One box- Open IoT Gateway platform

Terry Kim | Microcontroller group marketing manager
A Global Leader in Microcontrollers and Digital Networking Processors

Five Core Product Groups
- Microcontrollers
- Digital Networking
- Automotive MCU
- Analog & Sensors
- RF

Four Primary Markets
- Automotive
- Networking
- Industrial
- Consumer

>50 Year Legacy
>5,500 Engineers
>6,000 Patent Families
The Internet of Things is Driving **Explosive Growth**

In Connected Devices

- **World Population**
  - **2003**: 6.3B
  - **2008**: 6.5B
  - **2010**: 6.8B
  - **2015**: 7.2B
  - **2020**: 7.6B

- **# Connected Devices/Person**
  - **2003**: <1x
  - **2008**: 1x
  - **2010**: 2x
  - **2015**: 3.5x
  - **2020**: 6.5x

*Sources: Ericsson, February 2011; Cisco Internet Business Solutions Group (IBSG), April 2011*
INTERNET OF THINGS
Different Services, Different Technologies, Different Meanings for Everyone

And the Word “SMART” Is Everywhere!
Microcontrollers – Powering The Internet of Things

i.MX Applications Processors | Kinetis MCUs | DSCs

Telematics/Instrument Clusters
Digital Signage
Aerospace/Defense
Lighting
Security/Access Control
Point of Sale
Solar Inverters
Digital Power Conversion
Industrial Tablets
Factory Automation
Human – Machine Interface

Medical Tablets
Vision Camera Systems
Patient Monitoring

Home Health Monitors + Fitness
Smart Appliances

Gateways/Home Health Hub
Gaming Systems
Portable Media Players
eReaders

Home Security
Smart Meters

Home Health
Smart Appliances

Telematics/Instrument Clusters
Digital Signage
Aerospace/Defense
Lighting
Security/Access Control
Point of Sale
Solar Inverters
Digital Power Conversion
Industrial Tablets
Factory Automation
Human – Machine Interface
Automotive Internet of Things
Connecting Your Car to Your World

Freescale Connected Vehicle Vision Powered by i.MX
Freescale IoT Offerings

Xtrinsic Sensing
Intelligent Contextual Sensing.

The right combination of intelligent integration, logic and customizable software on the platform to deliver smarter, more differentiated applications.

For IoT it provides Context: Identity, Activity, Location, & Time

Connectivity BAN/ PAN/ LAN

Fully integrated Short Range radios with best in class power performance, and Powerline Communications

Edge products:
• Very small
• Low cost
• Low power
• Low complexity
• Industrial grade & robust

Kinetis Microcontrollers
Design Potential. Realized

Industry’s most scalable ultra-low-power, mixed-signal MCU solutions based on the ARM® Cortex™-M and Cortex™-M0+ architectures.

Vybrid Controller Solutions
Rich Apps in Real Time.

Real-time, highly integrated solutions with best-in-class 2D graphics to enable your system to control, interface, connect, secure and scale.

i.MX Applications Processors
Your Interface to the World.

Industry’s most versatile solutions for multimedia and display applications, with multicore scalability and market-leading power, performance & integration.

QorIQ Processors built on Layerscape Architecture
Accelerating the Network’s IQ

Industry’s first software-aware, core-agnostic networking system architecture for the smarter, more capable networks of tomorrow – end to end.

Scalable Industry Standard Solutions, Software and Development Ecosystem

S Sensing
P Embedded Processing
C Communications
ARM SOC Portfolio’s

How to Choose an ARM® Core & Supplier

Who is the Most Comprehensive ARM® Supplier?**

**Number of active product SKUs listed on website as of November 2013

Freescale™ Confidential and Proprietary | 7
Freescale’s Product Longevity Program

► The automotive market requires long-term product support

► Freescale has a longstanding track record of providing long-term production support for our products

► Freescale is pleased to introduce a formal product longevity program for the market segments we serve

  • For the automotive and medical segments, Freescale will make a broad range of solutions available for a minimum of 15 years

  • For all other market segments in which Freescale participates, Freescale will make a broad range of solutions available for a minimum of 10 years

  • Life cycles begin at the time of launch

► A list of participating products is available at: www.freescale.com/productlongevity
Freescale Quality Commitment

Screened Reliability

- Concept
- Process Development
- Product Development
- Product Reliability
- Reliability Analysis
- High Risk, Product Specific

Reliability Resources

Built-in Reliability

- Reliability Expectations
- Design for Reliability
- Reliability
- Reliability Learning
- Process Certification
- Data Reuse
- Reliability Verification
- Qualification
- Low-Risk Quality and Verification
- Reliability Risks

MAD Product Quality - PPM

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<th>PPM Fiscal Time Period</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q1</th>
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IoT Systems Powered by i.MX Processors

SONY: HAP-S1 HDD Audio Player System, i.MX 6D

HSAE: Car Infotainment, i.MX 6Q

Foryou: Car Infotainment, i.MX 6S

BMW: i series remote key, i.MX 28

Benesse: Educational Tablet, i.MX 6DL

FIC: Industrial Tablet, i.MX 6Q

Invoxia: NVX620 IP Phone, i.MX50

AMX: Building Control Tablet, i.MX 6Q

Atrust: T66/67 thin client, A66 AIO, i.MX 6Q

i’mWatch: Android watch, i.MX233

OrCam: Eyeglasses for visually impaired, i.MX 6Q

HMS: Android HDMI Stick, i.MX 6Q, 6DL

Navico: Marine Navigation, i.MX 6Q

Masimo Radical-7 Health Monitor, i.MX53

Pioneer Nex In-Dash Navigation, i.MX 6S

And much more!
i.MX Overview: Enablement

Hardware Platform

- Full Hardware evaluation and Development Platforms

+ Software

- Apps
- API
- Stacks
- Codecs
- MW
- OS
- Drivers
- HW

+ Ecosystem

- Tool chains
- Software – RTOS, OS, codecs, middleware/applications
- Hardware – embedded board solutions
- Design services
- System integrators
- Training

- Ease of Use – BSP and demo images, development environment build demonstration, video tutorials, schematic and layout, documentation
- Ranging from $149 development board to $999 full reference platform.

- Full-featured, scalable, optimized and proven OS – Linux, Windows, Android
- Software codecs for video, audio, graphics and communications.
- Product-worthy software for reference platforms and product development

www.imxcommunity.org
EcoMAPS: i.MX applications processor based on the ARM™ core

Non-proven partners and non connect partners included

For more partner options, visit freescale.com/partners
One Box for IoT
INTERNET OF THINGS
Different Services, Different Technologies, Different Meanings for Everyone

And the Word "SMART" Is Everywhere!
The Internet of Things (IoT) is about Machine to Entity (M2E):

- **Machine to Machine:**
  - Automatic diagnostics for cars: Automatic information collection from your car’s engine management system and sending real-time alerts to drivers or service centers

- **Machine to Infrastructure:**
  - Automatic bridge monitoring: Sensing and monitoring the structural integrity of a bridge in case of flooding

- **Machine to Human:**
  - Automatic health monitoring for people: Implant monitoring services or disease management via implantable electronics

- **Machine to Nature/Environment:**
  - Early detection of earthquakes: Distributed sensors to detect early tremors in specific places
INTERNET of THINGS

It’s the *Network of All Networks*, which will be connected through the Largest Control Data Network in the World

It’s all about the service layer infrastructure, because …

It’s ALL About the Services

Rolling out the IoT is like rolling out the largest control data network in the world.
# IoT ‘Box-level’ Product View

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<td>P</td>
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<td>Hierarchical Gateways</td>
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- **Layers of Embedded Processing** (P)
- **Sensors & Actuators** (S)
- **Connectivity: BAN/PAN/LAN/WAN** (C)

**Application/Action**
- User-driven actions via devices with screens or automatically driven actions based on data parameters.

**Insights/Big Data**
- Data analytics for business intelligence.

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*Medtronic's glucose monitor uses Bluetooth to "talk" to Ford Sync*
One-Box: What is It?

Configurable “One-Box”

- Ethernet
- 802.11n WiFi
- USB HS
- Bluetooth 4.0 (includes BT Low Energy)
- Processor with Operating System
- ZigBee Radio
- Sub GHz Radio
- 802.15.4j Radio
- 802.15.6 Radio
- Other
- Optional Plug-In Modules

One-Box is a scalable gateway device using scalable i.MX or Kinetis SOC’s and built with JAVA for Oracle big data services
ARM TechCon Demo: Sensinode <> OneBox <> Oracle

Sensinode (Java ME)

Sensors Tower Card

Data/Events Over CoAP

Sensor Data

K70 Kiel box

Devices: Zigbee Meter
Zigbee Wall Plug
Wi-Fi Thermostat (i.MX53 & K60)

One Box (Java SE)

Data/Events Over CoAP

Sensor Data
Wi-Fi Data
Zigbee Data
BT-LE Data

UI-2 (Opt) Consumer Control Panel
JAVA-FX

M2M Server

Data/Events Over CoAP Communication stack

UI-1 Consumer/SP info panel (Connected Home appl or custom UI)

REST APIs

Devices: i.MX 6Quad
OneBox Software/Hardware (i.MX 6 based)

Software

- Sensinode
  - JAVA SE
  - Aggregator
  - Local & Complex Events
- Sensinode
  - JAVA SE
  - Apps Wrapper
- Sensinode
  - Local Directory
- JAVA Embedded Suite (JES)
  - OEP Embedded
- JAVA VM
  - (SE)
- FSL openWRT AP-WLAN
  - Wireless Router Gateway Platform
- FSL MPU Linux-SDK BSP
  - Software Drivers
  - ZigBee 1.0
  - ZigBee 2.0
  - Gb Enet
  - Bluetooth 4.0
  - Wi-Fi

Hardware

- USB2
- USB2
- GMI
- SDIO
- FLASH
  - USB2
  - Think-Eco
  - USB2
  - Mohave
  - Gb Phy
  - SDIO Silex - Module
  - On-board 8 GB Flash

Phy Interface
- Inside Box Modules
- FSL i.MX 6Q Board Design

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CoAP interface: Register sensor (S) out to Oracle DB, take control, read data

Use of Ethernet external switch for connection (minimize noise from Wi-Fi)
ARM TechCon Demo: Sensor Data Flow
Registration of Sensor

Sensor 1 data sent to DB on OneBox via CoAP
Sensor 1 data sent to Oracle DB via JAVA-VM (JAVASE)
• Zigbee 2.0 Meter monitors Power Strip power
  - Lamp plugged into Zigbee 1.0 Modulet, Modulet plugged into Power Strip
  - When Meter power reaches xx Watts, Oracle DB turns off Lamp and turns on Fan
• iPAD (via Wi-Fi) monitors Wi-Fi Camera through OneBox
One-Box Deployment Example: Health Care

- Physician
- Social Networking
- Monitoring Center
- Loved Ones

Reference Platform
Gateway (i.MX28)

Tablet with Medical User Interface (i.MX6)

Nonin Pulse Ox (MC9S08GP32)

Panic Alarm (MC12311)

868MHz RF

Bluetooth HDP

Bluesooth SPP

Bluesooth Low Energy

USB PHDC

HealthCare

Weight Scale

Blood Pressure Monitors

Blood Glucose Meter

Thermometer

Ethernet

• Wired connection
• Wireless connection
• Medical monitoring
• WWW connection

TELE-HEALTH

HOME AUTOMATION

Expanding the Reference Platform
- Smart Plugs
- Smart Appliances
- Safety/Security
- Lighting Control
- Local Display

OneBox

Example: HealthCare OneBox

HOME AUTOMATION

Freescale

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Smart Home & Smart Health

Pervasive Remote Monitoring and/or Control

- Human beings’ vital statistics monitored via edge nodes communicating through body area networks (BAN) and personal area networks (PAN)
- Many other “things” in the smart home using local area network (LAN)
- All communicate with a home hub/gateway, which in turn communicates to the cloud via wide area networks (WAN)
Communication Topologies Across Hierarchies

Scalability based on use case, dictating processing and communications support.

Edge/Sensing Nodes

- BAN/PAN/LAN/HAN
- Zigbee
- BTLE
- Wi-Fi®
- HPGP
- BAN/PAN/LAN

Gateway (G)

WAN

Single family home/simple entity

Apartment building, enterprise campus, factory automation, neighborhood grid, road infrastructures, hospital wards, etc.

Edge/Sensing Nodes

- BAN/PAN/LAN/HAN
- Zigbee
- Bluetooth
- Wi-Fi®
- HPGP
- BAN/PAN/LAN

Gateway (G)

LAN/NAN

LAN/NAN

LAN/NAN

LAN/NAN

LAN/NAN

LAN/NAN

WAN