

Virtualization: The Bridge to New Technologies

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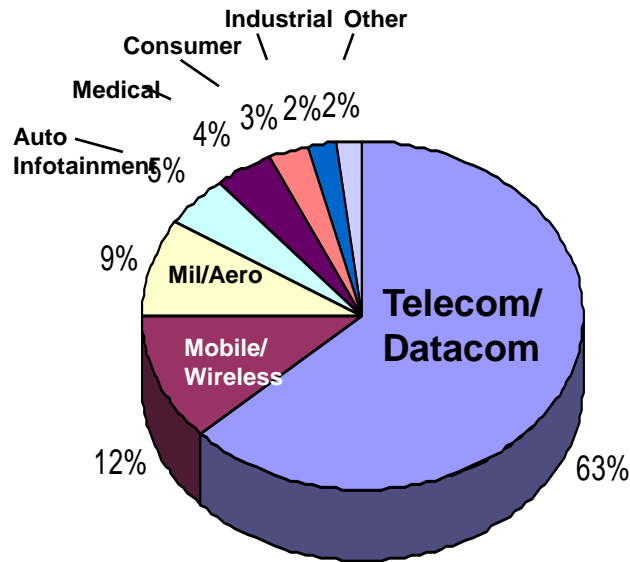
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- Business consolidation and competition driving need for technology migration in a rapid but controlled fashion to the following:
 - Carrier Grade Linux (access to more software technology)
 - COTS hardware, SAF flexibility, (R&D cost avoidance, flexibility)
 - **Multicore and Virtualization architectures**
 - (cost, performance, and footprint)

- Need to leverage over 1 billion lines of valuable telecom software assets

Multicore Processing – A Logical Move for Next Generation Networking

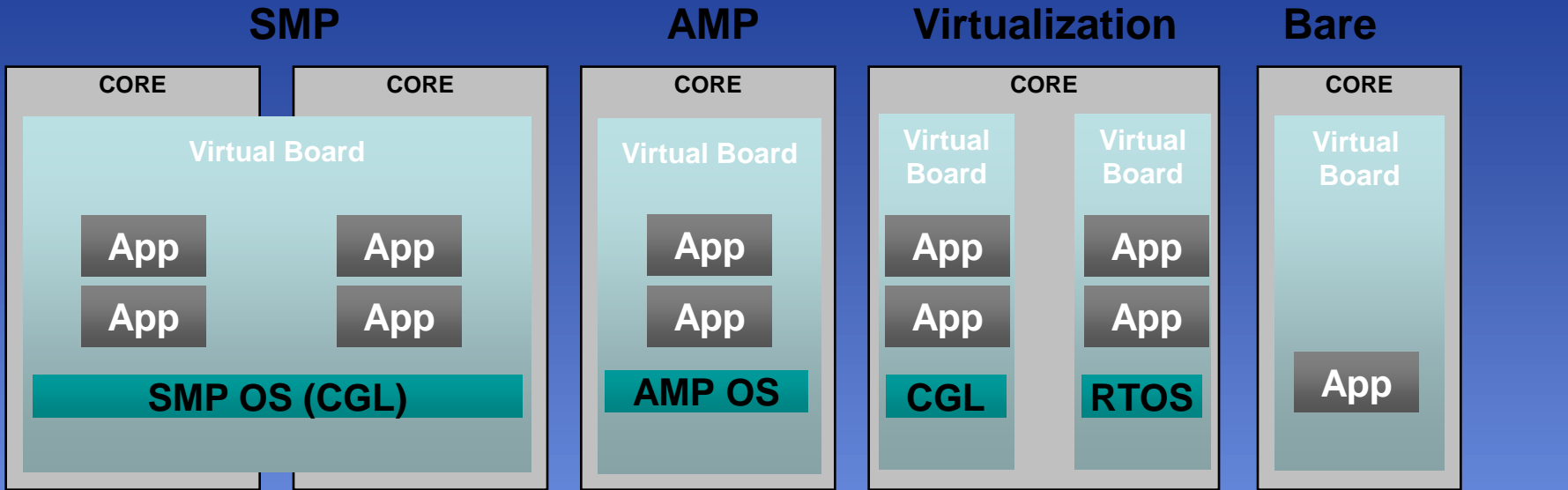
2009 Multicore CPUs Used, Vertical Market (us\$ spend)



Venture Development Corporation

- Increased Processing Power
- Smaller Footprint with Better Efficiency
- Greater flexibility
 - packet processing, control functions, and operating system all running on the same device

Multicore Enables Complex Solutions



- Single OS
- Load balances across cores - even at rapidly changing loads
- Can approach a linear increase in speed when more cores are added
- Application need not be written for particular number of cores

- Separate OS for each processor
- Typically higher OS performance than SMP, benefit depends on OS usage
- One OS could continue running when another is down
- Protection between operating systems isolates faults
- More scalable than SMP

- Can run two or more OS on one core
- Better core utilization per OS
- One operating system could be provided with real-time response through priority scheduling
- Rapid load balancing between operating systems

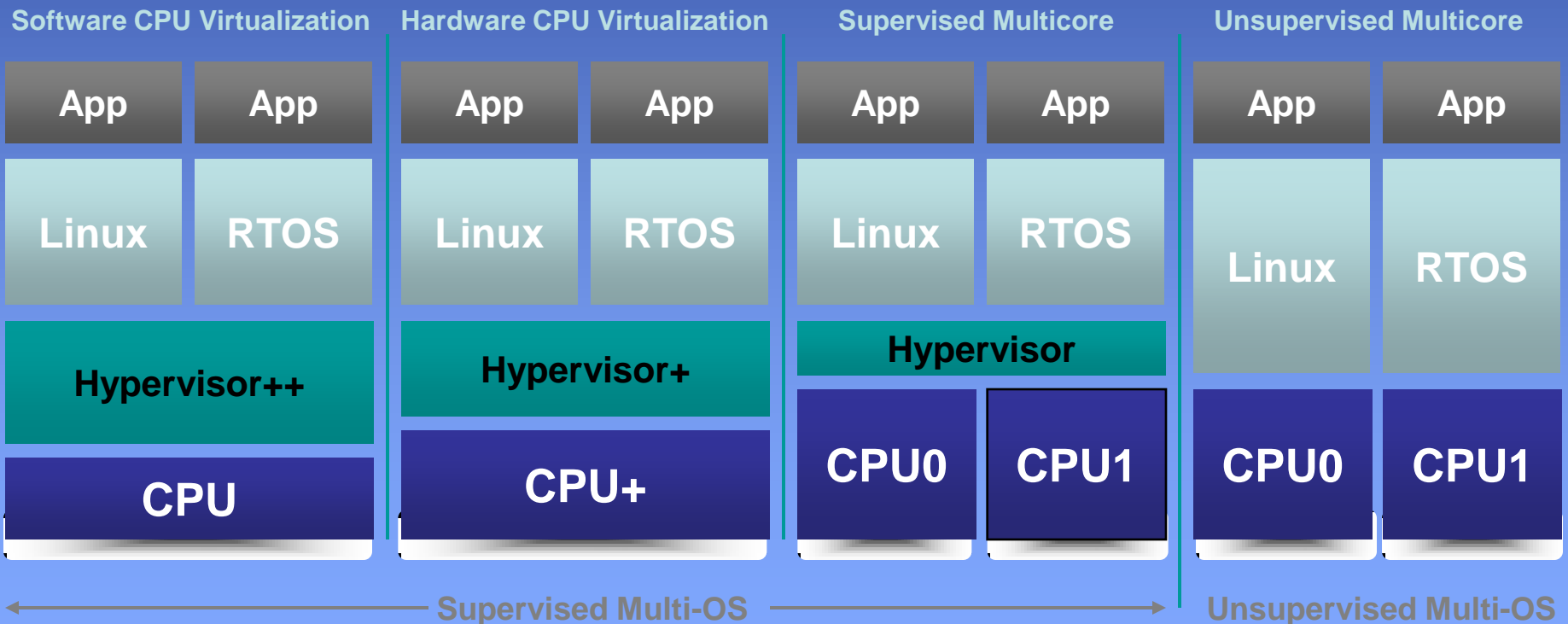
- Usually used together with an AMP/SMP OS configuration
- Provides very high performance
- Scales well with a highly parallel application

The Virtualization and Multicore Continuum

Both CPU virtualization and multicore enable multi-OS.

A supervised system with a hypervisor can additionally:

1. Virtualize, manage, and supervise CPU cores, memory, or devices
2. Provide system protection from OS-level fault propagation



Virtualization: Enterprise vs. Device Space

- Enterprise Market
 - Virtualization is a technology to consolidate servers to save on hardware, maintenance, and energy costs
- Device Market
 - Problems are more varied and complex
 - Tools become more complex
 - It's not clear what the right solution is for a given application

Key Virtualization Problems

Business Goal	Business Challenge	Description
Migration / Evolution	Time to Market & Risk	Legacy code on existing OS must run alongside new applications written for a newer or different OS
Complex System	Cost	Need both RTOS and GPOS on the same board
System Consolidation	Cost	consolidation of hardware
Demanding Application	Cost	overhead too high, increase performance by running on “bare metal”
Code reuse, portability	Time to Market / Cost	Lack of isolation from hardware causes portability and scalability problems
Complex, Connected System	Quality/Reliability	Poor reliability and/or availability for very large applications improved by separation/isolation

Virtualization Use Cases

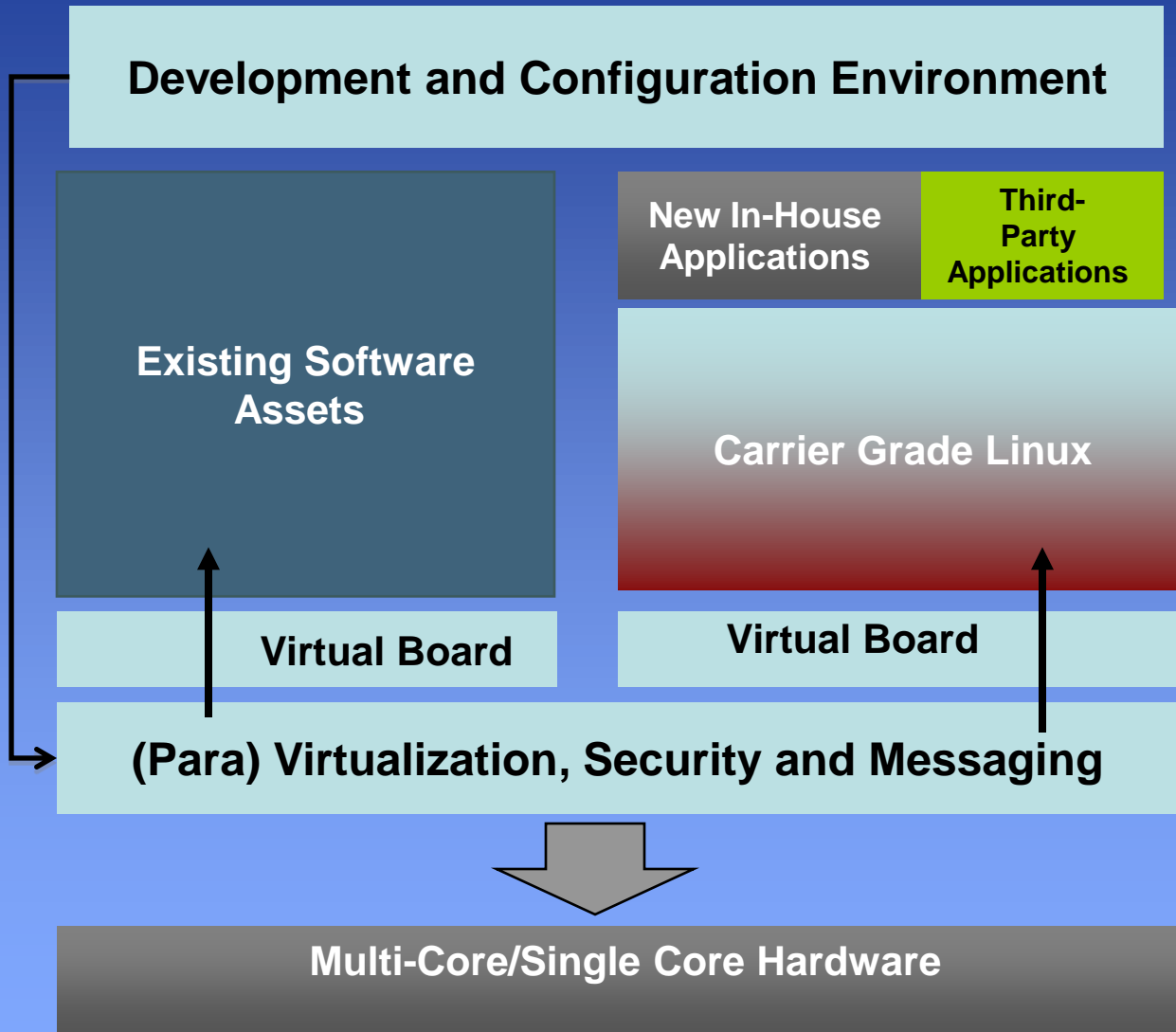
- **Costs – Cap Ex**
 - Convergence of different products into one hardware platform
 - Hardware consolidation: two boards become one

- **Legacy Application Support and Migration**
 - Coexistence of dual OS on single-core or multicore devices
 - Migration of applications from one OS to Platform for Network Equipment (Temporary Bridge)
 - Legacy code runs complete with legacy OS, concurrently with new applications on new OS (Perpetual Bridge)

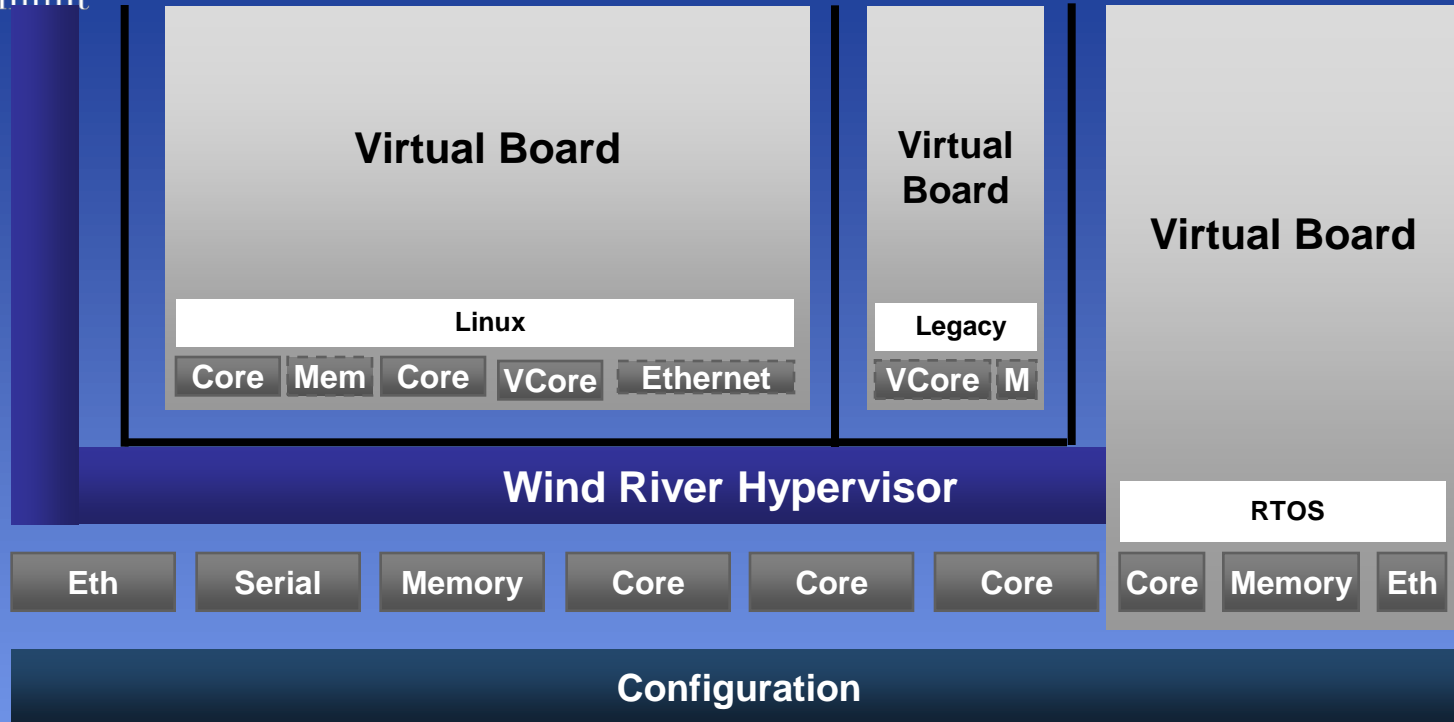
- **Performance and Security**
 - Scaling of legacy O/S on Multi-Core
 - Large application reliability increased by using separation

- **Software Upgrades**
 - E.g. VxWorks to VxWorks, Linux to Linux

Legacy Application Support and Migration Use Case



Protection and Zero-Overhead



- Linux and Legacy are protected from each other, but not from RTOS
- RTOS is protected from all other guests
- RTOS directly accesses all its hardware, Hypervisor does not execute on RTOS core

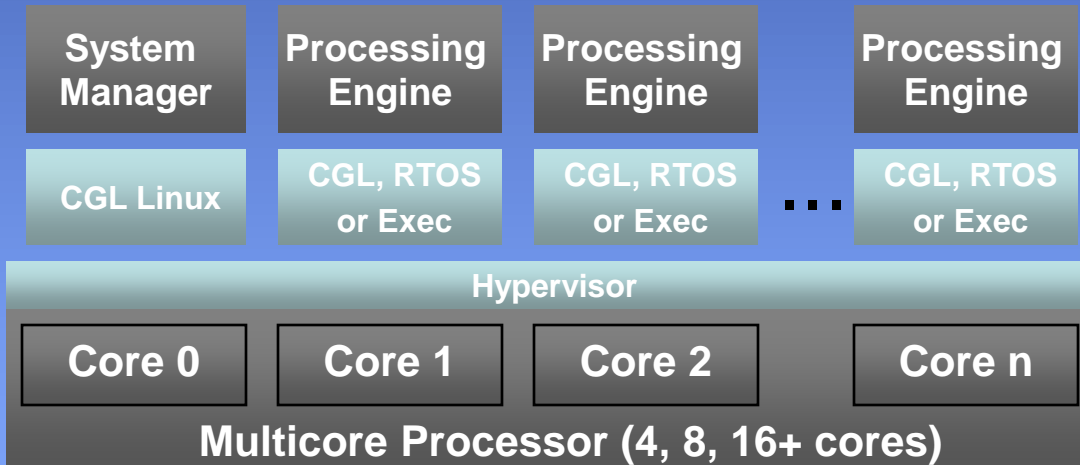
Processor Offload Use Case

Business Concern(s)

- **Cost**
- **Performance**

Usage Scenario(s)

- **Performance**
- **Consolidation**
- **Protection/Reliability**
- **Separation**



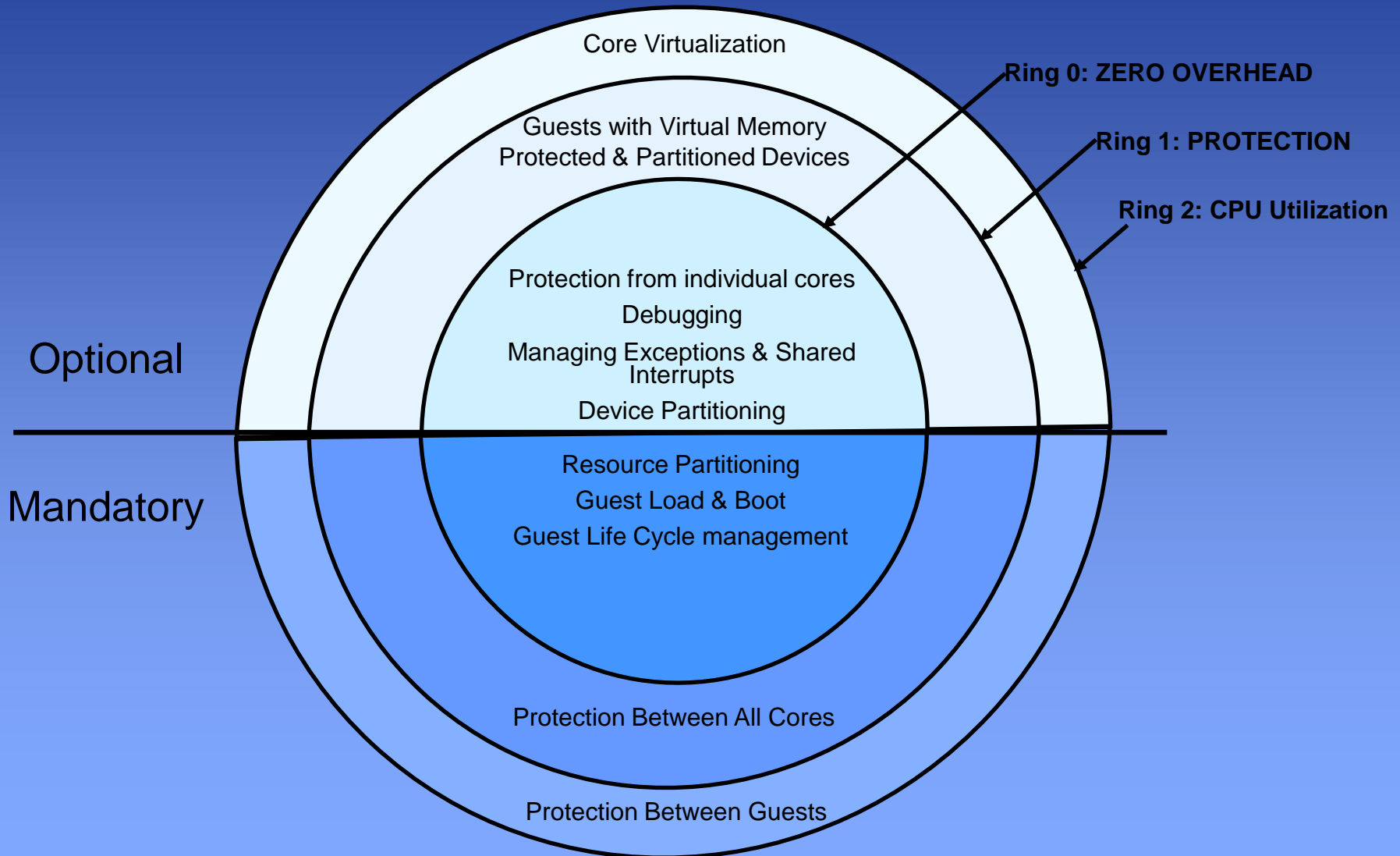
What is a Scalable Hypervisor?

- Virtualization - abstraction of computer resources (cores, memory, devices, etc.) , hiding the physical characteristics from the end user (OS or Application)

- Hypervisor - (also: virtual machine monitor) is a virtualization platform that allows multiple operating systems to run on a host computer at the same time”

- Scalable Hypervisor:
 - the degree of virtualization is configurable
 - creates “virtual boards” which are partitions of the physical hardware, each partition is assigned a guest operating system
 - virtual boards have a configurable level of protection from each other (from 0% runtime overhead)

Key Functions of a Scalable Hypervisor



Components of Multicore/Virtualization Solution

- Flexible multicore software configurations (SMP/AMP/Virtualization) for single and multicore devices
 - Advanced capabilities for boot, IPC, reliability and network offloading.
- Scalability allows balancing of security, reliability and safety against performance and footprint
- Extensive hardware support (PPC, Intel, MIPS, ARM)
- Leading Operating Systems
 - Real-time (VxWorks), General Purpose (Wind River Linux), and flexibility to support other operating systems and executives
- Advanced tools to manage complexity
 - Debug, profile, and optimize entire multicore and multi-OS systems

Summary

Benefits of Virtualization and COTS

- Choice and Flexibility: Build solutions with SMP, AMP, VT running Bare Metal, Linux, RTOS
- Bridge to the Future: Take advantage of the benefits of Multicore and CGL without porting legacy applications
- Standardization: Implement a common framework for configuration, build, debugging, IPC, device sharing, remote resources, health management
- Large Ecosystem: Leading innovators in multicore and virtualization technologies – Intel, Freescale, Cavium, Raza Micro, etc. all supporting CGL

Wind River Virtualization

- Leverages Wind River's expertise in safety critical and secure virtualization for aerospace and defense.
- Optimal integration with Wind River operating systems and open/flexible to support other operating systems
- Extensive hardware support (PPC, Intel, MIPS, ARM)
- Scalability allows balancing of security, reliability and safety against performance and footprint
- Wind River Workbench to provide system level debug and optimization of partitioned systems
- Wind River virtualization is a part of a Multicore Software Solution

- Multi-OS AMP designs are workable and the best solution in some situations.

- Introducing a hypervisor provides advantages:
 - Development productivity (automated partitioning, fewer faults, debug improvements)
 - More robust systems (memory protection, interrupt handling, lifecycle management)
 - Optimization of hardware resources (shared resources, core virtualization, leverage hardware virtualization features)

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