

Impossible is Nothing

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Clear Linux[®]
Project
for Intel[®] Architecture



The 10x Hypothesis

It is often easier to improve by **10x**
...than it is to improve by **10%**

Push Boundaries
by Focusing on
What's Possible



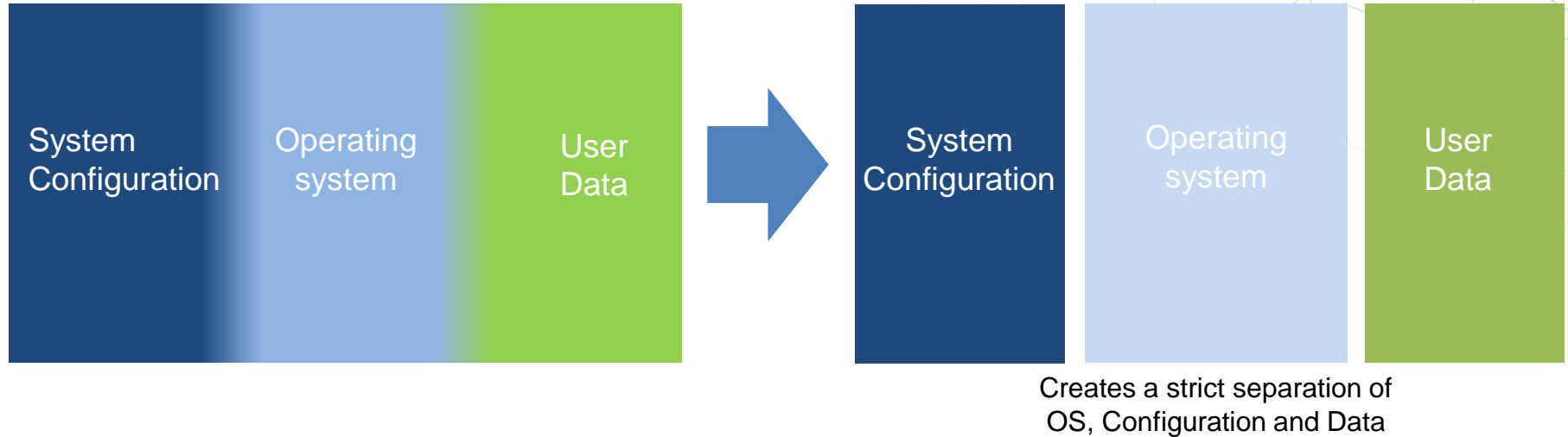
Data Center Linux Distribution by Intel



Challenging performance
limitations, and showing
what's possible with Intel
Architecture

<http://www.clearlinux.org>

Stateless OS

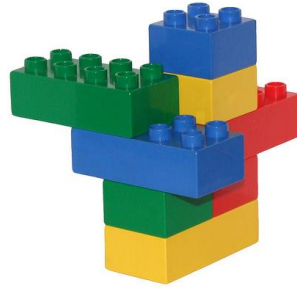


Stateless benefits: Greatly simplified deployment logistics, increased flexibility

Clear Linux OS is Coarse Modular



Micro OS...



Package based
distributions...

Fast & Reliable Update

One version number

Efficient

Content Staging

Resume-able



Operating System Fast Boot

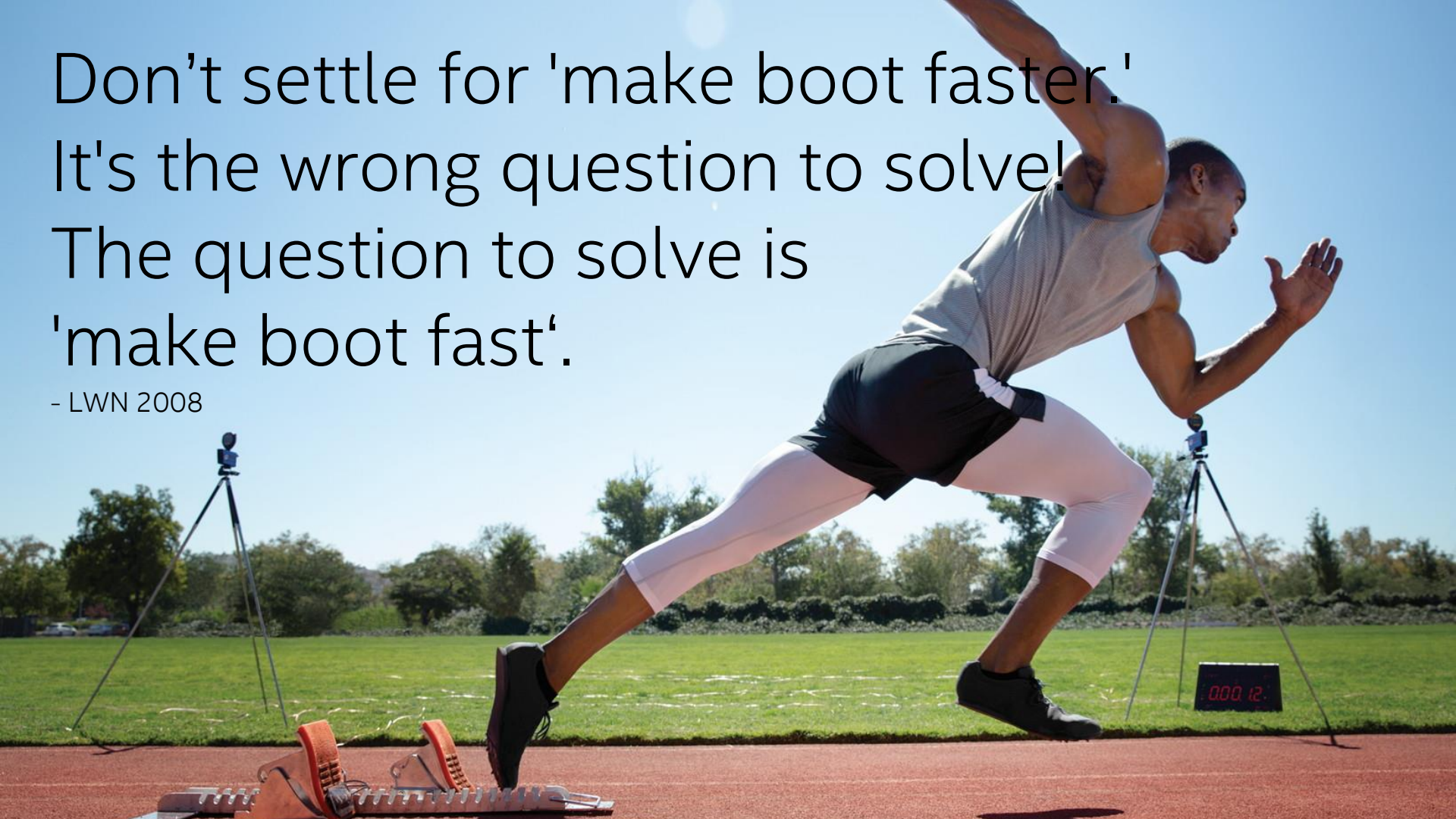
Objective:
Elasticity

Target: 100 milliseconds

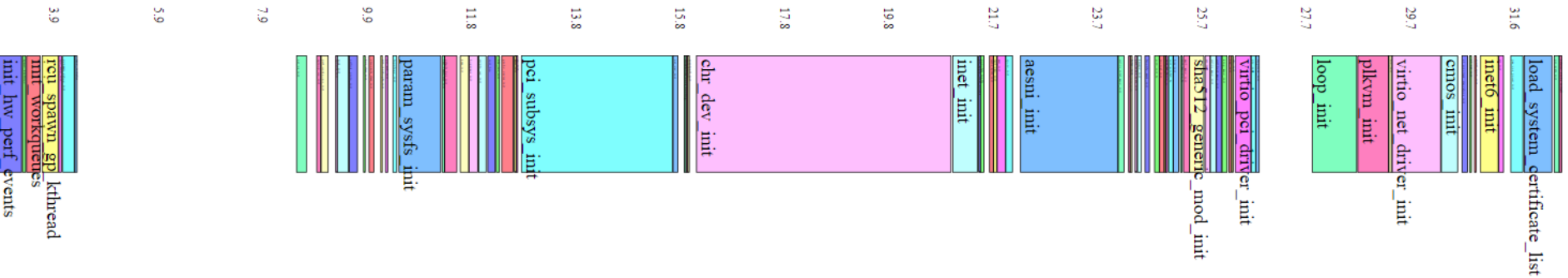


Don't settle for 'make boot faster.'
It's the wrong question to solve!
The question to solve is
'make boot fast'.

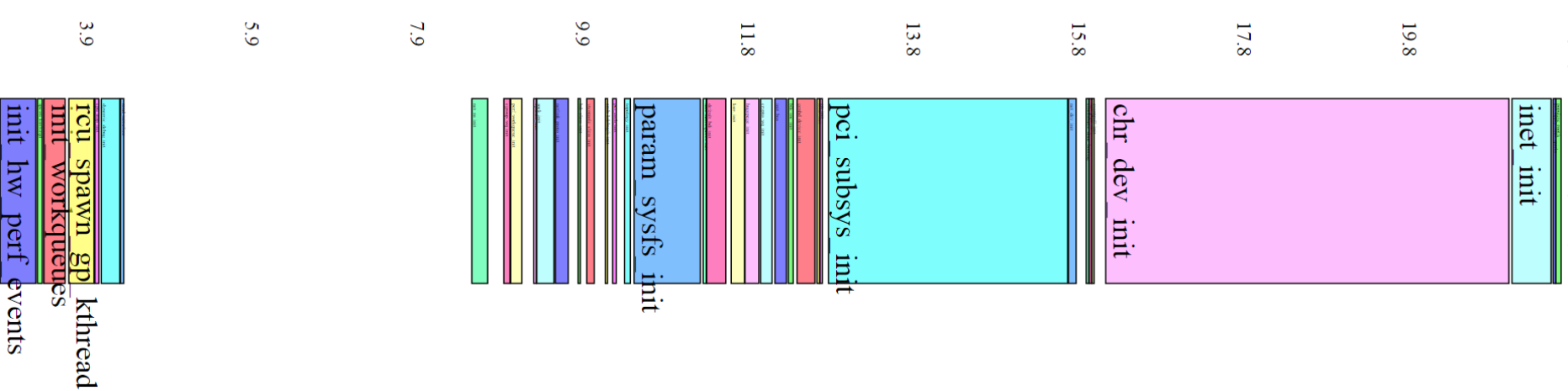
- LWN 2008



KVM optimized Kernel



KVM optimized Kernel



KVM optimized Kernel

31.6

load system certificate_list

inet6 init

cmos init

29.7

virtio net driver_init

plkvmm init

27.7

loop init

25.7

virtio pci driver_init

sha512_generic_mod_init

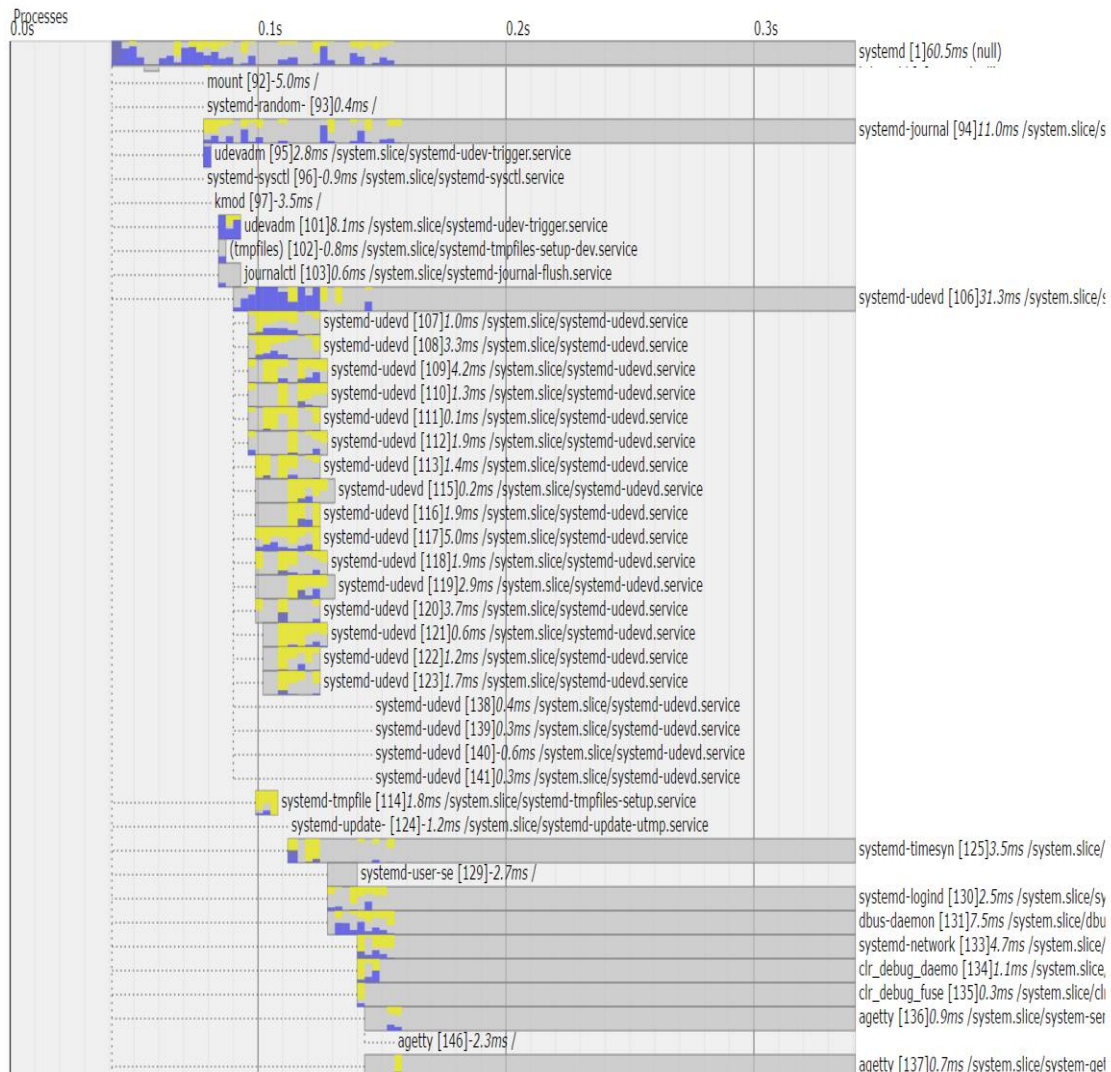
23.7

aesni init

21.7

inet_init

Userspace



10% example: Compiler tricks

Instruction set baseline matters!

Scalar	1 FPU operation / instruction
SSE 2	4 FPU operations / instruction (float)
AVX2	8 FPU operations / instruction
+FMA	16 FPU operations / instruction

Function Multi Versioning

```
int a[256], b[256], c[256];

__attribute__((target_clones("avx2", "arch=atom", "default"))))
void foo(){
    int i,x;
    for (x=0; x<MAX; x++){
        for (i=0; i<256; i++){
            a[i] = b[i] + c[i];
        }
    }
}
```

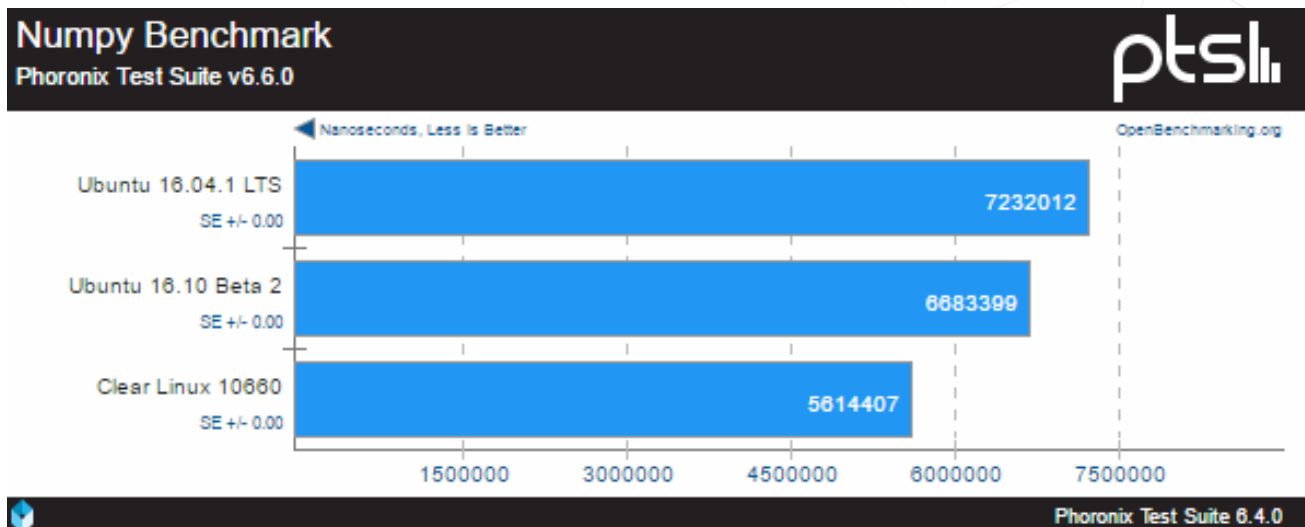
BLAS / LAPACK

- Vector & Matrix multiply
- Critical element of Deep Learning (& more)
- Intel MKL or OpenBLAS show good performance

Multi-library install

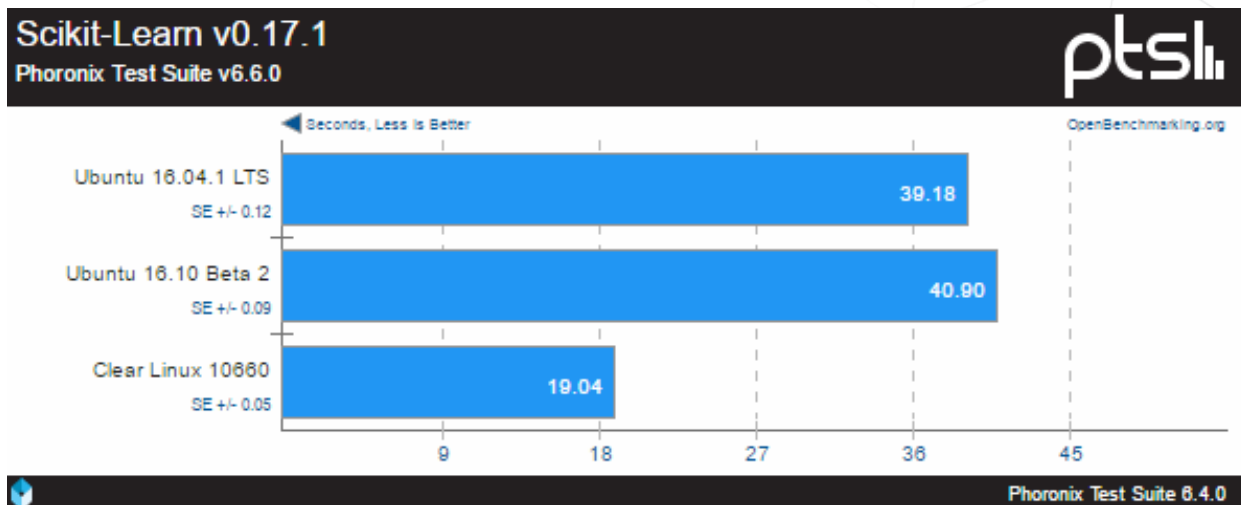
- Users want the same OS with and without AVX2
- Solution: `/usr/lib64/avx2/` directory
- Packaging support in Clear Linux
- Similar solution for Python plugins

Optimized Data Analytics

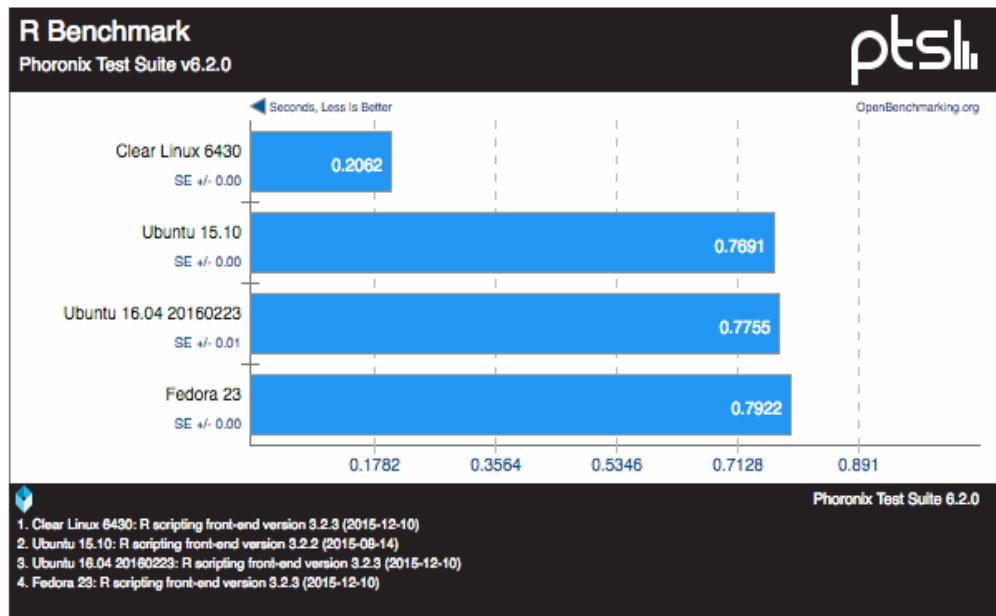


http://www.phoronix.com/scan.php?page=news_item&px=Clear-Linux-vs-1604-E3-1280v5

Optimized Data Analytics



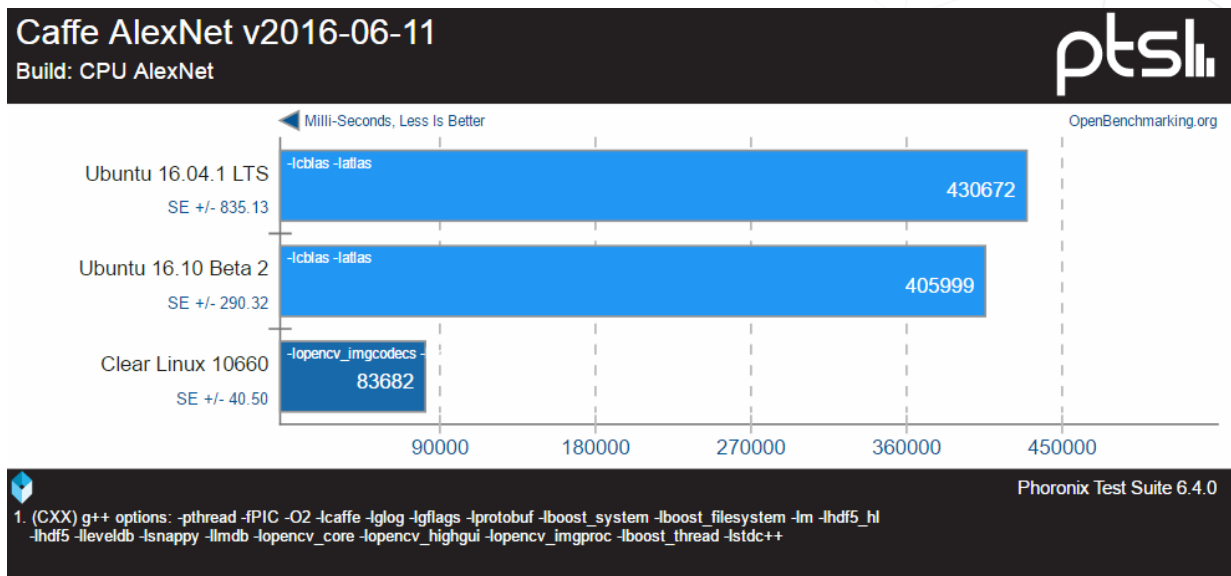
Optimized Data Analytics



“Clear Linux was one of the major winners of the last comparison as it's a server-oriented distribution by Intel that prides itself upon high performance with taking some rather aggressive defaults and other optimizations.”

-Michael Larabel
Phoronix* media and test suite

Optimized Machine Learning

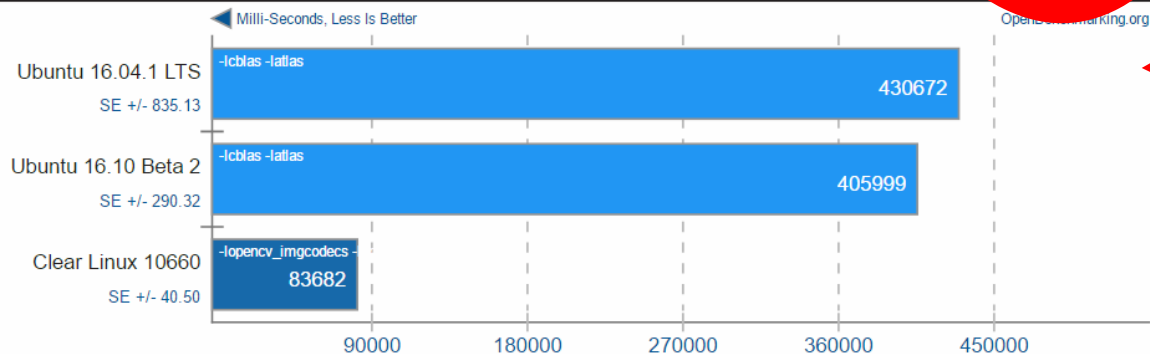


http://www.phoronix.com/scan.php?page=news_item&px=Clear-Linux-vs-1604-E3-1280v5

Optimized Machine Learning

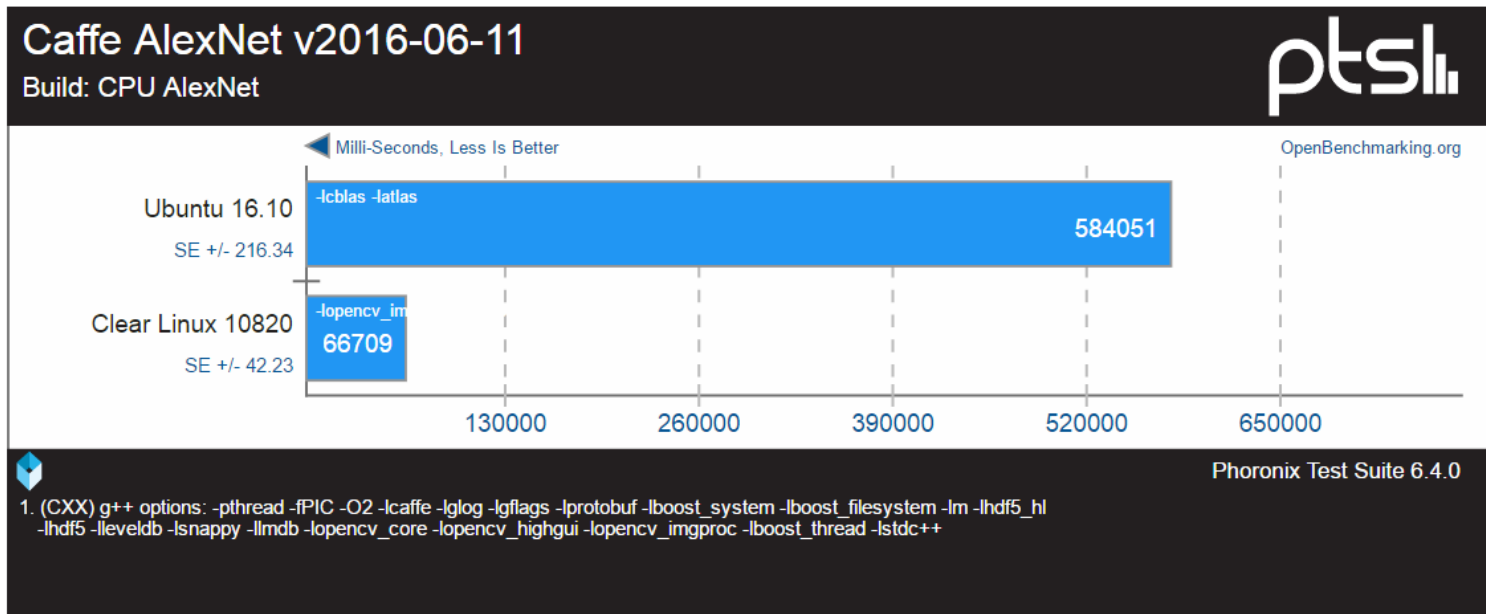
Caffe AlexNet v2016-06-11

Build: CPU AlexNet



1. (CXX) g++ options: -pthread -fPIC -O2 -lcaffe -lglog -lgflags -lprotobuf -lboost_system -lboost_filesystem -lm -lhdf5_hl -lhdf5 -lleveldb -lsnappy -lmdbc -lopencv_core -lopencv_highgui -lopencv_imgproc -lboost_thread -lstdc++

Optimized Machine Learning



<http://www.phoronix.com/scan.php?page=article&item=clr-ubuntu-yak&num=4>

Clear Linux: Try & See

Start Here!

- <https://clearlinux.org>
- [`docker run -it clearlinux`](#)

Check us out on github! Join the conversation!

- <https://github.com/clearlinux>
- IRC: #clearlinux on Freenode
- Mailing list: <https://lists.clearlinux.org/mailman/listinfo/dev>

Symptom of a 10% mindset:
Admiring the problem



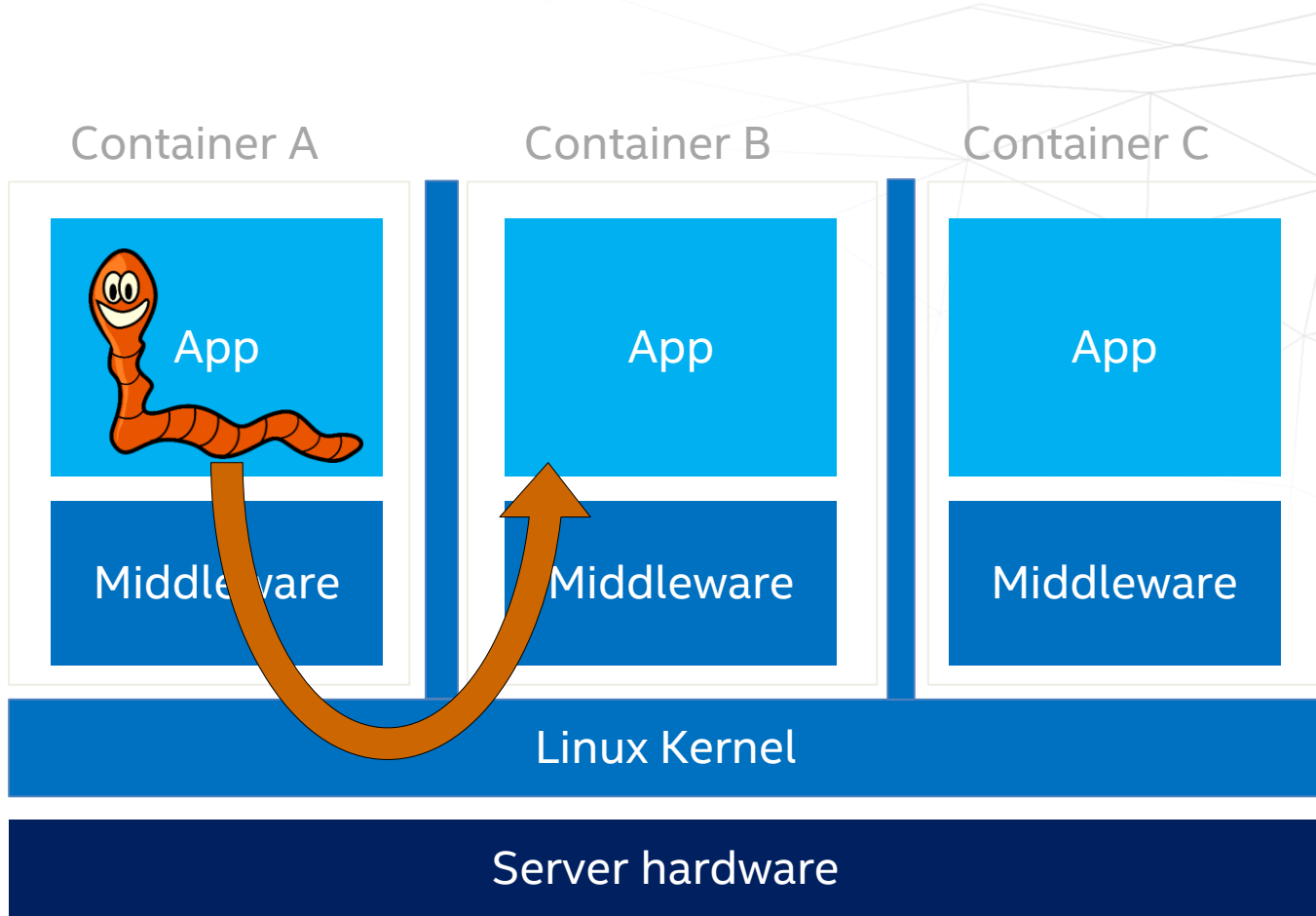
Container meet Virtual Machine

Virtual Machines are
Expensive

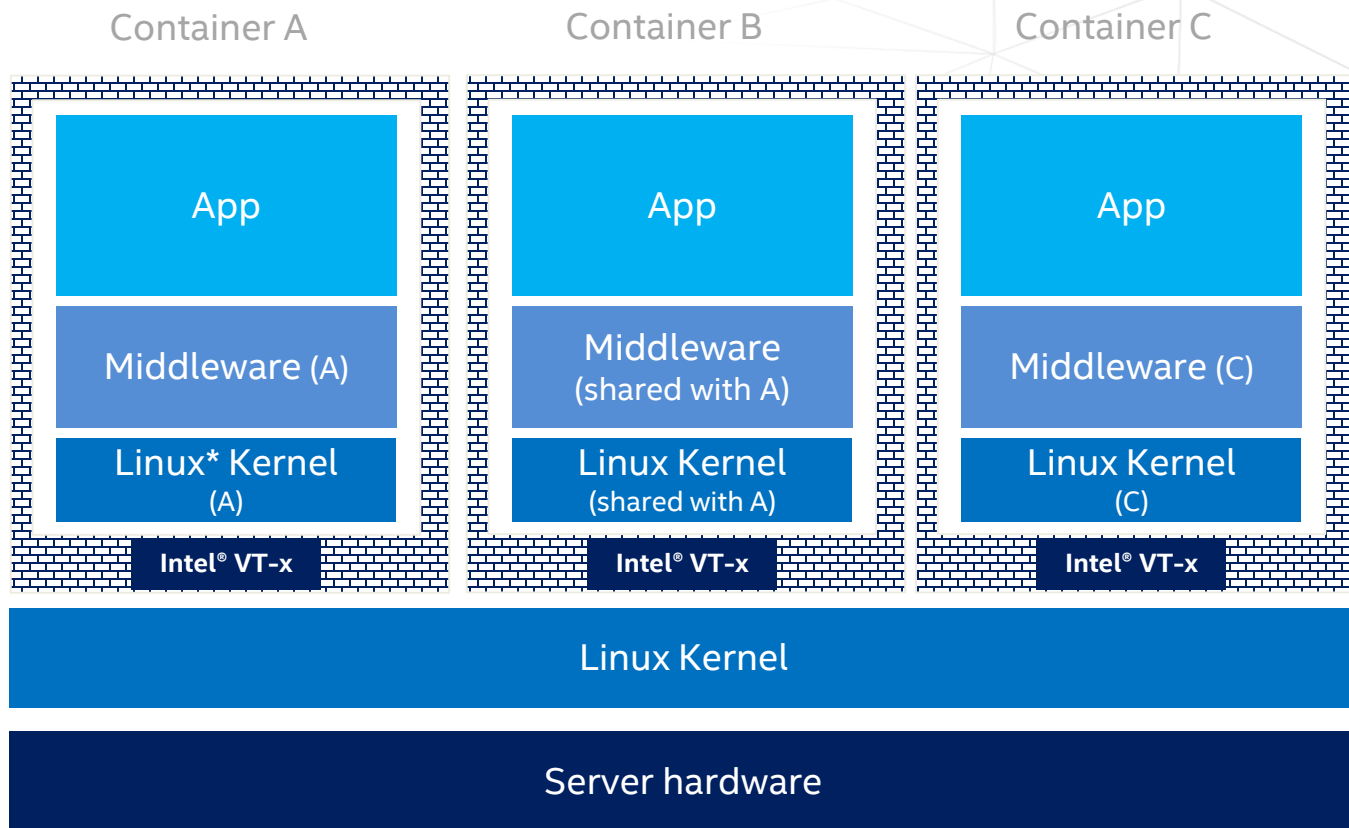
vs

Container Security
Concerns









First Challenge: Applying 10x



kvmtool

Results:
150msec &
20 Mbyte

Second Challenge: “We want Docker*”



1.12

Third Challenge: What About QEMU?



Can 10x
Be applied?


```
root@clearlinux ~ # docker run -it ubuntu bash
root@d0609b90c76a:/# cat /etc/os-release
NAME="Ubuntu"
VERSION="16.04.1 LTS (Xenial Xerus)"
ID=ubuntu
ID_LIKE=debian
PRETTY_NAME="Ubuntu 16.04.1 LTS"
VERSION_ID="16.04"
HOME_URL="http://www.ubuntu.com/"
SUPPORT_URL="http://help.ubuntu.com/"
BUG_REPORT_URL="http://bugs.launchpad.net/ubuntu/"
UBUNTU_CODENAME=xenial
root@d0609b90c76a:/#
```

Clear Containers: Get Involved

Start Here!

- [Talk to us here](#)
- <https://clearlinux.org/clear-containers>

Check us out on github! Join the conversation!

- <https://github.com/01org/cc-oci-runtime>
- <https://github.com/01org/qemu-lite>
- IRC: #clear-containers on Freenode
- Mailing list: <https://lists.clearlinux.org/mailman/listinfo/dev>

Improving OpenStack* VM launch



*Other names and brands may be claimed as the property of others.

Improving OpenStack* VM launch

A photograph of a space shuttle launching, with a large plume of smoke and fire. A large red '4x' is superimposed over the center of the image, indicating a fourfold speedup.

4x

Impossible is Nothing, but miracles are out of scope

[illegible]

Re-invention is in our DNA

“There is at least one point in the history of any company when you have to change dramatically to rise to the next level of performance. Miss that moment - and you start to decline.”

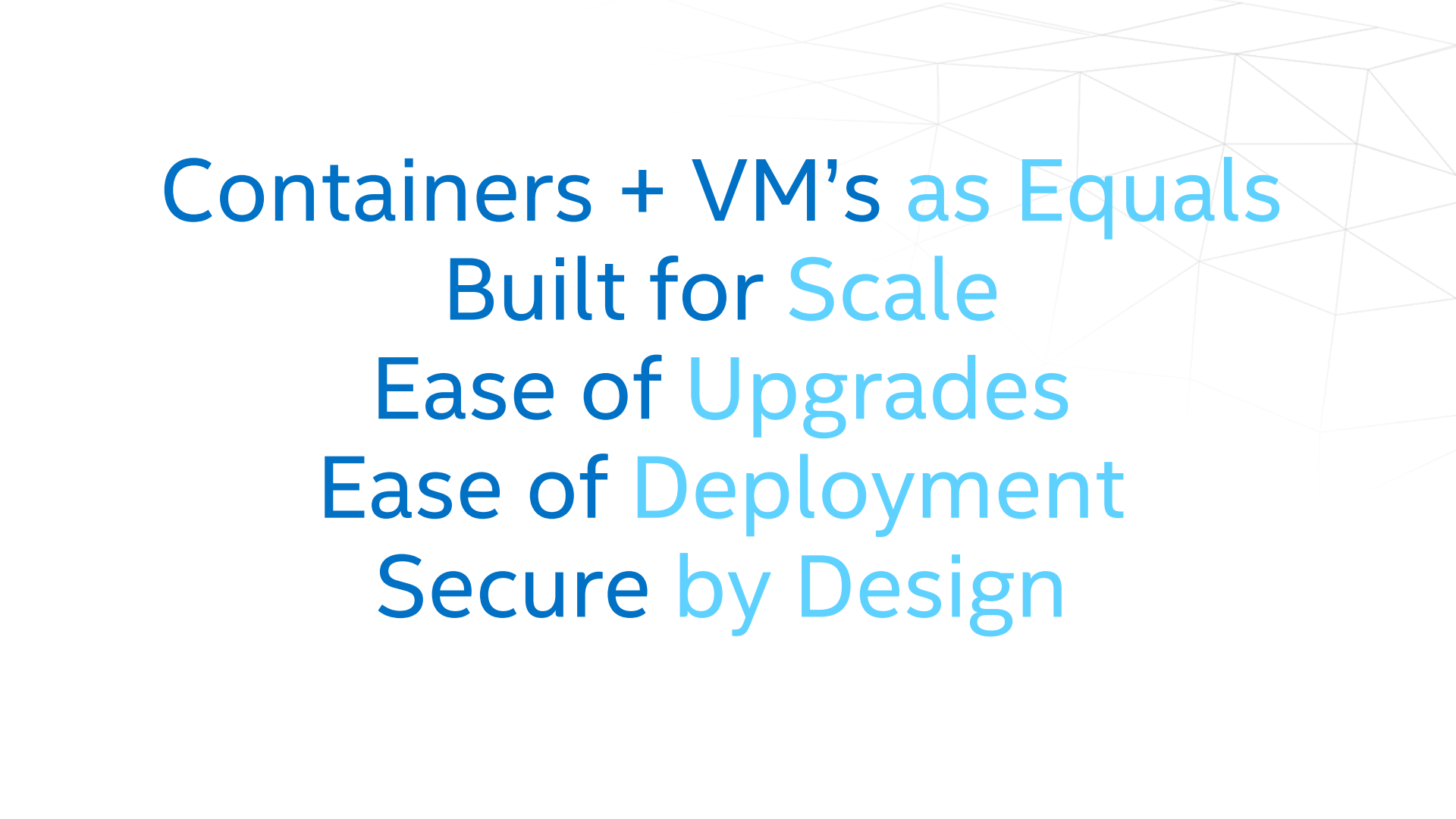
– *Andy Grove*



Applying Re-invention to Private Cloud

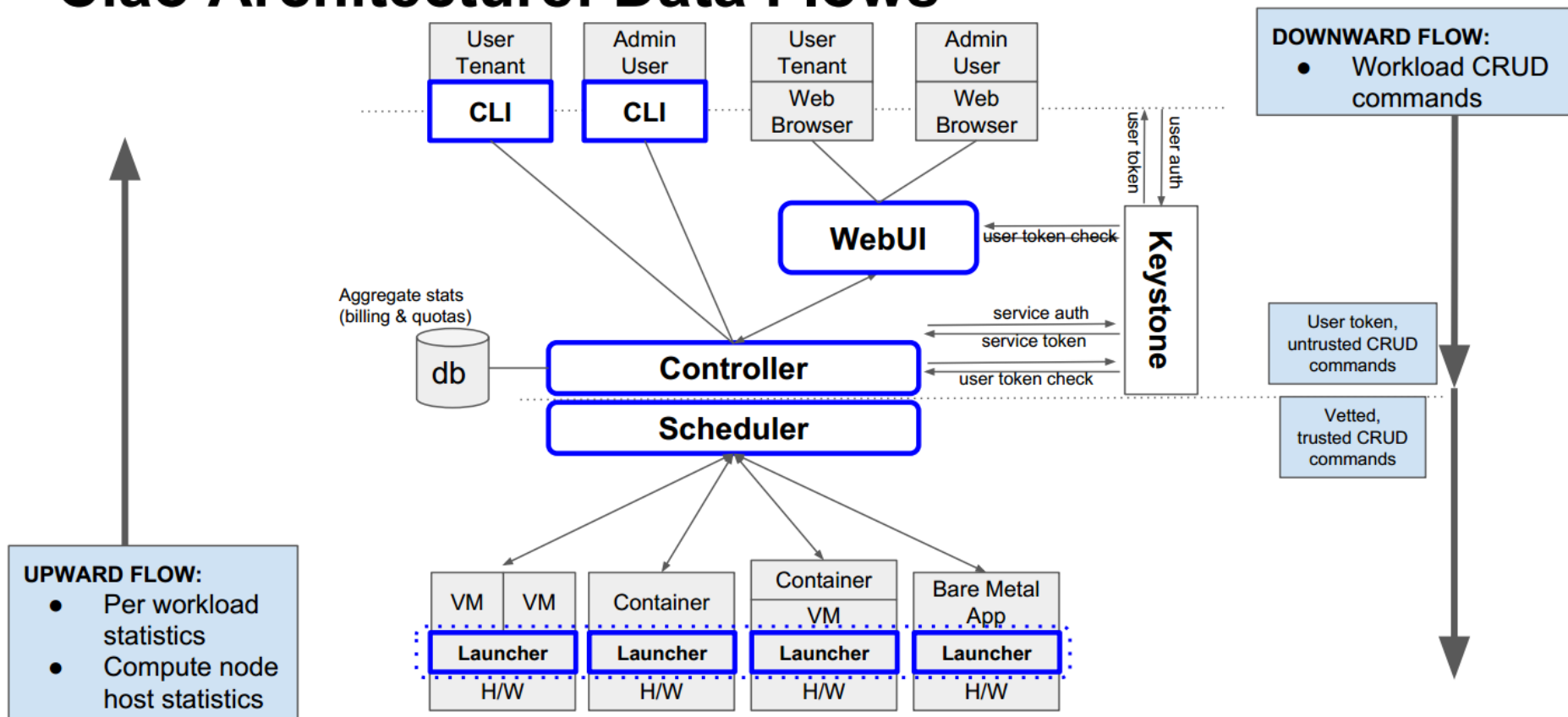
If we built it today,
what would
OpenStack look like?



A light gray geometric wireframe pattern, resembling a low-poly mesh or a stylized globe, is visible in the background of the slide.

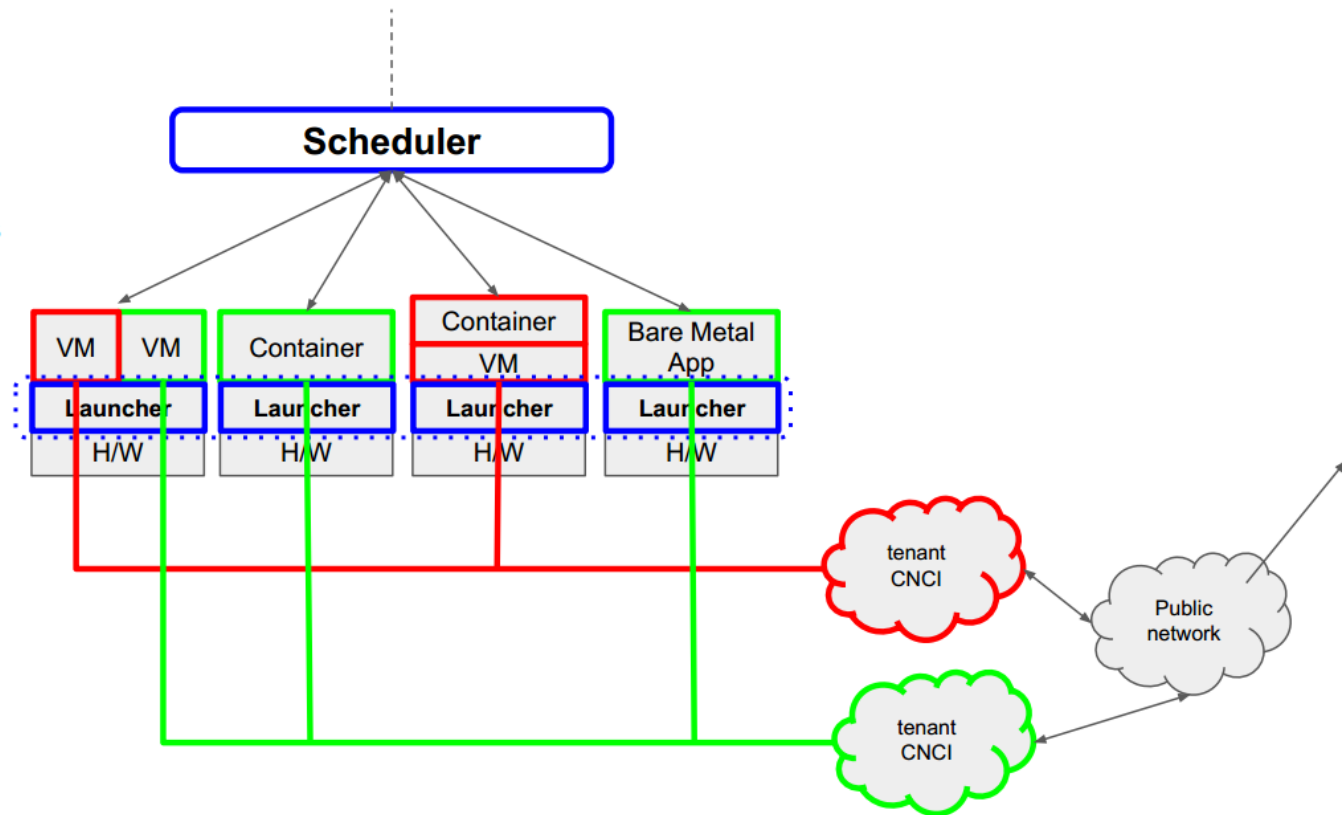
Containers + VM's as Equals
Built for Scale
Ease of Upgrades
Ease of Deployment
Secure by Design

Ciao Architecture: Data Flows

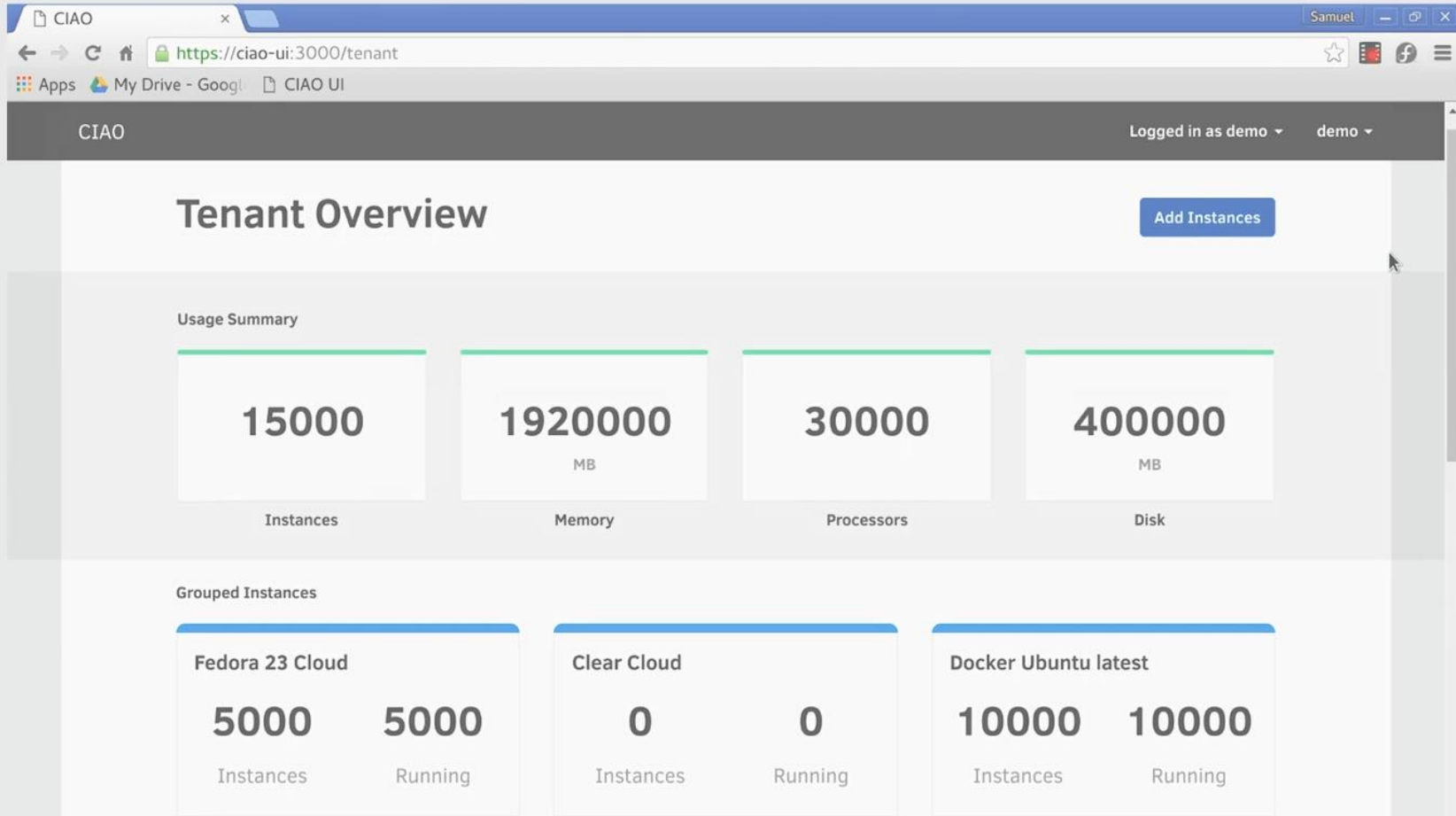


Ciao Architecture: Software Defined Networking

- Workload launch payload includes controller assigned network MAC & IP address
- Create per workload bridges on the fly and connect to a per-tenant virtual network concentrator (aka "CNCI")
- Tenant virtual networks isolated from each other



5k VMs. 10k containers. 1 minute.



ciao: Get Involved

Start Here!

- [Talk to us here](#)
- <https://clearlinux.org/ciao>

Check us out on github! Join the conversation!

- <https://github.com/01org/ciao>
- <https://github.com/01org/ciao-webui>
- IRC: #ciao-project on Freenode
- Mailing list: <https://lists.clearlinux.org/mailman/listinfo/ciao-devel>

Key to a 10x mindset: Self reflection

“I have learned a
healthy
disdain for the
word
Impossible”



Impossible is Nothing



Clear Linux[®]
Project
for Intel[®] Architecture



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