

# Semiconductor Technologies for Advanced Asset Management

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# Infineon at a Glance

## The Company

- Infineon provides semiconductor and system solutions, focusing on three central needs of our modern society: **Energy Efficiency, Mobility and Security**
- Revenue in FY 2012: € 3.904 billion
- 26,210 employees worldwide (as of June 2013)
- Strong technology portfolio with more than **17,250 patents and patent applications** (as of Sept. 2012)
- More than **20 R&D locations**
- Germany's largest / Europe's second largest semiconductor company
- Market position: **#2 Automotive - #1 Power - #1 Chip Card**

# US Electric Grid

- **Greatest Engineering Achievement in 20<sup>th</sup> Century...**

1. Electric Grid

2. Automobile

3. Airplane

- **...But Infrastructure is aging**

- Annual cost of power interruptions: \$79B-\$160B
- Voltage conservation potential: 90,107 GWh
- SAIDI = 138 (Japan=15, South Korea=17, China=480)

- **Smart Grid investment**

- Total investment required: \$330B-\$880B (through 2030)
- ARRA: \$7.9B (\$2.5B Distribution Automation)

**T&D\*): 2012: \$34B; 2011: \$30B; 2010: \$27B**

galvin

for electricity innovation

\*) without municipal utilities and rural coops

Sources: GTM; EIA; US Census Bureau; PNNL; Talquin Electric; Pike Research; National Academy of Engineering

# Semiconductors in the Smart Grid

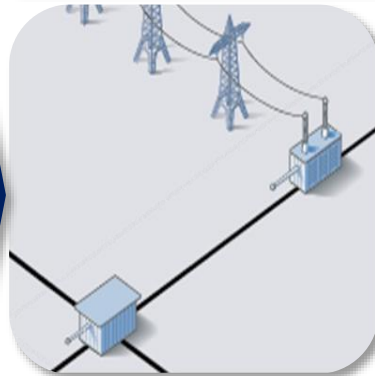
## Generation



## Transmission



## Distribution



## Consumption



### Major Applications

- Renewable energy integration

- Flexible AC Transmission Systems (FACTS)

- High-Voltage DC Transmission Systems (HVDC)

- Energy storage systems
- Advanced sensing
- Solid state switch gear
- Smart transformers
- Advanced metering infrastructure (AMI)
- Micro grids

- Electric vehicle charging
- Energy storage
- Distributed generation
- Smart meters
- Smart thermostats
- Smart appliances
- LED lighting

### Major Products

- Power semiconductors
- Drivers & controllers

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- Sensors
- Security ICs
- Communication ICs

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- Smart meter ICs
- Sensors
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# Applications in Distribution Automation



- F01 Automatic Voltage and VAR Control
- F02 Automatic Feeder Reconfiguration-Single
- F03 Automatic Feeder Reconfiguration-Multi-level
- F04 Optimum Power Flow Analysis
- F05 DER Monitoring
- F06 DER Control by Unit
- F07 DER Control by Class
- F08 Automatic Protection Reconfiguration
- F09 Isolation of Higher Impedance Faults
- F10 Automatic Switching – Local
- F11 Automatic Switching – Central
- F12 Automatic Condition-Based Equipment Maintenance
- F13 Low Impact Fault Detection
- F14 Automatic Islanding and Resynchronization
- F15 Real-time Communications from Utility to Customer

■ Near-term ▲ Mid-term ● Long-term

High Impact – Short-Term

High Impact – Mid-Term

# Sensors moving “Downstream”

**Substation**

**Consumer**

## Asset Monitoring

- Status and parameters of
  - Transformers
  - Circuit breakers
  - Batteries
  - Relays



## AMI

- Operation meters
- Multi-phase harmonics
- Low cost
- Supplement to line sensors
- Often not real-time capable



## „Bird-on-Wire“ Sensor

- Clamped to distribution lines or
- On pole tops
- Solar/battery powered or
- Power harvesting
- “Grounded” sensors for VAR/ $\phi$



# Examples

## Asset Management Hardware

**Low-Voltage Sensor / Analyzer (LVA)**



**Transformer Monitoring Dissolved Gas Analysis (DGA)**



**Circuit Breaker Monitor**



**Transformer Tank-Top Temperature Sensor**



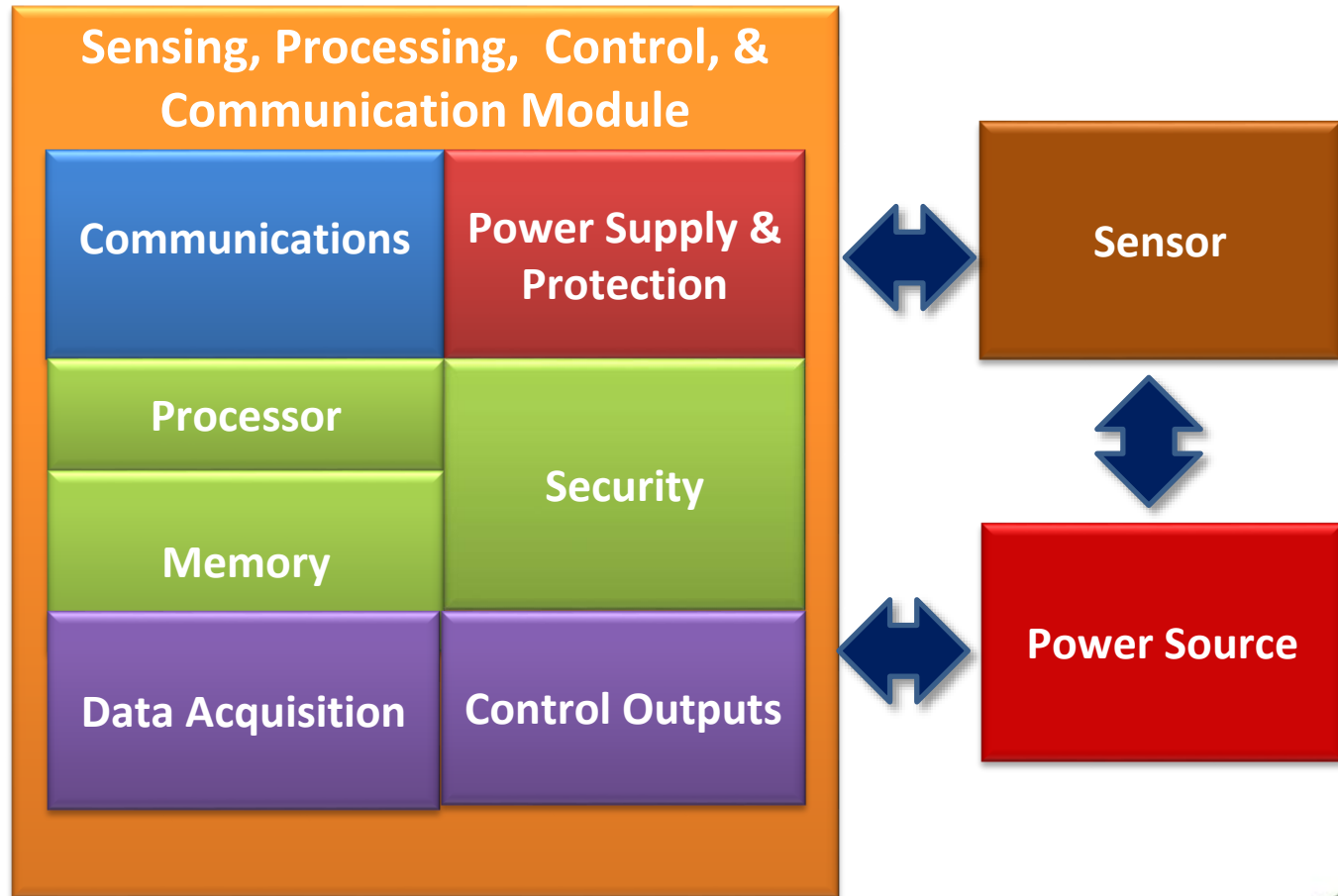
**RF Leakage Current Sensor**



**RF Conductor and Temperature Sensor**

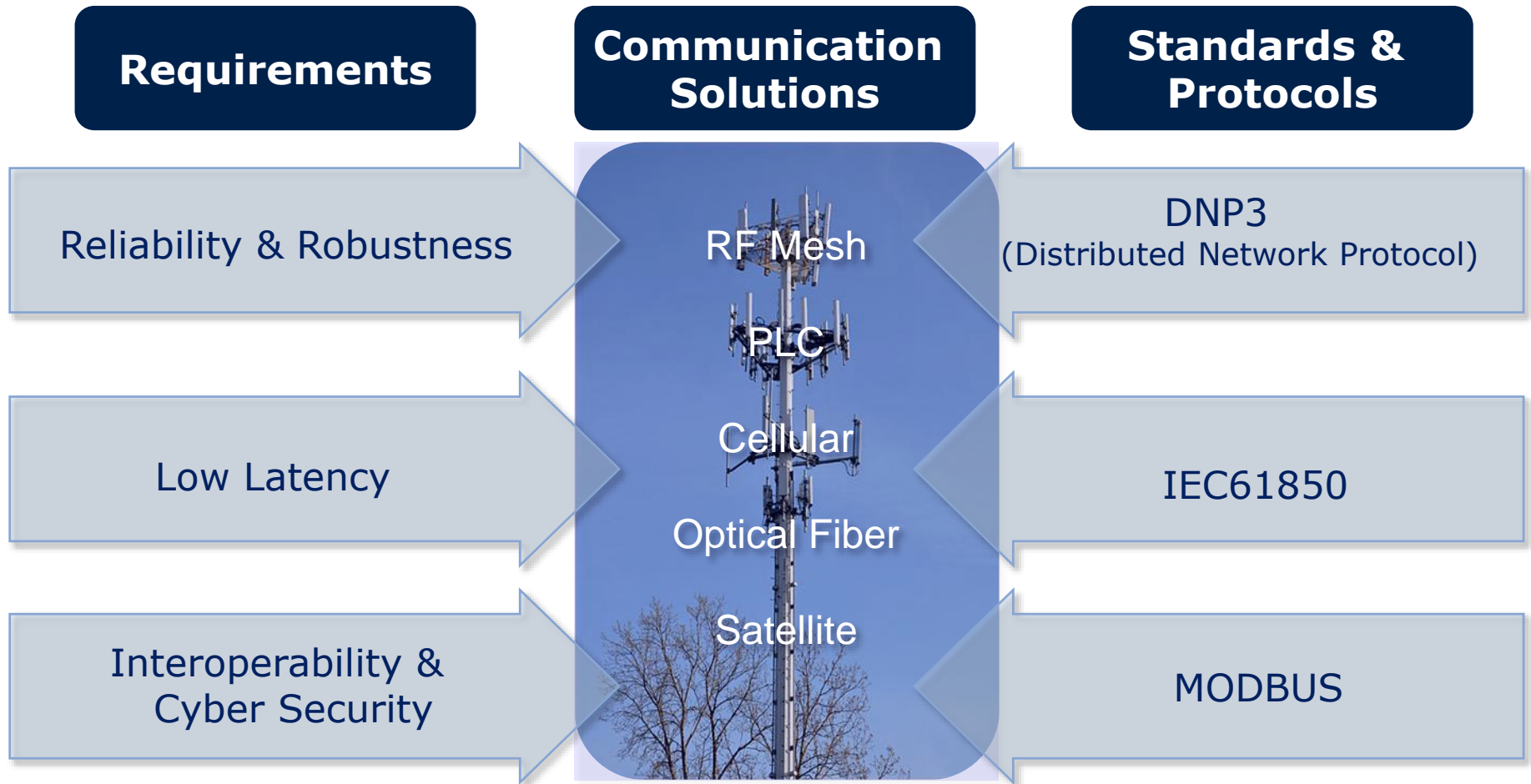


# Sensing, Processing, Control & Communication Module





# Secure Communication



# Semiconductor Requirements



## Wafer & Packaging

- Increasing wafer size (4" → 5" → 6" → 8" → 12")
- New packaging technologies



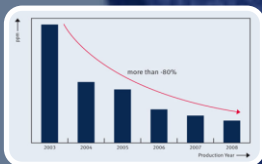
## Integration & Low Power Consumption

- Power management
- Sense & control
- Computing



## Robustness

- Extended temperature range
- EMC protection
- Robust design



## Quality & Sustainability

- Zero-defect culture
- Sustainable quality improvement
- Green mindset throughout value chain



## Life time & cycle

- Long product life times
- Support long industry life cycles

# Contact

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