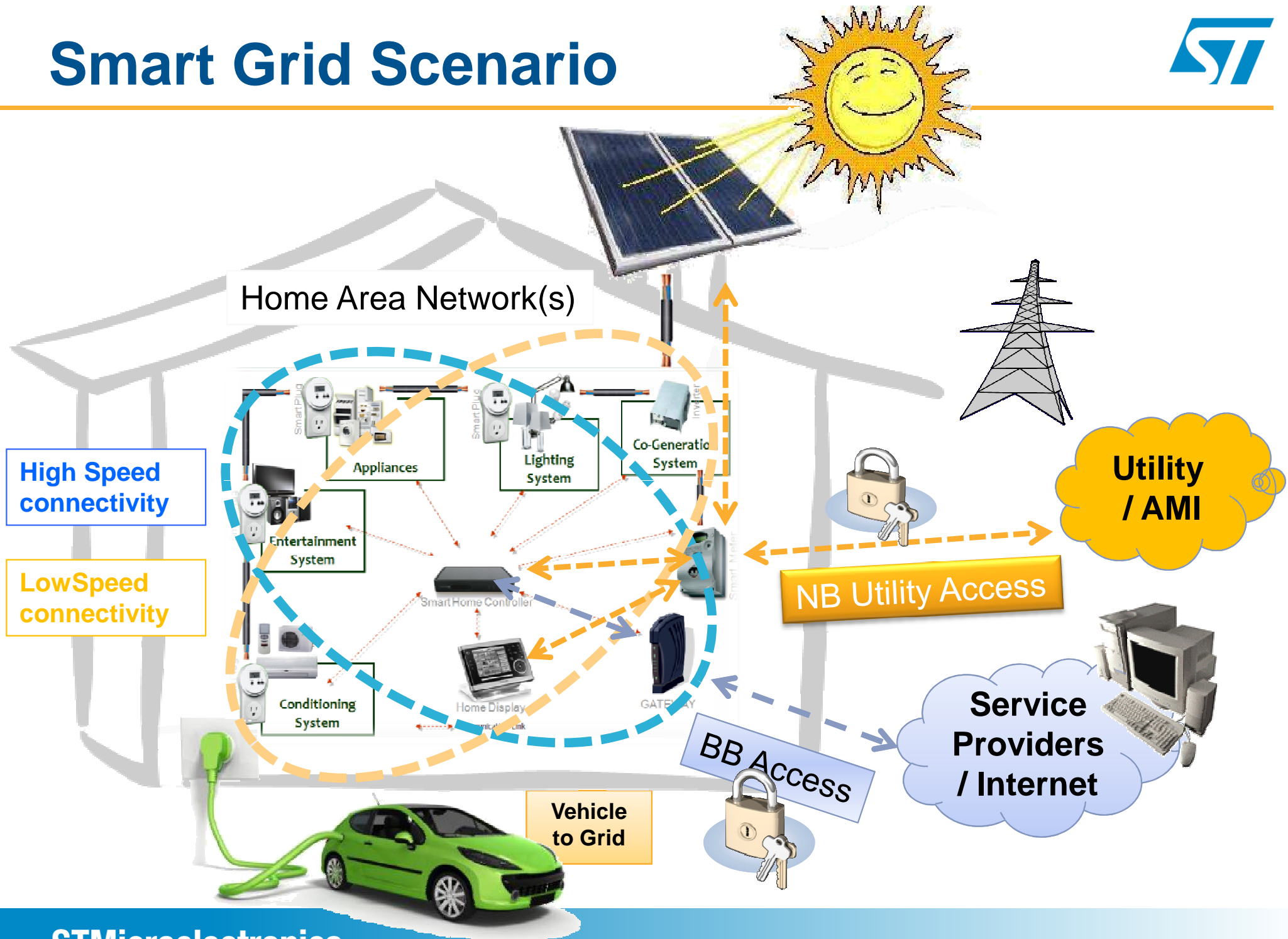


- From Smart Metering to Smart Grid
- Smart Grid drivers and PLC technologies
- PLC Implementation Examples
- Conclusions

From Smart Metering to Smart Grid



Smart Grid Scenario



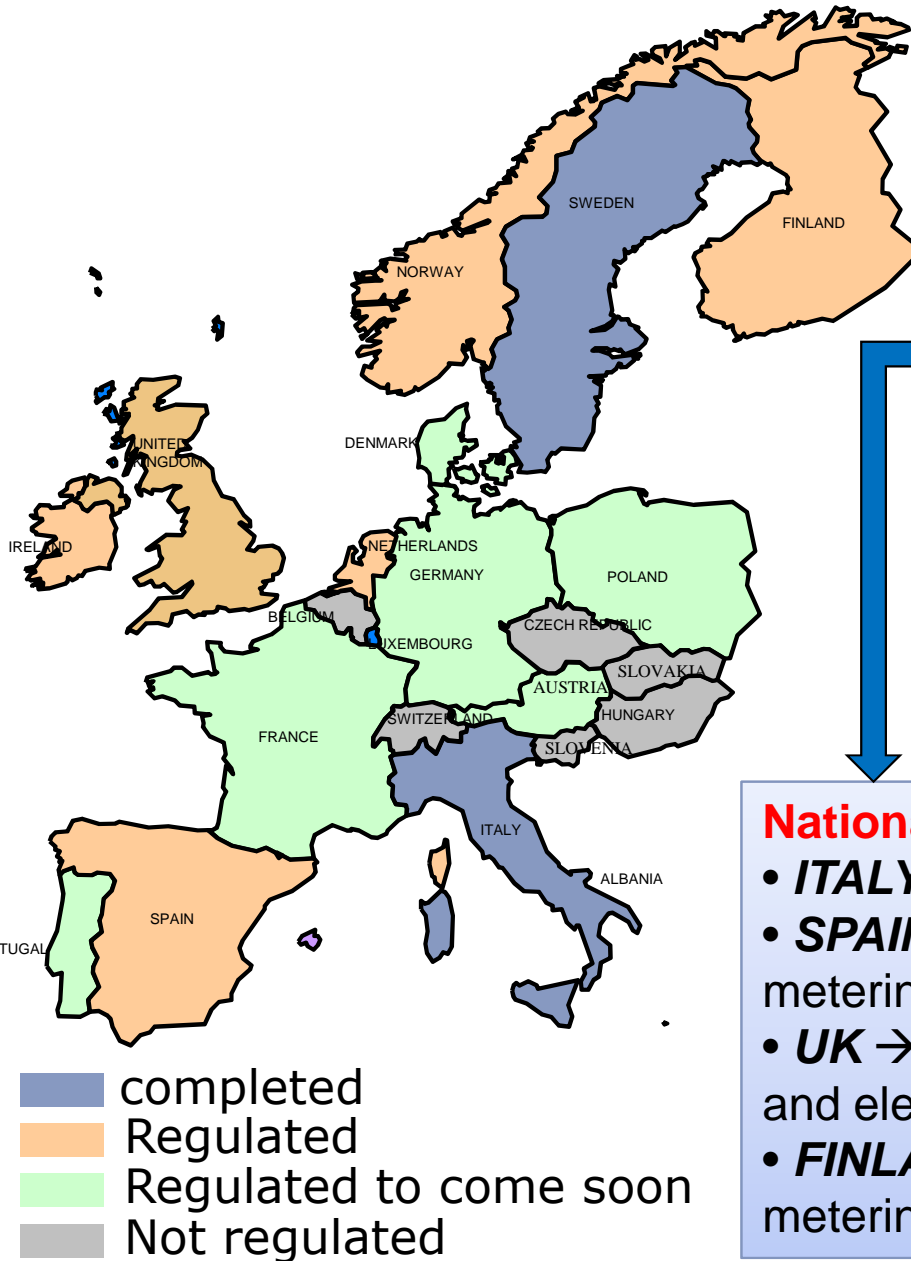
- Research reports estimate close to **250M installed smart meters by 2015**
- **Europe and North America** are leading with Asia growing fast
- **PLC is the most adopted communication** technology in Smart Meters:
60% share



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Smart Grid driving forces in EU:

EU mandates/directives & National regulations on Smart Metering first



EU Directives on climate change and smart meters deployments

- 2008 EU policy package: 20/20/20 objectives
- 2009 EU 3rd Energy Package: 80% smart meters coverage across all members by 2020
- 2009, M/441 to standardize an open architecture for Utility meters → **OPEN METER project**

EU Directives on metering and energy consumption functional requirements

- 2004/22/EC on measuring instruments
- 2006/32/EC on energy end-use efficiency and energy services

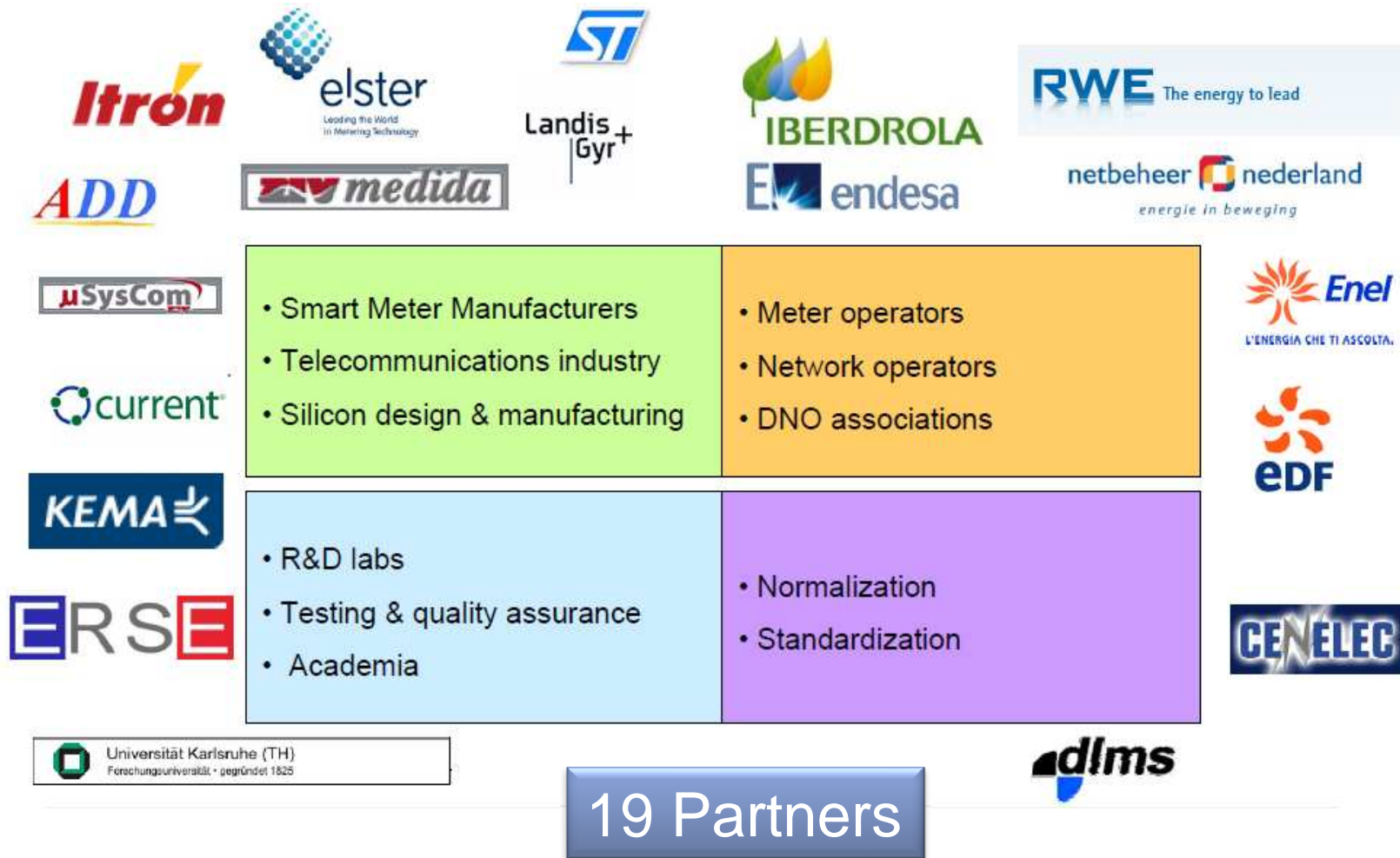
National regulations on smart metering penetration

- **ITALY & SWEDEN** → 100% roll out completed
- **SPAIN** → Royal Decree RD-1110 for 100% Smart metering roll out by 2018
- **UK** → New legislation (2009) defining 47million smart gas and electricity meters roll out by 2020
- **FINLAND** → New legislation (66/2009) for full smart metering penetration by 2014....

OPEN METER Project

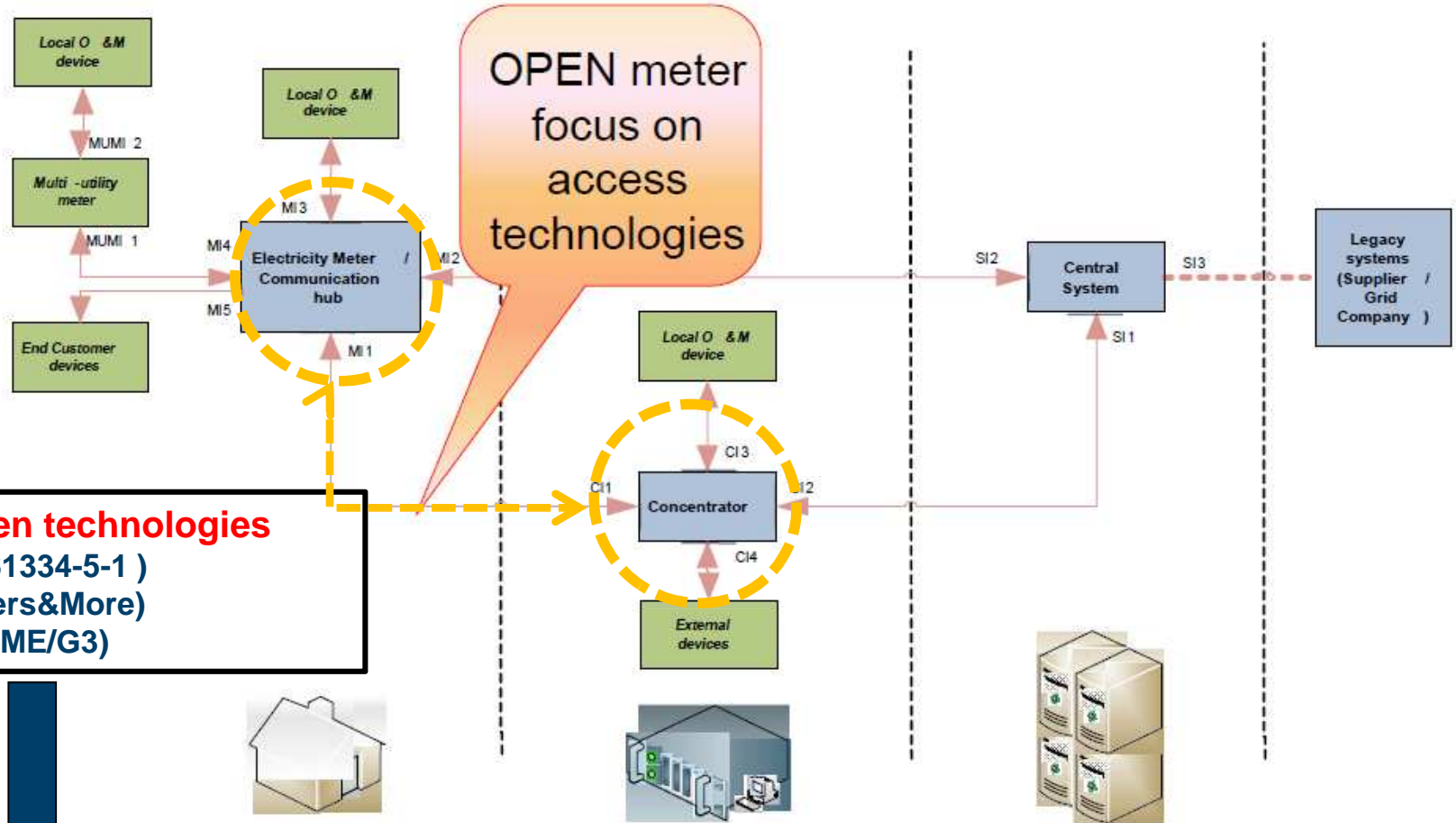


- The OPEN METER Project is an official initiative of EU Commission 7th Framework Programme (Topic Energy.2008.7.1.1) which responds to the EU Mandate 441 for the definition of an Open Access Standard for Smart Multi-Metering Services



OPEN METER Architecture & technologies

System components and interfaces



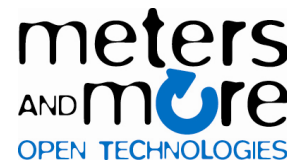
CENELEC Band A

Selected PLC open technologies

- S-FSK profile (IEC61334-5-1)
- N-PSK profile (Meters&More)
- OFDM profiles (PRIME/G3)



Relevant related Industrial associations:



...

Meters and More Association



- The two founding members of the association are Enel Distribuzione and Endesa Distribución Eléctrica.



- World leading companies from different business sectors have already joined the Association:



- Involved and interested members play different roles in the market:



Technology Providers



DSO



System Integrators



**Test and Validation
Service Providers**

- Meters and More open specifications have been defined as an evolution of the **Enel Telegestore protocol specifications**
- Meters and More application protocol has already been successfully operated on **several modulation schemes**, including FSK and BPSK
- **Efficient, robust and safe communication.**
 - Optimization of communication paths.
 - Very short messages, optimized for narrowband powerline communications.
 - Includes Encryption and authentication (128 bit AES)
- The new supported modulation scheme for the powerline communications is N-PSK with data rates ranging from high speed 8PSK uncoded mode at **28.8kbps** to high robust BPSK coded mode at **4.8 kbps**
- Proven on **more than 50Million installations** (Italy, Spain, Malta, Brazil..)

<http://www.metersandmore.eu/>

PRIME Alliance History



- **October 2007:**
 - IBERDROLA and few Industrial partners and R&D centers start working on the concept
- **May 2009**
 - PRIME alliance is officially launched including 8 principle members
- **October 2009**
 - PRIME Alliance proves successful multi-Vendor Interoperability
- **October 2010**
 - First Meter manufacturers pass official compliance tests by recognized independent third parties and are deployed on field (100k meters pilot)
- **April 2011**
 - PRIME Alliance reaches more than 30 members worldwide



- Open technology
- Robust and performing
 - OFDM up to 128kbps
 - n-PSK modulated subcarriers
 - Optional robust coded modes
 - 128-bit AES encryption
- Plug & Play
- Suitable for DLMS/COSEM and TCP/IP standards implementations
- Supported by multiple suppliers and stakeholders worldwide (silicon makers, meter manufacturers, utilities, technology providers,)
- Interoperable solutions available
- Big deployment started
- Approved profile/annex in IEEE and ITU NB OFDM PLC standardization groups



<http://www.prime-alliance.org/>

- Target features
 - 0 - 500 kHz frequency band, OFDM based
 - Up to 500kbps speed range
 - Communication over either LV or MV networks
 - Internet (IP) networking: IPv6 support
 - Coexistence with legacy single carrier technologies
 - PRIME and G3 profiles in CENELEC A band
- The IEEE P1901.2 Working Group has started the development of the standard in April of 2010 and expects to complete the work this year/beginning 2012
- IEEE P1901.2 Working Group is collaborative effort driven by the industry:
 - Accenture, Aclara/Esco Technologies Inc., ADD Semiconductor, Arkados, Cisco , Current Technologies International , devolo AG, Duke Energy, Echelon Corop, EDF/ERDF, HomePlug Powerline Alliance, iAd GmbH, Iberdrola, Itron, Kawasaki Microelectronics, Inc., Landis+Gyr, Lantiq, Maxim, Power Plus Communications AG, Sagemcom Energy & Telecom, Schneider Electric, STMicroelectronics, Texas Instruments Inc., Watteco, Yitran Communication
- HomePlug Alliance is sponsoring this standard for access and is developing the certification program for interoperability and compliance

Smart Grid driving forces in US:

Economic stimulus, security, energy & consumer markets innovation



American Recovery (ARRA) Stimulus:

- Smart Grid demo projects (\$4.5B)
- Energy Efficiency and Conservation Block Grant (\$3.2B)
- Transportation, including electric vehicles (\$1.7B)

“The smart grid is an instant replay of the Internet”

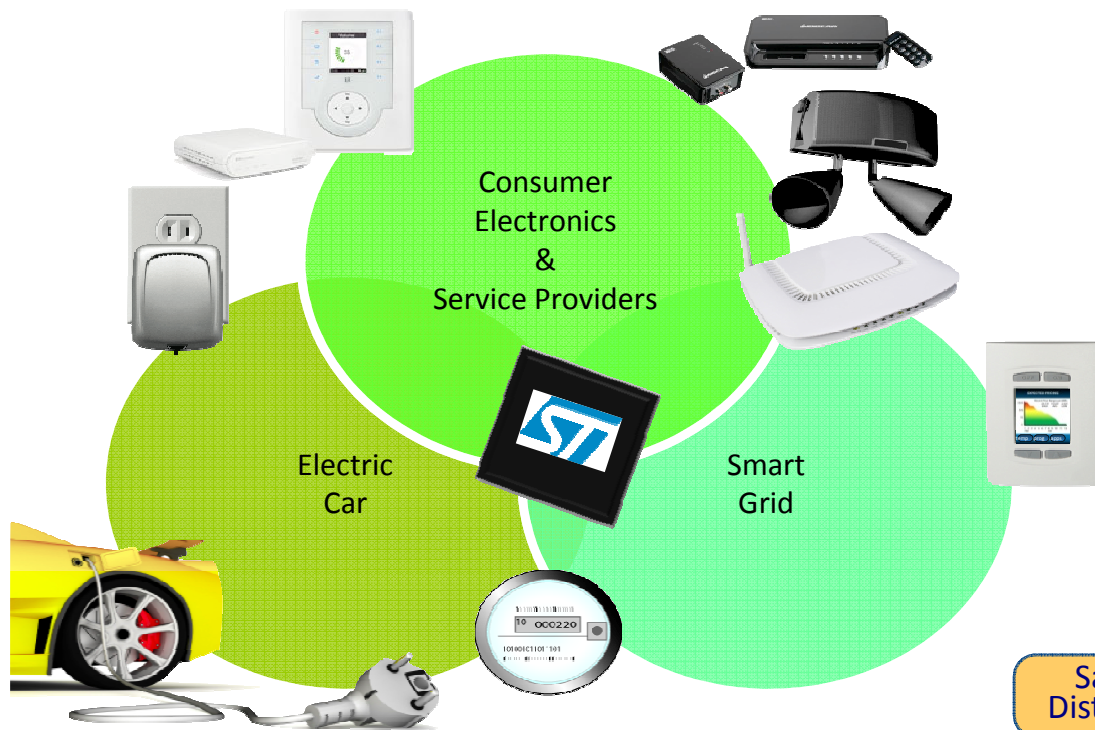
- Cisco CEO John Chambers

... but sometimes some barriers to Smart Grid deployments still remain:

- Energy management is not top of people mind, respect to consumer electronics
- Energy prices are still quite low in North America to commit customers to “energy efficiency”
- Security & Privacy is a concern

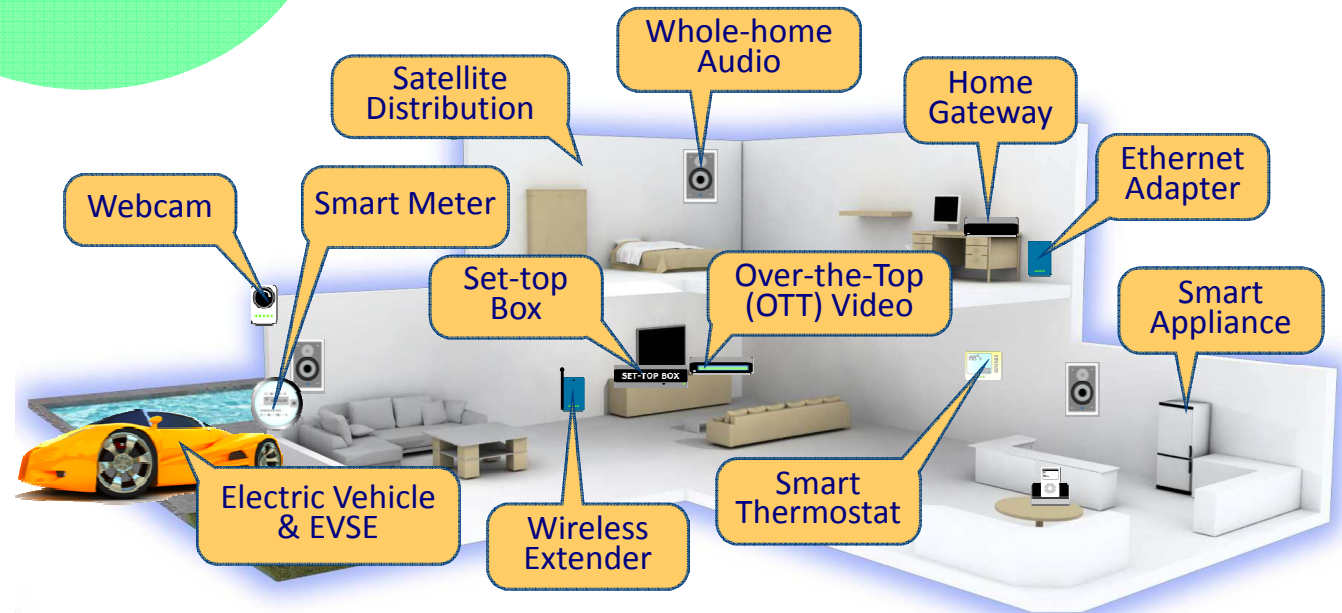


Expanding the Green Ecosystem in the Home: the “Quad Play” convergence opportunity



- The “triple play”, i.e., the convergence of all media (voice, video, data) into the home, provided by a single vendor, and streamed to a variety of consumer devices (phones, TVs, computers, and more) is today a reality
- By integrating “Home energy management systems” (HEMS) to feature-rich “triple-play” devices may enable wide smart grid functionalities penetration into the home

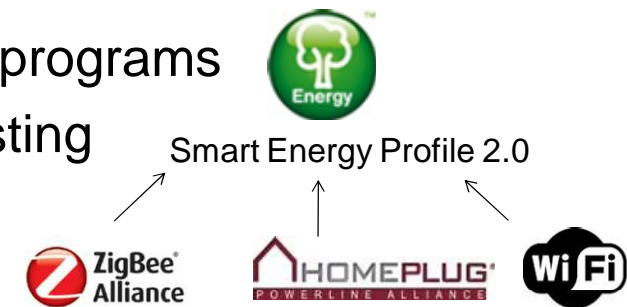
➤ ENERGY
➤ VOICE
➤ VIDEO
➤ DATA



HomePlug fast facts



- Mission: to create specifications and certification programs for using the power lines for broadband home networking and Smart Grid
- HomePlug works to accelerate worldwide PLC adoption
 - Promotion and market development; user education programs
 - Certification logo : compliance and interoperability testing
 - Formal liaison agreements with complementary key RF industry groups such as ZigBee and Wi-Fi
- Entity membership and support for key IEEE standards
 - 1901 -- broadband-speed powerline (standard published)
 - 1901.2 -- low-frequency, narrow-band powerline
 - 1905.1 -- convergent digital home network for heterogeneous technologies
- Estimated cumulative shipments: 65 million HomePlug devices



HomePlug: one of the largest industry group dedicated to powerline networking



Sponsor Members



8 companies



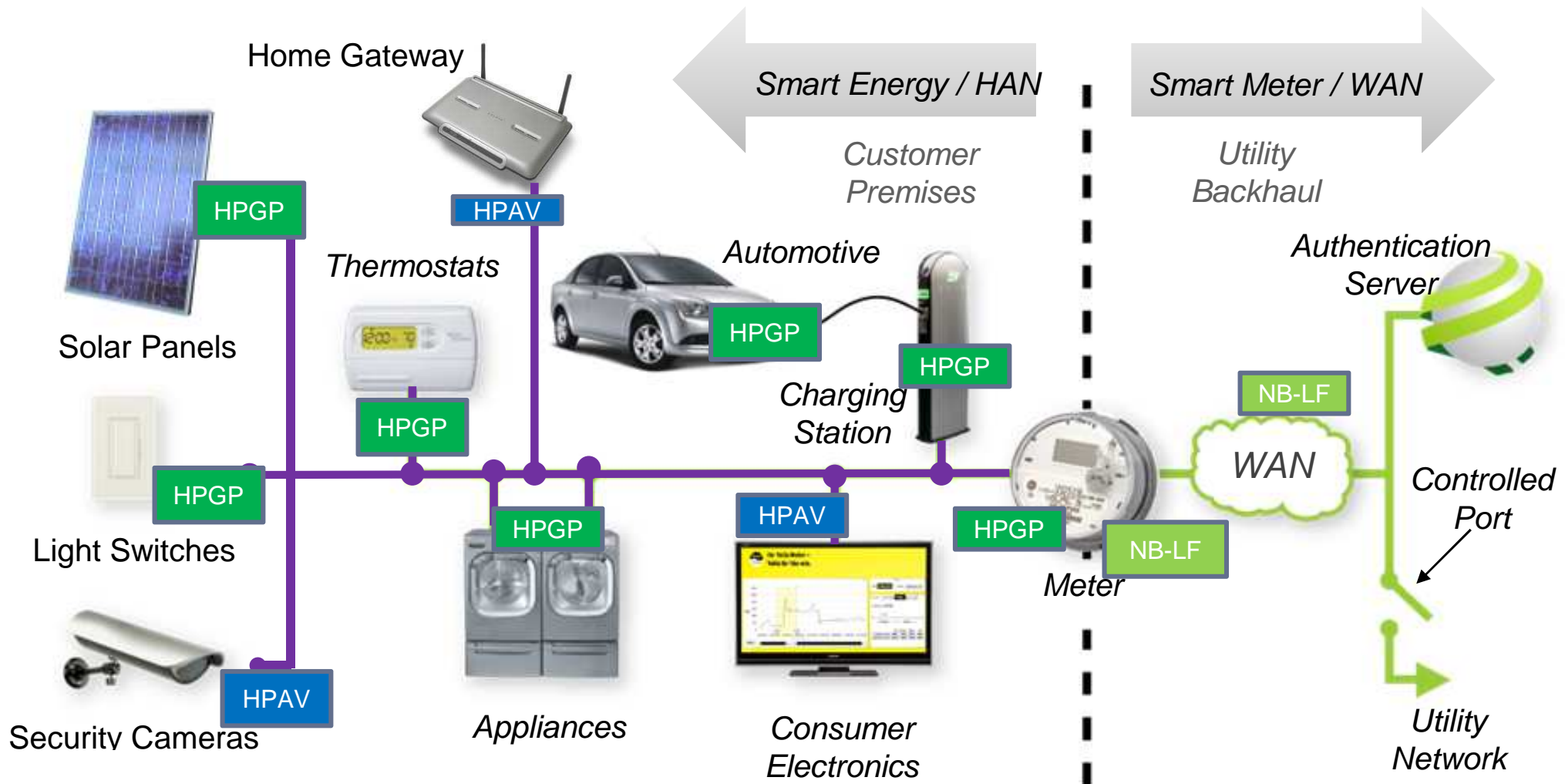
Adopter Members: 30 additional companies

HomePlug GP (“Green PHY”)



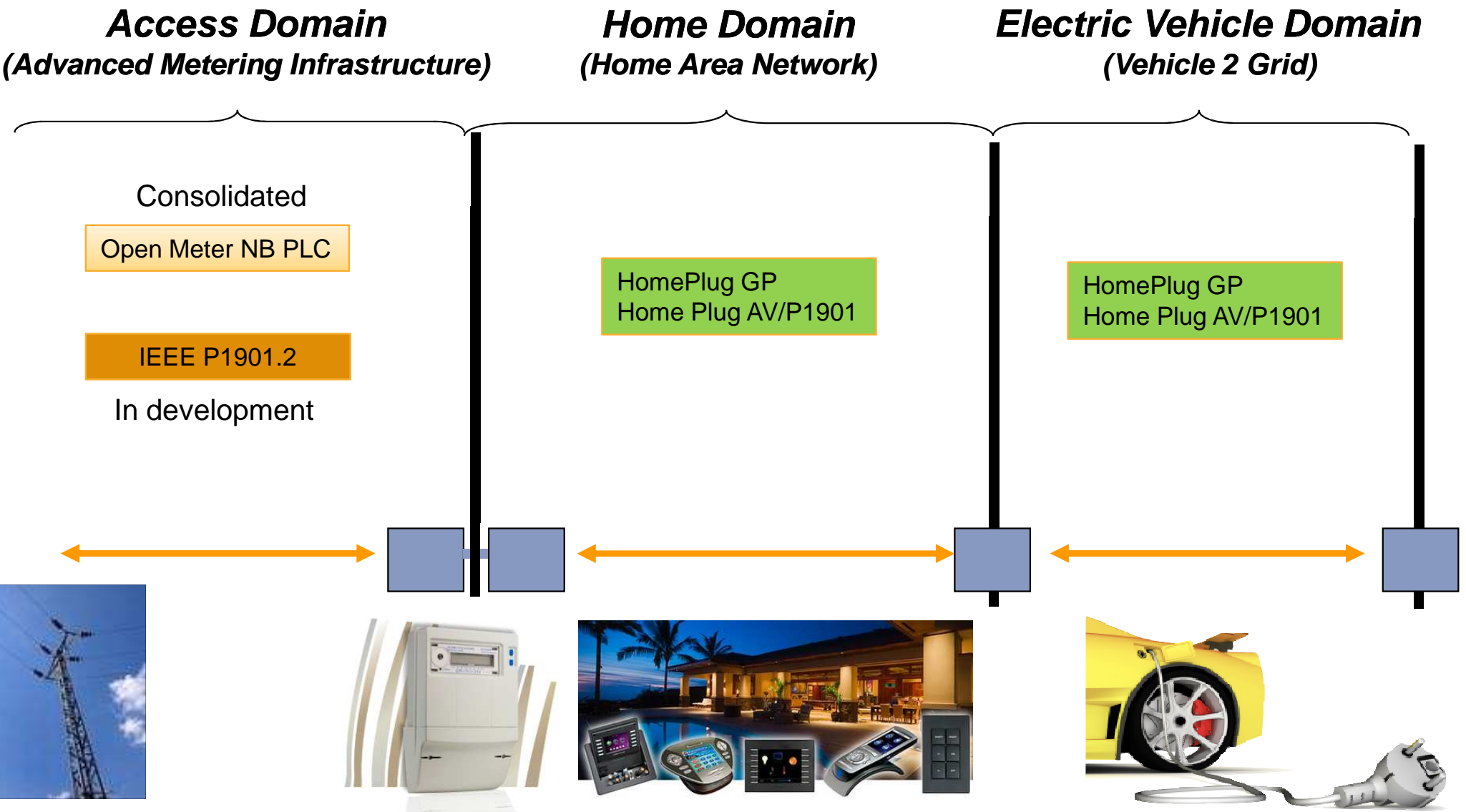
- Principle applications
 - Monitor and control devices via low speed, low cost powerline communications:
 - Smart Energy: demand response, load control, energy efficiency
 - Home/Building Automation
- Target features
 - Extremely robust and reliable
 - **interoperable** with **HomePlug AV** and **IEEE 1901**, but
 - lower power consumption (- 75% target), lower cost
 - Internet (IP) networking: 802.2, IPv6 support
 - minimum 1 Mbps effective data rate (3.8 Mbps peak PHY rate)
 - Support for firmware updates
- Specification ratified and released in June-2010

HomePlug Smart Grid Solutions



Smart Grid PLC standards by application domain

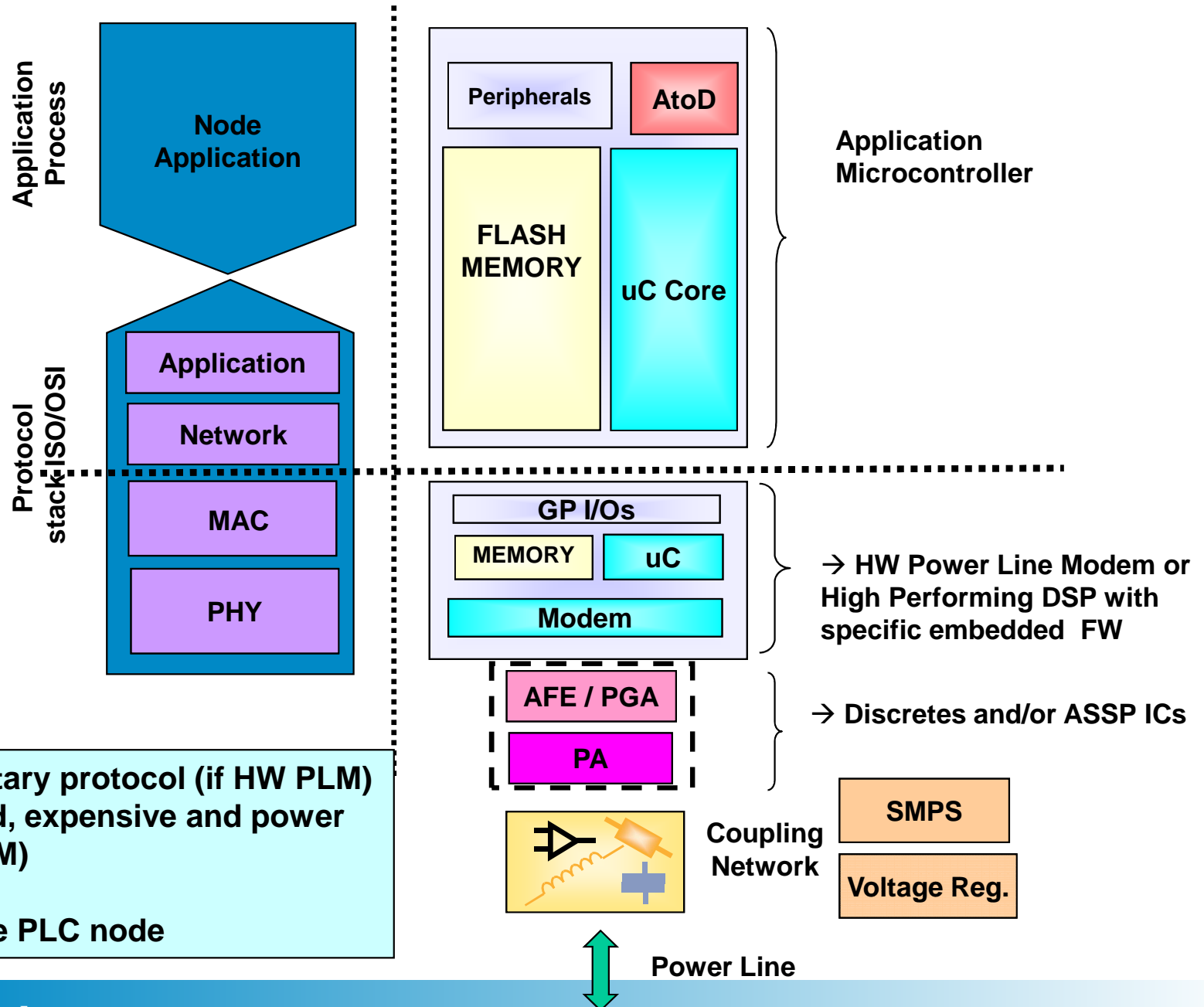
Possible scenario summary





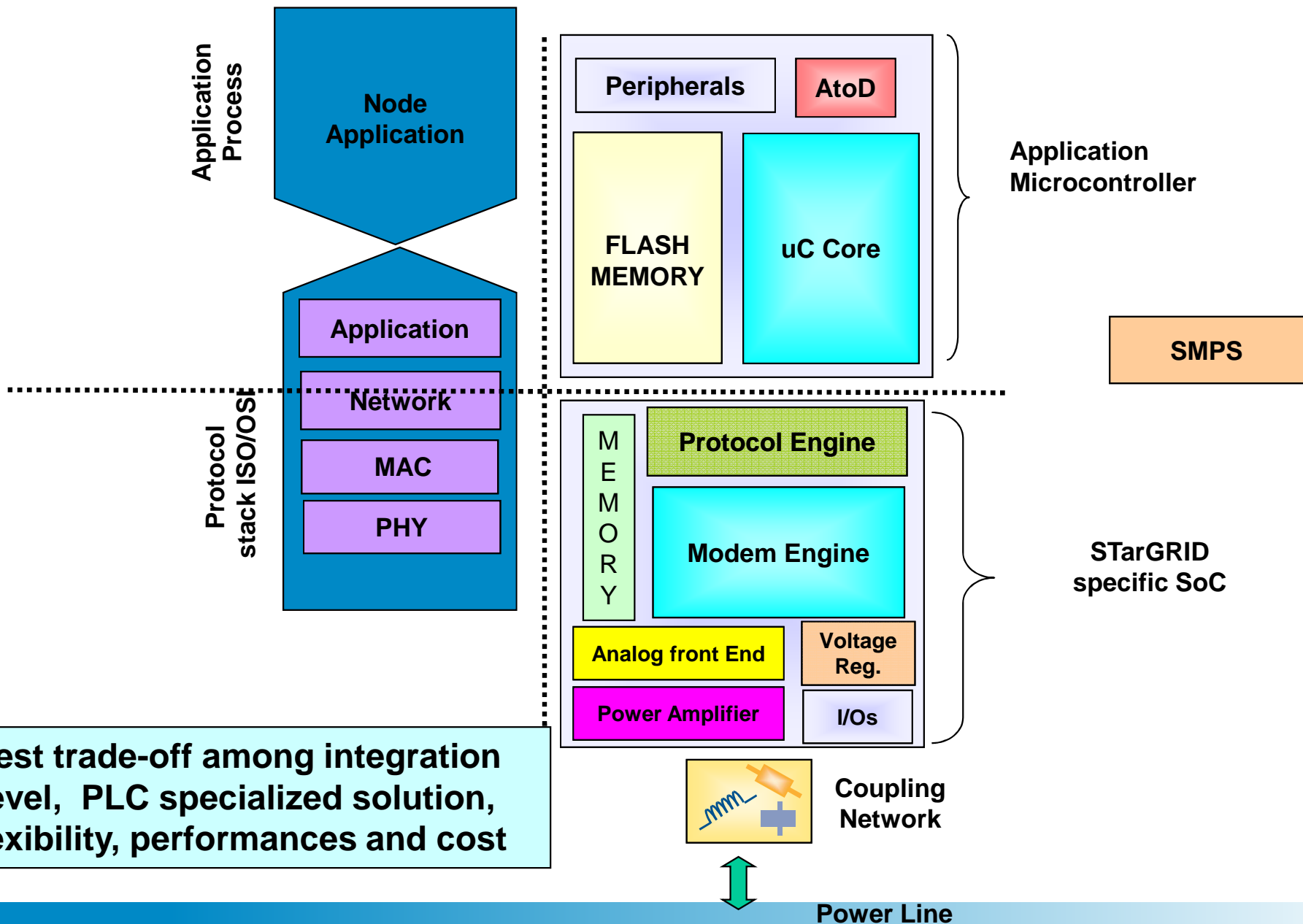
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Typical PLC node partitioning



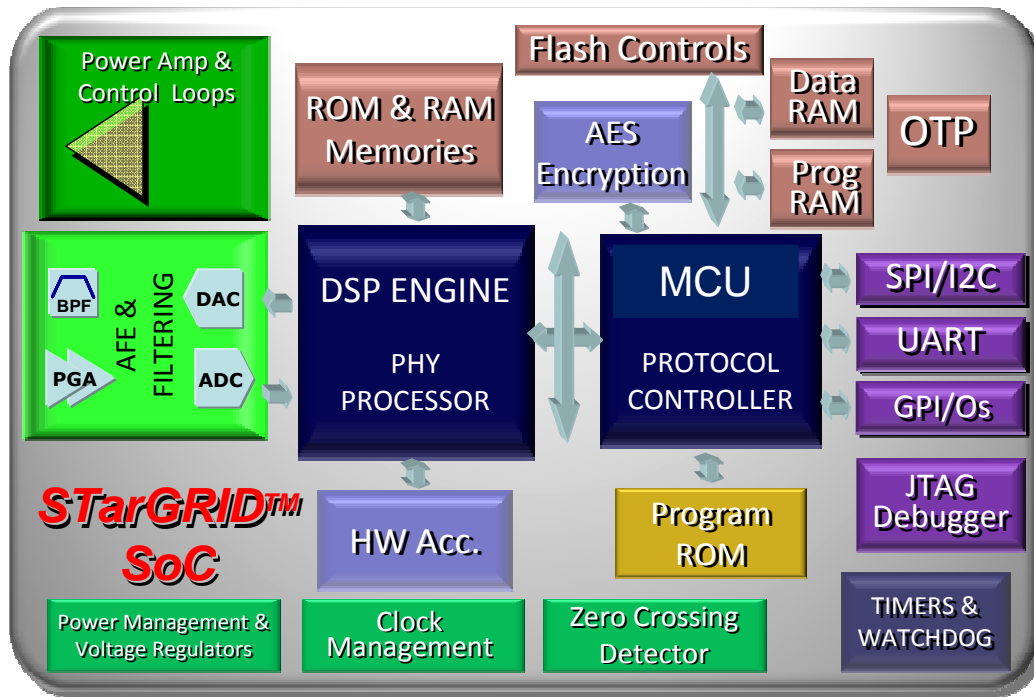
- Not flexible, proprietary protocol (if HW PLM)
- Not PLC specialized, expensive and power consuming (if DSP PLM)
- High Bill of Material
- Large and expensive PLC node

PLC node partitioning based on SoC approach



Best trade-off among integration level, PLC specialized solution, flexibility, performances and cost

NB PLC SoC implementation ("STarGRID" Platform)



OPEN meter

Open Public Extended Network metering



- Scalable pin-to-pin compatible solutions
- Programmable DSP for multiple modulations
- 8-bit core for multiple protocols management
- Suitable for CENELEC A, B, C, D bands
- Integrated Power Amplifier
- AES Encryption
- Lowest BOM



ST759x

- OFDM modulation
- 128 kbps baud
- **PRIME "certified"** by KEMA
- Ready for **IBERDROLA** deployments



ST758x

- n-PSK modulation
- 28.8 kbps baud
- The only **Meters&More** compliant
- Ready for **ENEL/ENDESA** deployments

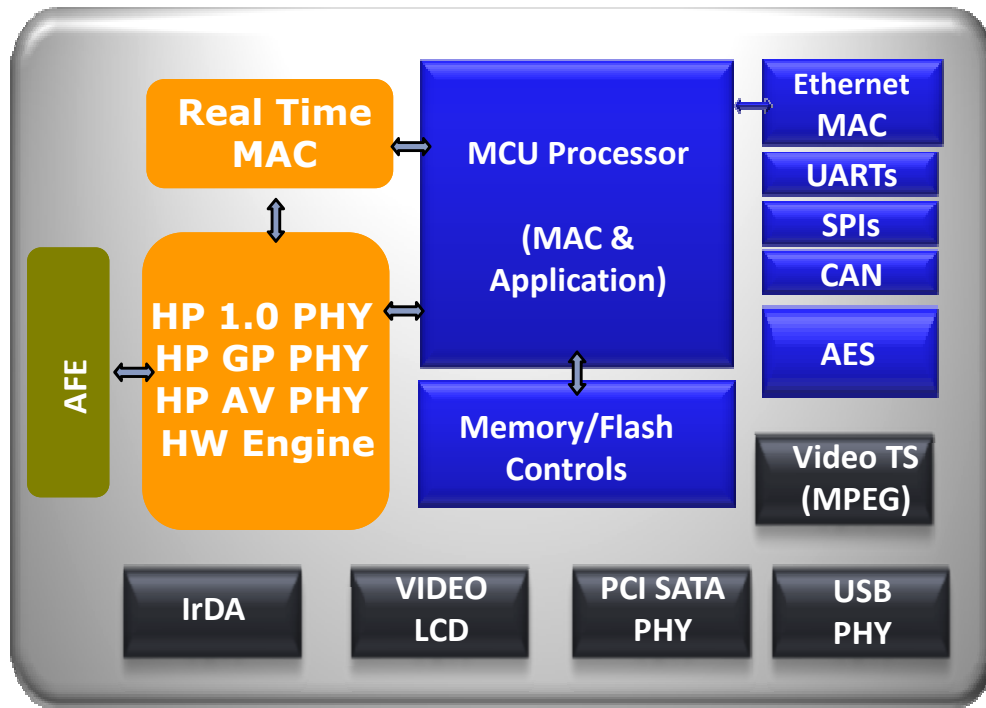


ST757x

- S-FSK modulation
- 2.4 kbps baud
- **IEC 61334-5-1 + LINKY** compliant
- Ready for **ERDF G1**



BB PLC SoC Implementation (HomePlug) for “Quad Play” applications (Home Area Network)



- MCU for protocol/application processor
- Dedicated Engine for Home Plug standards:
 - HomePlug GP
 - HomePlug 1.0
 - HomePlu AV
- Multiple connectivity peripherals
- Embedded AFE

CONCLUSIONS



- Smart Metering is the fundamental step towards Smart Grids
- PLC is becoming one of the preferred communication technologies for Smart Grids
- OPEN METER and HOMEPLUG technologies are today by the facto Smart Grid PLC standards
- SoC design allows flexible and cost effective PLC node implementations for widest adoption in all Smart Grid domains

Thank You

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