

KVM on Embedded Power Architecture Platforms

Stuart Yoder

Software Architect, Freescale Semiconductor

► Background

- Freescale / Networking
- Embedded Systems
- Use Cases

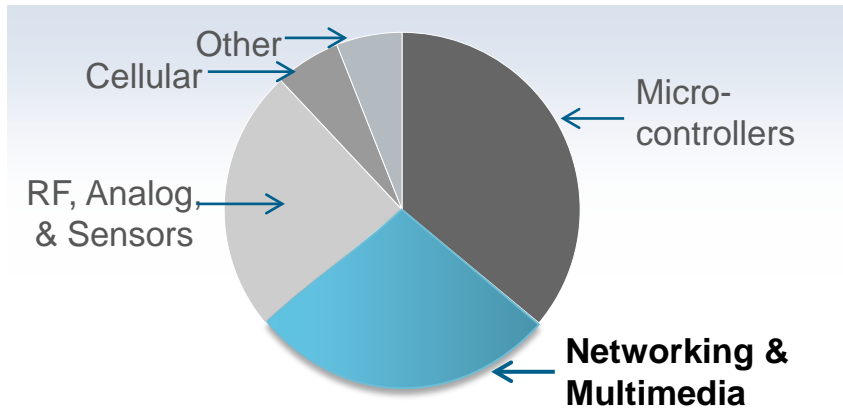
► KVM on Embedded Power

- New requirements
- Status

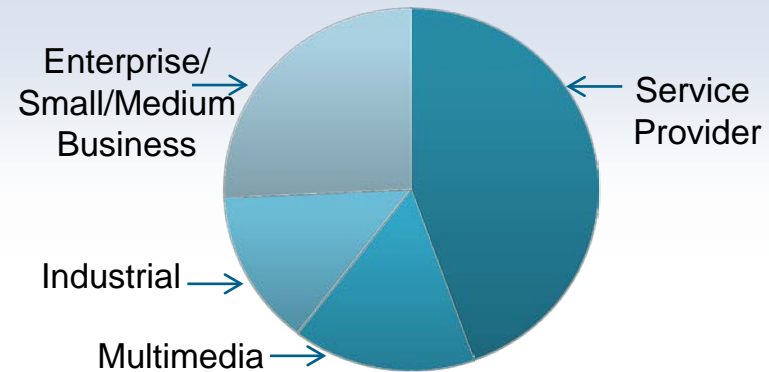
► Future / To Do

Freescale: Networking & Multimedia Group

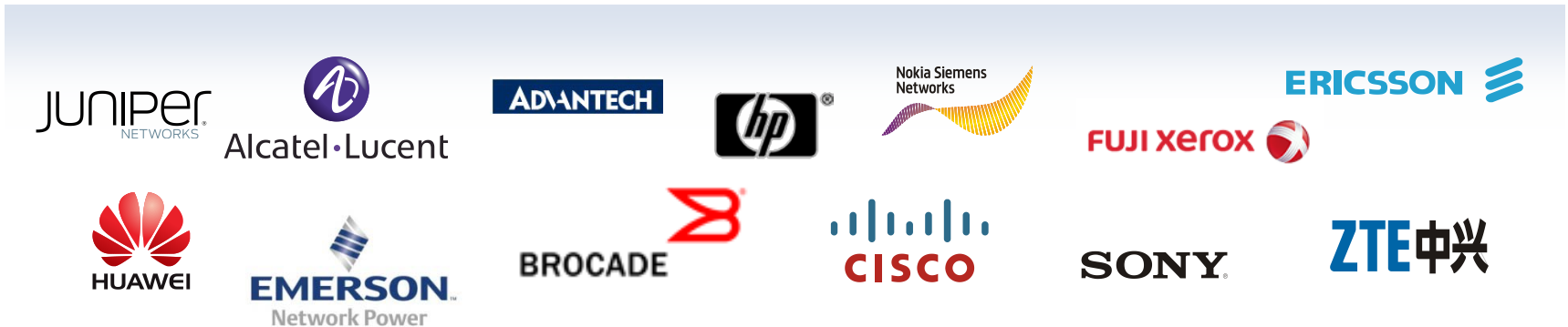
2010 Freescale Revenue



NMG Revenue by Market





















Key Networking Customers

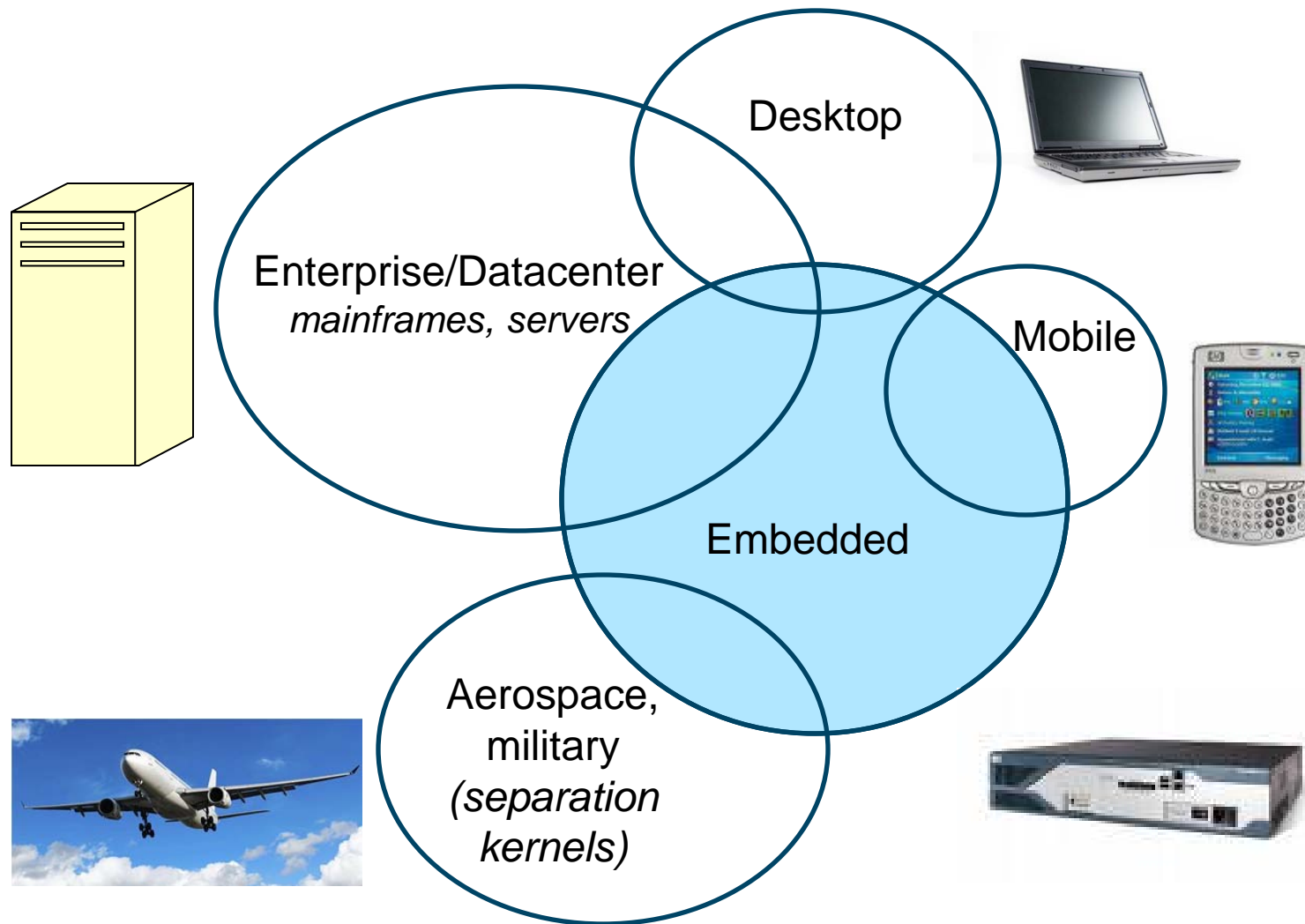


Freescale is #1 in the network/communications processor market
(300+million units shipped since 1989)

QorIQ Processing Platforms

QorIQ P5 P5020, P5010	64-bit High End Up to 2.2 GHz	 Service Provider Network Admission Routers	 Storage Networks	 Switching	
QorIQ P4 P4080, P4040	4 – 8 Cores Up to 1.5 GHz	 Metro Carrier Edge Router	 IMS Controller	 Radio Network Control	 Serving Node Router
QorIQ P3 P3041	2 – 4 Cores Up to 1.5 GHz	 Converged Media Gateway	 SSL, IPSec, Firewall	 Access Gateway	
QorIQ P2 P2040, P2020, P2010	1 – 2 Cores Up to 1.2 GHz	 Unified Threat Mgmt	 VoIP Carrier-Class Media Gateway	 Wireless Media Gateway	 Base Station
QorIQ P1 P1010, P1011, P1012, P1013, P1014, P1015, P1016, P1017, P1020, P1021, P1022, P1023, P1024, P1025	1 – 2 Cores 400 MHz to 1 GHz	 Integrated Services Router	 Network Attached Storage	 Home Media Hub	 Enterprise WAP

Virtualization — Trends

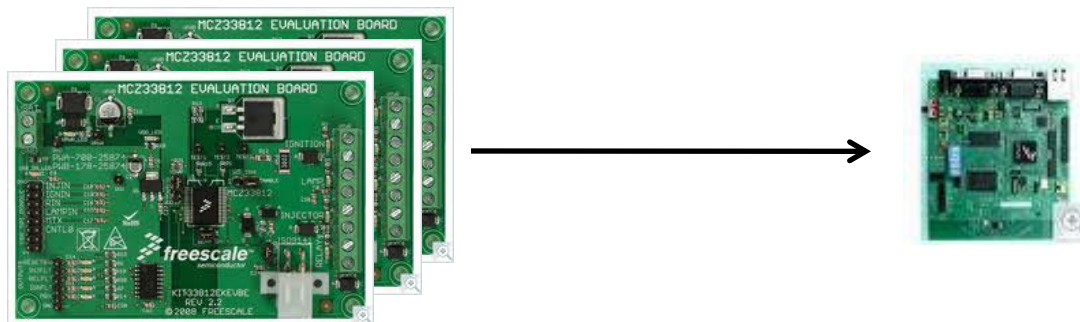


► How is embedded different?

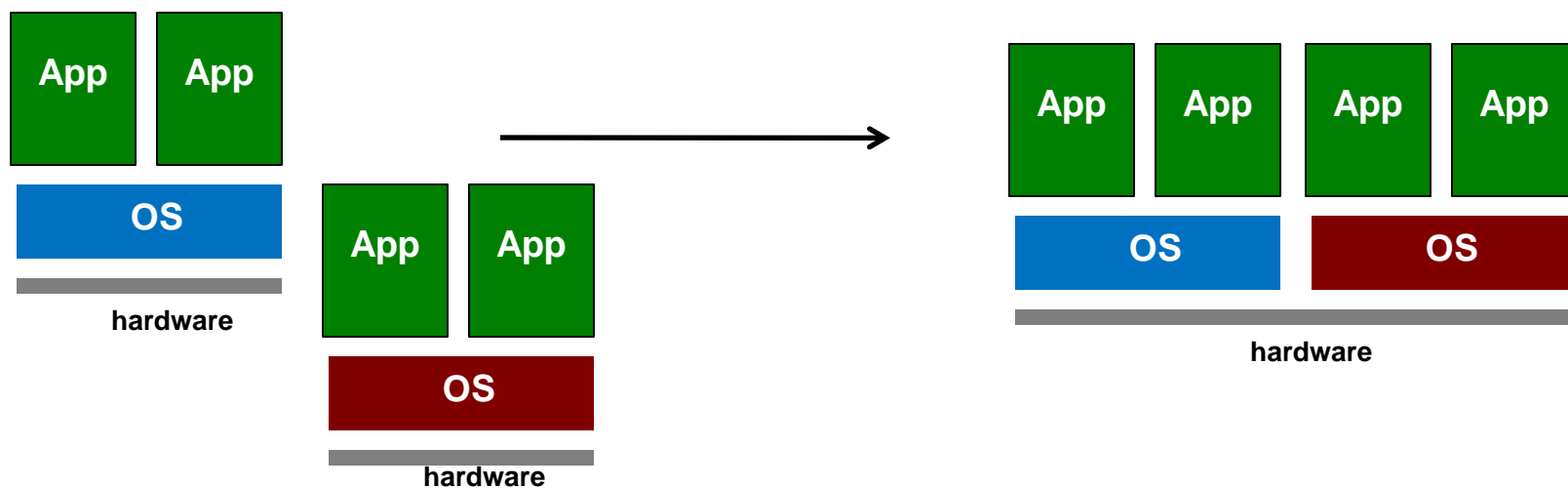
- Fixed function devices– not general purpose
- Huge variety of hardware platforms
 - No standard platforms (no BIOS, ACPI, UEFI)
- Real time constraints
- Large variety of operating systems
 - VDC Research (2011 report)
 - About 50% of devices shipped by survey respondents had no formal OS or an in-house developed OS

► Trend: move to multi-core SoCs, but SMP with a single OS will not be the only usage model

Trend: Consolidation on Multicore Processors



Benefit: Cost/power savings



- ▶ Control-plane / data-plane – split into partitions
- ▶ Migration — move to new hardware, preserve investment in software
 - Run legacy software alongside new software
 - Add Linux[®] to a system
- ▶ Sandbox — isolate untrusted software

Use Cases/Examples...continued

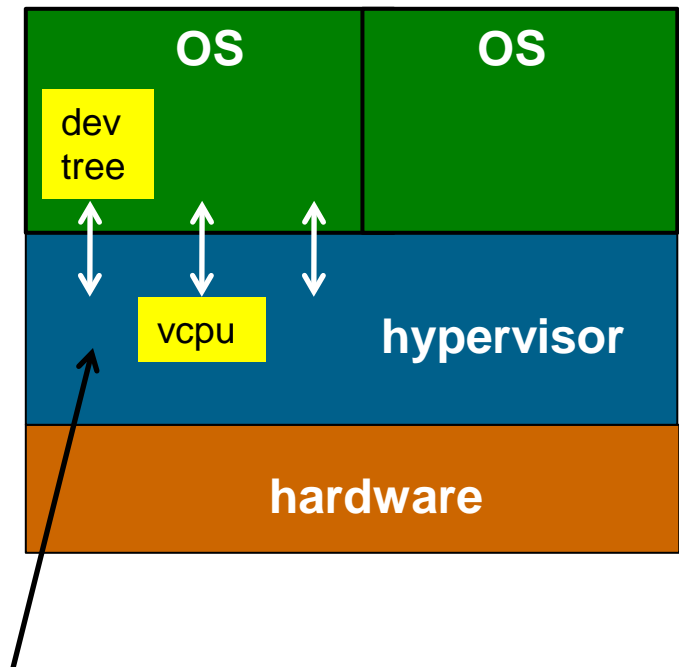
- ▶ High availability — active/standby configuration without additional hardware
- ▶ In-service upgrade
- ▶ Many more possibilities...

► power.org ePAPR

- Resource discovery (device tree)
- Multi-CPU boot
- v1.1 includes virtualization extensions
 - ABI
 - APIs (hcalls)

► Power ISA 2.06B

- Virtualized implementation notes



standard
interfaces

Why KVM for embedded Power Architecture?

Our customers are asking for it.

▶ 2007-2008:

- IBM developed 4xx processor (Book-III E) support (Hollis,Christian)

▶ 2009:

- Freescale did preliminary port to e500v2 (Yu Liu)

▶ 2009

- Port to server Book III S (Alex Graf)

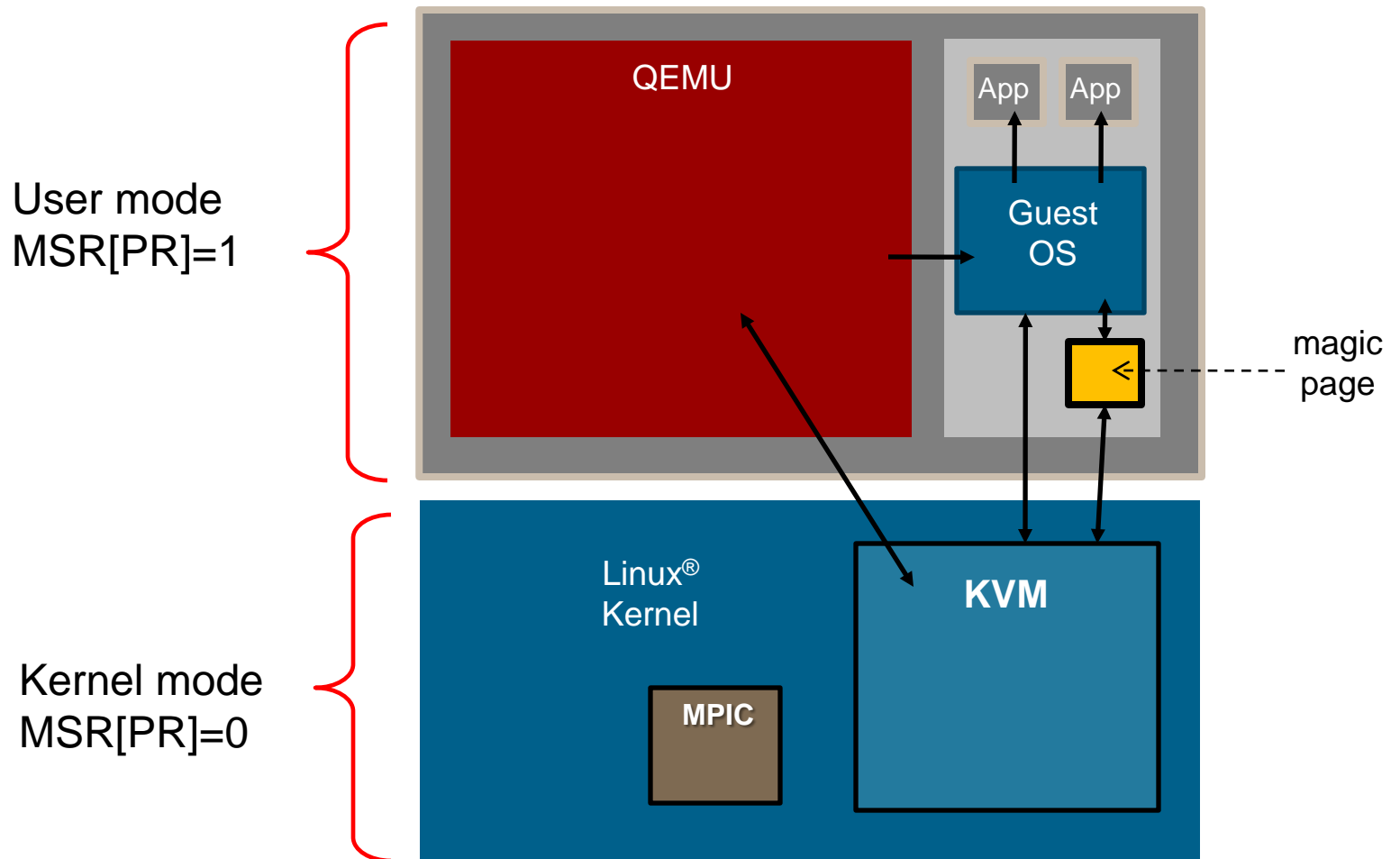
▶ 2010-2011

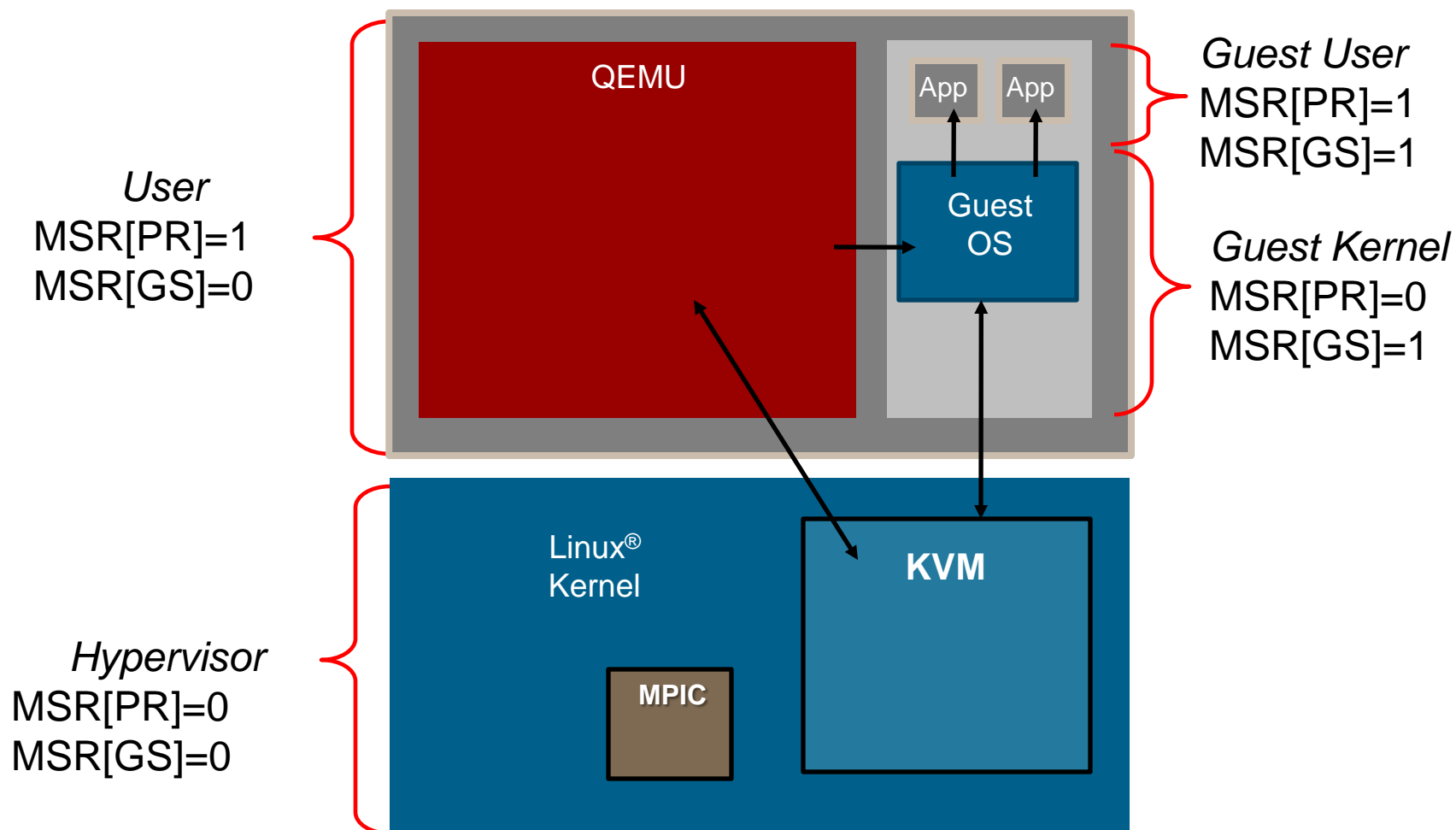
- In progress: port to e500mc, improve/consolidate e500v2 work

- ▶ Assign guests physically contiguous memory
 - e500 MMU – software managed
 - TLB0 – 4KB mappings
 - TLB1 – small number of variable sized, large pages
 - Needed for performance (e.g. 80% speedup in kernel boot time)
 - Required for pass-through I/O devices to do DMA
 - Freescale IOMMU supports a small number of DMA windows per device
 - Devices with no IOMMU (e500v2-based)

- ▶ Pass-through of SoC I/O devices (non-PCI) to guests

KVM – e500v2





- ▶ Initial ports to e500v2 and e500mc based SoCs are complete
 - Basic features are there— sufficient to boot Linux[®] guest
 - e500v2 uses paravirt— shared page of memory and guest side patching
- ▶ Prototype direct map (pass-through) support for memory and I/O devices is working
 - Use in-kernel MPIC
- ▶ Upstreaming in progress

- ▶ Patches --> upstream
- ▶ Performance analysis & tuning
- ▶ Get rid of static guest device tree files
- ▶ Work out an improved mechanism to pass-through non-PCI I/O devices and physical memory
 - Hugetlbfs
- ▶ IOMMU support for SoCs with a PAMU
- ▶ Guest SMP
- ▶ 64-bit support (e5500)
- ▶ Additional VCPU features— e.g. debug, perfmon, cache locking

- ▶ Error management
- ▶ Real time
- ▶ High availability
- ▶ Inter-partition communication/doorbells
- ▶ Direct hardware interrupts to guest OSES for pass-through devices
- ▶ Virtual time
- ▶ Libvirt
- ▶ Processor Roadmap
 - e6500 – has hardware threads and LRAT (logical to real address translation)

- ▶ Partitioning/virtualization is here to stay in the embedded space
- ▶ With some modest changes, KVM addresses many of the requirements
- ▶ Freescale sees direct customer demand for KVM and is committed to enabling this