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F2B Multicore Technology
Making Multicore Work for Your Design

Glenn Seiler
Senior Director, Networking and Telecom Market Development
Wind River Systems

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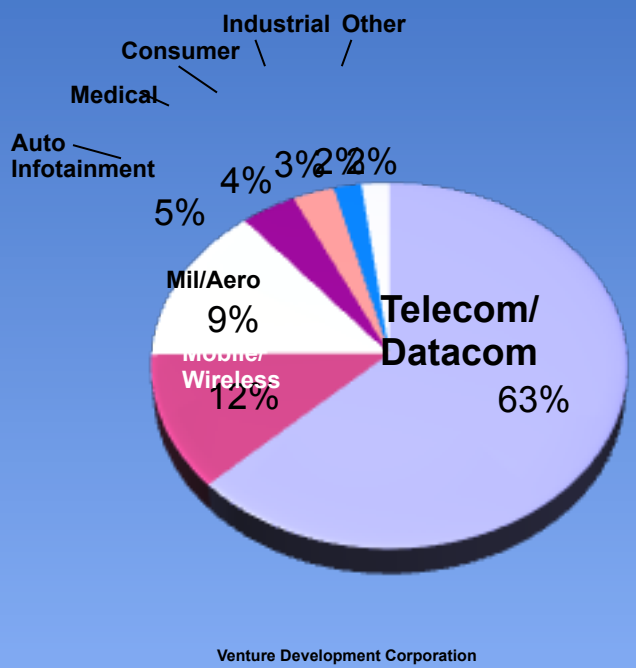
Multicore Processing – A Logical Move for Next Generation Networking

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

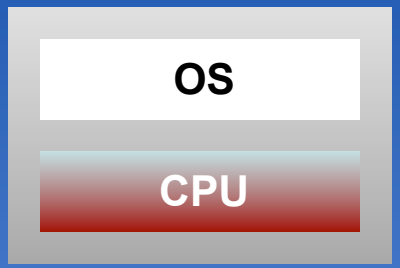


Venture Development Corporation

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

What Does Multicore Really Mean

Old School



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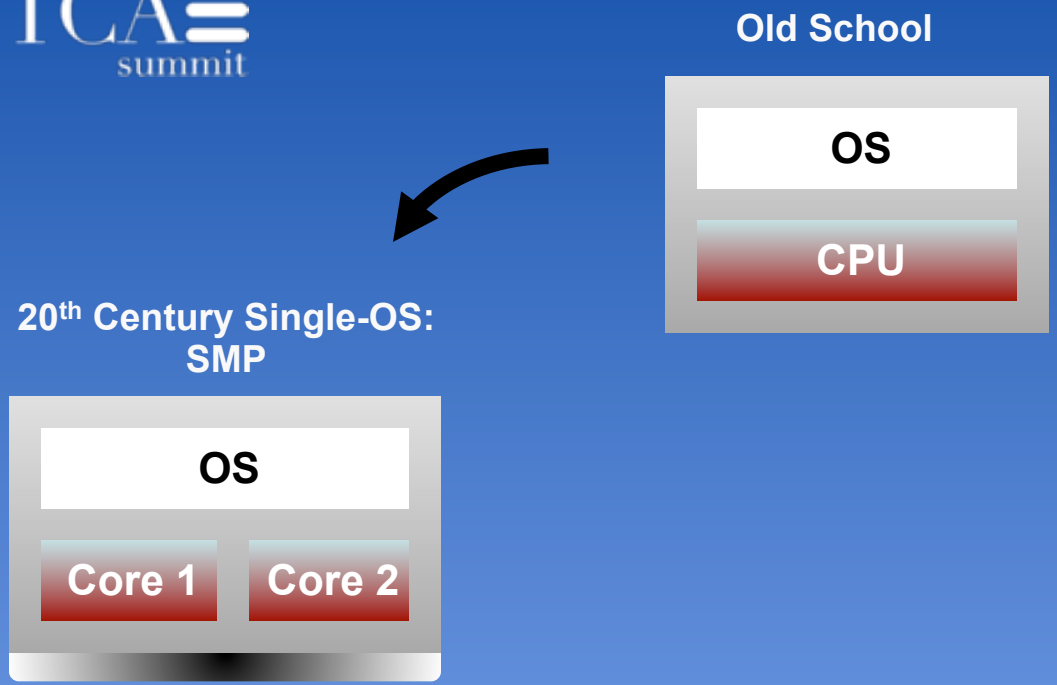

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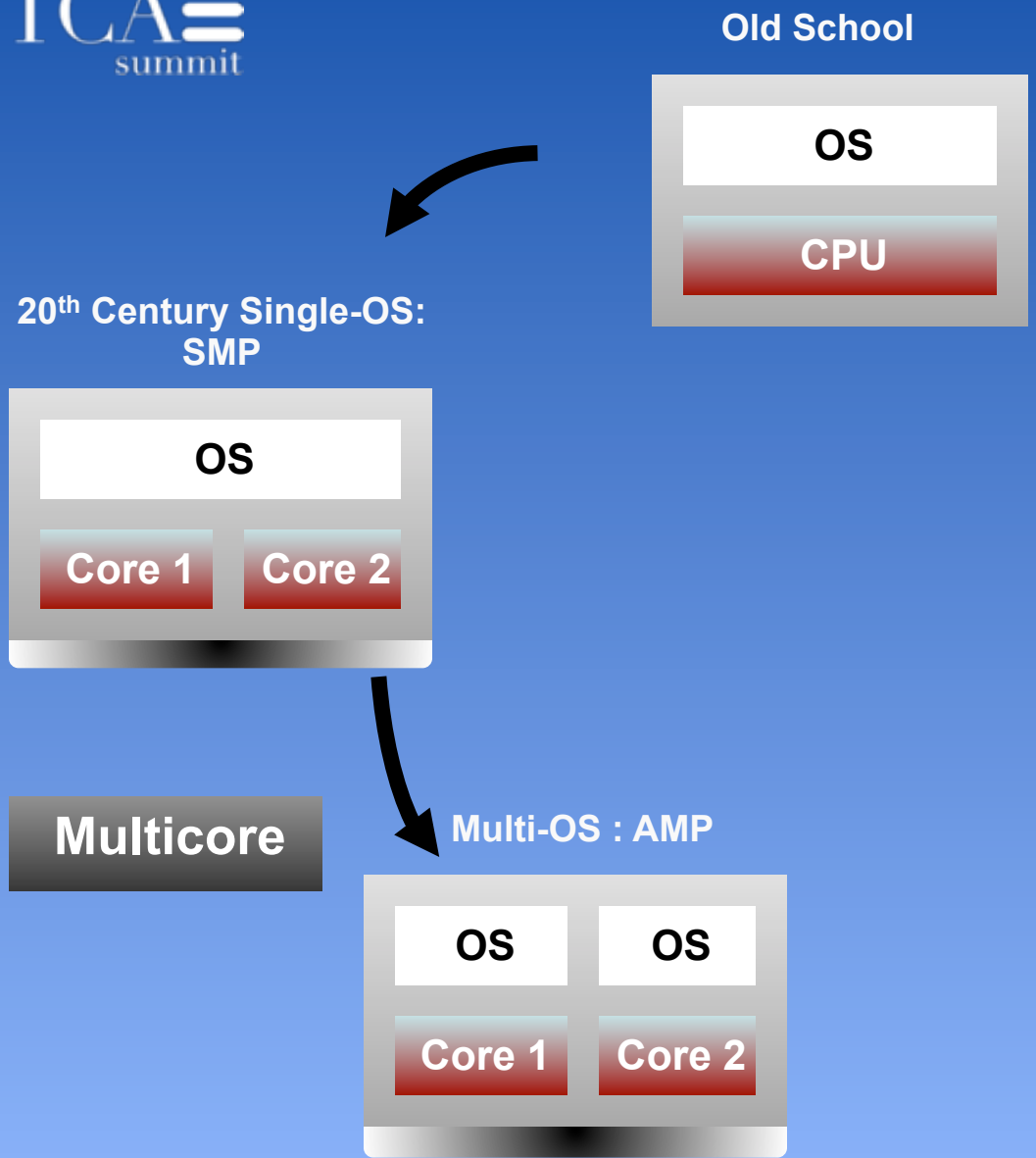

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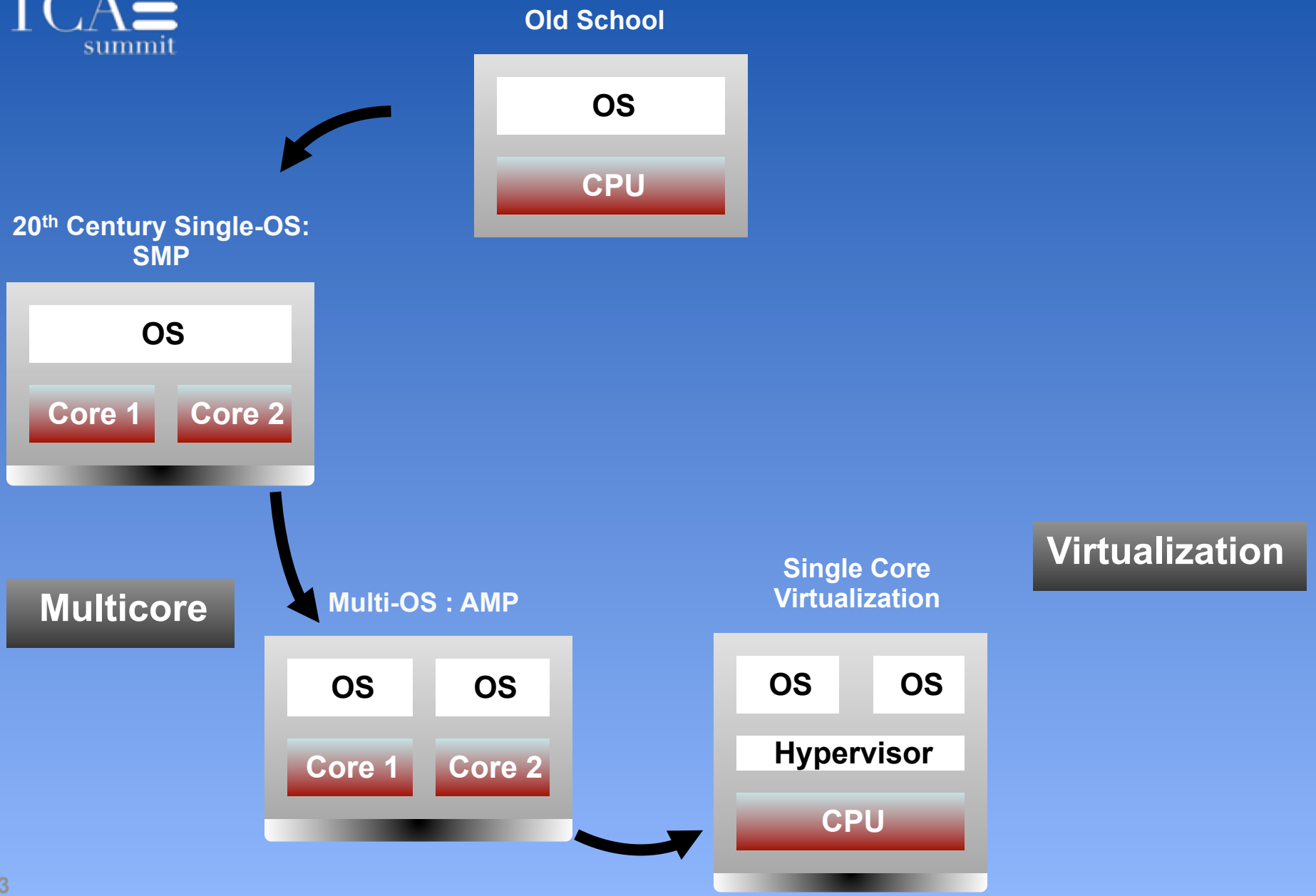

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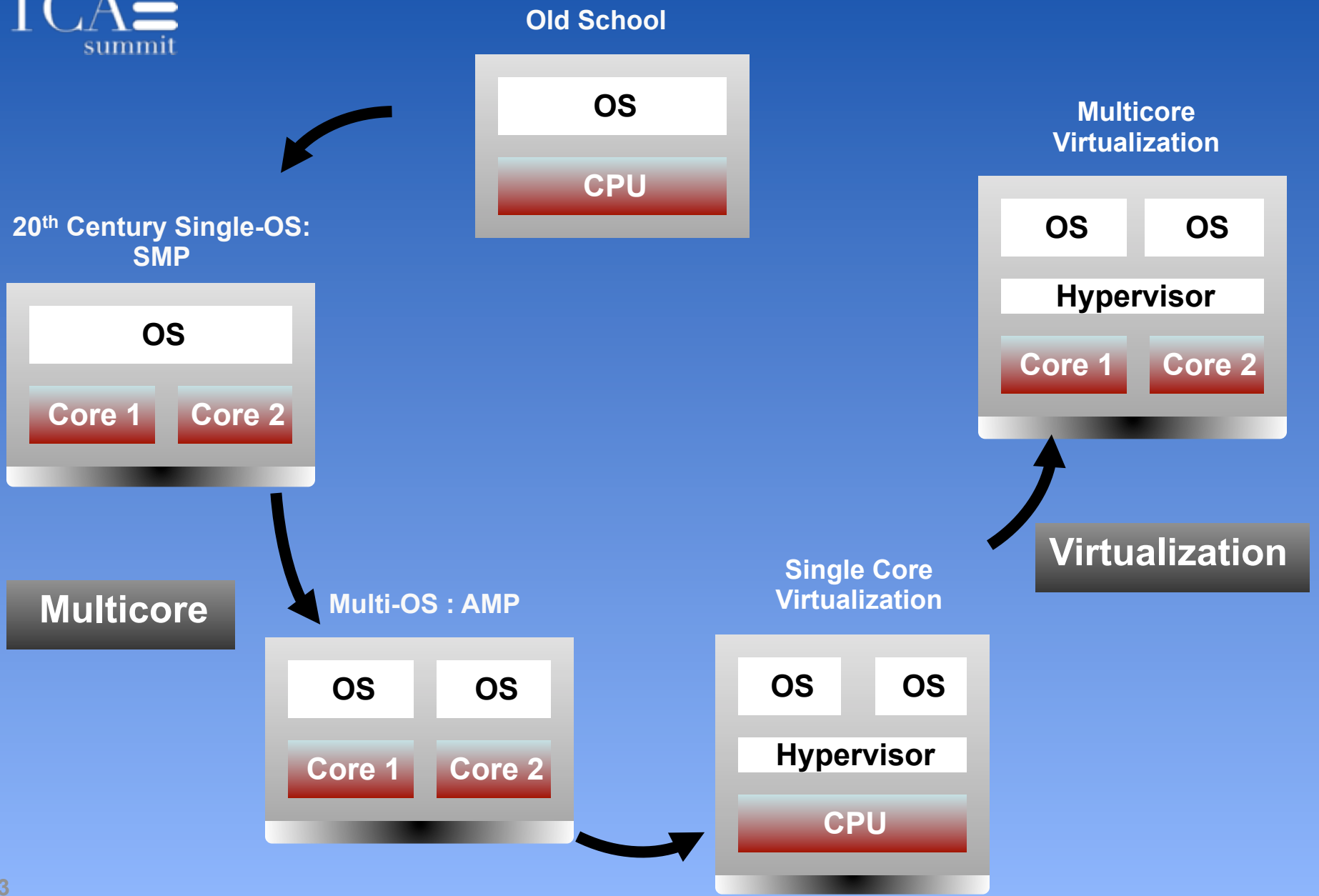

Multicore and/or Virtualization Usage Scenarios

Business Drivers

- **Cost**
- **Time to Market**
- **Competitive Products**

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Multicore and/or Virtualization Requirements Drivers

- Performance
- Consolidation
- Separation/Security
- Migration/Evolution
- Usability
- Portability/Scalability
- Certification
- Reliability

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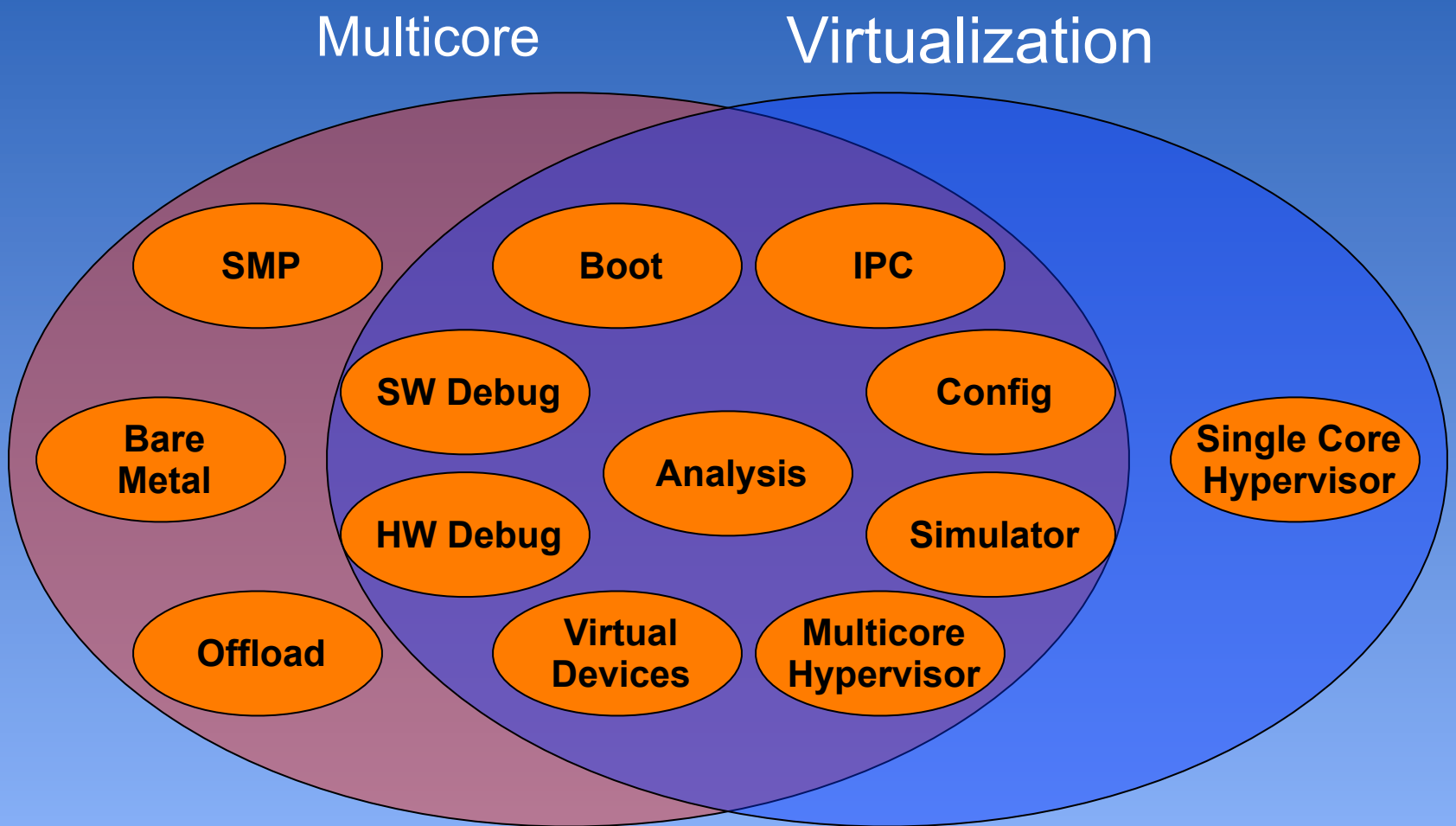
Initial interest often comes from either a multicore or virtualization perspective, however capabilities that may have been initially thought of classified as one or the other will be applicable.

Complexity of Multicore and Virtualization



What Is Your Path To Multicore?

- **Million dollar question**
  - **And not a single silver bullet**
- **It depends where you come from**
- **It depends on where you want to go**

Choosing SMP

- Use SMP when
  - Application is already multi-threaded, or is easy to multi-thread
  - Tasks/threads need to share data frequently
  - Load balancing is important
  - Application portability across different hardware is essential
- Things to watch for with SMP
  - SMP kernels have higher overhead than uniprocessor kernels
  - The same task/thread on an SMP OS is slightly slower than on a uniprocessor system
  - SMP systems require you to debug in a less deterministic, less familiar, and more complex application execution environment
  - Latent SW defects are likely to be exposed

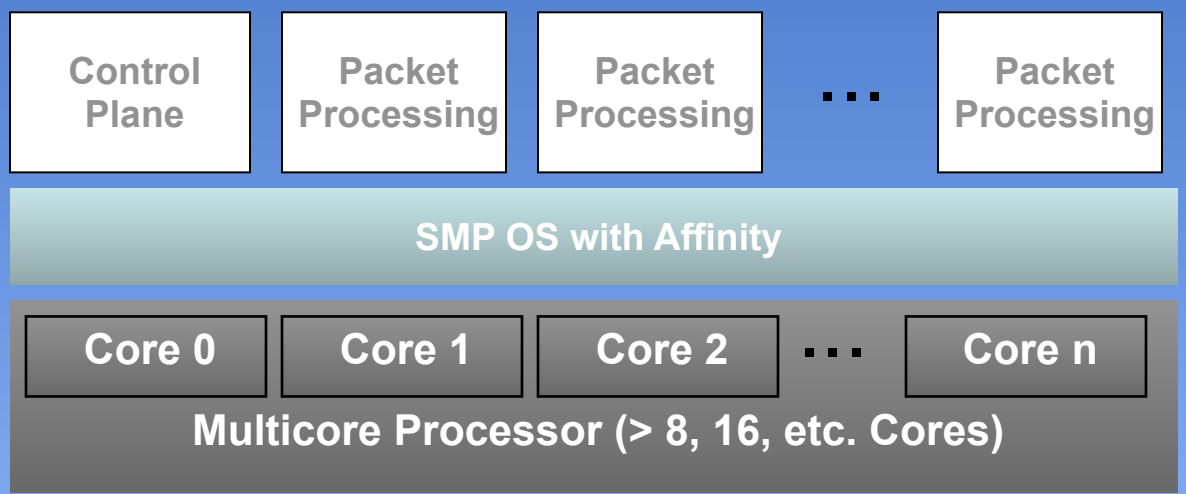
Choosing AMP

- Use AMP when
  - Application is easy to partition into loosely coupled “nodes”
  - Redundancy is needed for reliability
  - Hardware configuration is not suitable for SMP
  - Multiple processor or OS types are desirable
  - Assignment of applications to HW resources must be explicit
  - Minimum scheduling overhead is required
- Things to watch for with AMP
  - AMP design may use more memory (multiple OS images)
  - System needs to be tuned for that hardware configuration
  - Complexity of setting up communications between cores & debugging
  - AMP requires you to debug subsystems independently

Case Study: Networking Offload

Business Concern(s)

- Cost (Hardware, Development)
- Performance



SMP Configuration

- Easy SW migration if already concurrent
- OS handles things
- Less developer control
- Not ideal for cases requiring two different OS

Case Study: Networking Offload

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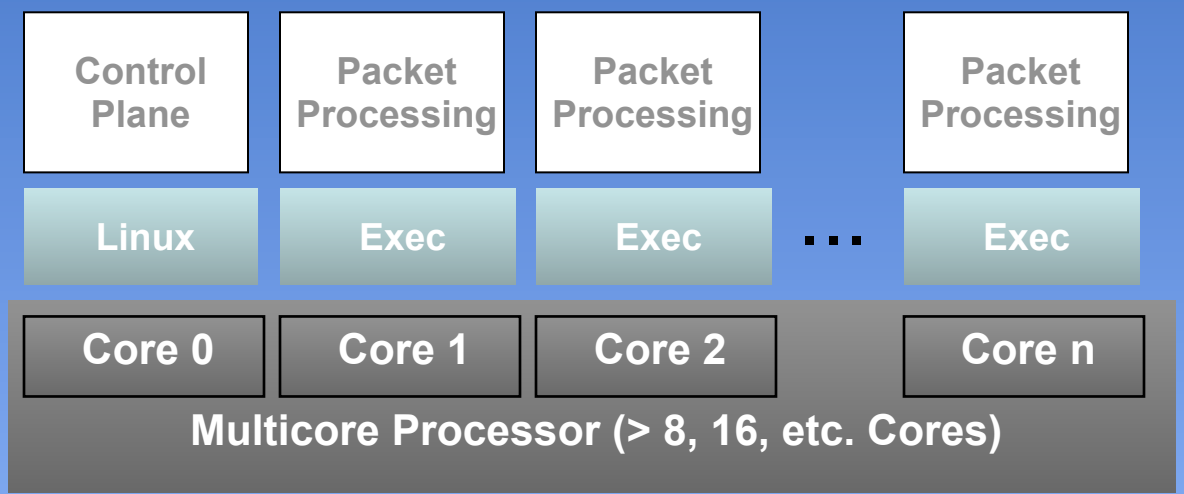


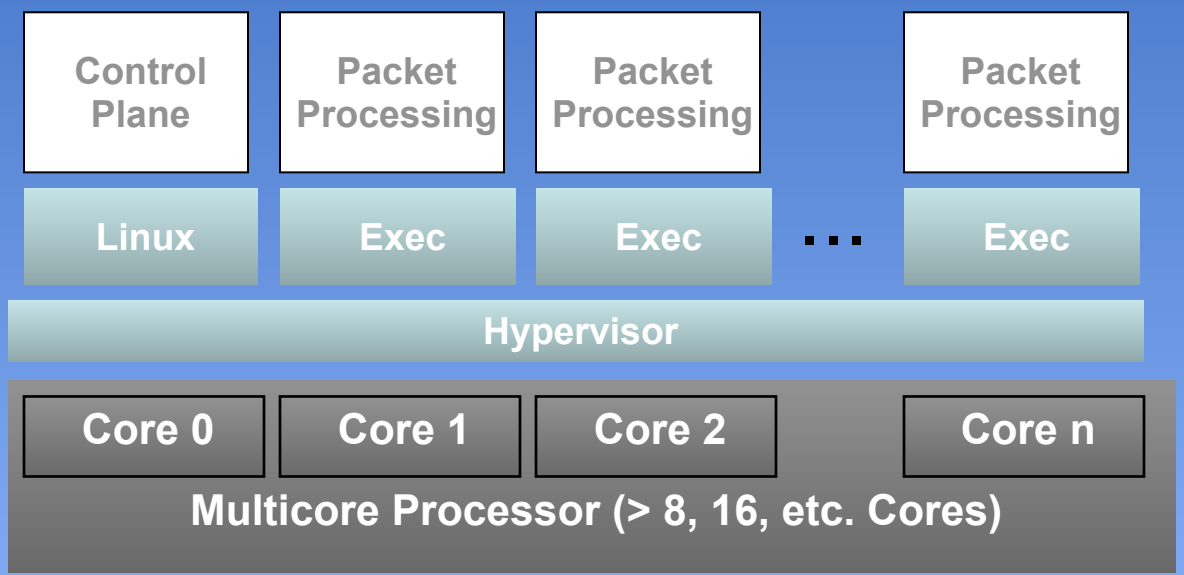
AMP Configuration

- Multiple OS, core loading
- More developer control
- Manual partitioning required
- Must deal with concurrent execution

Case Study: Networking Offload

Business Concern(s)

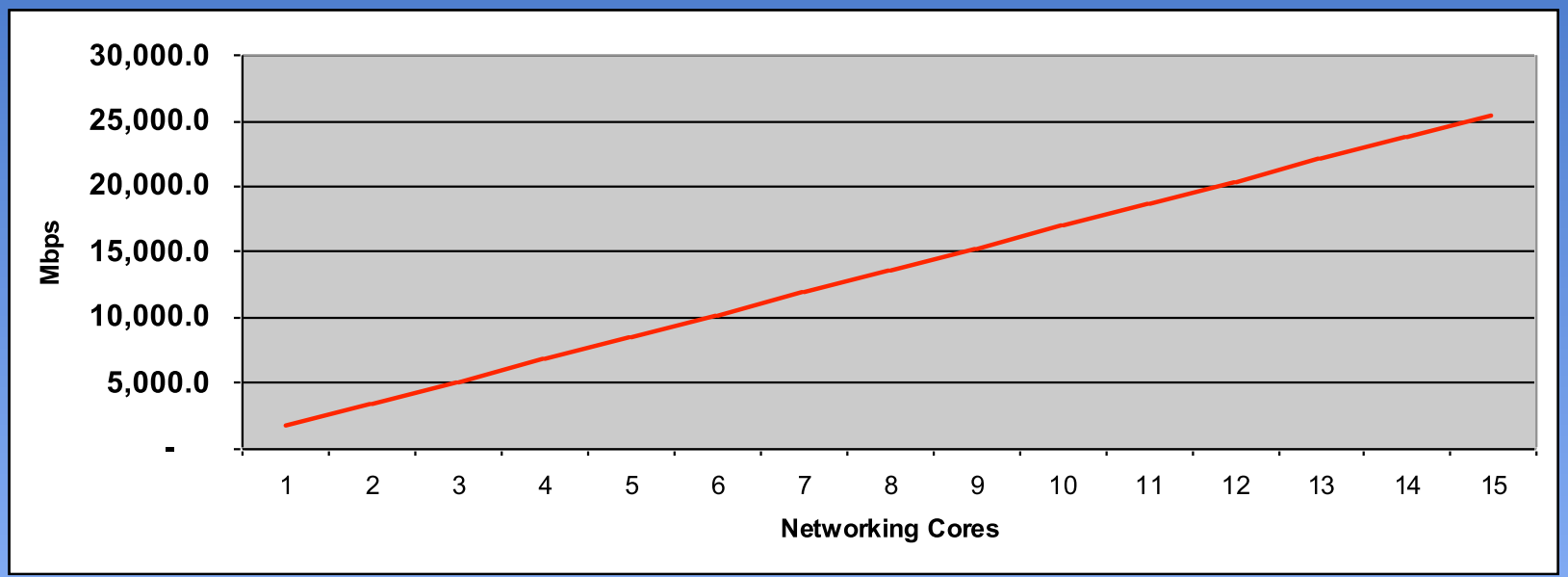
- Cost (Hardware, Development)
- Performance
- Reliability and Security



- Managed AMP
- Automated load, lifecycle mgmt.
- Memory Protection – robustness with low to no overhead

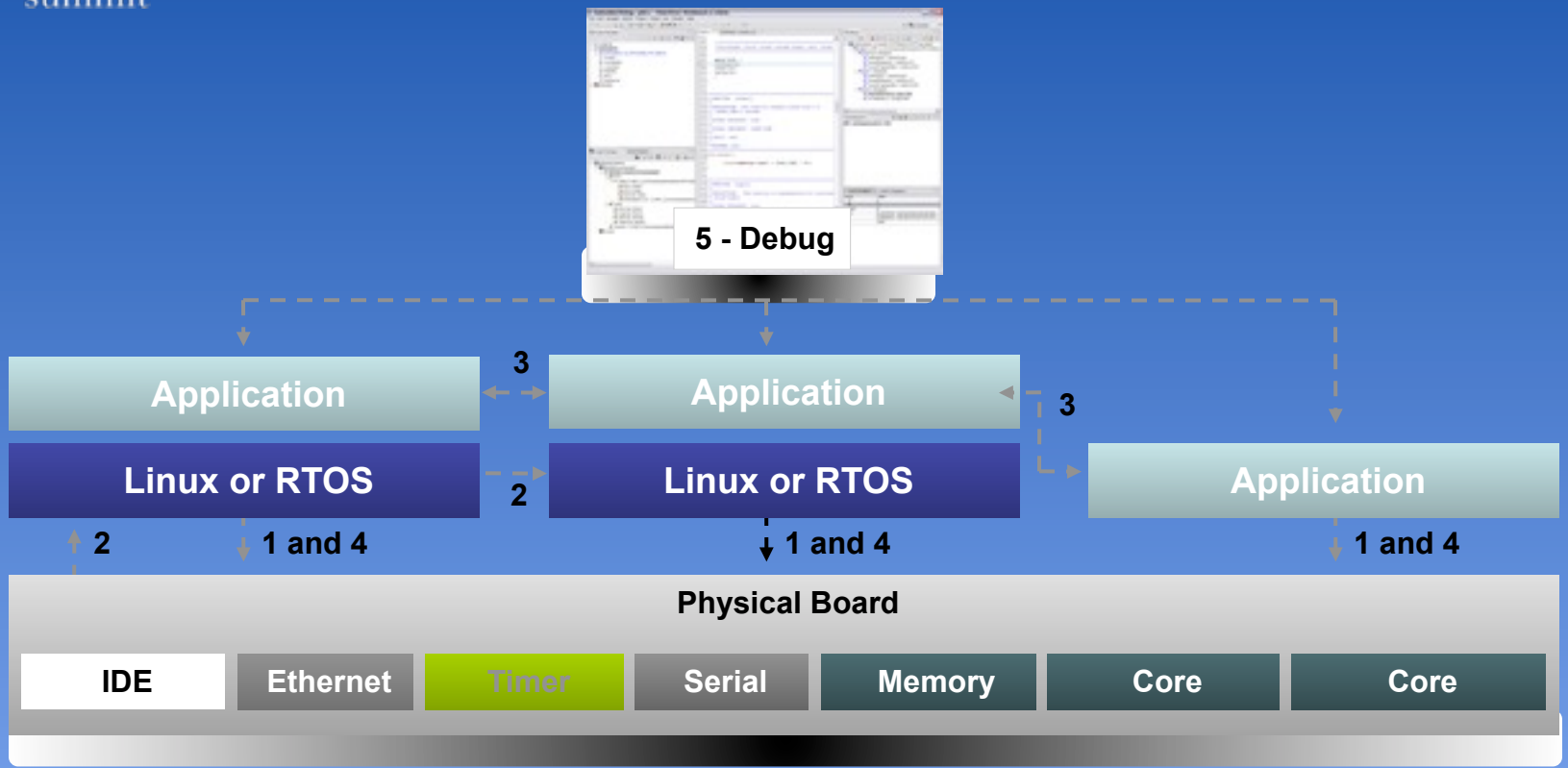
Linear Scaling of Networking Performance

- Each Network Acceleration Engine can forward 2.5 million packets per second*
  - Independent of packet size
  - No 'flattening' of the performance curve when adding cores



** 800 Mhz 5860, 667 Mhz memory*

Challenges of a Multi-OS Solution



1. Hardware resource partitioning
2. Multi-OS booting
3. High-speed IPC
4. Resource access/sharing (consoles, network interfaces, file IO)
5. Debug connectivity

Challenges of Multiprocessing/Multicore

- Application: How well-suited is it to multiprocessing?
  - Is a new algorithm needed?
- System Design: What is the best way to partition the work and resources?
  - Hardware, operating system, middleware, and algorithm choices
  - Partitioning, communication, synchronization
  - Bottlenecks, resource contention, and poor use of resources
  - Scalability
- Software Development and Test: What will it take to get software working and performing in the multiprocessing environment?
  - Software that used to work must be partitioned and made multiprocessing-safe
  - Multiprocessing applications are inherently more complex and difficult to debug
  - Developers must think differently
  - Is middleware available that takes advantage of multiprocessing?
  - Reuse or rewrite existing software

Components of a Future-Proof Multicore SW Solution

- **Flexible multicore software configurations (SMP/AMP/ Virtualization and combinations thereof)**
- **Support for real-time (RTOS) and general purpose (Linux) OSs - and the openess/flexibility to support other operating systems and executives**
- **High speed, transparent, and/or secure IPC infrastructure across board, core, and operating system boundaries**
- **Optimized middleware for multicore (networking offload/ crypto)**
- **Tools to configure, debug, analyze, and optimize entire multicore and multi-OS systems**

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Multicore Summary

- Moving to multicore is inevitable
- Multicore is both data-plane and control-plane
  - Though often very different use cases
- Multicore is for large core/edge devices and small access/cpe devices
  - Multicore in residential gateways and LTE MME
- Multicore can change everything!!
  - Tools, OS, performance, design, costs - everything


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