Containers and Virtual Machines

Everything old is new again (not really)

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Hardware-based virtualization

To overcome the overhead of running an OS inside another OS, the hardware was changed to accommodate for special instruction sets:

- The Intel VT-x and AMD AMD-V are processor extensions to the x86 architecture — they were released in years 2005-2006.
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- ► Cloud computing would have been **impossible** without hardware-based virtualization and **free software**.
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Why?

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Jails

In 1999 we added a partitioning facility to FreeBSD called jail(2). It reuses the chroot(2) implementation, but prevents well-documented means to escape chroot confinement. Jail offers semi-permeable partitioning of the file system, process, and networking namespaces, and removes all super-user privileges that would affect objects not entirely inside the jail.

Building Systems to be Shared Securely, Poul-Henning Kamp, ACM Queue July/August 2014.



FreeBSD Jails

The FreeBSD "Jail" facility provides the ability to partition the operating system environment, while maintaining the simplicity of the UNIX "root" model. In Jail, users with privilege find that the scope of their requests is limited to the jail, allowing system administrators to delegate management capabilities for each virtual machine environment. Creating virtual machines in this manner has many potential uses: the most popular thus far has been for providing virtual machine services in Internet Service Provider environments

Confining the Omnipotent Root, Poul-Henning Kamp and Robert Watson, Sane 2000.

- "(...) to delegate management capabilities for each virtual machine environment."
- "Creating virtual machines in this manner (...)"
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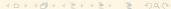


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Zones

In year 2005, Sun Microsystems launched Solaris Zones:

Zones provide a means of virtualizing operating system services, allowing one or more processes to **run in isolation** from other activity on the system.

This isolation **prevents processes** running within a given zone **from monitoring or affecting processes running in other zones**.

Virtualization and Namespace Isolation in Solaris (PSARC/2002/174), September 7, 2006.



Zones (continued)

A zone is a "sandbox" within which one or more applications can run without affecting or interacting with the rest of the system.

It also provides an abstraction layer that **separates applications from physical attributes** of the machine on which they are deployed, such as physical device paths and network interface names.

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Zones had just one little limitation ...

From the paper:

- So, you are basically running Solaris which is good ...if you are Sun Microsystem.
- But people wanted to consolidate Microsoft Windows.
- ► And run Linux, too

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- Namespaces.
- Copy-on-write storage:
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Container run-times

Alternatives:

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Questions



Thanks!

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