Lecture 09: VMs and VCS head in the clouds

Hands-on Unix system administration DeCal

2012-10-29

Projects

❖ Projects
Virtualization
Head in the clouds

- groups of four people
- submit one form per group with OCF usernames, proposed project ideas, and one SSH *public* key
- virtualization infrastructure is in place: we'll create accounts and send out an announcement by Wednesday
  - ✦ needed for this week's lab

❖ Projects

Virtualization

❖ What is virtualization?

❖ Virtualization is

❖ Why?

❖ Why not?

❖ Degrees of separation

❖ Process isolation

❖ Full virtualization

❖ Full virtualization cont'd

❖ More features

Head in the clouds

Virtualization

What is virtualization?

❖ Projects

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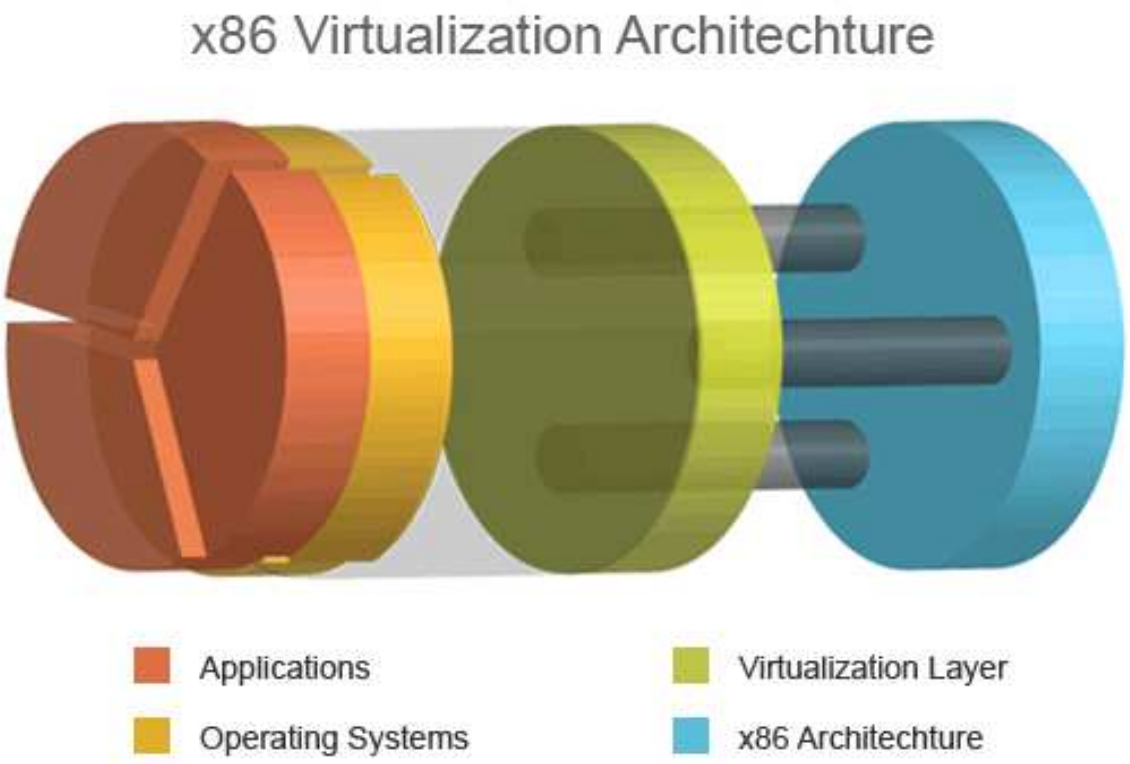
Head in the clouds

- predates Unix (IBM: 1964)



via `http://wowrack.com/images/misc/virtualization-architechture.gif`

Virtualization is

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Head in the clouds

- multiple virtual machines (VMs) on one physical computer
- what is a virtual machine?
  - processes, memory, disk, network traffic, input/output devices?
- how thoroughly virtualized?
  - can it run any operating system that supports a specific architecture?

Why?

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Head in the clouds

- consolidation
  - increase hardware utilization
  - decrease power consumption
- compartmentalization (reliability, security)
  - separate services on different VMs
- abstraction (flexibility)
  - easily provision/destroy servers

Why not?

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Head in the clouds

- single point of failure (reliability, security)
- restrictions on virtualized operating system
- performance impacts
- inadequate compartmentalization (security)
- licensing ($)

Degrees of separation

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Head in the clouds

- process isolation
  - ✦ one OS, many isolated user-space "containers"
- full virtualzation
  - ✦ one *hypervisor*, many OSes on virtual "hardware"
- lots of gray area in between
  - ✦ one kernel, many OSes?

Process isolation

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Head in the clouds

- varying degrees of isolated use-space (CPU, memory, I/O, network)
- enhanced chroot
- low abstraction, low overhead
  - ✦ cannot run a virtualized OS
  - ✦ compartmentalization is limited
- implementations: Linux containers, OpenVZ (Linux), FreeBSD jails, Solaris zones

Full virtualization

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Head in the clouds

- thorough hardware architecture (e.g., x86) abstraction by *hypervisor*
- more overhead, (nearly) full compartmentalization
- virtualized OS need not be aware
- virtualized OS can be aware: paravirtualization
  - ✦ one kernel, many OSes
  - ✦ "cooperative" drivers (e.g., virtio, "guest additions")

Full virtualization cont'd

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Head in the clouds

- physical hardware ("bare metal") need not be aware
- physical hardware can be aware: hardware-assisted
  - ✦ VT flag on modern processors
  - ✦ often necessary for decent performance
- implementations: qemu/KVM, VirtualBox, VMware, Hyper-V

More features

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Head in the clouds

- teleportation: migration of VMs between hypervisors
  - live vs. offline
- snapshots of state
  - live (RAM include) vs. offline (only disk, e.g., logical volume)
- automation?

❖ Projects

Virtualization

Head in the clouds

❖ What is the cloud?

❖ Business as usual

❖ Cloud computing is

❖ Examples

❖ IaaS

❖ Paradigm changes

❖ Amazon Web Services

Head in the clouds

What is the cloud?

- Projects
- Virtualization
- Head in the clouds
- What is the cloud?
- Business as usual
- Cloud computing is
- Examples
- IaaS
- Paradigm changes
- Amazon Web Services

via http://www.ibm.com/cloud-computing/images/smartcloud-smarterplanet.png

Business as usual

❖ Projects

Virtualization

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- economies of scale: pool labor and material resources
  - pay recurring costs (rent, utility price) vs one-time costs (equipment, software license)
  - "outsource" enterprise computing for speed and maintenance
- Big Brother?

Cloud computing is

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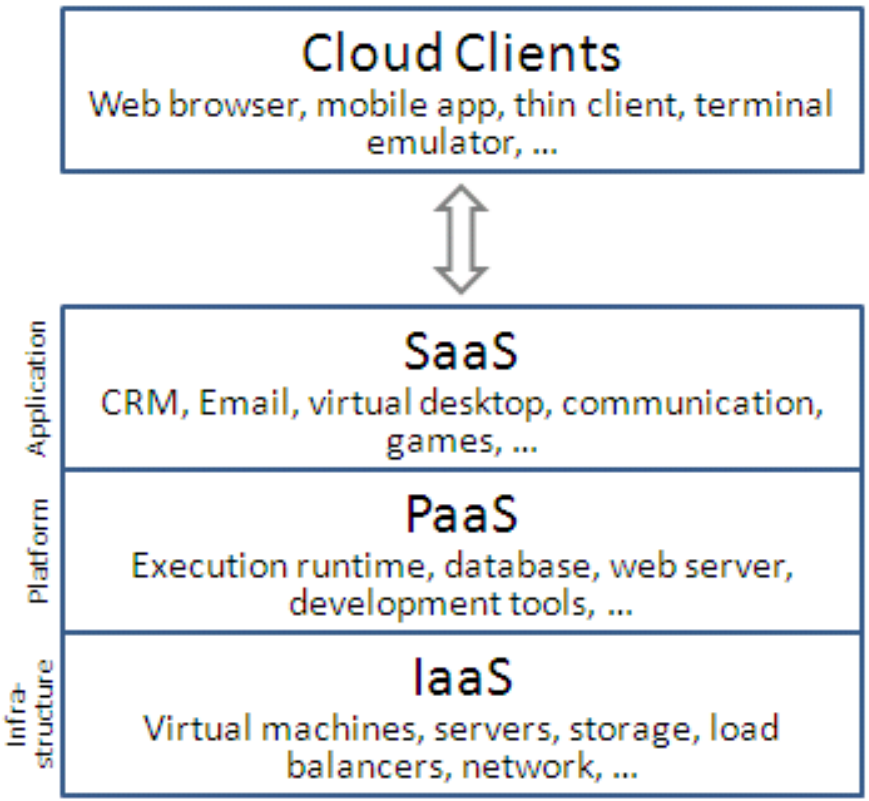
- computing resources delivered over a network (Internet)



via `wikimedia.org`

Examples

❖ Projects

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❖ Paradigm changes
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- Software as a Service (SaaS)
  - Google Apps, iCloud, Dropbox/Box, ?
- Platform as a Service (PaaS)
  - Heroku, Google App Engine
- **Infrastructure as a Service** (IaaS)
  - Amazon AWS (e.g., EC2), Rackspace Cloud, Microsoft Azure

IaaS

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❖ Amazon Web Services

- virtualization on large scale
  - data centers of hypervisors
  - image, device (block), file storage
  - virtual LANs (VLANs), firewalls
- on demand scaling

Paradigm changes

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- instance storage
- load balancing
- rapid deployment, centralized management

Amazon Web Services

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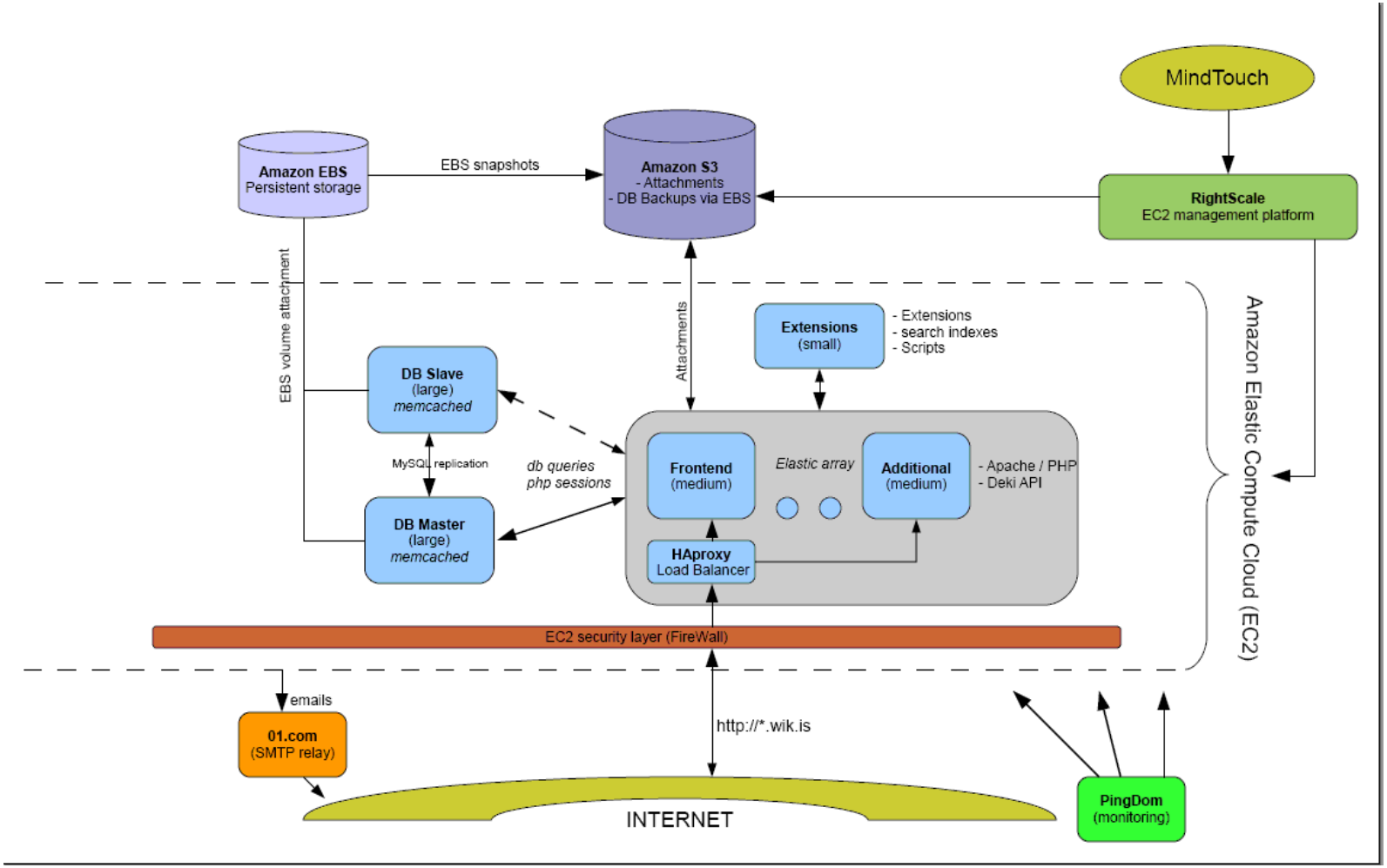

via http://developer.mindtouch.com/Wik.is/EC2_Infrastructure