



FTF | FREESCALE TECHNOLOGY FORUM
POWERING INNOVATION

The Smart Grid: Market and Solutions Overview

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Session Objectives

- Gain knowledge of components of Smart Energy market
- Learn about Freescale solutions
- Understand how to get more information





Agenda

- Market Overview
- Freescale Solutions
 - Metrology
 - Home Energy Management
 - Communication Solutions
 - Grid Infrastructure
 - Renewable Energy
- Smart Energy Standards
- Summary



Smart Grid Market Enablers and Growth Drivers

Environmental Factors

- Growing demand for electricity



Governmental Mandates

- EU plan 20% reduction of energy consumption by 2020
- Deregulations (leading to separation of energy transport and energy provider)
- USA: \$4.3 B for direct investment in smart grid through stimulus package
- China \$9.7B investment to deploy AMR/AMI



Utility Companies

- Optimization of distribution infrastructure and prevention of potential black-outs (peak management)
- More services to end consumer

Renewable Energies and E Vehicle

- Residential solar and solar farm decentralized productions
- Consumer production sold back to energy provider
- Plug-in Hybrid Electric Vehicles (PHEV)



In-Building Customer Comfort

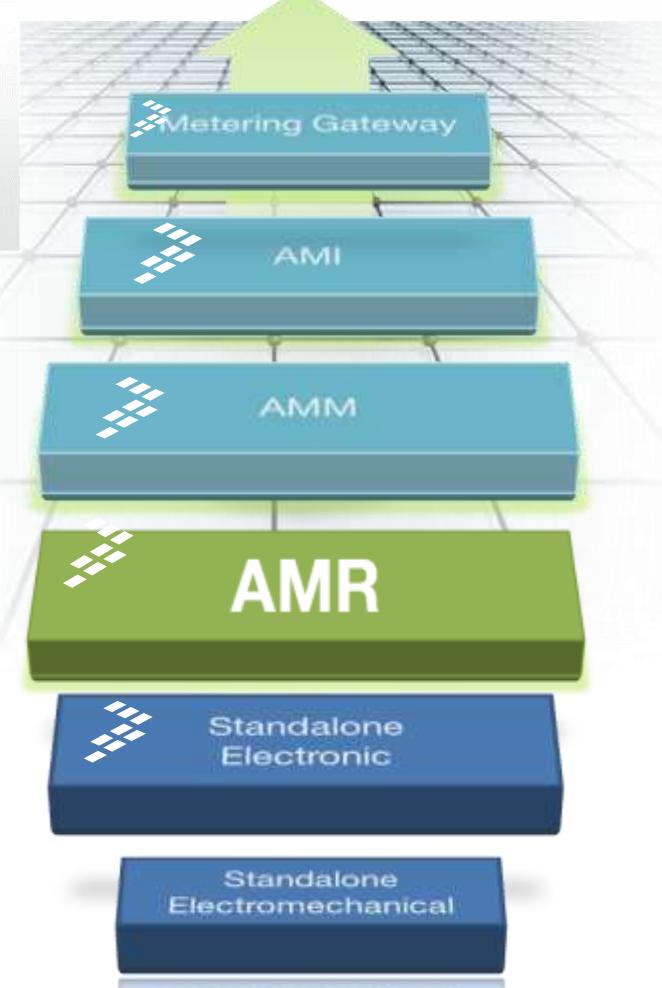
- e-thermostats, smart and user-friendly displays, home-automation
- End-customer energy savings (controls when, how, how much)



What Makes the “Smart Grid” Smart?



Smart Grid will enable the power distribution network to support a bi-directional flow of power and communication capabilities from power distribution facilities to consumption locations



Key Initiatives of Smart Grid

- Reduce power consumption through intelligent monitoring and control
- Increase power availability through optimized distribution
- Improve power reliability and quality
- Expand consumer choices for electrical energy
- Improve resiliency of electric power grid
- Enable easier use of renewable energy and distributed generation

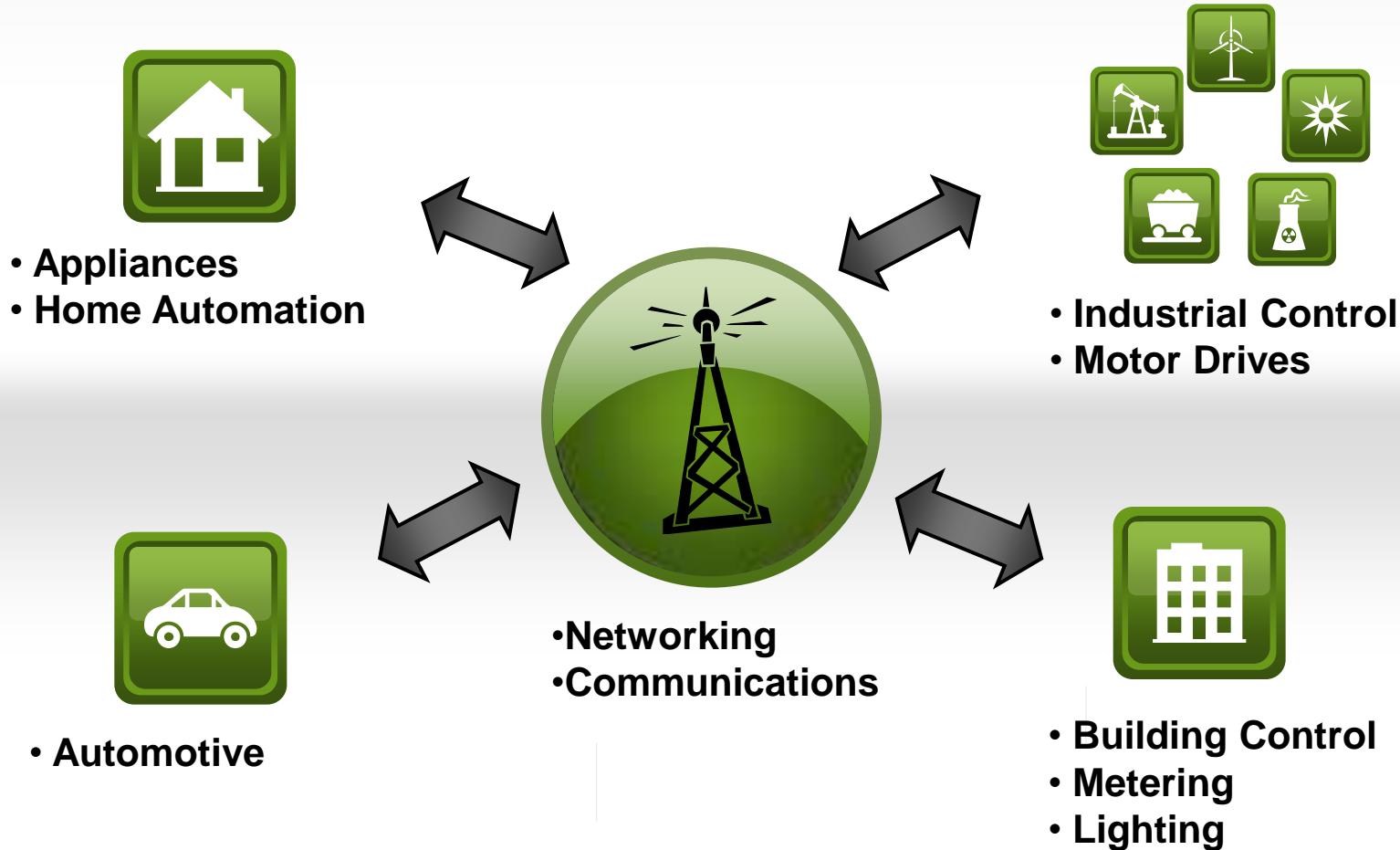


Agenda

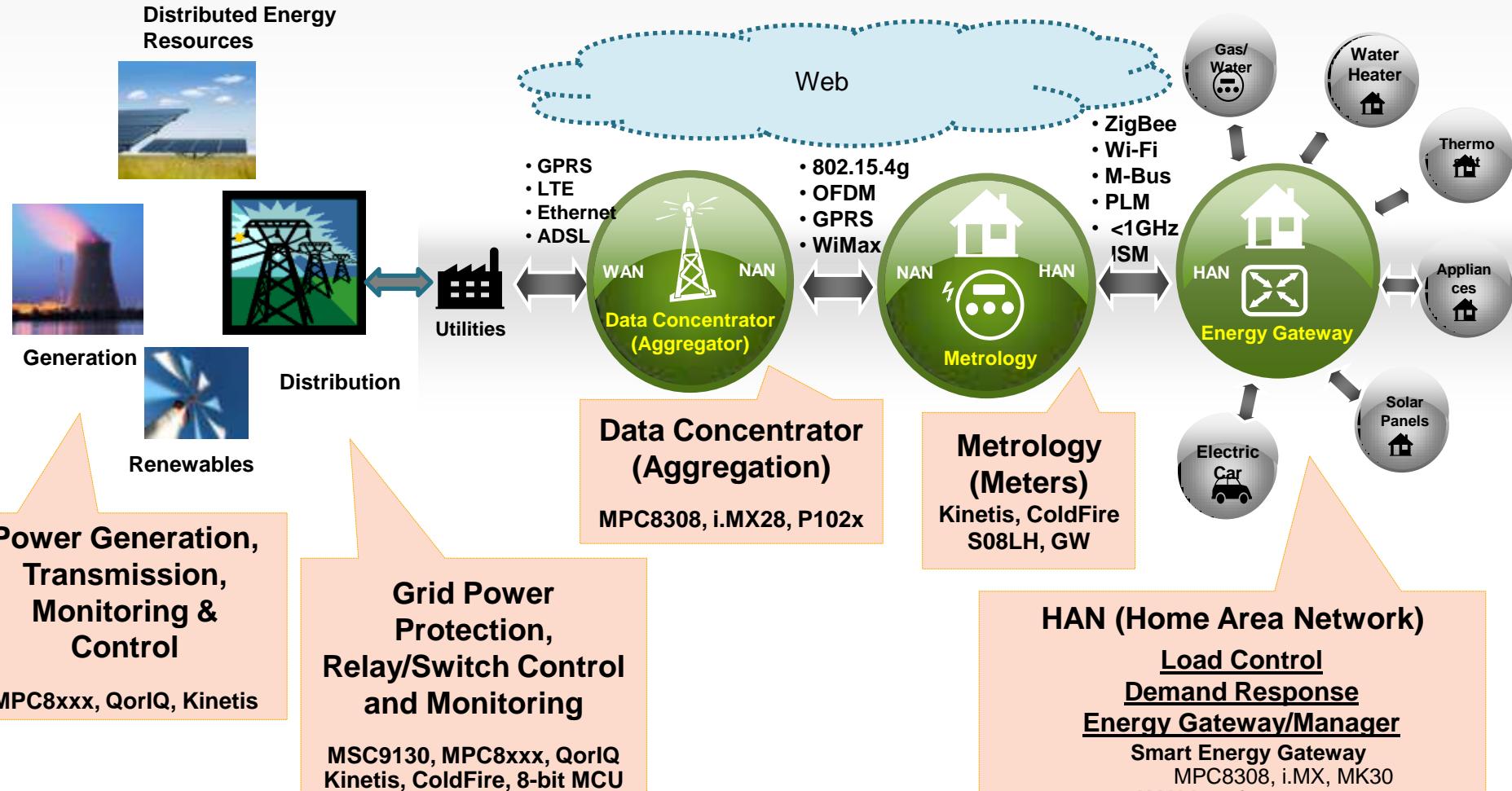
- Market Overview
- **Freescale Solutions**
 - Metrology
 - Home Energy Management
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Freescale Solutions Enable the Smart Grid



Freescale Smart Grid Solutions



Freescale Product Longevity Program

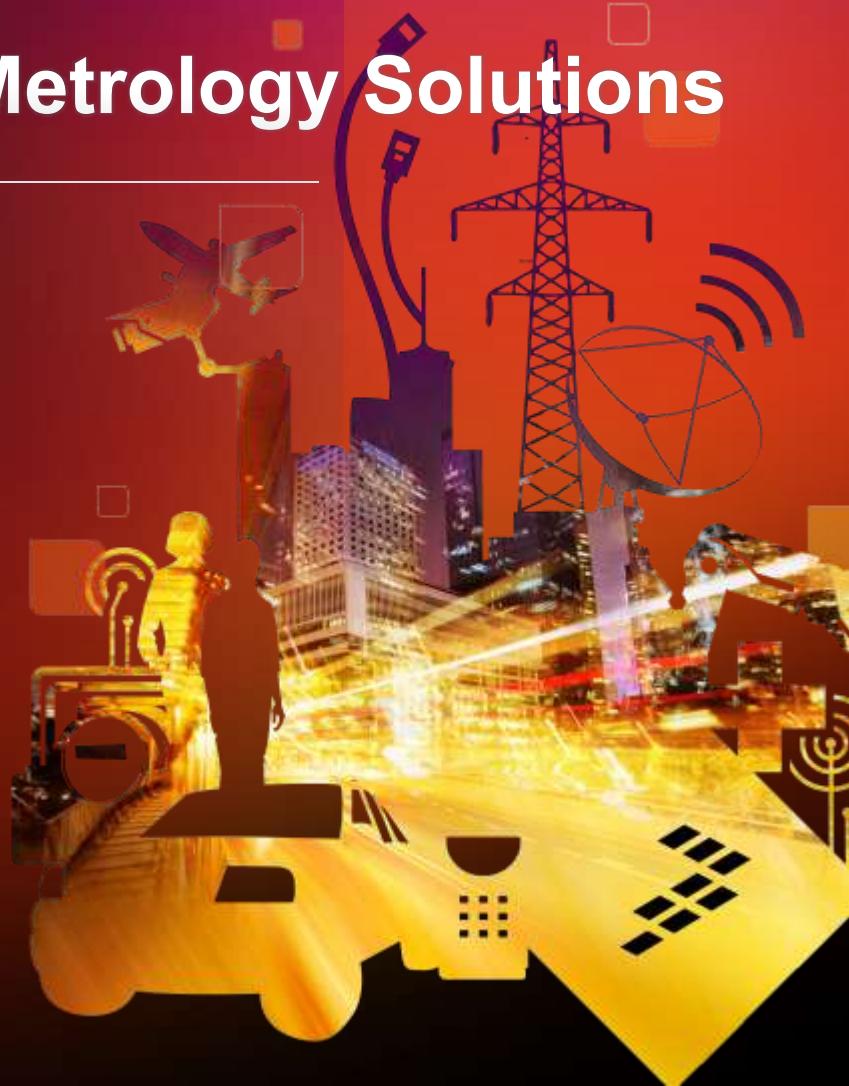
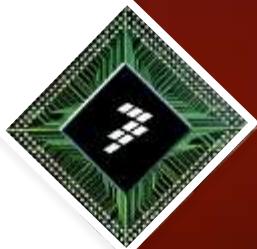
www.freescale.com/productlongevity

- Embedded market needs long-term product support*
- Freescale has track record of providing long-term production support for our products
- Freescale offers a formal product longevity program for the market segments we serve:
 - For automotive and medical segments, Freescale will make a broad range of program devices available for a minimum of 15 years
 - For all other market segments in which Freescale participates, Freescale will make a broad range of devices available for a minimum of 10 years
 - Life cycles begin at the time of launch

* For terms and conditions and to obtain a list of available products, visit: www.Freescale.com/productlongevity

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Freescale Metrology Solutions

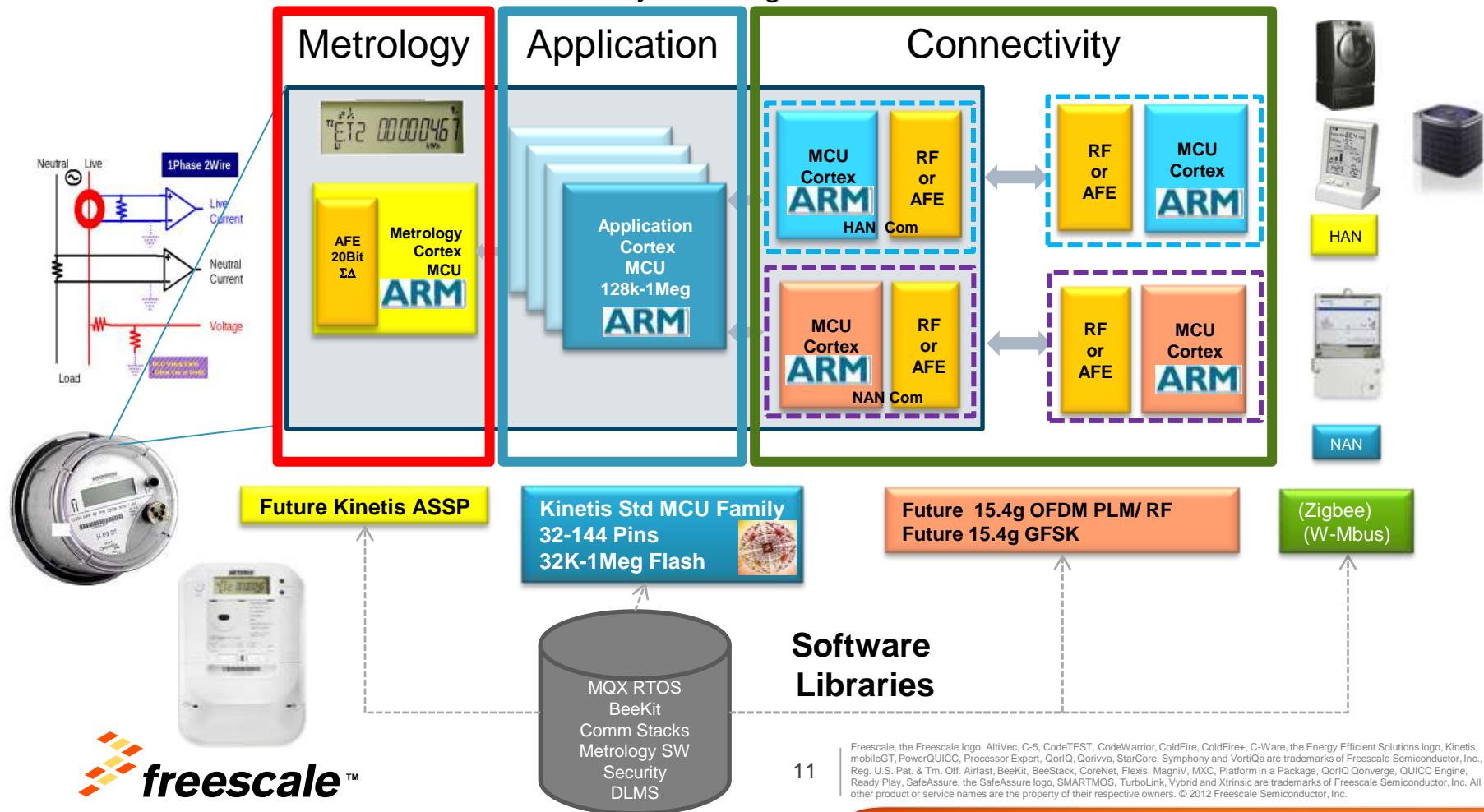


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Metering Business Unit Vision & Commitment

Freescale Platform for Smart Metering and Smart Grid

Freescale is proposing the industry's first and most scalable platform for smart metering and energy management. Building on the success of the Kinetis microcontroller family, this innovative platform uses Freescale's most advanced mixed signal MCU and connectivity solutions and is supported by an extensive software library including communication stacks and RTOS.



Metering Solutions

MCU/MPU



- Leader in MCUs
- 8-bit to 32-bit
- S08, ColdFire and **Kinetis** families
- Cortex M4, M0+



2.4 GHz



- Long-time leader in ZigBee® technology
- Pioneer for RF4CE
- Leader in ZigBee SE2.0 HAN
- Continued rollout of improved products



Sub-GHz



- Sub-GHz includes many protocols
- Introduced first MCU-radio October 2011
- Investing in advanced OFDM-RF modulation



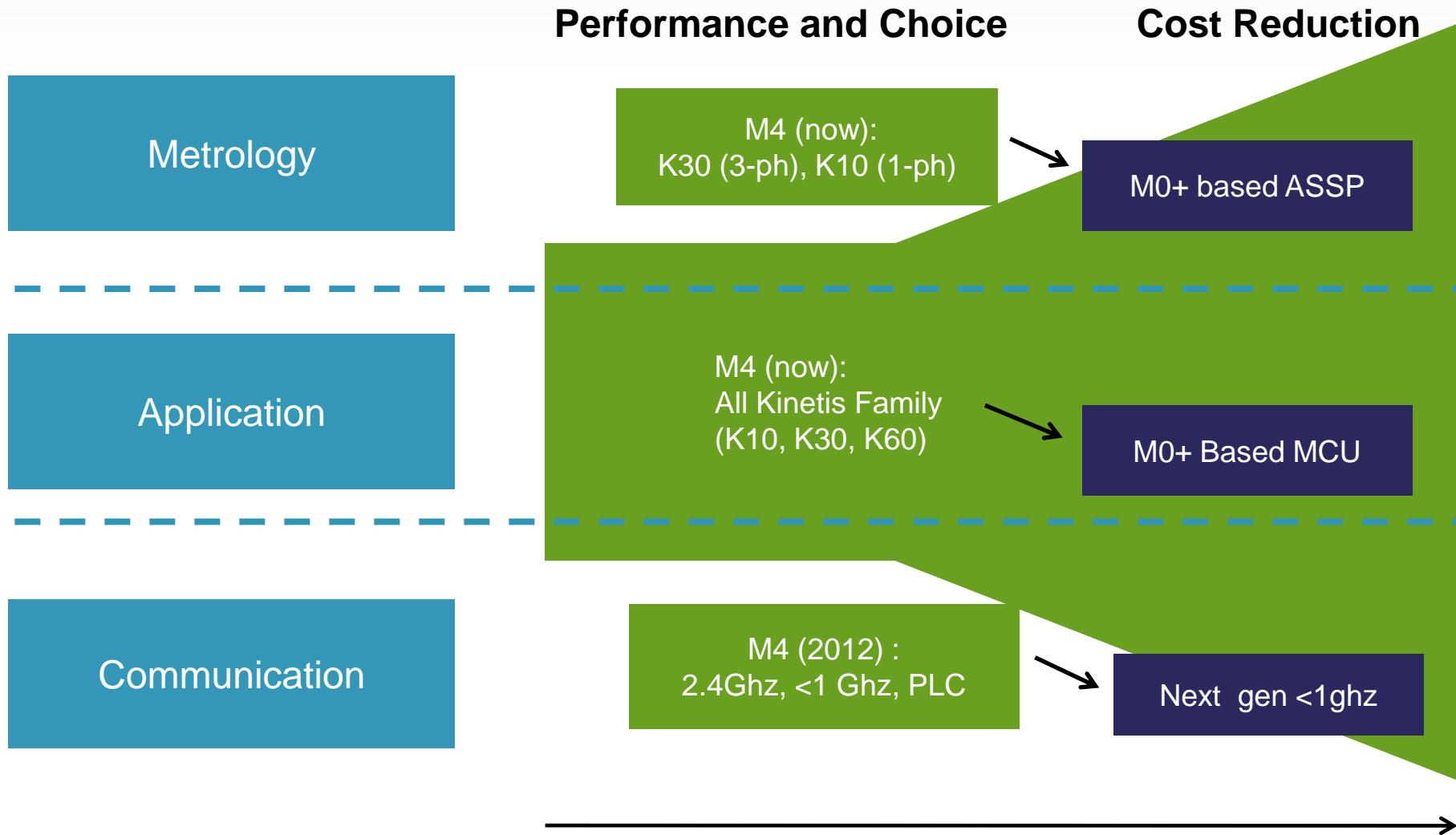
Power Line Communication



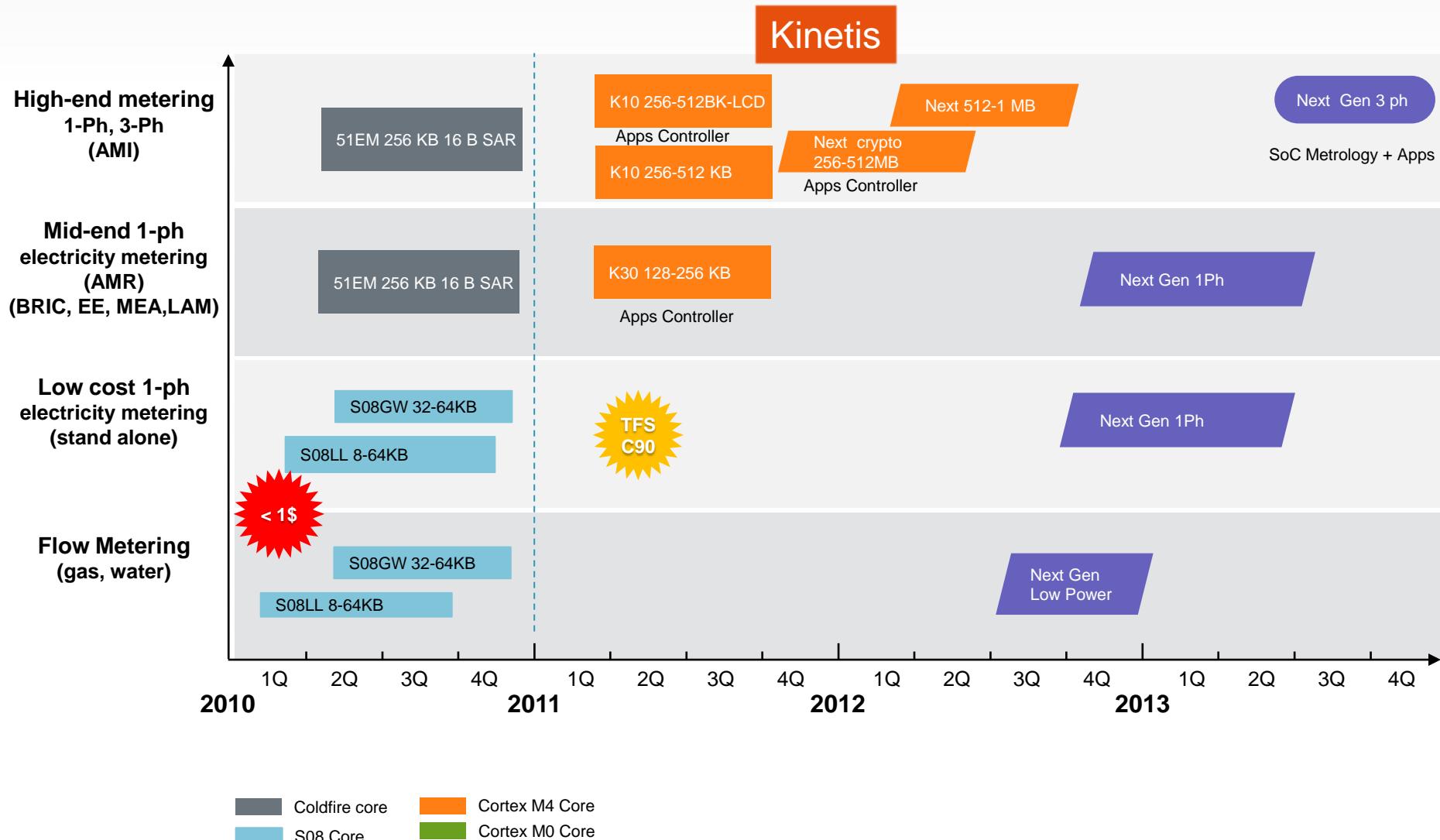
- Worldwide standards maturing for smart energy
- Investing in advanced OFDM-PLC modulation



Freescale Metering Roadmap: ARM Core Convergence



Metering MCU Solutions & Roadmaps



Cortex based architecture features for Smart Metering

- **Performance**
 - Up to 100 MHz Cortex-M4 w embedded DSP ; down to 210uA/MHz run current (all modules off)
- **Memory Management (512kB Flash/128Kbytes RAM)**
 - Support for robust code update on Flash
 - Memory Protection Unit (MPU) to provide hardware access control for all memory references
- **Single-Phase Analogue Front End (AFE)**
 - 240 to 1 meter dynamic range with 0.5% accuracy with fixed gain setting [Class 1.0; 0.5 - 10(60)A]
 - Interfacing various sensors such as shunt resistor (50uOhm, one-phase meter), Rogowski coils and CT
 - Up to 2 Programmable Gain Amplifier (PGA) with 1x-64x gain
 - Programmable Delay Block supporting current sensor phase shift compensation.
 - 1.2V Voltage Reference (33 PPM)
- **High-performance and low power 90nm thin film flash (TFS) storage process technology**
 - 1.71V to 3.6V Operating voltage
 - Ultra low power RTC operation (<0.55uA when CPU not accessing RTC registers)
 - 10 low power modes
 - IEC 60730 compliant watchdog monitor
 - Independent Real Time Clock (IRTC) with independent power domain (Battery)
 - IRTC with Crystal & Temperature Frequency Compensation (Correction range ~ ±.12ppm .. ~ ±3900ppm)
- **Data Encryption Support for Secure Communication (K50-K70 –K12 only)**
 - Memory-mapped Cryptographic Acceleration Unit (MMCAU)
 - Significantly improves performance of security algorithms
 - AES{-128,-192,-256}, DES, MD5, SHA{-1,-256}
 - 32x32 multiply with 64-bit result for ECC & RSA acceleration
 - Random Number Generator with NIST Compliant SP800-90 (DRGB)



Kinetis Product Family Features

MCU Family	USB OTG (FS & HS)	Dual CAN	Ethernet (IEEE 1588)	Encryption (CAU+RNG)	LCD (Segment/Graphics) (~120MHz-150MHz only)	NAND Flash Controller (~120MHz-150MHz, only)	Floating Point Unit (~120MHz-150MHz, only)	Hardware Tamper Detect	DRAM Controller (256 pin MAPBGA only)
K70 Family 512KB-1MB, 196-256pin	●	●	●	●	●	●	●	●	●
K60 Family 256KB-1MB, 100-256pin	●	●	●	●		●	●	●	●
K50 Family 128-512KB, 64-144pin	●		●	●	●				
K40 Family 64-512KB, 64-144pin	●	●			●				
K30 Family 64-512KB, 64-144pin		●		●					
K20 Family 32KB-1MB, 32-144pin	●	●			●	●			
K10 Family 32KB-1MB, 32-144pin		●			●	●			

Common System IP	Common Analog IP	Common Digital IP	Development Tools
32-bit ARM Cortex-M4 Core w/ DSP Instructions	16-bit ADC	CRC	Bundled IDE with Processor Expert
Next Generation Flash Memory High Reliability, Fast Access	Programmable Gain Amplifiers	I ² C	Bundled OS USB, TCP/IP, Security
FlexMemory w/ EEPROM capability		SAI (I ² S)	Modular Tower Hardware Development System
SRAM	12-bit DAC	UART/SPI	
Memory Protection Unit		Programmable Delay Block	
Low Voltage, Low Power Multiple Operating Modes, Clock Gating (1.71V-3.6V with 5V tolerant I/O)	High-speed Comparators	External Bus Interface	
DMA		Motor Control Timers	
-40 to 105C	Low-power Touch Sensing	eSDHC	Application Software Stacks, Peripheral Drivers & App. Libraries (Motor Control, HMI, USB)
		RTC	Broad third party ecosystem



Kinetis K30 Family Overview for Segment LCD Applications

Flexible, low power LCD interface

- Segment LCD blink mode lowers average power
- Segment fail detect prevents erroneous readouts and reduces LCD test cost
- Front/back plane reassignment provides pin-out flexibility and allows configuration changes in firmware

Diverse communications suite

- A multitude of serial interfaces with UART support for ISO7816 SIM/smart cards & IrDA interfaces
- Dual CAN for industrial network bridging

System reliability & safety

- Hardware cyclic redundancy check safeguards memory contents and communication data
- Memory Protection Unit increases SW reliability
- Independently-clocked watchdog prevents code runaway for fail-safe applications (IEC60730)

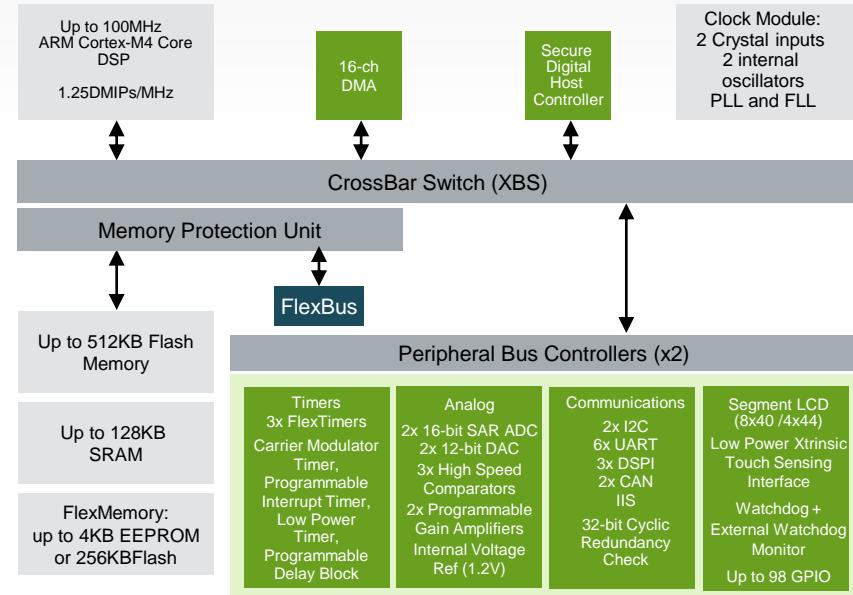
Hardware and software compatibility

- Common packages and peripherals across families enable rapid feature growth with minimal hardware and software disruption

Built-in voltage regulator (K40)

- 5V regulator input with 3.3V regulated output
- 3.3V regulated output can power MCU and also external components (source current up to 120mA)

K30 Family Block Diagram



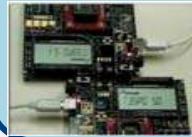
- Enablement bundle
- TOWER development system
- Complementary MQX RTOS with USB stack
- Eclipse-Based CodeWarrior 10.0 IDE
- Processor Expert Rapid Application Development Tool
- IAR, Keil and full ARM ecosystem support

Family	USB OTG + DCD	Segment LCD
K30	-	X
K40	X	X

Smart Metering Reference Designs

3-Phase
Meter

3-ph Simulation
DEMOEM
MCF51EM256



PolyPhase
Meter
MCF51EM256



3-ph E Meter
MK30



1-Phase
Meter

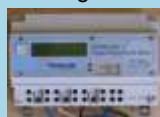
Low Cost Meter
9RS08KA8/LA8/LL/LG32



1-ph E Meter
MZ60 (China)



Low Cost
Meter
9S08LH64
Integrated



1-ph E Meter
9S08GW64



1-Phase
Meter
MCF51EM256
Integrated



1-ph E Meter
MK30



Secure,
Prepaid MK30
with NFC



Flow
Meter

Water Meter
9S08GW64



Gas Meter
9S08GW64



Connectivity

Smart Plug with
Display 9S08GW64+
MC13214



802.15.4/Zigbee SE 1.0/
HAP/ DLMS
MC1322x



Low-Cost In-Home
Energy Display
MK30/40 + MC13226
(Zigbee) + MC12311
(WMBus)



OFDM Power Line
Communication
Demo



Gateway/
Concentrator

Energy Gateway
i.MX28



Energy Gateway
MPC8308



Data Concentrator
MPC8308



Data Concentrator
(China)
MC5441x

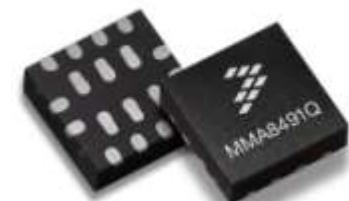


Hi-end Data
Concentrator
P1025



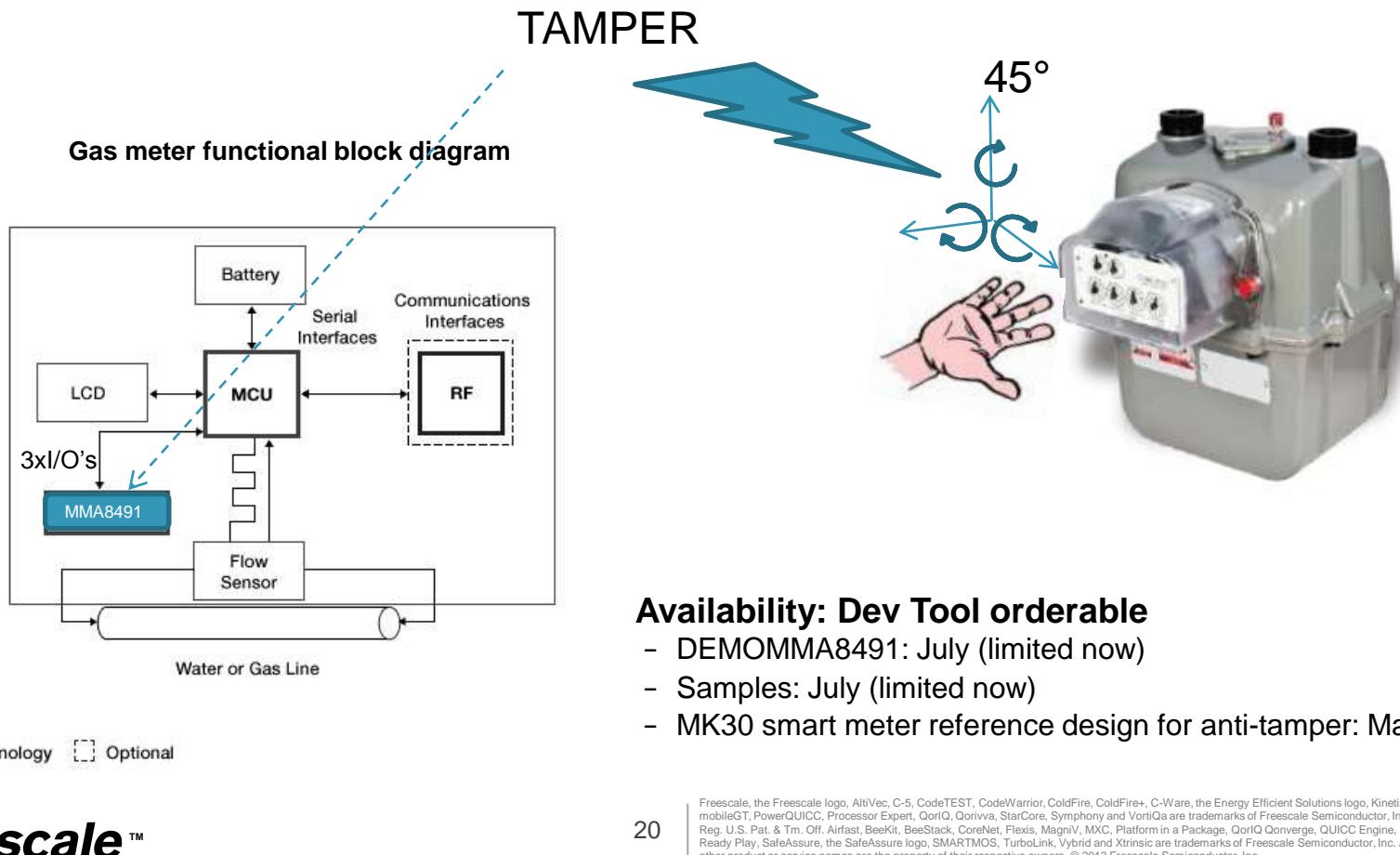
MMA8491Q: Best-in-Class Power Consumption

- Extreme low power compatible with 20+years battery lifetime
- “Easy to use” with very simple 3 x logic outputs to flag tilt on the three axis
- “Ball in a box” replacement with improved reliability and no impact on battery life time
- MMA8491 is a tilt sensor for ultra low power applications
- 3 axis, 1.95V-3.6V, +/-8g range.
- 3-axis logic outputs (above/below threshold) provides tilt indication
- Tilt threshold, 45° default value
- MMA8491Q has a dedicated enable pin with 2 functions:
 - **ON**: Trigger one shot measurement
 - **OFF**: Shutdown mode, 10nA current consumption
- Low Current Consumption <0.4µA/ hz
- Measured data available through I²C interface as well
- Package allows for easier soldering for equipment:
 - 0.65 pitch, detail: 3x3x1.05mm, 0.65mm pitch, 12-pin, QFN
 - Visual solder joint inspection capability allows end customers to insure quality in manufacturing
- Extended Industrial qualification for longer life device, device included in Freescale *Longevity Program* for 10+ year
- MK30 smart meter tamper detection reference design / targeted for industrial market



MMA8491Q Implementation Example

- MMA8491 is a tilt tamper designed for metering application (gas, water, electric)
- Required only 3 I/Os at MCU side
- “Easy to use” default 45° tilt detect but programmable threshold
- “Ball in a box” replacement: high reliability on tilt tamper detection on three axis



MAG3110FC: Main Features

- 3 axis digital magnetometer in a 2x2x0.85mm DFN package
- 1.95V to 3.6V supply voltage
- Magnetometer resolution down to 0.12uTesla = 1.2 mGauss
- Noise down to 0.5 mGauss rms
- Output data rates (ODR) from 2.5Hz to 80Hz
- Maximum field of 10G (1mTesla)
- Multiple selectable oversampling options
- Current consumption down to 24uA at 1.25Hz
- Standby mode current consumption 2uA typical
- I²C digital interface output; calibrated DC offset and gain
- Internally temperature compensated
- Capable of measuring geomagnetic field accelerations
- Extended temperature range of -40°C to +85°C
- Calibration software available under free software license agreement

Applications:

- ✓ e-compass, 1° angular error
- ✓ current measurement
- ✓ Magnetic tamper for metering



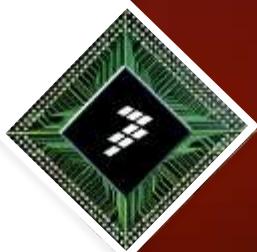
0.83\$ rsl for 100Ku



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Home Energy Management



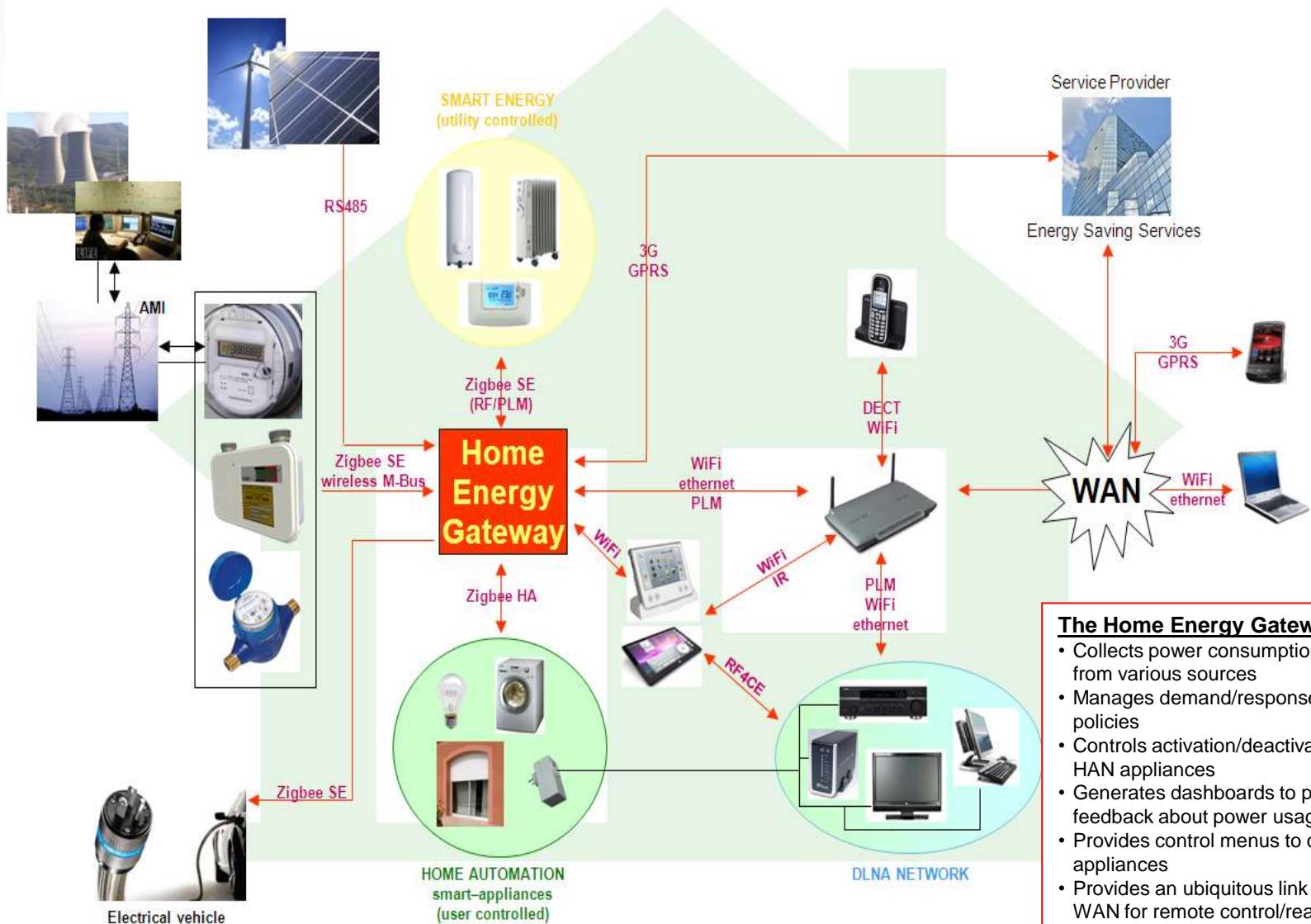
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Home Energy Management (HEM) is a Hot Topic For Several Good Reasons:

1. Increasing cost of energy bills, consumers want to reduce the amount they spend each month on electricity
2. Utilities need to switch from a model of getting people to consume more to consuming less (for capital cost and regulatory reasons)
3. Societies around the world need to put the brakes on increasing use of fossil fuels, much of which go to generate electricity



Home Energy Gateway in the Home Area Network



Freescale Home Energy Management Overview



MPC8308 NSG
Networked Smart Gateway



Home Media Controller
HAN-enabled WiFi
Router
Security Console
Controller



i.MX28 HEM
Home Energy Manager



Connected Thermostat
Security Panel
Stand Alone HEM



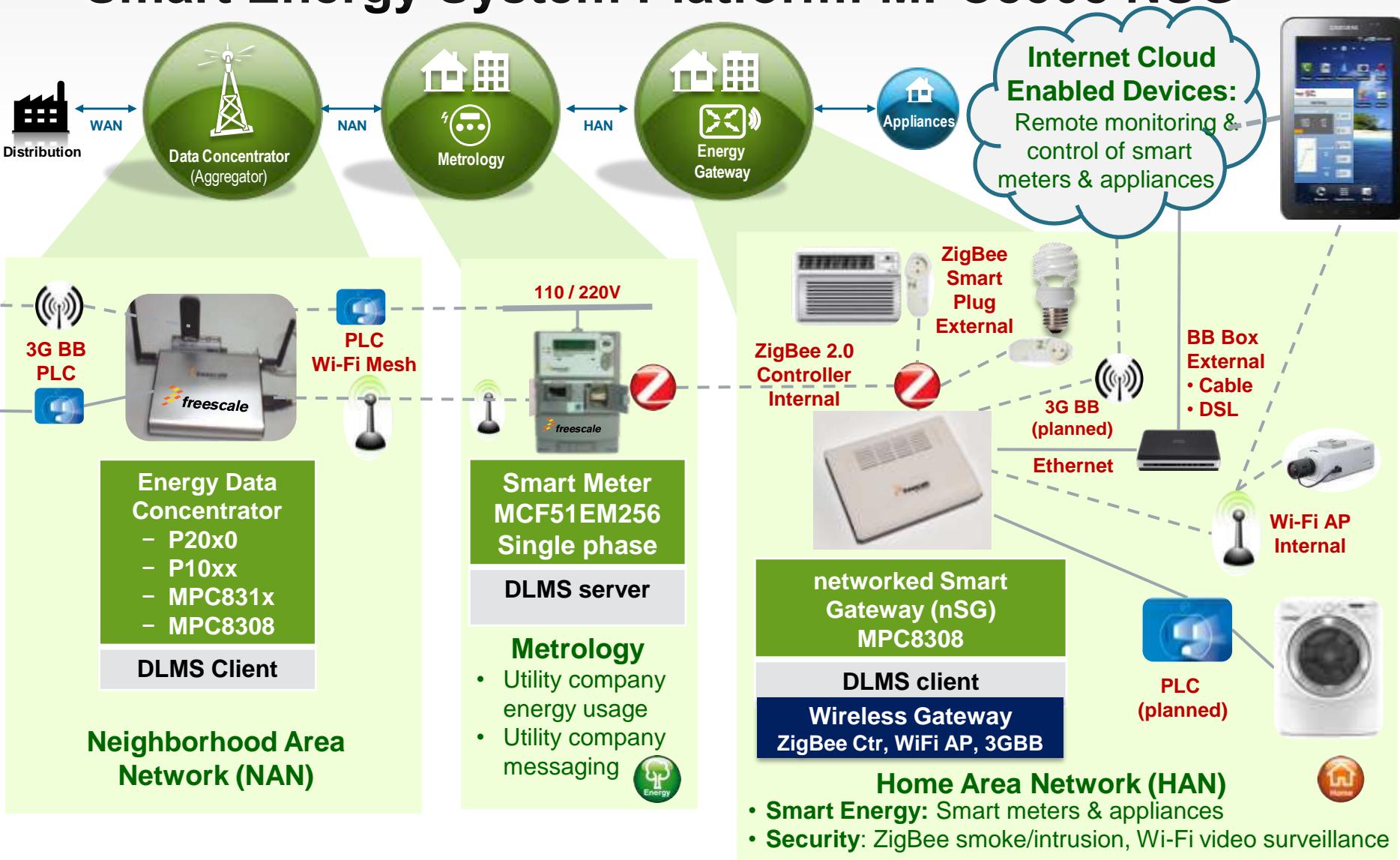
K40 IHED
In Home Energy Display



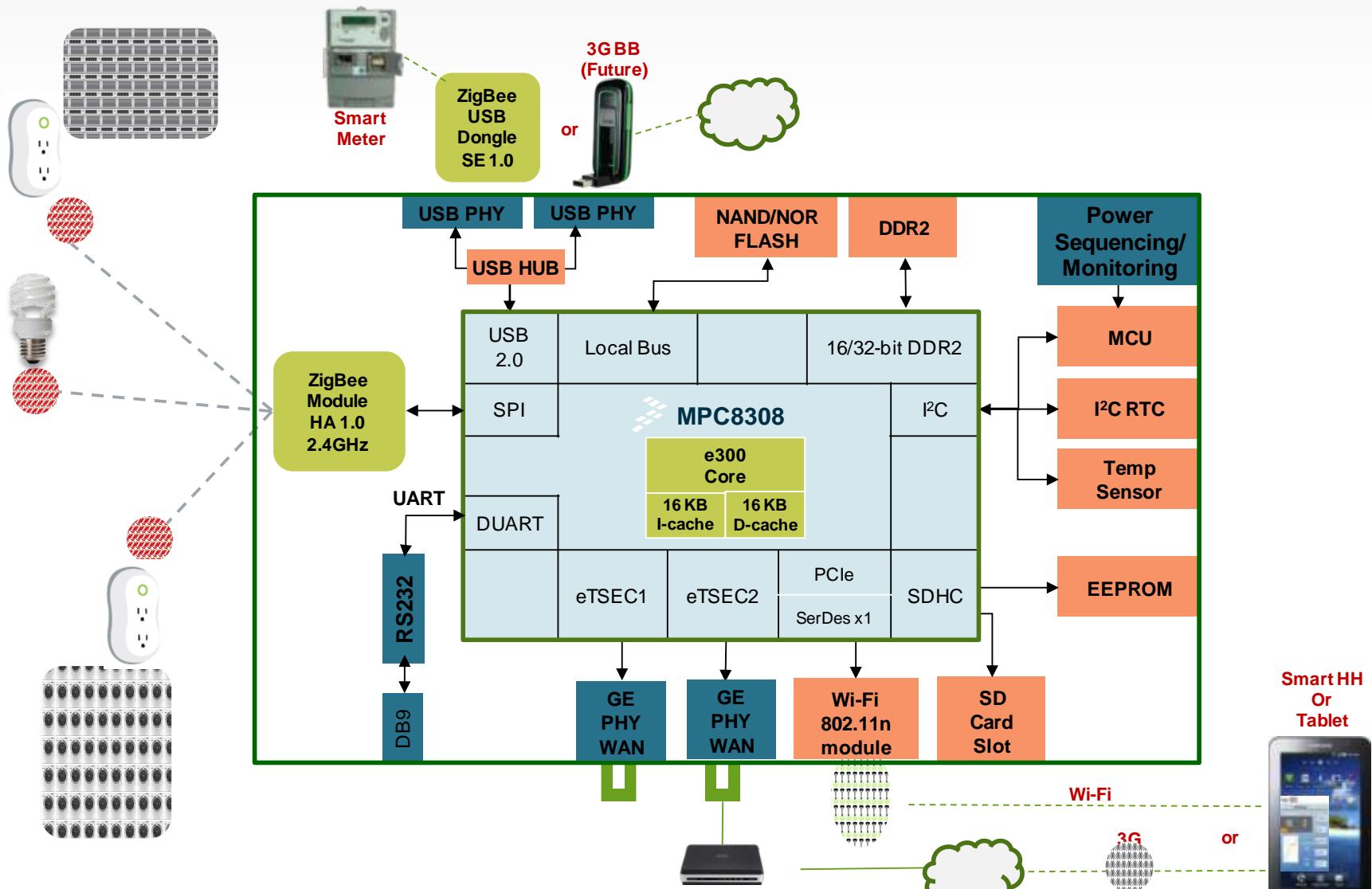
In Home Energy Monitor
Stand Alone HEM

	NSG	HEM	IHED
Home Area Networks	ZigBee HA	X	X
	ZigBee SE	X	X
Connectivity & Control	Integrated Display Capability		X
	WIFI Connectivity	X	X
	Mobile Control	X	X
Value Added Services	Router	X	
	Video Surveillance	X	
	DLNA Media Serving	X	
	VOIP	X	

Smart Energy System Platform: MPC8308 NSG



Networked Smart Gateway: MPC8308



HEG Typical Available Demo



Sabre2 i.MX53



iPad



PC



iPod



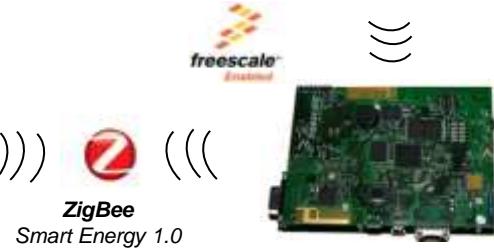
Smart Meter



**MCF51EM256
MC13224V**



**ZigBee
Smart Energy 1.0**



**HEG
i.MX28 & MC13224
Linux/Java/OSGi &
Windows Emb. Compact 7**



**ZigBee
Home Automation**



Modlet



MC13224

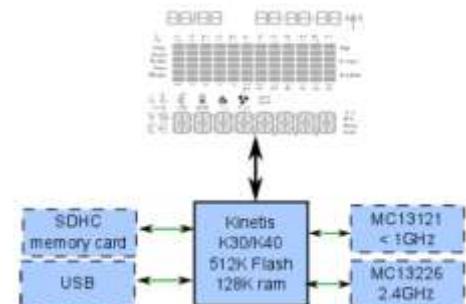


MC13224



In Home Energy Display (IHED)

- Prompt and convenient feedback on electrical or other energy use
- Displays cost of energy used and estimates of carbon footprint
- Energy efficient solution: <5uA for driving display
- Design allows creation of flexible product to meet utility needs
- Can be used with utility meters, appliance meters, wind/solar generation and load control modules
- Various connectivity options (<1GHz, 2.4GHz)

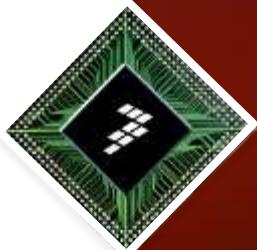




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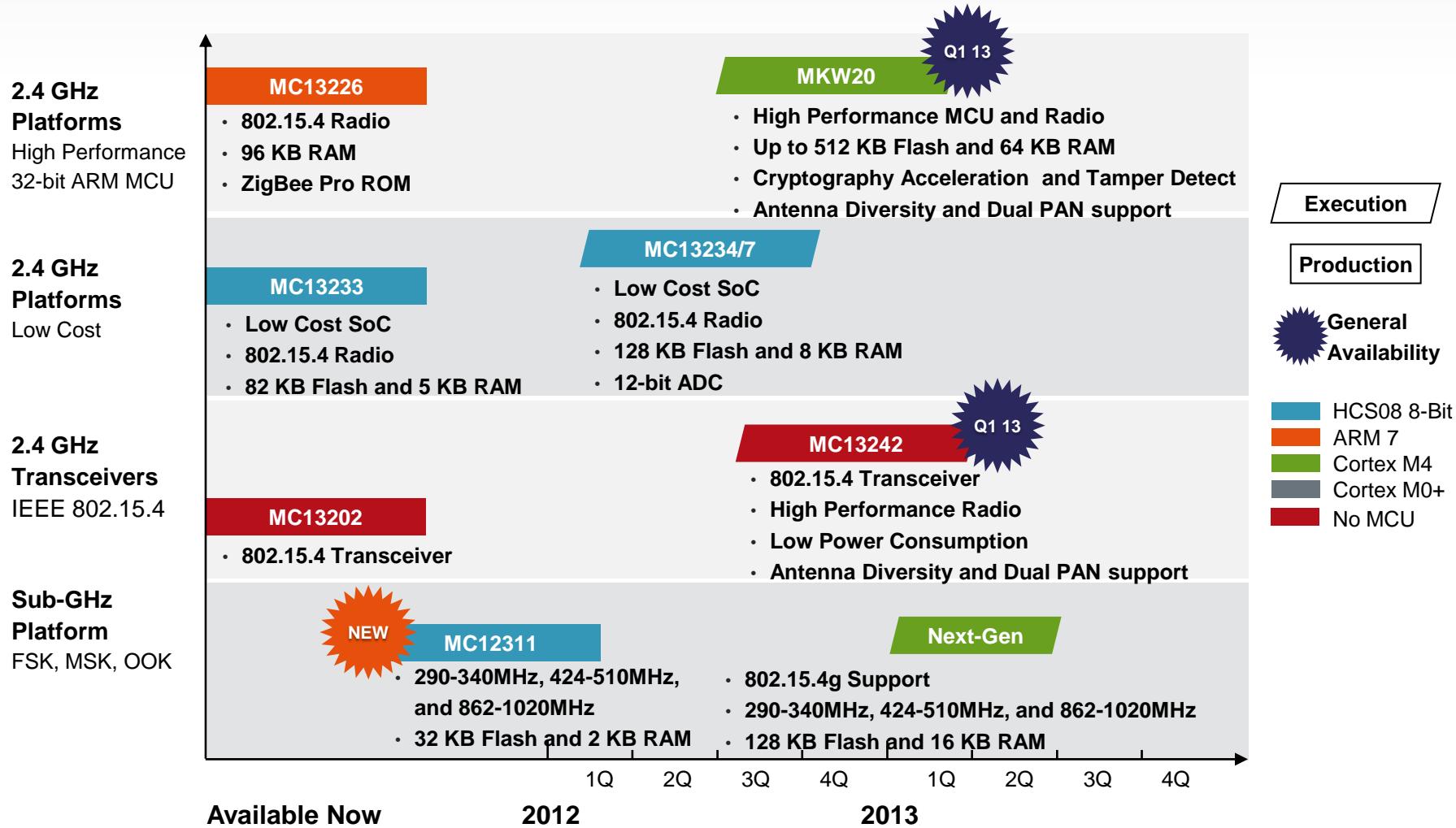
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Communication Solutions



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Freescale Wireless Roadmap



Kinetis MKW20 Wireless MCU

High-Performance RF and MCU

- 50 MHz Cortex M4 with up to 512 KB flash
- Best-in-class link budget
 - -102 sensitivity with +10dBm output power
- Improved reliability with antenna diversity
 - Automatic selection of antenna

Low Power

- Low RF power consumption
 - 15mA TX and RX
 - Low power receive mode
- Multiple low power modes
 - Support Kinetis low power modes

Secure

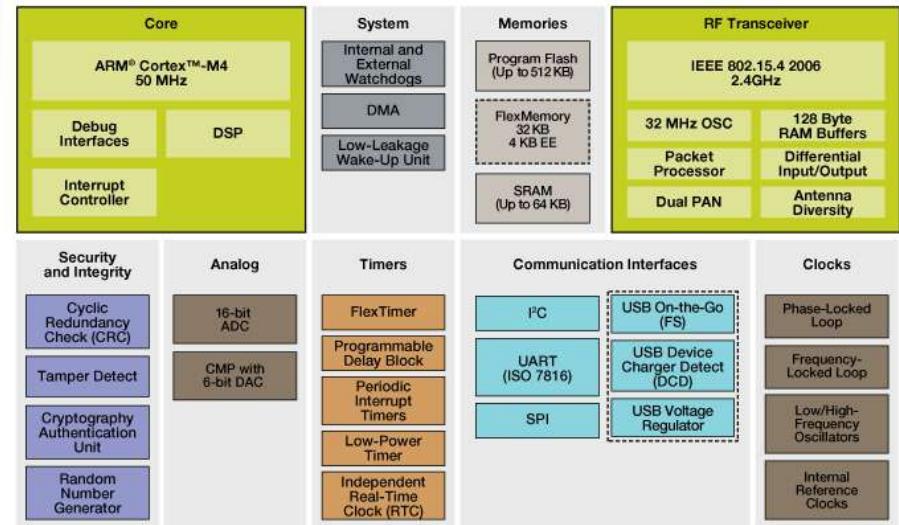
- Increased security with tamper detect and hardware crypto engine

Flexible

- Dual Pan
 - Supports 2 networks simultaneously
- Common software and tools with MC13242 + Kinetis
- Industrial operating temp



Kinetis KW20 Wireless MCU



□ Optional

Device	Flash	RAM	Package
MKW21D256VHW5	256 KB	32 KB	8x8 56-pin LGA
MKW21D512VHW5	512 KB	64 KB	8x8 56-pin LGA
MKW22D512VHW5	512 KB	64 KB	8x8 56-pin LGA
Features	Description		
Software and Protocol Stacks	SMAC, 802.15.4 2006, SynkroRF, ZigBee (RF4CE, Pro, IP)		
2013 1K SRP	\$4.49 (MKW21D256VHW5)		
Availability	Samples January 2013 Production – March 2013		

MC13242 High-Performance 802.15.4 Transceiver

High-performance 2.4 GHz IEEE 802.15.4 RF transceiver

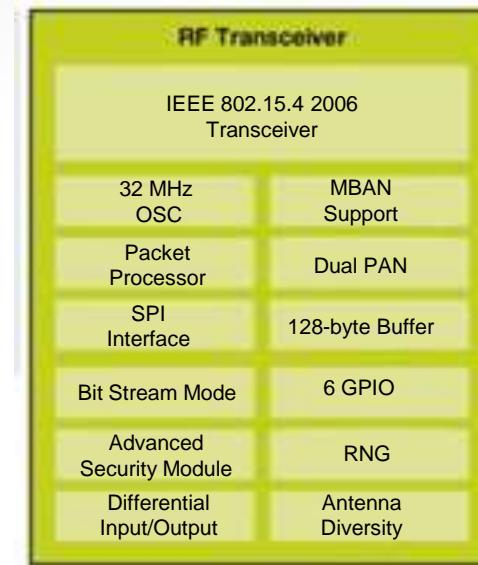
- Packet processor for hardware acceleration
- Supports single ended and diversity antenna options
- Dual PAN support
 - Can participate in two ZigBee networks simultaneously
- -Best-in-class link budget
 - -102 dBm sensitivity
 - +10 output power
- Low power consumption
 - TX 15mA @ 0dBm (CPU sleep)
 - RX 15mA (CPU sleep)

Advanced Security features

- AES encryption engine and random number generator

Compatible with KW20 and Kinetis MCUs

- Software protocol stacks, tools and IDE are compatible with the Kinetis KW20 wireless MCU



Device	Flash	RAM	Package
MC13242	N/A	N/A	5x5 32-pin LGA
Features	Description		
Software and Protocol Stacks	SMAC, 802.15.4 2006, SynkroRF, ZigBee (RF4CE, Pro, IP)		
2013 1K SRP	\$1.59		
Operating Temperature	-40 to +125		
Availability	Samples: January 2013 Production: March 2013		



MC12311 Smart Radio Overview

Demonstrates exceptional RF performance with a budget link up to +137dB

- Up to -120dBm sensitivity @ 1.2kbps, -105 dBm @38.4 Kbps. -18 to + 17dBm output in step of 1 dBm
- Bullet-proof front end: IIP3 = -18 dBm, IIP2 = +35 dBm, 80 dB Blocking Immunity

Very low power suitable for battery operated equipments

- Low-power features such as 100nA with radio configuration retention, 16 mA Rx current, 20 mA Tx current at 0 dBm and 33 mA Tx current at +10 dBm

Flexibility and Compliancy with Multiple Standards

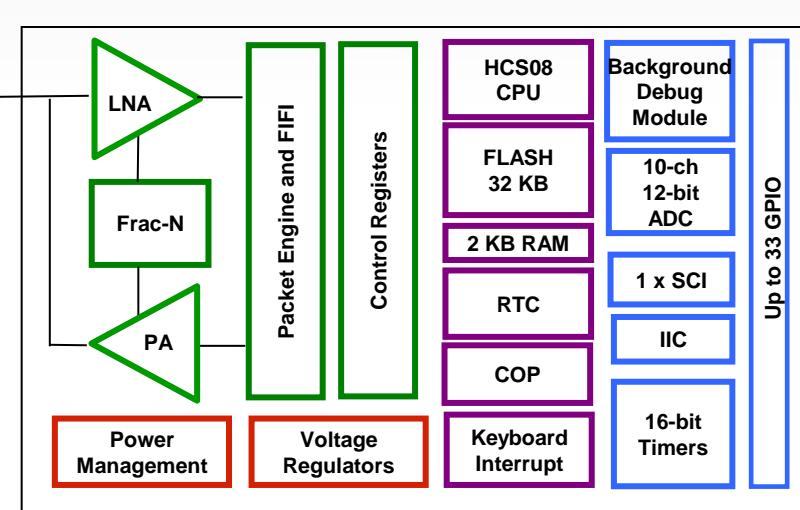
- Support of multiple modulation schemes (GFSK, MSK, GMSK and OOK)
- Supports 290-340MHz, 424-510MHz and 862-1020MHz frequency bands

High Integration Level

- Includes the proven HCS08QE 8-bit MCU core with up to 50MHz performance, embedded 32KB flash and 2KB of RAM supporting wireless communication protocol + application in one chip

Full set of peripherals

- Offers multiple 16-bit timers, up to 33 GPIO, 13-bit port keyboard interrupt, 10 channel-12-bit ADC, SCI, I2C and dual analog comparators



System Features

- 40 to +85°C operating temperature
- 1.8V to 3.6V
- RoHS compliant
- 8x8 mm 60 pin LGA
- Supported Protocols & Software**
 - GUI for RF evaluation
 - SMAC
 - Subset of 802.15.4g
 - Wireless M-Bus

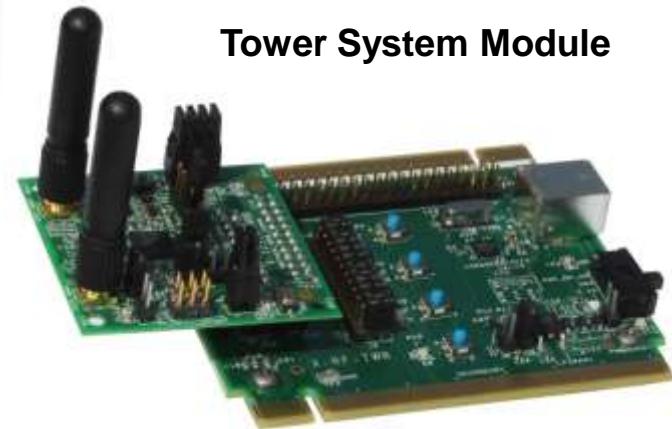
MC12311 Development Tools – Easy to Use

See for yourself: Evaluate wireless networking in minutes

- Development kits that meet your design and budget objectives
- TWR-12311: Tower System Module – \$75
- TWR-12311-KIT: Tower System Kit – \$149
- “- NA” for 915 MHz for North America
- “- EU” for 868 MHz for Europe
- “- JA” for 920 MHz for Japan

Learn quickly / develop rapidly – Right out of the box

- Development kits come with everything you need to jump start your design; tower module plugs into tower system development platform
- BeeKit allows users to easily create, modify and update Freescale wireless networking stacks
- Out of the box application; sample code



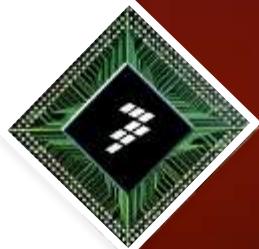
Tower System Module

Tower System Kit
Rapid Development Platform



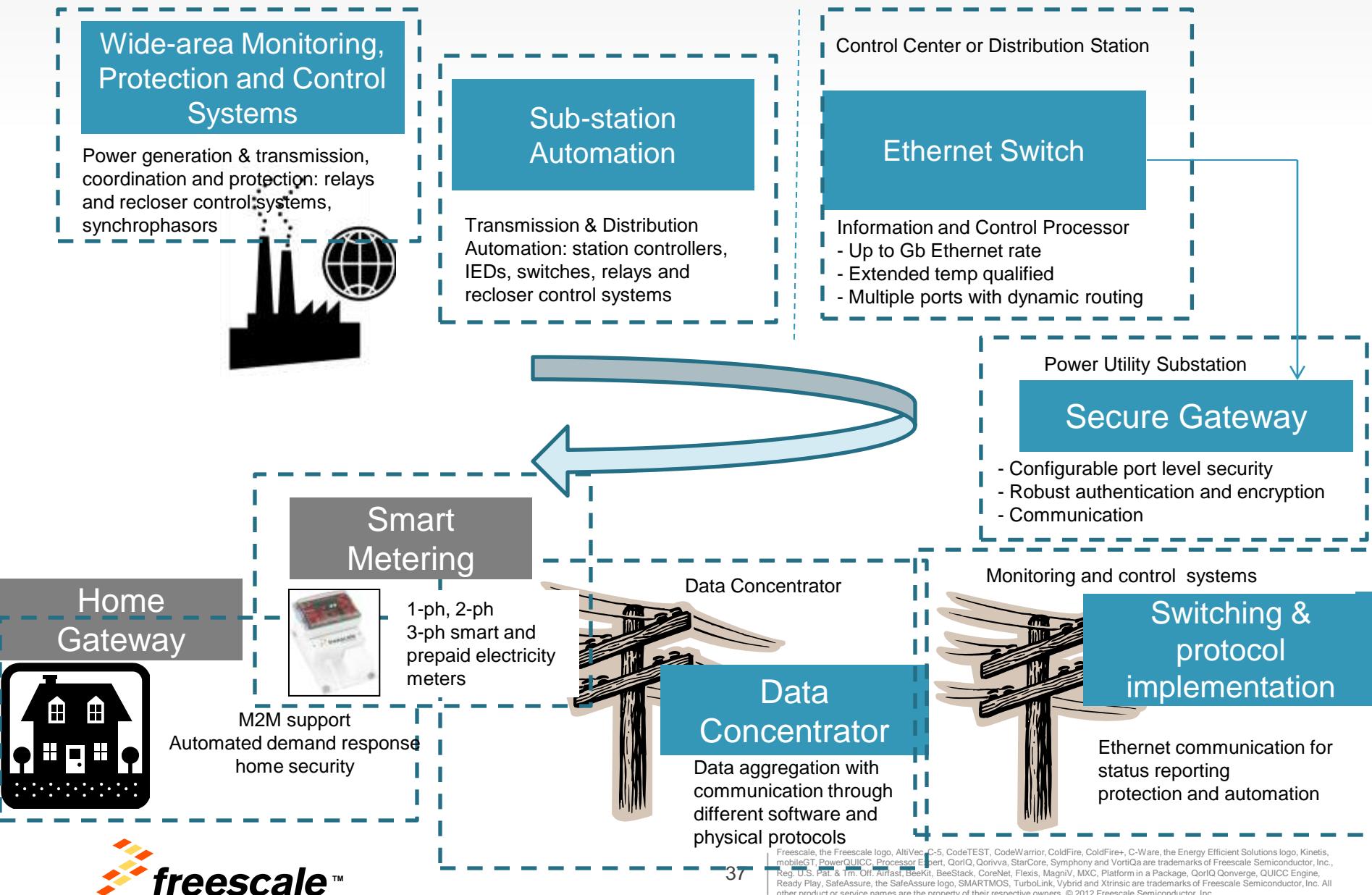
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Grid Infrastructure



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The Smart Grid (Freescale Processors Field of Play)

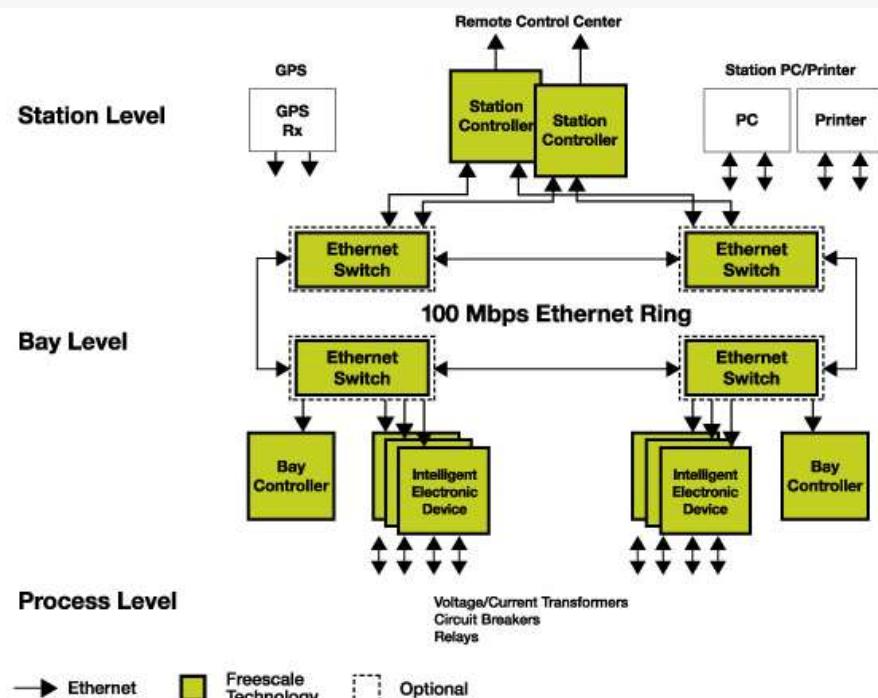


Typical Grid Infrastructure Solutions Requirements

- High-performance processors (>1.5 GHz core)
- Mixed control and data plane
- Connectivity
- Security features
- Low power
- Software stack support
- Robustness – Industrial temperature
- Product longevity
- Solid ecosystem



Substation Automation



Solutions

- Single-, dual- and quad core Power Architecture-based microprocessors, other 32-bit microcontrollers/microprocessors
- Bay Controller: P2020/10, MPC8569E (PQIII)
- Ethernet Bay Controller: P1010, P1025/16
- Intelligent Electronic Device (IED): P1010/14, P1025, P2020
- Ethernet Switch: P1010/14, P1025/16, MPC8569E III, ColdFire, Kinetis

Requirements

- Flexible performance and cost points for substation control nodes and IEDs
- Flexible interfaces to support synchronized and high availability field/process bus communications
- Interfacing with switched and switchless Ethernet networks in various topologies, such as star, line, tree, ring, redundant ring
- Trust platform to prevent theft of functionality, data, uniqueness
- Advanced power management to reduce energy consumption and need for fan, thus reducing BOM cost
- Common core architecture simplifies performance and cost migration

Management Processors for High End Switching



Supervisor card processors in modular switches, data centers and core switches

Typical Requirements:

- 2 to 4 cores, 1.5GHz
- Mixed control and data plane
- Multiple PCI-express Gen 2 controllers
- XAUI + multiple RGMII/SGMII
- DDR3

Additional Requirements:

- Security and high availability
- Virtualization
- Accelerators – RegEx, data path, crypto

Example QorIQ Processor Solutions



- Quad-core, up to 1.2GHz
- 1MB front-side cache
- 3 PCI-express Gen 2 controllers
- 2 SATA, 5 Ethernet
- Data path acceleration
- Security and high availability
 - Crypto acceleration
 - Secure boot
 - Control plane policing



- Quad-core, up to 1.5GHz
- Similar features as P2040 plus XAUI and 128KB L2 per core



- Dual-core, up to 2GHz
- 512KB L2 per core and 2MB L3
- Pin-compatible with P3041

Secure Gateway

- **Used in Power Utility Substations**
- **Requirements:**
 - Configurable port level security
 - Robust authentication and encryption
 - Enablement (software stacks)
- **Freescale Security Solutions:**
 - Firewalls and intrusion detection and prevention systems using signature detection and filtering techniques
 - Cryptographic techniques for authentication, data integrity and data privacy
 - Platform assurance and trust techniques for increased attack resistance
 - Physical tamper detection

Freescale understands security



Freescale's Software (VortiQa) Product Line Comparison

	Control Center	Monitoring Control	Home Gateway	
	VortiQa SW for Service Provider Equipment	VortiQa SW for Enterprise Equipment	VortiQa SW for Small Business Gateways	VortiQa SW for SOHO/Residential Gateways
Market Segment Target	Service provider edge router, UTM's, switches, IMS	Enterprise UTM, security appliances, secured routers and switches	Multi-service business gateways - SME, SMB	xDSL, PON, FTTH, and other CPE devices
Functionality	Firewall IPSec VPN Inline IPS DDoS mitigation (Traffic Anomaly) Virtual routing Virtual security gateway	Firewall IPSec VPN Inline IPS DDoS mitigation (Traffic Anomaly) Anti-Virus Anti-Spam QoS / TM High availability	Routing Firewall IPSec VPN WAN Load Balancing WAN Fail Over SIP, IP-PBX TR-069,TR-098	Routing Firewall IPSec VPN VoIP – SIP, MGCP TR-069,TR-098
Freescale Silicon	P4080	8377E 8572E P2020 P4080	8377E P2020	8315E 8314E P1020

Integration of networking and security simplify customer applications



ODM Solutions for Your OEM Customers

Production-ready BOM & Performance Optimized Fully Integrated Solutions

Solutions Outcome

- Cost-optimized: UTM appliance portfolio, from low-end to high-end, from major ODMs (2-4Gbps to 20 Gbps)
- Ready to ship: FCC, UL and CE certified
- Performance: Performance optimized software

NETWORKING OEM	END USER PRODUCT (OEM Branding + Channel + Support)
VortiQa Software	PRODUCTION READY SECURITY SOFTWARE APPLICATION (Software Platform + Integration with Freescale Silicon + Integration testing + Regression testing + Certifications, where applicable)
HARDWARE ODM/CM	QorIQ or MPC silicon based H/W Platform (PCBA + OS and Board support package)



Management Processors for High End Switching



Line card processors in modular switches, data center and core switches

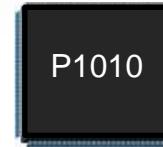
Typical Requirements:

- Single core up to 667MHz core
- PCI-Express: One to two lanes x1
- RGMII/SGMII: One to two GbE
- DDR3 or DDR3L

Additional Requirements:

- Security and high availability
- Virtualization to run 2 OSs on single core
- Low power

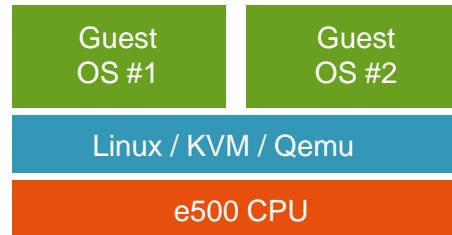
Example QorIQ Processor Solutions



- P1010 is a single-core up to 800MHz (2.4 DMIPS/MHz) at <3W
 - Supports security and high availability through secure boot and runtime monitoring

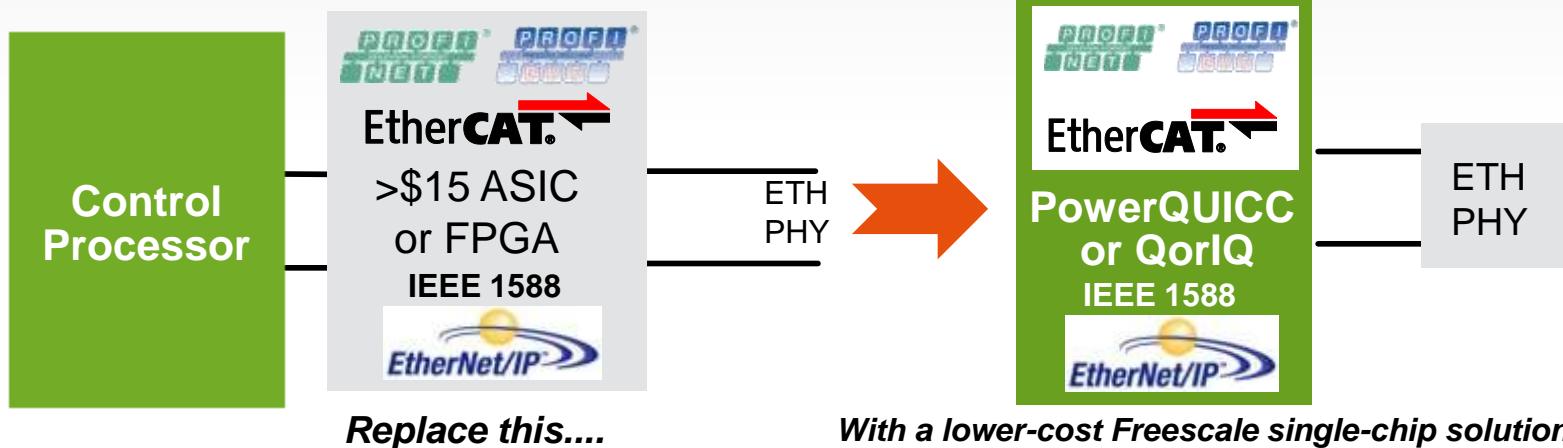


- P1014 is a pin-compatible, lower-cost option
- P1011 is part of a scalable, pin-compatible processor family that goes from 400MHz single-core to 1.2GHz dual-core



- QorIQ processors support virtualization: A single core can support two or more guest OSs over a Linux Kernel Based Virtual Machine (KVM)

Freescale Addresses the Most Popular Industrial Network Protocols



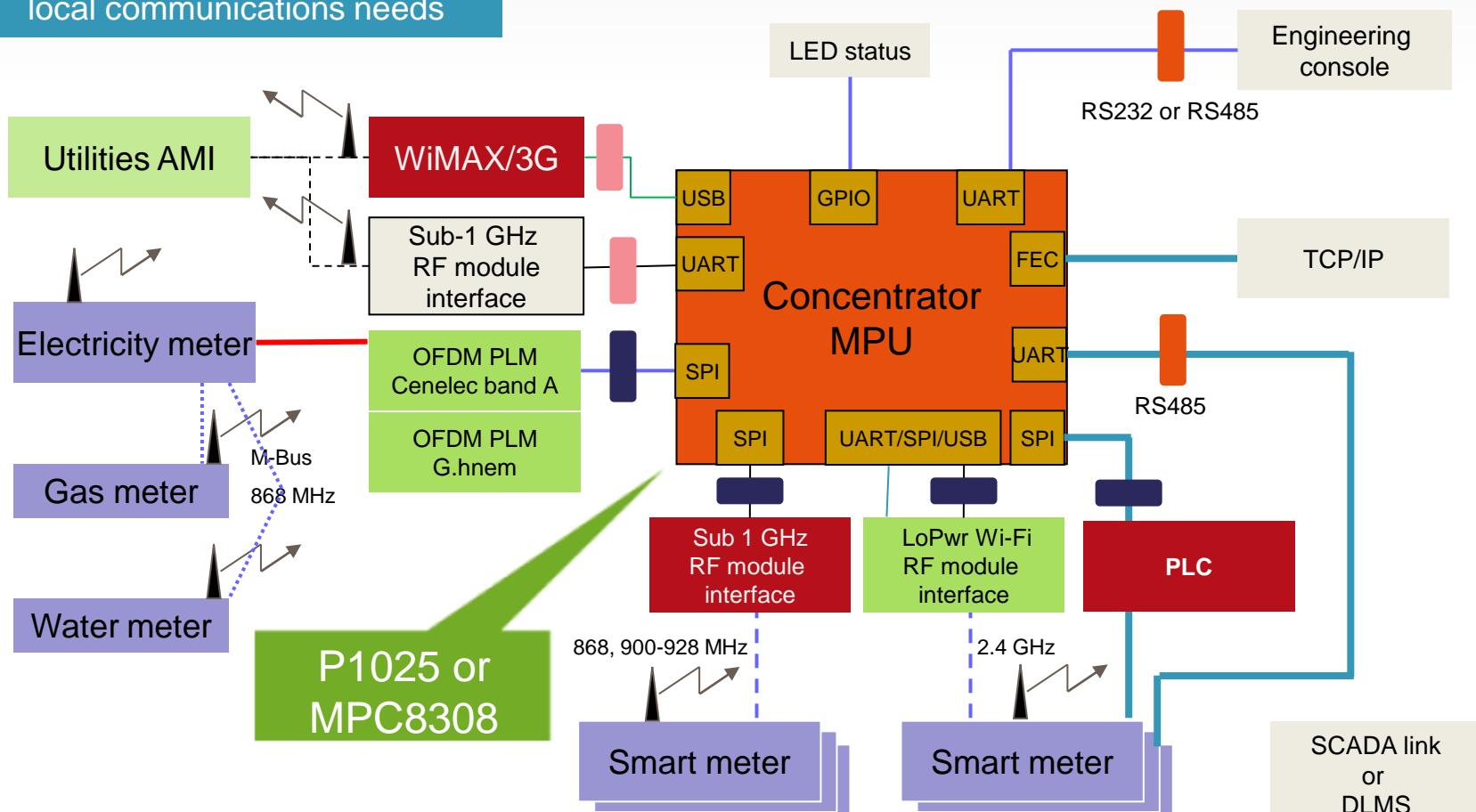
Field Bus (Discrete or I/O oriented)	Industrial Ethernet
Most popular fieldbus solution. 35M+ nodes installed; 24% CAGR (PTO 2011). Introduced by Siemens.	3M+ PROFINET nodes installed; >40% CAGR (PTO 2011). Introduced by Siemens.
CIP™ application layer on CAN. Very popular and still growing. Introduced by Rockwell.	CIP application layer on Ethernet. Growing fast. Introduced by Rockwell.
Very popular SAE-sponsored standard but losing share in factory automation. Supported by many.	May dominate due to technology and ease of use. Predict >3 Mu by 2011. Introduced by Beckhoff.

Lower cost protocol implementations



Data Concentrator – Superset System

Country-specific versions to suit local communications needs



QorIQ P1025 Data Concentrator

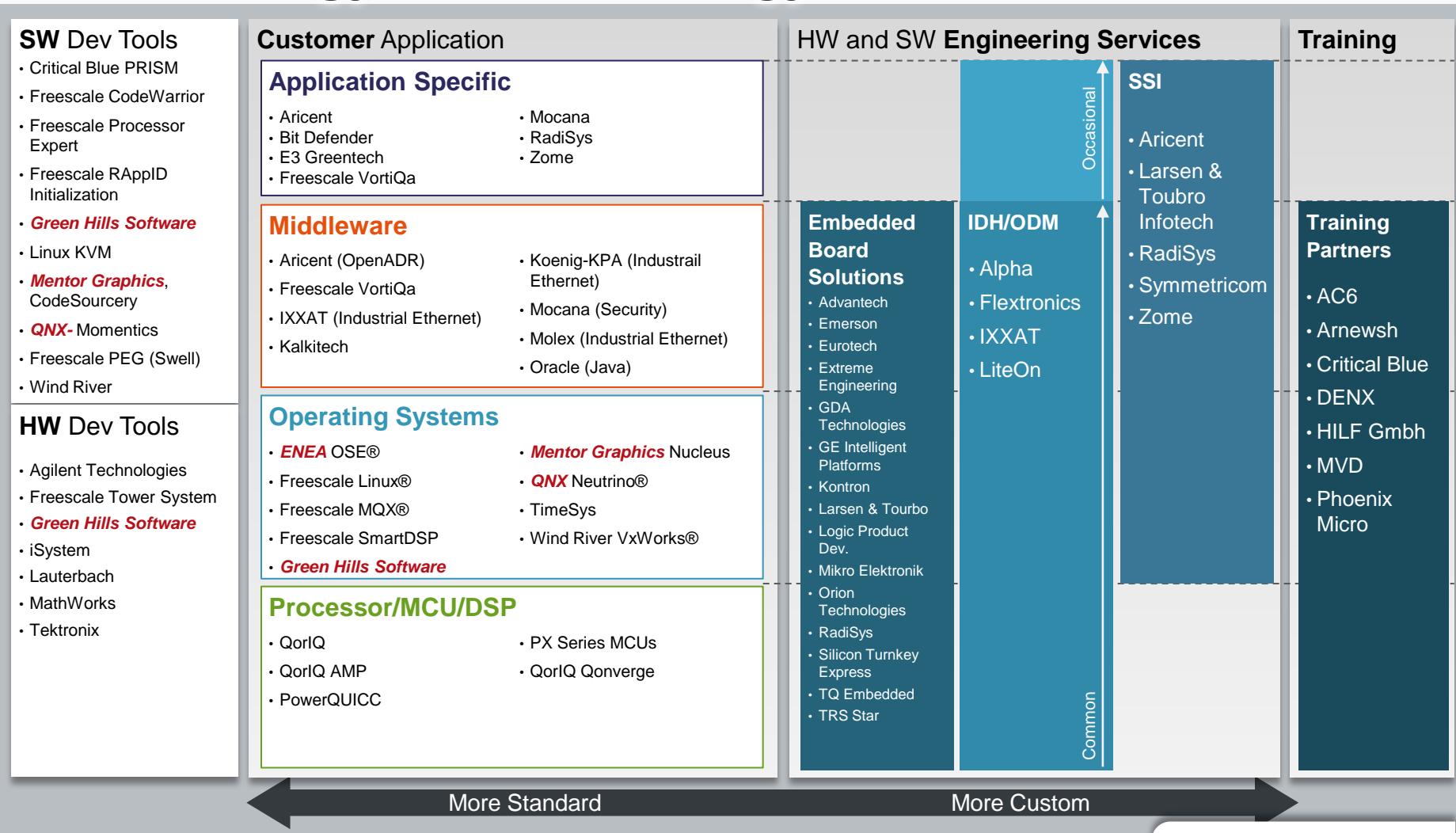


- Enabled with an advanced metering infrastructure (AMI), allows for bi-directional real-time monitoring and control
- Communicates with smart metering devices via the industry standard device language message specification or DLMS (IEC 62056)

P1025 QorIQ Data Concentrator Specs

Processor	<ul style="list-style-type: none">P1025 QorIQ processor 667MHz/800MHz dual core deviceCapabilities for IEEE1588 time stamping and security acceleration
Connectivity & Functionality	<ul style="list-style-type: none">Serial line drivers for communication to power line communication controllers3G, WiMax or WCDMA communication via USB interface3 Giga-bit Ethernet capable ports to enable WAN/LAN communicationsTime stamping capability (IEEE 1588 protocol)Encryption communication capability leveraging the device's security accelerator
Memory	<ul style="list-style-type: none">Up to 128 MB of NOR/NAND flash memoryCapability to interface to DDR2/3 memory up to 800MHz data rate
Enclosure and design	<ul style="list-style-type: none">Energy efficient passive cooled design, natural convection capableRuggedized, weather resistant construction
Future development	<ul style="list-style-type: none">Power line communication (PLC) interfacing and protocol development

Freescale EcoMAPS: Power Architecture Technology in Smart Energy



IDE: Integrated Development Environment

BDM: Background Debug Module

JTAG: Joint Test Action Group

*Preferred Partners

BSP: Board Support Package

OS: Operating System

HAL: Hardware Abstraction Layer

Embedded Board Solutions

including SBC and SOM:

Single Board Computers and System on Modules

IDH: Independent Design House

ODM: Original Design Manufacturer

Freescale EcoMAPS

SSI: Software and Solution Integrators

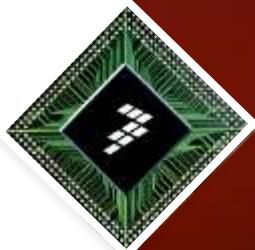
For more partner options, visit: Freescale.com/Partners



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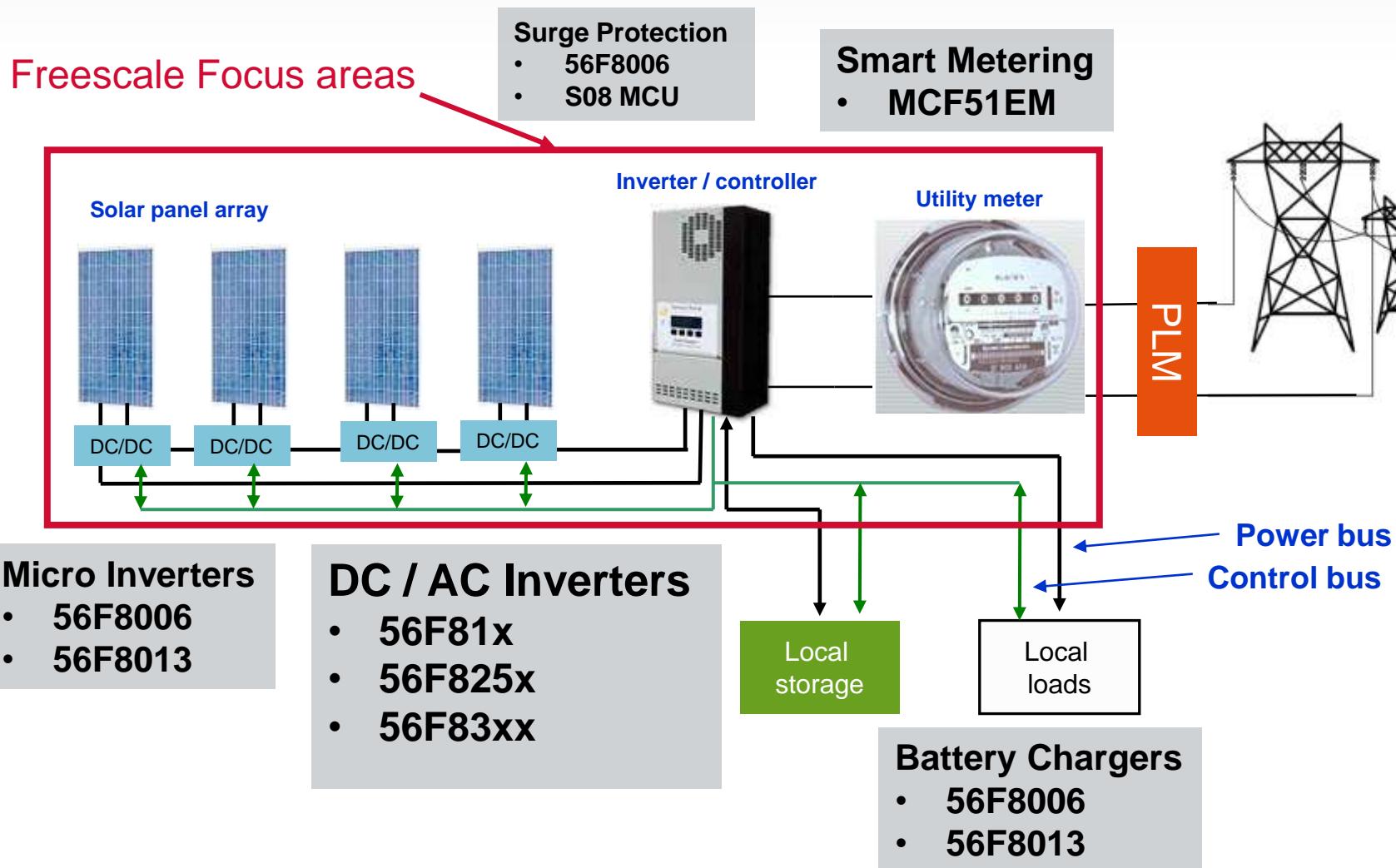
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Renewable Energy Solutions



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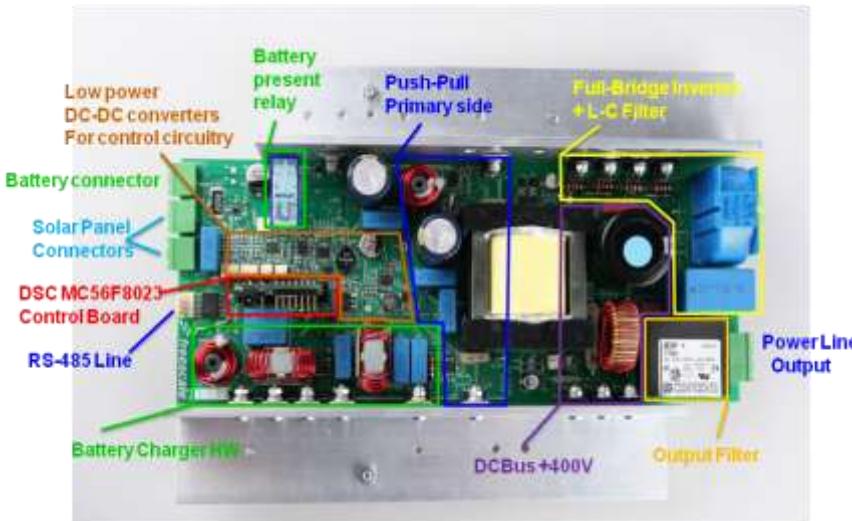
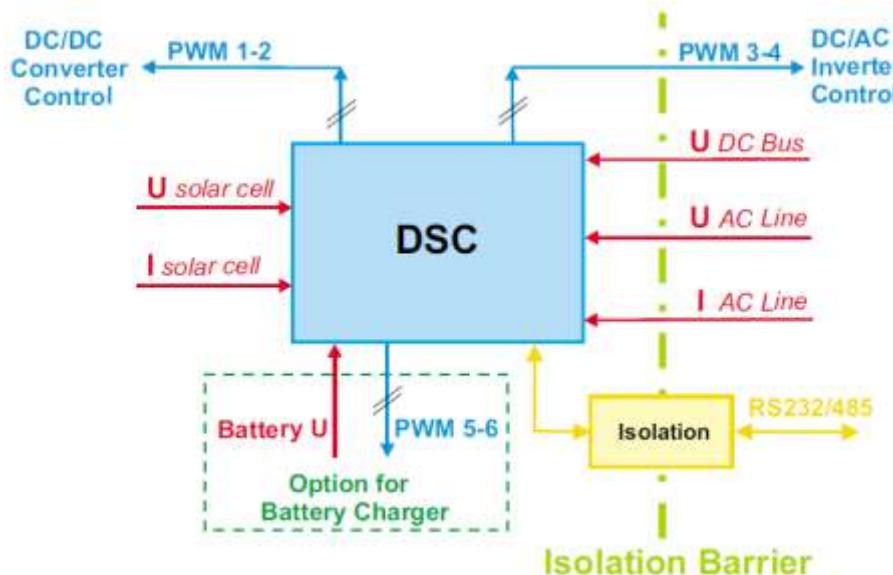
Renewable Energy – Photovoltaic System – Freescale Focus Areas



Inverter Control Circuits

MC56F8023 DSC used

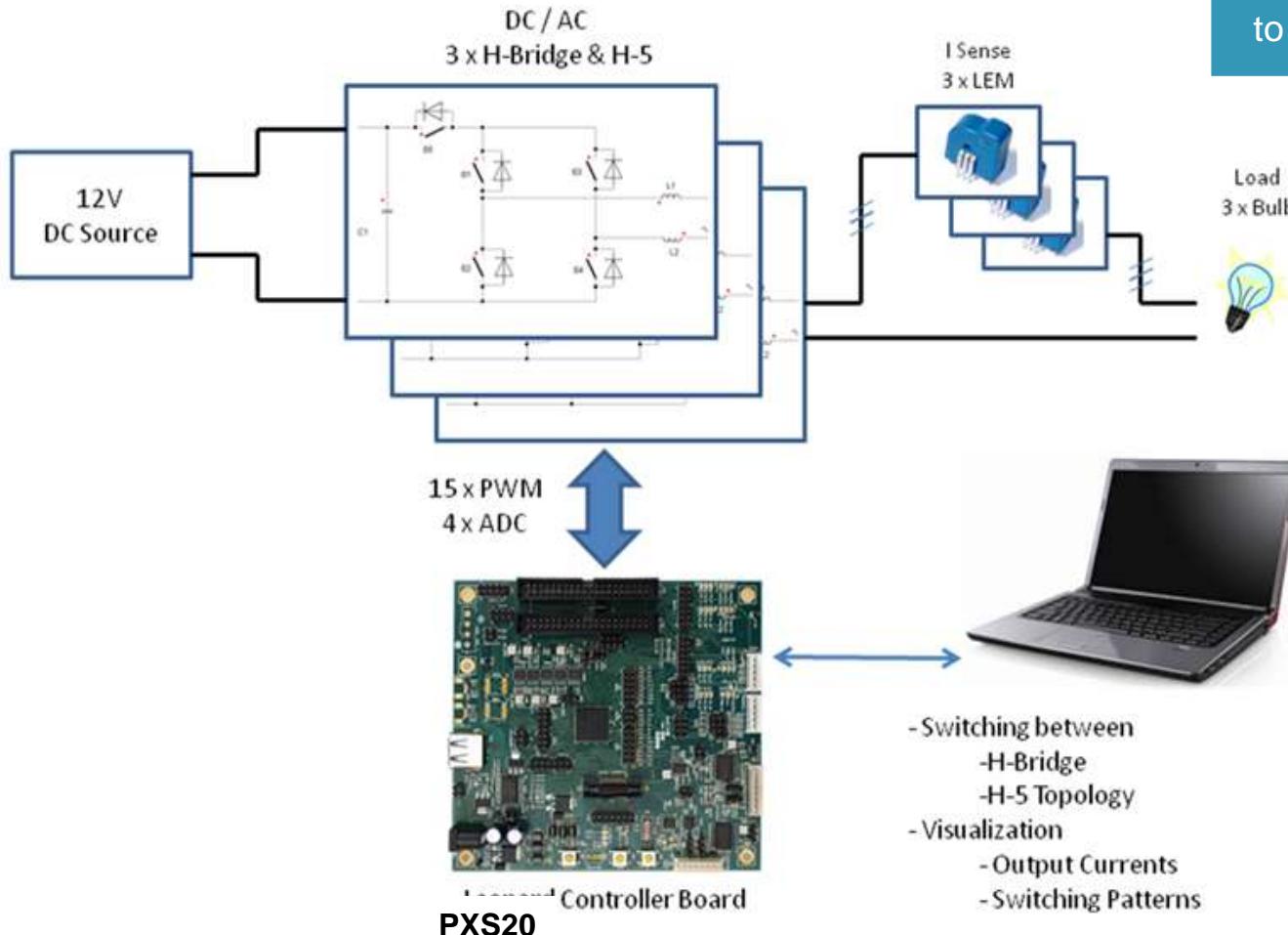
- Controls the DC/DC converter and DC/AC inverter
- MPPT software algorithm for the solar panel implemented
- Battery charger control – as option
- RS-485 line interface for supervisor's line communication
- Output over-current, over-voltage, short-circuit & input under-voltage fuses implemented
- ON-GRID or OFF-GRID mode



Solar Power Inverter Demo (MPC564xL/PXS20)

PXS20

3-Phase Solar Inverter Demo



- H-bridge/H-5 topologies to be implemented

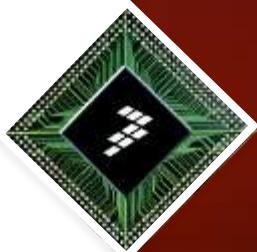
- Switching between
 - H-Bridge
 - H-5 Topology
- Visualization
 - Output Currents
 - Switching Patterns



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Smart Energy Standards



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Freescale Presence in Standards Bodies

Promoter and Contributor Member

- G3 OFDM Alliance
- P1901 we have voting seat now
- ZigBee Alliance: Creation and project management of Smart Energy profile spec
- IPSO (IP for Smart Objects) Alliance
- 6LoWPAN
- G.hnem
- IEEE P1901.2 (evaluating participation)
- ETSI Board Smart Grid strategic topic: Freescale is member of this board and one of the champions of the Smart Grid strategic topics

Contributor Member

- IEEE 802.15/ IEEE 802.15g Smart Utility Network (SUN) wireless standard
- ETSI M2M and ETSI M/441 strategic team (M/441 is the EC mandate to define smart meter)

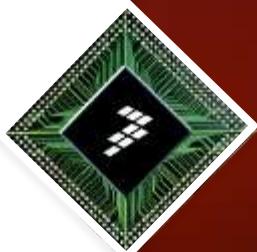
Participating Member

- Smart Grid Interoperability Panel (NIST)
- Pecan St. Project, TX
- ITU-T Smart Grid focus group

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Smart Energy Resources

freescale.com/smarterenergy



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Freescale Resources for Smart Grids/Meters

- **External:**

www.freescale.com/smartergy



- **Collateral:**

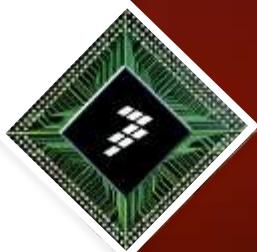
- Smart Energy Brochure
- Application Notes
- White Papers
- Webcasts
- Training Materials
 - Smart Energy Blogs

A screenshot of the Freescale website's "Smart Energy" section. The page features a banner with the text "Smart Energy Design" and "Your essential source for smart energy solutions". Below the banner, there is a detailed description of the "Single-Phase Electricity Meter Reference Design", which is a high-performance solution based on the Kinetis KMC3249 microcontroller. The page also includes sections for "Smart Energy Applications" (listing Home Energy Gateway, Residential Power Monitoring, Electricity Meters, Gas and Water Meters, Electronic Heat/Meter/Meters, Wireless Solutions for metering, Data Concentrator, Smart Power Line Monitor, Home Appliances, Home Control, and Consumer), "Featured Videos" (including a video on Home Energy Gateway Reference Design), and "Training & Events" (listing various webinars and events).

A screenshot of the Freescale website's "Smart Grid and Smart Metering" section. The page features a banner with the text "Smart Grid and Smart Metering". Below the banner, there is a detailed description of the "Smart Grid and Smart Metering Solutions", which include solutions for smart metering and circuit grid automation. The page also includes sections for "Smart Grid and Smart Metering Applications" (listing Home Energy Gateway, Meter Data Concentrator, Data Power Inverters, Residential Grid Power Inverters, Commercial Grid Power Inverters, DC-DC Solar Power Inverters, Electric Heating, Photovoltaic Electricity Meter, Low-Voltage Direct Type with Kinetis KMC3249, Low-Voltage Electronic Type Meter, Mid-Voltage Electronic Type Meter, Integrated Electronic Type Meter, Power Meters, Gas and Water Meters, Electronic Heat/Meter/Meters, Data Concentrator, Wireless Head Unit, Wireless Infrastructure for Metering, ZigBee® for Home Energy Metering, ZigBee® PT for Home Automation Area Network (Last Mile), and Power Line Communication), "Featured Videos" (including a video on Home Energy Gateway Reference Design), and "Training & Events" (listing various webinars and events).

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Summary



Freescale Smart Energy Solutions Summary

- **Freescale has smart energy solutions across the grid**
 - QorIQ for grid infrastructure and data concentrators
 - Kinetis platform solution for smart metering
 - i.MX/PowerQUICC home energy management solutions
 - Communications portfolio for Sub GHz, ZigBee and PLC
 - DSC portfolio and PXS20 renewable energy
- **References designs to decrease time to market**
 - Pre-certified smart metering and prepaid meter solutions
 - Data concentrators
 - Home energy monitors and gateways
- **Extensive ecosystem support**
- **Product longevity: up to 15 years**
- **Quality: Automotive and industrial drive with zero-defect mentality**
- **Participation in industry standards bodies**





Recap

- **Hope you enjoyed learning about Freescale solutions for the smart grid!**
- **You can identify key components of the grid**
 - Metrology
 - Home Energy Management
 - Communication Solutions
 - Grid Infrastructure
 - Renewable Energy
- **You have a general overview of Freescale solutions for smart energy**
- **You know where to go for more information:**
www.freescale.com/smarterenergy

Freescale on Kaixin

Tag yourself in photos
and upload your own!



Weibo?

Please use hashtag
#FTF2012#



Session materials will be posted @ www.freescale.com/FTF

Additional FTF Sessions Related to Smart Energy

SESSIONS

- **FTF-SEG-F0207 The Smart Grid: Market and Solutions Overview (THIS SESSION)**
- FTF-SEG-F0041 Electricity Meter Solutions
- FTF-SEG-F0186 Residential Smart Energy, Part 1: Coming Soon to a Home Near You
- FTF-SEG-F0185 Residential Smart Energy Solutions, Part 2: The Technical Detail
- FTF-SEG-F0141 Metering and the Smart Grid Roadmap: Last Mile and Home Area Networking
- FTF-SEG-F0198 Smart Energy 2.0: Protocols and Their Applications
- FTF-SEG-F0092 Hands-on Workshop: ZigBee® Smart Energy Application Development with BeeKit Technology
- FTF-SEG-F0192 Security Solutions: Security of the Smart Grid and Critical Infrastructure
- FTF-SEG-F0221 Xtrinsic Sensing: Application of Tamper Detection for Smart Metering, Part 3, Option E
- FTF-IND-F103 Industrial Control and Networking Trends and Roadmap
- FTF-IND-F0107 Industrial Network Protocols - Part 1: EtherCAT Industrial Ethernet Protocol
- FTF-IND-F0176 Power Conversion, Part 1: Trends and Roadmap Overview
- FTF-IND-F0105 Industrial MCUs Based on Power Architecture® Technology
- FTF-IND-F0219 Wireless Connectivity, Part 2: Sub-GHz Industrial Solutions
- FTF-IND-F0183 QorIQ Qonverge Solutions for Aerospace/Defense and Smart Grid Applications
- FTF-CSD-F0139 M2M Connectivity for Smart Energy and Home Automation Applications

PANEL DISCUSSION/ LUNCH n Learn

- FTF-SEG-0163 Panel: Current and Future Smart Grid Trends
- FTF-IND-F0166 Panel: Security of the Smart Grid and Critical Infrastructure
- FTF-CSD-F0167 Panel: The Business Models Needed for Building Today's Connected Home
- FTF-SEG-F135 Lunch and Learn: Industrial Network Protocols, Part 2: Smart Energy and Factory Automation Solutions with QorIQ Processors

Check Out Smart Energy Demos at FTF Techlab!

Home Energy Manager

i.MX28 HEM + M30 Meter + Develco Plug - demo energy management, zigbee connectivity, metering

Renewable Energy & Connectivity Demo with Low-cost Display

IHED + Solar Panel / inverter – demo energy monitoring, mbus communications, PV inverter from Future Energy solutions (Freescale Distribution Partner)

Smart Meters

Prepaid Meter/ 2ph - 3ph with Tamper Proof Meter/Smart Secure Connected Meter

Grid Infrastructure Demos

P1025 Data Concentrator

Ethercat solutions for Grid and Industrial networks

QORIQ Ethercat Master and Kinetis EtherCAT Slave”

- Tower QorIQ (Ethercat Master)
- Kinetis (Ethercat Slave layer 7 ported by IXsat)
- Beckoff Programmable Logic Controller (Ethercat Slave)

In Connected Home section

- Networked Smart Gateway: Embedded smart elements (phone, security, HEM, meter, thermostats) into the home

Industrial Wireless Enablement demo

