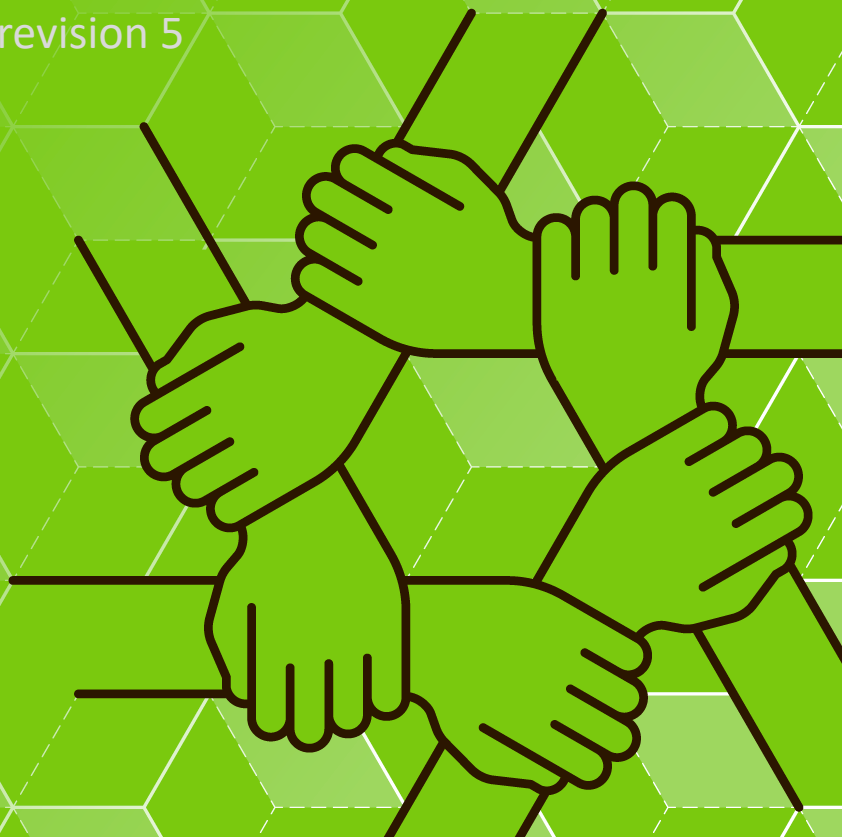
Sharpening Our Pencils on Carbon Measurement

revision 5



EMPOWERING OPEN.

OCP REGIONAL SUMMIT

APRIL 19-20, 2023
PRAGUE, CZ

Sharpening Our Pencils on Carbon Measurement

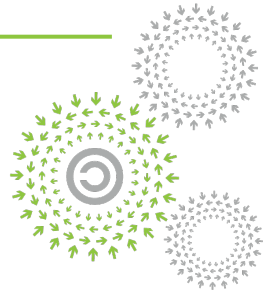
Erik Riedel, PhD

Chief Engineering Officer

Flax Computing

OPEN Compute Project

SOLUTION PROVIDER®



OPEN SILVER™

Abstract

This talk will show that using carbon footprint as a common metric to assess a piece of computing equipment allows straightforward comparison of technologies and designs on a “performance per carbon” basis, bringing together operational (energy use inputs) and scope 3 (production & materials inputs) carbon, along with workload-aligned performance metrics to compare technologies and systems. Our proposed methodology to apply “carbon points” to hardware components and systems can allow system-level, rack-level, and data-center-level quantification of detailed carbon footprints, which can then be optimized and reduced. You cannot improve what you cannot measure, and we believe that carbon footprint can be used today as a successful common metric for comparison. We will outline our database of footprint calculations and comparisons with real OCP systems, and we will review our success in bringing carbon-advantaged computing to OCP deployments in several real customer scenarios worldwide.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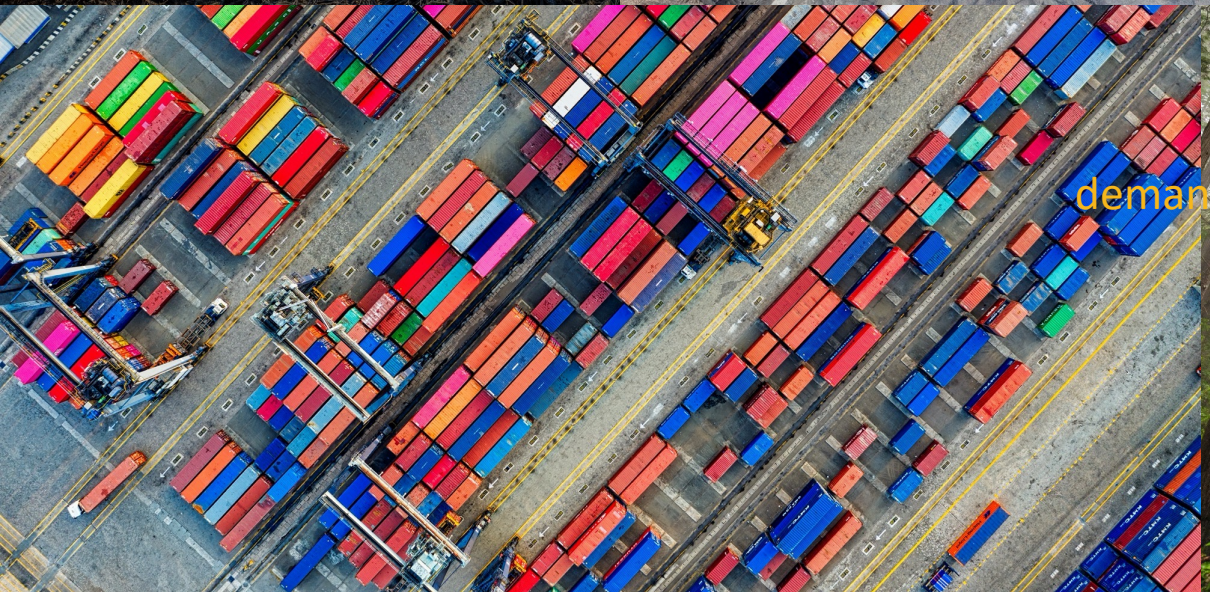
natural resources


carbon
footprint


demandgrowth

Outline

- Advances in computing technology drive hardware upgrade cycles
- Important to quantify the benefits
  - proposal: performance / carbon
- Example – networking cards
- Example – flash drives
- Extending server life – why it works
- Call to action


Technology Advance
Drives Upgrades

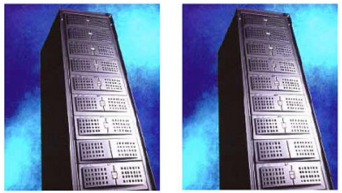
Technology Constantly Advances

hardware, software, operations, applications, methods, methodologies

Computing Technology has advanced in leaps & bounds.

Makes sense to regularly consider updates & refreshes.

Network "Appliances" Can Win Today



Dell PowerEdge & PowerVault System

Dell PowerVault 650F	$40,354 x 12 =484,248
512 MB cache, dual link controllers, additional 630F cabinet, 20 x 9 GB FC disks, software support, installation	
Dell PowerEdge 6350	$11,512 x 12 = 138,144
500 MHz PIII, 512 MB RAM, 27 GB disk	
3Com SuperStack II 3800 Switch	7,041
10/100 Ethernet, Layer 3, 24-port	
Rack Space for all that	20,710

NASRaQ System

Cobalt NASRaQ	$1,500 x 240 =	360,000
250 MHz RISC, 32 MB RAM, 2 x 10 GB disks		
Extra Memory (to 128 MB each)	$183 x 360=	65,880
3Com SuperStack II 3800 Switch	$7,041 x 11=	77,451
240/24 = 10 + 1 to connect those 10		
Dell PowerEdge 6350 Front-End		11,512
Rack Space (estimate 4x as much as the Dells)		82,840
Installation & Misc		50,000

Comparison

	Dell	Cobalt
Storage	2.1 TB	4.7 TB
Spindles	240	480
Compute	6 GHz	60 GHz
Memory	12.3 GB	30.7 GB
Power	23,122 W	12,098 W
Cost	$650,143	$647,683

Slide from my PhD thesis defense in 1999

Today

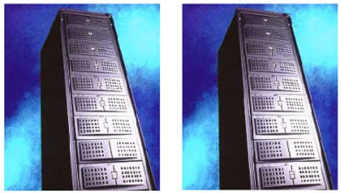
100G networking

PB storage

THz computing

TB memory

Network "Appliances" Can Win Today



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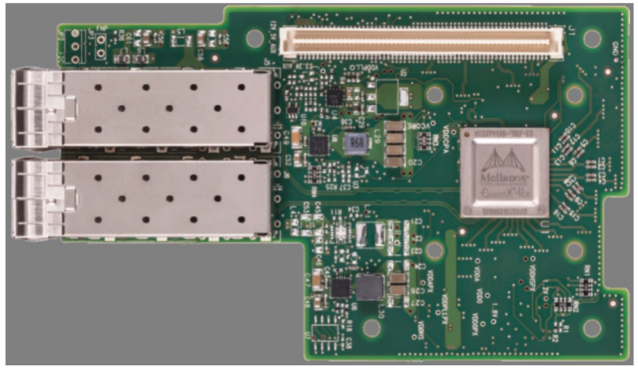
1999

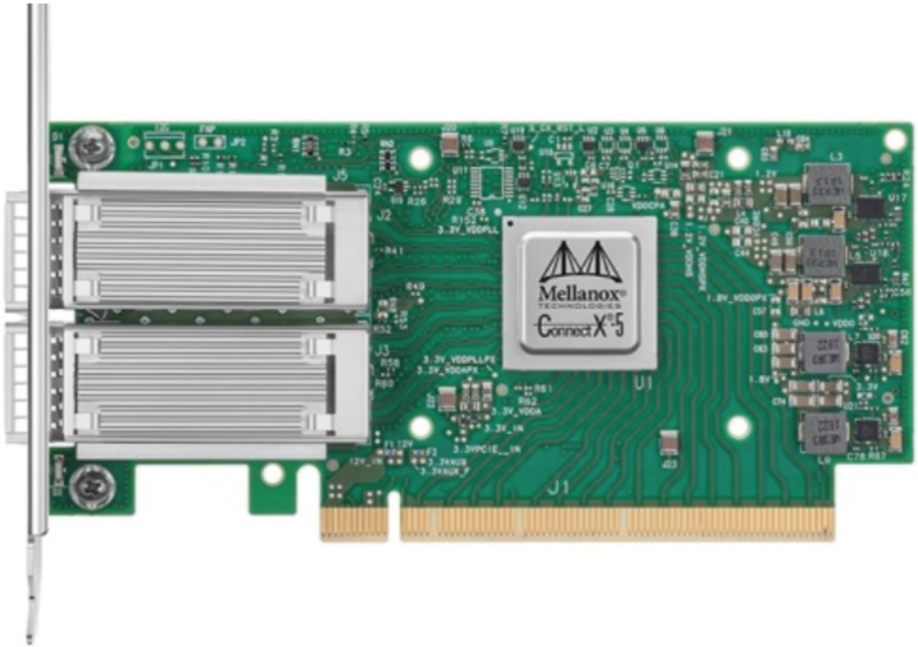
2022

8,640 TB	storage
480	spindles
1,152 GHz	compute
122,880 GB	memory
76,800 W	power
$650,000	cost

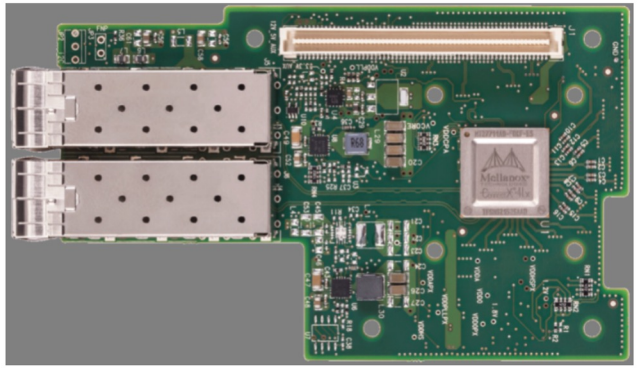
Detailed Example – Networking Cards

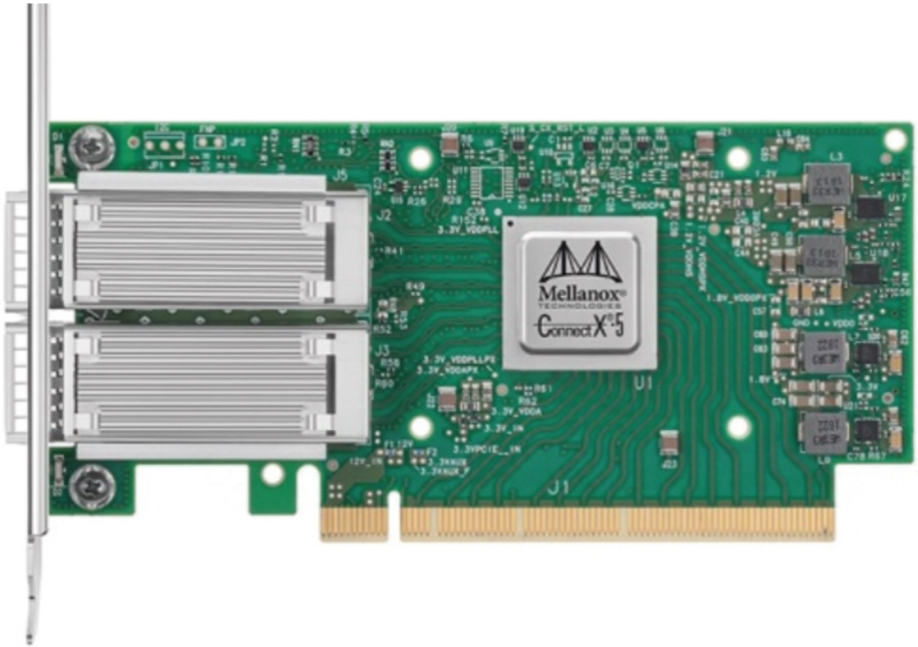


Mellanox MCX-4421A
dual 25G networking to x8 PCI
60 cm^2 board area
272 mm^2 chipset (1m transistors)



Mellanox MCX-516A
dual 100G networking to x16 PCI
90 cm^2 board area
625 mm^2 chipset (2m transistors)





ConnectX-4

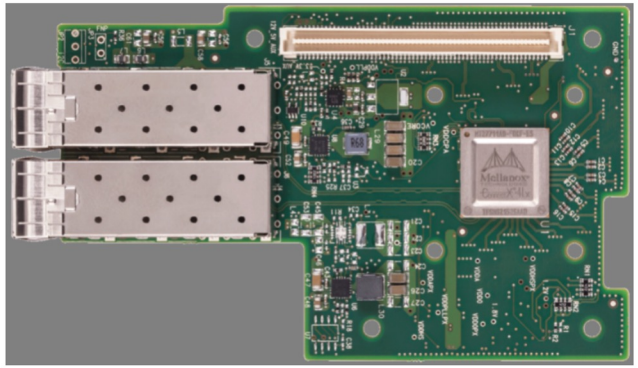
Mellanox MCX-**4**421A
dual 25G networking to x8 PCI
60 cm^2 board area
272 mm^2 chipset (1m transistors)

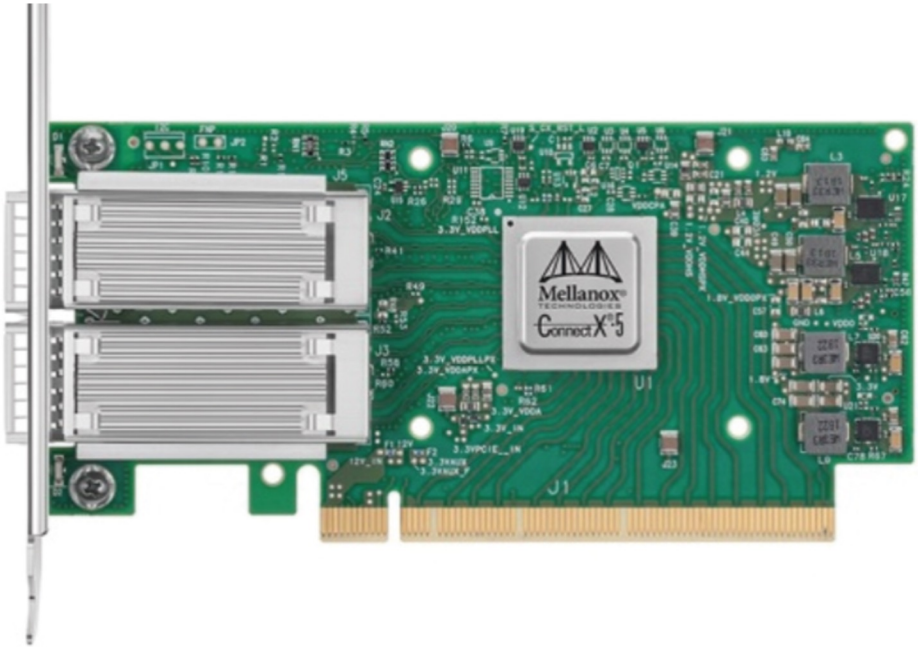
ConnectX-5

Mellanox MCX-**5**16A
dual 100G networking to x16 PCI
90 cm^2 board area
625 mm^2 chipset (2m transistors)

ConnectX-6

ConnectX-7



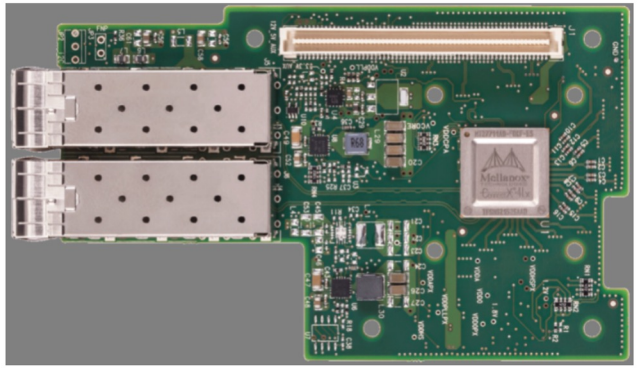


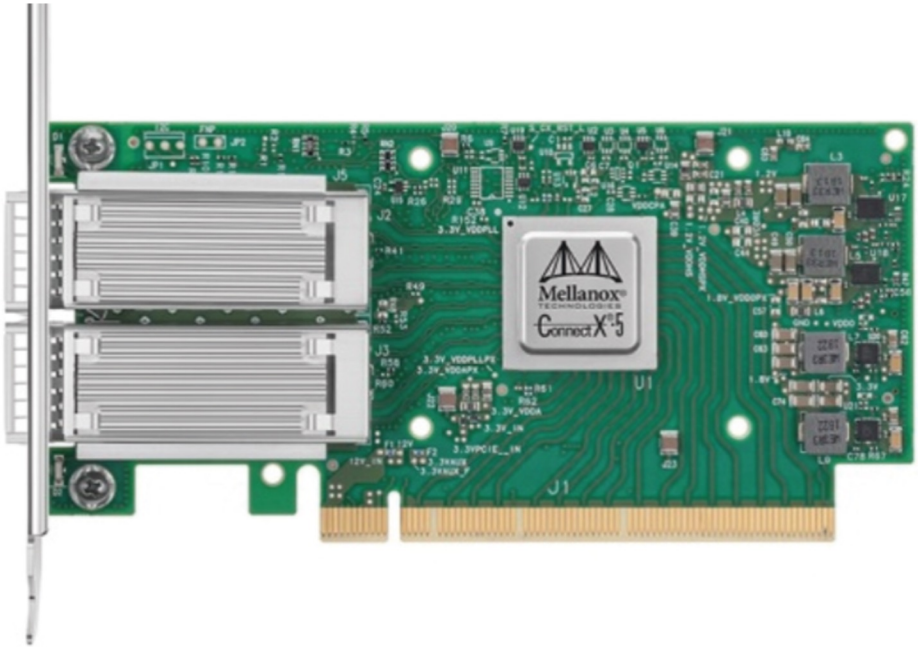
Mellanox MCX-4421A
dual **25G** networking to x8 PCI
60 cm^2 board area
272 mm^2 chipset (1m transistors)

measured performance **23 Gbit/s**
msrp $255 street $180

Mellanox MCX-516A
dual **100G** networking to x16 PCI
90 cm^2 board area
625 mm^2 chipset (2m transistors)

measured performance **32 Gbit/s**
msrp $1509 street $890





Mellanox MCX-4421A
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measured performance **23 Gbit/s**
msrp $255 street $180

Mellanox MCX-516A
dual **100G** networking to x16 PCI
90 cm^2 board area
625 mm^2 chipset (2m transistors)

96 Gbit/s
measured performance ~~**32 Gbit/s**~~
msrp $1509 street $890

Detailed Example – Flash Drives

Flash Drive Performance Comparisons

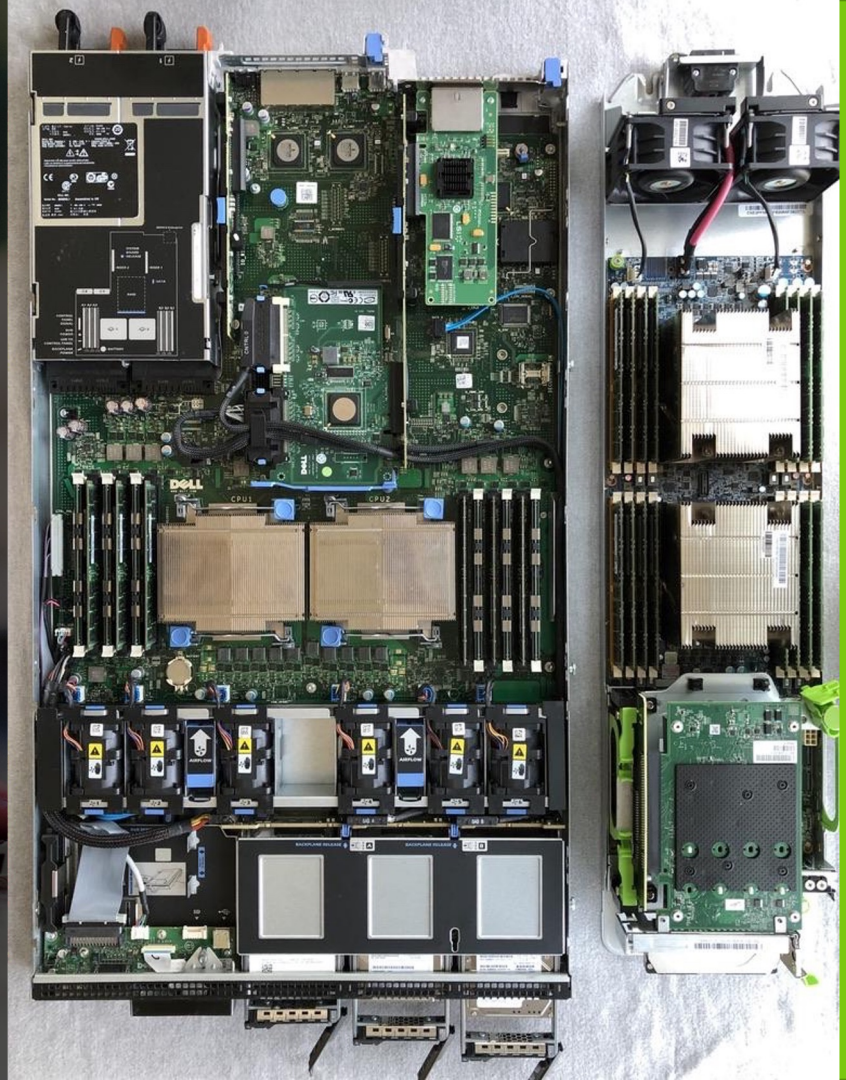
					weight	IOPS	BW	variation
Samsung	PM983	NVMe/M.2	960 GB	MZ1LB960HAJQ	12g	527,000	2,931 MB/s	2.55%
Samsung	PM983	NVMe/M.2	3840 GB	MZ1LB960HAJQ	15g	518,000	2,750 MB/s	3.69%
WD	SN720	NVMe/M.2	2000 GB	SDAQNTX-2T	7g	314,000	3,172 MB/s	0.02%
WD	SN630	NVMe/U.2	7680 GB	WUS3BA176C7P3E3	65g	435,000	2,100 MB/s	4.15%
…								
…								
…								
…								
Kingston	KC600	mSATA	256 GB	SKC600M	5g	136,000	567 MB/s	0.07%

Comparison

Upgrading Your Servers

traditional server

- dual CPUs, two 1U heatsinks, twelve 1U fans



OCP node - dual CPUs, two 2OU heatsinks, two 2OU fans

Partnerships

Project OriginMark

- joint with molg

d

ICA Founding Companies

Hyperscaler

aws, Google, Meta, Microsoft

Colocation

Aligned, AQ, Chayora, CloudHQ, COMPASS, COMPUTENORTH, CUMULUS, CyrusOne, Cyxtera, DATABANK, DIGITAL REALTY, edgeconnex, EdgePresence, EQUINIX, EVOQUE, Green Mountain, IRON MOUNTAIN, KAO DATA, KevlinX, Netrality, NTT, PURE DC, STACK, STREAM, switch, VANTAGE, VPLS, Walhalla, yondr

Product

ARTESYN, EATON, ENCONNEX, HUAWEI, INTEGRA, legrand, MIRATECH, Natron Energy, NOVOS, OMNI-THREAT, Schneider Electric, Tate, VERTIV.

Service

ARCHELIX, CBRE, CIRKLA, Net, CRITICAL, EDGEVANA, HYPERCO, JLL, INODE POLE, northshore, ON VALUE, Rahi, SALUTE, SMITH

Finance

GI PARTNERS, sip

Power Utility

ENCHANTED ROCK, TALEN ENERGY

Software

CATO, molg, nZero

Introducing iMasons Climate Accord

The role of the digital infrastructure industry in fighting climate change

By InterGlobix

Traceability

to building scale and beyond

Given OriginMark's unique assembly relationship data structure, valuable data, **such as embodied carbon**, can be computed based on roll-up **aggregate total of materials and processes** inside the individual components, whether that is an **individual units, an entire buildings, or a global asset portfolios.**


Consider Extending
Server Life

The Best Server Is The One You Already Have

(Maybe)

Understand the full carbon footprint of your computing.

Reduce your footprint. And your complexity. And your costs.

Comparison

Upgrading Your Ride

17 MPG fuel economy	0 to 60 in 12 seconds
25 MPG fuel economy	0 to 60 in 2 seconds

Comparison

Upgrading Your Ride

17 MPG fuel economy	0 to 60 in 12 seconds
— MPG fuel economy	0 to 60 in 4 seconds

Comparison

Upgrading Your Servers

traditional server

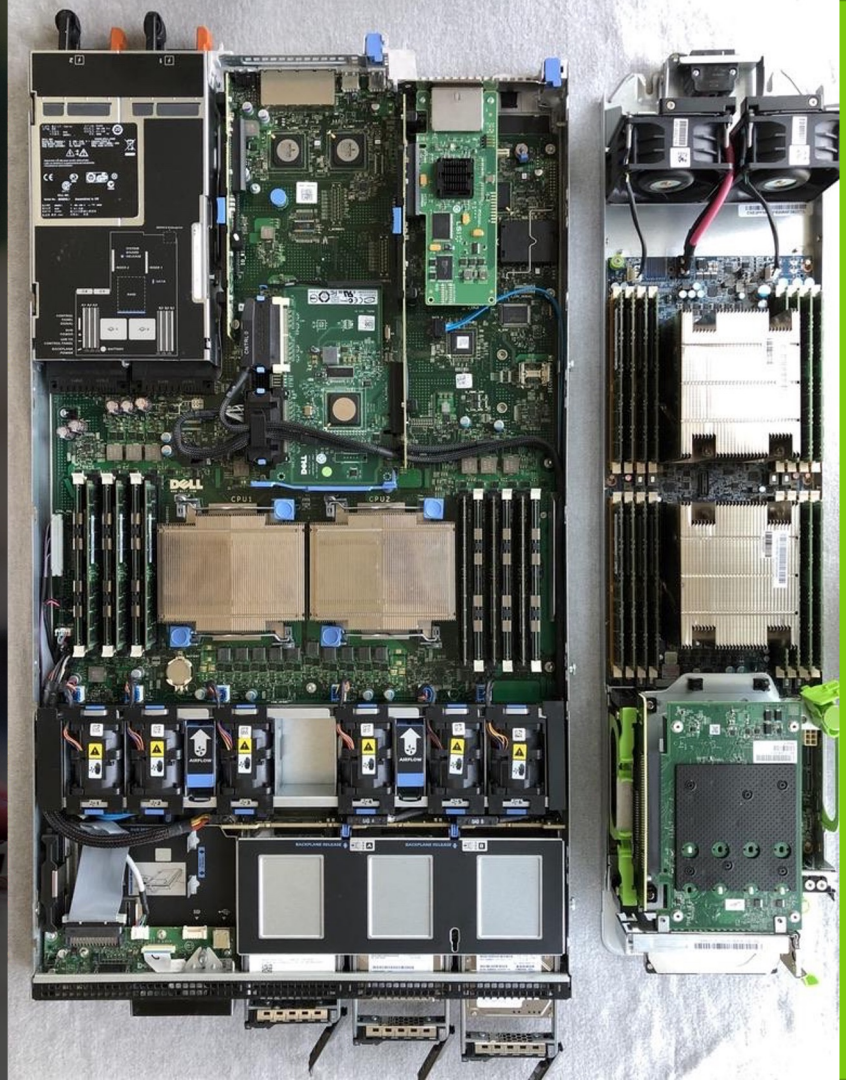
OCP node

Comparison

Upgrading Your Servers

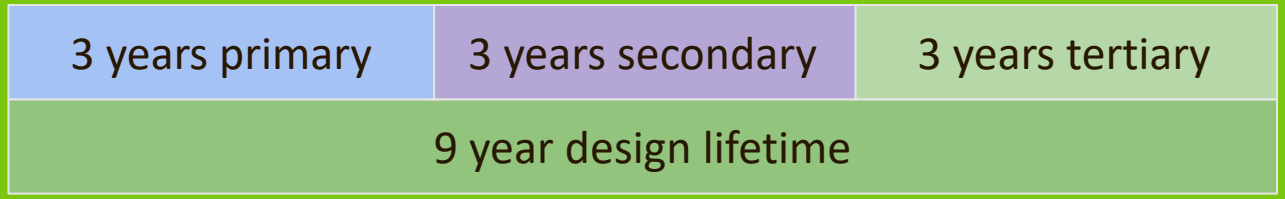
traditional server

- dual CPUs, two 1U heatsinks, twelve 1U fans



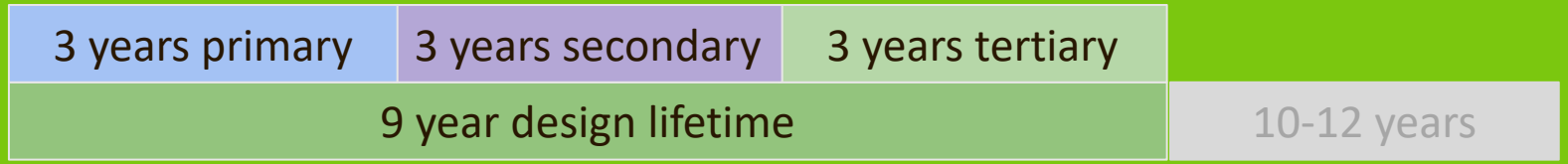
OCP node - dual CPUs, two 2OU heatsinks, two 2OU fans

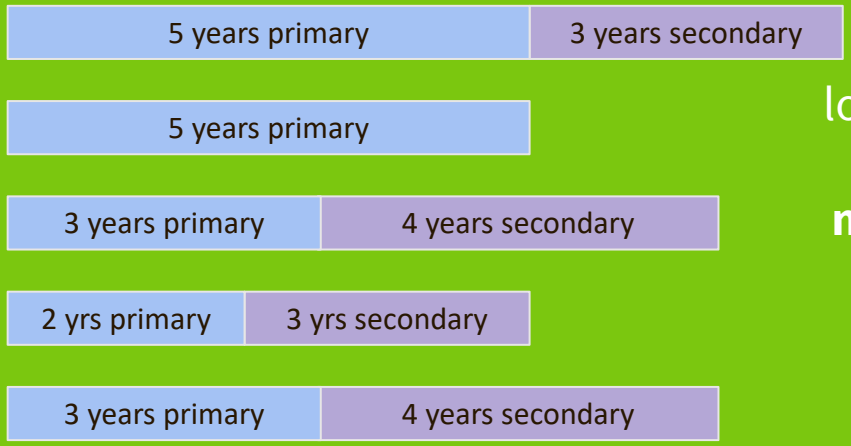
Why it works



Recertified hardware approach – facilitate secondary and potentially tertiary use stages for technology assets in various forms

Why it works





In fact, anything that keeps technology running longer will be beneficial, as long as the technology is still **useful** for something by somebody, plus **maintainable** & **serviceable**. SO use those actual criteria to evaluate ALL technology: workload performance, ongoing maintenance complexity & ongoing service costs.

Call to Action

- Reach out to us to get involved
- Engage us to evaluate / quantify your server carbon footprints
  - www.flaxcomputing.com
- Evaluate your own servers, share the results with us report @ flaxcomputing.com
- Contribute measurements and component details data @ flaxcomputing.com

Erik Riedel, PhD, Chief Engineering Officer, Flax Computing
Twitter: @er1p, @RiedelAtWork email: erik @ flaxcomputing.com

Open Discussion

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clouds
drive
demand

Green
Software
Foundation

About Working Groups Projects Resources Articles

We are building a trusted ecosystem of people, standards, tooling and best practices for

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https://greensoftware.foundation/

inefficient
toolchains

software footprint

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