Freescale Powering Innovation

Internet of Things/M2M, Wireless Smart Gateways, and EDA - Next Big Thing

Kwok Wu, PhD
Head, Embedded Software and Systems
Freescale Semiconductor

Post-Mobile Era
Internet of Thing (IOT)
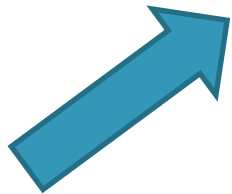
Mobile Internet Access

Post-PC Era

Oct 2012

Internet of Things/M2M and Wireless Smart Gateways

- Motivation
  - Machine-to-Machine (M2M) & Internet of Things (IOT)
  - Wireless sensor network (WSN)
    - Zigbee, Wifi PAN
    - WiDi – WiFi Direct – streams HD1080p & 5.1 Surround sound (Wireless HDMI)
    - Power Efficiency: Standard based IP platform

- IOT & Wireless Smart Gateways Applications
  - Smart Energy: Smart Grid (NAN) and Smart Connected Home (HAN)
  - Smart health monitoring, Safety/security
  - Smart connected cars, transportation/Logistics

- Sustainable Living

- Summary – Internet of Everything (IOE)

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Driving Force: IOT (Internet of Things), M2M Increase connected devices demand

- Smart Converged Connectivity Integration

M2M (Machine-to-Machine), IOT (Internet of Things)

Computing Growth Drivers Over Time, 1960-2020

INCREASING INTEGRATION

Smart phone

Tablet Smart Mobile Device (SMD)

Mobile Consumer
10B + Units

10B -> 50B connected devices by 2020

Cell Phone/ Desktop Internet
1B + Units / Users

PC
100mm + Units

Minicomputer
10mm + Units

Mainframe
1mm + Units

Smart Appliances (TV, Energy Meters)

Devices / Users (mm in Log Scale)

1,000,000
100,000
10,000
1000
100
10
1

1960 1970 1980 1990 2000 2010 2020

Source: ITU, Mark Lipacis, Morgan Stanley Research

Mobile Traffic 5X in 3 years

2012: 1.2EB
2015: 6.3EB

(EB –Exabyte/month)

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Trusted Services for Connected World

Cloud-based services

**Smart cloud services
via secured, efficient, converged networking**

Smart Networks
Wireless & Wired

3G
4G
LTE

**Residential/
Mobile**

**Industrial,
Energy**

**Enterprise
& SMB**

**Virtualized
Multicore
Resources**

*10B (to 50B) mobile
connected devices by 2020**

Smart networking backbone for trusted service delivery

**Source ITU, Morgan Stanley
**Source Gartner*

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Motivation for M2M, IOT

- M2M – Connected objects (communicate wired or wireless)
- IOT – Smart Physical objects seamlessly integrated

  cloud connected information network,

  (network of smart collaborative agents/objects)

  analyze data into information & knowledge, make decision & take action
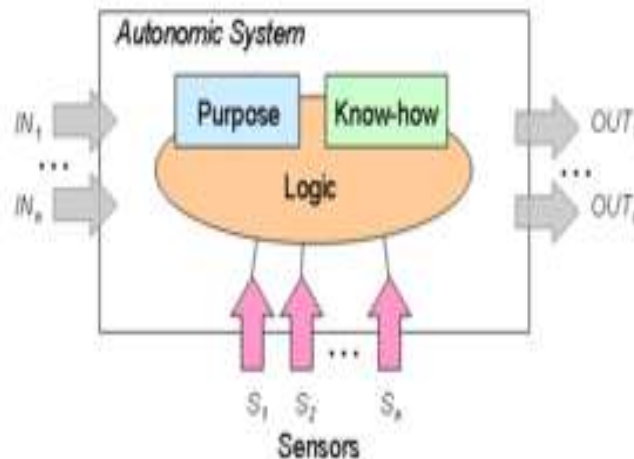
RF Wireless Data Rates (Performance) & Ranges

Peak Data Rate (Performance) — vertical axis (Faster / Slower)

Range — horizontal axis (Closer / Farther)

Video

Data

Voice

Monitoring & Control

Wireless Video Applications

WAN

WLAN

UWB

802.11g/n /AC

Medium Power

(Medium Cost)

Wireless Data Applications

IrDA

802.11a

Wi-Fi®

Medium-Power
(Low- Cost)

802.11b

Smart Converged Gateway

4G

2.5G/3G

WiDi (wiFi Direct)

WiFi PAN

BT (LE)

Bluetooth™

Cellular

3G/4G BB

NFC   RFID

Sub-GHz Sensors

High-Power
(High Cost)

Low Data-Rate Transfer

ZigBee™

WSN

Low-Power

Wireless Sensor Networking

(Long Battery Life

Low Cost)   WSN (PAN)

Mesh Network

Low-Power
(Long Battery Life, Medium Cost)

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RF Radios Communication Technologies

Communication Technologies

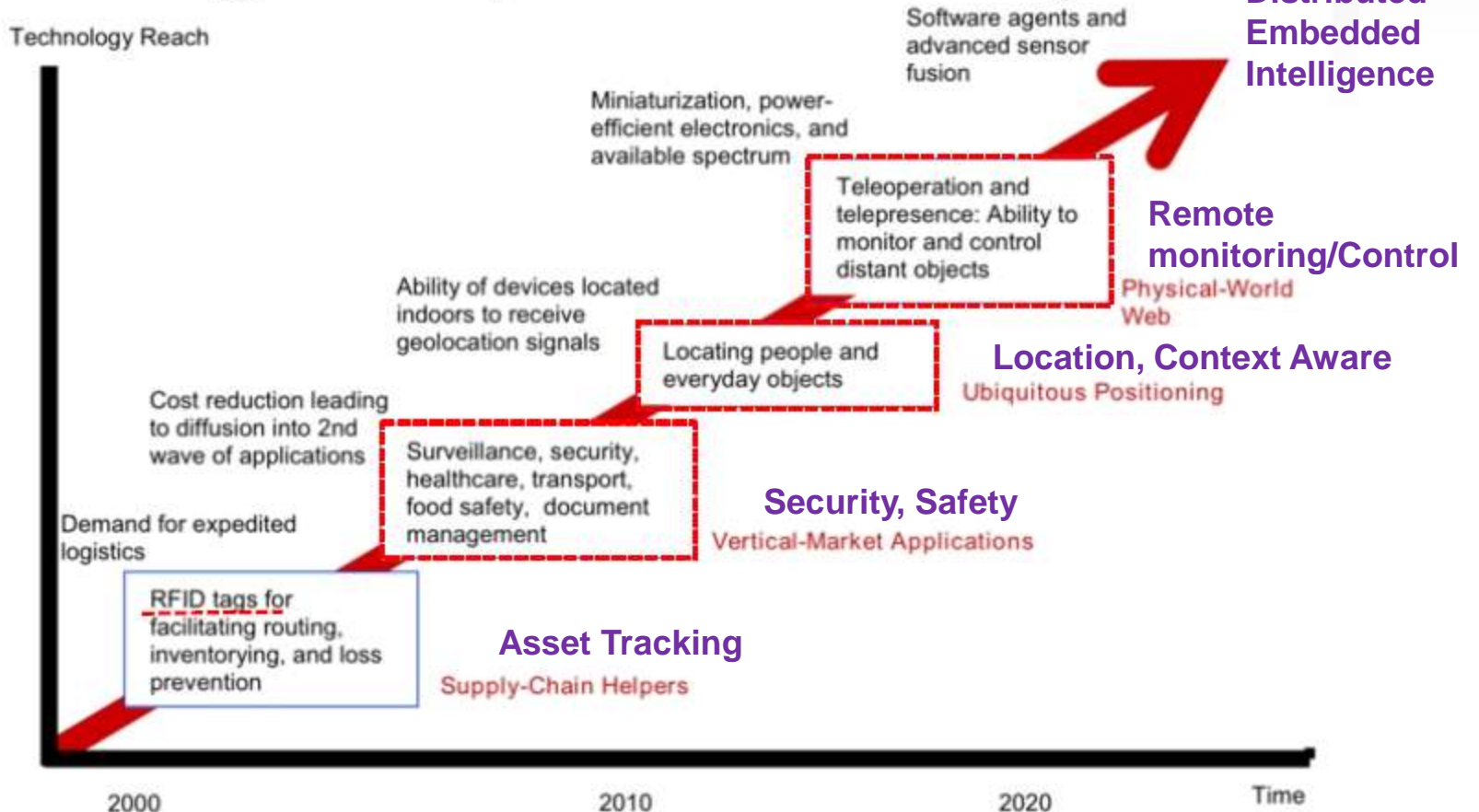|	NFC	RFID	Bluetooth®	Bluetooth® LE	ANT	Proprietery (Sub-GHz & 2.4 GHz)	Wi-Fi®	ZigBee®	Z-wave	KNX	Wireless HART	6LoWPAN	WiMAX	2.5–3.5 G
Network	PAN	PAN	PAN	PAN	PAN	LAN	LAN	LAN	LAN	LAN	LAN	LAN	MAN	WAN
Topology	P2P	P2P	Star	Star	P2P, Star, Tree Mesh	Star, Mesh	Star	Mesh, Star, Tree	Mesh	Mesh, Star, Tree	Mesh, Star	Mesh, Star	Mesh	Mesh
Power	Very Low	Very Low	Low	Very Low	Very Low	Very Low to Low	Low-High	Very Low	Very Low	Very Low	Very Low	Very Low	High	High
Speed	400 Kbs	400 Kbs	700 kbs	1 Mbs	1 Mbs	250 kbs	11-100 Mbs	250 kbs	40 Kbs	1.2 Kbps	250 kbs	250 Kbs	11-100 Mbs	1.8-7.2 Mbs
Range	<10 cm	<3 m	<30 m	5-10 m	1-30 m	10-70 m	4-20 m	10-300 m	30 m	800 m	200 m	800 m (Sub-GHz)	50 km	Cellular network
Application	Pay, get access, share, initiate service, easy setup	Item tracking	Network for data exchange, headset	Health and fitness	Sports and fitness	Point to point connectivity	Internet, multimedia	Sensor networks, building and industrial automation	Residential lighting and automation	Building automation	Industrial sensing networks	Senor networks, building and industrial automation	Metro area broadband Internet connectivity	Cellular phones and telemetry
Cost Adder	Low	Low	Low	Low	Low	Medium	Medium	Medium	Low	Medium	Medium	Medium	High	High

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IOE – Internet of Everything

Technology Roadmap: The Internet of Things

Technology Reach

Software agents and advanced sensor fusion

Autonomous, Distributed Embedded Intelligence

Miniaturization, power-efficient electronics, and available spectrum

Teleoperation and telepresence: Ability to monitor and control distant objects

Remote monitoring/Control

Physical-World Web

Ability of devices located indoors to receive geolocation signals

Locating people and everyday objects

Location, Context Aware

Ubiquitous Positioning

Cost reduction leading to diffusion into 2nd wave of applications

Surveillance, security, healthcare, transport, food safety, document management

Security, Safety

Vertical-Market Applications

Demand for expedited logistics

RFID tags for facilitating routing, inventorying, and loss prevention

Asset Tracking

Supply-Chain Helpers

2000   2010   2020   Time

Source: SRI Consulting Business Intelligence

Freescale Reference Designs Solutions for IOT & Wireless Smart Gateways

WLAN EAP

OpenFlow Switch

SmartNIC

C29x PKE

Security Appliance

Networked Smart Gateway Smart Energy Gateway

Factory Automation

Multiservice Gateway

Right Partners

Accelerated Time to Market

Right Platforms (Eval systems, Ref Designs)

Turnkey SW (VortiQa and others)

Best Processors (QorIQ Chip)

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Faster Time to Market with Key ODM Turnkey Designs

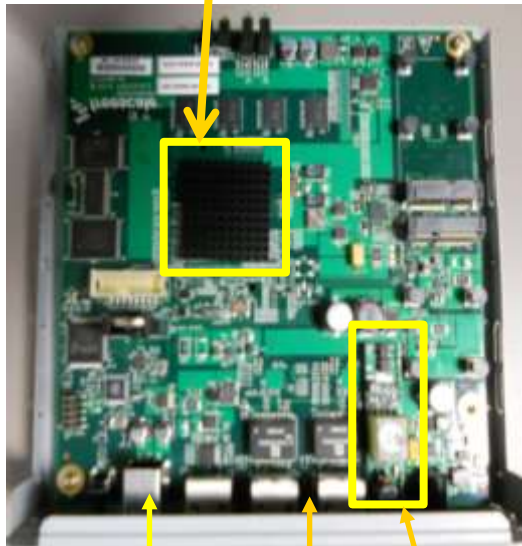| Best Processors	Turnkey Software	Key Platform	Right Partners
Freescale QorIQ Processors	VortiQa Software Security Applications	Optimized Reference Design	ODM Integration Partners

Freescale Reference Designs

Sample of ODM Partners

- Accton
- Alpha Networks
- Senao
- Sercomm
- USi
- Wistron / Neweb

QorIQ P1 Family Processors

2 x USB 2.0 **2 x GbE** **PoE Module**

P1020 WLAN
Reference Platform

P1023 WLAN
Reference Platform

Power Architecture™ – Powering the Embedded World & Internet of Everything (IOE)

P1022RDK, P1020MBG

Smart Telehealth Gateway
-Remote Diagnosis (Sonogram,)
- Remote surgery HD video
- stream EMS data

Health Care

Aerospace and Defense

Smart Energy

Power

Industrial Automation and Control

Automotive

8308nSG

Home Automation

Smart Home Gateway
HAN: nSG, HEG

Networking
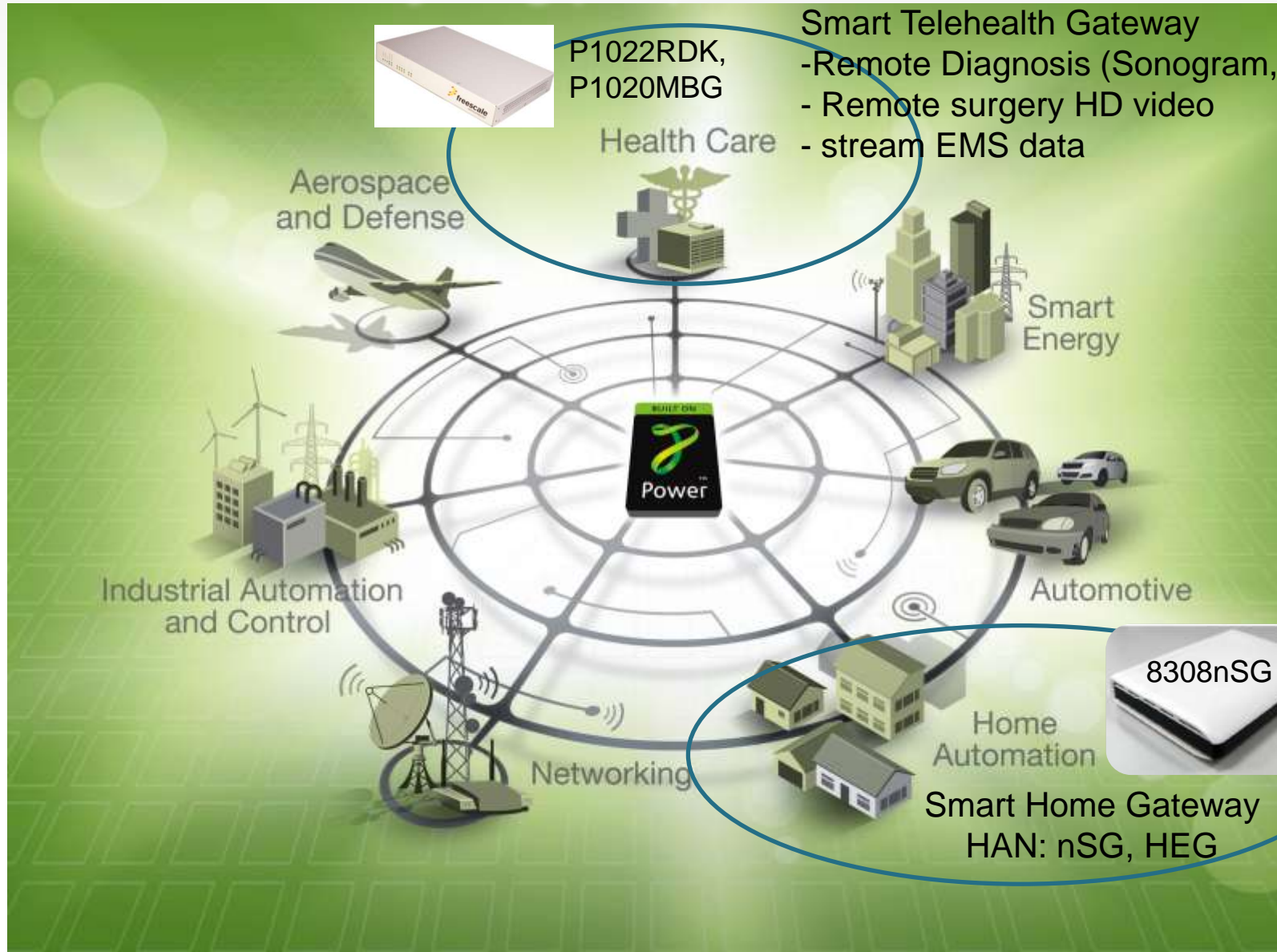
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Smart Connected Home

Energy

Safety, Security

Automation

Smart Connected Home – Smart Home Gateway

Home Energy Gateway in the Home Area Network

The Home Energy Gateway:
- collects power consumption data from various sources
- manages demand/response policies
- controls activation/deactivation of HAN appliances
- generates dashboards to provide feedback about power usage
- provides control menus to control appliances
- provides an ubiquitous link to the WAN for remote control/readout
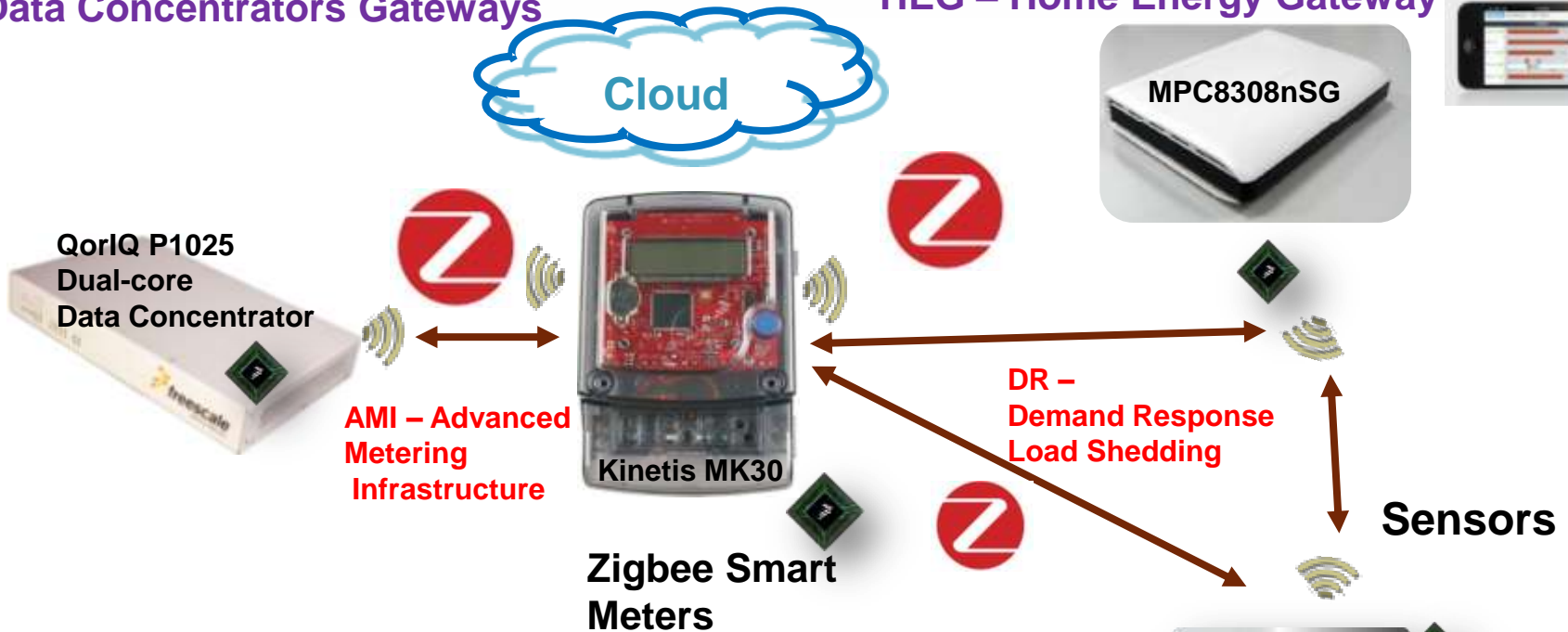
Smart Mobile Devices

Freescale Smart Energy
Wireless sensor network (WSN) & Smart Gateways for NAN, HAN

NAN – Neighborhood Area Network
Data Concentrators Gateways

HAN – Home Area Network
HEG – Home Energy Gateway

Cloud

MPC8308nSG

**QorIQ P1025
Dual-core
Data Concentrator**

Kinetis MK30

**AMI – Advanced
Metering
Infrastructure**

**DR –
Demand Response
Load Shedding**

Sensors

**Zigbee Smart
Meters**

For remote metering, energy management,
building control and automation.

Smart Thermostat

Kinetis K40 HED
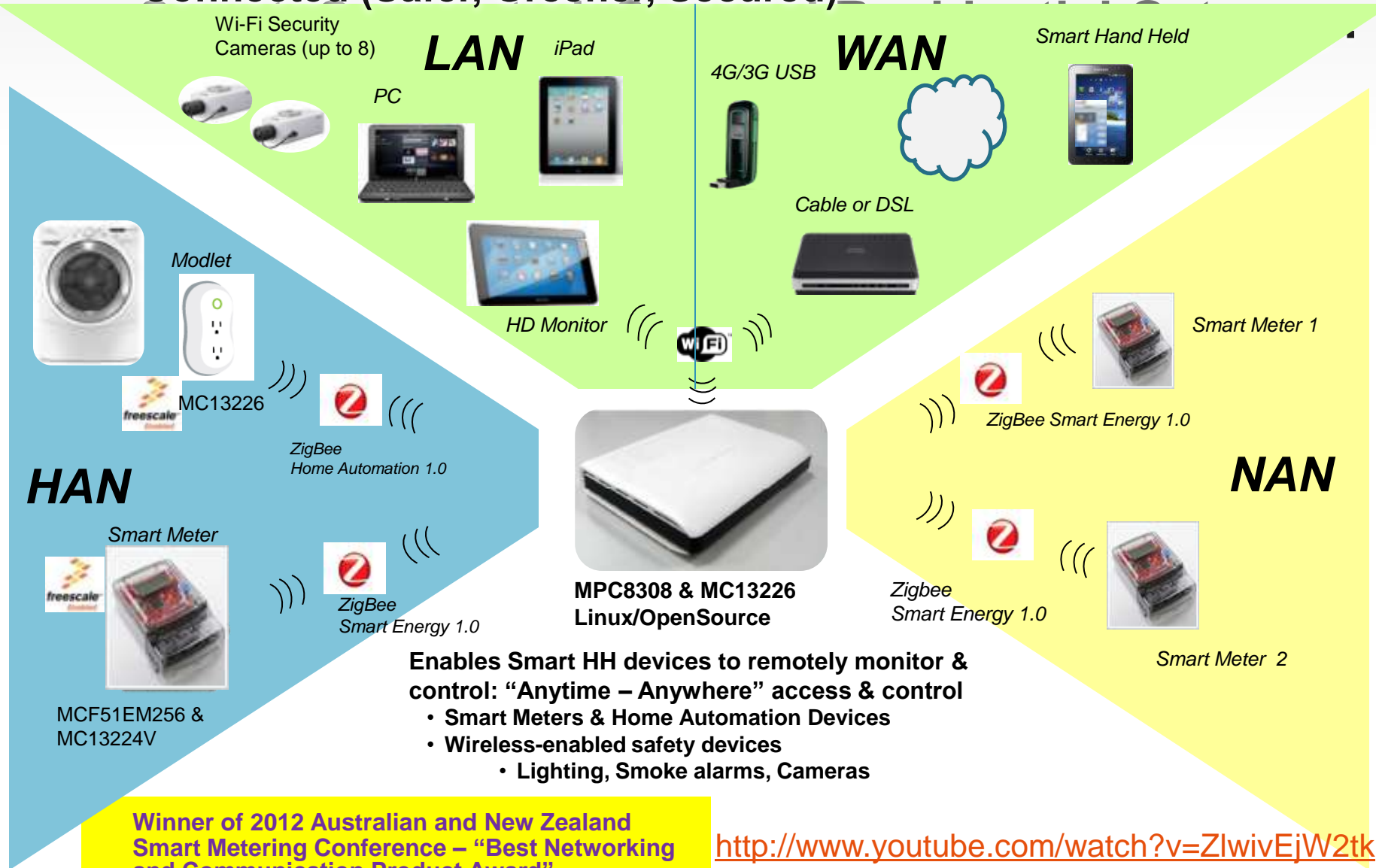
Up to several hundred meters

**i.Mx28 Programmable Communicating
Thermostat (PCT) or Kinetis K40 HED**

www.nest.com

Residential/Mobile Smart Converged Gateway: 8308nSG – Connected (Safer, Greener, Secured)

Wi-Fi Security Cameras (up to 8)

LAN

iPad

PC

4G/3G USB

WAN

Smart Hand Held

Cable or DSL

Modlet

HD Monitor

MC13226

ZigBee Home Automation 1.0

HAN

Smart Meter

ZigBee Smart Energy 1.0

MCF51EM256 & MC13224V

MPC8308 & MC13226 Linux/OpenSource

Smart Meter 1

ZigBee Smart Energy 1.0

NAN

Zigbee Smart Energy 1.0

Smart Meter 2

Enables Smart HH devices to remotely monitor & control: "Anytime – Anywhere" access & control
- **Smart Meters & Home Automation Devices**
- **Wireless-enabled safety devices**
  - **Lighting, Smoke alarms, Cameras**

Winner of 2012 Australian and New Zealand Smart Metering Conference – "Best Networking and Communication Product Award"

http://www.youtube.com/watch?v=ZlwivEjW2tk

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What make's Nest Smart Thermostat Smart?

- Cloud connected control by smart mobile devices anytime, anyplace, on-demand (anytime, always-on)
- Adaptive – learning, auto-scheduling, auto-away
  - Sensors – temperature, humidity, ambient light, activity (motion)
  - How does it knows one is not just going in & out to the backyard?
- Context aware – weather aware etc

- Make it smarter – Ambient Intelligence?
  "EveryWare"
  - More context aware – presence of specific person, Who, Where, When
  - Personalized
  - Arbitration
  - Anticipatory (sense discomfort level, sweating, mood etc)
  - etc.

- Ubiquitous Computing: Smart Connected Objects with Smart information processing
  - Remote Smart Garage Door, other Smart Doors (Hotel, Car, Home etc)
  - Etc.

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IOT and MCC- Mobile Cloud Computing

Smart Mobile Devices (SMD)

On-Demand Remote monitoring & Control
(via Smart Phones, Smart Tablets)

Knowledge-Dirven Action

Global Cloud

Information Network

Knowledge

Information

Big Data

Local Cloud
Smart Wireless Gateways

Smart Mobile Devices (SMD)

Other Smart Objects

Remote Garage Doors

Smart Thermostat
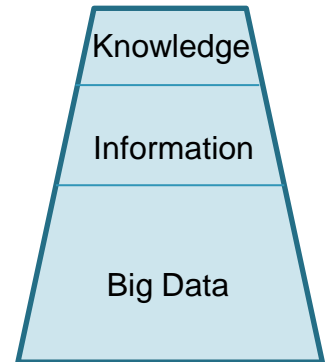
1. Sense,

AAA -
2a. Analyze
   2b. Adapt
3. Action: Control

Augmented Reality

Other Smart Doors:
Car, Hotel, Home Doors

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8308nSG Networked Smart Gateway (NSG)

Key Features:

- **Multiple Applications in Single Architecture**
  - Wireless HD media gateway
  - Home security & safety surveillance
  - Smart energy
  - Home automation & management (M2M)

- **Seamless Wireless Connectivity (TCP/IP, 802.11n, ZigBee)**
  - Smart metering connectivity via SE 1.0 or MBus
  - Smart appliance management via ZigBee HA1.0
  - Anytime/Anywhere access via internet connected devices

- **Integration of four essential software stacks**
  - TCP/IP - Broadband WAN/LAN connectivity
  - ZigBee Home Automation 1.0 Profile
  - ZigBee Smart Energy 1.0 Profile
  - Web-based GUI (Java) for Ease of Use

- **Fully ready for Mass Production NOW**
  - Freescale owned hardware & software
  - Solid hardware partnerships
  - Several ODMs are engaged
  - Traction with several consumer & utility OEMs
  - Branding, value and eCommerce enabling platform

Ordering Information:
P/N: MPC8308-NSG
KIT price: $349.00 USD

Includes:
- ✓ Free Schematics/Orcad & Gerbers
- ✓ Free OpenWRT software
- ✓ Complete cBOM available

Winner of 2012 Australian and New Zealand Smart Metering Conference – "Best Networking and Communication Product Award"

http://www.youtube.com/watch?v=ZlwivEjW2tk

Other M2M market Applications: Smart Health monitoring, safety/security

Health Monitoring Platform and other markets

Sensors for other markets: e.g. safety/Security, smoke/temp sensor, motion sensor Image sensor – video surveillance etc
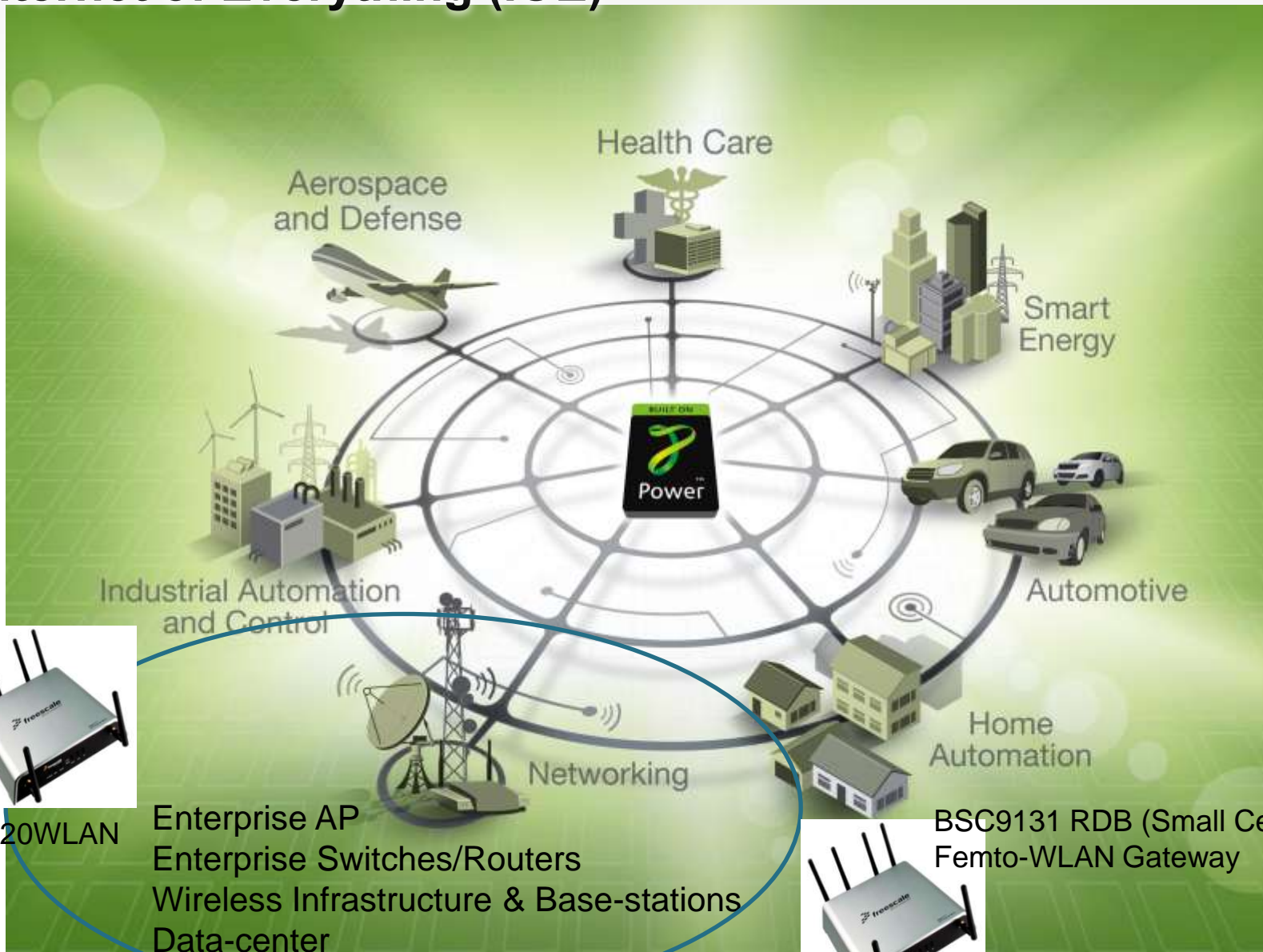
Smart Hand Held

Health DB

i.Mx53Tablet with JavaFx

Cloud

WiFi Ethernet

Home Health Gateway i.MX28 with Java VM, SE

WiFi

HOME AUTOMATION

Smart Converged Connected Gateways Platform
Smart Plugs (ThinkEco)
Smart Appliances
Safety/Security
Lighting Control
Local Display, iHED, Smart Thermostat (www.nest.com)
HD Media Streaming (BT, WiDi)

3G/4G

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TELE-HEALTH

868MHz RF

Bluetooth HDP

Bluetooth SPP

Bluetooth Low Energy

HHH Panic Alarm MC12311

Blood Glucose Meter

MC9S08GP32

Thermometer

Blood Pressure Monitor

Weight Scale

	Wired connection
- - -	Wireless connection
	Medical monitoring
	WWW connection

2012 EE Times ACE Award – Best Reference Design of the Year

Confidential and Proprietary

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Power Architecture™ – Powering the Embedded World & Internet of Everything (IOE)
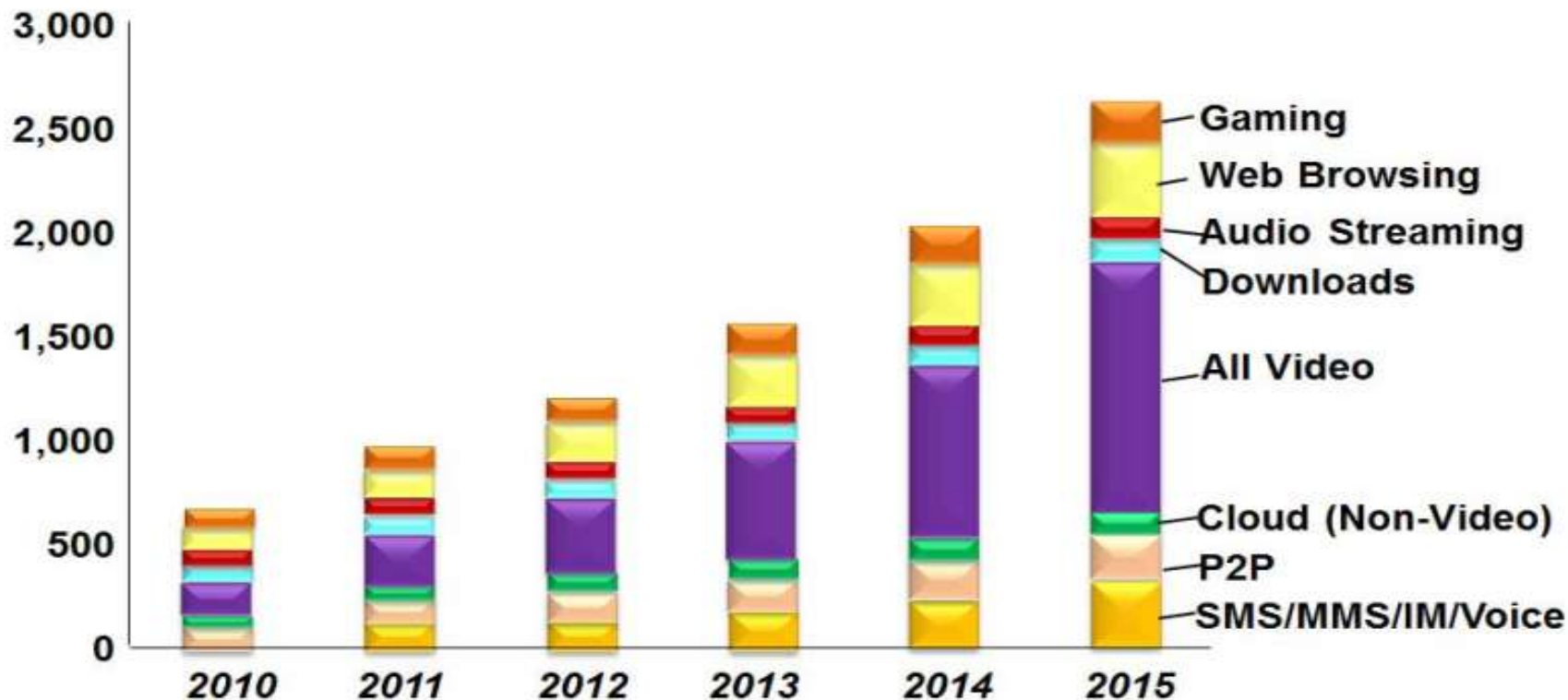

P1020WLAN

Enterprise AP
Enterprise Switches/Routers
Wireless Infrastructure & Base-stations
Data-center

BSC9131 RDB (Small Cell)
Femto-WLAN Gateway

Voice/SMS moved to Data Services

Mbps/month/user

Legend (top to bottom):
- Gaming
- Web Browsing
- Audio Streaming
- Downloads
- All Video
- Cloud (Non-Video)
- P2P
- SMS/MMS/IM/Voice

Y-axis: 0, 500, 1,000, 1,500, 2,000, 2,500, 3,000

X-axis: 2010, 2011, 2012, 2013, 2014, 2015

Single user monthly data consumption forecast (source: Alcatel-Lucent)

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Telehealth: High-Performance Multi-core, Multi-Service Gateway (P1020MBG)

Display, Streaming Media

3G/ 11na 11ac

Remote Access Device

802.11n And 802.11ac

11n, 11ac

WLAN IP Camera (wired, wireless)

P1025 Tower

Connection to Energy Gateway

g.729

g.729

VoIP Call

ZigBee

Zigbee- WSN Wireless Sensor Network

Winner of 2011 Broadband World Forum: Infovision Award - "Freescale Secure Broadband Gateway (based on QorIQ) speed time to market"

http://www.youtube.com/watch?v=5Ni0tbZk8 aQ

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MSG (Multi-Service Gateway) Cloud Applications Platform
OpenSource Linux openWRT – Linksys WRT54G, Netgear WGR614

Gateway

Unified Communication

Security

Multi-Service Core Functions

Collaboration / Conferencing

Office Services (email / fax / print)

Management Dashboard

VoIP / IP-PBX

WLAN

- Representative Features:
    - Audio conferencing
    - File sharing and collaboration
    - Web conferencing
    - Remote access to call forwarding
    - Web access to both voicemail and email
    - Email fax

    – Video conferencing
    – Click to call from email
    – Instant Messaging in a conference
    – Presence management
    – Text to voice (email into a voicemail)
    – Telepresence

Also review Java-based OSGI – Open System Gateway Initiative

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Enterprise AP-WLAN Turnkey Reference Solution

- Complete turnkey hardware and software (P1020WLAN)
  - Proven Opensource OpenWRT application
  - BOM-optimized, production-ready systems from leading ODMs

- Power Over Ethernet (POE) eliminates the need to run 110/220 VAC power to wireless access points

- Single & dual-core solutions for a wide range of products at varying price points, P1010 Trusted Boot

P1020WLAN

Feature	Comment
O/S, BSP	Linux 2.6.xx or later with redundant boot process from FLASH
Wireless Wi-Fi	*802.11ac*, 802.11 a/b/g/n compatible, AP Repeat/bridging (multiple APs WDS), **802.11s wireless mesh planned**
Wireless Modules	Broadcom, Atheros and Ralink
Wireless Security	PSK, WEP, WPA2, ipv4/ipv6 authentication with Radius (w/ Ralink RT3092 Wi-Fi)
System Config & Mgmt	Browser based, TFTP: FTP & Telnet, System config restore in FLASH
TR-069	**TR-069 based remote configuration & management (Planned)**
Protocols	IPv4 and **IPv6**, **RIP v1/v2,** TCP/IP, UDP, PPTP, PPPOE, DMZ, VLAN, Bridging, NAT/PAT, IGMP, VPN , Firewall, ACL, IDS
UPnP	Open Source SDK with configuration interface and integration
DHCP	DHCP Client, DHCP Relay Agent, DHCP Server
DNS	DNS Relay, Dynamic DNS

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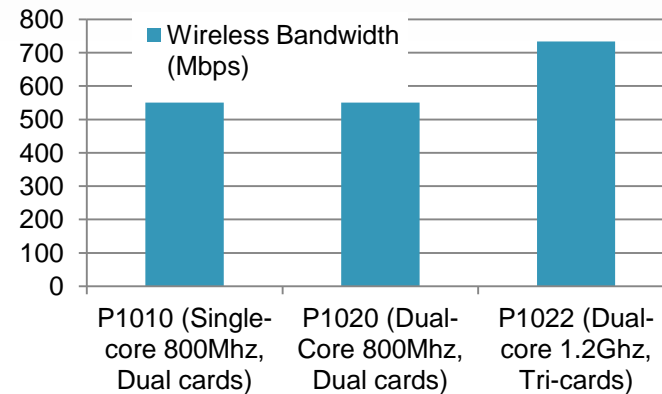
Freescale Enterprise AP-WLAN –Value Leadership Performance Efficiency: Performance/Watt/Dollar 802.11n, 11AC 3x3MIMO, DBDC, DBTC

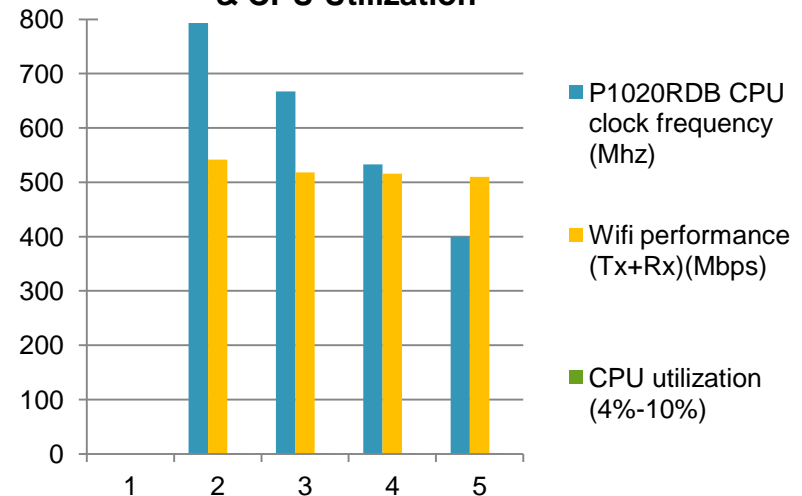## Scalable Offerings for WLAN

Device	P1020	P1010 / P1014	P1017/ P1023	P1013/ P1022
Cores	Dual	Single	1-2	1-2
Max MHz	800	1000	800	1200
SoC Power (W)	2.6	3.0	2.54	4.04
System Power	3.6	3.8	3.14	4.83
Hardware Offload	SEC	SEC, Trust Arch, RAID, SATA	SEC, MACsec, CAPWAP, DTLS	SEC, RAID, SATA, Power Mgmt
# WiFi Cards Supported	2	2	3	3

Wireless Bandwidth (Mbps)

Bar chart legend: Wireless Bandwidth (Mbps)

Categories:
- P1010 (Single-core 800Mhz, Dual cards)
- P1020 (Dual-Core 800Mhz, Dual cards)
- P1022 (Dual-core 1.2Ghz, Tri-cards)

WiFi Performance, Core MHz, & CPU Utilization

Legend:
- P1020RDB CPU clock frequency (Mhz)
- Wifi performance (Tx+Rx)(Mbps)
- CPU utilization (4%-10%)

Power Efficiency – mW/MHz & Power/Watt/Dollar

- Design A (1.5Ghz) delivers 1.5X performance over Design B (1Ghz),
  - Finish in 66% of the clock cycles than design B

  if Design B consumes k mW/clock cycle

  and Design A consumes (10% more power/cycle) 1.1k mW/clock cycle

- If Design B completes in 100 clock cycle, uses 100k mW

  then Design A completes in 66 clock cycle, uses =66.6*1.1 =73k mW

- Power efficiency: Design A uses 73% of energy than Design B

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New Connection Model for Mobiles

Cellular

Seamless hand off between 3GPP and WiFi Networks
[3GPP TS23.261 Rel10]

HotSpot2.0

WiFi

Seamless interworking between networks and hand off
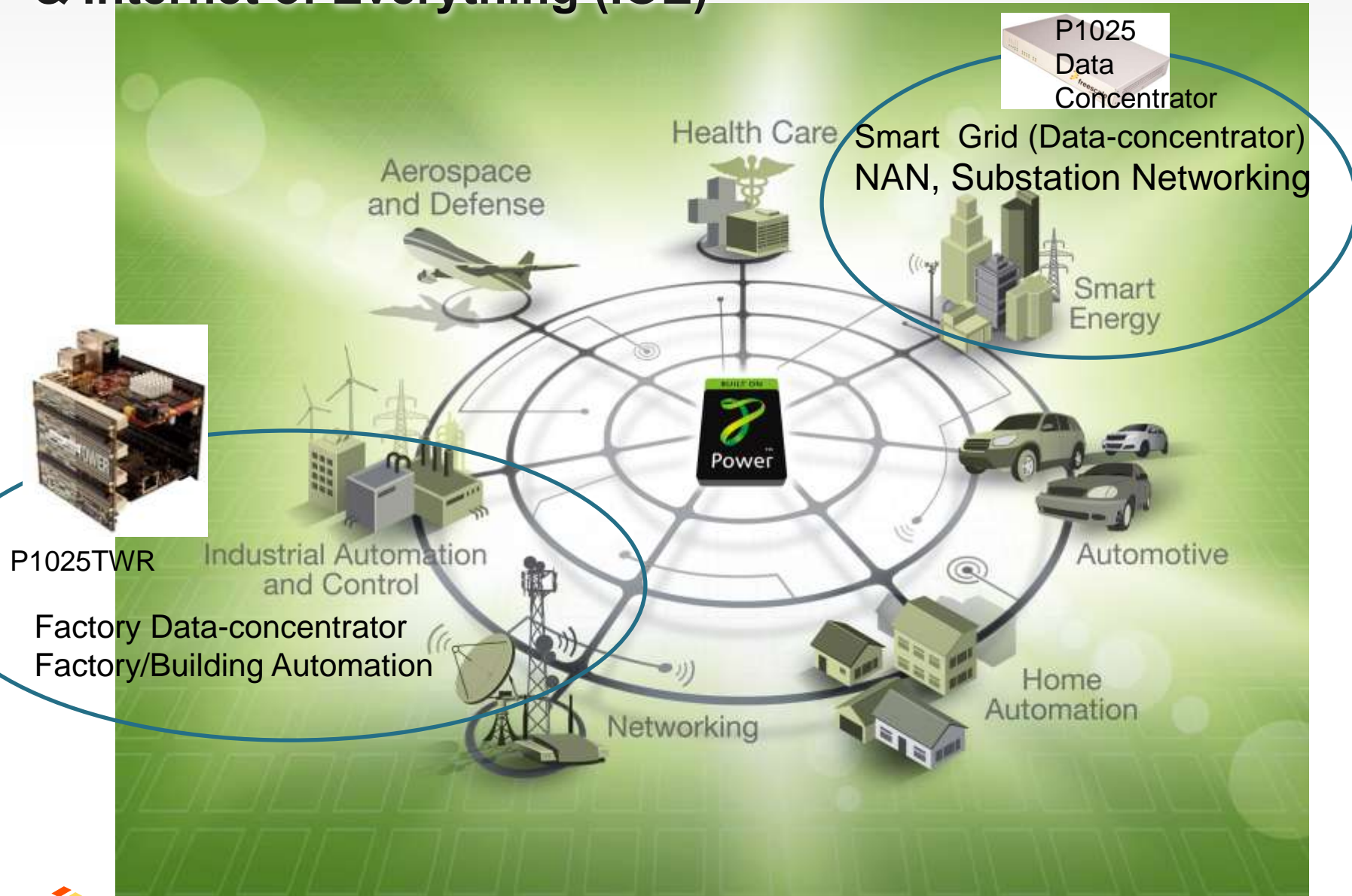[IEEE 802.11u]

SIM based **A**uthentication **A**uthorization and **A**ccounting
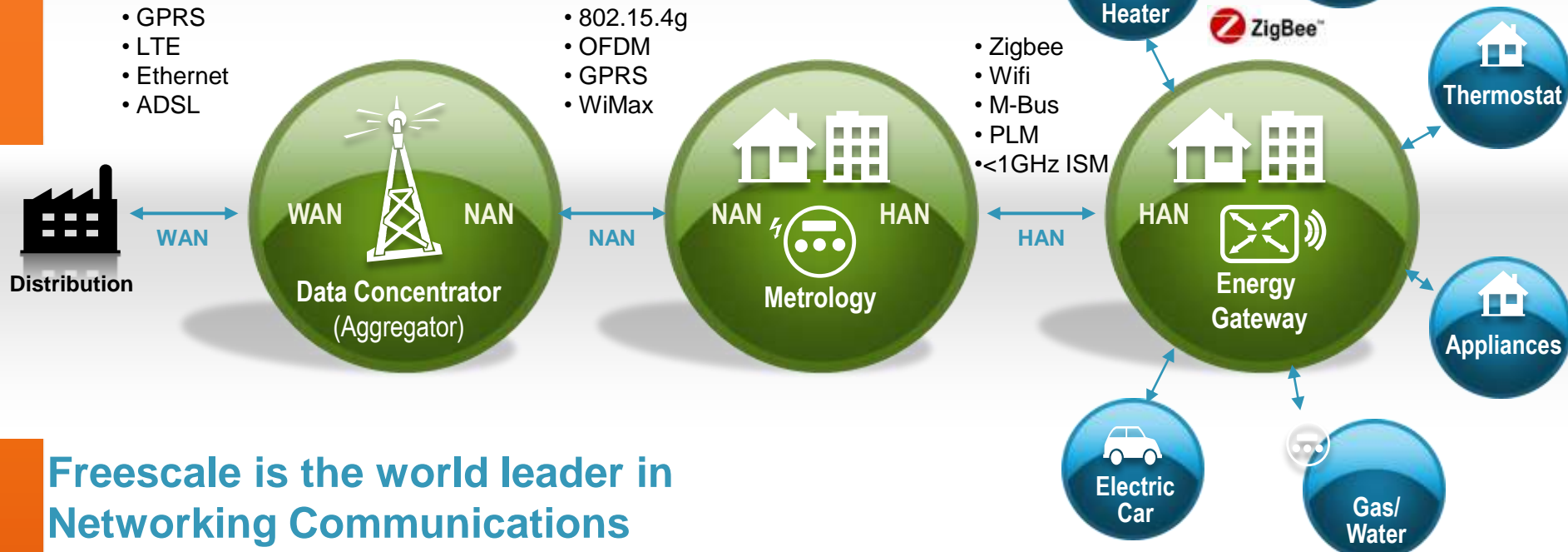[IEEE 802.1X]
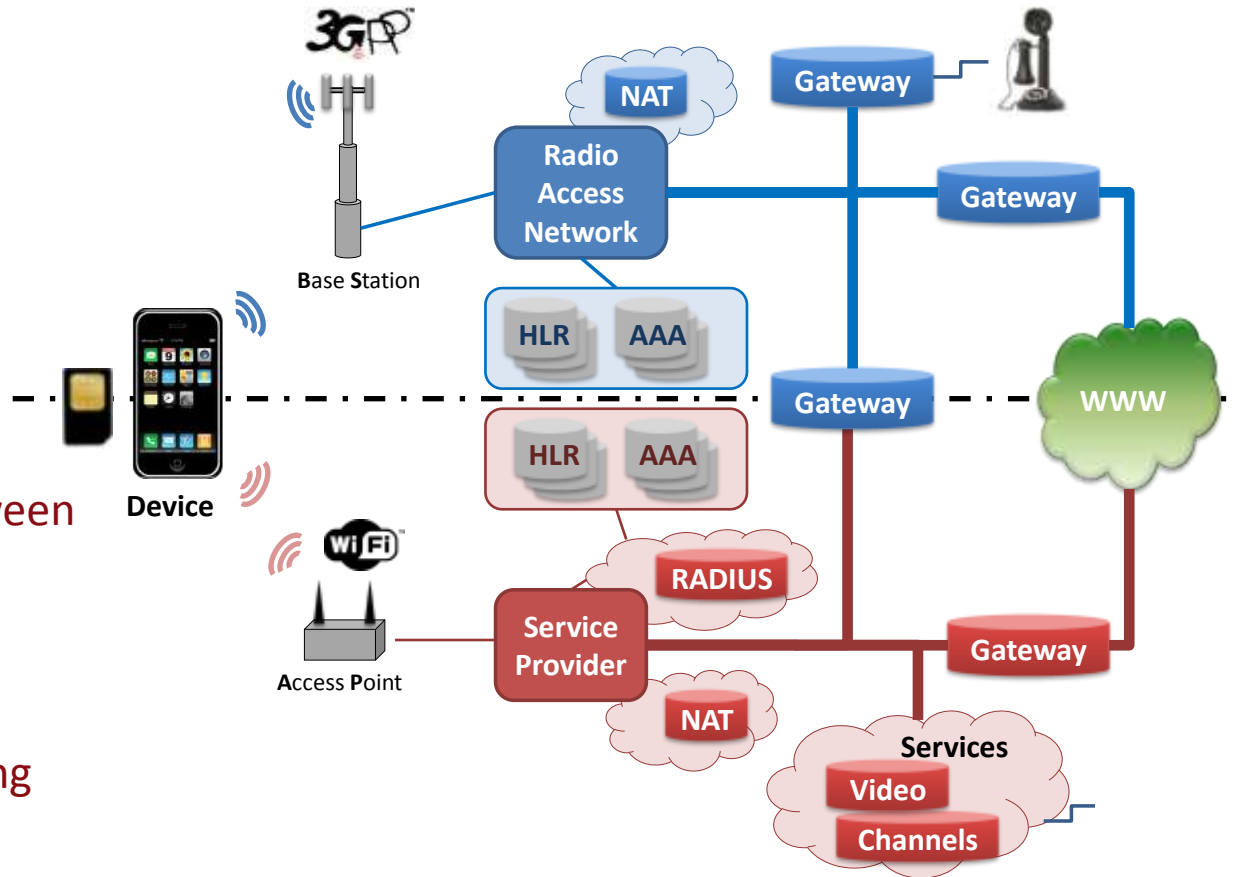
- **Bandwidth where needed**
- **Lower cost infrastructure and back haul**
- **Efficient spectrum usage**

Femto-cell (Small Cell) - Femto-WLAN Gateway

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Power Architecture™ – Powering the Embedded World & Internet of Everything (IOE)

P1025
Data
Concentrator

Smart Grid (Data-concentrator)
NAN, Substation Networking

Health Care

Aerospace and Defense

Smart Energy

P1025TWR

Factory Data-concentrator
Factory/Building Automation

Industrial Automation and Control

Automotive

Networking

Home Automation

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Freescale in Smart Energy

Cloud

- GPRS
- LTE
- Ethernet
- ADSL

- 802.15.4g
- OFDM
- GPRS
- WiMax

- Zigbee
- Wifi
- M-Bus
- PLM
- <1GHz ISM

Distribution

WAN

Data Concentrator (Aggregator)
WAN — NAN

NAN

Metrology
NAN — HAN

HAN

Energy Gateway
HAN

ZigBee

Hot Water Heater

Renewable Energy

Thermostat

Appliances

Electric Car

Gas/ Water

Freescale is the world leader in Networking Communications

Grid Power Protection, Relay/Switch Control and Monitoring
Grid Power supervision, control and network protection system solutions; Protective Relays and Switches control for Power Grid

NAN (Neighborhood Area Network), Data Concentrator (Aggregator):
Sends data collected (or commands) to and from Neighbor Area Network (NAN) or Home Area Network (HAN) to utility

Metrology:
Hardware that measures and controls flow of energy to/from building

HAN (Home Area Network):
Wireless or wired network used for load control and dynamic response by utilities
- Electric meter communicating with T-Stats, appliances, water heaters, pool pumps, electric hybrids, etc. (Load Control)
- Send pricing signals to consumers for smarter energy consumption (Demand Response)

Challenges: Multiple meter vendors, with various devices and message API and various tranceivers and remote provisioning ease of deployment
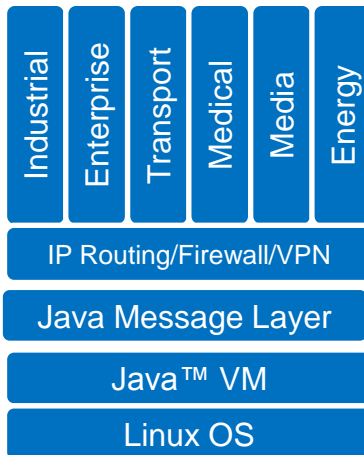
30

QorIQ P1025 Data Concentrator

P1025 Data Concentrator

- Advanced Metering Infrastructure (AMI), bi-directional real-time monitoring and control
- Communicates with smart metering devices via the industry standard device language message specification (DLMS) (IEC 62056)
- **Zigbee wireless connectivity to meters and 3G BB to Utility server**

Smart industrial gateway—P1025 Data Concentrator

http://www.youtube.com/watch?v=nl3Jb1LHL44

Industrial	Enterprise	Transport	Medical	Media	Energy

IP Routing/Firewall/VPN

Java Message Layer

Java™ VM

Linux OS

Processor	• P1025 QorIQ processor 667MHz/800MHz dual core device • Capabilities for IEEE1588 time stamping and security acceleration
Connectivity & Functionality	• Serial line drivers for communication to power line communication controllers • 3G, WiMax or WCDMA communication via USB interface • 3 Giga-bit Ethernet capable ports to enable WAN/LAN communications • Time stamping capability (IEEE 1588 protocol) • Encryption communication capability leveraging the device's IPSEC security accelerator
Memory	• Up to 128 MB of NOR/NAND flash memory • Capability to interface to DDR2/3 memory up to 800MHz data rate
Enclosure and design	• Energy efficient passive cooled design, natural convection capable • Ruggedized, weather resistant construction
Next Release	• Sub-GHz and Power line communication (PLC) interfacing and protocol development

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Power Architecture™ – Powering the Embedded World & Internet of Everything (IOE)

Aerospace and Defense

Health Care

Smart Energy

Vehicle Networked Communication Gateway

Smart Connected Car V2V, V2I

Automotive

Industrial Automation and Control

Networking

Home Automation

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Smart Connected Cars (& Collaborative Computing)

- Active Safety, Accident avoidance (V2V, V2I)
- Wifi Peer-to-Peer (P2P) Mesh Networking **(DN's AP Mesh)**
  - 802.11p for V2V (Vehicle-to-Vehicle), V2I (Vehicle-to-Infrastructure)
- Car Tracking (Location, Speed etc); Logistics: Taxi, Truck etc
- Autonomous Car (Google Car)

Source: U.S. DOT

Sustainable Living

Sustainable Living

COMMUNICATIONS
wired and wireless, mobile, RF connectivity solutions (Bluetooth, WIFI, WiMAx, GPRS, ...), smartcards, telecommunications, secure communications, home networking equipment

CONSUMER
cameras, games, entertainment, radio, digital TV, electricity savings in home appliances through power management

AUTOMOTIVE
safety management, fuel efficiency, engine control sensors, entertainment

INDUSTRIAL
medical equipment, efficient solid state lighting, aerospace, smart metering, speed motor control, laboratory, test, control and measurements

DATA SERVERS & COMPUTERS
energy efficient data centres & servers, efficient memory applications, mainframe, peripheral office equipment and reduced power in personal computers

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Sustainable Living

- Smart Energy (Green) – Clean/Alternate Energy (Wind, Solar etc)
- Smart Environment – Clean Air, water (pollution sensors)
- Smart Health (monitoring)
- Smart iCare (Romba iRobot, WinBot, LawnBot …)
  - iCare: walk the Dog, water the plants etc
- Smart Connected Home
  - Smart TV, Smart Thermostat, Smart Garage Door, Smart Refrigerator…
  - Smart curtain, smart window (Dreamliner 787)

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Internet of Things/M2M: Smart Converged Gateway for Smart Cities

Summary – Internet of Everything (IOE)

Kwok Wu, PhD

Head, Embedded Software and Systems

Freescale Semiconductor

Oct 2012

Smart Objects and Smart Cities IOT, M2M)
Smart == Connected by collaborative Global and Local Clouds
Smart Converged Gateway Platforms (Smart Clouds, Smart Networks)

- Wireless
    - Wifi mesh-network
    - 3G, 4G
    - Wireless senor network (Zigbee mesh-network)
    - etc.

- Wired
    - PLC (Powerline Communication), HomePlug GreenPhy
    - Ethernet

Global Cloud
-Utility servers
-Remote applications
-Mobile connectivity

Local Cloud (s)

Smart Meters

SMD

Smart TV

Smart Appliances (HVACs, washers/Dryers)

Smart phone, tablets

Smart Plugs,
PCTs (Programmable Communicating Thermostat_
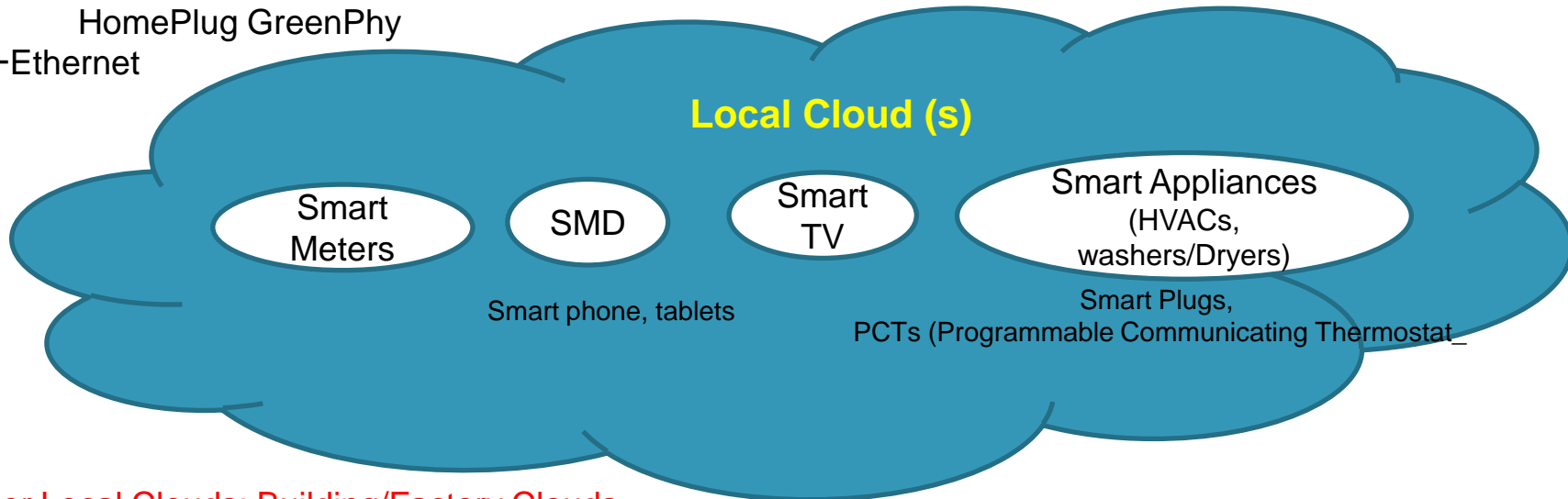
Other Local Clouds: Building/Factory Clouds
Office/Enterprise Clouds
Transportation clouds

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IOE – Internet of Everything

Technology Roadmap: The Internet of Things

Autonomous, Distributed Embedded Intelligence

Technology Reach

Software agents and advanced sensor fusion

Miniaturization, power-efficient electronics, and available spectrum

Teleoperation and telepresence: Ability to monitor and control distant objects

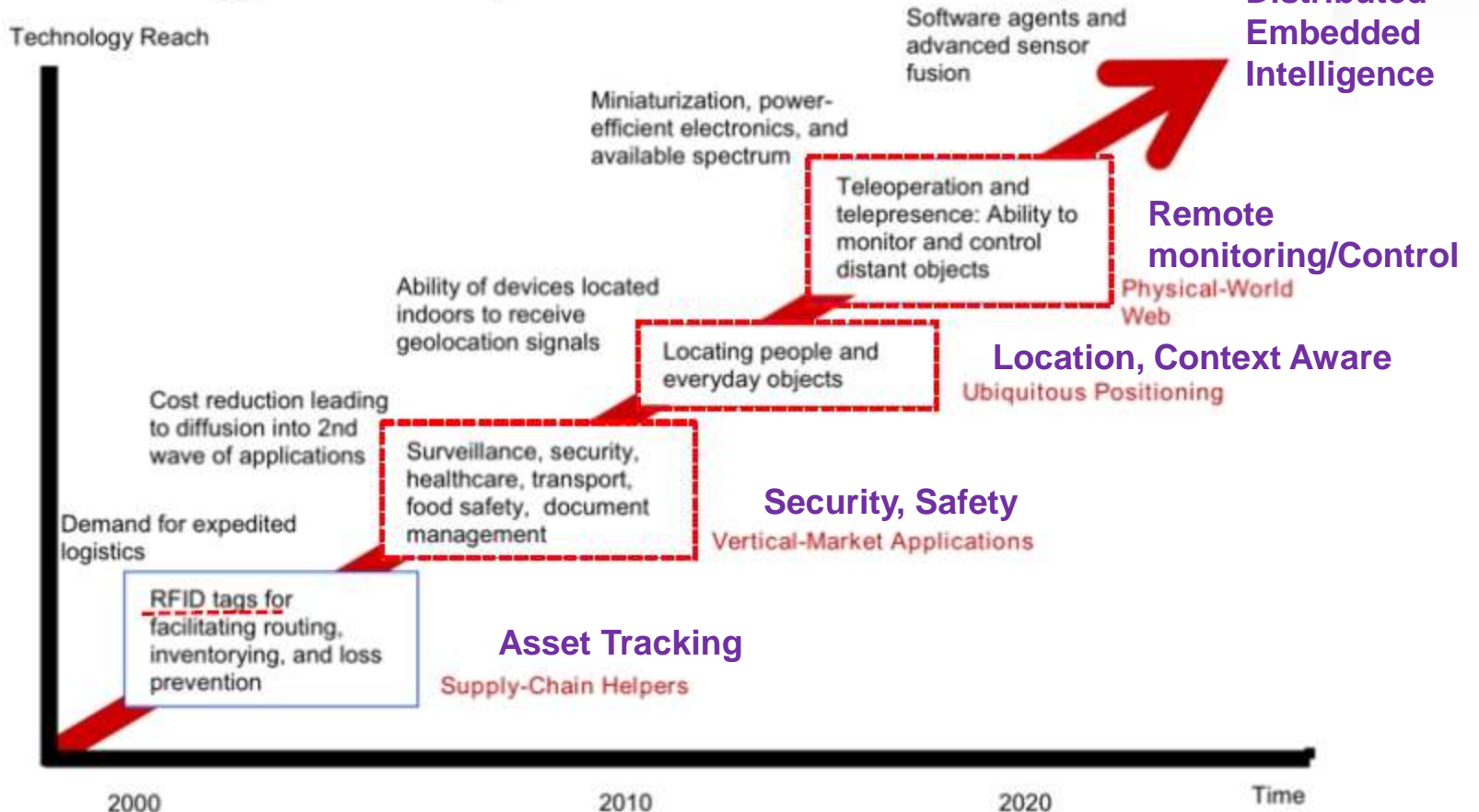**Remote monitoring/Control**

Physical-World Web

Ability of devices located indoors to receive geolocation signals

Locating people and everyday objects

Location, Context Aware

Ubiquitous Positioning

Cost reduction leading to diffusion into 2nd wave of applications

Surveillance, security, healthcare, transport, food safety, document management

Security, Safety

Vertical-Market Applications

Demand for expedited logistics

RFID tags for facilitating routing, inventorying, and loss prevention

Asset Tracking

Supply-Chain Helpers

2000   2010   2020   Time

Source: SRI Consulting Business Intelligence

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Summary and Q&A

- IOE has enormous Growth Opportunities In

  ✓ Smart Connected Homes, connected Automotives, Tele-health, Industrial (smart energy, buildings/factories) etc

- Freescale's opportunities

  ✓ offer RF radios (Zigbee), integrated with MCU or MPU;

  ✓ offer MPU for smart connected gateways in homes, clinics, automobiles etc

- Success Criteria for IOE:

  ✓ Easy to install/Use, Stability, Security/Safety etc

  ✓ Support connectivity for various standards

- Platform Solutions

  – Power Efficiency: Standard based IP platform

Freescale Smart Software Platform for Smart Energy, Smart Home, Smart Health, Smart Cars

- Internet of Things (IOT) and m2M (machines to Mankind)
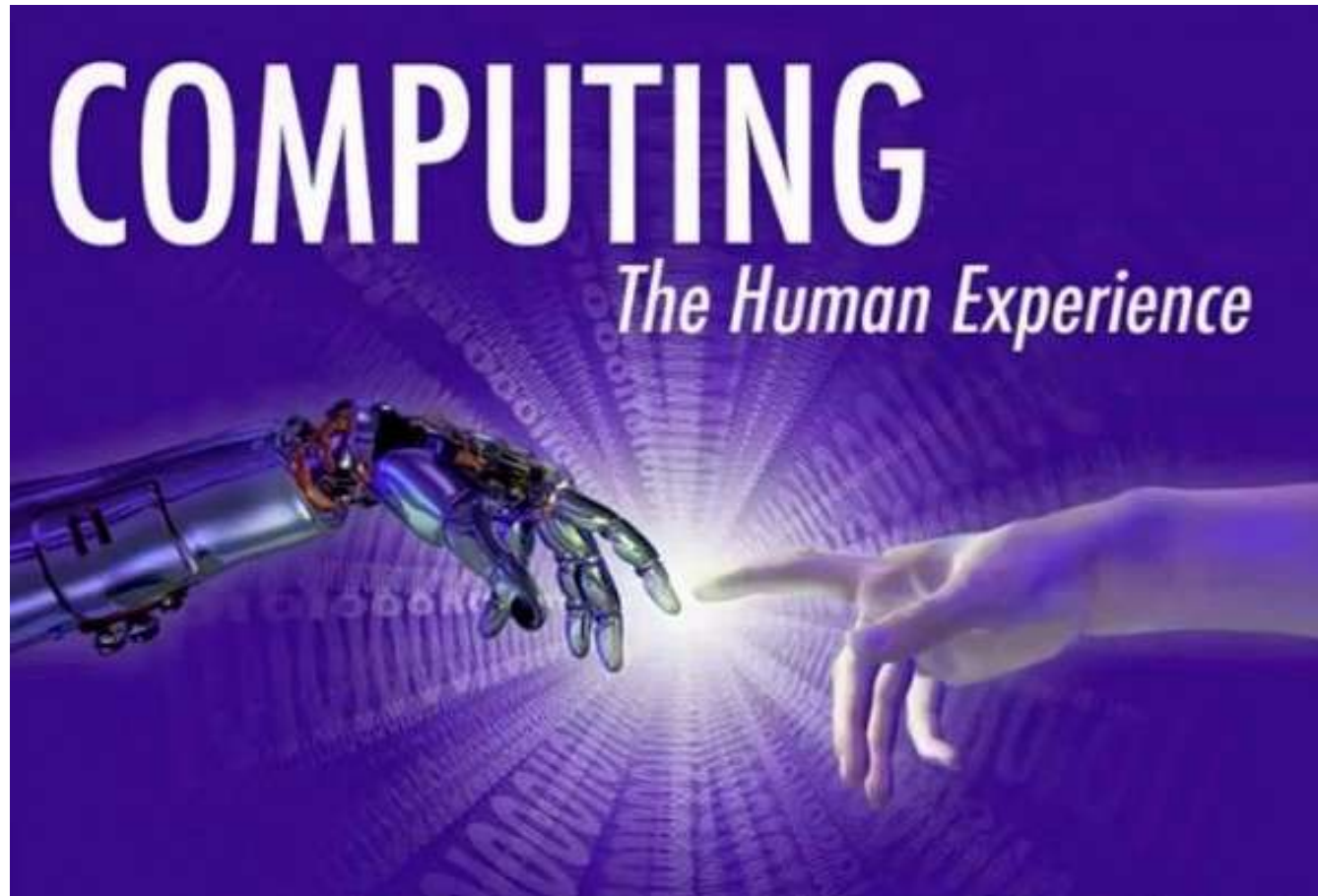
Contacts

Kwok Wu, PhD,   Kwok.wu@freescale.com   Mobile 1-512-971-5364

Head, NPD's Embedded Software and Systems, Freescale Seimconductor

Youtube Video: P1025 Data concentrators

http://www.youtube.com/watch?v=nl3Jb1LHL44

Youtube Video: Winner of 2012 Australian and New Zealand Smart Metering Conference – "Best Networking and Communication Product Award" – Smart Gateway (HAN) & IOT

http://www.youtube.com/watch?v=ZlwivEjW2tk

Winner of 2011 Broadband World Forum: Infovision Award
"Freescale Secure multi-core Broadband Gateway speed time to market" – Smart multi-service Business Gateway
http://www.youtube.com/watch?v=5Ni0tbZk8aQ
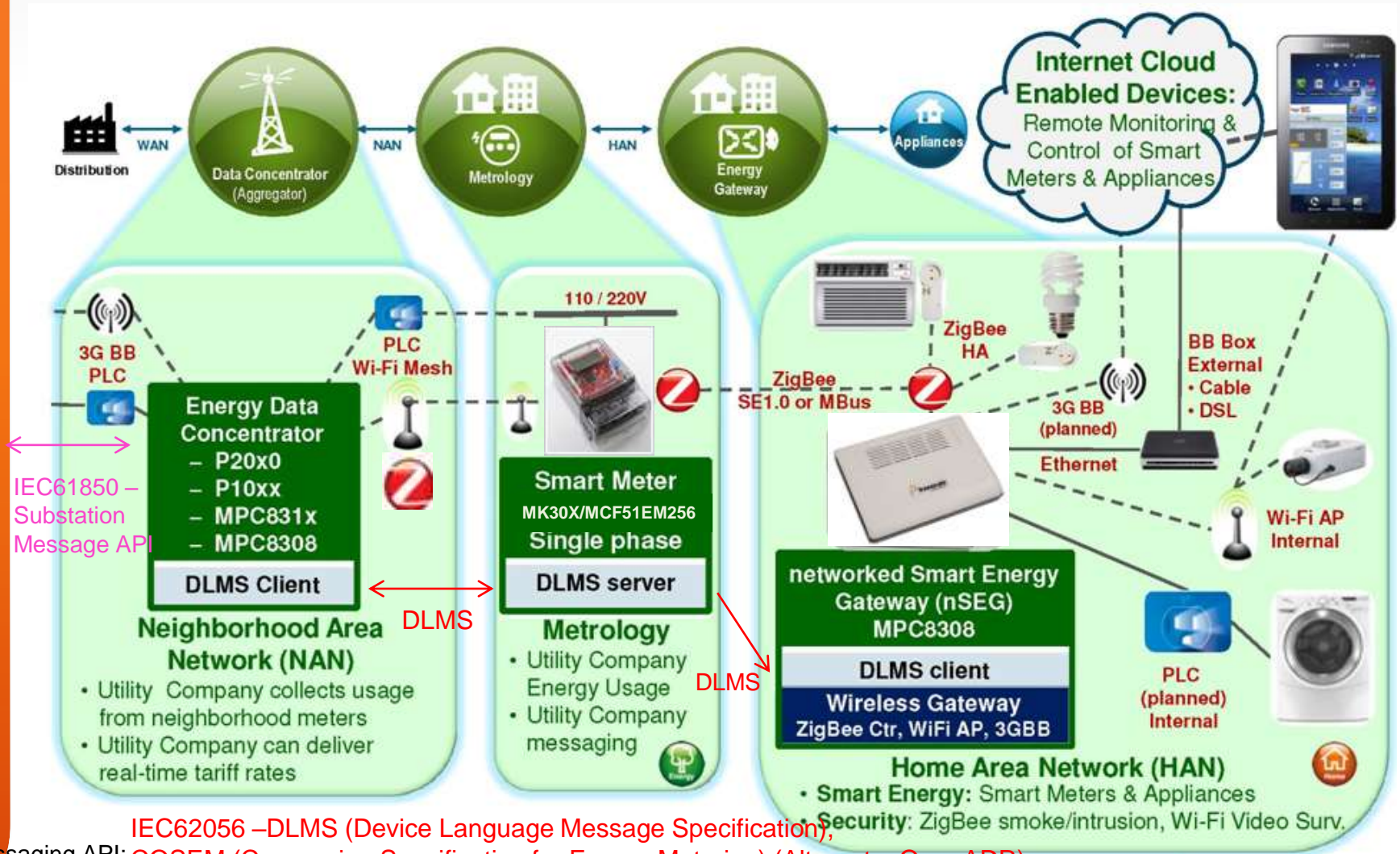

2012 Innovator of the Year by ECD – Embedded Computing Design Magazine for his platform approach to Wireless Smart Gateways

http://embedded-computing.com/articles/2012-solutions-freescale-semiconductor/

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Segment Solutions Backup

Internal Use Only

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Freescale Smart Grid

IEC61850 – Substation Message API

DLMS

DLMS

Messaging API: IEC62056 –DLMS (Device Language Message Specification),
COSEM (Companion Specification for Energy Metering) (Alternate: OpenADR)
IEC61850 - Substation Automation, SCADA

Real-time monitoring of Utility usage data

Freescale & Partner
QorIQ P1 Tower Demos

Networking

- WLAN
- NAS
- DLNA
- Video Surveillance
- VoIP

Industrial

- Home Automation w/ Think Eco Modlet
- Home Automation w/ Future Plug Meter
- PROFIBUS (with TMG)
- Java-Enabled M2M Demo (from Oracle)
- 3G M2M Demo (from Arkessa)
- EtherCAT PLC Demo (with QNX, ISaGRAF & Koenig)

Smart Energy

- Data Concentrator/Edge Router (from Nivis)

VoIP, WLAN, NAS, DLNA, Video Surveillance

3G M2M

EtherCAT PLC

Data Concentrator
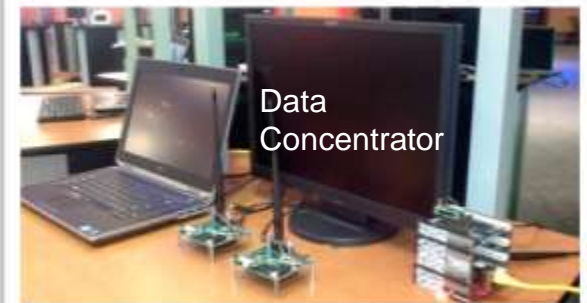
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Freescale Products for Internet of Things

- Connectivity: Zigbee (IEEE802.15.4)
- Sensor:
  - Acceleration Sensors
  - Battery Sensors
  - Magnetic Sensors
  - Pressure Sensors
  - Touch Sensors
- Processors and Controllers

Xtrinsic
Smart Sensors

- 1st Advanced Safety 77GHz Chipset
- Integrated Solution: Processing + Connectivity + Power Mgmt.

ARM

Kinetis
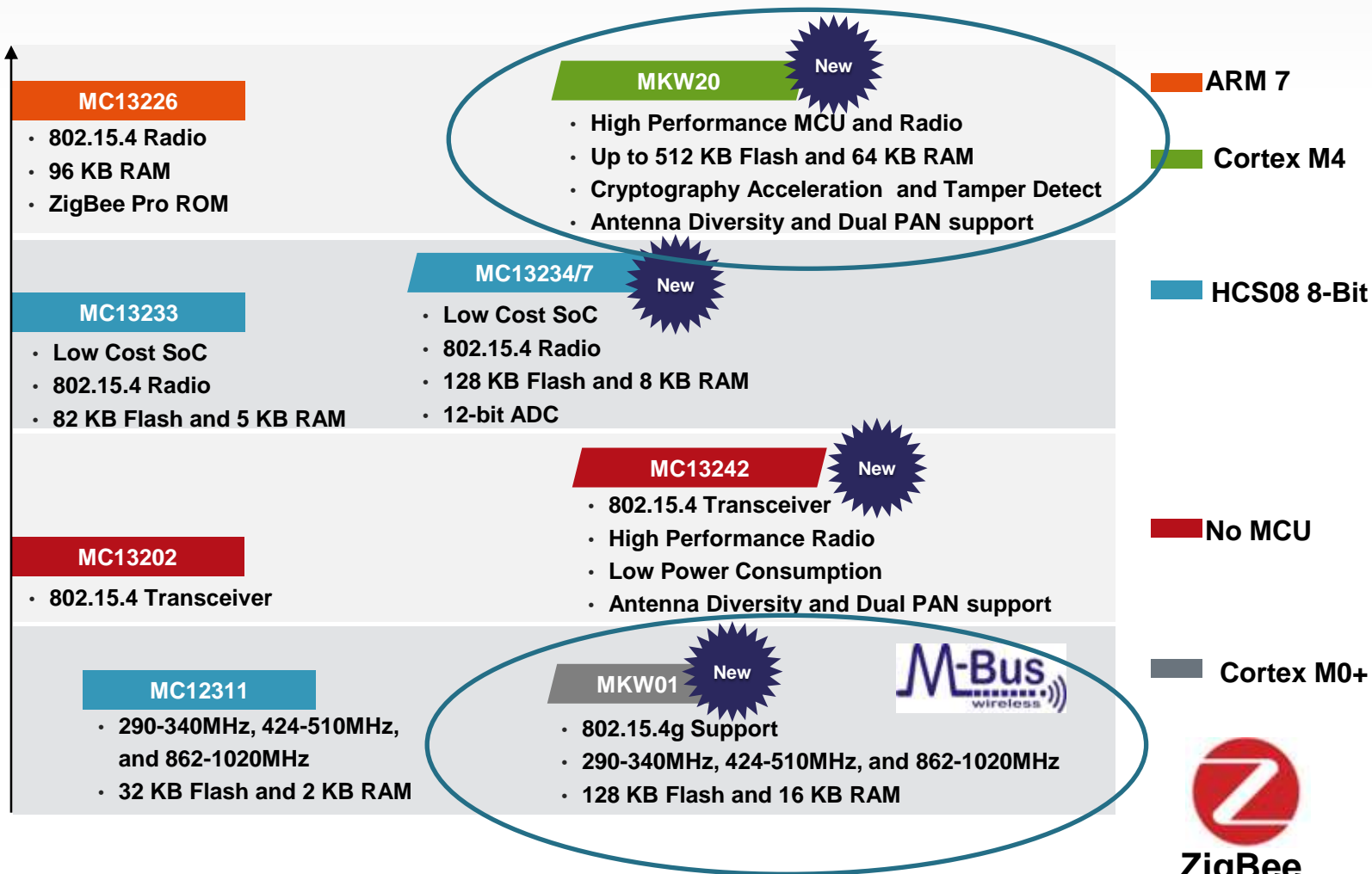Microcontrollers

i.MX
App Processors

Convergence

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Freescale Wireless Sensor Network Technologies

2.4 GHz Platforms
High Performance 32-bit ARM MCU

MC13226
- 802.15.4 Radio
- 96 KB RAM
- ZigBee Pro ROM

MKW20 *New*
- High Performance MCU and Radio
- Up to 512 KB Flash and 64 KB RAM
- Cryptography Acceleration and Tamper Detect
- Antenna Diversity and Dual PAN support

2.4 GHz Platforms
Low Cost

MC13233
- Low Cost SoC
- 802.15.4 Radio
- 82 KB Flash and 5 KB RAM

MC13234/7 *New*
- Low Cost SoC
- 802.15.4 Radio
- 128 KB Flash and 8 KB RAM
- 12-bit ADC

2.4 GHz Transceivers
IEEE 802.15.4

MC13202
- 802.15.4 Transceiver

MC13242 *New*
- 802.15.4 Transceiver
- High Performance Radio
- Low Power Consumption
- Antenna Diversity and Dual PAN support

Sub-GHz Platform
FSK, MSK, OOK

MC12311
- 290-340MHz, 424-510MHz, and 862-1020MHz
- 32 KB Flash and 2 KB RAM

MKW01 *New*
- 802.15.4g Support
- 290-340MHz, 424-510MHz, and 862-1020MHz
- 128 KB Flash and 16 KB RAM

M-Bus wireless

ARM 7

Cortex M4

HCS08 8-Bit

No MCU

Cortex M0+

ZigBee SE 1.x, 2.x

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IMM Markets for IOT connected objects/devices - Mobile Cloud Services (MCS)

(Networked Communicator Gateway)

Portable Consumer
- Smartbook
- E-Reader
- Smartphone
- Portable Media Player

Automotive Infotainment
- Audio
- Connectivity and Telematics
- Video and Navigation

Smart Converged Connected Gateways Platform
Smart Plugs (ThinkEco)
Smart Appliances
Safety/Security
Lighting Control
Local Display, iHED, Smart Thermostat (www.nest.com)
HD Media Streaming (BT, WiDi)

3G/4G

Low-Power
High Integration
Advanced Performance
Platform Software

Home Consumer
- Media Phone/Terminal
- iPod accessories
- Remote controls
- Digital Photo Frame
- Appliances

Industrial
- POS/Scanners/Printers
- Security and Surveillance
- Industrial HMI
- Medical
- Metering

Smart Plug (ThinkEco)
Smart Thermostat (www.Nest.com)
PCT – Programmable Communicating Thermostat

Internet of Things: Smart Cities

Asset Tracking

Connected Cars /Transportation/Logistics

Trusted Networking

Home/Building/Factory Automation

Smart Energy (AMI)

Medical/Health Monitoring

Created by markarma