# Xen Project 4.4: Features and Futures

Russell Pavlicek

Xen Project Evangelist
Citrix Systems

# About This Release

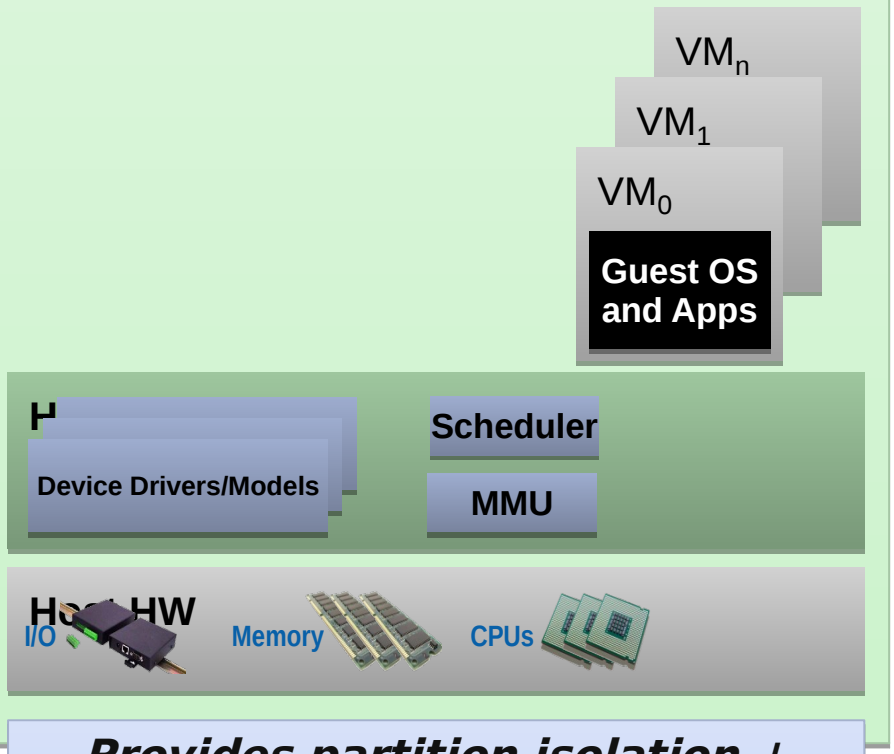
- Xen Project 4.4.0 was released on March 10, 2014.
- This release is the work of 8 months of development, with 1193 changesets.
- Xen Project 4.4 is our first release made with an attempt at a 6-month development cycle.
  - Between Christmas, and a few important blockers, we missed that by about 6 weeks; but still not too bad overall.

# Xen Project 101: Basics

# Hypervisor Architectures

## Type 1: Bare metal Hypervisor

A pure Hypervisor that runs directly on the hardware and hosts Guest OS's.




***Provides partition isolation + reliability, higher security***

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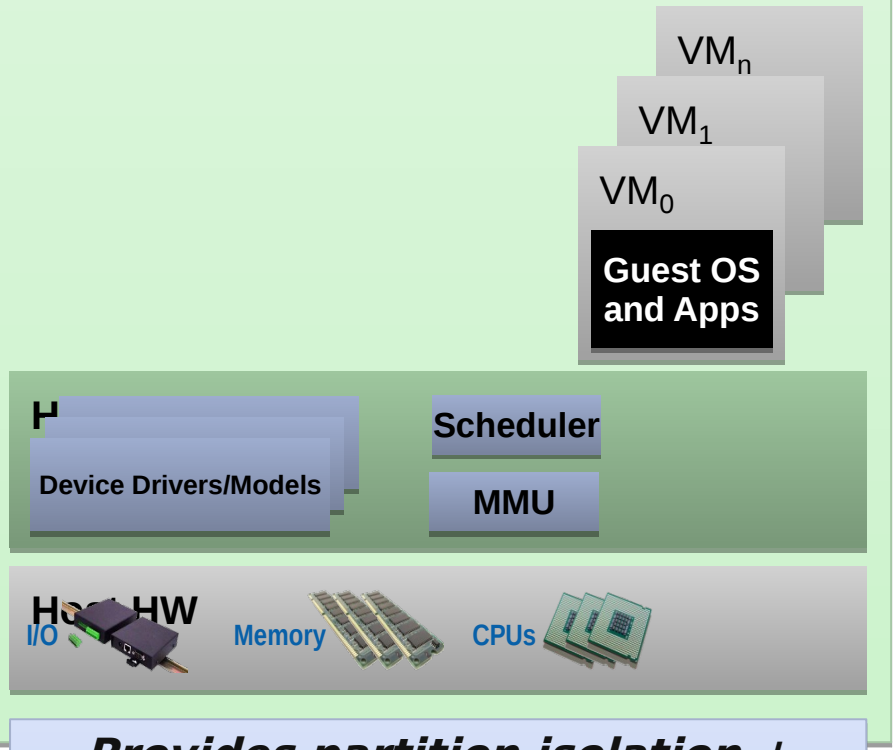
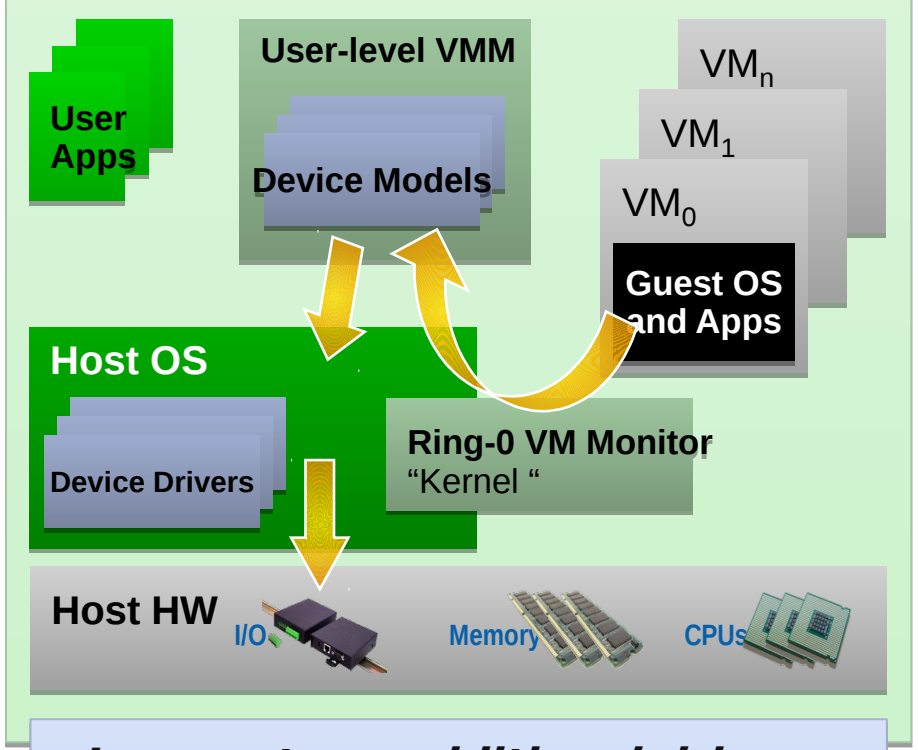



***Provides partition isolation + reliability, higher security***

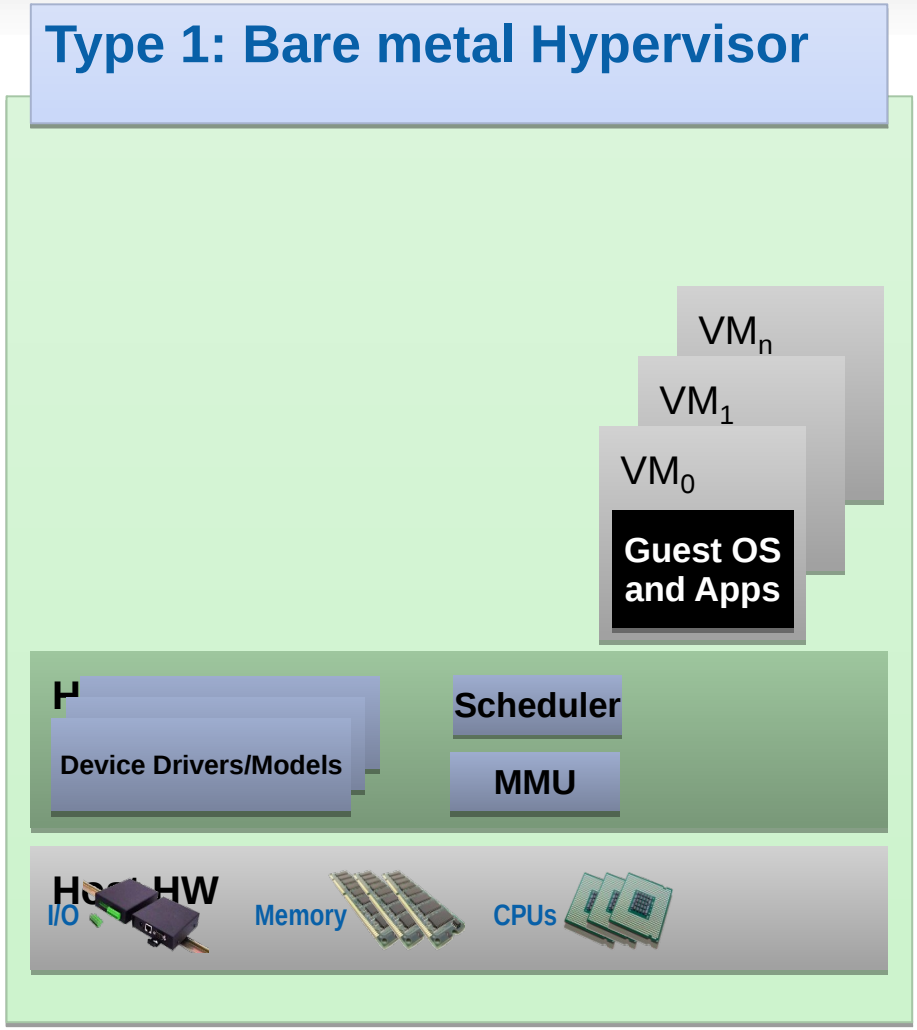
## Type 2: OS 'Hosted'

A Hypervisor that runs within a Host OS and hosts Guest OS's inside of it, using the host OS services to provide the virtual environment.




***Low cost, no additional drivers Ease of use & installation***

# Xen Project: Type 1 with a Twist



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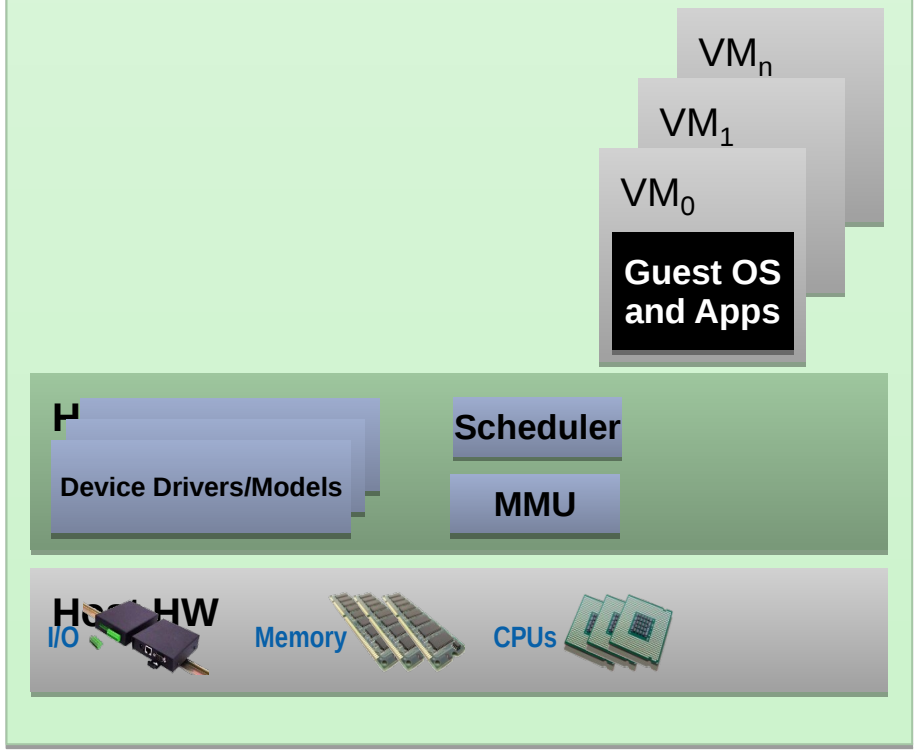
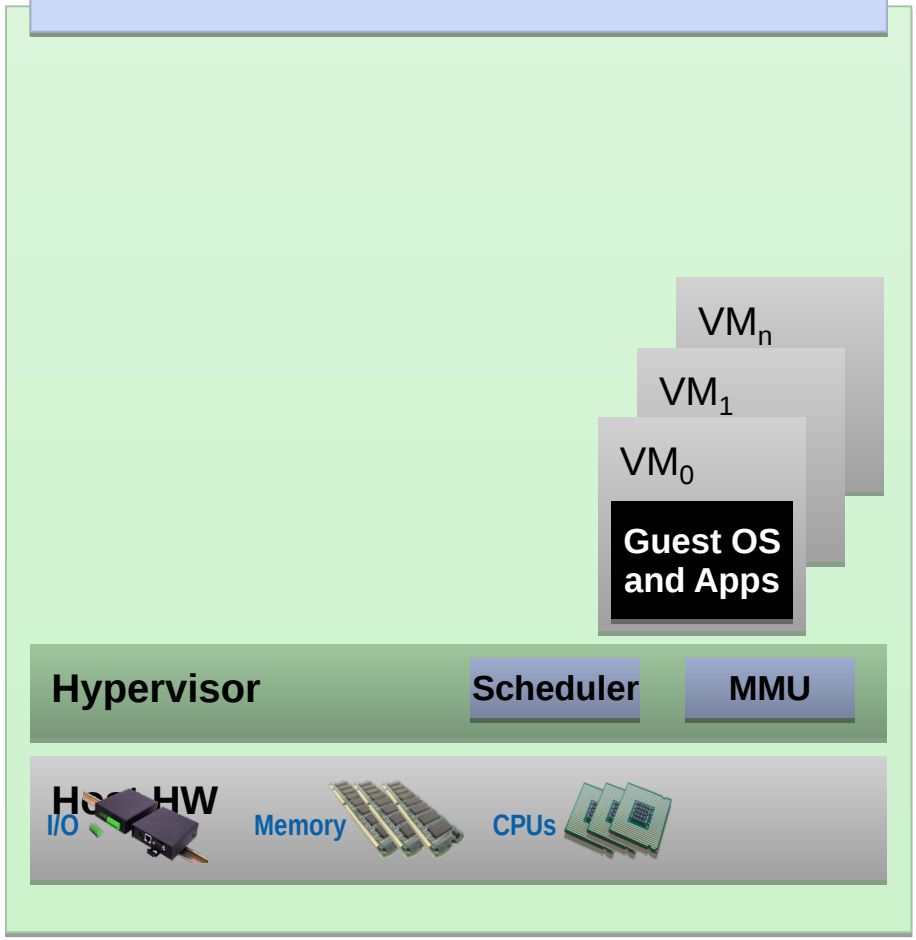



## Xen Architecture



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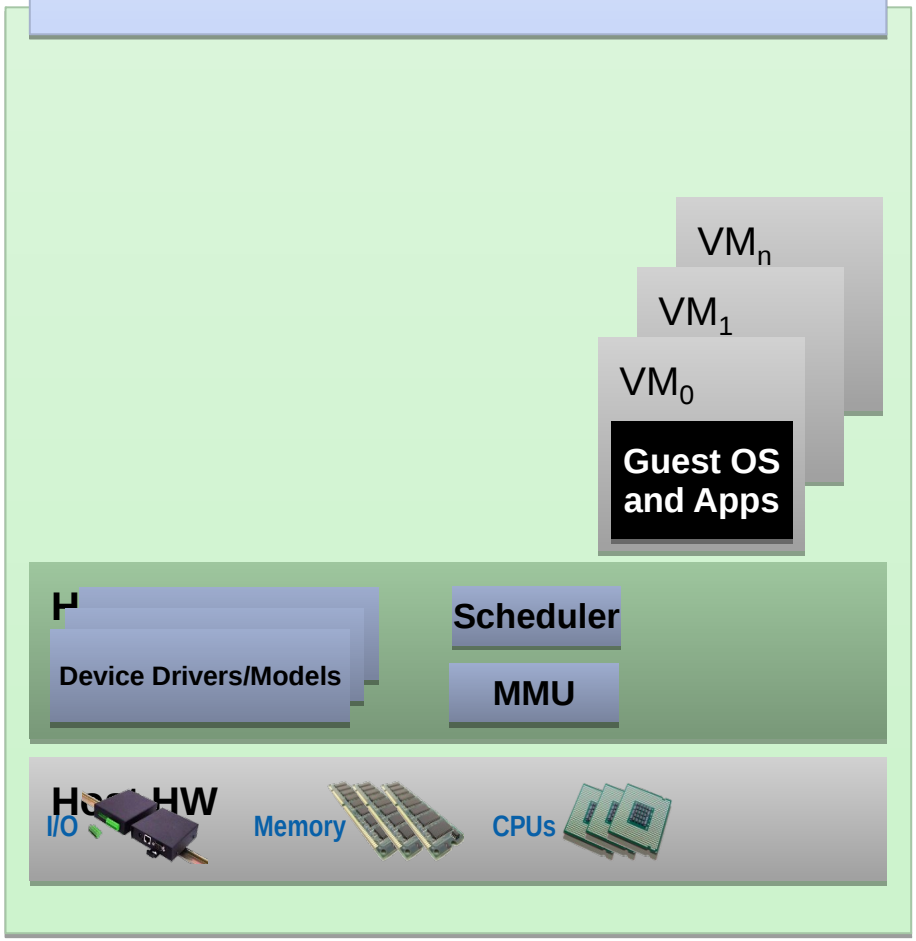


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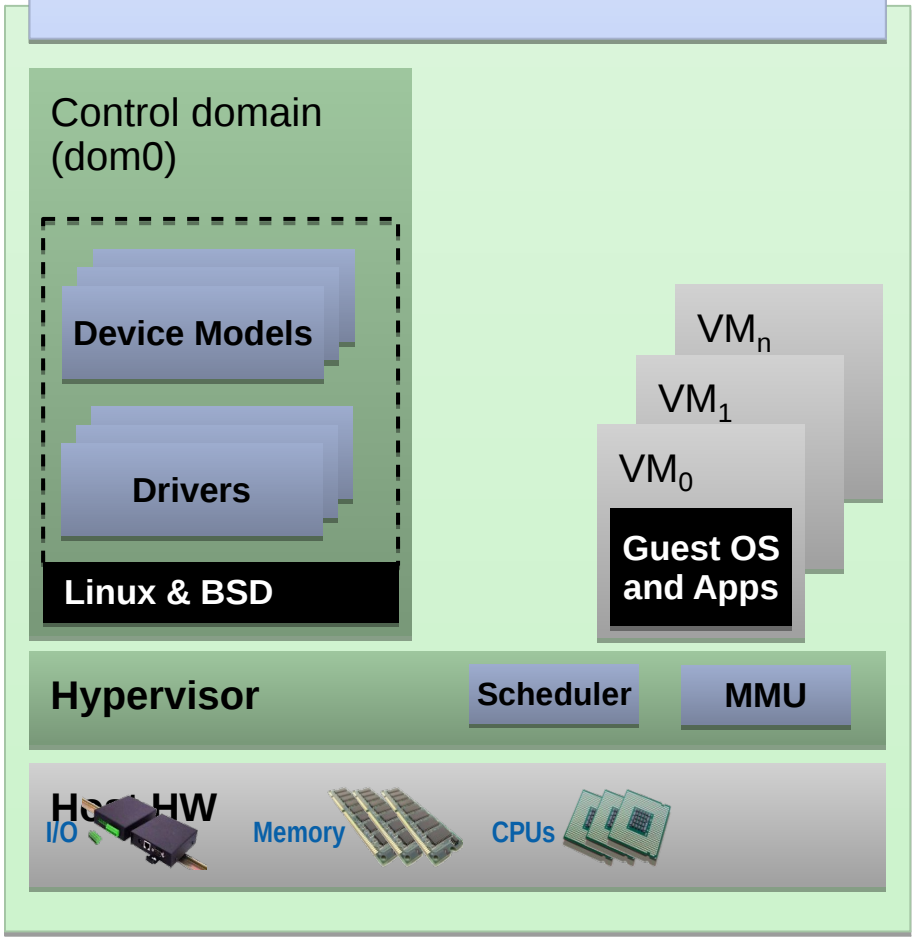
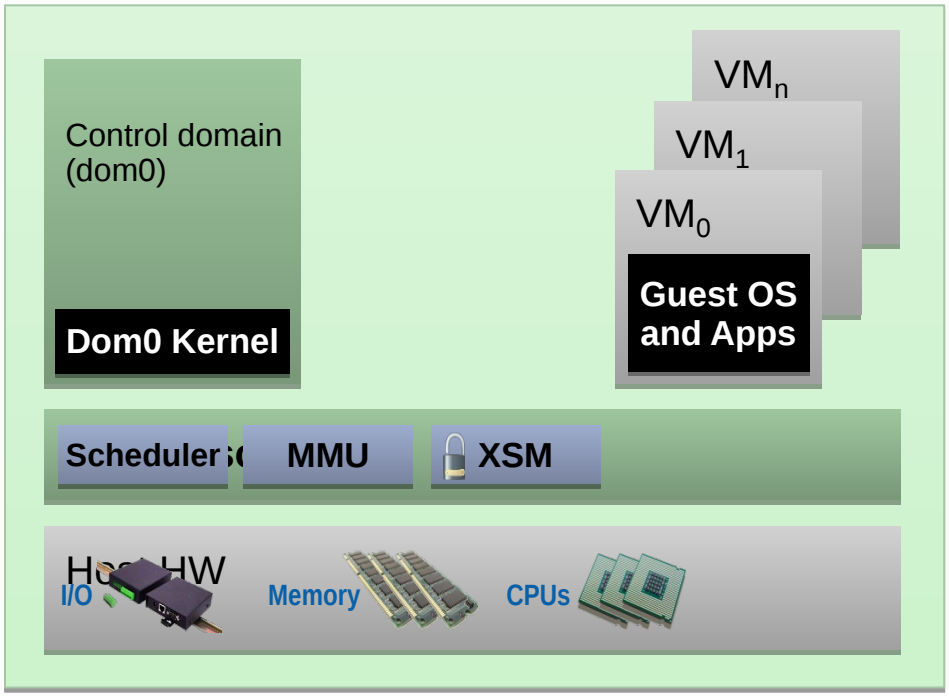


# Basic Xen Project Concepts




Trusted Computing Base

**Console**

- Interface to the outside world

**Control Domain aka Dom0**

- Dom0 kernel with drivers
- Xen Management Toolstack

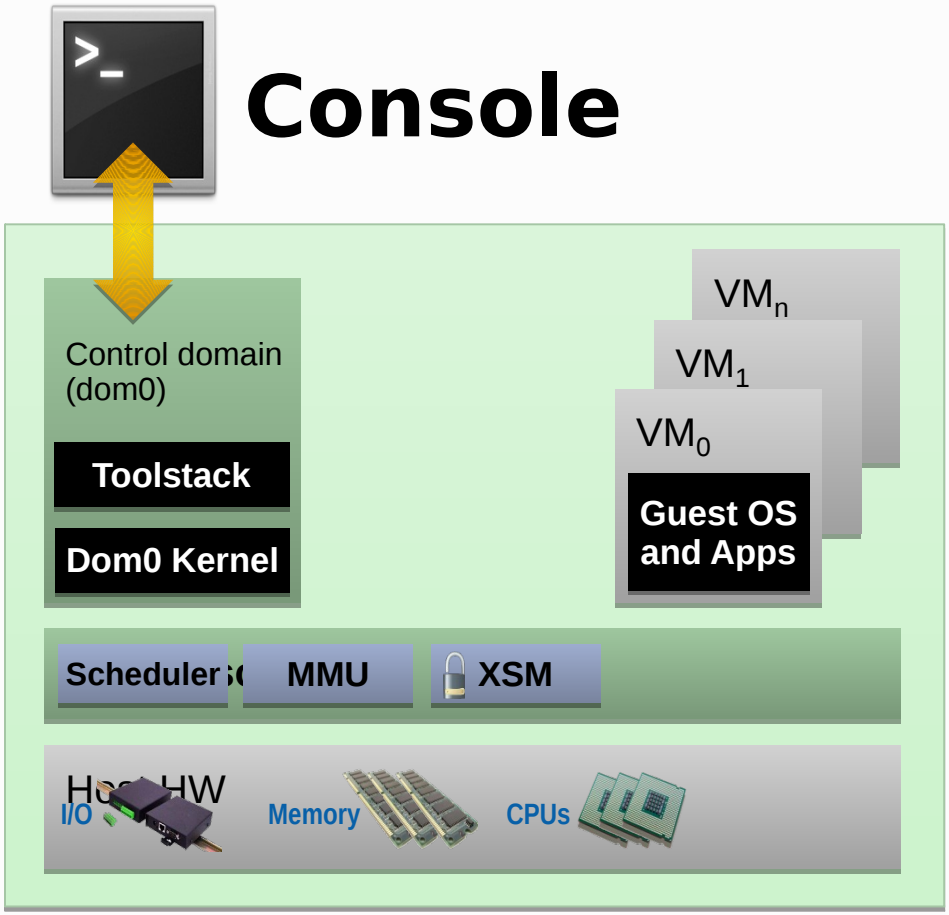
**Guest Domains**

- Your apps

**Driver/Stub/Service Domain(s)**

- A "driver, device model or control service in a box"
- De-privileged and isolated
- Lifetime: start, stop, kill

# Basic Xen Project Concepts: Toolstack+

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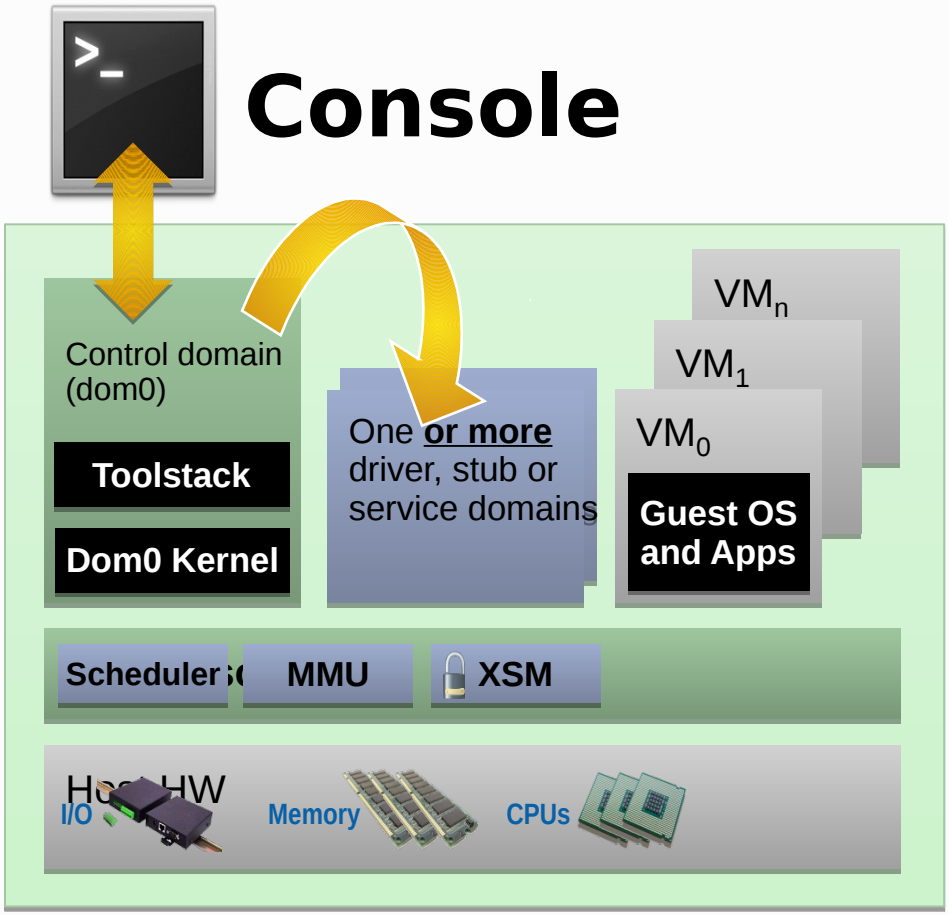
# Basic Xen Project Concepts: Disaggregation

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# Xen Project 4.4 Features

# Improved Event Channel Scalability

- Event channels are paravirtualized interrupts
- Previously limited to either 1024 or 4096 channels per domain
  - Domain 0 needs several event channels for each guest VM (for network/disk backends, qemu etc.)
  - Practical limit of total number of VMs to around 300-500 (depending on VM configuration)

# Improved Event Channel Scalability (2)

- New FIFO-based event channel ABI allows for over 100,000 event channels
  - Improve fairness
  - Allows for multiple priorities
  - The increased limit allows for more VMs, which benefits large systems and cloud operating systems such as MirageOS, ErlangOnXen, OSv, HalVM
  - Also useful for VDI applications

# Experimental PVH Guest Support

- PVH mode combines the best elements of HVM and PV
  - PVH takes advantage of many of the hardware virtualization features that exist in contemporary hardware
- Potential for significantly increased efficiency and performance
- Reduced implementation footprint in Linux,FreeBSD
- Enable with "pvh=1" in your config

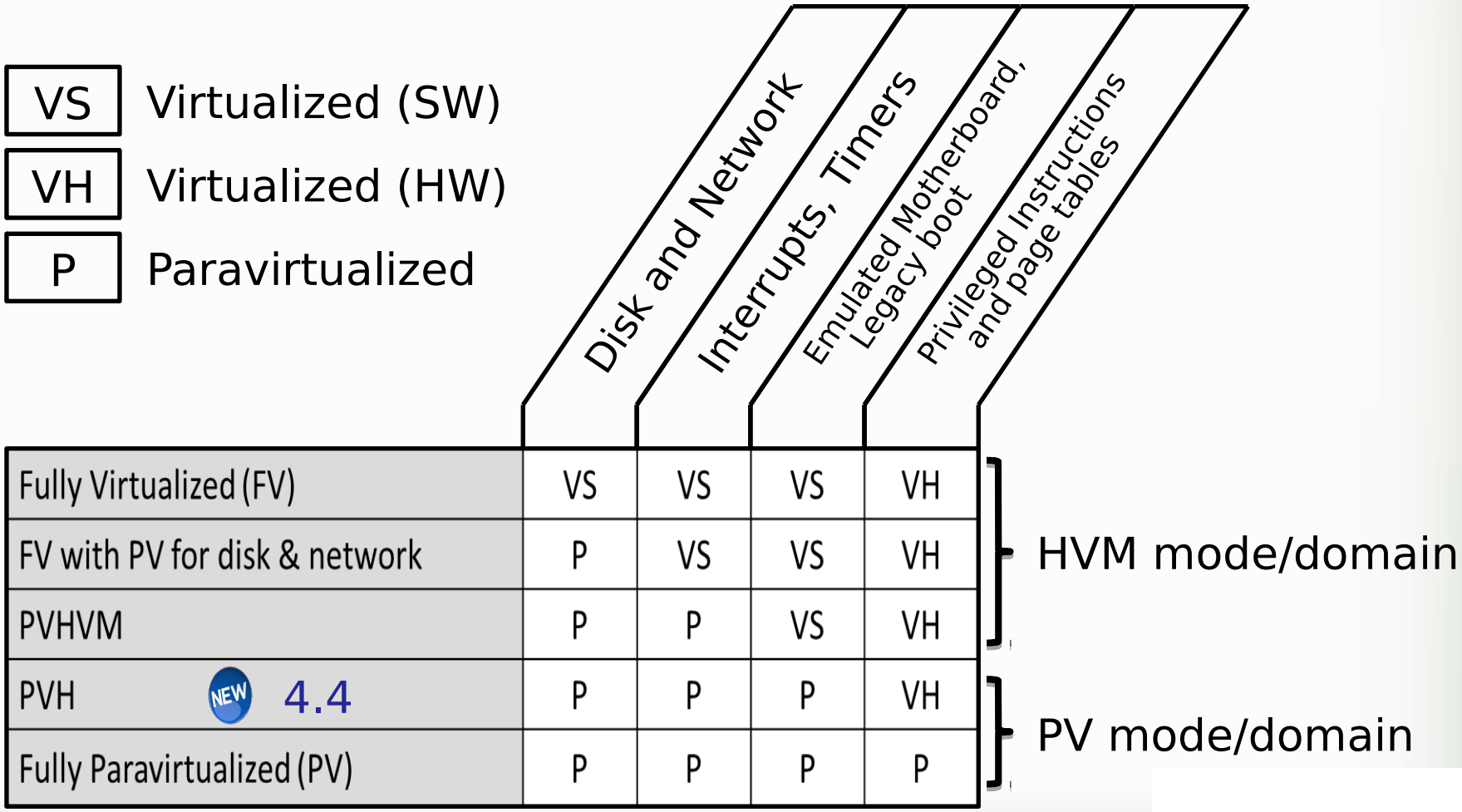
# Xen Project Virtualization Vocabulary

- PV – Paravirtualization
  - Hypervisor provides API used by the OS of the Guest VM
  - Guest OS needs to be modified to provide the API
- HVM – Hardware-assisted Virtual Machine
  - Uses CPU VM extensions to handle Guest requests
  - No modifications to Guest OS
  - But CPU must provide the VM extensions
- FV – Full Virtualization (Another name for HVM)

# Xen Project Virtualization Vocabulary

- PVHVM – PV on HVM drivers
  - Allows H/W virtualized guests to use PV disk and I/O drivers
  - No modifications to guest OS
  - Better performance than straight HVM
- PVH – PV in HVM Container (New in 4.4)
  - Almost fully PV
  - Uses HW extensions to eliminate PV MMU
  - Possibly best mode for CPUs with virtual H/W extensions

# The Virtualization Spectrum



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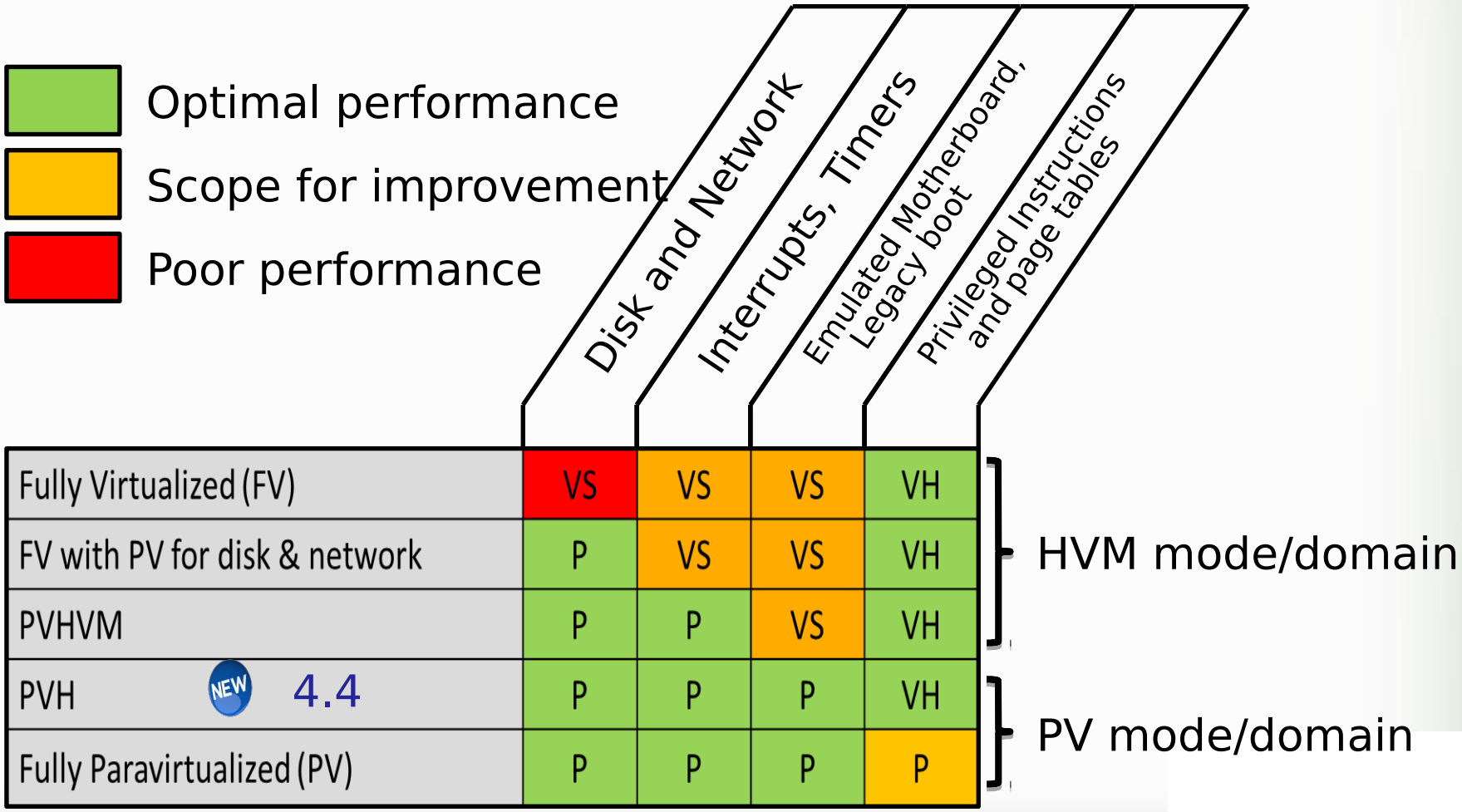

# Improved Disk Driver Domains

- Linux driver domains used to rely on udev events in order to launch backends for guests
  - Dependency on udev is replaced with a custom daemon built on top of libxl
  - Now feature complete and consistent between Linux and non-Linux guests
  - Provides greater flexibility in order to run user-space backends inside of driver domains
  - Example of capability: driver domains can now use Qdisk backends, which was not possible with udev

# Improved Support for SPICE

- SPICE is a protocol for virtual desktops which allows a much richer connection than display-only protocols like VNC
- Added support for additional SPICE functionality, including:
  - Vdagent
  - clipboard sharing
  - USB redirection

# GRUB 2 Support of Xen Project PV Images

- In the past, Xen Project software required a custom implementation of GRUB called pvgrub
- The upstream GRUB 2 project now has a build target which will construct a bootable PV Xen Project image
  - This ensures 100% GRUB 2 compatibility for pvgrub going forward
  - Delivered in upcoming GRUB 2 release (v2.02?)

# Indirect Descriptors for Block PV Protocol

- Modern storage devices work much better with larger chunks of data
- Indirect descriptors have allowed the size of each individual request to triple, greatly improving I/O performance when running on fast storage technologies like SSD and RAID
- This support is available in any guest running Linux 3.11 or higher (regardless of Xen Project version)

# Improved kexec Support

- kexec allows a running Xen Project host to be replaced with another OS without rebooting
  - Primarily used execute a crash environment to collect information on a Xen Project hypervisor or dom0 crash
- The existing functionality has been extended to:
  - Allow tools to load images without requiring dom0 kernel support (which does not exist in upstream kernels)
  - Improve reliability when used from a 32-bit dom0
  - kexec-tools 2.0.5 or later is required

# Improved XAPI and Mirage OS support

- XAPI and Mirage OS are sub-projects within the Xen Project written in OCaml
- Both are also used in XenServer (http://XenServer.org) and rely on the Xen Project OCaml language bindings to operate well
- These language bindings have had a major overhaul
  - Produces much better compatibility between XAPI, Mirage OS and Linux distributions going forward

# Tech Preview of Nested Virtualization

- Nested virtualization provides virtualized hardware virtualization extensions to HVM guests
  - Can now run Xen Project, KVM, VMWare or HyperV inside of a guest for debugging or deployment testing (only 64 bit hypervisors currently)
  - Also allows Windows 7 "XP Compatibility mode"
  - Tech Preview not yet ready for production use, but has made significant gains in functionality and reliability
  - Enable with "hap=1" and "nestedhvm=1"
- More information on nested virtualization: http://wiki.xenproject.org/wiki/Xen_nested

# Experimental Support for Guest EFI boot

- EFI is the new booting standard that is replacing BIOS
  - Some operating systems only boot with EFI
  - Some features, like SecureBoot, only work with EFI

# Improved Integration With GlusterFS

- You can find a blog post to set up an iSCSI target on the Gluster blog:
  - http://www.gluster.org/2013/11/a-gluster-block-interface-performance-and-configuration/

# Improved ARM Support

- A number of new features have been implemented:
- 64 bit Xen on ARM now supports booting guests
- Physical disk partitions and LVM volumes can now be used to store guest images using xen-blkback (or is PV drivers better in terms of terminology)
- Significant stability improvements across the board
- ARM/multiboot booting protocol design and implementation
- PSCI support

# Improved ARM Support (2)

- Some DMA in Dom0 even with no hardware IOMMUs
- ARM and ARM64 ABIs are declared stable and maintained for backwards compatibility
- Significant usability improvements, such as automatic creation of guest device trees and improved handling of host DTBs

# Improved ARM Support (3)

- Adding new hardware platforms to Xen Project on ARM has been vastly improved, making it easier for Hardware vendors and embedded vendors to port to their board
- Added support for the Arndale board, Calxeda ECX-2000 (aka Midway), Applied Micro X-Gene Storm, TI OMAP5 and Allwinner A20/A31 boards
- ARM server class hardware (Calxeda Midway) has been introduced in the Xen Project OSSTest automated testing framework

# Early Microcode Loading

- The hypervisor can update the microcode in the early phase of boot time
  - The microcode binary blob can be either as a standalone multiboot payload, or part of the initial kernel (dom0) initial ramdisk (initrd)
  - To take advantage of this use latest version of *dracut* with *--early-microcode* parameter and on the Xen Project command line specify: *ucode=scan*.
  - For details see *dracut* manpage and http://xenbits.xenproject.org/docs/unstable/misc/xen-command-line.html

# Xen Project Futures

# More Fun to Come...

- Xen Automotive
  - Xen Project in the entertainment center of your car?
- XenGT
  - Virtualized GPU support
- Even More ARM Support
  - On your server, in your phone, wherever...
- PVH stability and performance
  - The new hypervisor mode to get harder and faster
  - Domain 0 support, AMD support

# And Still More Fun to Come...

- Native support of VMware VMDK format
- Better distribution integration (CentOS, Ubuntu)
- Improvements in NUMA performance and support
- Additional libvirt support
- Automated Testing System
  - http://blog.xenproject.org/index.php/2014/02/21/xen-project-automatic-testing-on-community-infrastructure/
- General performance enhancements

# Questions?

Russell.Pavlicek@XenProject.org
Twitter: @RCPavlicek