Performance Evaluation of Container-based Virtualization

Research Report

Bogdan Purcăreață
Supervisor: Răzvan Deaconescu

February 7, 2013

Context

Technology Overview

Related Work

Performance Analysis

Future Work

Q & A

Introduction

Virtualization

- ▶ simulation of software and/or hardware
- ▶ virtual machines
- ▶ autonomous computing
- ▶ utility computing

OS-level virtualization

- ▶ multiple running OS instances
- ▶ rootfs, system libs, binary files
- ▶ process hierarchies

LinuX Containers Overview

- ▶ mainline kernel support
- ▶ application vs. system containers
- ▶ currently in active development (v. 0.9.0-alpha3)

Kernel Features

- Control Groups
- Namespaces
- Shared Subtrees
- File POSIX Capabilities

Userspace Tools

- ► C source code
    - ► access underlying kernel features
- ► Configuration files
    - ► network
    - ► filesystem
    - ► console, tty, pts
- ► Templates
    - ► sshd (proof of concept)
    - ► Busybox
    - ► Full distro: *Debian*, *Fedora*, *Ubuntu*, *Arch*
- ► BASH scripts
    - ► bring them all together

Related Work

Container technologies

- ▶ FreeBSD Jails
- ▶ Linux-VServer
- ▶ OpenVZ

Connected features

- ▶ CRIU (Checkpoint-Restart in Userspace)
- ▶ Libvirt

Network Overhead

TCP Stream (MB/s)

Network sharing scenario	host	lxc	degr. %
Virtual Ethernet Device	913	903	-1.10
MAC-VLAN	912	919	0.77
VLAN	910	910	0.00

CPU Overhead

Context Switch Time (ms)

Proc. Size	No. Procs	10	50	100	200	500
0k	host	2.96	4.31	4.76	5.49	7.00
	lxc	5.26	6.31	8.49	8.35	10.06
	ovr.%	**77.34**	**46.39**	**78.22**	**52.21**	**43.77**
1k	host	3.46	5.38	6.00	6.63	8.77
	lxc	5.73	8.22	9.45	9.55	11.83
	ovr.%	**65.49**	**52.71**	**57.57**	**44.09**	**34.85**
8k	host	6.24	11.27	11.87	15.26	18.32
	lxc	7.99	14.62	15.45	17.82	21.09
	ovr.%	**28.14**	**29.75**	**30.16**	**16.71**	**15.15**
16k	host	12.82	18.96	22.28	27.90	28.88
	lxc	13.07	21.56	25.16	30.54	32.05
	ovr.%	**1.91**	**13.74**	**12.93**	**9.49**	**10.96**
32k	host	26.25	33.28	46.03	46.67	47.21
	lxc	20.88	35.58	49.36	49.91	50.54
	ovr.%	**-20.43**	**6.93**	**7.24**	**6.95**	**7.04**

Usage Scenarios in Embedded Networking

- Control and data plane separation
    - **container privilege hierarchy**
    - one management container
    - multiple "worker" containers
- Multiple userspace driver instances
    - **partial isolation**
    - one userspace driver for multiple containers
    - isolated applications

Bibliography

- Official LXC package page, http://lxc.sourceforge.net
- Control Groups,
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- Kernel Namespaces in Linux Containers,
  http://lxc.sourceforge.net/index.php/about/
  kernel-namespaces/
- Linux Kernel Subtrees, http://lwn.net/Articles/159092/
- CRIU project wiki, http://www.criu.org

Questions

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