Embedded – market trends & challenges

IoT is the new “Embedded” – from sensors & wearables to automotive & industrial

- IoT is everywhere
  - IoT is “connected” embedded device
  - Security is an important design consideration
    - Security of device – spans from “cheap” to “very expensive”
    - and data – It will have a lot of personal data
  - Reliability of device – continuous use for months, if not years – Boeing 787 software “bug”
Rogue device requests service

To Internet service provider

ISP Gateway

Ethernet

Networked Web Cam

Rogue IoT device

Malware installed in IoT device

Hack to wireless LAN

Malware installed in access point

Hack to home network

Rogue App requests service

Internet service provider

To Internet service provider

Rogue device requests service
IoT Sensor processing workflow

Example from Microchip for Hub module with Bosch sensors

- Enhanced with multiple sensor inputs

Data Acquisition → Sensor Compensation → Information Enhancement → Decision Making

**Fast Context Switch**
- Shadow Register
- Multi-threading

**Analog Adjustments**
- Bitwise Operations
- DSP
- MSA

**Signal Processing**
- Multi-threading
- DSP
- MSA

**Security**
- OmniShield
- Virtualization
- Multi-threading
IoT Compute functions

*Embedded must move to 32-bit processing for both local compute & networking*

- **Analytics and control – local and cloud**
  - Local analytics
    - Smart devices that monitor and control locally
    - Collect and assemble data into informational points of value
    - Device management includes revisions and updates to Analytics process and policy
    - Local storage data security
  - Cloud
    - Aggregate data analysis
    - Real-time analysis
    - Reconfigure sensor nodes
    - Management of devices
    - Communication security

- **32-bit processing essential**
- **Processing**
- **Network**
3 Processors are used today in small IoT

Multiple Processors present design challenges, add cost and decrease battery life!
Integrated IoT radio and control

Virtualization support for secure and independent tasks

Collect and Analyze Data

Device Control & Response

Secure/non-Secure OS

MIPS M51xx

Trusted Hypervisor + Secure Kernel

Sensor

MIPS

Ensigma RPU

Control

Collect and Analyze Data

Device Control & Response

Single Processor to increase battery life
- M51xx with Virtualization
- I6400 – Virtualization and Multithreading

Multiple secure and independent Operating Systems share resources of microcontroller
Key Value of MIPS Processor in IoT

Solutions for IoT devices to Sensors to Servers

- **MIPS P5600**
  - Ultimate Performance
  - 16-stage SuperScalar (SS) Out-of-Order (OoO) Multi-core CPU
  - OmniShield-ready: virtualized up to 15 guests
  - *Ultimate performance in a power-efficient processor*

- **MIPS I6400**
  - Powerful & Efficient
  - 9-stage SuperScalar (SS) Multi-Threaded Multi-core CPU
  - OmniShield-ready: virtualized up to 31 guests
  - Multithreading – up to 24 Virtual Processors
  - *Virtualization + Multithreading => hardware-secured Virtual Worlds*

- **MIPS M5100/5150**
  - Ultimate Embedded
  - Deeply Embedded MCU (RTOS) and MPU (Linux)
  - OmniShield-ready: virtualized up to 7 guests
  - **MCU**: high performance for RTOS
  - **MPU**: power-efficient; designed for *Linux* and other rich OS
Processor + on-chip connectivity for IoT

Implement right-sized components for optimum power performance

- Wi-Fi, Bluetooth, Sensors
  - RF to baseband on-chip
  - Wi-Fi 802.11ac down to low power 802.11n-
  - Bluetooth Smart and Classic
  - 802.15.4 and 6LowPan

- Power-optimized design
  - Configurable Tx/Rx speed for area & power
  - Optimize both dynamic and sleep power
  - Trading noise for power consumption
  - Configurable power output levels
Everything needed for multimedia SoC solutions

- **PowerVR Camera ISP**
- **PowerVR GPU**
- **PowerVR Video Decoder**
- **PowerVR Video Encoder**
- **MIPS CPU**
- **Ensigma RPU (WiFi BTLE)**
- **MIPI**
- **Custom Processing**
- **OmniShield Security & Virtualisation**
- **Advanced Pathway**
- **Comprehensive IDE and debug environment**
- **Heterogeneous Compute**
- **Mature ecosystems**
- **Advanced Vision Algorithms**

Key components and paths:
- Image stream and statistics
- Low latency zero memory video encode path
- Re-entrant vision functions path
- Statistics assisted encode path
- Video Display Output

Additional features:
- Optimised multi-core integration
- Multiple CMOS Sensors
- Comprehensive IDE and debug environment
- Custom Processing
- Encoded Video Output
- Video Display Output
- Optimised multi-core integration
IoT hardware requirements – one architecture

Wearables use case examples

- High-end: Performance-centric
  - High processing throughput
  - Packet Inspection, Vision processing
  - Image recognition

- Mid-range: Efficiency-centric
  - Interrupt driven systems
  - Display with touch inputs
    - Human response times

- Low-end: Power & cost-centric
  - 7-30 days battery life
  - Sensors key components
  - Processor and RF need to manage power efficiency – reduced bandwidth
prpl Ecosystem – open source, community driven
Charter: hardware-level security scope

Common security framework across hardware and software components in both single tenant and multitenant use cases
Conclusions

- **Device and Data security is becoming mandatory**
  - Imagination’s OmniShield™ multi-domain, heterogeneous technology delivers hardware-enforced security for future generations of SoCs across many embedded markets
  - Fully supported in all M-class MIPS Warrior embedded MCUs and MPUs

- **Select IP that can deliver the right feature sets**
  - OmniShield brings Security and Portability – and faster Time to Market
  - MIPS Multi-threading brings higher performance and efficiency
  - MIPS Virtualization & Multithreading deliver new levels of security, performance and efficiency

- **Integration is a must to maintain competitiveness**
  - Do not overdesign – IoT devices must be carefully optimized to fit the application

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