Virtualizing the Locomotive: Ready, Set, Go!

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Imagination at work.
Presentation Disclosure

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Agenda

The Locomotive System

Use Cases for Virtualization

Hardware Platform

What’s Important to Us in Virtualization
Speaker Background

**Mark Kraeling**

- GE Transportation Cab Electronics
  - Products for Locomotive Onboard
  - Based in Melbourne, FL

- Product Manager/Architect
  - Wired/Wireless Communications
  - Linux and ARM®-based Designs
The Locomotive System
The Locomotive
It’s All About Information...
It’s All About Information...
Smart Data Processing

Want to process data onboard – offload alerts, data snippets, and messages when needed
Use Cases for Virtualization
What GE Transportation Did...

Single OS runs on a single hardware platform, typically with a collection of applications based on resources.
Virtualization Use Cases – Cost Reduction

Consolidation:
• Redeploy multiple discrete systems/domains onto a single multi-core processor

Benefits:
– Cost effective: bill-of-material, power
– Preserve investment: software re-use
– Improved hardware utilization
– Flexibility
Virtualization Use Cases – Reliability & Protection

Sandboxing:
- Add untrusted software to a system, e.g. operator applications
- Run GPL based software in isolation
- Run test software safely
- Isolate security-sensitive tasks: access rights control, rule definitions, key management, ...

High availability
- active/standby configuration without additional hardware
Virtualization Use Cases – Flexibility & Scalability

Run legacy software / OS on Linux
Add functionality to existing system by dropping in a VM
Use different versions of the Linux kernel
Better resource management
  • Allocation of physical CPUs / control CPU load
  • Create/destroy VMs as needed
Maps well to split workload
  • e.g. control plane, data plane
In-service upgrade
Virtualization Use Cases: Summary

**Cost Reduction**
- Consolidation
  - Multicore HW

**Flexibility and Scalability**
- Split Workload
  - Data Plane
    - OS
  - CTRL Plane
    - OS
- Dynamic Resource Management
  - Multicore HW

**Reliability and Protection**
- Sandboxing
  - Mutlicore HW
- Failover
  - Multicore HW

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Hardware Platform
Locomotive Chassis

Shift from Separate Boxes to Modules that Support Applications

- Simplification
- Reduced cost
- Free up space
- Redundancy
Linux Containers
Don’t Shoot the Messenger…
• Being considered for ARM®-based solutions where operating systems could share a common kernel
• Performance on 32-bit becomes important

Lightervisors
• LXC / LXD (OS)
• Docker / Rocket (Apps)
What’s Important to Us in Virtualization
KVM Execution

• Boot times not necessarily important – typically applications power-up and run for a very long time

• For 32-bit processors, need hypervisor to limit amount of resources that are required (low CPU and RAM memory overhead)
Local Management of Guests

- Need rules-based capability for HyperVisor to automatically restart guests, or even start a different guest
- HyperVisor to Guest handshaking/status
- Better pool management – HyperVisor can coordinate with others in the pool, and make smarter decisions including migration of guests where it makes sense
Standardized Imaging

- Probably something easy... but...
- Need non-UUID fixed ways to move entire HyperVisor images from one module to another
- Includes pooled pairs being able to be swapped out and have pools maintained (network-based rules)
Conclusions

- Virtualization is necessary for a locomotive mobile data center – many applications and data resources.
- 32-bit hardware (to date) has not quite had enough horsepower to run KVM effectively, but more work is required here.
- 64-bit hardware necessitates virtualization – must be able to leverage multiple applications on hardware.