

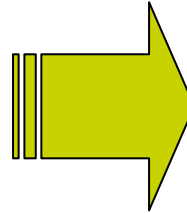


Smart Metering Solutions

Rolf Hertel – Global Applications Marketing

Neal Frager – Smart Metering Applications Engineer

October 2010



Smart Metering Selling Guide

What is Smart Metering?



Stakeholders in Smart Metering



- ▶ Governments rule regulations to reduce CO₂ emissions and energy consumption



- ▶ Utilities desire to have better peak load management



- ▶ Consumers benefit from energy awareness and can adapt accordingly

Market Drivers

- ▶ **Smart Metering Value Proposition to Utilities (energy generation & grid)**
 - Cost savings by efficient remote reading & billing
 - Better peak load management / more efficient grid usage
 - New tariff model offerings
 - Better protection against tampering / remote turn-on and turn-off
 - Possibility to combine remote reading of gas, water and electricity usage
- ▶ **Smart Metering Value Proposition to Consumers**
 - More accurate and frequent billing
 - Cost reduction by better insight into consumption
 - Ability to switch significant consumption to less expensive hours
 - Intelligent load management as a consumer / home automation
- ▶ **Smart Metering Value Proposition for Governments**
 - Contribution to committed CO2 emission reduction.
 - Increased awareness of energy consumption pattern leads to reduction of consumption
 - Investment in smart metering networks will stimulate economy

Evolving Smart Metering Networks

2015 & beyond

Smart meter evolving into home gateway for building control (security, alarms...)

Smart grid managing distributed energy generation (solar, wind) by households.

2010-2014

Global phase-out of electromechanical meters

Massive roll-out of bidirectional AMI networks in EU, US and China; simpler networks in developing countries

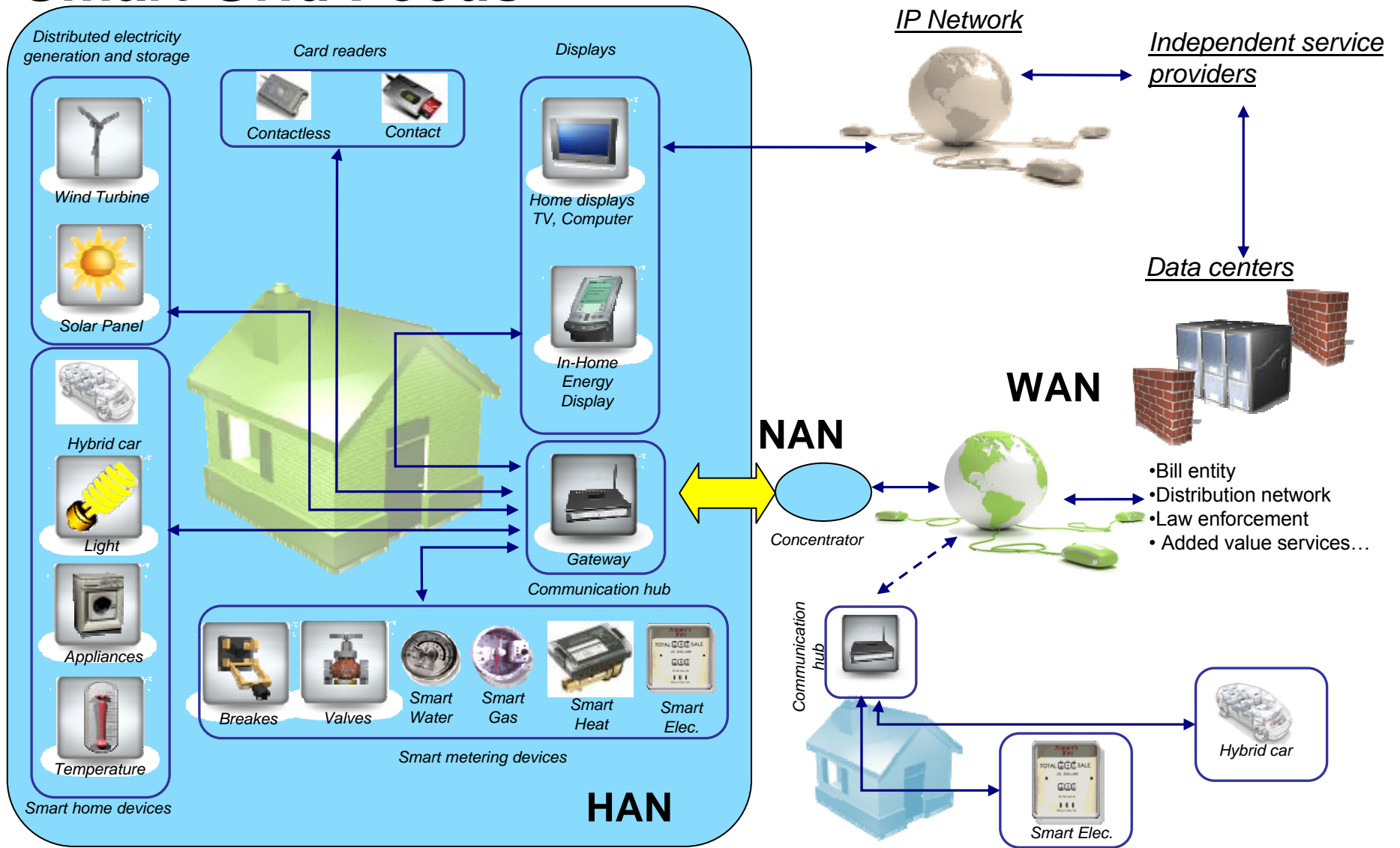
Smart meter as simple home gateway for multi-utility AMR and load management

2000-2009

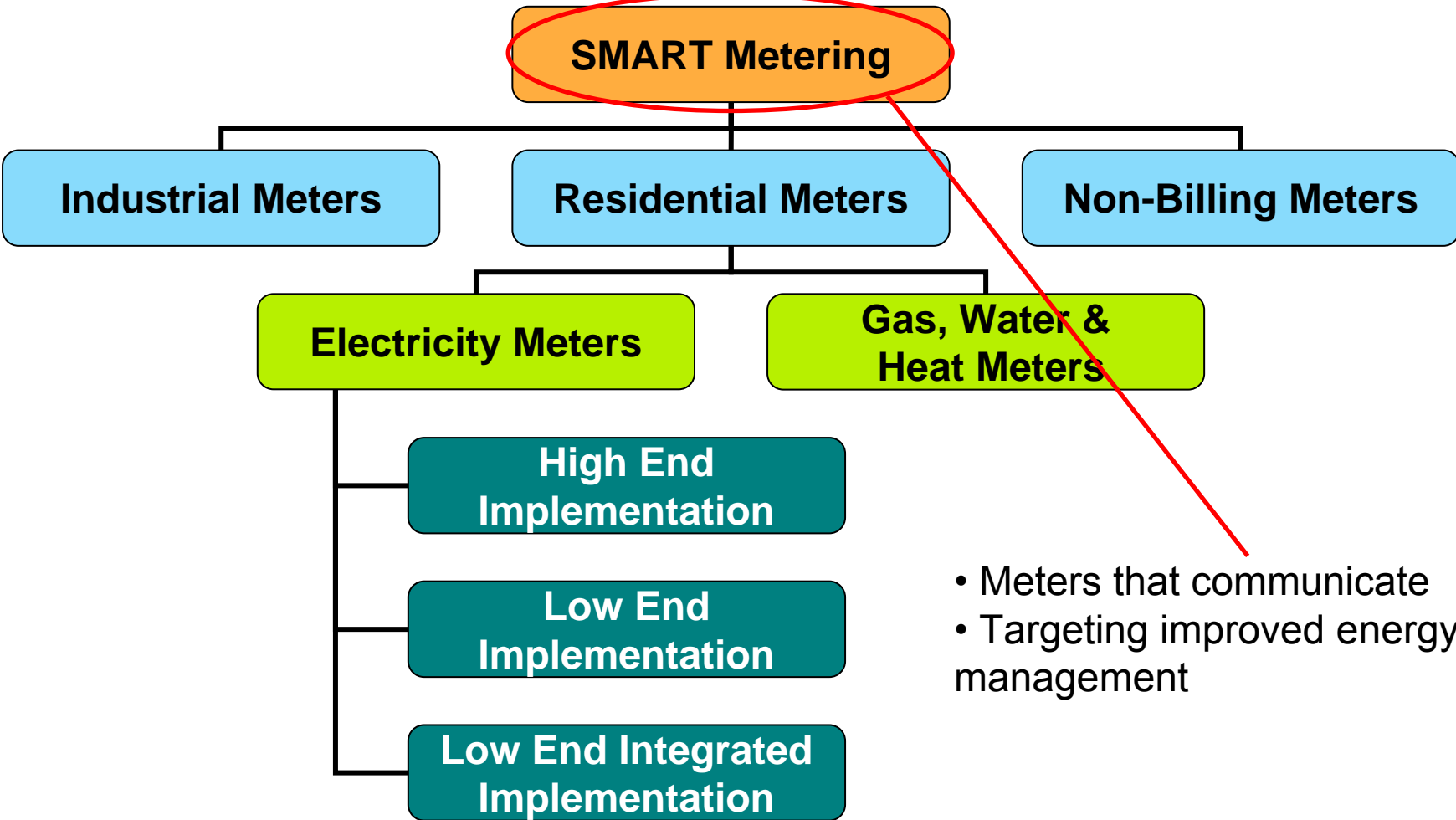
Start of replacement of electromechanical by electronic meters

First roll-outs of AMR networks based on one-way communication (US, Europe)

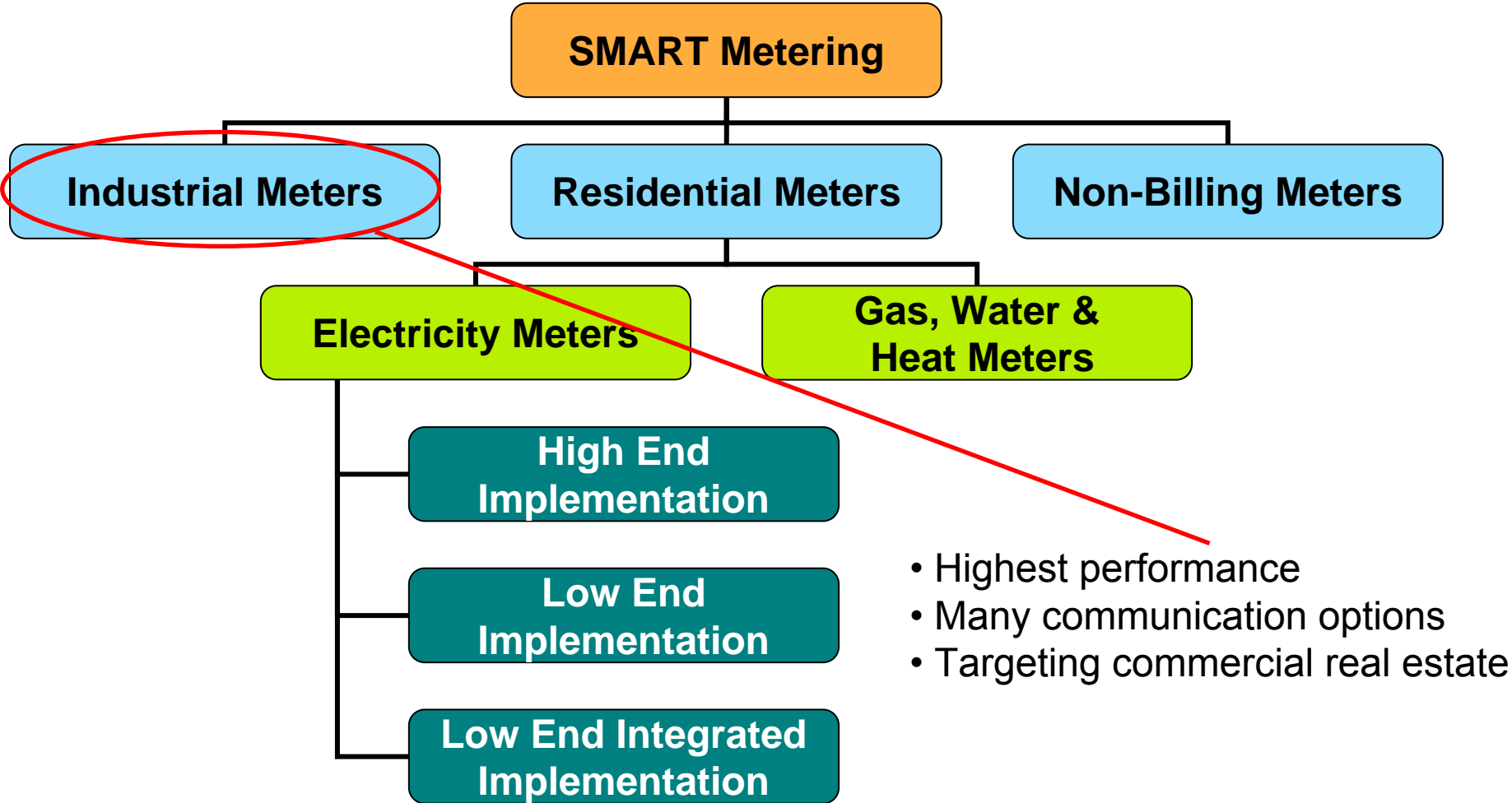
Smart Grid Focus



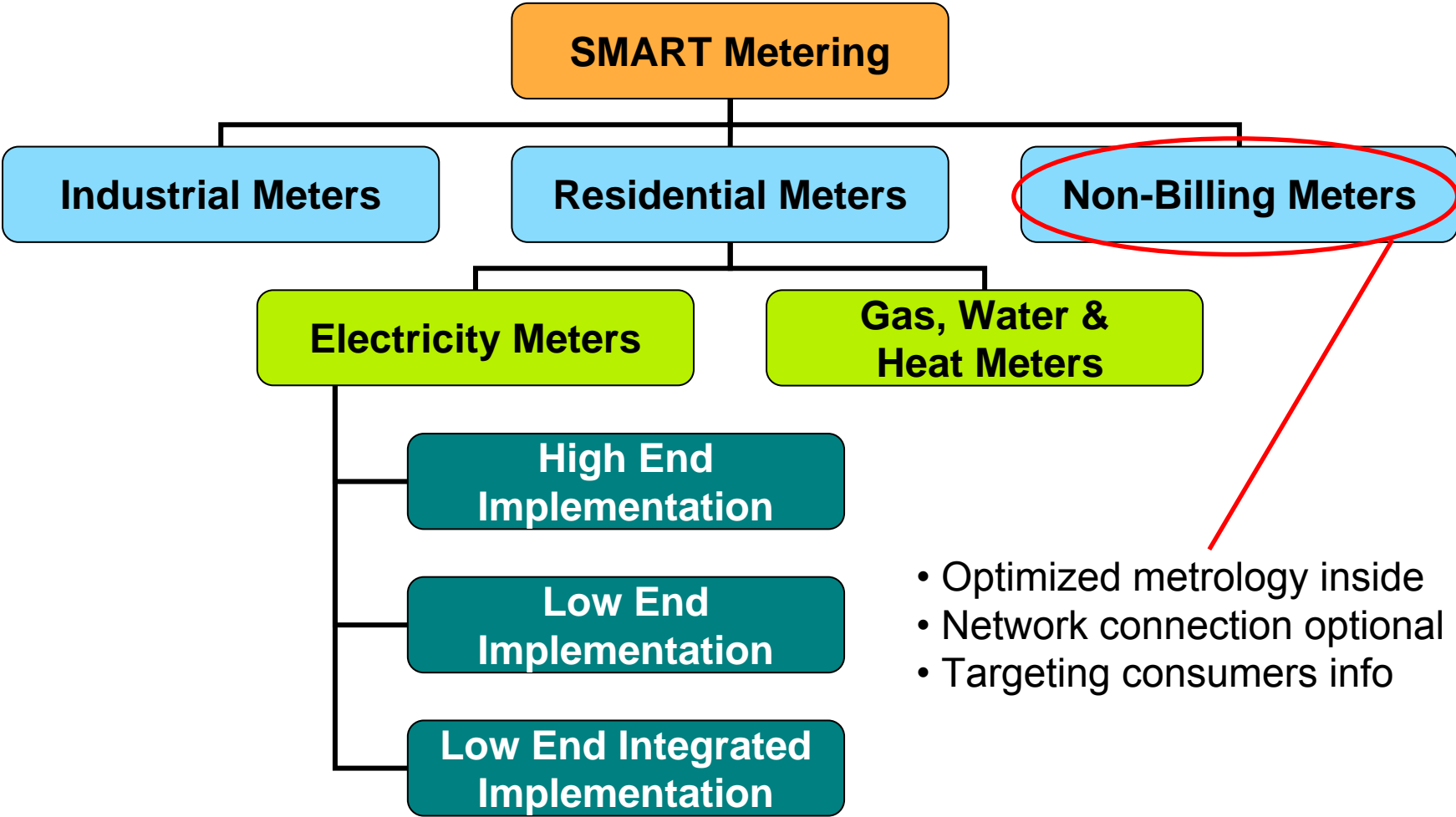
Market Segmentation & Characteristics



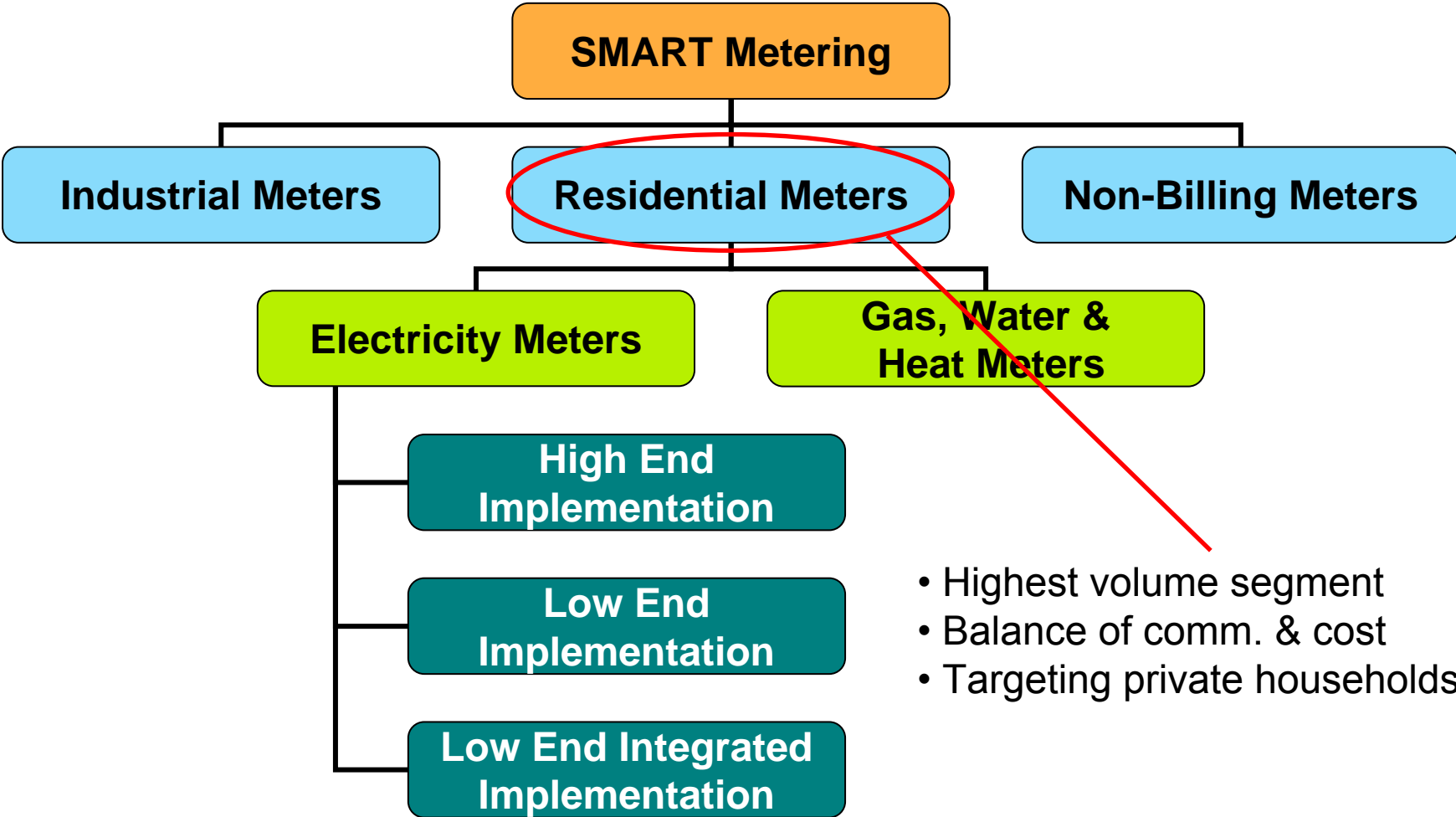
Market Segmentation & Characteristics



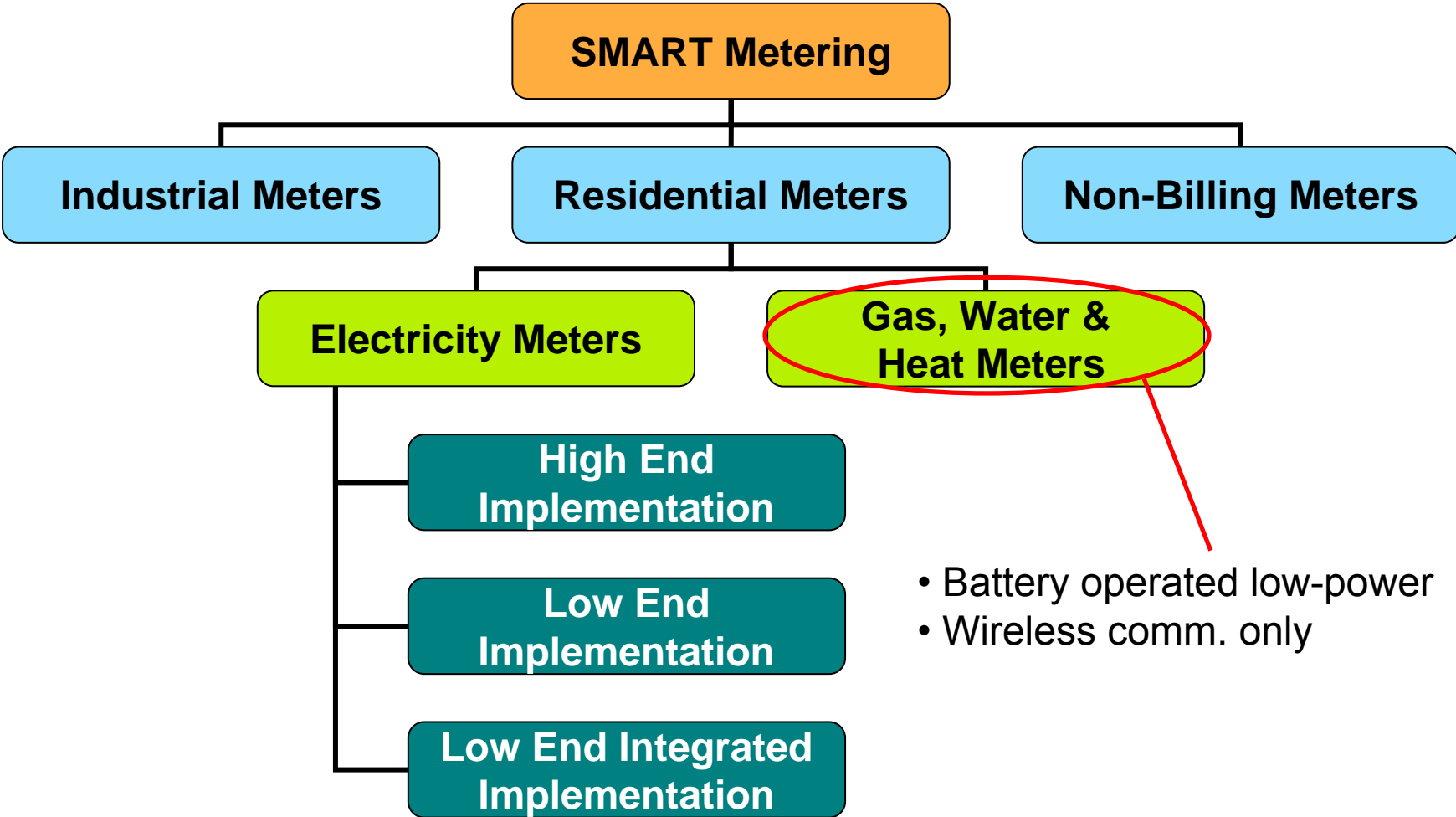
Market Segmentation & Characteristics



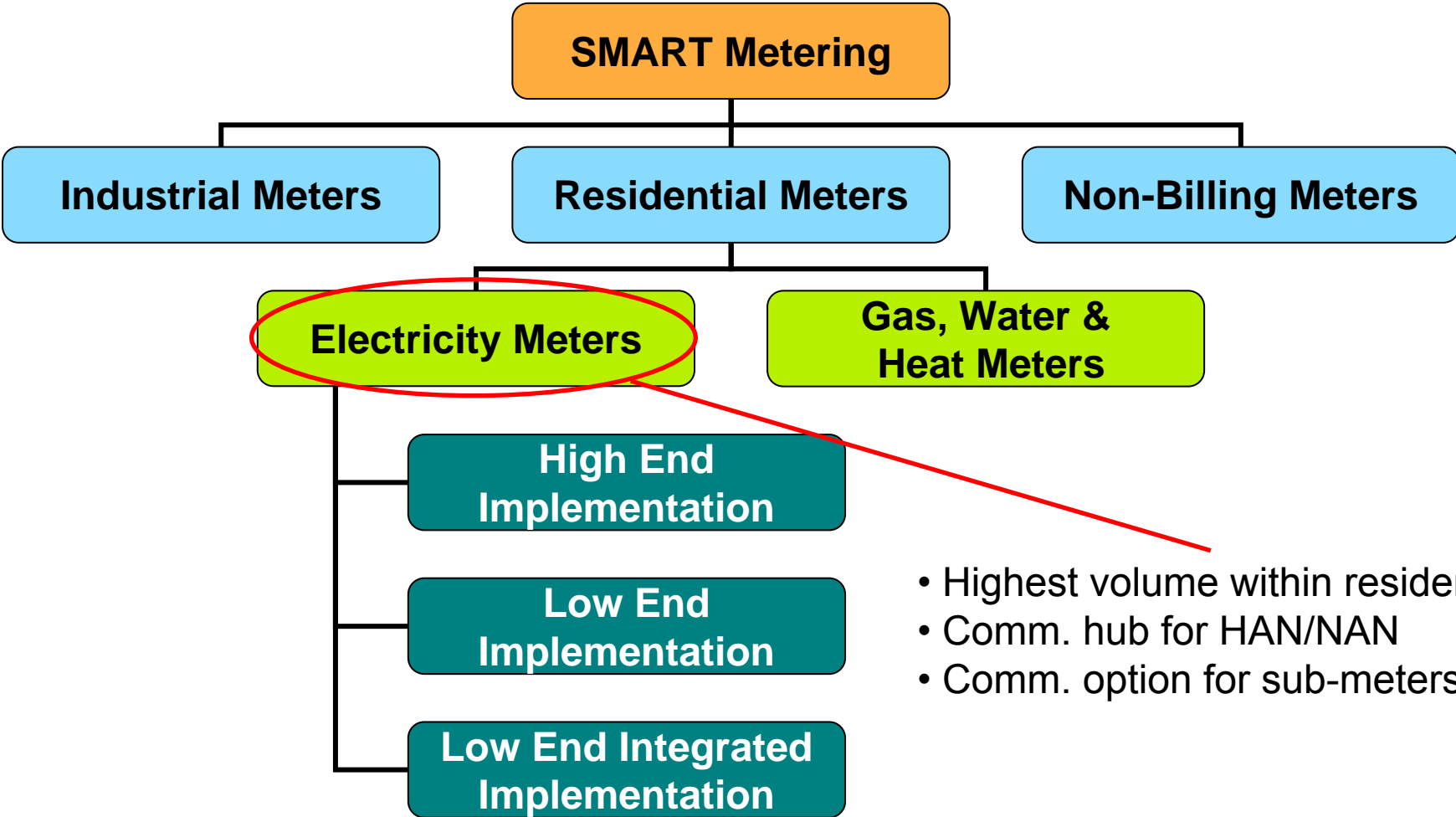
Market Segmentation & Characteristics



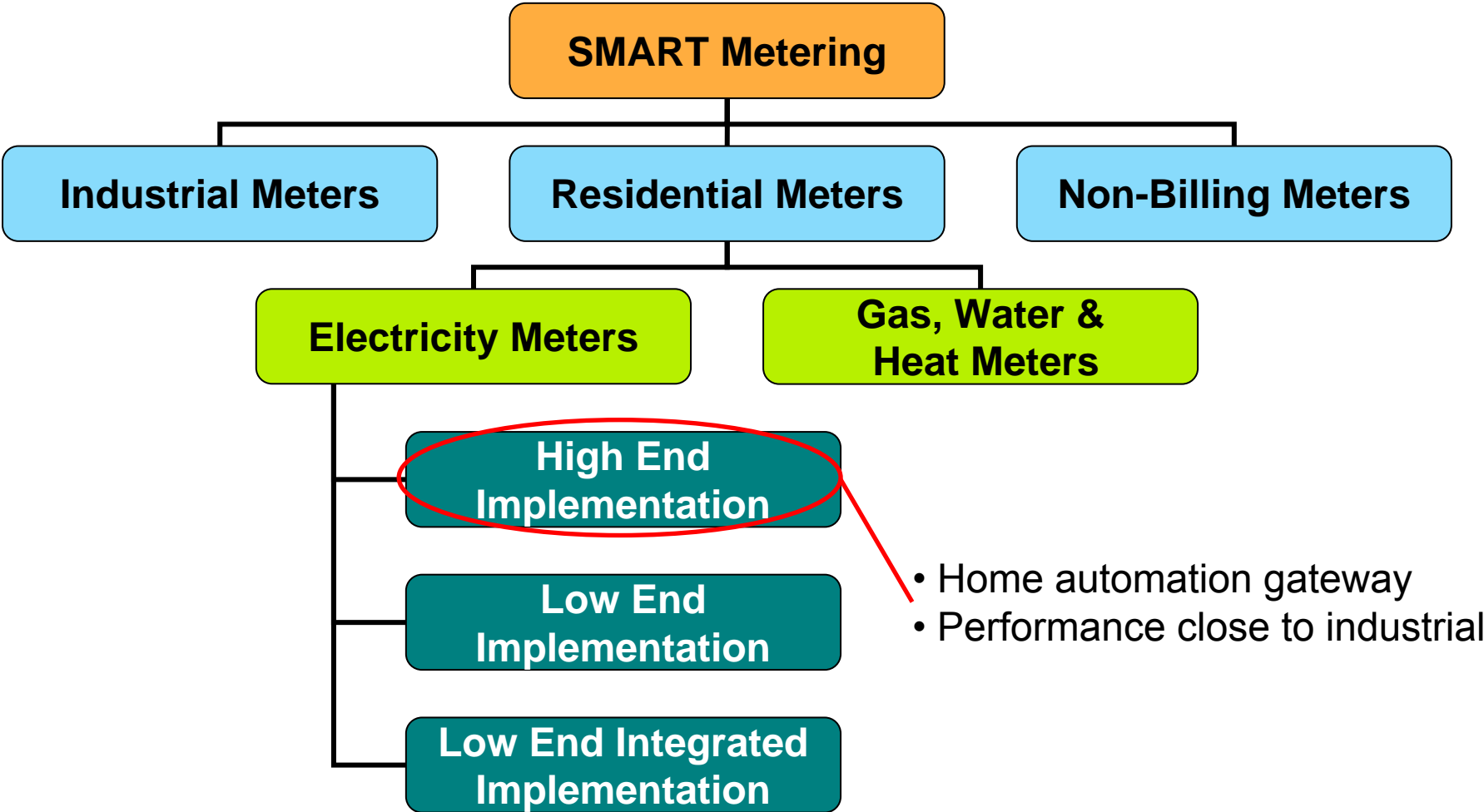
Market Segmentation & Characteristics



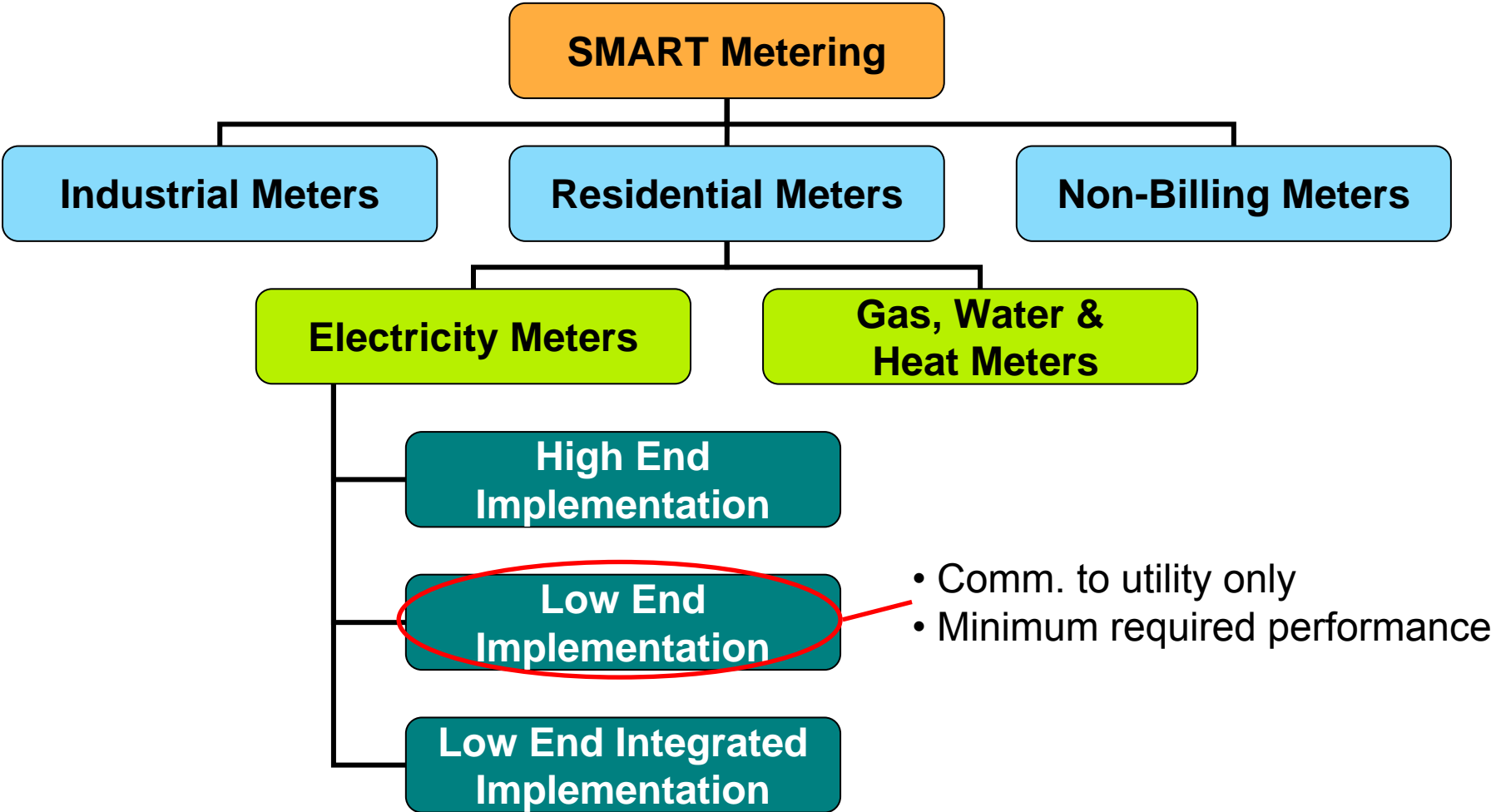
Market Segmentation & Characteristics



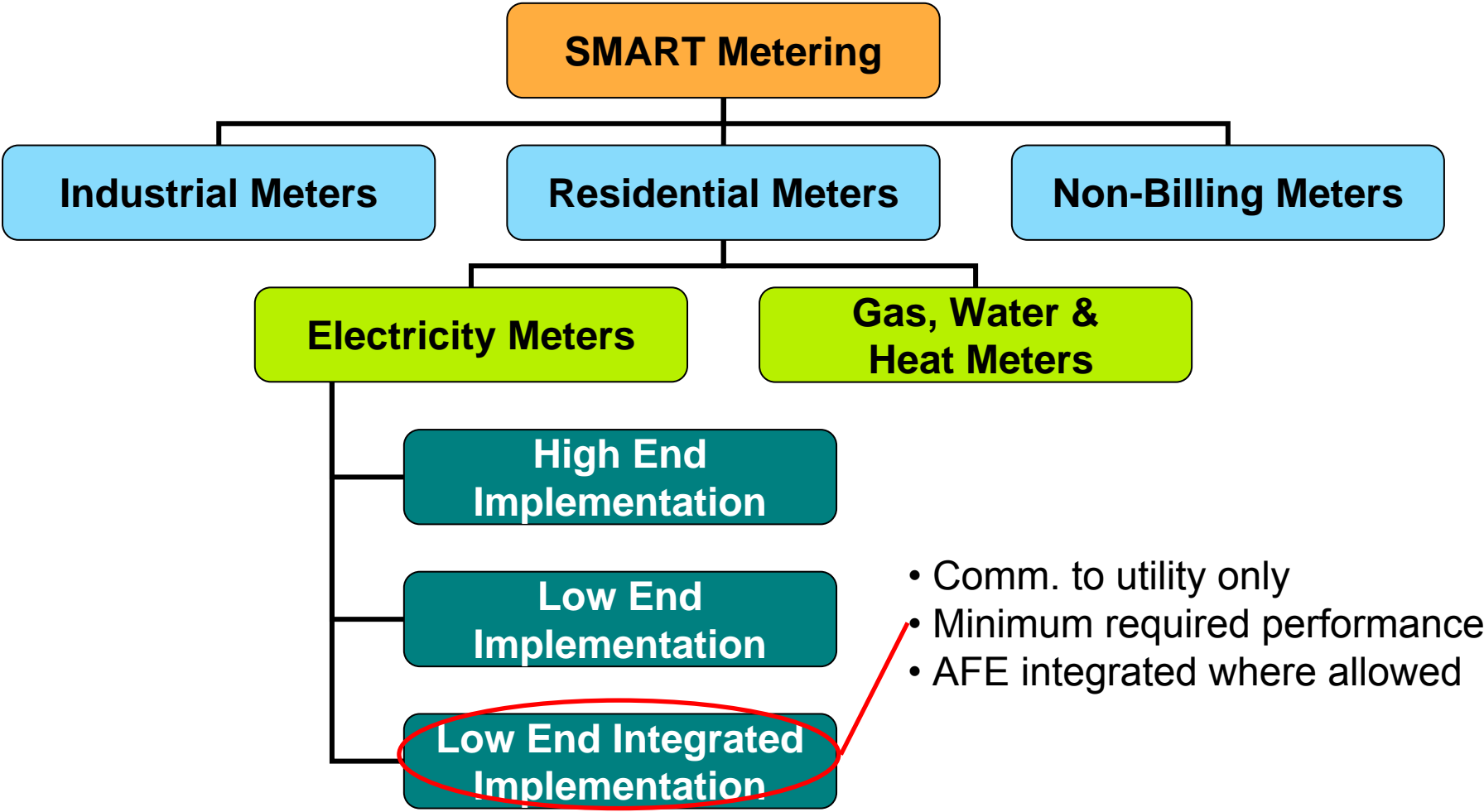
Market Segmentation & Characteristics



Market Segmentation & Characteristics



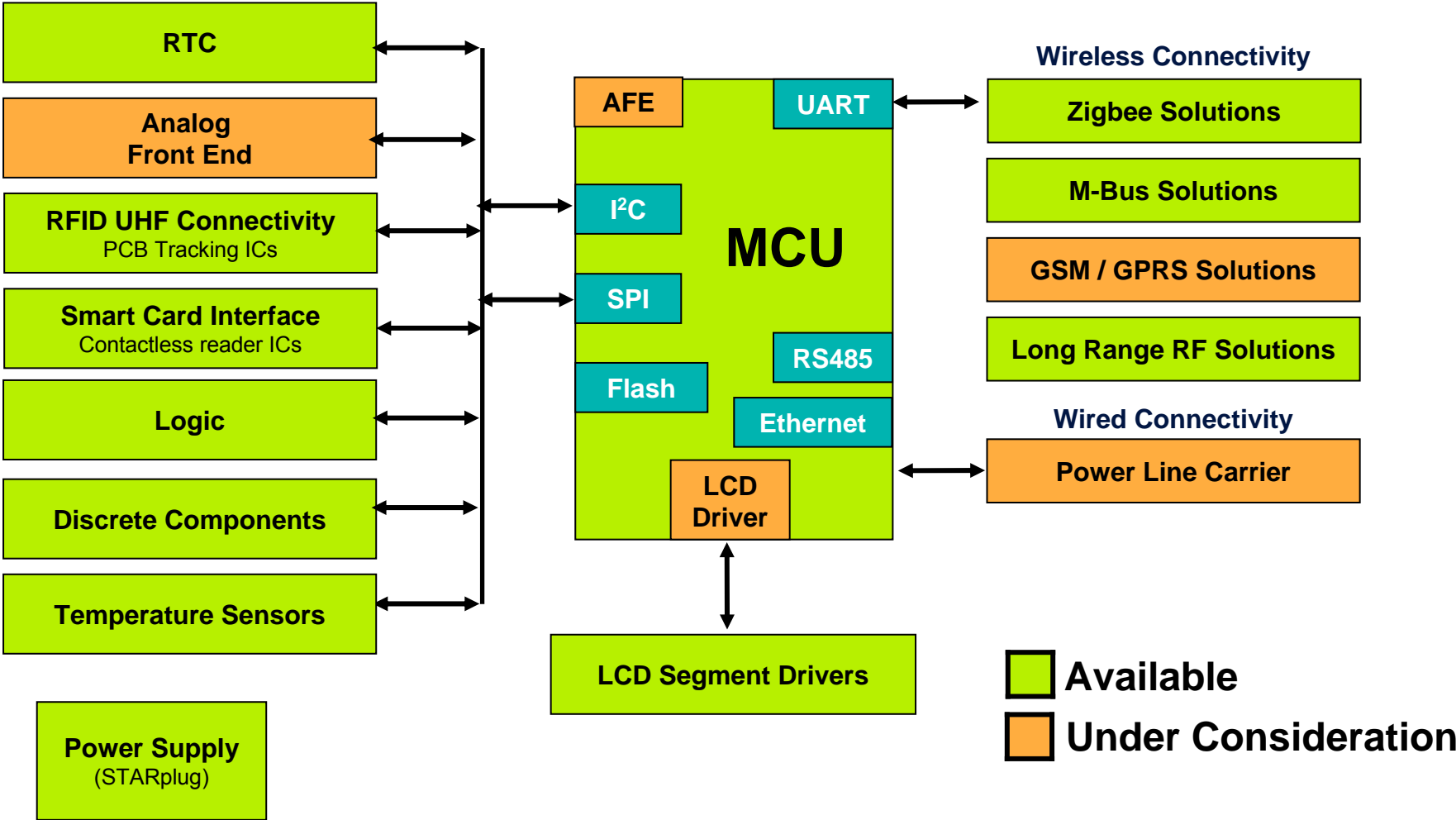
Market Segmentation & Characteristics



The background features a vertical blue bar on the left side. To its right, a dark green shape is positioned, with a diagonal line extending from the top-left corner towards the center. The area to the right of this line is a large, bright yellow-green field. The text 'Smart Metering Building Blocks' is centered within this yellow-green area.

Smart Metering Building Blocks

Smart Metering Building Blocks



Smart Metering Building Blocks

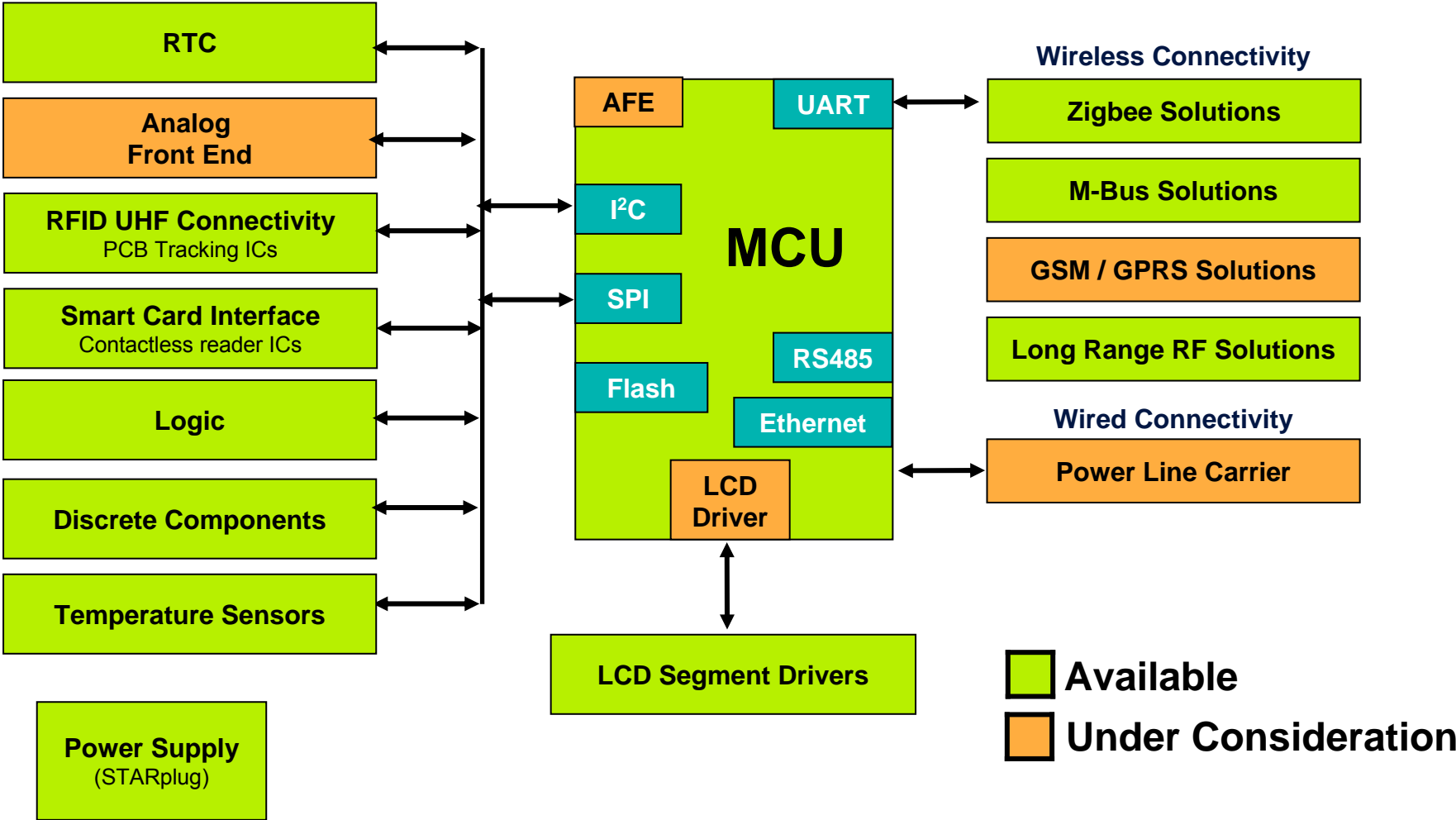
hyperlinks to www.NXP.com pages

<p><u>ARM Cortex M3</u> LPC17xx family Samples end 2008 M3 Core release 2, 120 MHz up to 64kB SRAM up to 512kB Flash Rich peripheral set True 12bit ADC True RTC (<1µA) Ethernet, USB, 5 UARTs</p> <p><u>ARM Cortex M0</u> LPC11xx family 50 MHz up to 8kB SRAM up to 32kB Flash UART / SPI / I2C</p>	<p><u>ARM7 LPC2000</u> LPC2000 family > 50 family members up to 72 MHz up to 1MB of Flash up to 100kB of SRAM Rich peripheral set Ethernet, USB, CAN on chip LCD Driver 10bit ADC 4 UARTs</p> <p><u>ARM9 LPC3000</u> growing family, 270MHz 256KB RAM, LCD, Touch sc. Ethernet, (HS)USB, ...</p>	<p><u>Jennic JN5148</u> <u>Zigbee Pro</u> <u>Transceiver</u> 2.4 GHz transceiver with built-in low power MCU for Zigbee Pro and JenNet SW stacks</p> <p><u>RF M-Bus</u> <u>OL23xx Family</u> 315 / 434 / 868 / 915 MHz operation 112 kcps to support all M-Bus protocols</p>	<p><u>Lowest Power RTC</u> <u>PCF2123</u> typ. 120nA, Tunable to +/-1ppm at room temp.</p> <p><u>Accurate RTC (aRTC)</u> <u>PCF2127.9</u> temperature sensor with compens. (3ppm) Quartz oscillator integrated</p> <p><u>Low Power, Low cost</u> <u>RTC, PCF8563/85</u> w/w.o. RAM, low power 250nA</p>	<p><u>LCD Segment Driver</u> PCF8562: 128 sgmt PCF8576D: 160 sgmt PCF8534A: 240 sgmt</p> <p><u>LCD Character Driver</u> PCF2113: 120 icons & 2*12 / 1*24) (line*character) PCF2119: 160 icons & 2*16 (lines* characters)</p> <p><u>LCD Graphic Driver</u> PCF8535: 65x133 PCF8531: 34x128</p>	<p><u>Power Supply ICs</u> <u>Starplug TEA15xx</u> with integrated MOSFETs Valley switching for incr. efficiency and less EMI</p> <p><u>Contact and</u> <u>contactless Reader</u> <u>ICs</u> RFID/NFC 13.56MHz contact smart card readers for prepaid meters</p>
<p>Microcontrollers</p>		<p>Connectivity</p>	<p>Real Time Clock</p>	<p>LCD Display Driver</p>	<p>Power Supply</p>

<p><u>Logic ICs</u> largest portfolio of functions and packages</p>	<p><u>Transistors, Diodes and ESD Protection</u> large portfolio, ultra small packages, Low $R_{DS(ON)}$, MOSFETs, low $V_{CE(sat)}$ (BISS) trans., Low V_f Schottky diodes, ESD protection diodes and arrays, Complex discretes: RETs, loadswitches, etc</p>
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Smart Metering Building Blocks



Evolving Metering MCU Family Roadmap



Gas Water & Heat Metering MCU	<ul style="list-style-type: none">• Ultra Low Power Platform• All Regions• Under Consideration
Integrated LE Metering MCU	<ul style="list-style-type: none">• 3-Phase with AFE Included• India and Eastern Europe• Under Consideration
Industrial Metering MCU	<ul style="list-style-type: none">• Ethernet IP Metering• All Regions• Q4-2010
HE Residential Metering MCU	<ul style="list-style-type: none">• Anti-Tampering 3-Phase• Western Europe and USA• Q4-2010
LE Residential Metering MCU	<ul style="list-style-type: none">• Single Phase Metering• China and Eastern Europe• Q3-2010
Non-Billing Energy Metering IC	<ul style="list-style-type: none">• Single-Phase Non-Billing• All Regions• EM773 Available NOW!!!

Energy Metering IC for Non-Billing Meters EM773



- ▶ Perfect solution for non-billing metering apps
 - Plug meters
 - SMART appliances
 - Industrial sub-meters
- ▶ Exceeds market requirements with better than 1% metering accuracy
- ▶ Most integrated and cost efficient solution
- ▶ No metering know-how required
- ▶ Fast time-to-market with demo designs
- ▶ Product differentiation via application SW
- ▶ Wireless M-Bus demonstrator design

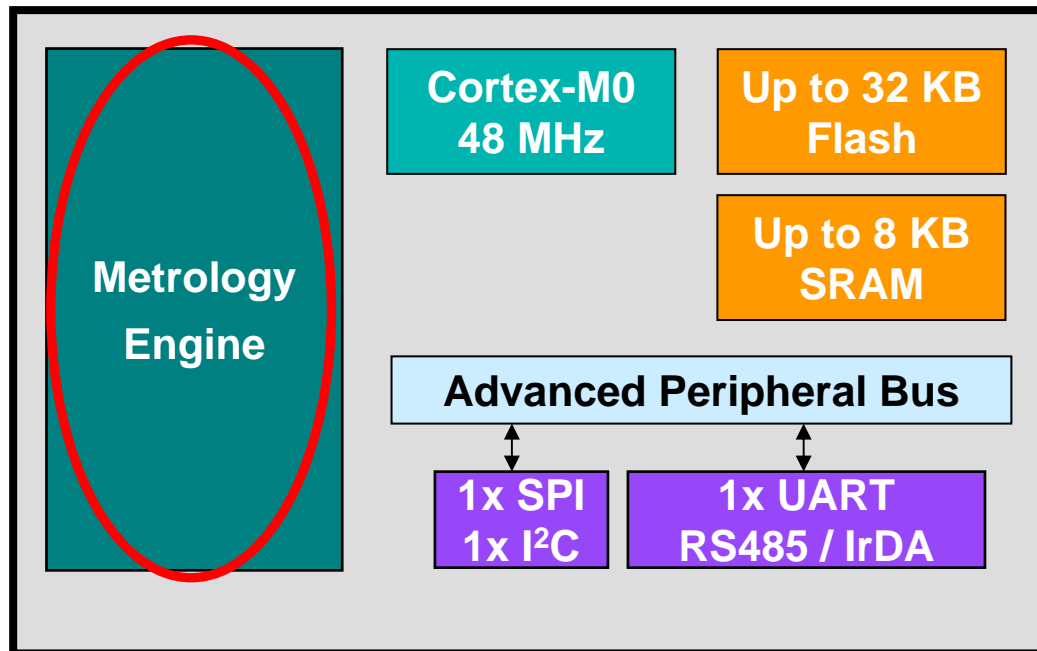


Energy Metering IC for Non-Billing Meters

EM773



Optimized metrology inside with optional network connection



- ▶ Built-in metrology engine hardware and software
- ▶ Application programmable
- ▶ UART available for communications port
- ▶ Standard ARM support ecosystem available for easy development

33-pin HVQFN

Available NOW!!!

Energy Metering IC Firmware

Integrated and Programmable E-Meter Solution



- ▶ **Single phase measured hardware parameters:**
 - W, VA, VAr, kWh, kVAh, kVArh, V, I, frequency, $\cos\phi$
 - Correct reactive power, also for non-sinusoidal currents
 - Registers for consumed, produced and total energy
 - Indication of energy costs (total and day counters)
Optionally Real Time Clock for tariff differentiation
- ▶ **Wireless M-Bus output** (SPI to OL2381)
- ▶ **Serial output** (I2C / UART / SSP / SPI)
- ▶ **Programmable device:** enables customized applications
 - Low CPU load, other applications can run in-parallel with meter application
 - Example software with Low cost Real Time Operating System
- ▶ **Low cost front end:** Resistive voltage divider and shunt resistor (or current transformer for very high currents when required)
 - Multiple operational amplifier gain channels for large dynamic range
 - Depending on mains isolation requirements: Voltage transformer

Energy Metering IC EM773

Principle block diagram

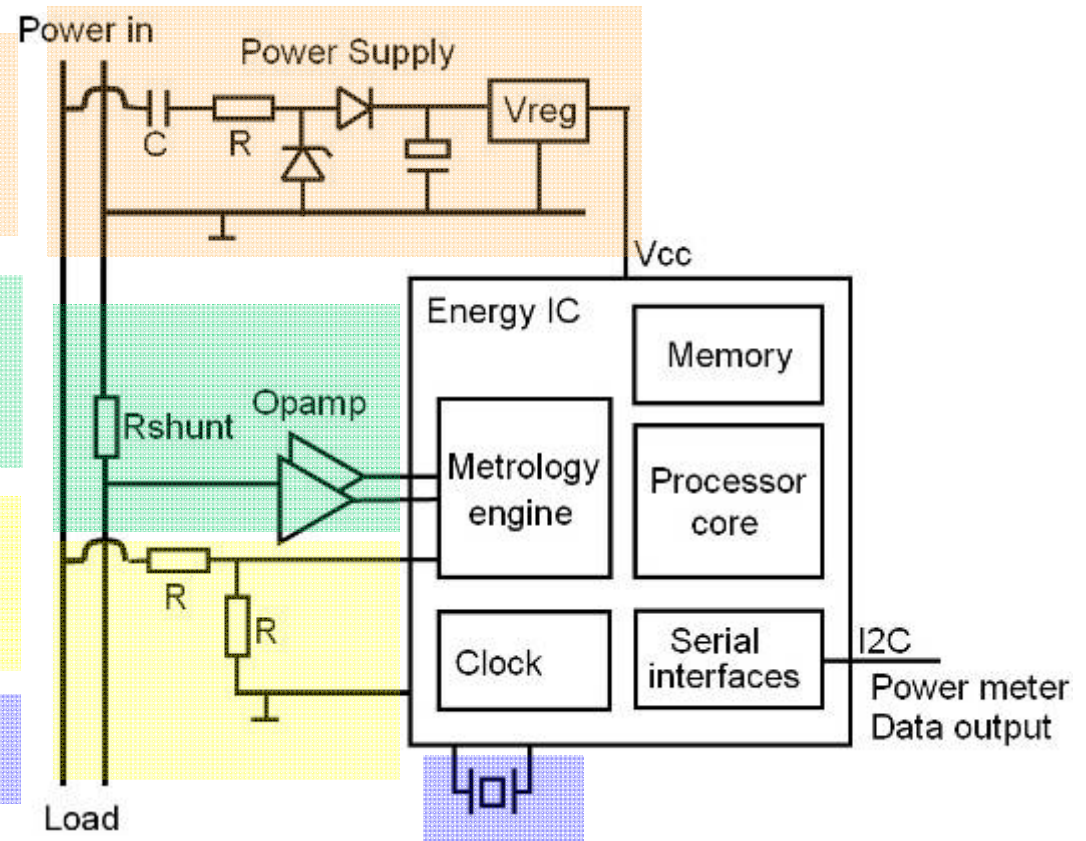


- ▶ Power supply
 - 3.3V as V_{DD} required

- ▶ Analog circuitry for current measurement
 - accuracy options

- ▶ Analog circuitry for voltage measurement

- ▶ Oscillator



Energy Metering IC EM773

Analog input circuits options

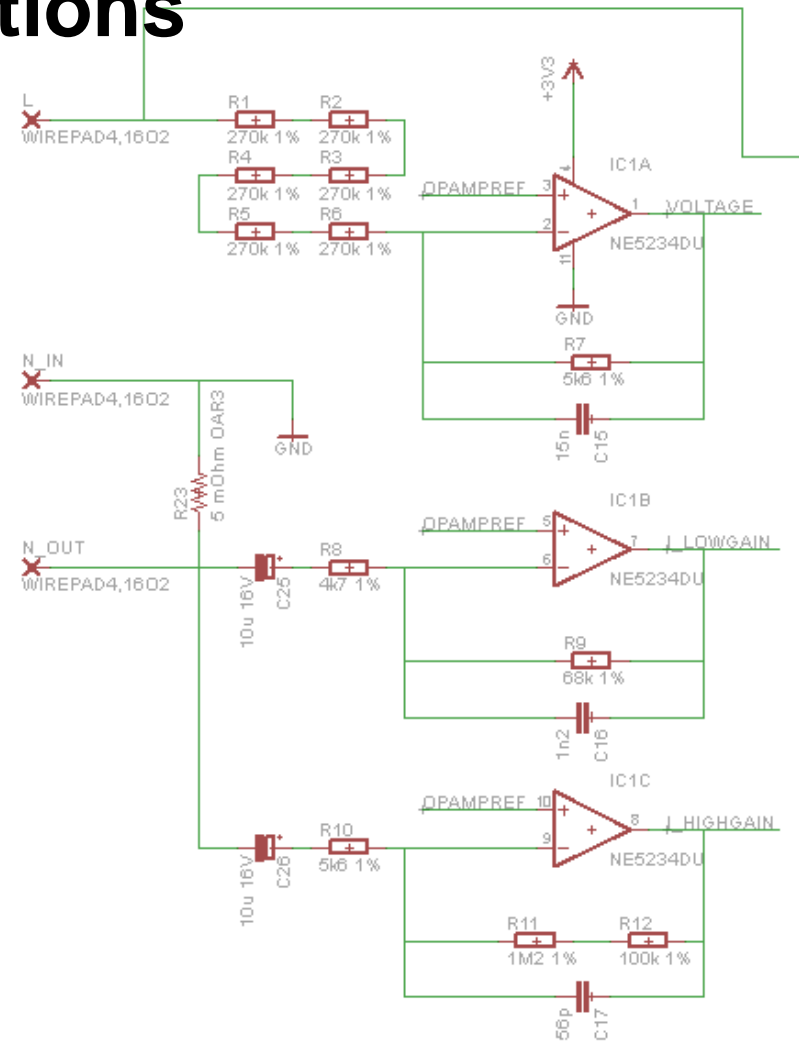


Voltage measurement circuit

- ▶ Voltage Divider
 - Cost efficient solution
- ▶ Transformer
 - Full galvanic isolation

Current measurement circuit

- ▶ Shunt Resistor
 - Series resistor with defined low resistance
 - Cost efficient solution
- ▶ Current Transformer
 - Low dissipation at high current
 - Standalone or PCB mounted



Energy Metering IC EM773

Metrology engine – Key functionality



- ▶ Embedded calculation of all relevant energy measurement parameters
 - P_{real} , $P_{reactive}$, $P_{apparent}$, V_{rms} , I_{rms}
- ▶ Accuracy better than 1% for 1:400 power range. Examples:
 - 0.1 W accuracy at 10 W load for a 4000 W_{max} meter
 - 0.092 W accuracy at 9.2 W for a 3680 W_{max} (230V 16A) plugmeter
 - 0.058 W accuracy at 5.8 W load for a 2300 W_{max} (115V 20A) appliance
- ▶ Improved accuracy for top end of the specified power range
- ▶ Automatic DC offset tracking
- ▶ Measurements include harmonics of the mains
 - Up to 40 harmonics for 50 Hz net frequency
 - Up to 33 harmonics for 60 Hz net frequency
- ▶ Correct reactive power calculation for non-sinusoidal currents (e.g. switched mode power supplies)

Energy Metering IC EM773

Definition of API input values



- ▶ API Input: Voltage and Current
 - Start Metrology Engine with standard settings for V_{pp} , I_{1pp} and I_{2pp} derived from input circuits
 - Measure voltage and current from a calibrated source
 - Correct the voltage and current ranges V_{pp} , I_{1pp} and I_{2pp} with the relative difference

- ▶ API Input: Phase Correction
 - Measure the phase difference between voltage and current channels for two resistive loads (high current and low current) and enter this value Φ_1 and Φ_2 as the required phase correction

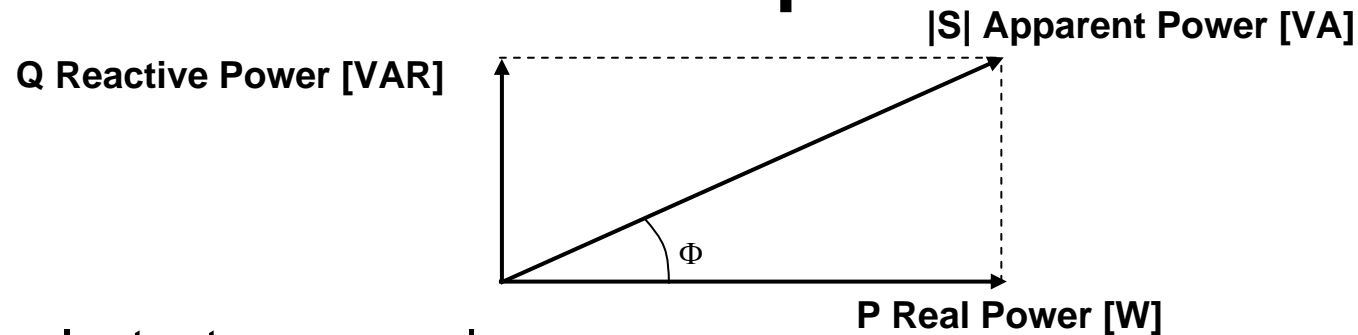
Energy Metering IC EM773 Calibration



- ▶ Real time calibration adjustments
 - The calibration parameters can be adjusted real-time by the application running on the Cortex M0 processor core.
 - This feature can for example be used to implement temperature compensation or to switch between different measurement inputs

Energy Metering IC EM773

Definition of API output values



▶ Instantaneous values:

- Real Power (P) [W]
- Reactive Power (Q) [VAR]
- Apparent Power (|S|) [VA]
- Voltage (V) [V]
- Current (I) [A]
- Power factor = Real / Apparent Power $\Rightarrow \cos(\Phi)$

▶ Accumulated over time in application SW

- Energy [kWh]

Energy Metering IC EM773

Application software options



- ▶ Process P_{real} , $P_{reactive}$, $P_{apparent}$, V_{rms} , I_{rms} from Metrology Engine
 - Calculate kWh energy registers for one or more tariffs (T1, T2, ...)
 - 4-quadrant meter, measures both consumed energy (+T1, +T2, ...) and produced energy (-T1, -T2, ...)
- ▶ Energy-Creep filtering
 - Thresholds can be configured to prevent measuring noise energy
- ▶ Positive-accumulate-only option
 - Some applications require 2-quadrant operation
- ▶ Fully programmable to enable a multitude of output devices
 - Examples for Wireless M-bus, I2C LCD, UART output
 - Use the 50 MHz Cortex M0 processor core in the Energy Metering IC with up to 32 kB flash and 8 kB SRAM memory

EM773 Tool Highlights



- ▶ Evaluation boards
 - Plug meter with EM773 and OL2381
 - USB transceiver with LPC1343 and OL2381
 - Wireless M-Bus S1 Mode Software Included!
- ▶ IDEs Supporting EMxxx Metrology Engine
 - IAR Embedded Workbench for ARM (NOW!!!)
 - Keil and Code Red (Coming soon!)
- ▶ SWD debuggers
 - All debuggers supporting Cortex-M0

EM773 Plug Meter



PC Energy Display



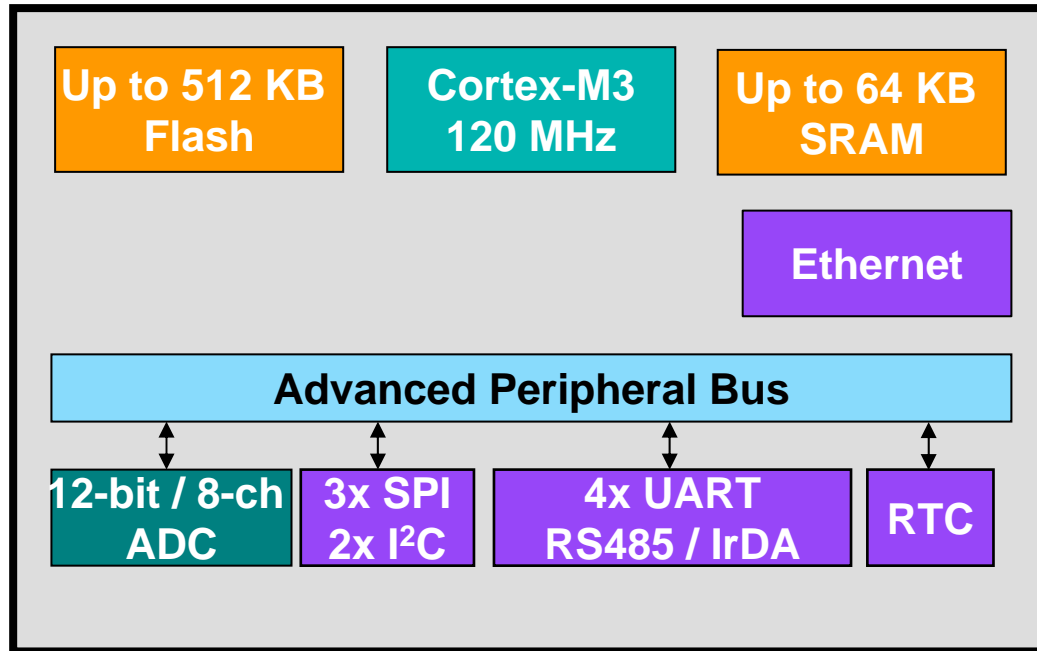
M-Bus USB Adapter

MCU Residential & Industrial Electricity Meters

LPC17xx – Available NOW!!!



Highest performance with many options including ethernet



- ▶ Optimized solution for industrial metering
- ▶ Advanced apps with superior MCU performance
- ▶ Ultimate flexibility for modular development
- ▶ Integrated ethernet MAC for IP network connection

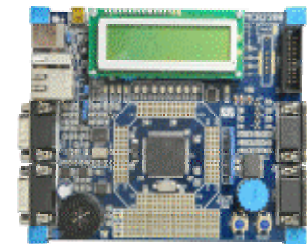
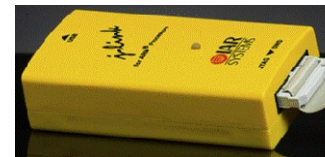
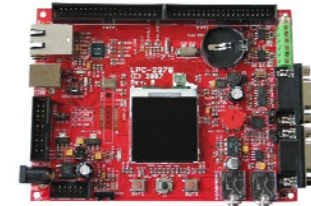
80/100-pin LQFP

<http://ics.nxp.com/products/lpc1000/lpc17xx/>

LPC1700 Tools Highlights



- ▶ Evaluation boards
 - Embedded Artists
 - Hitex LPC17xx-Stick
 - IAR KSDK-LPC17xx
 - Keil MCB17xx
 - mBed LPC1768
- ▶ IDEs
 - IAR Embedded Workbench for ARM
 - ARM/Keil μ Vision4
 - CodeRed RedSuite
 - Hitex HiTOP
- ▶ JTAG debuggers
 - All debuggers supporting Cortex-M3
- ▶ Plus many more tools available!

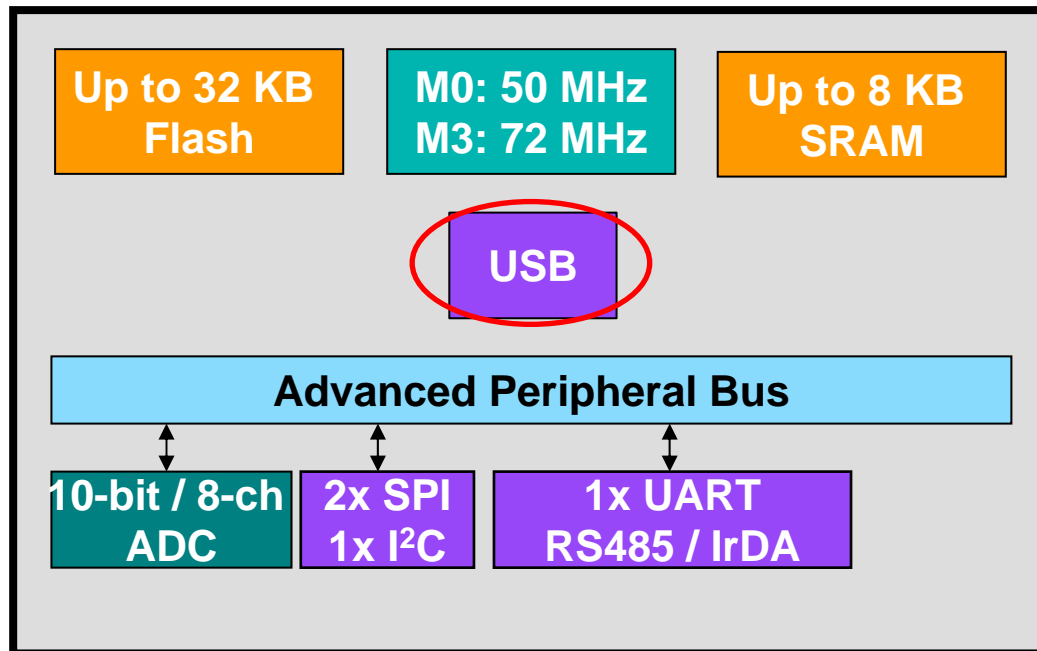


MCU Smart Metering Communications Modules

LPC13xx & LPC11xx – Available NOW!!!



Perfect MCU options for adding communications to existing meters



- ▶ Optimized solution for communications module
- ▶ Integrated USB option with LPC13xx family
- ▶ Demo USB keys available with LPC1343 and OL2381

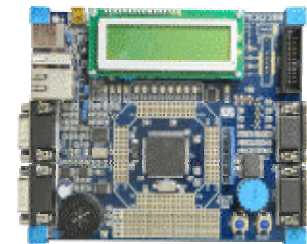
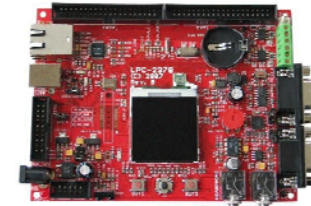
33-pin QFN / 48-pin LQFP

<http://ics.nxp.com/products/lpc1000/lpc11xx/>
<http://ics.nxp.com/products/lpc1000/lpc13xx/>

LPC1300/1100 Tools Highlights



- ▶ Evaluation boards
 - LPC Xpresso
 - Hitex Sticks
 - IAR Kickstart Kits
 - Keil MCB1000
- ▶ IDEs
 - IAR Embedded Workbench for ARM
 - ARM/Keil μ Vision4
 - CodeRed RedSuite
 - Hitex HiTOP
- ▶ JTAG debuggers
 - All debuggers supporting Cortex-M0/M3
- ▶ Plus many more tools available!



Where to get started?



- ▶ www.nxp.com/microcontrollers

- MCU homepage



- ▶ www.nxp.com/lpczone

- Product updates and training



- ▶ www.nxp.com/lpcpresso



- ▶ www.mbed.org



mbed

Social media for NXP microcontrollers



<http://twitter.com/LPCZone>

- ▶ Online community for NXP LPC microcontrollers.
- ▶ Follow LPCZone and you will have the most up-to-date information on the LPC product families.



<http://www.youtube.com/user/LPCZone>

- ▶ Design videos, trainings, interviews, fun

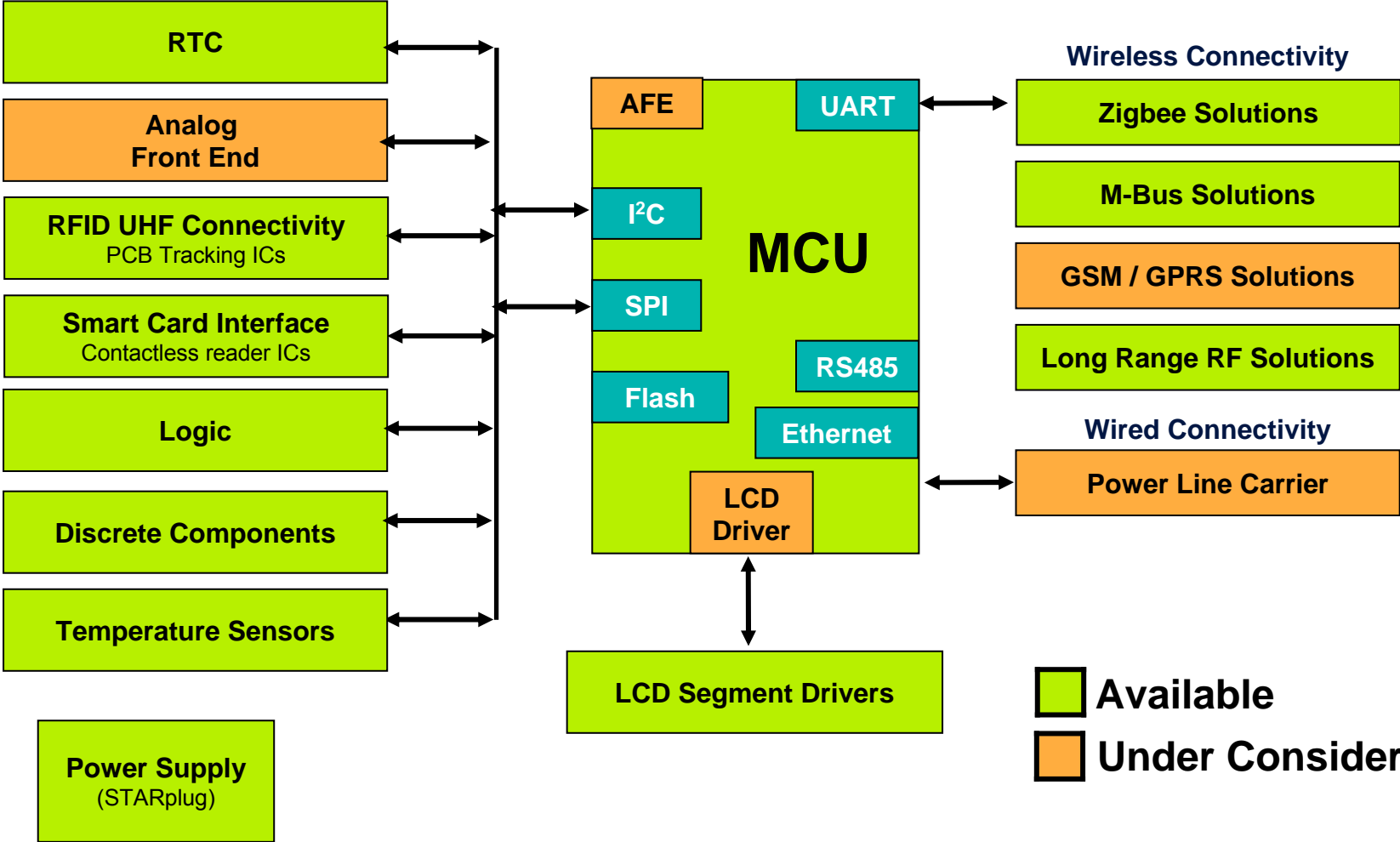


<http://tech.groups.yahoo.com/group/lpc2000/>

- ▶ More than 8,700 registered members (as of May 24, 2010)
- ▶ The #1 active Microcontroller user forum on Yahoo!



Smart Metering Building Blocks



NXP Wireless M-Bus Product offering



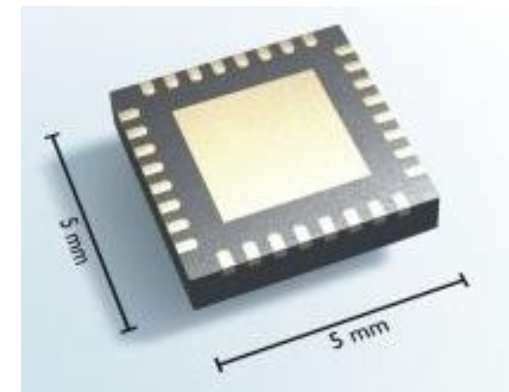
- ▶ Use Cases for In-house communication
 - Wireless Display -- Sub-Meters (Gas / Water / Heat)
 - Smart Appliances -- Remote Switches
 - USB dongle to access meter data by PC / mobile devices

- ▶ Advantages of Wireless M-Bus
 - Reliable and cost-efficient wireless solution
 - Technical advantages over Zigbee
 - Less installation cost

- ▶ NXP products for Wireless M-Bus solutions
 - OL2300: RF Transmitter
 - OL2311: RF Receiver
 - OL2381: RF Transceiver

- ▶ Full Wireless M-Bus Compliance

- ▶ Reference design available

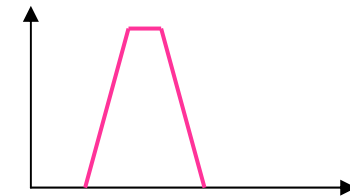


NXP RF Products for Wireless M-BUS

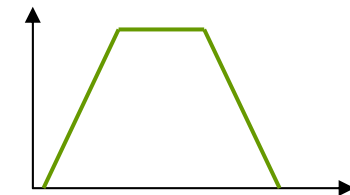


Value Propositions

- ▶ **Efficient Transmitter Power Amp** (required for S1 and S1m M-BUS modes)
 - Programmable power output for optimal performance in every M-BUS Tx Class
- ▶ **Highly Sensitive Receiver** (required for all receiving M-bus modes)
 - Programmable receiver gain for optimal reception performance / current consumption balance.
- ▶ **Flexible Data Rate** (required for T M-BUS modes)
 - Up to 112kcps data rate for compatibility with all M-bus modes
- ▶ **Polling Timer & Preamble Detection** (required for all M-BUS modes)
 - Flexible Signal Monitors prevent 'false wakeups' & allow long system battery life.
- ▶ **Multi-Channel Operation** (required for R2 M-BUS mode)
 - Entire RF Range can be programmed on-the-fly to operate on different radio channels (jammer avoidance)



Low Data Rate
(S & R modes):
Narrowband for communication distance

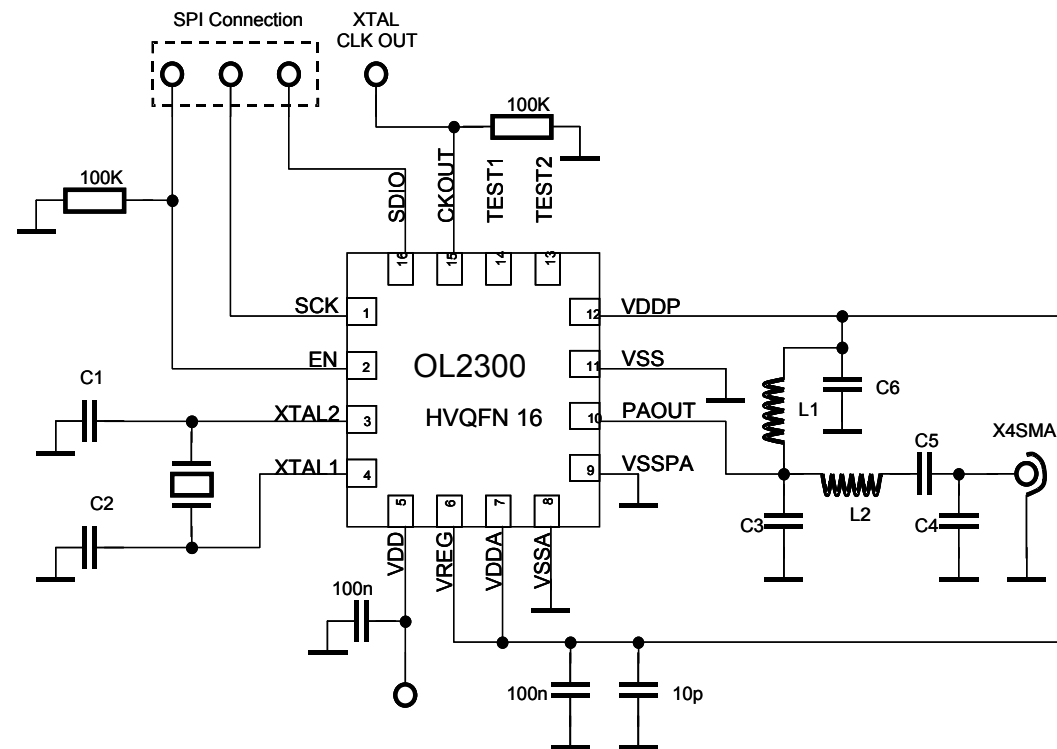


High Data Rate
(T modes):
Broadband channel filter

OL2300 Overview



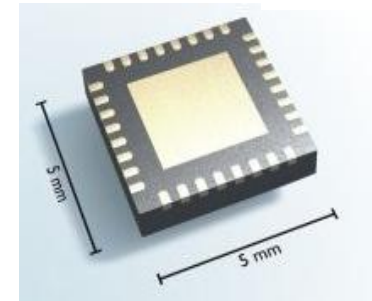
- Fractional N PLL based RF Transmitter Solution
- 315 / 434 / 868 / 915 MHz operation
- Auto Antenna Tuning capability
- Data Rate up to 112kchips/s
- Fully software configurable
- HVQFN 16
Small package outline
3mm x 3 mm



Transceiver - Bidirectional OL2381 Overview



- Two Way RF Transceiver Solution (half duplex)
- Fractional N PLL: 315 / 434 / 868 / 915 MHz
- Value Proposition
 - Fully software configurable, including On-Chip programmable IF-Filter
 - Low Power Polling timer and preamble detection
 - High RX Sensitivity & High TX Efficiency



HVQFN32 Package

Quick Reference Data

Supply Voltage: 2.1V ... 3.6V

Receive Current: 16.5 mA

Transmit Current: 9mA @ 0dBm

Sensitivity ASK -118 dBm @2.4kpbs (50kHz BW)

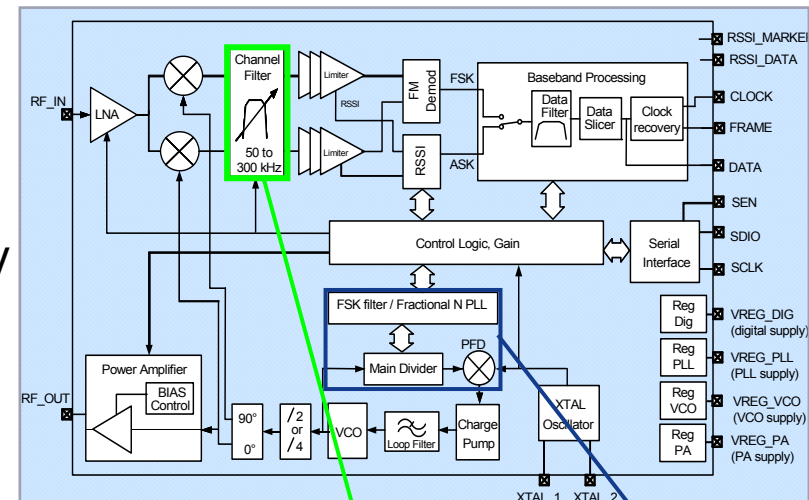
Sensitivity FSK -112 dBm @2.4kpbs (50kHz BW)

Lo Frequency Step Width: 150 Hz

IF Channel BW: 50/75/100/150/200/300kHz

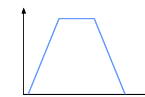
RSSI Dynamic Range: 80 dB

Frequency Change Latency Time: 150µs



Wide band required

Narrow band desired



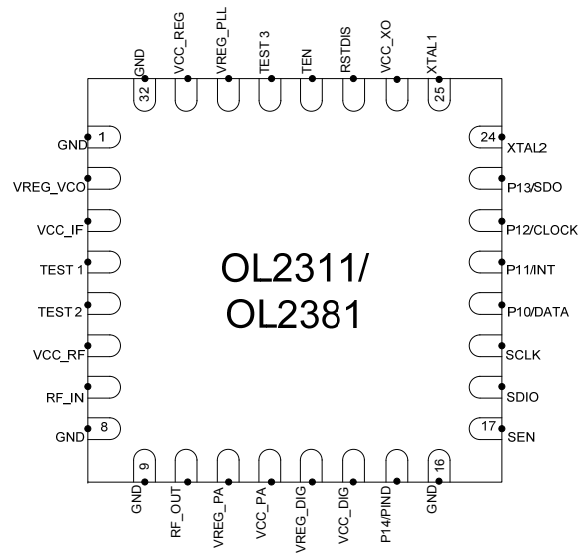
w/ optional multi-channel use



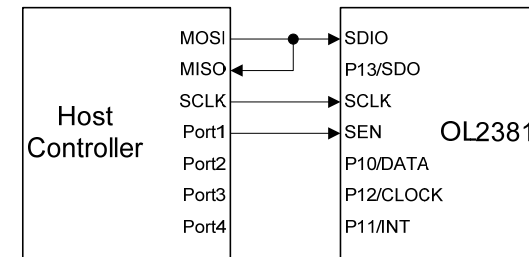
Key Application Strengths: Size and Integration



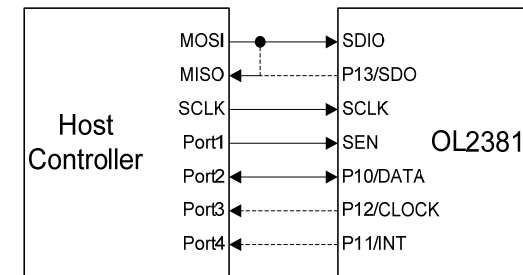
- ▶ LNA
- ▶ IF Polyphase Variable Channel Filter
- ▶ VCO +TANK
- ▶ PA
- ▶ SPI Interface



Minimum



Maximum



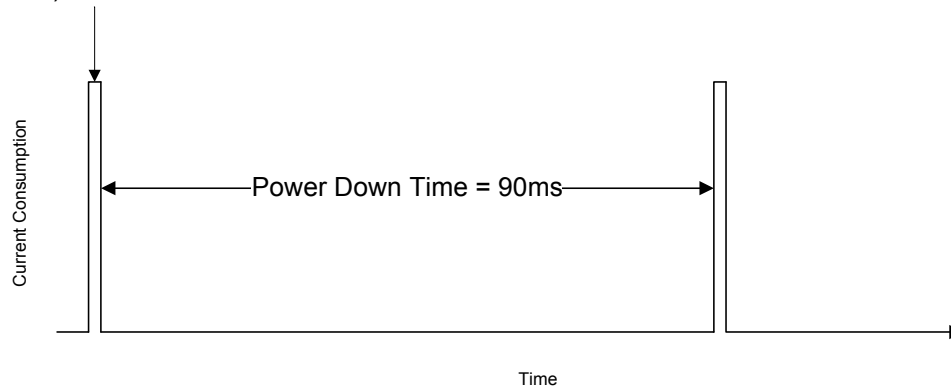
Application Strength – Low System Power Consumption with Intelligent Polling



Average System Current Consumption (mA)*

$$\frac{(16.5mA \times 10ms) + (5\mu A \times 90ms)}{100ms} = 1.65mA$$

Power Up (Wake Up Search) Time = 10ms



*Communication protocol and application dependent



Product Range Overview



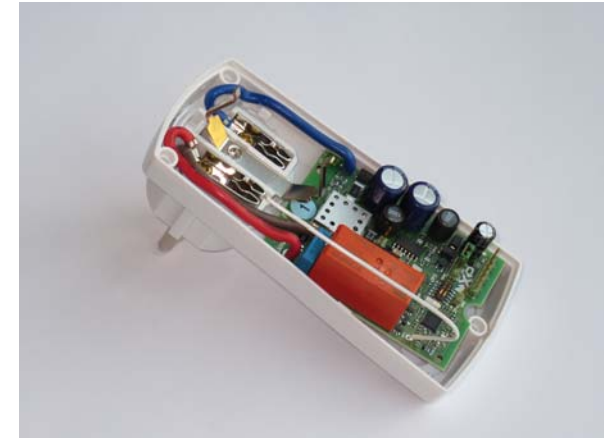
Type Number		OL2300	OL2311	OL2381
Product Type		Transmitter	Receiver	Transceiver
Supply Voltage		2.1 V to 3.6 V	2.1 V to 3.6 V	2.1 V to 3.6 V
Operating Temperature	HVQFN	- 25 °C to + 85 °C	- 25°C to + 85 °C	- 25 °C to + 85 °C
Power Down Current		50 nA	500 nA	500 nA
UHF Carrier Frequency		300 - 920 MHz	300 - 928 MHz	300 - 928 MHz
Xtal Frequency		9 - 19 MHz	16 MHz	16 MHz
Transmitter			N/A	
Supply Current	XTAL PLL Tx@6dBm	180 µA 1.3 mA 7 mA		900 µA 5 mA 14 mA
Max Output Power		up to 12dBm		up to 10dBm
Data Rate		up to 112 kcps		up to 112 kcps
Modulation		ASK, FSK		ASK, FSK
Phase Noise	@100kHz @10MHz	-76 dBc -115 dBc		-86 dBc -130 dBc
Receiver		N/A		
Supply Current			16.5 mA	16.5 mA
Data Rate			up to 112 kcps	up to 112 kcps
Modulation			ASK, FSK	ASK, FSK
Sensitivity	ASK FSK@50kHz BW		-118 dBm -112 dBm	-118 dBm -112 dBm
Adjacent channel rejection			10 dB	10 dB
Image channel rejection	calibrated		40 dB	40 dB
Channel Filter BW			50 to 300 kHz	50 to 300 kHz
Polling Timer Period			1ms to 4096ms	1ms to 4096ms
RSSI	Dynamic Range Absolut Accuracy / Variation		80 dB ±12 dB / ±3 dB	80 dB ±12 dB / ±3 dB
Package		HVQFN16	HVQFN32	HVQFN32

OL23xx Tool Highlights



- ▶ Evaluation boards
 - Plug meter with EM773 and OL2381
 - USB transceiver with LPC1343 and OL2381
 - Wireless M-Bus S1 Mode Software Included!
- ▶ IDEs Supporting EMxxx Metrology Engine
 - IAR Embedded Workbench for ARM (NOW!!!)
 - Keil and Code Red (Coming soon!)
- ▶ IDEs Supporting Wireless M-Bus Stack
 - IAR Embedded Workbench for ARM (NOW!!!)
 - Keil and Code Red (Coming soon!)
- ▶ SWD debuggers
 - All debuggers supporting Cortex-M0

EM773 Plug Meter



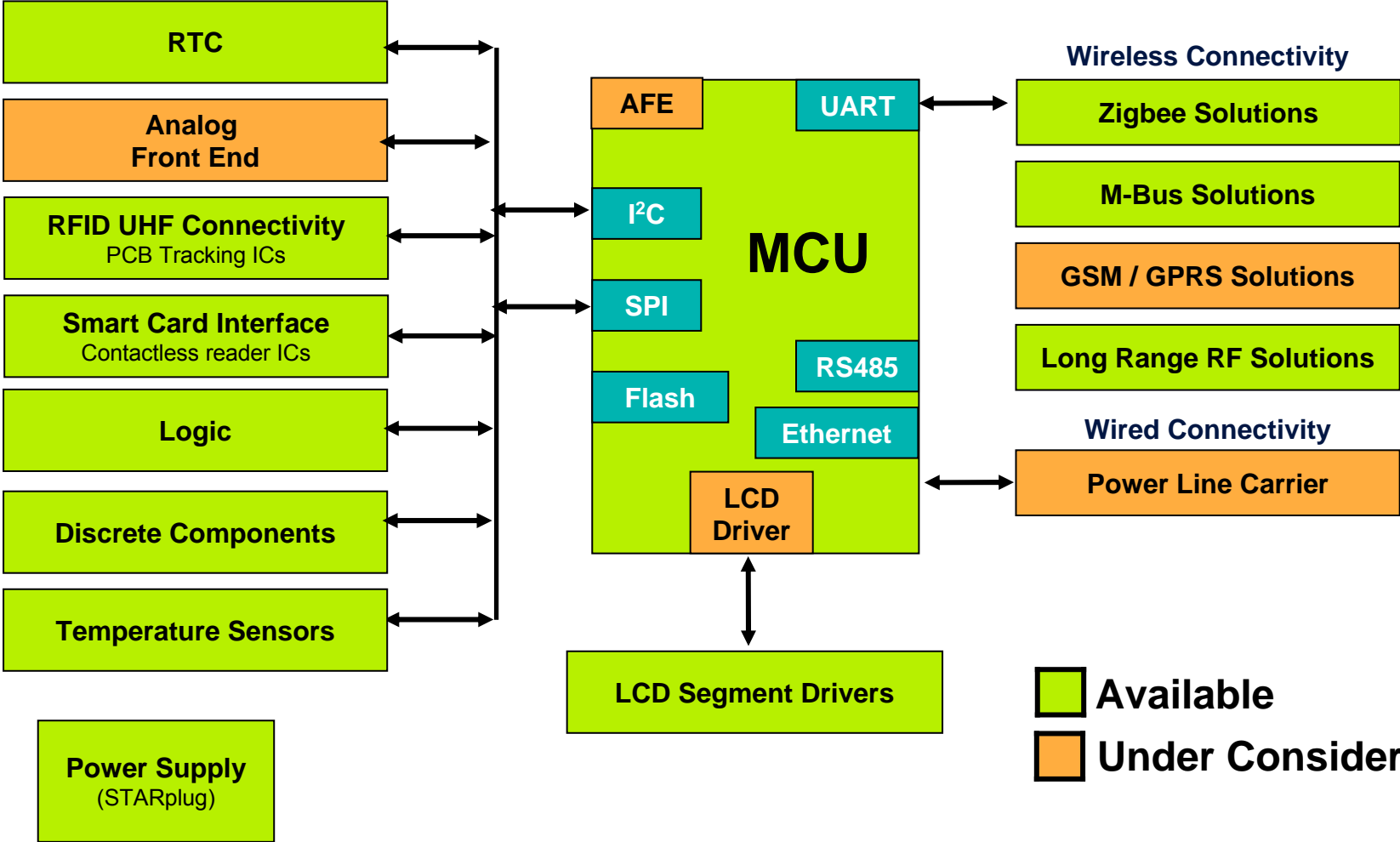
PC Energy Display



M-Bus USB Adapter

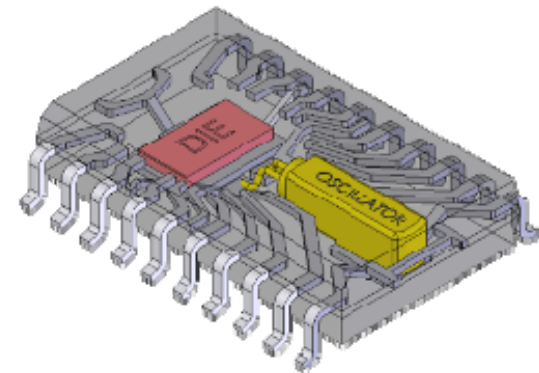


Smart Metering Building Blocks



NXP Value Proposition for Real Time Clocks (RTC)

- ▶ Application context / why does timing matter?
 - Tariff switching
 - Time stamping (e.g. billing, anti tampering etc.)
- ▶ Timing accuracy levels
 - The accuracy of normal RTC's is temperature dependant
 - Options to achieve higher accuracy
 - Temperature compensation
 - Synchronization via network
 - Rule of thumb: longer / no synchronization intervals – higher accuracy needed
- ▶ NXP most recommended parts
 - PCF2127A / PCF2129A (highly accurate)
 - PCF2123 / PCF8523 (ultra low power)
- ▶ Advantages:
 - Integrated crystal
 - Temperature compensated (incl. calibration)
 - Ultra low power consumption (key for battery operated / backed systems)



CWG Realtime Clocks

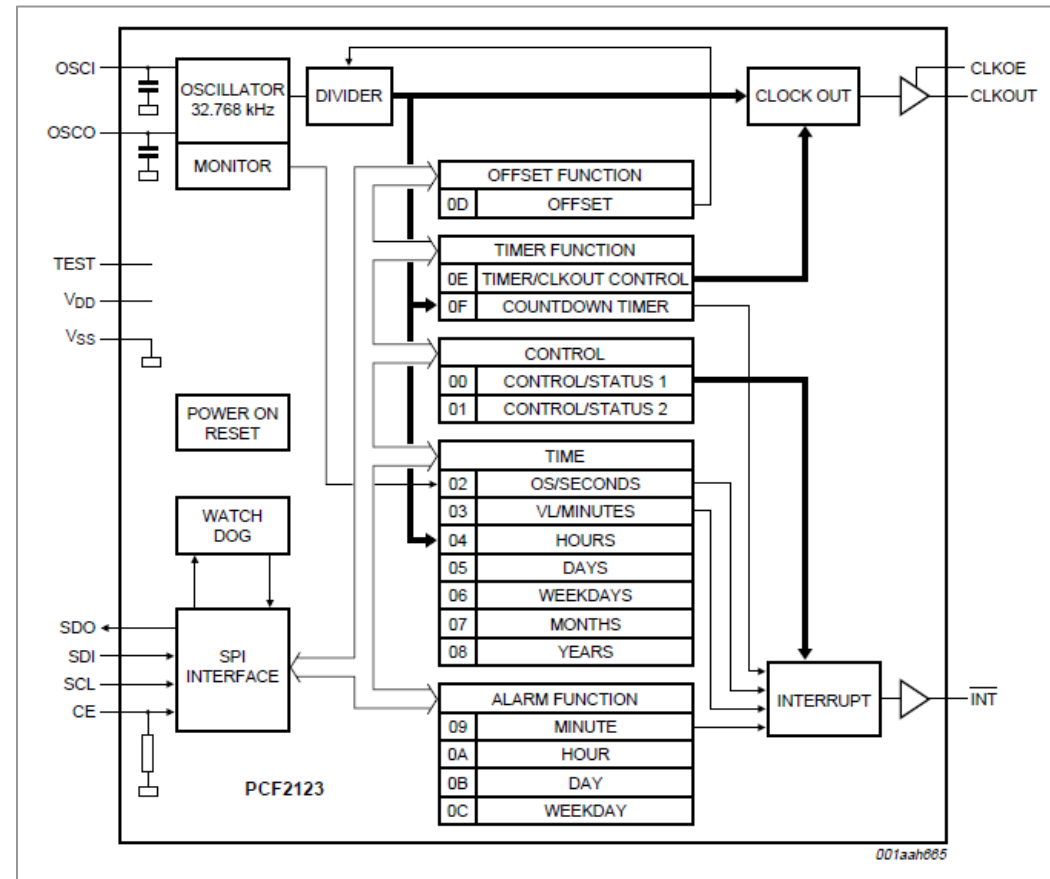
Low-power RTC Family



▶ PCF2123 Ultra-low Power RTC (100nA (typ.) at $V_{DD} = 2.0V$ and $T_{amb} = 25^{\circ}C$)

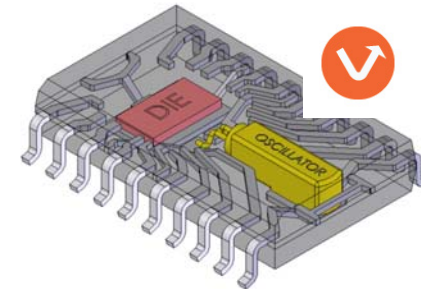
Key Features:

- ▶ Ultra low power **100nA/2V** (typ.)
- ▶ Large voltage range 1.5...5.5V
- ▶ SPI bus up to 6MHz
- ▶ Clock from seconds to 99 years
- ▶ Programmable Timer
- ▶ Frequency output with output enable pin
- ▶ Electronic tuning
- ▶ Small packages TSSOP14, HVQFN16 and U (die only)



CWG Realtime Clocks

Accurate RTC Family



▶ Selection Table High Accuracy

- Highly accurate time reference independent of temperature
- To enable accurate tariff switching in utility metering systems

Part	Description	Interface	Accuracy (typ.)	Package	Status
PCF2127A	real time clock/calendar; integrated RAM; temperature compensation; integrated quartz crystal; power management support; operating temperature range -40°C to +85°C	I ² C & SPI	+/- 3ppm -15°C to +60°C +/- 5ppm -25°C to -15°C and +/- 5ppm +60°C to +65°C	SO20	<i>released</i>
PCF2129A	real time clock/calendar; temperature compensation; integrated quartz crystal; automotive option available; operating temperature range -40°C to +85°C	I ² C & SPI	+/- 3ppm -15°C to +60°C +/- 5ppm -25°C to -15°C and +/- 5ppm +60°C to +65°C	SO20	<i>released</i>

PCF2129A and PCF2127A NOW released and in volume production !!!

CWG Realtime Clocks

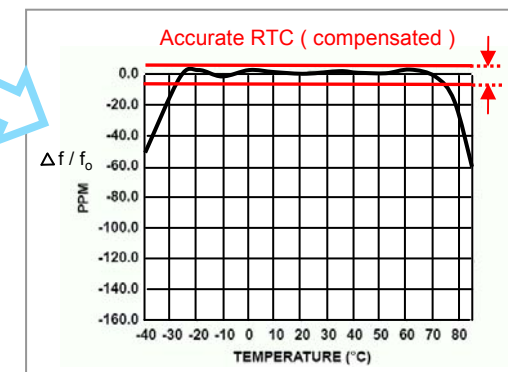
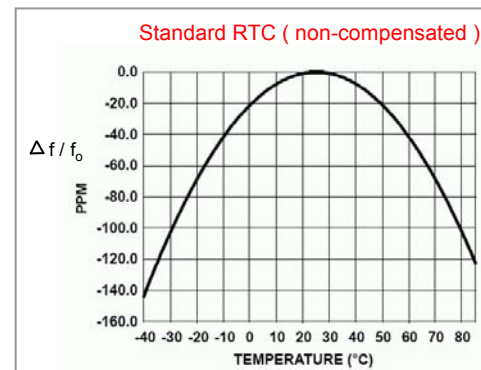
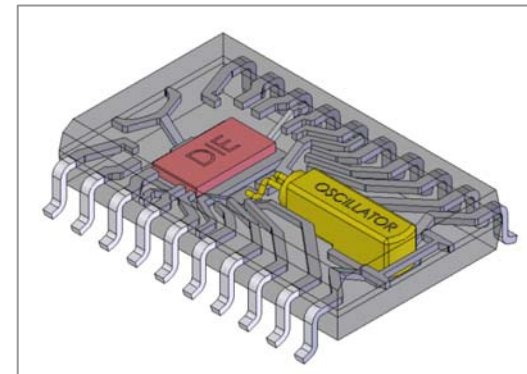
Accurate RTC Family



- ▶ **PCF2129A/27A Highly accurate RTC** ($\pm 3\text{ppm}$ (typ.) over $T_{\text{amb}} = -15^{\circ}\text{C}$ to $+60^{\circ}\text{C}$)

Key Features:

- ▶ $\pm 3\text{ppm}$ accuracy -15°C to $+60^{\circ}\text{C}$ (typ.)
- ▶ Integrated Quartz Crystal
- ▶ Temperature Compensation
- ▶ Factory calibrated
- ▶ 512 Byte of on-chip RAM (PCF2127A)
- ▶ SPI & I2C Interface
- ▶ SO20 Package



CWG Realtime Clocks

Accurate RTC Family



▶ PCF2129A/27A Highly accurate RTC ($\pm 3\text{ppm}$ (typ.) over $T_{\text{amb}} = -15^{\circ}\text{C}$ to $+60^{\circ}\text{C}$)

Type	PCF2127A	PCF2129A
Operating Temp. Range	-40°C, ..., +85°C	-40°C, ..., +85°C
Accuracy (typ.)	+/- 3ppm -15°C to +60°C +/- 5ppm -25°C to -15°C +/- 5ppm +60°C to +65°C	+/- 3ppm -15°C to +60°C +/- 5ppm -25°C to -15°C +/- 5ppm +60°C to +65°C
Interface	I ² C and SPI	I ² C and SPI
RAM	512 Byte	–
Package	SO20	SO20
Supply Voltage Range VDD	1.8V – 4.2V	1.8V – 4.2V
Battery Supply Voltage Range VBat	1.8V – 4.2V	1.8V – 4.2V
Supply Current (typ.)	650nA @ 3.0V and Tamb=25C	650nA @ 3.0V and Tamb=25C
Battery Switch over function	Yes	Yes
Battery Low-Detection Function	Yes	Yes
Extra Power Fail Detection Function	Yes	No
Battery backed Output Voltage Pin	Yes	Yes
Reset Output Pin	Yes	No
Countdown timer and watch dog function	Yes	Watchdog only
Time Stamp Function	Yes	Yes

The 5V version of PCF2127 formerly named PCF2128 is currently not in focus

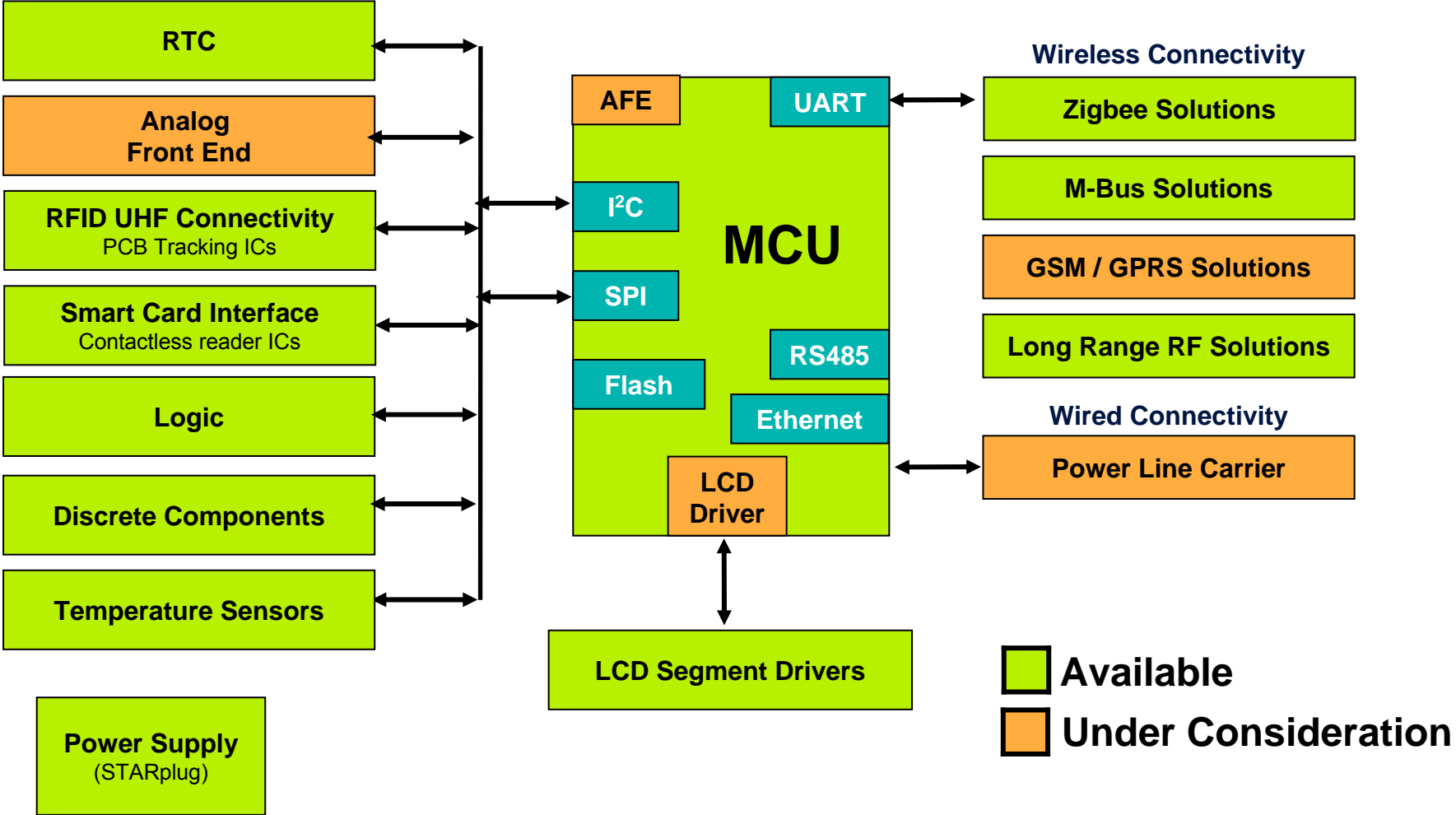
CWG Realtime Clocks



▶ More Information:

- <http://ics.nxp.com/products/real.time.clock.calendars/>

Smart Metering Building Blocks



NXP Value Proposition for LCD Display Driver



- ▶ Application context
 - Display drivers are used to show the meter measurement data
 - Typical requirement is 128 to 160 segment display in the meter
- ▶ Implementation options
 - Integrated in MCU
 - Chip-on-Glass / Chip-on-Board
 - Stand-alone devices
- ▶ NXP most recommended stand-alone parts
 - PCF85162: 128 segment driver (4 x 32 segments)
 - PCF85176: 160 segment driver (4 x 40 segments)
- ▶ Advantages:
 - Low power consumption
 - Design flexibility (placement of DD vs. display)
 - Support of various displays technologies



LCD Drivers: Key Products



Segment Drivers	Character Drivers	Graphic (Dot Matrix) Drivers
<ul style="list-style-type: none"> • PCF85162 4 x 32 Segments NEW • PCF85176 4 x 40 Segments NEW • PCF85134 4 x 60 Segments NEW • PCF85133 4 x 80 Segments NEW • PCF85132 4 x 160 Segments NEW • PCA9620 8 x 60 Segments ^[1] 	<ul style="list-style-type: none"> • PCF2113 2-line x 12-Character Plus 120 icons • PCF2116 2-line x 24-Character • PCF2119 2-line x 16-Character Plus 160 icons 	<ul style="list-style-type: none"> • PCF8531 34 x 128 Small 4-x-20 Text Characters Full Graphics • PCF8811 80 x 128 Large Universal display

[1] In Development

For Details, see the LCD Drivers Selection Guide



CWGG LCD Drivers


Segment Driver Family

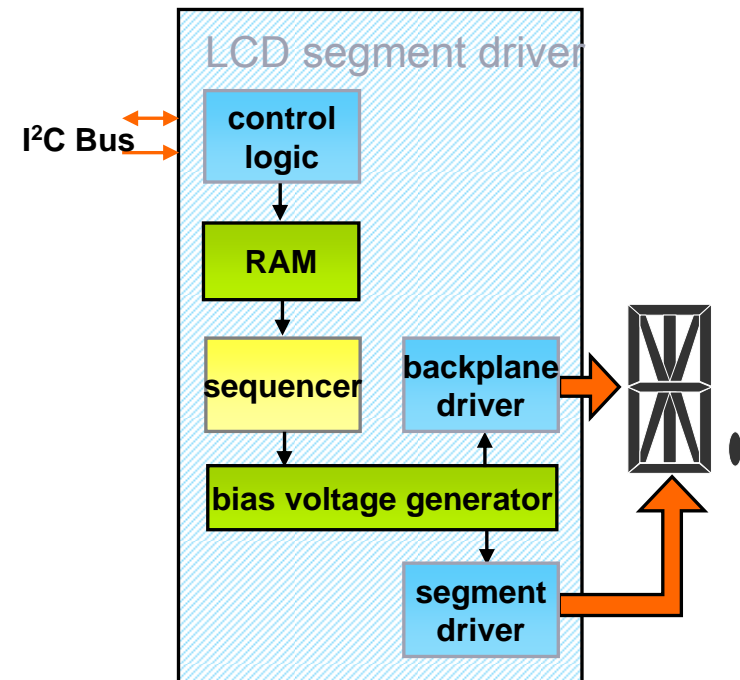
LCD Segment Drivers

Features

- ▶ Drives wide range of displays from 128, 160, 240, 320, 480 up to 640 segments
- ▶ Supports four different Multiplex Rates: 1:1 (static), 1:2, 1:3 and 1:4 (PCA9620 additionally Mux 1:8)
- ▶ On-chip RAM with auto incremental addressing
- ▶ Low power consumption
- ▶ Wide power supply range
- ▶ Two selectable frame frequency ranges: 82Hz typically or 110Hz typically (PCF85133)
- ▶ Programmable frame frequency from 60Hz to 90Hz (PCF85132)
- ▶ Internal charge pump and VLCD temperature compensation for better optical performance (PCA9620)

Key products

- ▶ PCF85162 4 x 32 segments 
- ▶ PCF85176 4 x 40 segments
- ▶ PCF85134 4 x 60 segments
- ▶ PCF85133 4 x 80 segments
- ▶ PCF85132 4 x 160 segments
- ▶ PCA9620 8x 60 segments (in development)



<http://ics.nxp.com/products/lcd.drivers/segments/>

CWG LCD Drivers

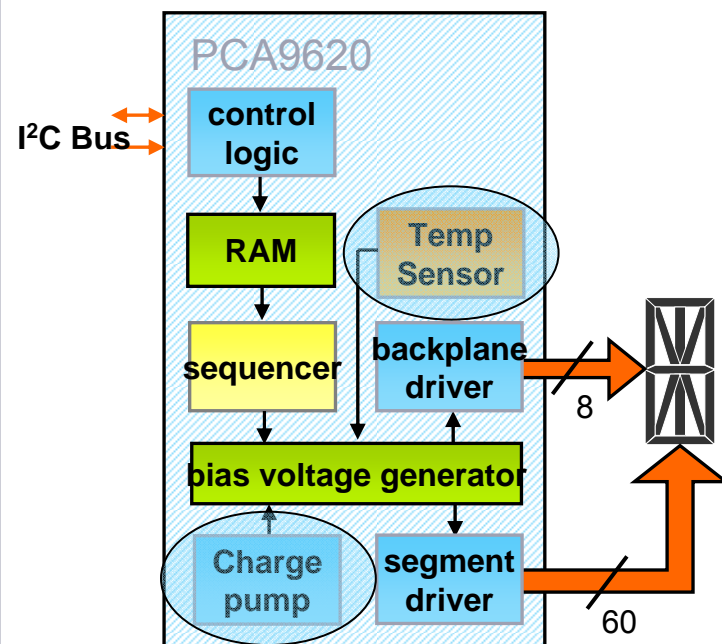
Segment Driver Family



▶ PCA9620 60x8 COG LCD Segment Driver (supports up to 480 segments)

Key Features:

- ▶ 480 Segment Drive in Mux 1:8 Mode
- ▶ I2C Interface
- ▶ Integrated charge pump
- ▶ Integrated temperature sensor
- ▶ On-chip VLCD generation
- ▶ Temperature compensated VLCD voltage
- ▶ Programmable and calibrated frame frequency
- ▶ Wide frame frequency range 60Hz to 300hZ
- ▶ Wide digital power supply range 1.8V to 5.5V
- ▶ Wide analog power supply range 2.5V to 5.5V
- ▶ Wide VLCD range 2.5V to 9.0V
- ▶ Wide operating temp range -40 to +95°C
- ▶ 12 x 12 x 1.4 mm LQFP80 package



In Development

CWG LCD Drivers

Character Driver Family

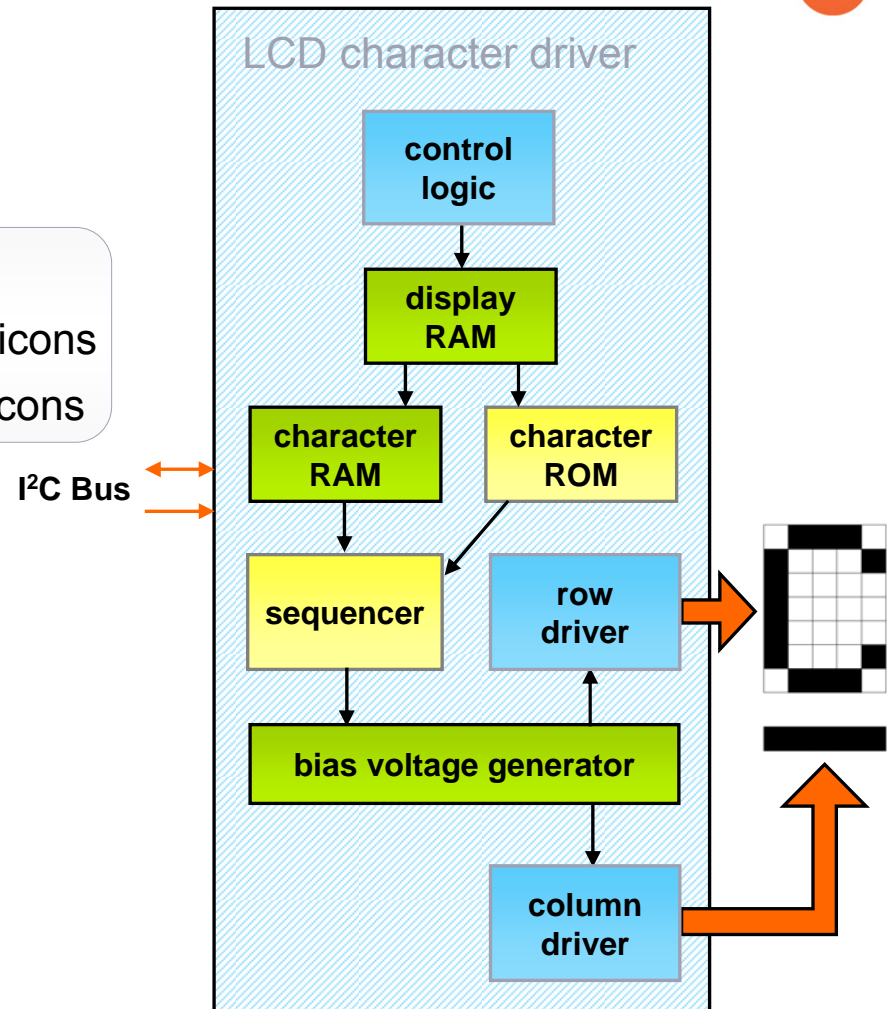
▶ LCD Character Drivers

Key products

- ▶ PCF2113 2 line by 12 characters + 120 icons
- ▶ PCF2119 2 line by 16 characters + 160 icons

Features

- ▶ On-chip character generator
- ▶ On-chip temperature compensation
- ▶ On-chip character ROM and RAM
- ▶ Low power consumption
- ▶ Minimum of external components
- ▶ On-chip LCD bias voltage generation
- ▶ Cursor support



<http://ics.nxp.com/products/lcd.drivers/characters/>

CWG LCD Drivers

Graphic Driver Family



▶ LCD Graphics Drivers

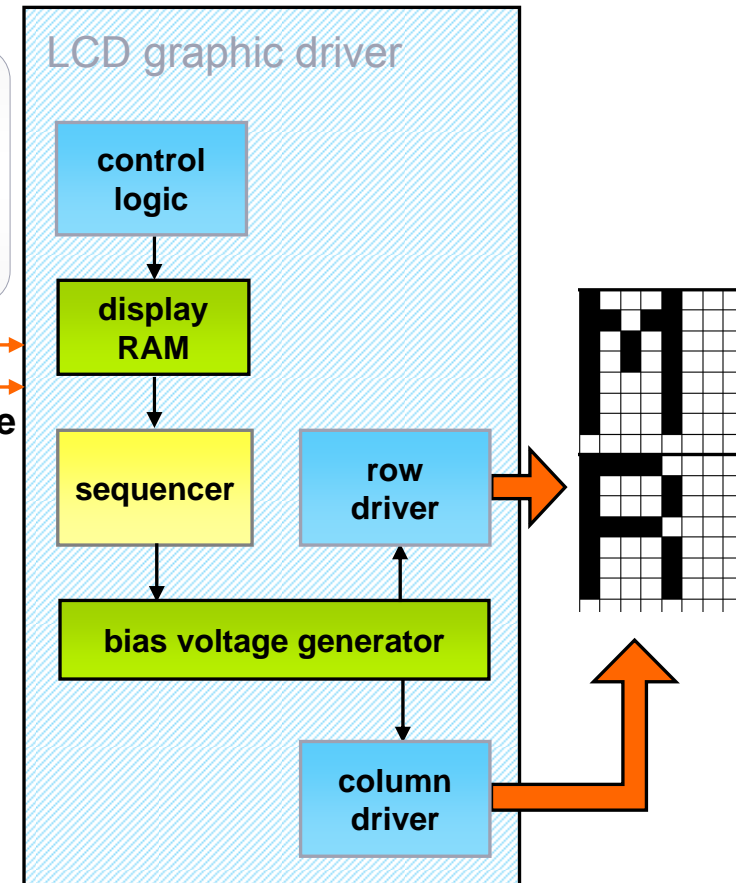
Key products

- ▶ PCF8531 34 x 128 small 4 x 20 chars of text, full graphic
- ▶ PCF8811 80 x 128 large universal display

Features

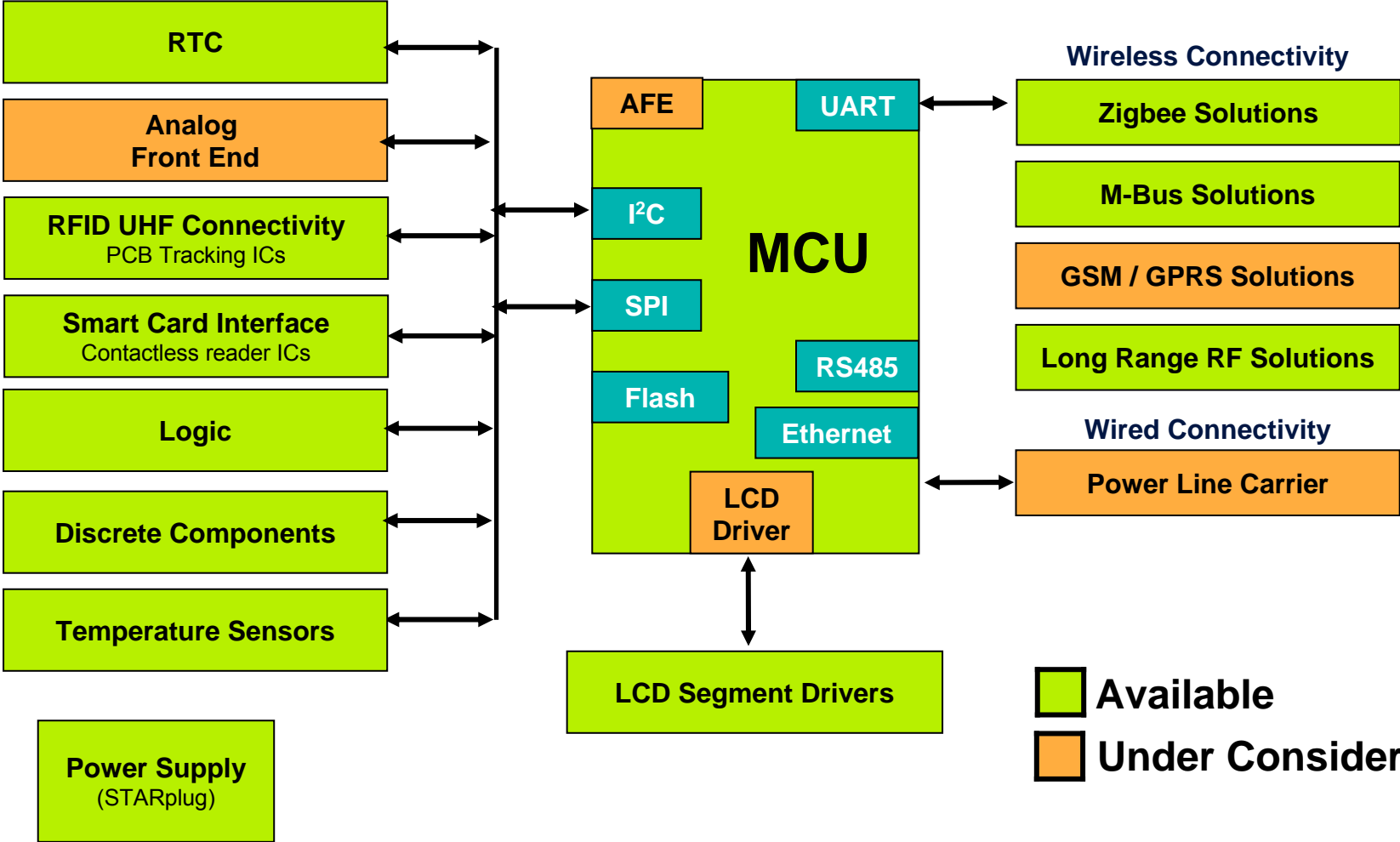
- ▶ Wide range of mux rates to optimize power and display size
- ▶ On-chip generation of LCD bias voltages
- ▶ Low number of external components
- ▶ Low power consumption
- ▶ Temperature compensation

Serial /
parallel /
I²C Interface



<http://ics.nxp.com/products/lcd.drivers/graphics/>

Smart Metering Building Blocks



NXP Value Proposition for Power Supply



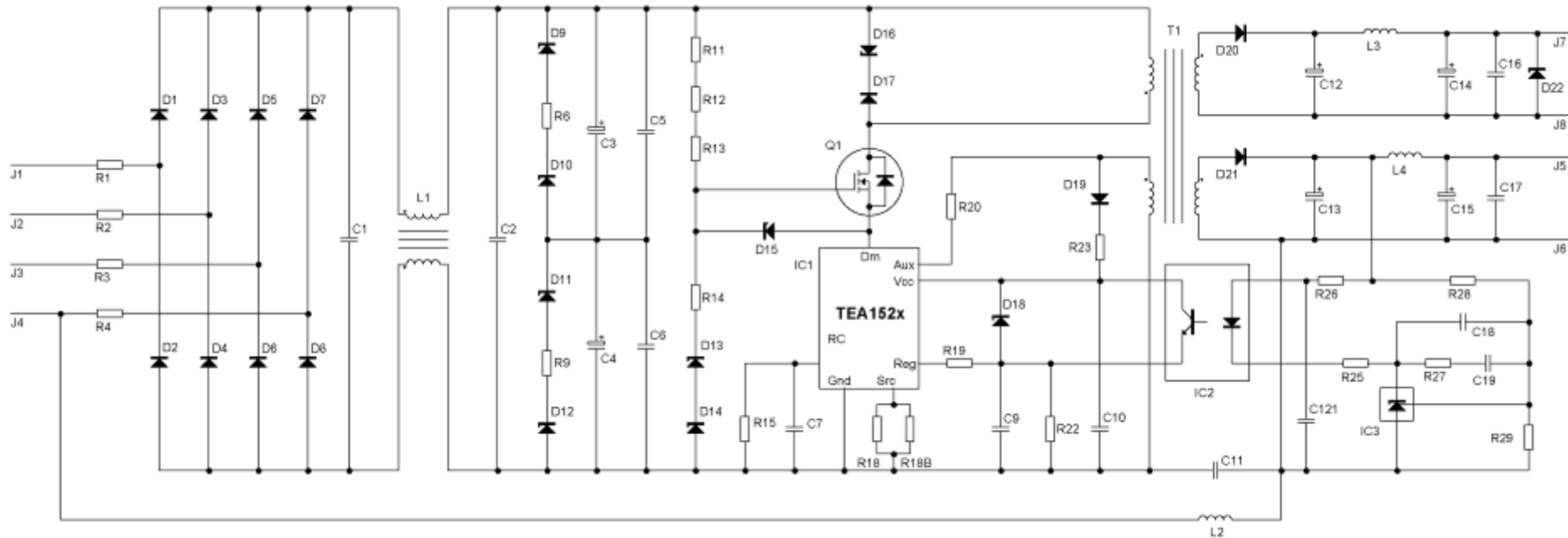
Switch Mode Power Supply (SMPS)

- ▶ Application context
 - Power supplies in metering applications need to stay operational during over-voltage situations
 - Voltages up to 1200 V can occur in 3-phase meters!
- ▶ NXP recommended parts
 - TEA1520T AC/DC converter from StarPlug™ family
- ▶ Implementation
 - StarPlug™ + cascaded MOS-FET (to cope with the 1200 V)
- ▶ Metering Reference Design available (can be used for 3-phase systems)
- ▶ Advantages:
 - Designed for reliability
 - Universal design for ww mains supply
 - Low radiation (EMI)
 - Good efficiency, exceeds Energy Star standard



Universal 3-phase Mains SMPS w/ STARplug

(Specifically intended for E-Metering applications)



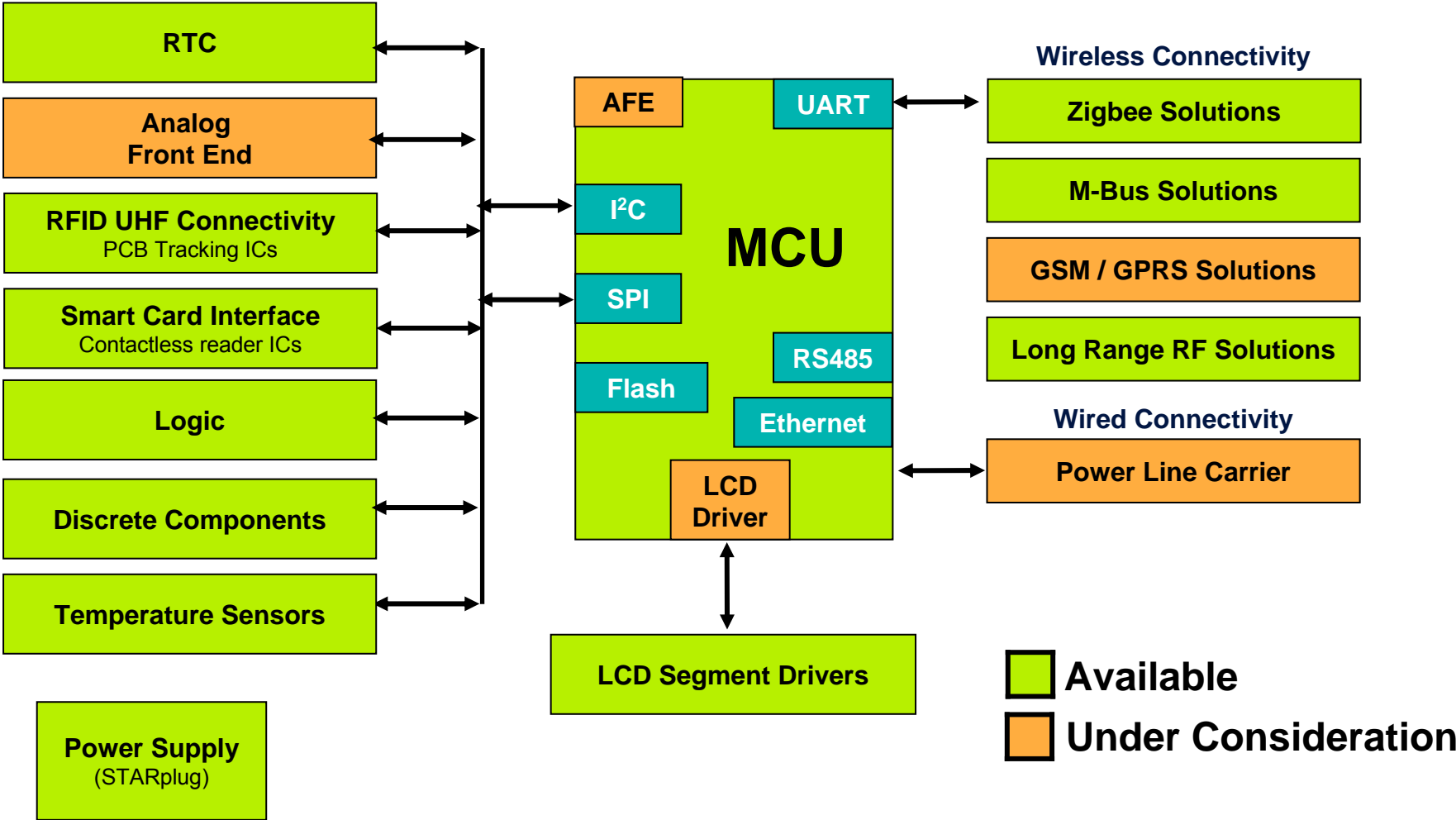
- Supports all Global Mains Electricity Utility Networks (1-, 2- and 3-Phase).
- At least 20% additional voltage margin on the input stage and switching stage.
- Highly reliable
- Efficiency and no load power fully compliant with Energy Star 2.0
- EMI fully compliant with EN55022A

Power Supply STARplug™ portfolio



Type	Package	$R_{DS(on)}$	Max. output power
		Ω	Global mains
TEA1520T/N2	SO-14	48	2 - 5W
TEA1520P/N2	DIP-8	48	2 - 5W
TEA1521T/N2	SO-14	24	3 - 7W
TEA1521P/N2	DIP-8	24	3 - 7W
TEA1522T/N2	SO-14	12	7 - 9W
TEA1522P/N2	DIP-8	12	7 - 9W
TEA1523P/N2	DIP-8	6,5	9 - 12W
TEA1620P/N1	DIP-8	48	2 - 5W
TEA1622P/N1	DIP-8	12	7 - 9W
TEA1623P/N1	DIP-8	6,5	9 - 12W
TEA1623PH/N1	HDIP-16	6,5	12 - 30W

Smart Metering Building Blocks

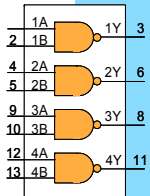


Leverage Selling Logic Products



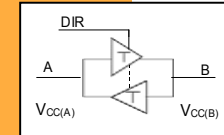
The solutions to tune and complete a design quickly

Control and Interface logic



- AND, OR, NAND, NOR, INV, BUF . . .
- 1, 2, 4, 8, 16 & 32-bit solutions
- 5.0 V HC/T, AHC/T; 3.3 V LVC; 1.8 V AUP

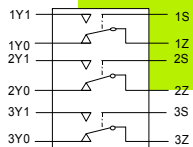
Level translators



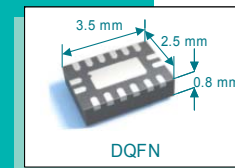
- Bi-directional translation
- 1, 2, 4, 8, 16 & 20-bit solutions
- 74LVCnT, 1.5 V ↔ 5.5 V
- 74AVCnT, 1.2 V ↔ 3.6 V

Analogue Switches

- Low leakage for sensor multiplexing
- Low attenuation and distortion
- NX3, NX5, HEF, HC/T, LV, LVC

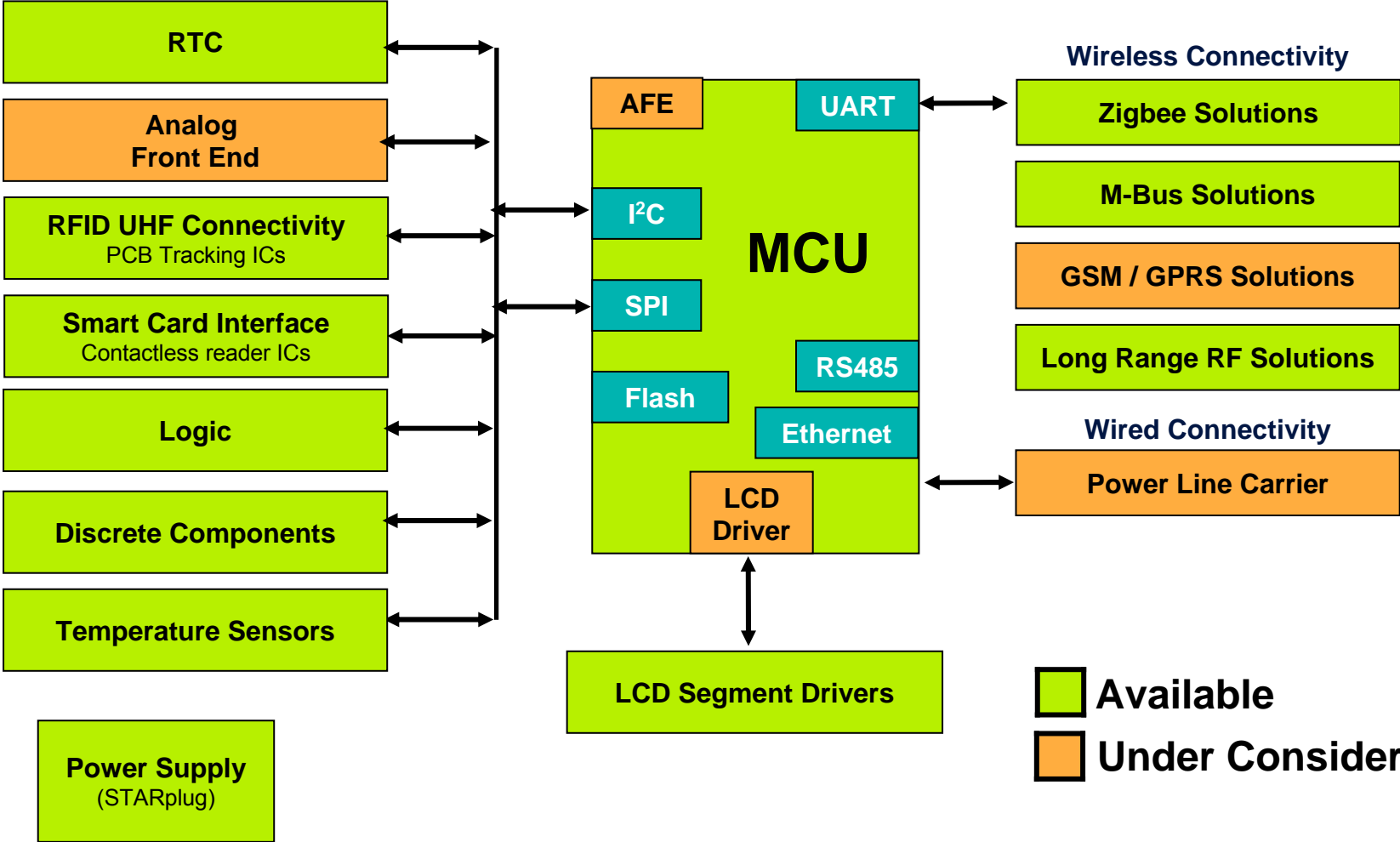


Innovation in Packages



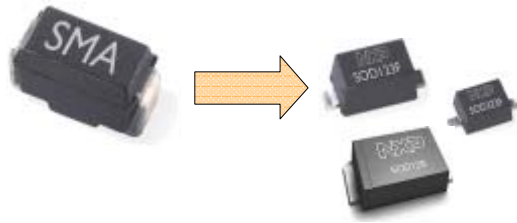
- SO & TSSOP
- Small footprint DQFN
 - 0.5 mm & 0.4 mm pitch
- Picogates and MicroPak
 - 0.5 mm, 0.35 mm & 0.3 mm pitch

Smart Metering Building Blocks



Leverage Selling Discrete Components

GA's broad portfolio offers one-stop shopping possibility



Flatpower packages:
SOD123W, SOD128

Leadless packages:
SOD882, SOT883
SOT886

ESD protection
PESD-series

TVS protection
PTVS-series



Innovation in Packaging

- ▶ superior size/
performance ratio
- ▶ increased design
options

**ESD protection
EMI filtering**

- ▶ safeguard sensitive ICs
- ▶ match the triangle small size,
low line capacity
robust protection

**Energy- efficient
Eco- friendly**

- ▶ lower power consumption
- ▶ generate less heat
- ▶ halogen-free

Small- scale integration

- ▶ reduce part count
- ▶ save costs
- ▶ increase reliability

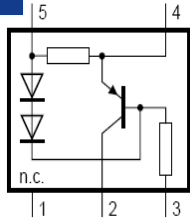
MEGA Schottky
diodes
PMEG-series

Low V_{CEsat} (BISS)
Transistors
PBSS-series

Double RET's /
double Transistors

Double / Triple /
Quad Diodes

Loadswitches,
MosFet drivers



General Application Discretes

Broadliner in standard products



Diodes

- Low V_F (MEGA) Schottky diodes
- Zener diodes
- Small-signal switching diodes

Protection and signal conditioning

- ESD protection diodes, TVS diodes
- EMI and ESD filters, Integrated Discretes
- HDMI Transceiver / Receiver

Transistors

- Low V_{CEsat} (BISS) transistors
- Resistor-equipped transistors (RETs)
- Small-signal and medium power bipolar transistors

Small-signal MOSFETs

Standard Linear products

- Adjustable shunt voltage regulator ICs
- Voltage regulators

.... in 43 packages

- Ultra-small leadless
- Medium power leadless
- FlatPower and Flat-lead
- Standard industry packages

... over 384,000 km

All discretes produced in three years easily cover the distance from earth to moon

ESD protection, TVS diodes



New IC technology is vulnerable for ESD, NXP has the right solution

- ▶ ESD protection Diodes,
 - There are many interface connectors, NXP will protect them with there best in class PESD devices, for single and multiple lines
 - Protection diodes with low (C_d) capacitance for high speed data lines like USB. Special devices for HDMI
- ▶ 400W TVS diodes to protect against surge charges.
 - Best in class value for surge/PCB area - double compared to competition
 - Smallest package offering 400 W surge capability
 - Low maximum leakage current –10x lower than competition



ESD protection
EMI filtering

- ▶ safeguard sensitive ICs
- ▶ match the triangle small size,
low line capacity
robust protection

ESD protection
PESD-series

TVS protection
PTVS-series

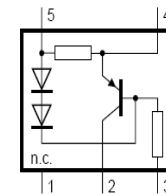
Integration



The way forward to make it Cost effective & Reliable

- ▶ Pick & Place cost
 - This is becoming a large part of the total cost, when product prices are close to 0.01€
- ▶ Less components improve the quality
 - Thermal stress on the solder joints leads to 50% of the malfunctions of electronic equipment
- ▶ Solution:
 - Voltage regulators
 - Loadswitches
 - RET's & double RET's
 - Mosfet Drivers
 - Matched Pairs Transistors
- ▶ Combination:
 - Triple & Quad Diodes
 - Double Transistors
 - Double Low V_{CEsat}
 - Low V_{CEsat} / Low V_F Modules

Small-scale integration



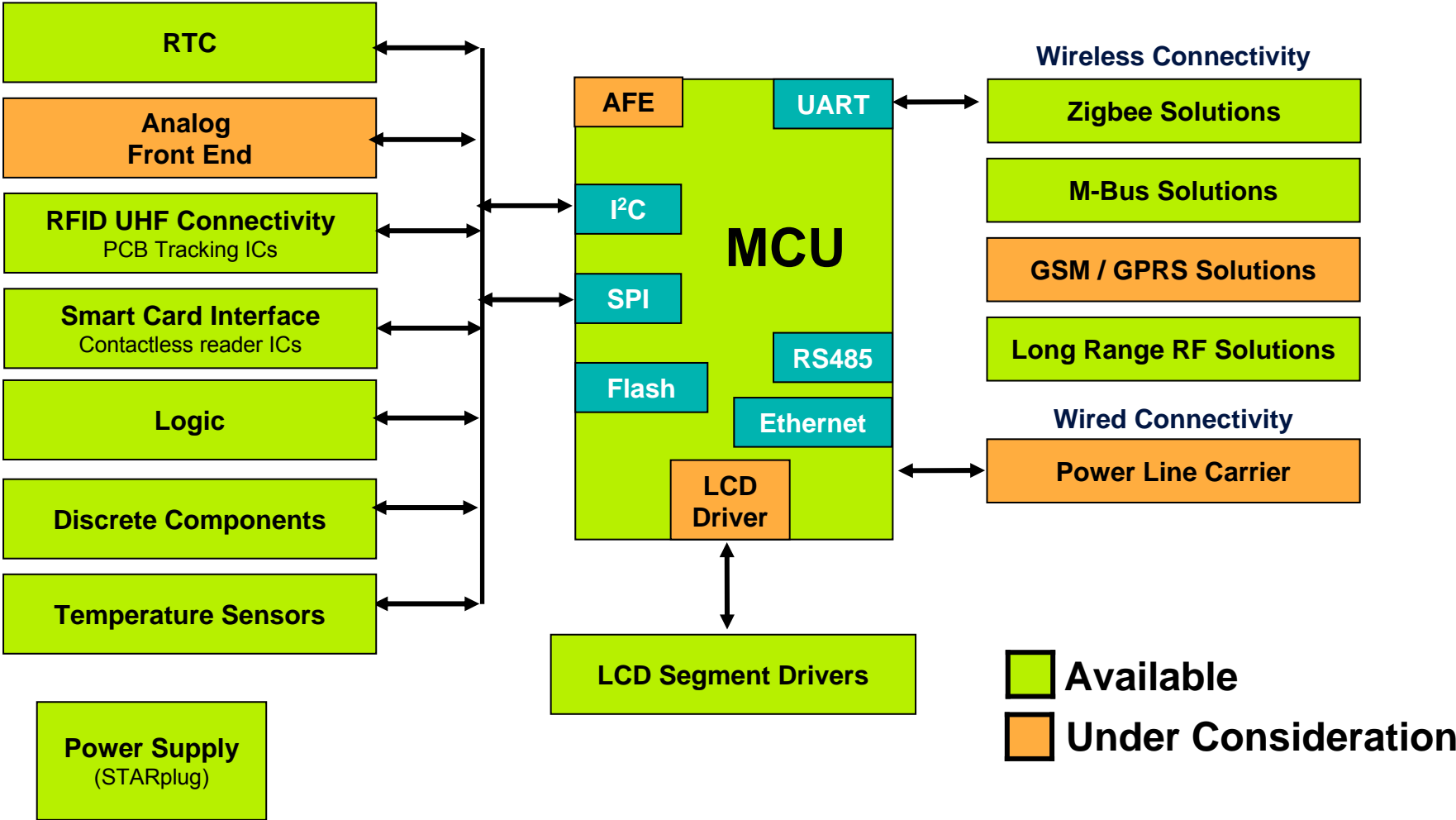
Small- scale integration

- ▶ reduce part count
- ▶ save costs
- ▶ increase reliability

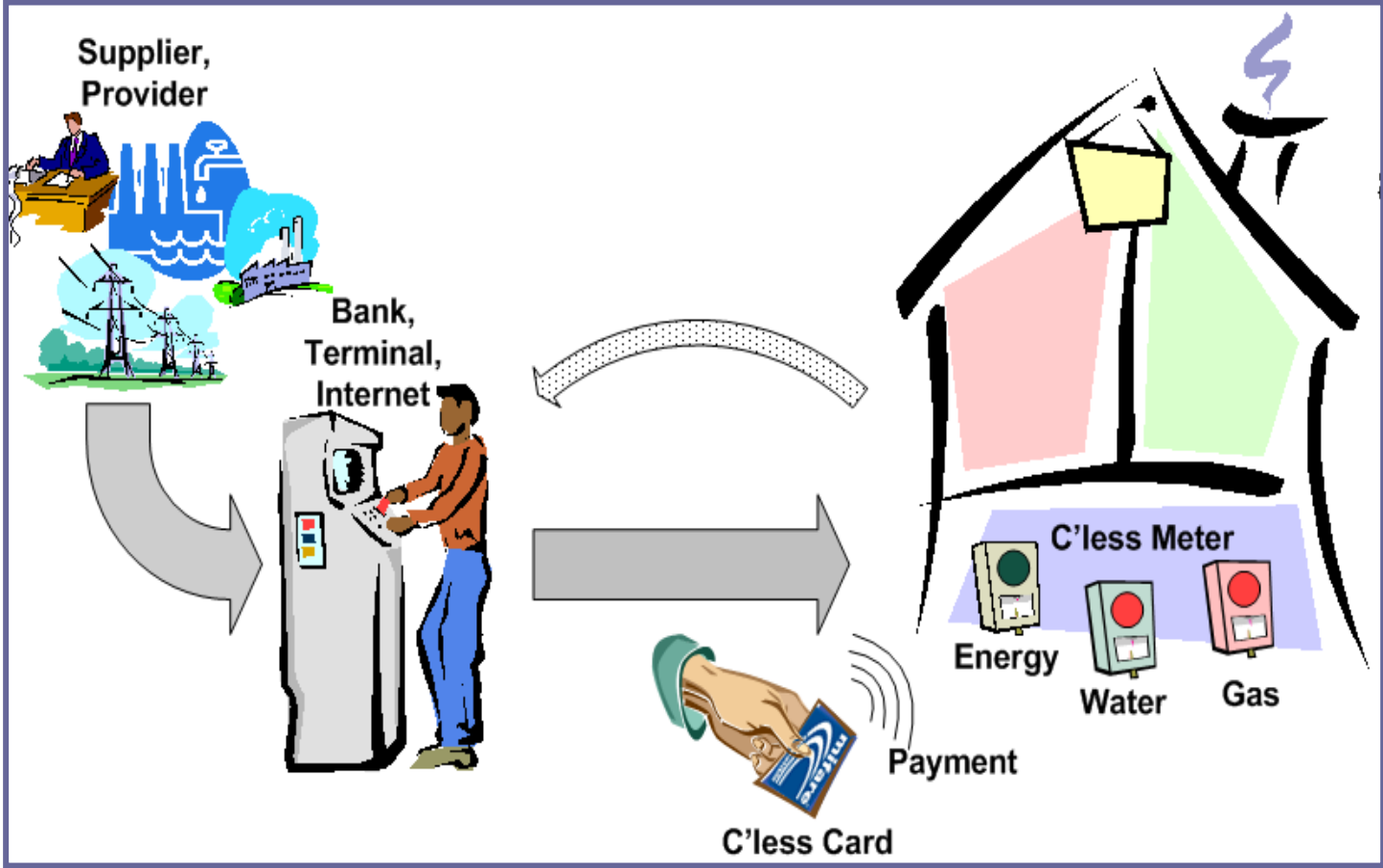
RETs
PDTC/A-series
PBRN/P-series

Complex discretes
e.g. PBLs-, PMD-,
PMP-series

Smart Metering Building Blocks

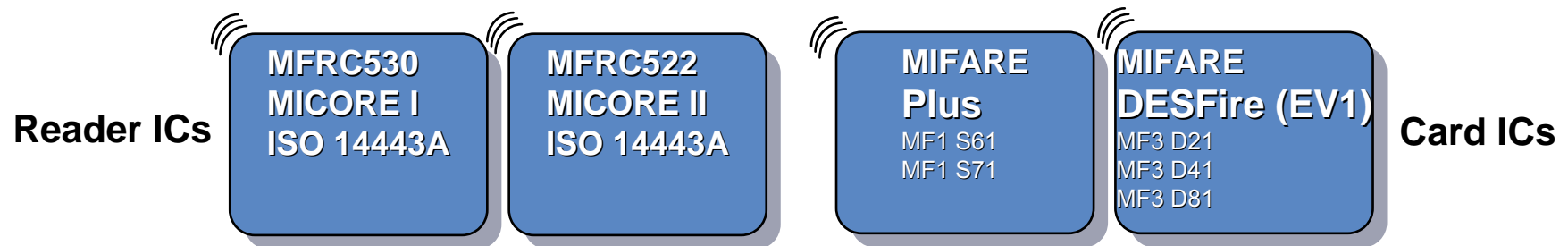


Principle of Prepaid Contactless Metering



NXP Value Proposition in Prepaid Metering

- ▶ Current solutions for prepaid meters
 - Magnetic cards
 - Contact smart cards
 - Tokens
 - Keypad / Numeric tokens
- ▶ Advantages of contactless technology
 - Better protection against environmental effects (dust, humidity, etc.)
 - Longer lifetime, no maintenance
 - User convenience
- ▶ NXP offers a broad card IC and reader IC portfolio for prepaid metering
- ▶ Most recommended solutions



NXP supports prepaid metering with a broad card IC and reader IC portfolio



Most recommended reader ICs

Most recommended card ICs

	Most recommended reader ICs		Most recommended card ICs		
	MFRC530 MICORE I ISO 14443A	MFRC522 MICORE II ISO 14443A	MIFARE Plus MF1 S61 MF1 S71	MIFARE DESFire (EV1) MF3 D21 MF3 D41 MF3 D81	
Operating Distance	Up to 10 cm				HW Crypto
Power Supply	3,3 / 5 V	3,3 V	2, 4 Kbyte	2, 4, 8 Kbyte	EEPROM
RF Interface Power	Up to 500 mW	Up to 500 mW w. amplifier	MIFARE Classic compatible	-	Special Features
Serial Interface	8 bit parallel, 3,3 V digital supply, SPI	I2C, SPI, RS232, 3,3 V digital supply	CC EAL 4+	CC EAL 4+	Certification

MFRC522 – MIFARE Reader

Customer Benefits

- Low cost RF front-end IC
- ISO14443 A, MIFARE
- Provided with SW BFL (Basic Function library)
- Easy integration

Supported RF protocols

Reader/Writer mode

- ISO/IEC A R/W support up to 848 kbit/s
- R/W support for MIFARE 1K, 4K
- ISO/IEC 14443-3 (ULC)
- ISO/IEC 14443-4 (DESFire, Plus)

Market

- Infrastructure Contactless Reader
- Portable equipment, consumer device
- Metering



Features

- 64 Byte FIFO
- Interrupts using IRQ pin
- Dedicated ID for every Operating Mode
- 2.5 V- 3.6 V power supply, typ. 3.3V
- PVDD interface supply voltage down to 1,6V
- Low cost packages HVQFN32
- Basic Function Library (source code)

Interfaces

- SPI, I²C, Serial UART

MFRC530

MIFARE Reader

Customer Benefits

- High Power RF front-end IC
- ISO14443 A support
- Provided with SW BFL (Basic Function library)
- Easy integration

Supported RF protocols

Reader/Writer mode

- ISO/IEC14443A R/W support up to 424 kbit/s
- R/W support for MIFARE 1K, 4K
- ISO/IEC 14443-3 (ULC)
- ISO/IEC 14443-4 (DESFire, Plus)

Market

- Infrastructure Contactless Reader
- consumer device
- Metering



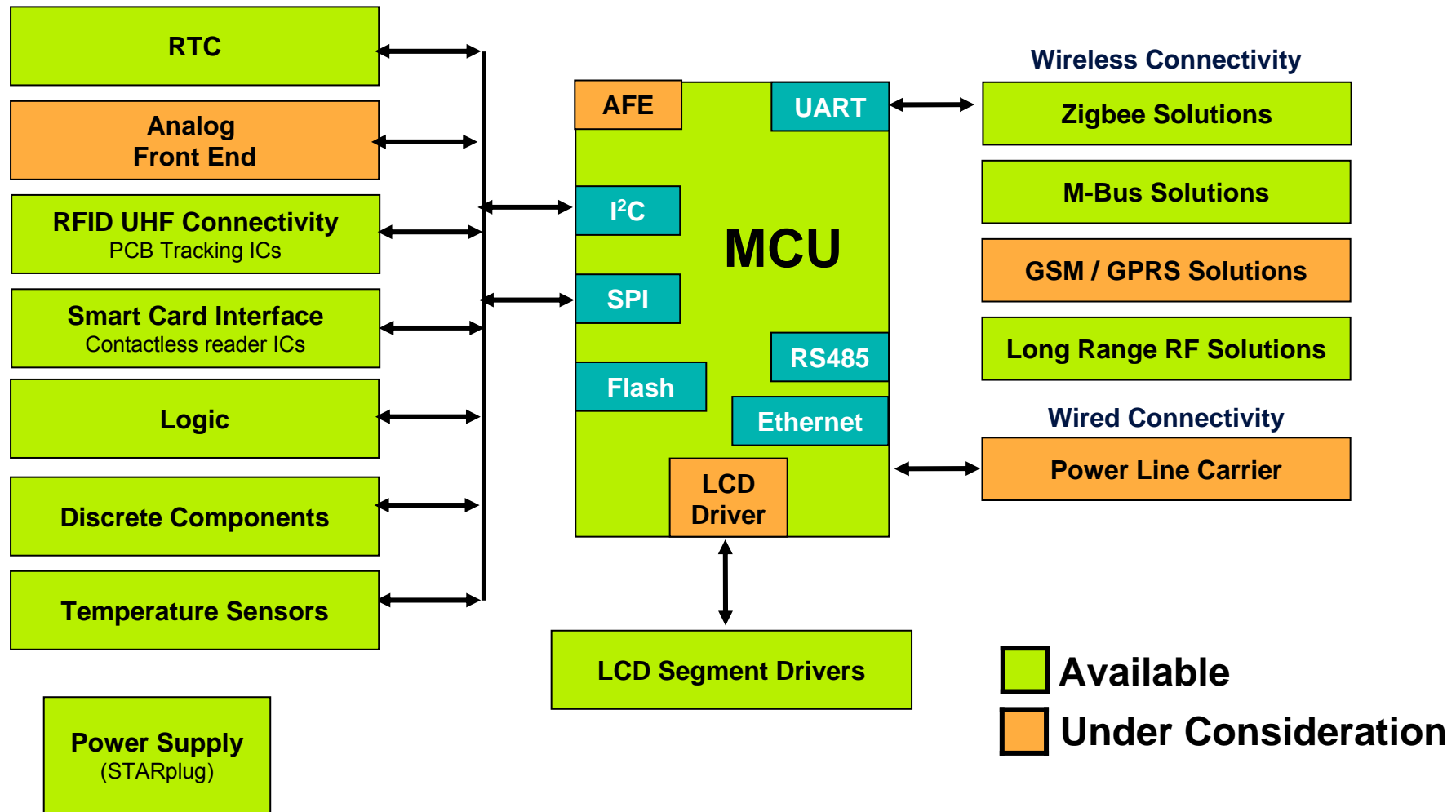
Features

- 64 Byte FIFO
- Interrupts using IRQ pin
- Dedicated ID for every Operating Mode
- 2.5 V- 3.6 V or 4.5V - 5.5V power supply,
- SO 32 High power package
- Basic Function Library (source code)
- Unique serial number

Interfaces

- SPI, 8 bit parallel interface

Smart Metering Building Blocks



Temperature Sensor Value Proposition



Why used?

- Determine the temperature
- Set window for Interrupt, alarm, fan control, shutdown, etc.

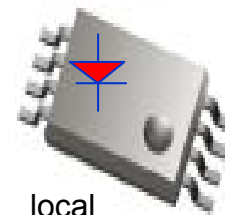
Where used?

- Instrumentation for front-end data calibration
- On-board temperature measurement for system management

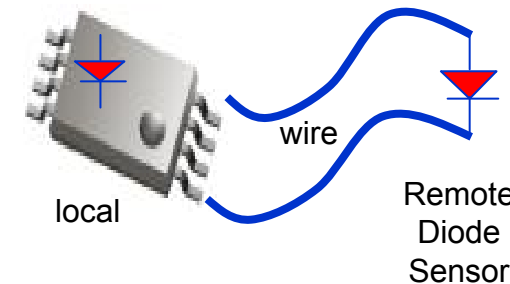
Why NXP Thermal Sensor?

- Large selection of commonly used local sensor and local/remote sensor thermal sensors in a wide range of packages
- Invented the I²C-bus, very proficient designers with bullet proof designs
- Continuous innovation with new low price LM75B local sensor in small 2 x 3 mm package

Part #	Accuracy	SMBus Timeout
LM75A / 75B	±2 °C	A = No; B = Yes
SE95	±1 °C	No
SE98A / 98B	±1 °C	Yes
SE97 / 97B*	±1 °C	Yes



local



local

wire

Remote Diode Sensor

Part #	Local Sensor Accuracy	Remote Sensor Accuracy
NE1617A	±2 °C	±3 °C
NE1619**	±3 °C	±5 °C
SA56004	±2 °C	±1 °C

Note: * With 2Kbit EEPROM; ** With voltage monitors

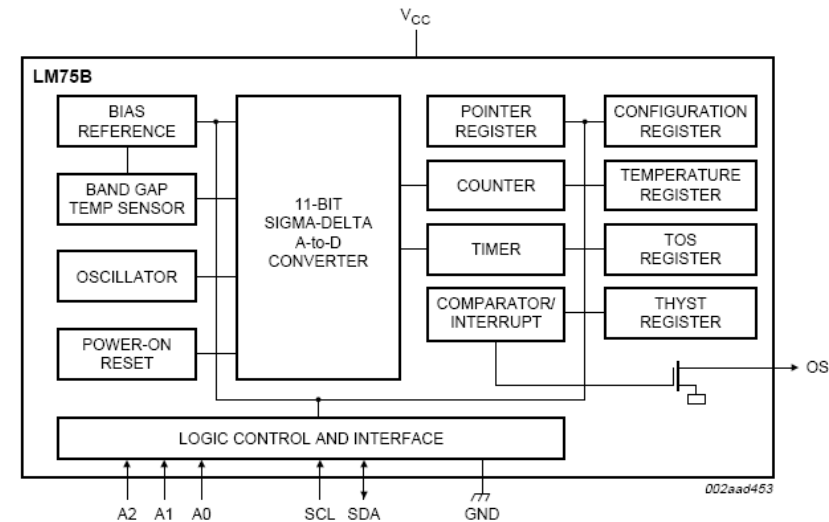


LM75B

Local Digital Temp. Sensor & Thermal Watchdog

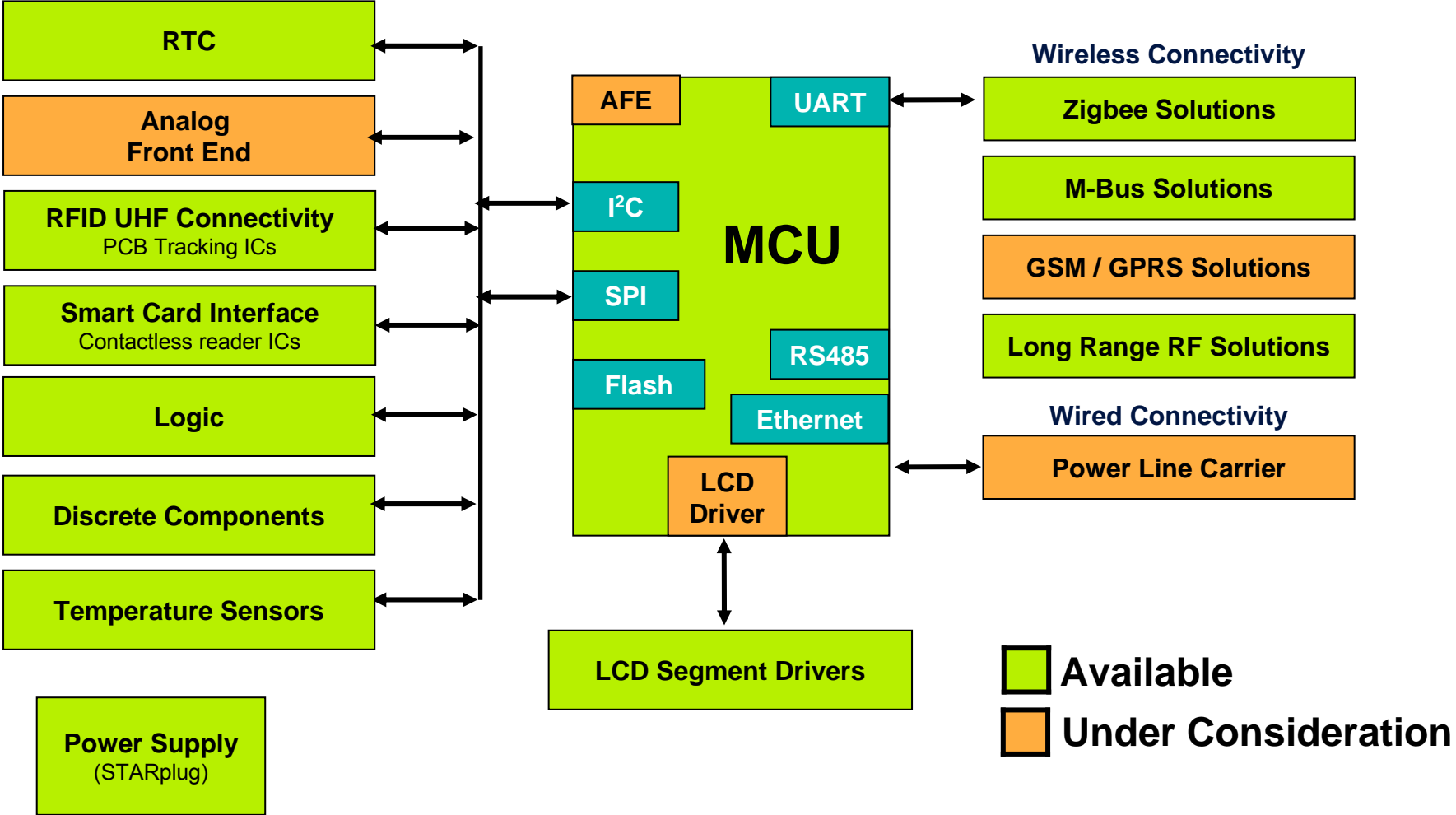
Features

- ▶ Pin-for-pin replacement for industry standard LM75 and LM75A
- ▶ I²C-bus interface - 8 devices on the same bus
- ▶ Power supply range from 2.8 V to 5.5 V
- ▶ Temperatures range from -55 °C to +125 °C
- ▶ Frequency range 20 Hz to 400 kHz with bus fault time-out to prevent hanging up the bus
- ▶ 11-bit ADC - temperature resolution of 0.125 °C
- ▶ Temperature accuracy of:
 - ±2 °C from -25 °C to +100 °C
 - ±3 °C from -55 °C to +125 °C
- ▶ Programmable temperature threshold and hysteresis set points
- ▶ Max supply current of 1.0 μA in shutdown mode
- ▶ Stand-alone operation as thermostat at power-up
- ▶ ESD protection exceeds 4500 V HBM per JESD22-A114, 450 V MM per JESD22-A115 and 2000 V CDM per JESD22-C101
- ▶ Small 8-pin package types: SO8 and TSSOP8



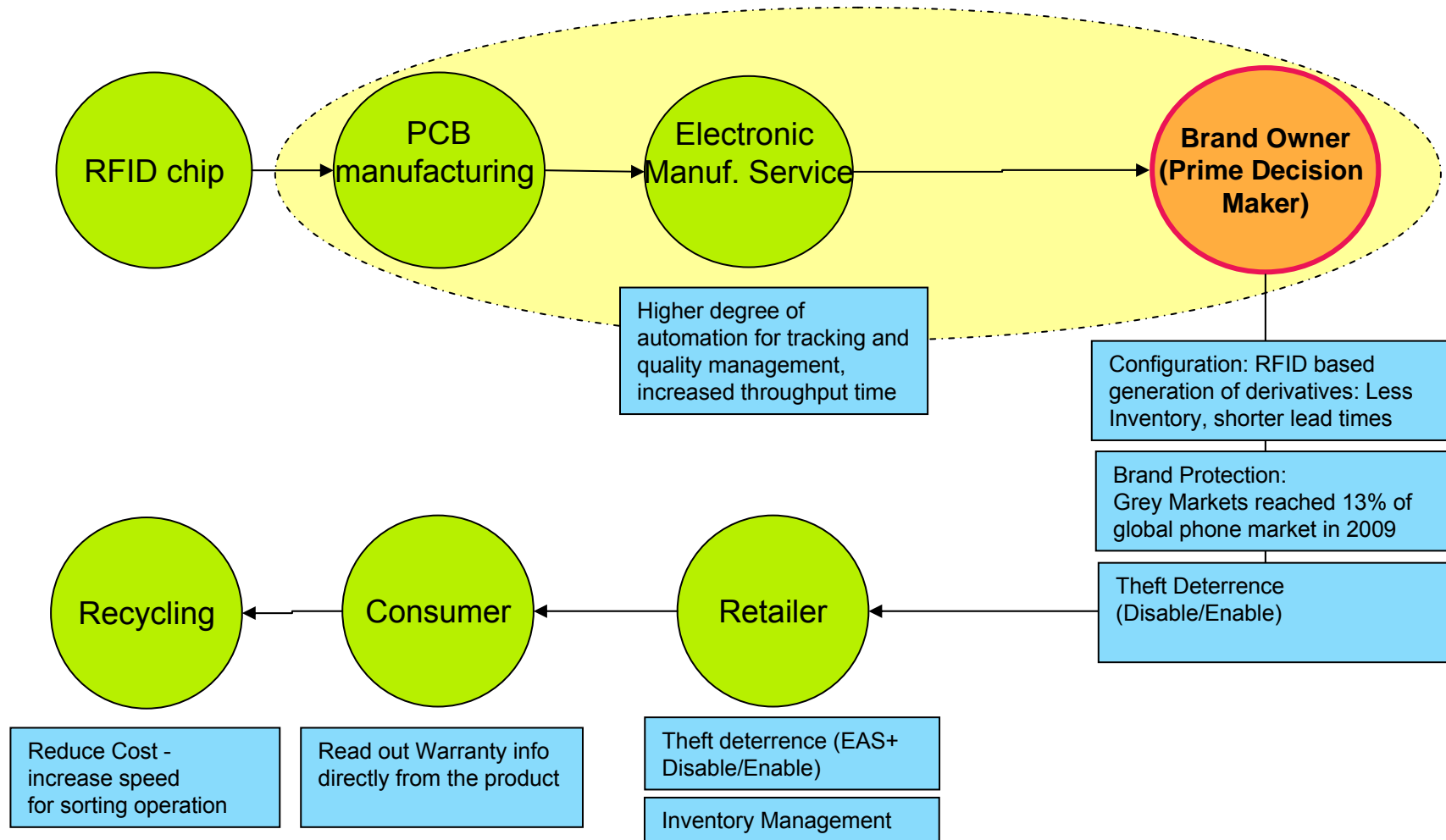
Type number	Topside mark	Package		Version
		Name	Description	
LM75BD	LM75BD	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1
LM75BDP	LM75B	TSSOP8	plastic thin shrink small outline package; 8 leads; body width 3 mm	SOT505-1
LM75BGD	75B	XSON8U	plastic extremely thin small outline package; no leads; 8 terminals; UTLP based; body 3 × 2 × 0.5 mm	SOT996-2

Smart Metering Building Blocks



Why RFID in Consumer Electronics

Who benefits?

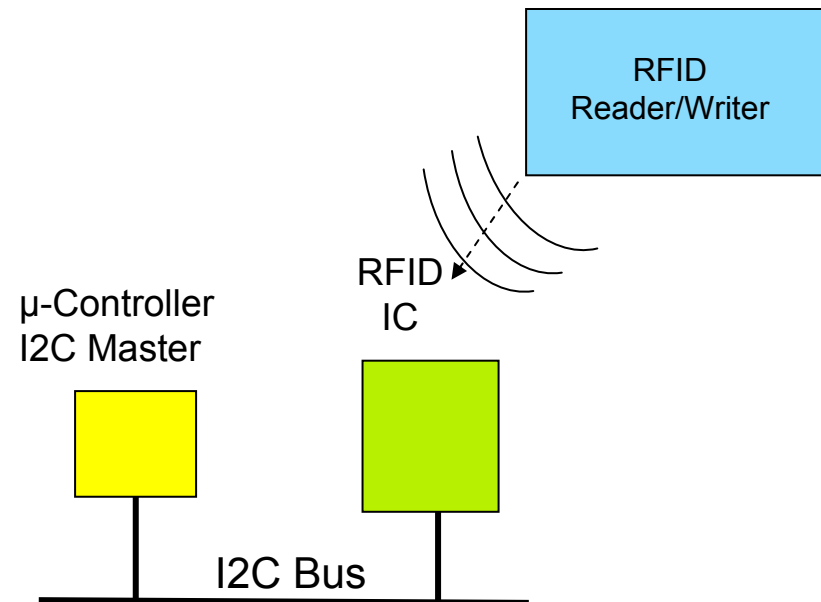


Use Case: Product Configuration



Reduction of order lead times as well as cost of stock keeping

- ▶ Use RFID to configure/modify the product at late stage in supply chain
- ▶ Create commercial derivatives in the warehouse, while device is already packaged and inside the box



Use Case: Service Efficiency



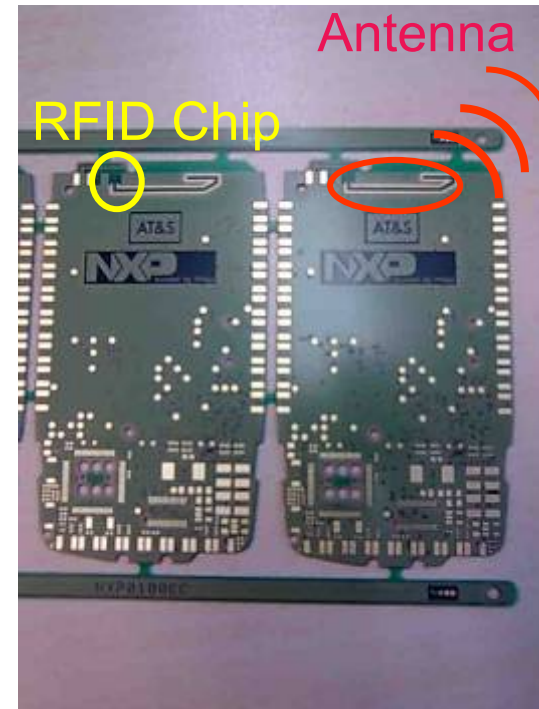
- ▶ Fast check via RFID if warranty does apply for the product
 - Has the product been sold through an authorized sales channel ?
 - Has warranty time period exceeded ?
- ▶ Write service operation history into the RFID memory
- ▶ Safe time during service with product specific info stored on RFID chip
 - Which firmware version was used, production lot number, etc.
- ▶ Read-out of basic product information stored on the RFID chip in case electronics device doesn't boot anymore.



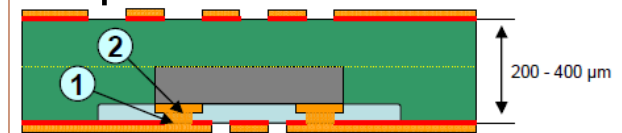
RFID easy to use on PCBs



- ▶ Mounting of the RFID IC onto of the PCB
- ▶ RFID chip embedded inside the PCB
- ▶ The RFID antenna is part of the PCB



Chip embedded



Why NXP ? – Our offering



- ▶ Superior product portfolio with special features tailored to the requirements for RFID in the electronics device market
- ▶ NXP provides technical support
 - RFID system optimization and reference antenna designs

Product Offering	Application
UCODE G2XL, G2XM 512 bit user memory	PCB tracking and tracing, theft deterrence, production control
UCODE G2iL, G2iL+ data transfer, digital switch	Product Configuration , PCB tracking and tracing, theft deterrence, production control

Note: for further information on UCODE products please refer to the UCODE product presentation



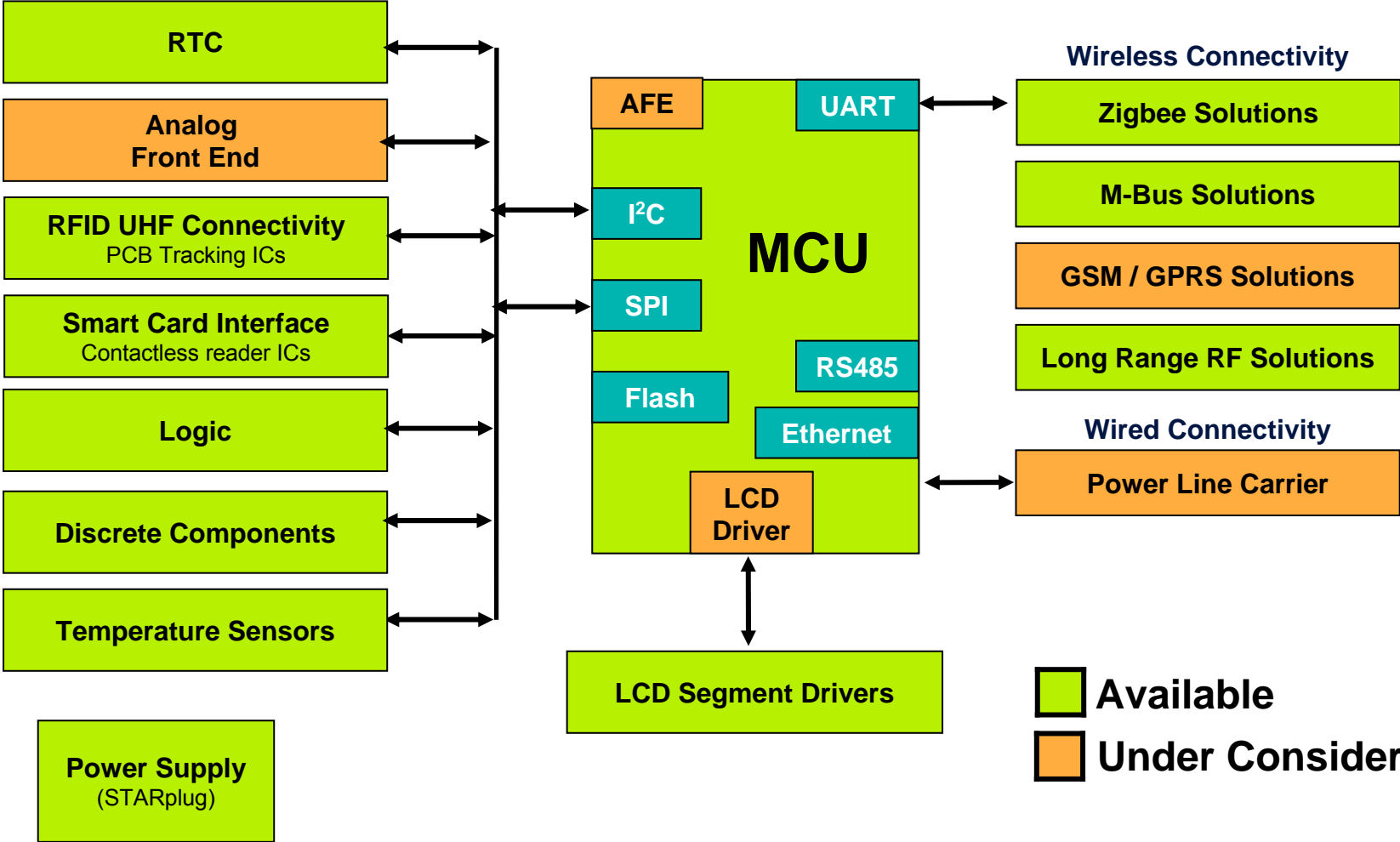
Comparison RFID v. Barcode



- ▶ RFID advantages:
 - no line of sight
 - Fast read outs, bulk reading
 - Data storage

	Scan technology	PCB area required	Scan - Speed	Degree of Automation	Flexibility	Long Term Data Retention	Robust
Barcode	Optically – requires line of sight	1 cm ² for 2-D barcode	Slow , only one at a time – often done manually	Need to Re-adjust scanner for product changeover	Stores fixed Identification number only. New barcode needed for derivative generation	Can be removed, or get lost – Labels are only stuck to the product	No small parts of dirt lead to read failures
RFID	Electro-Magnetically Can read through everything except Metal	1 cm ² for antenna	Fast 100+/second	No re-adjustment Reader “finds” the RFID tag in the antenna field independent from its location	Fixed unique ID number + read/write Memory Write derivative UID into memory and lock it.	RFID chip is an invisible fixed part of the product and stays with the product until recycling	Yes No line of sight required Chip embedded inside the PCB

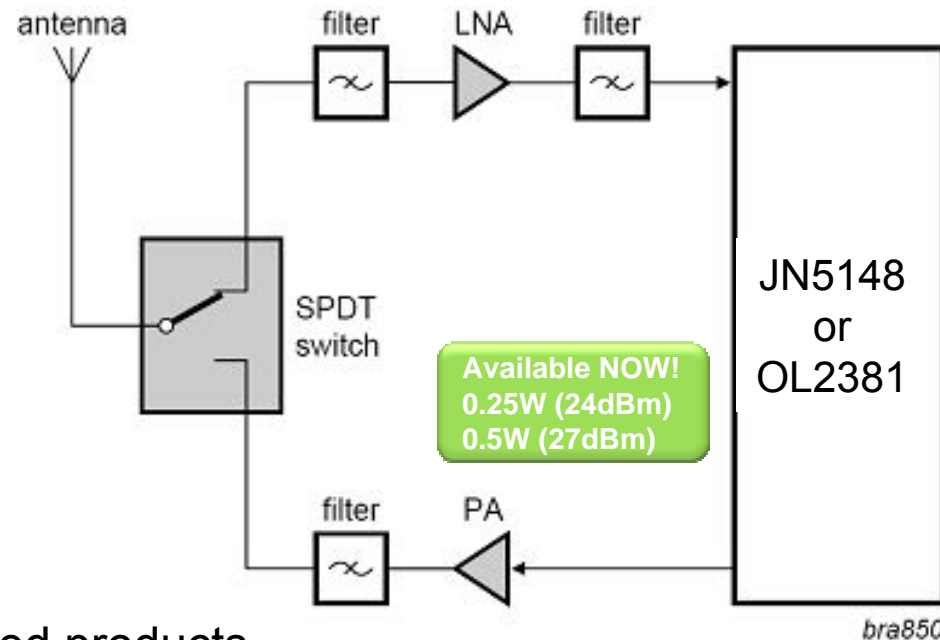
Smart Metering Building Blocks



Long Range RF in Smart Metering



NXP Solutions for Sensitivity and Antenna Range Extension



Recommended products

- LNA: **BGU7003**, BGA2001, MMIC; **BFU6/7xxF**, SiGe:C RF Tr, SOT343F
- PA: **BGA7024** (24dBm), **BGA7027** (27dBm), MMIC, SOT89 **NEW!**

Need more choice? www.nxp.com/rfmanual (p. 36)



400-2700MHz Medium Power Amplifiers (MPA)

Released



BGA2031

5th generation Medium Power Variable Gain Amplifier MMIC

- *Gain up to 23 dB
- *Gain Control Range 56 dB
- *P1dB up to **13 dBm**



BGA6589

5th gen Medium Power MMIC Amplifier

- *Gain up to 17 dB
- *P1dB up to **20 dBm**



5th gen RF Transistor MPA

BFG21W

- *Gain up to 12 dB
- *P1dB up to **24 dBm**

*for detail pls. refer to datasheet

NEW Products

24 and 27dBm 6th generation MMIC Medium Power Amplifier



BGA7124 – 0.25W

BGA7127 – 0.5W

SOT908

- plastic thermal enhanced very thin small outline package
- body 3 x 3 x 0.85 mm

BGA7124 – 0.25W

BGA7127 – 0.5W

SOT89

- Plastic surface-mounted package
- Collector pad for good heat transfer
- 3 leads



In Development

30, 33dBm 6th generation Medium Power Amplifiers

BGA	7x27	7x30	7x33	
P1dB	27	30	33	dBm
Gain	16	13	13	dB

- Wideband, 400MHz to 2700MHz
- Single stage, gain @ 2GHz

BGA7204 6th generation Variable Gain amplifier

- P1dB 27dBm
- Wide frequency range, 400-2750MHz
- Small-signal gain, 20dB @ 2GHz
- Broad gain-control range, 30dB
- OIP3 40dBm
- NF 5dB at maximum gain setting

BGU7003 7th generation LNA MMIC



- ▶ Applicable between 40 MHz and 6 GHz
- ▶ Integrated, temperature-stabilized bias for easy design
- ▶ Bias current configurable with external resistor
- ▶ Low noise figure (NF): 0.80 dB at 1.575 GHz
- ▶ High insertion power gain: 18.3 dB at 1.575 GHz
- ▶ Optimized performance at low 5 mA supply current
- ▶ ESD protection > 1 kV Human Body Model (HBM) on all pins
- ▶ Low current consumption in power-down mode (<1 μ A)
- ▶ Supply voltage: 2.2 to 2.85 V
- ▶ Small, 6-pin SOT891 leadless package (1.0 x 1.0 x 0.5 mm)
- ▶ Proven, robust QUBiC4X SiGeC process technology ($f_T = 110$ GHz)

6th & 7th Generation Wideband Transistors



LNAs (BFU710, 610, 730, 630)

DRIVERS & DISCRETE PA

Higher gain/ Lower NF and OIP3

Higher linearity (OIP3) / Output power (P1dB)

7th Generation

BFU710

- High Gain 17.3 dB @ 12 GHz
- $f_T = 43$ GHz @ 12 mA
- max Vceo = **2.8 V**
- Applications:
 - Ku-band LNA
 - 1st stage LNA SDARS
- Competitors:
 - IFX: BFP720

BFU730

- High Gain 20.1 dB @ 5.8 GHz
- $f_T = 55$ GHz @ 25 mA
- max Vceo = **2.8 V**
- Applications:
 - Ku-band LNA
 - 5-GHz WLAN, LTE
- Competitors:
 - IFX: BFP740
 - NESG3031M05

BFU760

- Gain 24.0 dB @ 1.8 GHz
- $f_T = 45$ GHz @ 55 mA
- max Vceo = **2.8 V**
- Applications:
 - High linearity amplifiers
- Competitors:
 - IFX: BFP750

BFU790

- Gain 21 dB @ 1.5 GHz
- $f_T = 25$ GHz @ 100 mA
- max Vceo = **2.8 V**
- Applications:
 - High linearity amplifiers
- Competitors:

6th Generation

BFU610

- High Gain 20.2 dB @ 5.8 GHz
- $f_T = 15$ GHz @ **4 mA**
- max Vceo = **5.0 V**
- Applications:
 - DRO satellite LNB
- Competitors:
 - NEC: NESG2021M05

BFU630

- High Gain 26 dB @ 1.8 GHz
- $f_T = 21$ GHz @ 10 mA
- max Vceo = **5.0 V**
- Applications:
 - WLAN, WiMax
 - SDARS, LTE
- Competitors:
 - IFX: BFP640
 - NESG2031M05

BFU660

- Gain 23.7 dB @ 1.8 GHz
- $f_T = 21$ GHz @ 20 mA
- max Vceo = **5.0 V**
- Applications:
 - High linearity amplifiers
- Competitors:
 - NESG2101M05

BFU690

- Gain 13.7 dB @ 1.8 GHz
- $f_T = 18$ GHz @ 50 mA
- max Vceo = **5.0 V**
- Applications:
 - High linearity amplifiers
- Competitors:
 - IFX: BFP650

5th Generation Medium Power MMICs



	OIP3	P1dB	OIP3	P1dB	NF	NF
Type	850 MHz	850 MHz	2400 MHz	2400 MHz	@ 850	@1950
BGA6289	31.4	16.6	24.5	15.1	3.8	4.05
BGA6489	33.2	20.4	27	17.4	3.29	3.5
BGA6589	33.5	20.1	30.5	19.9	3.25	3.45

- Features
 - high linearity
 - In **cost effective** bipolar silicon process
 - 50 ohm in/ out
 - 20 dBm output pwr
 - single supply



5th Generation MMICs



Low Noise Wideband Amplifiers															Package: SC88/ SOT363	
Type	Limits			@ 900MHz			@1800 MHz			Gain ³ (db) @				@		
	Vs (V)	Is (mA)	Ptot (mW)	NF (dB)	Gain (dB)	IIP ₃ (dBm)	NF (dB)	Gain (dB)	IIP ₃ (dBm)	100 mhz	1 GHz	2.6 ghz	3.0 ghz	Vs (V)	Is (mA)	
BGA2001	4.5	30	135	1.3	22 ¹⁾	-7.4	1.3	19.5 ¹⁾	-4.5	20	17.1	11.6	10.7	2.5	4	
BGA2003	4.5	30	135	1.8	24 ¹⁾	-6.5	1.8	16 ¹⁾	-4.8	26	18.6	11.1	10.1	2.5	10 ²⁾	
BGA2011	4.5	30	135	1.5	19 ³⁾	10	-	-	-	24	14.8	8	6.5	3	15	
BGA2012	4.5	15	70	-	-	-	1.7	16 ³⁾	10	22	18.2	11.6	10.5	3	7	

Notes : 1. MSG 2. Adjustable bias 3. $|S_{21}|^2$ 4. Under development

2 Stage Variable Gain Linear Amplifier															Package: SC88/ SOT363	
Type	Limits			Frequency Range (MHz)	@ 900MHz				@1900 MHz				@			
	Vs (V)	Is (mA)	Ptot (mW)		Gain ¹ (dB)	ΔG^2 (dB)	P1dB (dBm)	ACPR (dBc)	Gain ¹ (dB)	ΔG^2 (dB)	P1dB (dBm)	ACPR (dBc)	Vs (V)	Is (mA)		
BGA2031/1	3.3	50	200	800-2500	24	62	11	49	23	56	13	49	3	51		

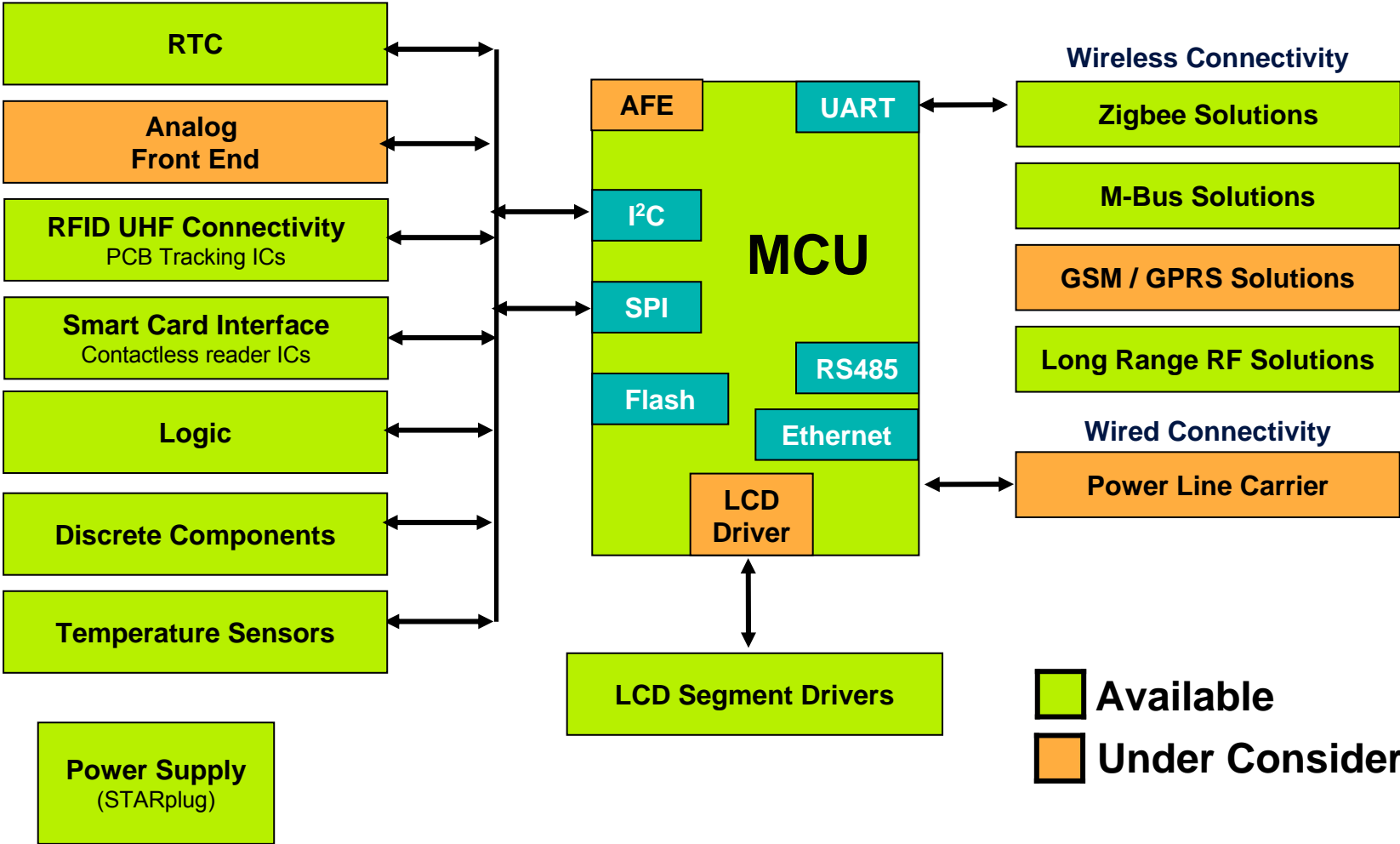
Notes: 1. Gain = G_p, power gain. 2. ΔG = Gain control range

Wideband Linear Mixer															Package: SC88/ SOT363	
Type	Limits			RF Input Range (MHz)	IF Output Range (MHz)	@ 880MHz			@2450 MHz			@				
	Vs (V)	Is (mA)	Ptot (mW)			NF (dB)	Gain ¹ (dB)	OIP3 (dBm)	NF (dB)	Gain ¹ (dB)	OIP3 (dBm)	Vs (V)	Is (mA)			
BGA2022	4	10	40	0-2500	0-500	9	5	4	9	6	10	3	6			

Notes: 1. Gain = G_c, Conversion gain



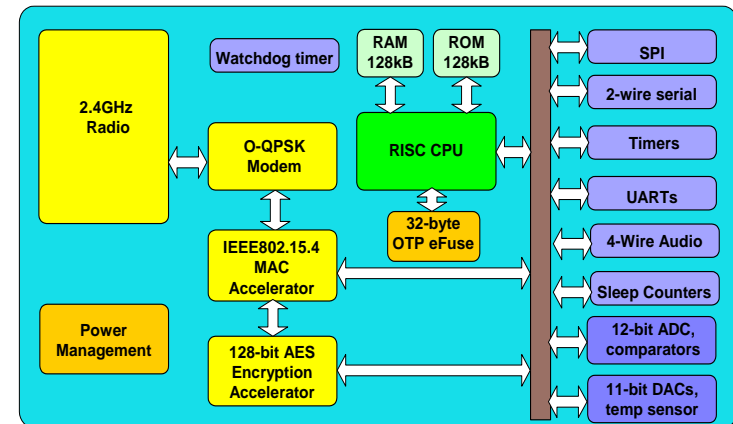
Smart Metering Building Blocks



Jennic JN5148 Low Power Zigbee Wireless



- ▶ Single Chip Device:
- ▶ Microcontroller:
 - High Performance 32-bit RISC CPU core – programmable clock, 4-32MHz
 - *Rich User Peripherals* – mixed digital and analogue
 - UARTs, SPI, 2-Wire Serial (I²C), GPIO, Timers, PWM, 12-bit ADC, DAC, Comparators
 - JTAG debug port,
 - Large memory footprint - 128kBytes RAM
 - 128kBytes ROM for 15.4 MAC, stacks
- ▶ IEEE802.15.4 2.4GHz transceiver
 - 98dB link budget, achieving 30-50m indoors
 - 128-bit AES encryption, highly secure networking
- ▶ System implementation
 - Low sleep power consumption - 1.3uA with timer
 - Low power - 15mA TX, 18mA RX (35% less than competition)
 - External BOM (<50c) – Crystal, Discretes, Serial Flash



Jennic JN5148 Module Product Range



- ▶ All modules include JN5148 chip, plus support components

- ▶ Standard power modules:
 - With integrated printed antenna

JN5148-001-M00



- With uFl connector

JN5148-001-M03



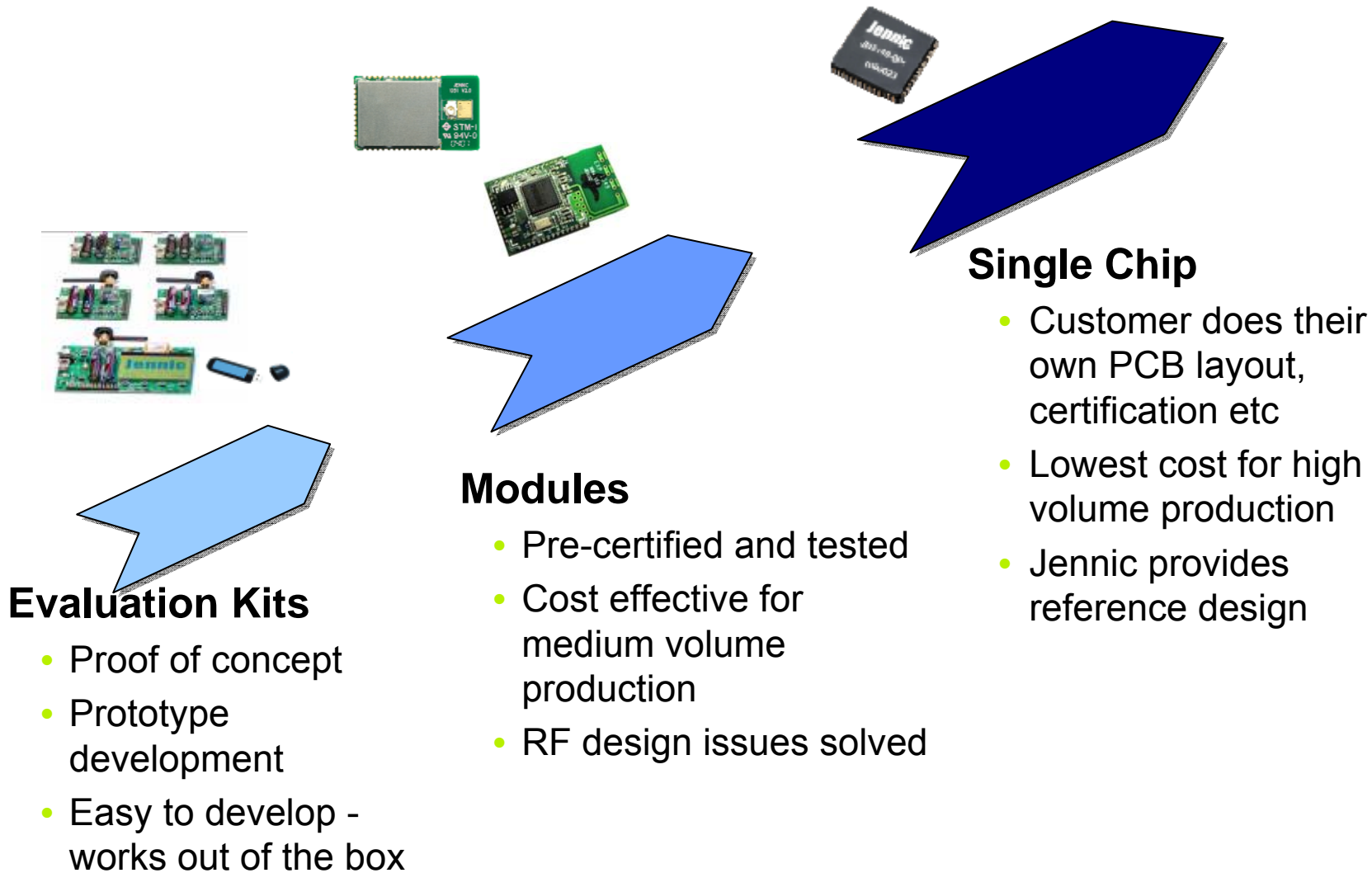
- ▶ High power module:
 - High Power with uFl connector
 - +20dBm

JN5148-001-M



- » Module value proposition
 - Fast time to market
 - Ready approved to FCC and EU regulations
 - No need for RF design resource for board and test design
 - Overall cheaper cost of implementation up to 20-50ku

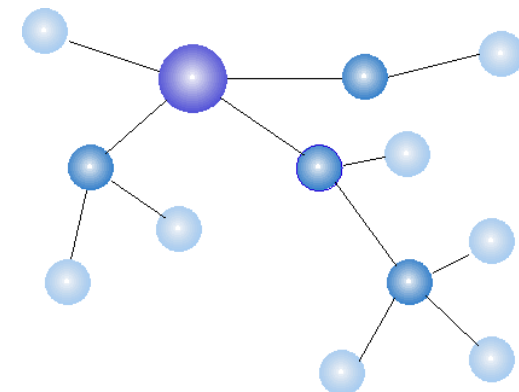
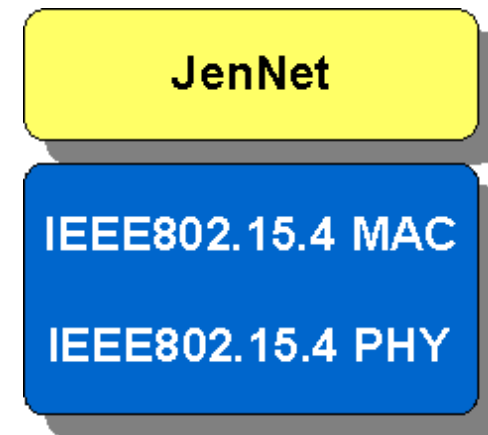
Jennic JN5148 Product Cycle



Software: JenNet Network Stack



- ▶ Proprietary network stack
 - No Alliance membership fee
 - No additional cost for product certification
- ▶ For JN5148 family of chips and modules
 - Proprietary network - supports star, tree and linear topologies
 - 85kB code space for application on coordinator/router
 - 95kB code space for application on end device
 - Recommended maximum network size is 500 nodes
 - Reliable and robust communication
 - Advanced network management and self repair mechanism
 - Easy to use compared to ZigBee PRO



Software: ZigBee PRO



- ▶ ZigBee software stacks are developed and managed by the ZigBee Alliance
 - Feature rich, but very complicated to use
 - Recommended only if interoperability is the key requirement
- ▶ ZigBee PRO
 - Standardised mesh networking stack with profiles to address specific applications
 - Ensures interoperability
 - Focus market is the emerging Smart Energy market
 - Other profiles include Home Automation, Commercial Building Automation
 - Provides features to support real world scenarios
 - Frequency agility, enhanced security
- ▶ The ZigBee Alliance operate a rigorous certification process
 - To ensure interoperability at a platform and system level
 - Provide a recognisable logo / branding
- ▶ NXP ZigBee PRO solution provides:
 - ZigBee Compliant Platform using JN5148
 - Smart Energy profiles for In-Premises Display (IPD)
 - Smart Energy Load Control and Demand Response
 - Home Automation profiles



JN5148 Evaluation Kit



- ▶ Hardware
 - Controller and 4 sensor boards

- ▶ Eclipse IDE
 - Graphical software development tool
 - C compiler, assembler, debugger
 - Home sensor demo out of the box
 - IEEE802.15.4 Protocol stack
 - Stacks supplied as object library with APIs

- ▶ JenNet kit
 - JenNet Library

- ▶ ZigBee PRO kit
 - ZigBee PRO networking library
 - Smart Energy profile on request
 - Home Automation profile on request



Evaluation kit roll-out into distribution on October 1st

