FreeBSD/Xen update

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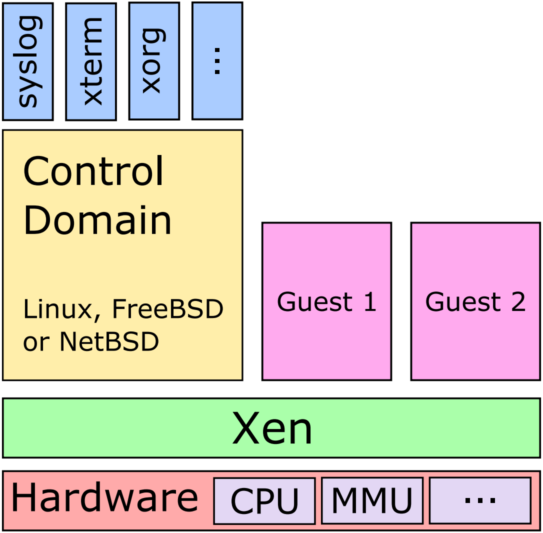
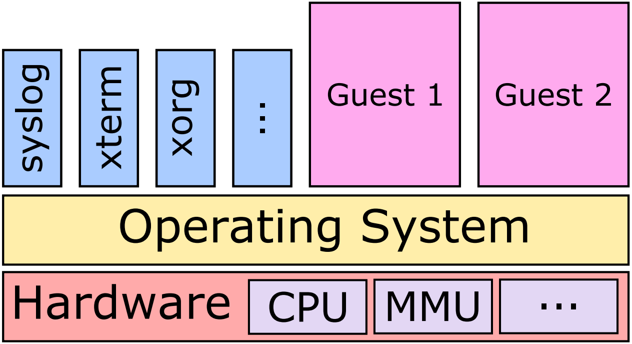
Xen Architecture (type-1 hypervisor)

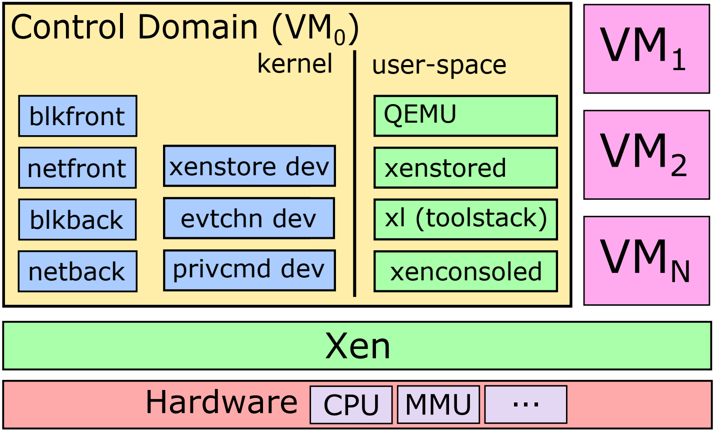


Type-2 hypervisor architecture



Xen architecture in detail

🟦 Part of FreeBSD
🟩 Part of the Xen package



Control Domain (VM_0)

kernel

user-space

blkfront

netfront

blkback

netback

xenstore dev

evtchn dev

privcmd dev

QEMU

xenstored

xl (toolstack)

xenconsoled

VM_1

VM_2

VM_N

Xen

Hardware

CPU

MMU

···

xen-block related improvements

- Remove broken block protocol extensions (r284296).
- Unmapped IO support for blkfront (r290611).
- Indirect descriptors support, by Colin Percival (r286062).

Dom0 improvements

- Multiple fixes for the multiboot support in the loader (r277291, r277418, r280953, r280954).
- Improved PIRQ handling (r278854, r278855).
- Indirect descriptors support, by Colin Percival (r286062).
- Improvements to foreign memory mapping (r282634).
- Added save, restore and live migration support to the Xen package (r398918).

EC2 specific improvements

- Allow creating EC2 AMIs from the FreeBSD build system (r280928) by Colin Percival.
- Support for SR-IOV (A.K.A EC2 Enhanced Networking) for FreeBSD guests.

Generic fixes and improvements

- Xenstore device fixes (r278844).
- Add a handler for the debug interrupt (r280838).
- Update Xen headers to 4.6, previous version was 4.2 (r288917) by Julien Grall.
- Cleanup and unification of Xen files (r289685, r289686) by Julien Grall.
- New PV console driver (r289033) by Julien Grall.
- Add run-time options to disable PV devices (r286999).
- Removal of the i386 UP PV port (r282274) by John Baldwin.

xen-net related improvements

- Fix initial ARP sending on restore from migration (r282908).
- Preserve configured options across migrations (r285098).
- Fix PF to work with netfront (r289316) by Kristof Provost
- Clean-up and new feature
  - Remove obsolete page flipping mode (r289583)
  - Implement multiqueue (r294442)
  - Throughput from guest to host with iperf: 1 queue 5.8 Gb/s, 4 queues 11.2 Gb/s (with WITNESS and INVARIANTS)

The full virtualisation spectrum

VS	Software virtualisation
VH	Hardware virtualisation
PV	Paravirtualized

🟥	Poor performance
🟨	Room for improvement
🟩	Optimal performance

	Disk and network	Interrupts and timers	Emulated motherboard	Privileged instructions and page tables
HVM	🟥 VS	🟥 VS	🟨 VS	🟩 VH
HVM with PV drivers	🟩 PV	🟥 VS	🟨 VS	🟩 VH
PVHVM	🟩 PV	🟩 PV	🟨 VS	🟩 VH
PVH	🟩 PV	🟩 PV	🟩 PV	🟩 VH
PV	🟩 PV	🟩 PV	🟩 PV	🟨 PV

Why PVH?

- Performance: use hardware feature as much as possible
- Security
  - No emulation eliminate a main class of security bugs
  - No PVMMU etc, a lot less complex code for both guest kernel and Xen toolstack
- Maintenance
  - No PVMMU etc, a lot less code
- Easier to port new OSes

Gory details about PVH

- PVH-classic vs HVMlite
- PVH-classic is first attempt for the design, to make PV guest look like HVM guest
- HVMlite is the new approach, to make HVM guest look like PV guest
- They will converge at some point, the agreed upon road map is to make HVMlite canonical "PVH"
- End users probably won't notice the difference

Guest support

- List of OSes and virtualisation support:

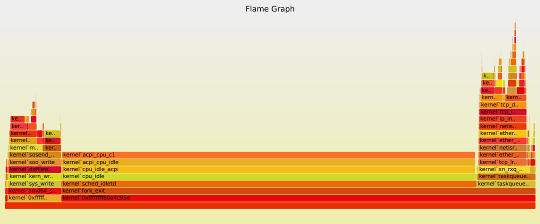
	PV	PVH*	PVHVM	HVM with PV drivers	HVM
Linux	YES	YES	YES	YES	YES
Windows	NO	NO	NO	YES	YES
NetBSD	YES	NO	NO	NO	YES
FreeBSD	NO	YES	YES	YES	YES
OpenBSD	NO	NO	YES	YES	YES
DragonflyBSD	NO	NO	NO	NO	YES

Better scalability

- Finer grained locks in hypervisor: per-vcpu maptrack free lists, per-cpu rwlock
- Fairer locks in hypervisor: queue rwlock
- Should benefit all guests, especially Xen virtual devices with multiqueue support (net, block)
  - 2-socket Haswell-EP systems, Linux 16 queues inter-VM network throughput jumped from 15 Gb/s to 48 Gb/s

Virtual Performance Monitoring Unit

- Fully implemented in Xen 4.6, works for both PV and HVM
- Intended for non-production use
- Use dtrace(1) or pmcstat(8) to profile your VM



xSplice - hypervisor hot-patching

- Rationale:
  - Rebooting hypervisor to fix security bugs are not desirable
  - A large number of security bugs require very simple patch to fix
- Phase one goal is to handling patching functions, patching structure is yet to come
- User space tooling is not tied to particular operating system

Q&A

Thanks

Questions?