SmartCoDe
System-in-Package (SiP) Considerations

SmartCoDe Expert Cooperation Workshop
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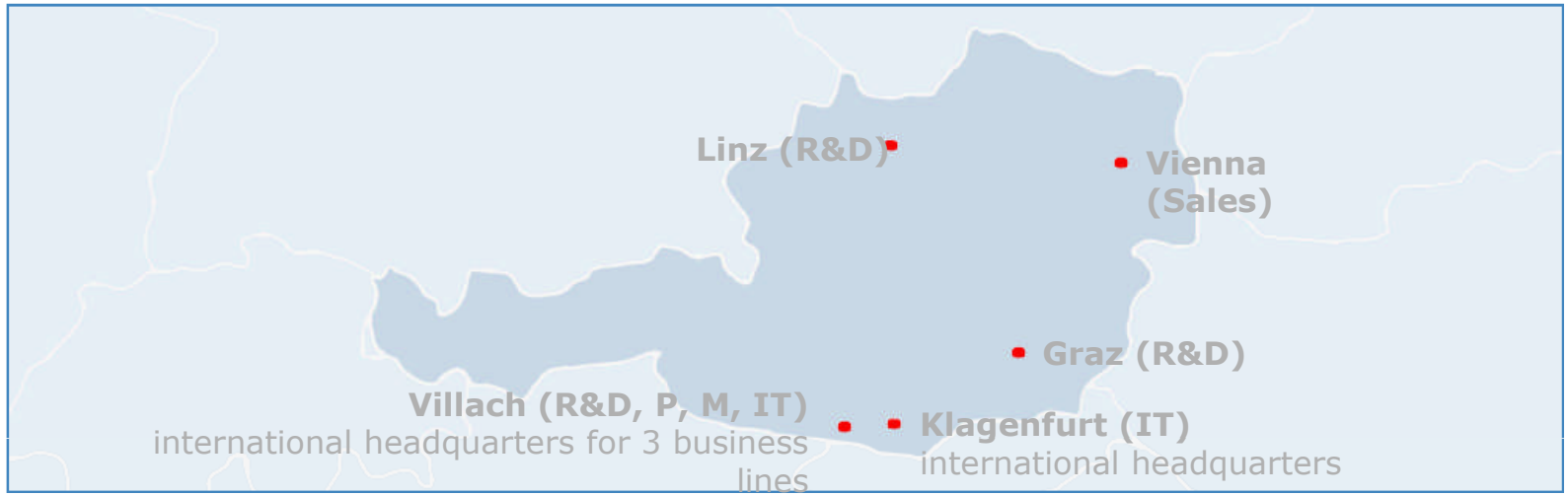
- Status Development of Key Elements: Metering IC, Power Supply
- Discussion on partitioning SiP/SoC
- Conclusion

Introduction & Scope

Infineon Austria – Company Overview

Infineon Technologies Austria AG incl. subsidiaries



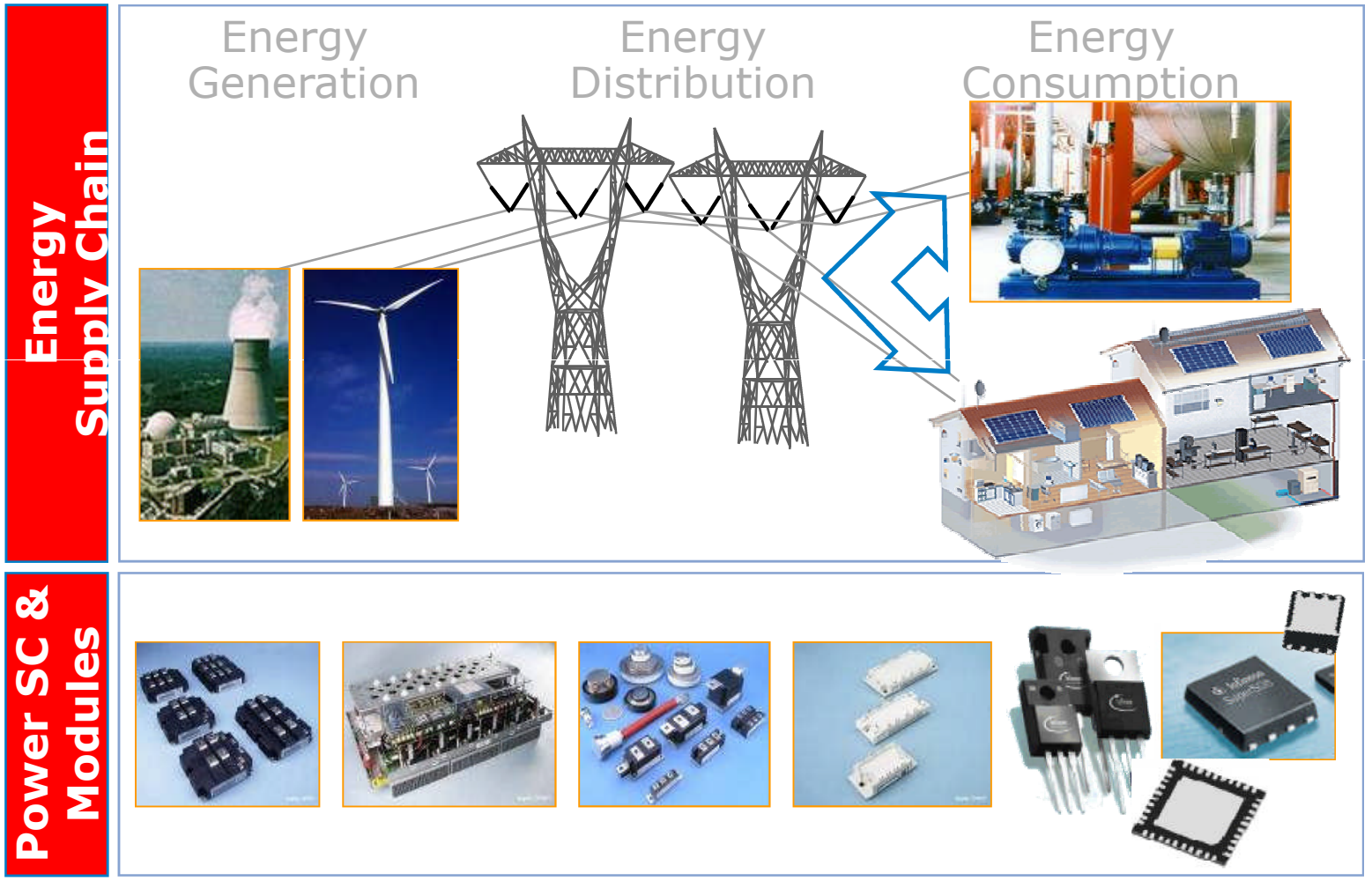
Villach	Graz	Vienna	Klagenfurt	Linz
				

foreign subsidiaries:	Kulim (Malaysia)	Bucharest (Romania)

Environmental Sustainability at Infineon

Enabling a Sustainable Society: Our Products

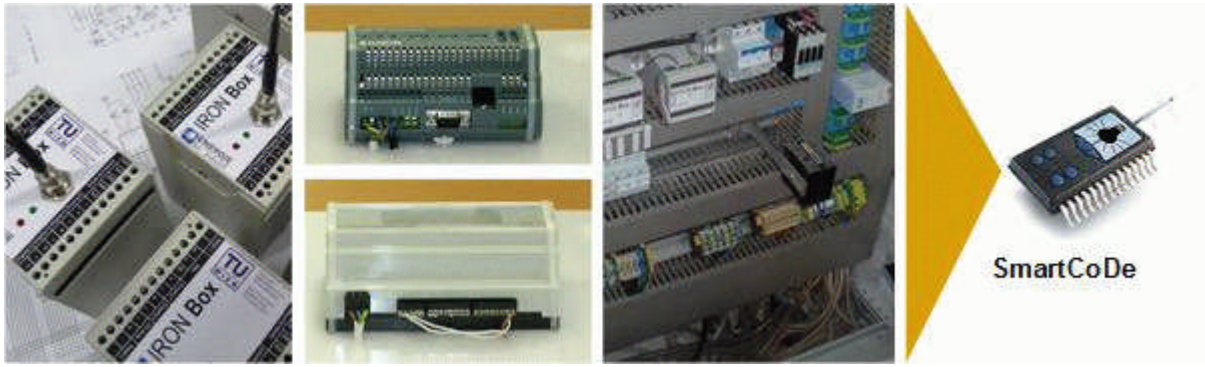
IFX provides products and solutions for the whole energy value chain



…Now Going Further to the Energy CONTROL Level

SmartCoDe Target Module

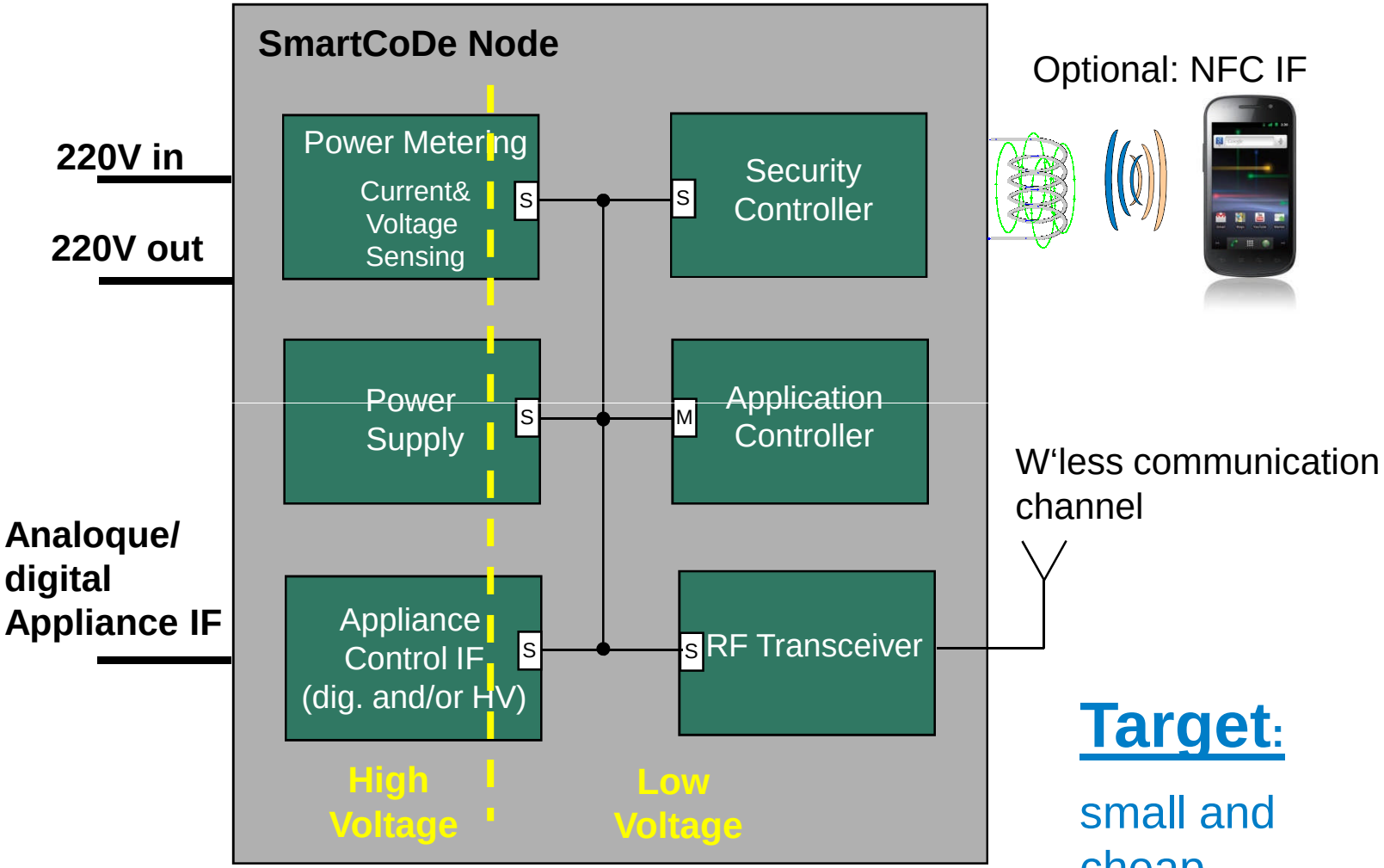
› Miniaturized wireless networked smart device for power metering and control of energy using products at low costs
  – **Lighting units**
  – **(Home-) appliances**
  – **Intelligent power plug**
  – **…**



Application cases to be considered

- Lighting units (**LED**, neon lamps, halogen lamps, bulb, …)
- Appliances control (e.g. fridge, washing machine, ..; with digital or analogue interface)
- Intelligent power plug (Power plug control & metering)
- Smart Metering only (measure, store and report metering information)
- Sensors (temperature, humidity, presence, light level,…)
- Master- resp. Gateway Node (need to also perform SW-centric network management tasks, key management,…)
- ….

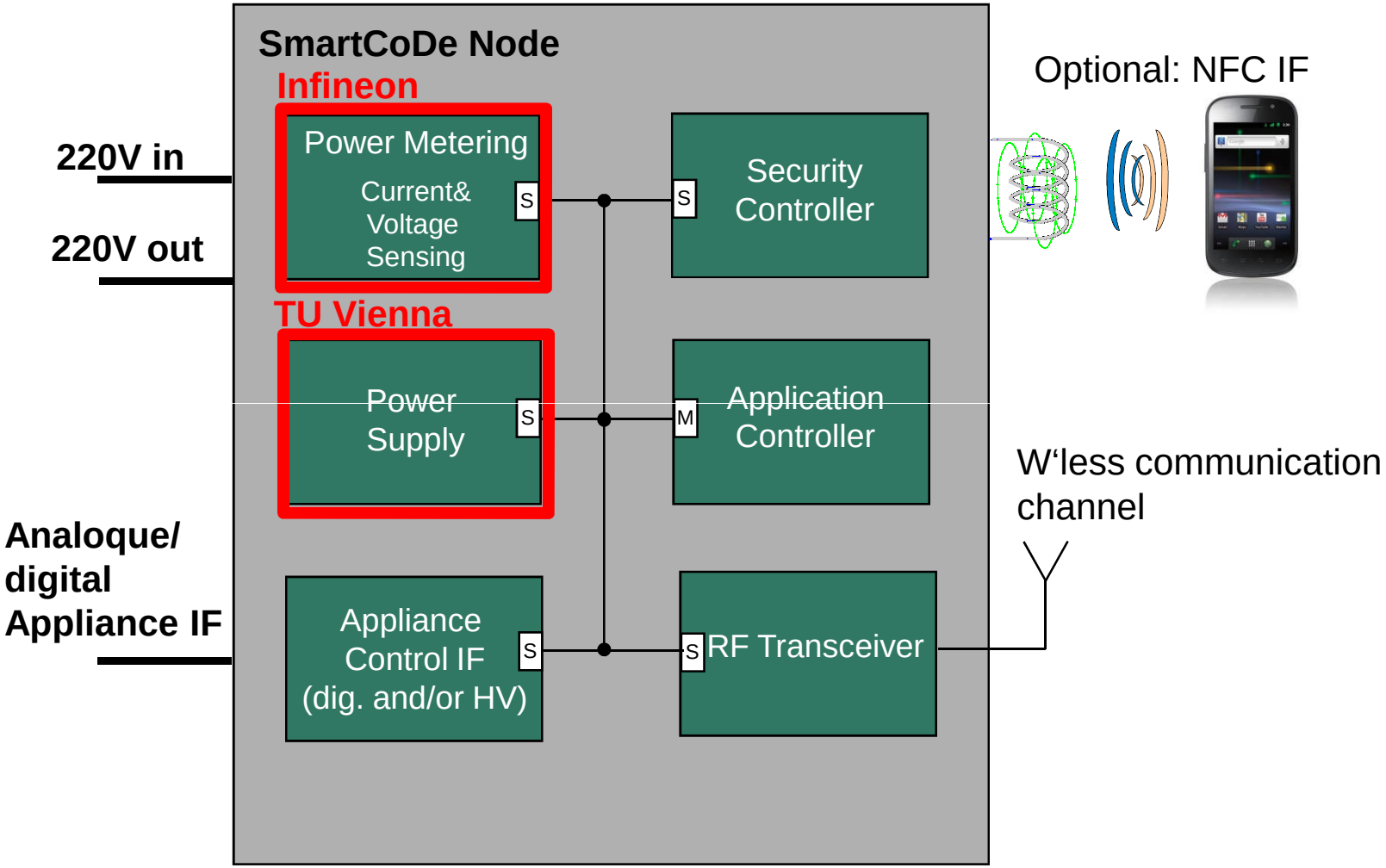
Basic Functional Blocks of a full functional SmartCoDe Node



Target:

small and cheap

Key Components developed throughout SmartCoDe

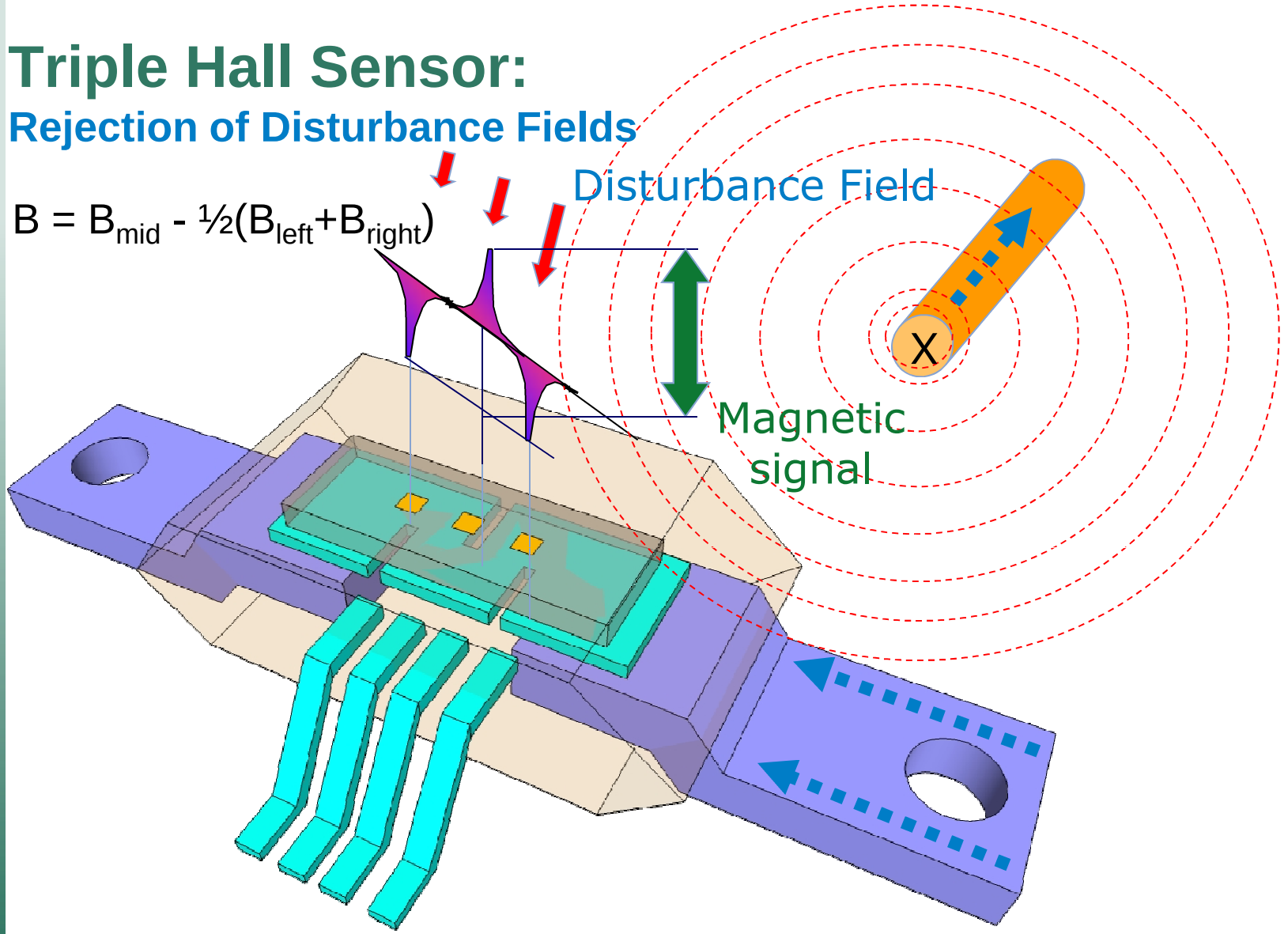


Key element: Current (Power) sensing

Triple Hall Sensor:

Rejection of Disturbance Fields

$B = B_{mid} - \frac{1}{2}(B_{left}+B_{right})$

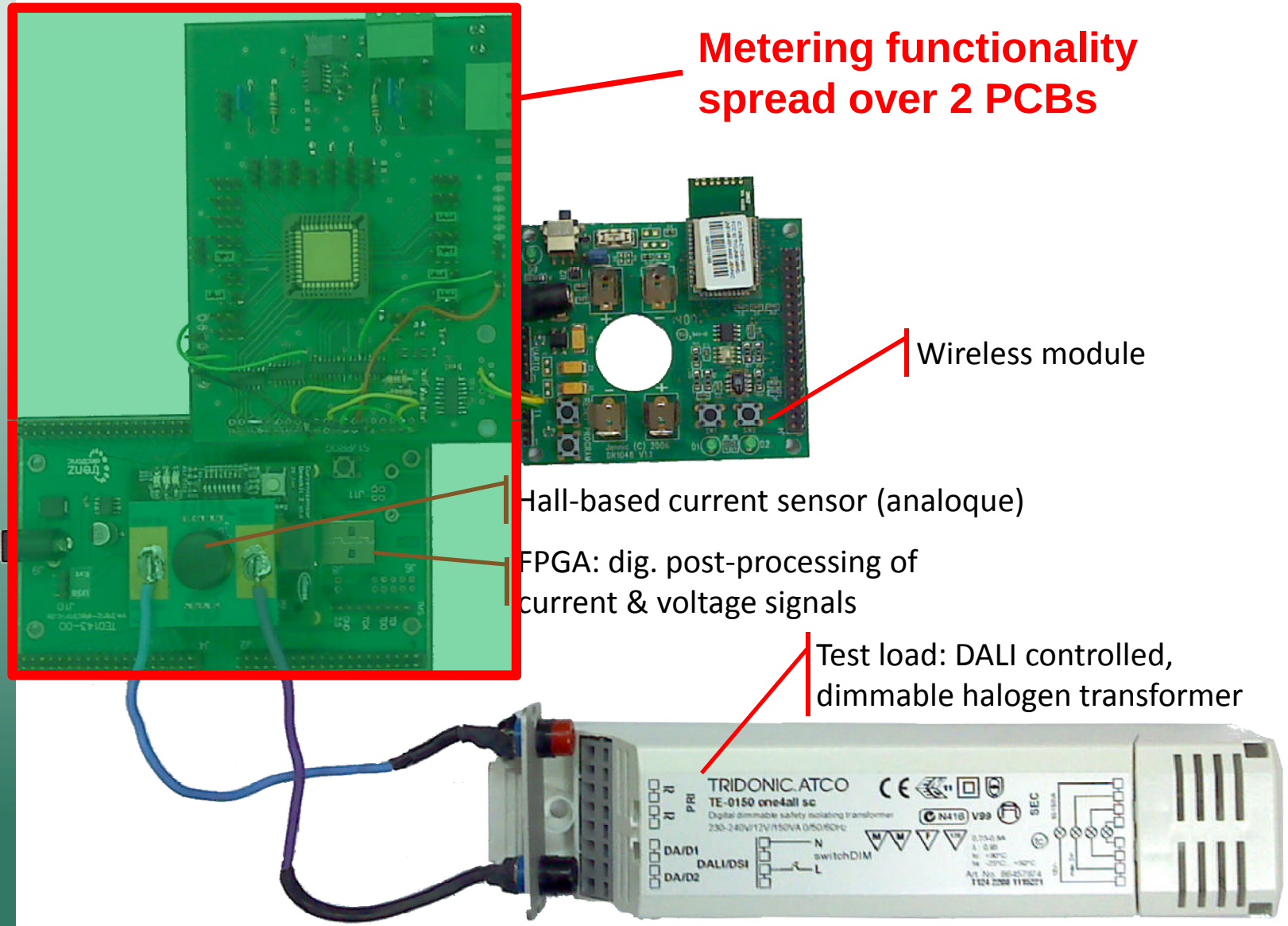


Dual Hall Sensor:

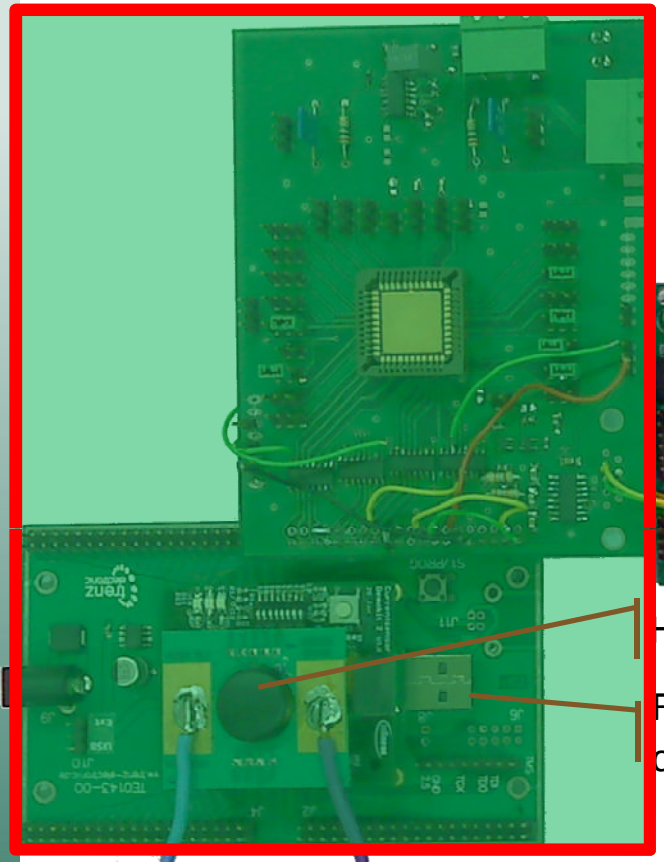
Differential principle

$B = B_{left}-B_{right}$

First functional Demonstrator (year 1)

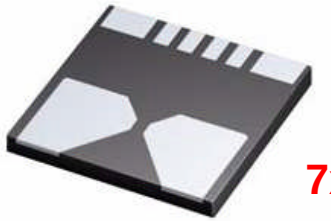


Metering Sensor: First fully integrated samples now ready for test

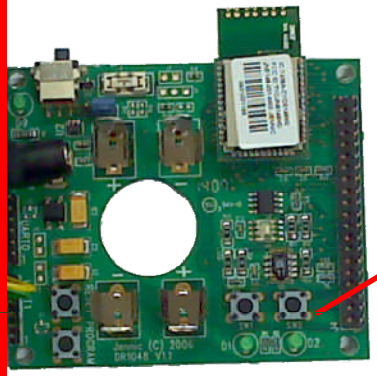


Analoque+digital

Metering IC



7x7mm

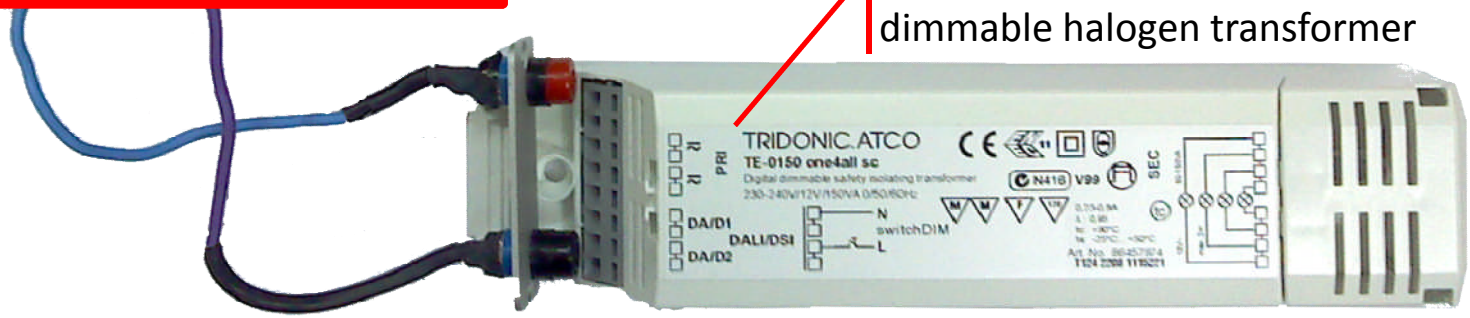


Wireless module

Hall-based current sensor (analoque)

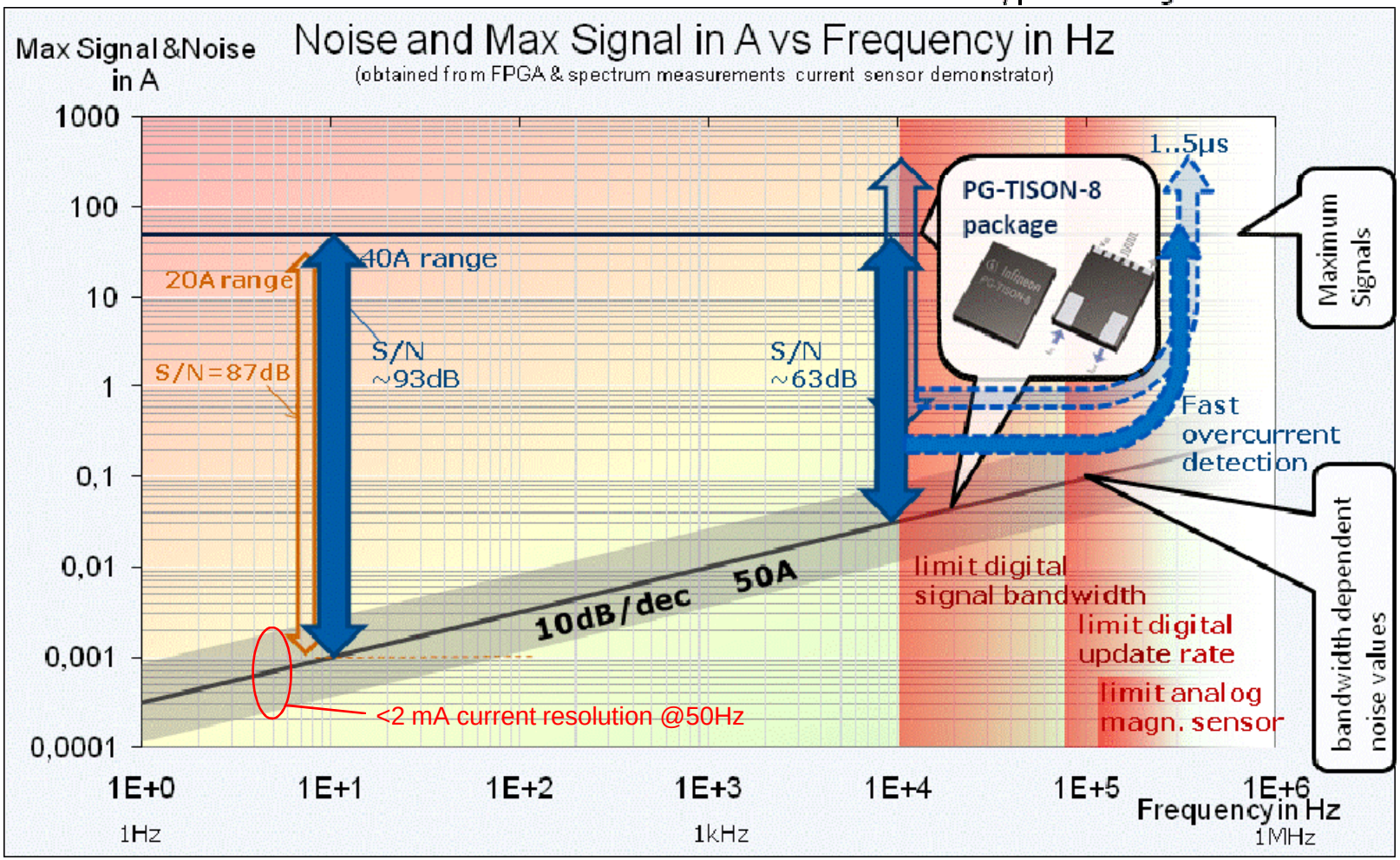
FPGA: dig. post-processing of current & voltage signals

Test load: DALI controlled, dimmable halogen transformer



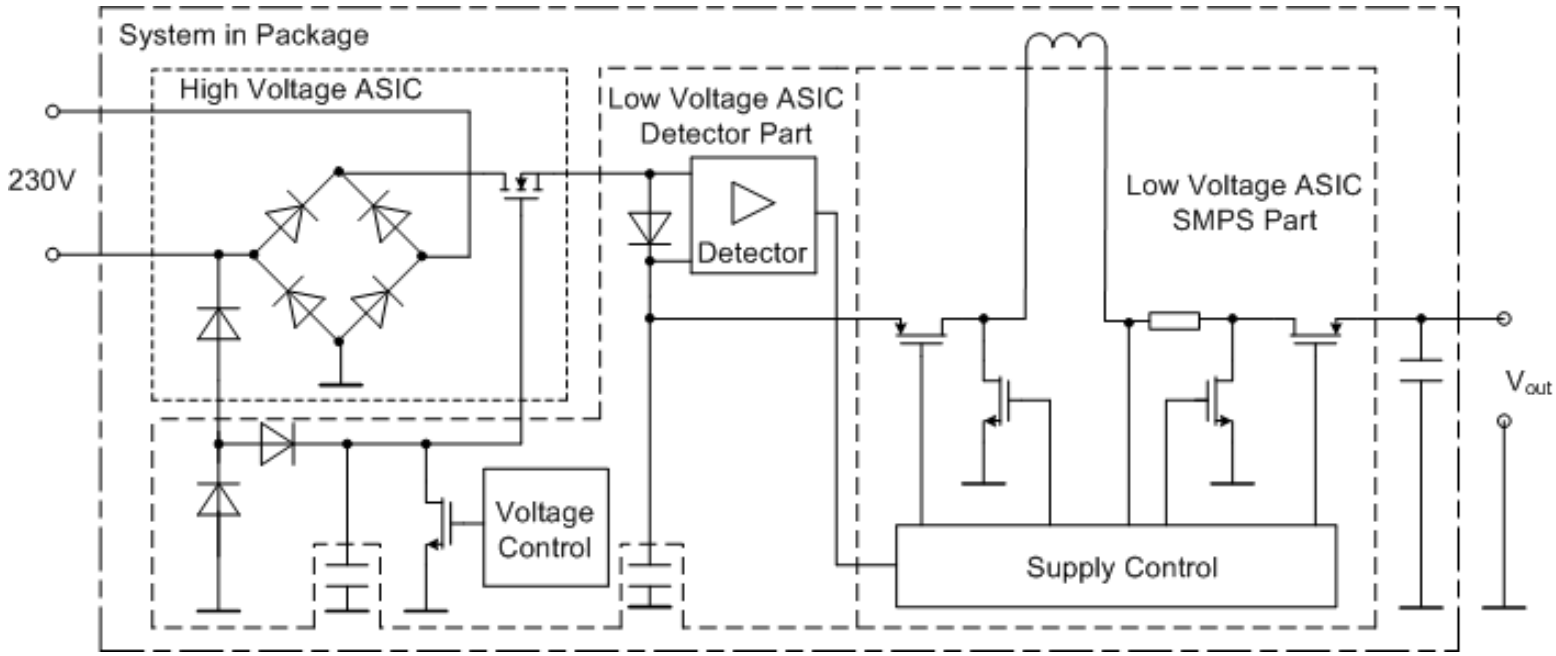
Noise & Dynamic Range of Current Sensor Section

typical & target values



Power Supply

SmartCoDe Power Supply
SMPS based, with detector and capacitive startup

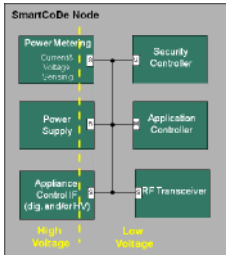


- No clumsy components
- Low count of external passives
- High efficiency

Development ongoing

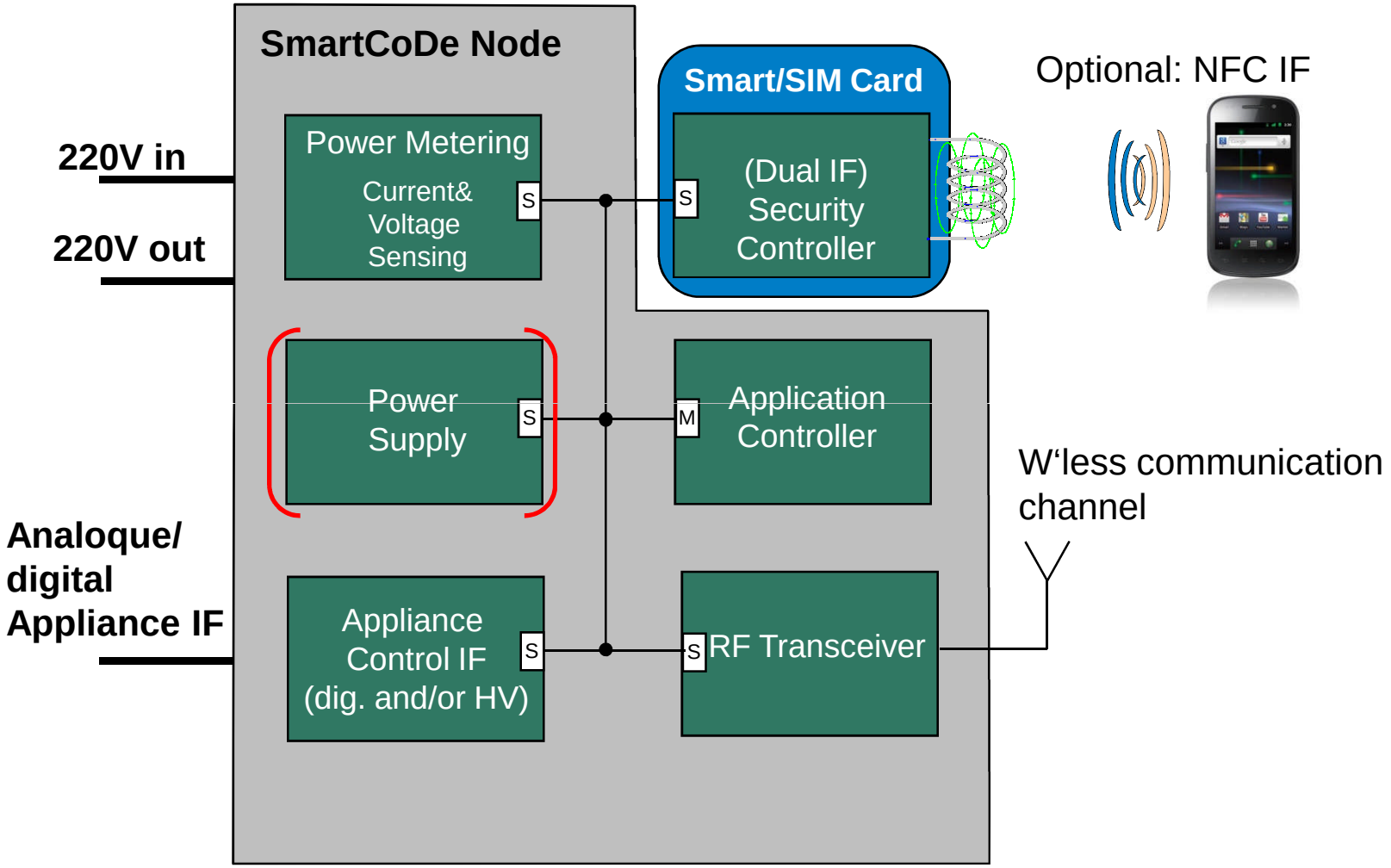
Discussion: Partitioning SiP/SoC

SoC or SiP ?

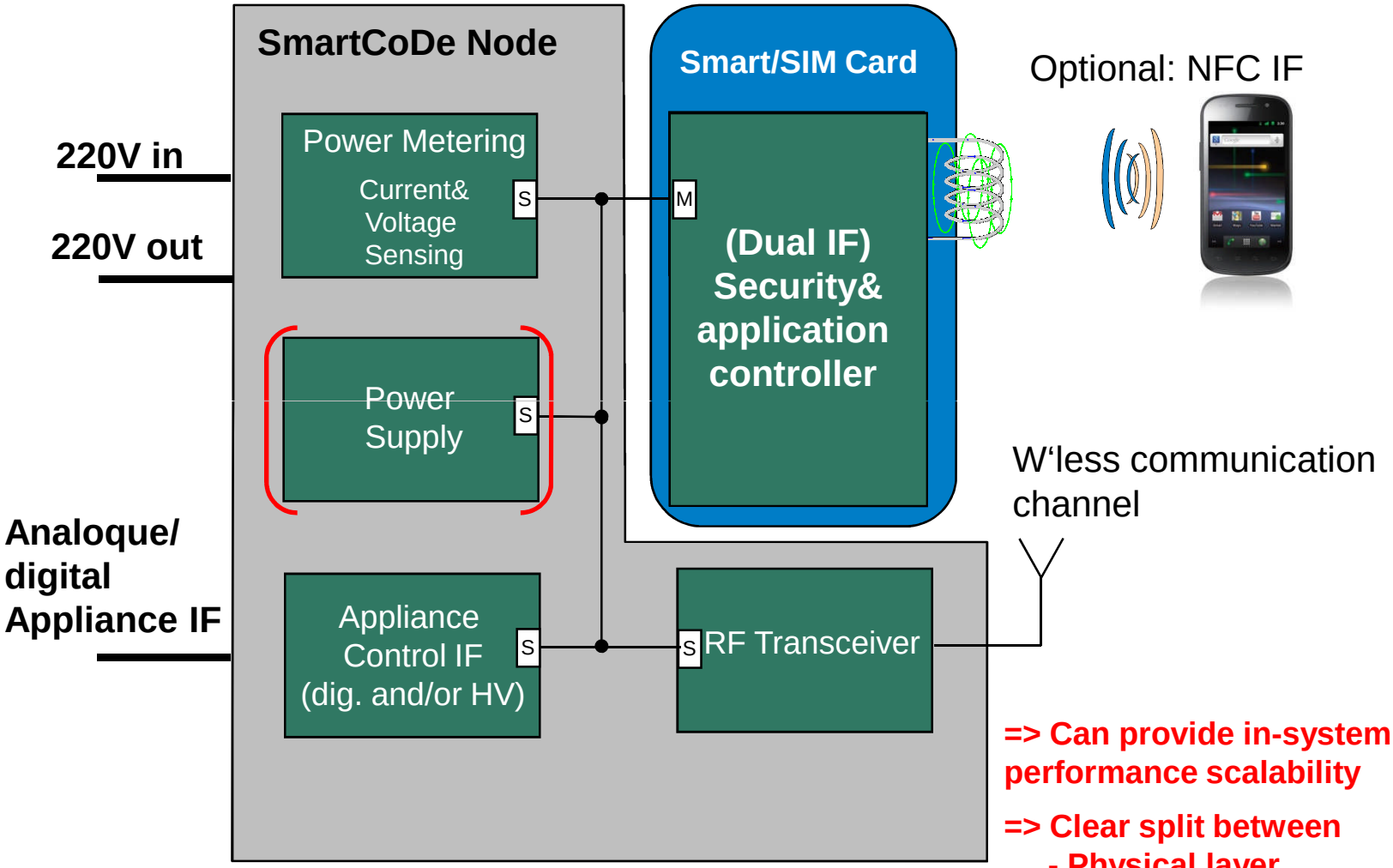


- SoC:
  - Integrating CMOS technologies can implement almost all functions on single chip, with some external passives
  - Optimize chip-area, reduce assembly- and logistic costs
  - Pays off only for highest volume
  - Could be long term target once standardizing issues are clearly settled
- SiP:
  - Can use different, “best fitting” semiconductor technologies and specific process optimizations
  - Due to low number of component-I/Os and interconnects in a SmartCoDe node this does not add significant costs:
    - **no multi-layer substrates/PCBs required**
    - **Could apply cheap sub-packaging**
      - **e.g. SMD only to make use of homogeneous assembly line**
      - **cope with heterogeneous reliability/hermeticity requirements**
    - **low risk of yield drop**
  - Mid-term target: chip embedding/eWLP => keep value chain in wafer fab
    - **paves the way towards a true integration of frontend- and backend-processes. It streamlines the manufacturing process undergone by a highly heterogeneously integrated device, like a SmartCoDe module, from silicon start over assembly, packaging, testing and shipment.**

SmartCoDe Partitioning Option 1



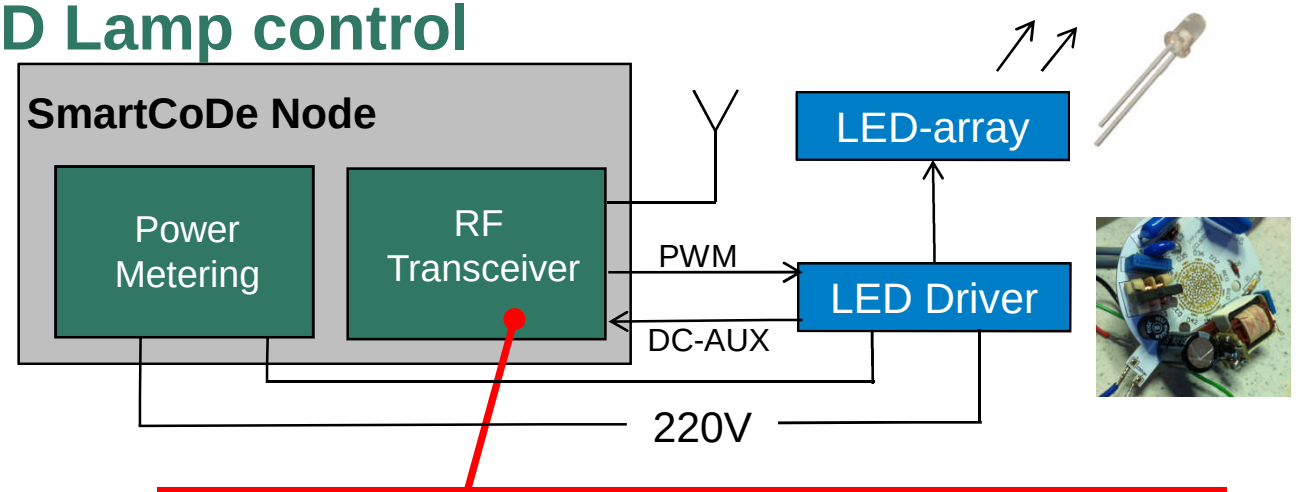
SmartCoDe Partitioning Option 2



=> Can provide in-system performance scalability

=> Clear split between
- **Physical layer**
- **Abstract layer / computing platform**

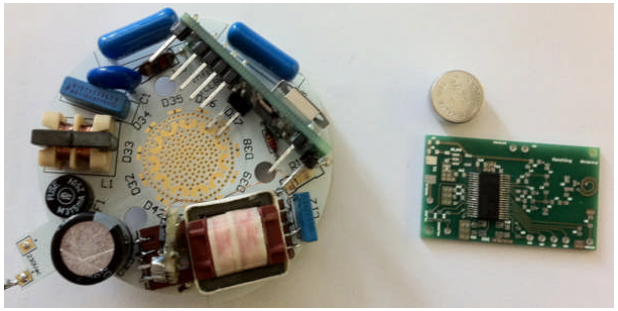
Example of a „minimum“ system configuration: LED Lamp control



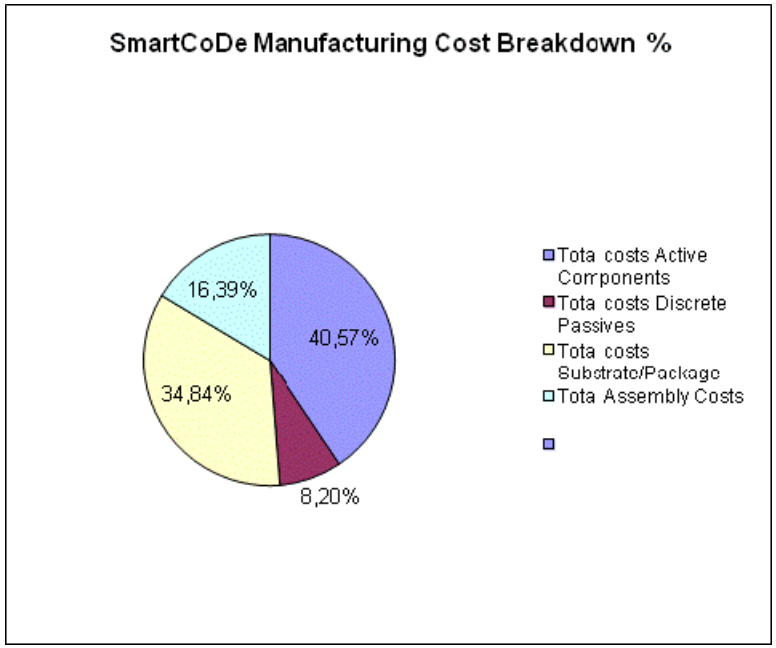
Infineon Smart TRX (prototype from EU funded project. „CHOSeN“): includes RF-FE, BB, AES crypto acceleration, programmable iSM for MAC-acceleration & simple protocols/applications

⇒ not all applications might require all functional units

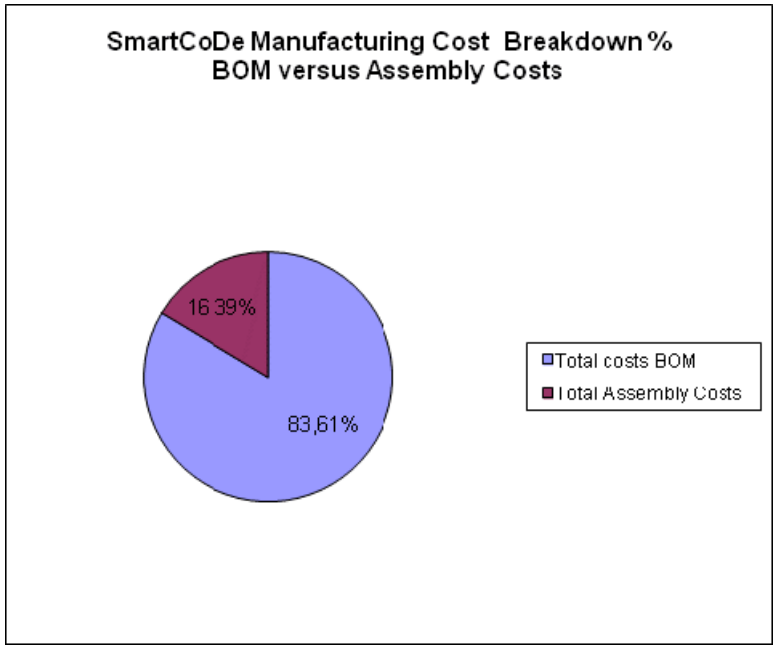
⇒ due to the high number of light sources in buildings a highly optimized approach is particularly interesting



Initial SmartCoDe HW Node Cost Indications



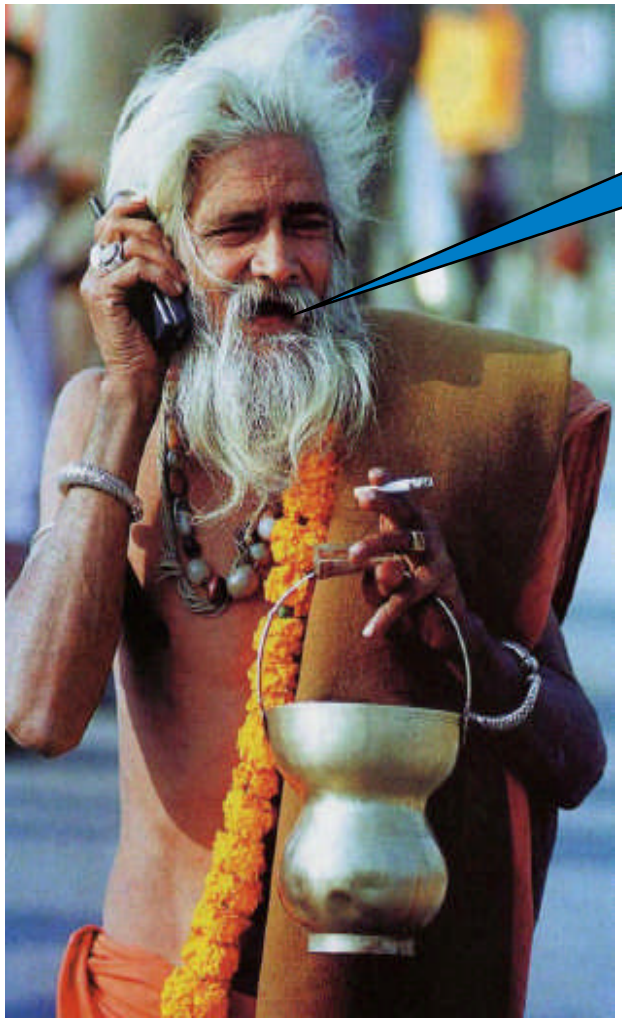
- Total costs: < 5€ possible (based on full functional node)
- Lower costs possible if not all functions are required or when striving for higher single chip integration (costs are BOM dominated)



Possible Cost Optimizations

- Costs dominated by
  - **active components**
  - **substrate/packaging**
- Means for Optimization
  - **cost drop over the years**
    particularly for eWLP once mature, homogeneous Frontend/Backend fabs are set in place
  - **higher single chip integration (of heterogeneous functions; e.g. usage of CMOS integration technologies)**
  - **tailoring/optimization to specific (killer-niche) application**
  - **digitally intensive approaches (digital logic shrinks best)**
  - **different feature variants (w/wo security, power supply, metering)**

An affordable technology for everyone…



Tent lights off !

Thank you for your attention…

Never stop thinking