Cloud: The Next Disruption in HPC

Gabriel Broner, VP & GM of HPC, Rescale
Barcelona Supercomputing Center, March 2018

Agenda

- Evolution of High Performance Computing
- Disruptions and Challenges
- HPC in the Cloud
- Use Cases
- What is needed in the Cloud
- Intro to Rescale
- Incorporating Cloud in HPC
- The Future

High Performance Computing

Aerospace

Oil & Gas

Automotive

Life Sciences

Evolution of HPC

Cray 1
1976

Special Architecture
160 MegaFlops

Evolution of HPC

Cray T3E MPP
1995

Standard Processors
2048 nodes
1 TeraFlop

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Evolution of HPC

SGI NASA Columbia
2004
60 Teraflops

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Evolution of HPC

SGI NASA Pleiades
2018
7 Petaflops
Standard Intel Nodes

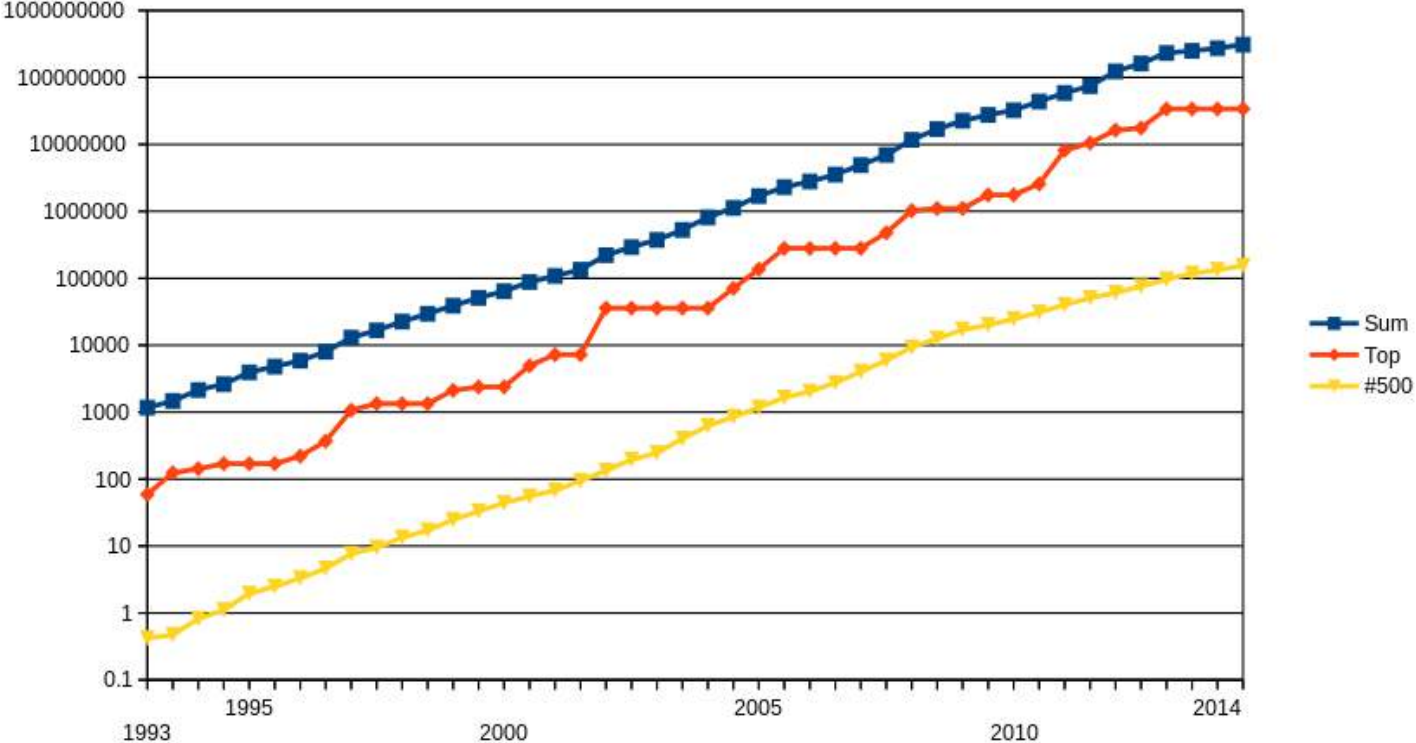Gabriel Broner, Rescale – Cloud: The Next Disruption in HPC – March 2018

Evolution of HPC

Barcelona Mare Nostrum
2018
11 Petaflops

Supercomputing Performance (FLOPS)

High Performance Computing
A History of Disruptions

Cray 1	Cray MPP	SGI Altix	SGI ICE
Proprietary	Standard CPU, Memory	Linux	Intel 2-cpu nodes
1970s	1990s	2000s	Now
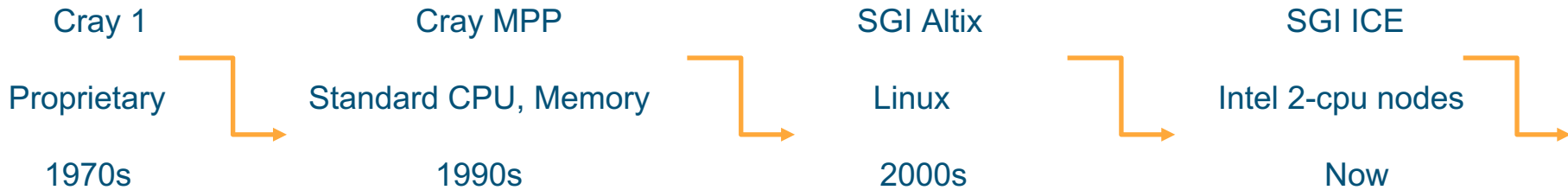
Processor Performance Reaching a Plateau

40 Years of Microprocessor Trend Data

Transistors (thousands)

Single-Thread Performance (SpecINT x 10³)

Frequency (MHz)

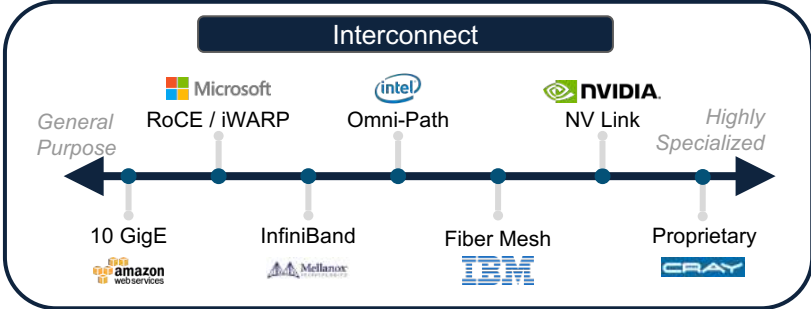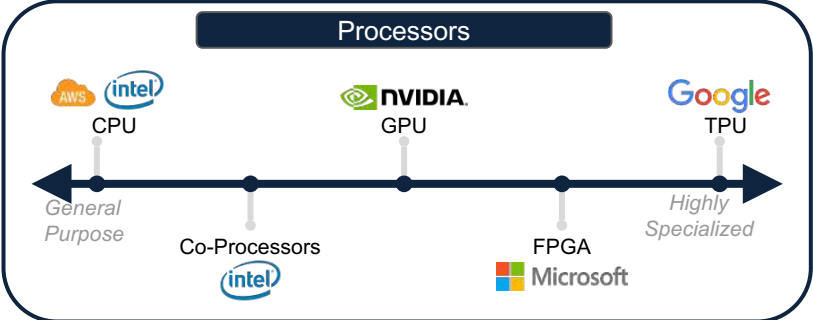Typical Power (Watts)

Number of Logical Cores
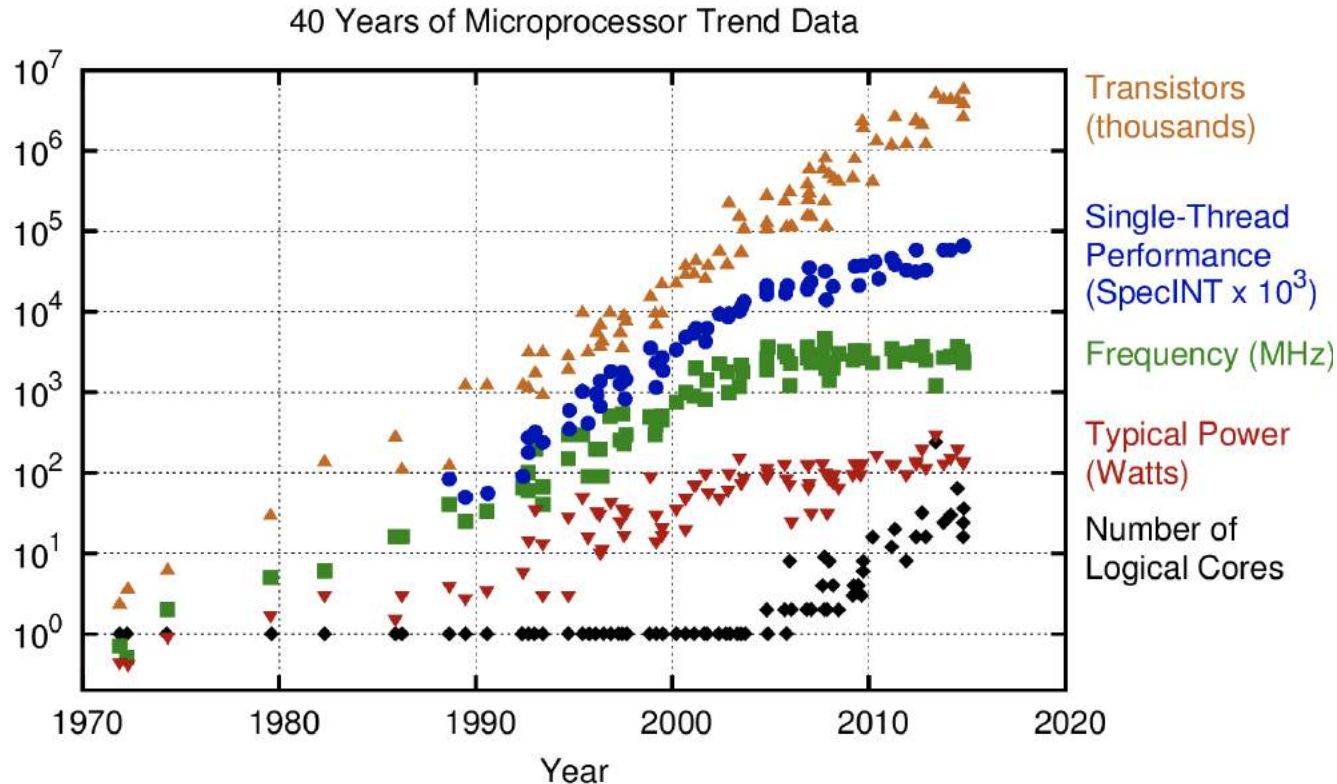
Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten
New plot and data collected for 2010-2015 by K. Rupp

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Multiple Architectures

More difficult to select an on-premise system

Processors

CPU · GPU · TPU

AWS, intel — CPU
NVIDIA — GPU
Google — TPU
Co-Processors — intel
FPGA — Microsoft

General Purpose → Highly Specialized

Interconnect

General Purpose → Highly Specialized

RoCE / iWARP — Microsoft
Omni-Path — intel
NV Link — NVIDIA

10 GigE — amazon web services
InfiniBand — Mellanox
Fiber Mesh — IBM
Proprietary — CRAY

"What architecture should I buy?"

HPC in the Cloud

- Instant access to unlimited resources
- Choice of architectures
- Applications available and tuned
- Application runs on best suited architecture
- Jobs run with no wait
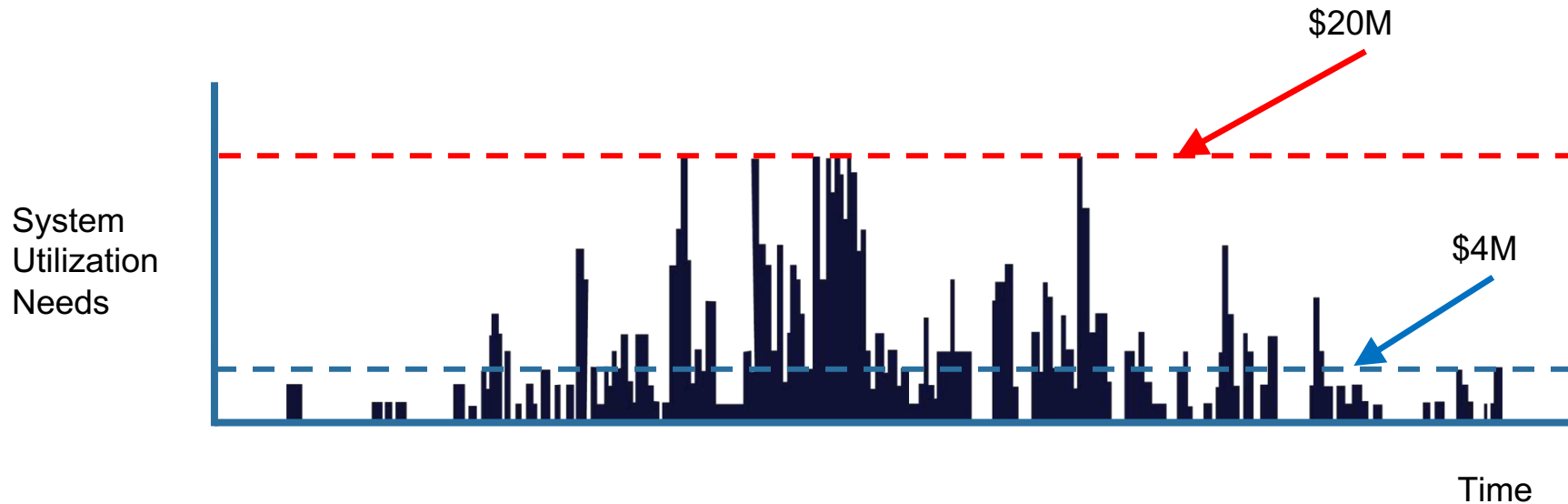- Engineers not constrained by the size of a system

- Faster innovation, shorter cycles, improved time to market
- Immediate provision, variable size, no capital investment
- System utilization, job queues, downtimes, are a thing of the past

Automotive Supplier Challenge

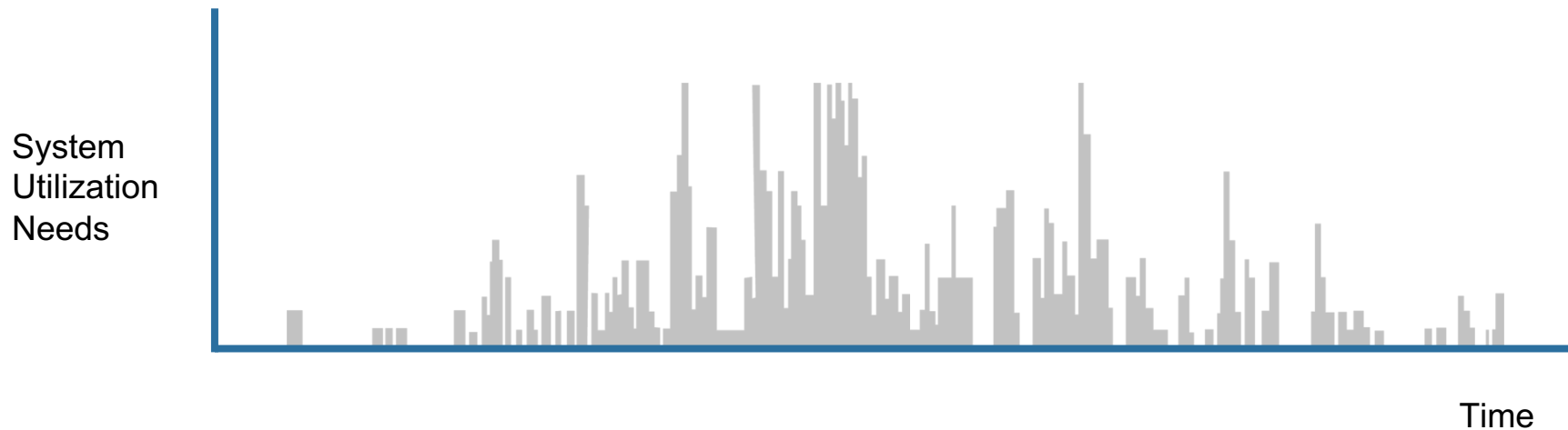*What size on-premise system should I buy?*

$20M

$4M

System
Utilization
Needs

Time

- $4M for a system with high utilization, wait in queue
- $20M for a system sized for the peaks, no wait

Automotive Supplier
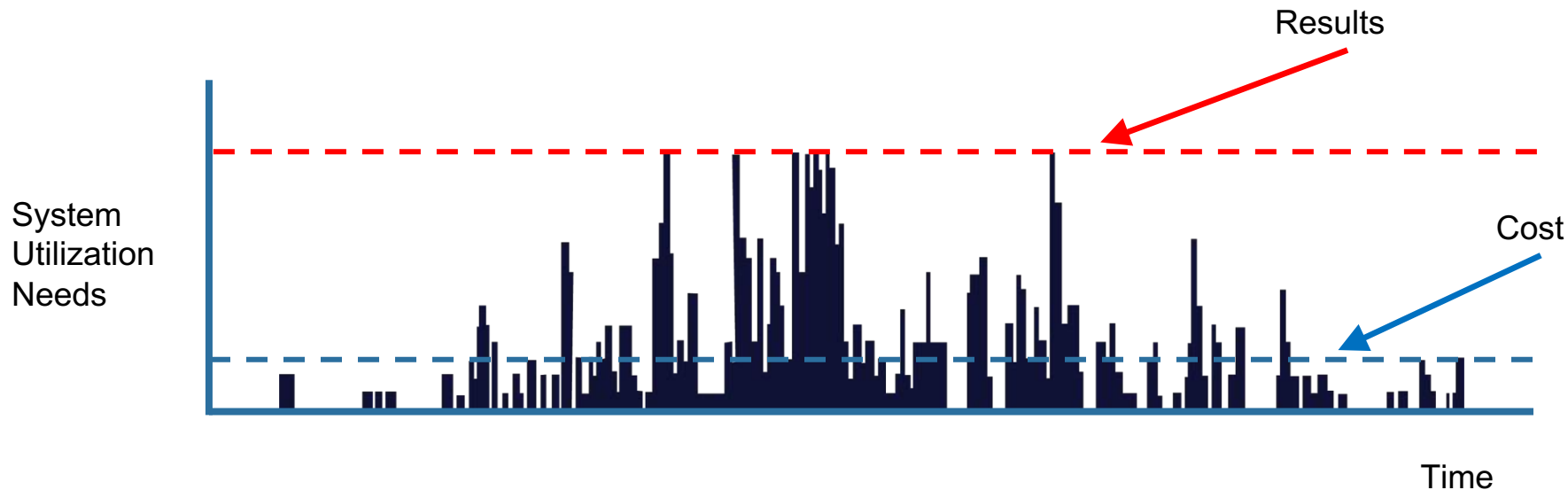
With Cloud HPC

System
Utilization
Needs

Time

With Rescale, match the workload needs at $50-100K per month

Automotive Supplier

With Cloud HPC

- Depreciation of a $4M system is $111K per month - Rescale costs less
- Users run with no wait, like if owning a $20M system sized for the peaks

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Wing Design

With Cloud HPC

- Instant access to a large system
- 3 month development in 24 hours
- 787 wing lighter by 150 pounds
- Cost savings of $180M

Rocket Design

With Cloud HPC

- Instant access to 1000 cpus
- Development speedup of 24x
- Tens of thousands of simulations validate design before launch
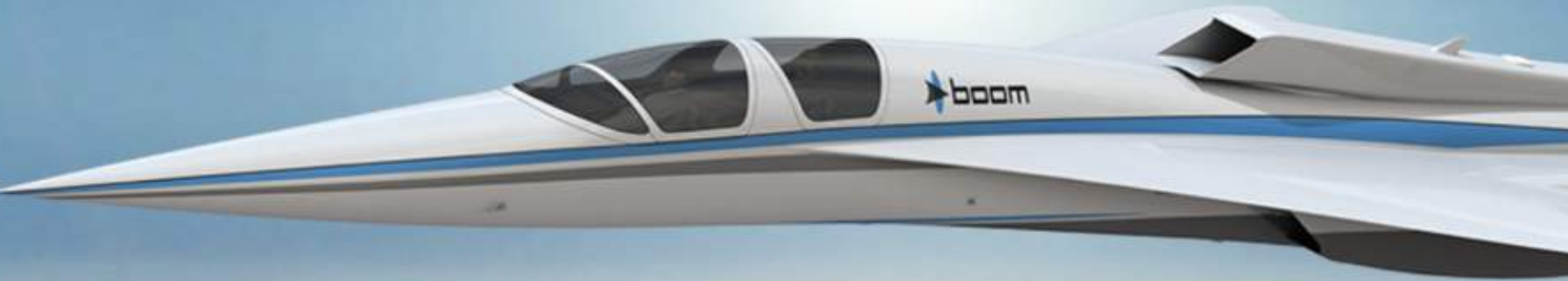
Formula 1 Racing

With Cloud HPC

- Real world sensor data
- Trackside simulation
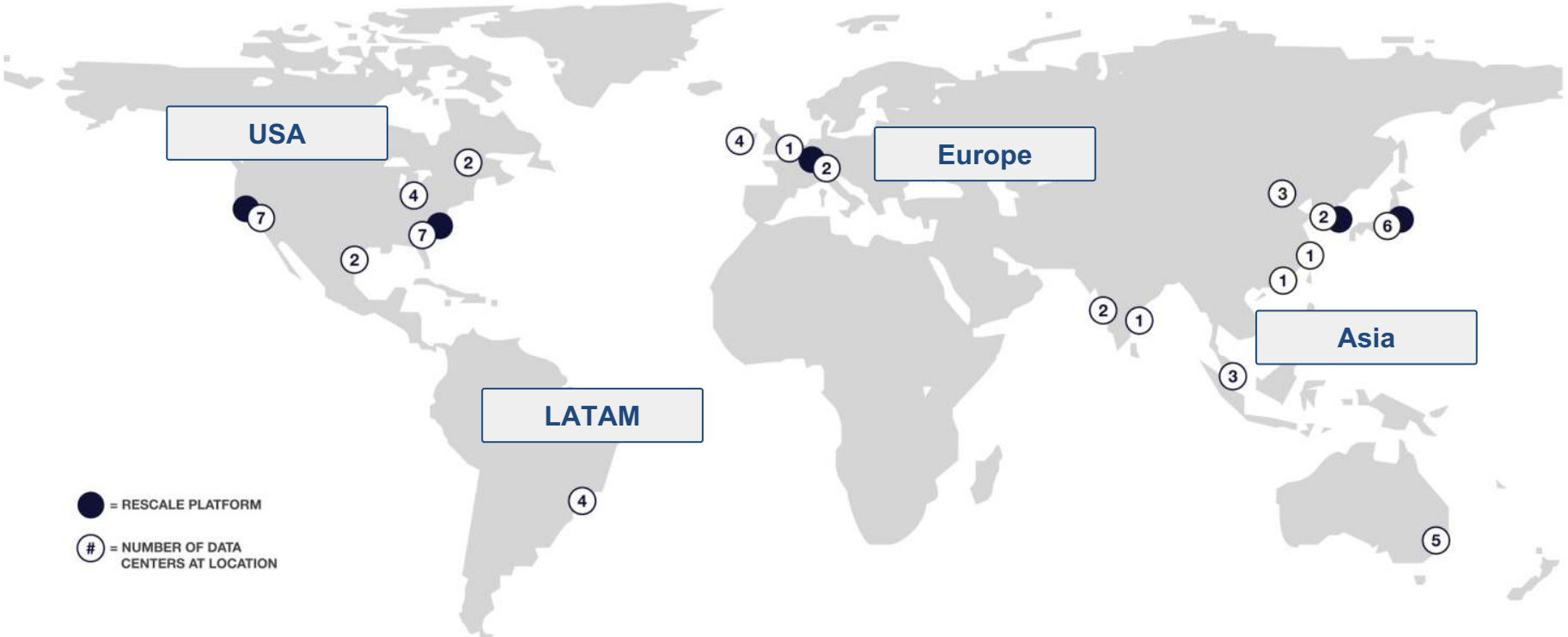- 3000 simulations per lap
- F1 team adjusts race strategy

Designing and Flying a Supersonic Virtual Plane

With Cloud HPC

- Pilots fly in the simulator the model of the plane being designed

Challenge: Accessing Diverse Data Centers

USA

Europe

LATAM

Asia

● = RESCALE PLATFORM

(#) = NUMBER OF DATA CENTERS AT LOCATION

Challenge: Availability of Applications

Challenge: Run on the best suited architecture

Abaqus/Standard	LS-DYNA	TensorFlow
	On demand cluster provisioning	

AWS

| 10 GigE Network |
| 31GB SSD Storage |
| 3.3 GB Memory |
| 16 K80 GPU & 32 CPU |

SERVER TUNING

Up to **5X speed up** over standard hardware

Microsoft Azure

| Infiniband Network |
| 50 GB Storage |
| 8 GB Memory |
| 256 CPU |

SERVER TUNING

Up to **2X speed up** over standard hardware

Google

| 10 GigE Networking |
| Storage |
| Memory |
| TPU |

SERVER TUNING

Up to **30X speed up** over standard GPUs

Challenge: Reliability and Security
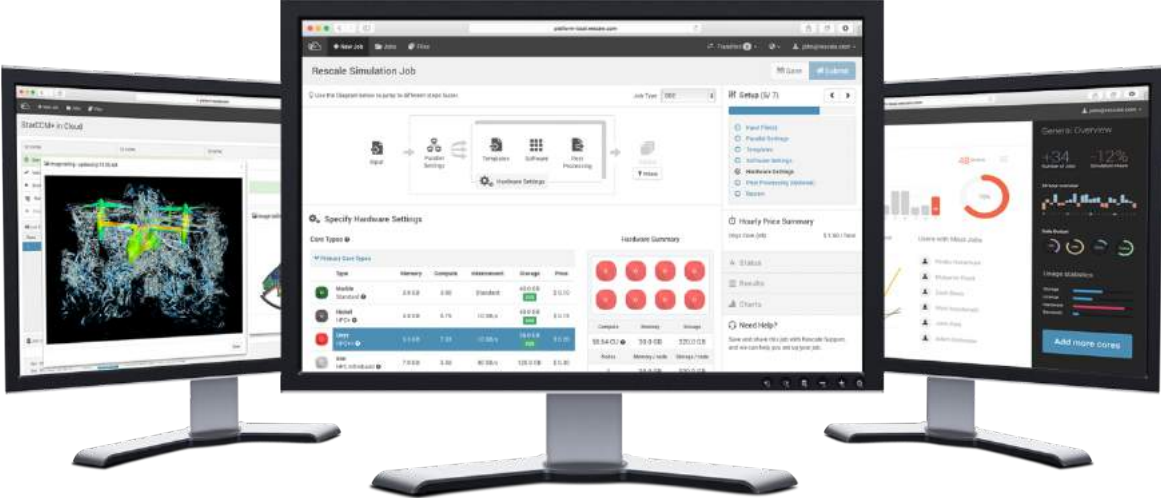

SOC 2 Type 2 Certified   ISO 27001 Certified   CSA Certified   ITAR Compliant

Challenge: Simple User Interface

Intro to Rescale

Rescale Overview

Global Footprint

Founded in 2011, **San Francisco, USA HQ**
APAC office Singapore/Tokyo, EMEA office Munich

Technology

Cloud-based HPC and simulation platform
100+ data centers, 250+ software solutions

Industry Sectors

100+ leading Global 2000 enterprise customers

Aerospace   Oil & Gas   Automotive   Life Sciences   Industrials   Semiconductor   Financial Services
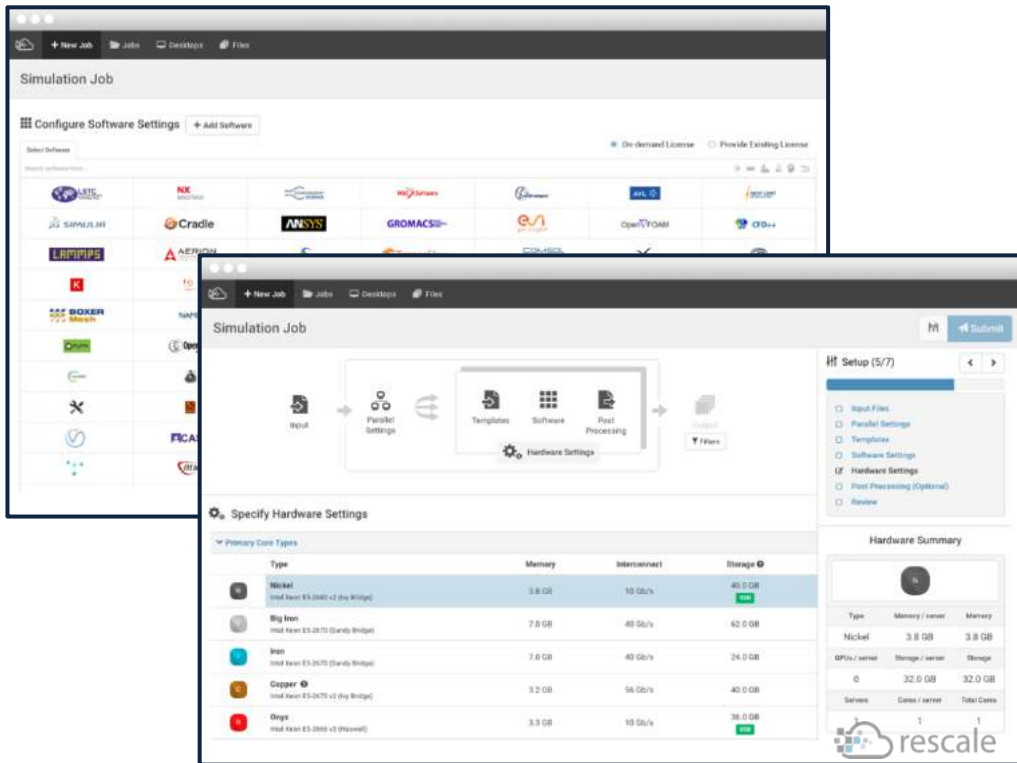
Investors

Jeff Bezos   Richard Branson   Peter Thiel

TRANSLINK CAPITAL
Microsoft   TRG
ITV ITOCHU TECHNOLOGY VENTURES   JumpCapital

Rescale is the Leading Enterprise Simulation Platform

Software

250+ turnkey software solutions

Multi-cloud

Hybrid, private, public & on-premise

Workflow

Support team; ease of use; customized

Administration

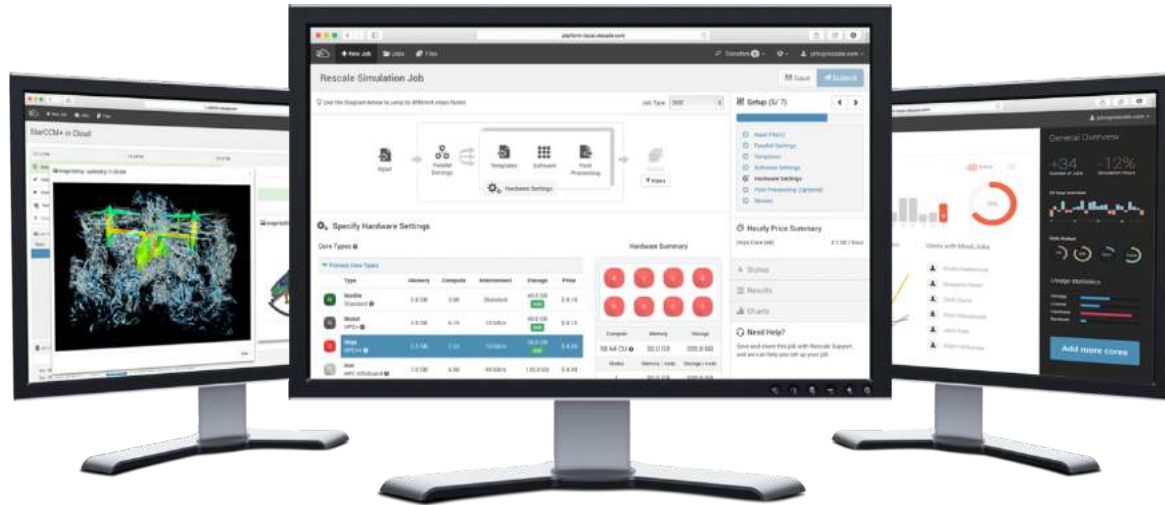Manage usage, Costs & resources

Security

Data and user security

Rescale - Cloud HPC Simulation Platform

Library of 260+ simulation and deep learning software packages

SaaS workflows for engineers, IT administrators, and ISV partners
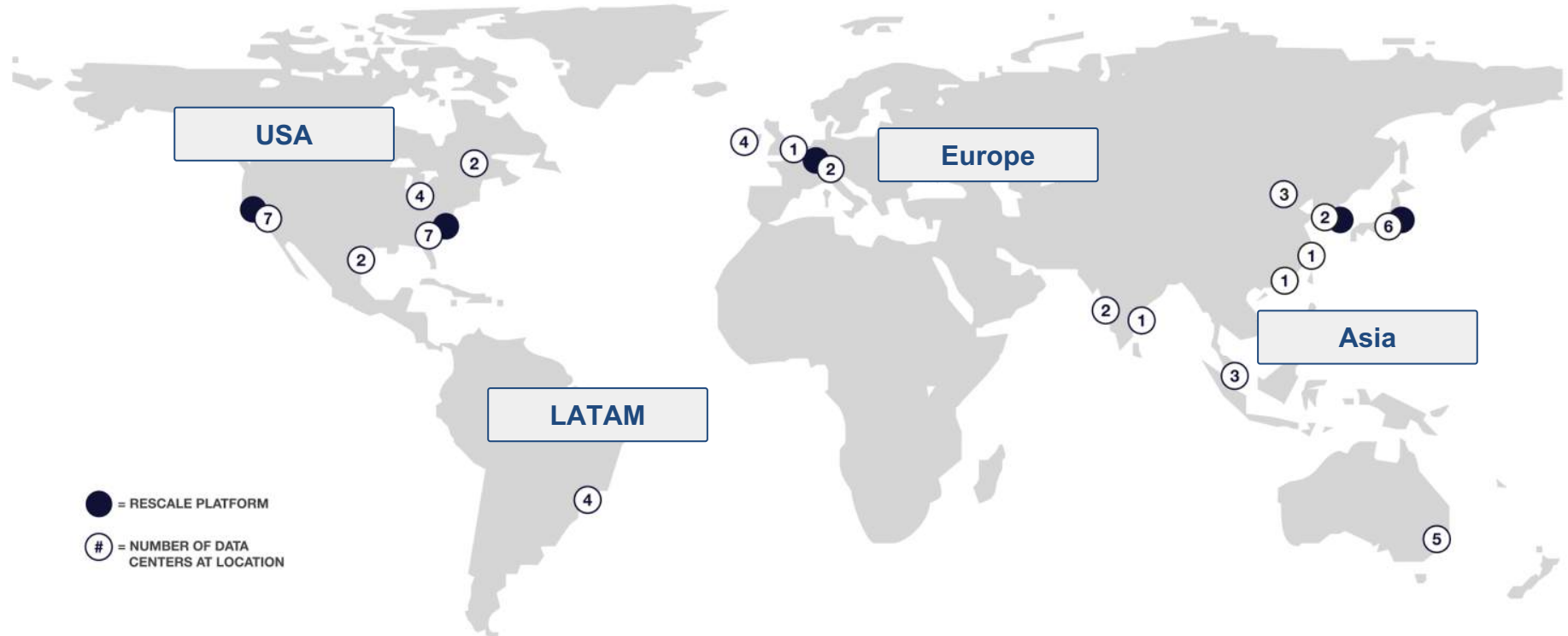
Zero IT footprint, turn-key cloud platform with best-in-class security

Global HPC resources provided and supported in multiple IT environments

Rescale's global multi-cloud HPC infrastructure network

Over 100 data centers worldwide

USA

Europe

Asia

LATAM

④ ② ④ ⑦ ⑦ ② — USA markers

④ ① ② — Europe markers

③ ② ⑥ ① ① ② ① ③ — Asia markers

④ — LATAM marker

⑤ — Australia marker

● = RESCALE PLATFORM

(#) = NUMBER OF DATA CENTERS AT LOCATION

amazon web services

Microsoft Azure

SOFTLAYER an IBM Company

Google Cloud Platform

IBM

DELL

Hewlett Packard Enterprise

One Platform, All Codes

1. Licenses
On-demand licensing in the cloud or use your existing license.

2. Software
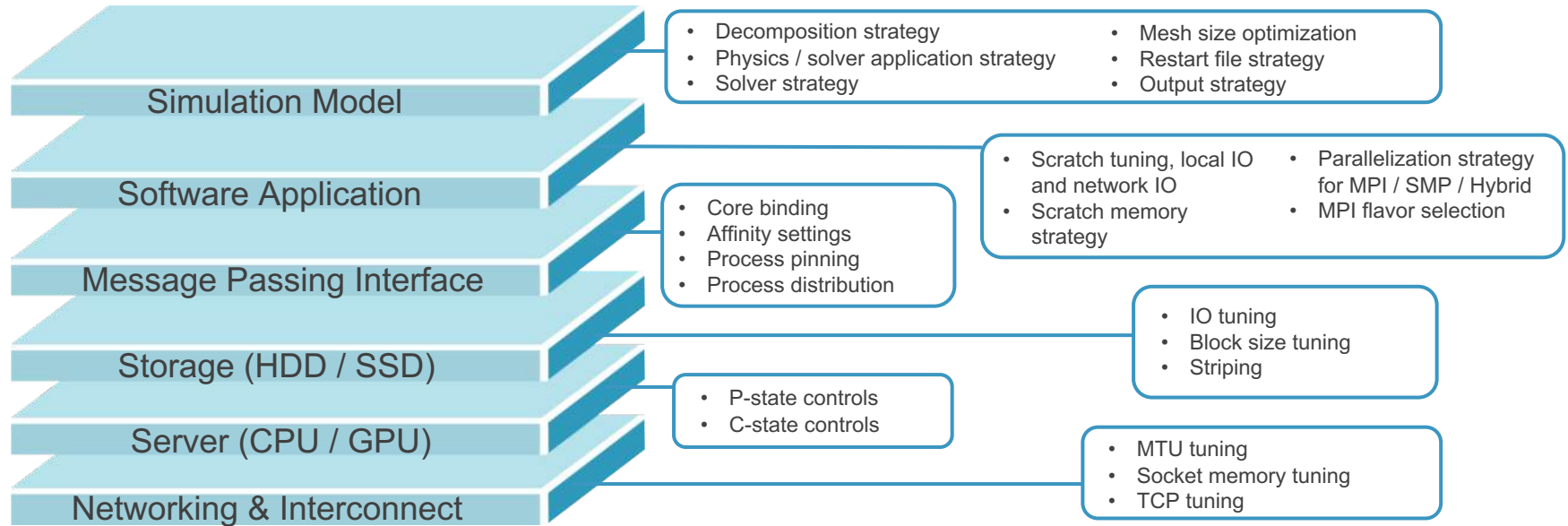Wide package selection with new versions added regularly.

3. Workflow
Easy workflow for pre- & post-processing. View results online with the GUI app.

4. Support
Best-in-class support from experts through instant chat, email, phone.

Proprietary Technology **Enabling Optimal Performance**

Simulation Model

- Decomposition strategy
- Physics / solver application strategy
- Solver strategy
- Mesh size optimization
- Restart file strategy
- Output strategy

Software Application

- Scratch tuning, local IO and network IO
- Scratch memory strategy
- Parallelization strategy for MPI / SMP / Hybrid
- MPI flavor selection

Message Passing Interface

- Core binding
- Affinity settings
- Process pinning
- Process distribution

Storage (HDD / SSD)

- IO tuning
- Block size tuning
- Striping

Server (CPU / GPU)

- P-state controls
- C-state controls

Networking & Interconnect

- MTU tuning
- Socket memory tuning
- TCP tuning

Performance Tuning
Automated tuning through proprietary software results in sustainable best performance

A seamless experience for Enterprise IT

Rescale delivers Best-in-class security layer across entire platform

Compliant with the strictest industry security standards

- Full administrative management and IT dashboard provide comprehensive controls and visibility

- Software defined security policy implementation tools to enforce proper IP handling

- Encryption in transfer with high-grade TLS and multi-layered encryption at rest with 256-bit AES

SOC 2 Type 2 Attested   CSA Registered   ITAR Compliant *   HIPAA Certified *
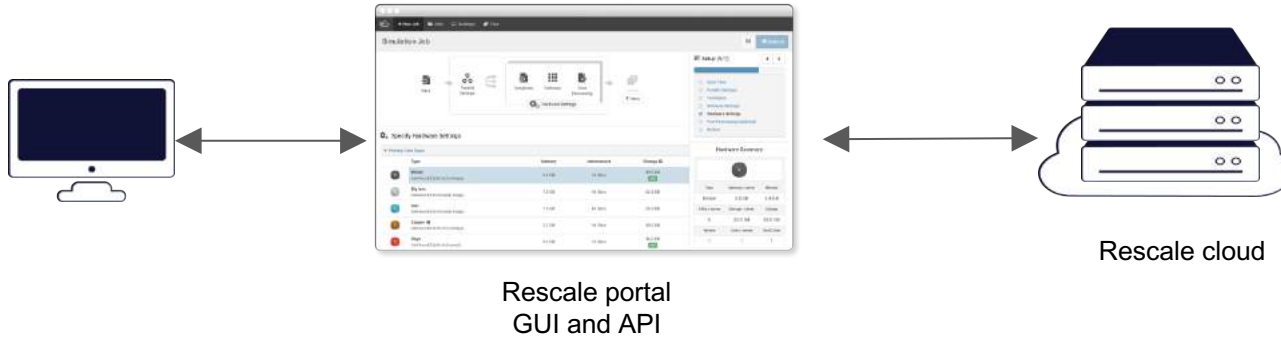
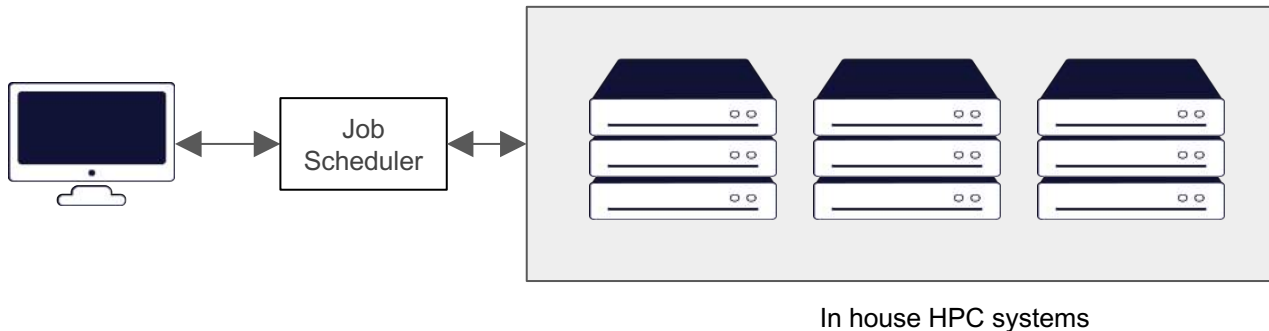* Not available in all geographical regions.

Hybrid - Incorporating Cloud in HPC

Incorporating Cloud in HPC

1. Move selected jobs to the cloud

1

Rescale portal
GUI and API

Rescale cloud

Select a few jobs
to move to the
cloud
Use the Rescale
portal directly

Job
Scheduler

In house HPC systems

Most jobs
continue to run on
premises
unchanged

Incorporating Cloud in HPC

Iterate

Rescale portal
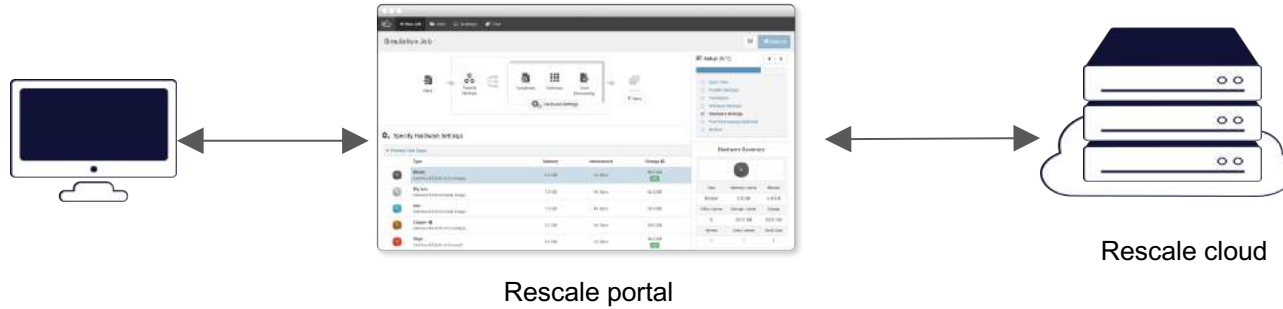
Rescale cloud

Learn from experience
Iterate
Move bigger jobs and
more users to the
cloud
Refine implementation

Job
Scheduler

In house HPC systems
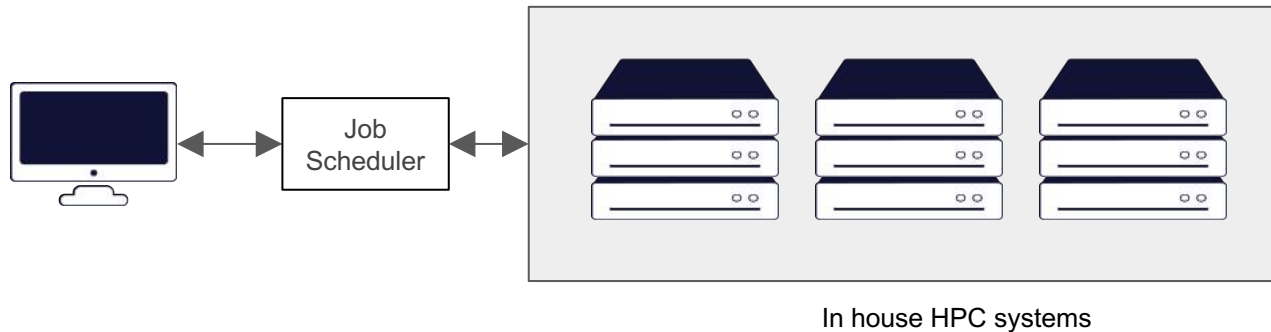
Incorporating Cloud in HPC

2. Access cloud and on premise from the Rescale portal

Rescale portal

Rescale cloud

2

Rescale portal submits jobs to the cloud **and** on premises

Job Scheduler

In house HPC systems

Continue to run on-premises unchanged

Multiple in house HPC systems can be pooled behind the Rescale interface Accounting and tracking

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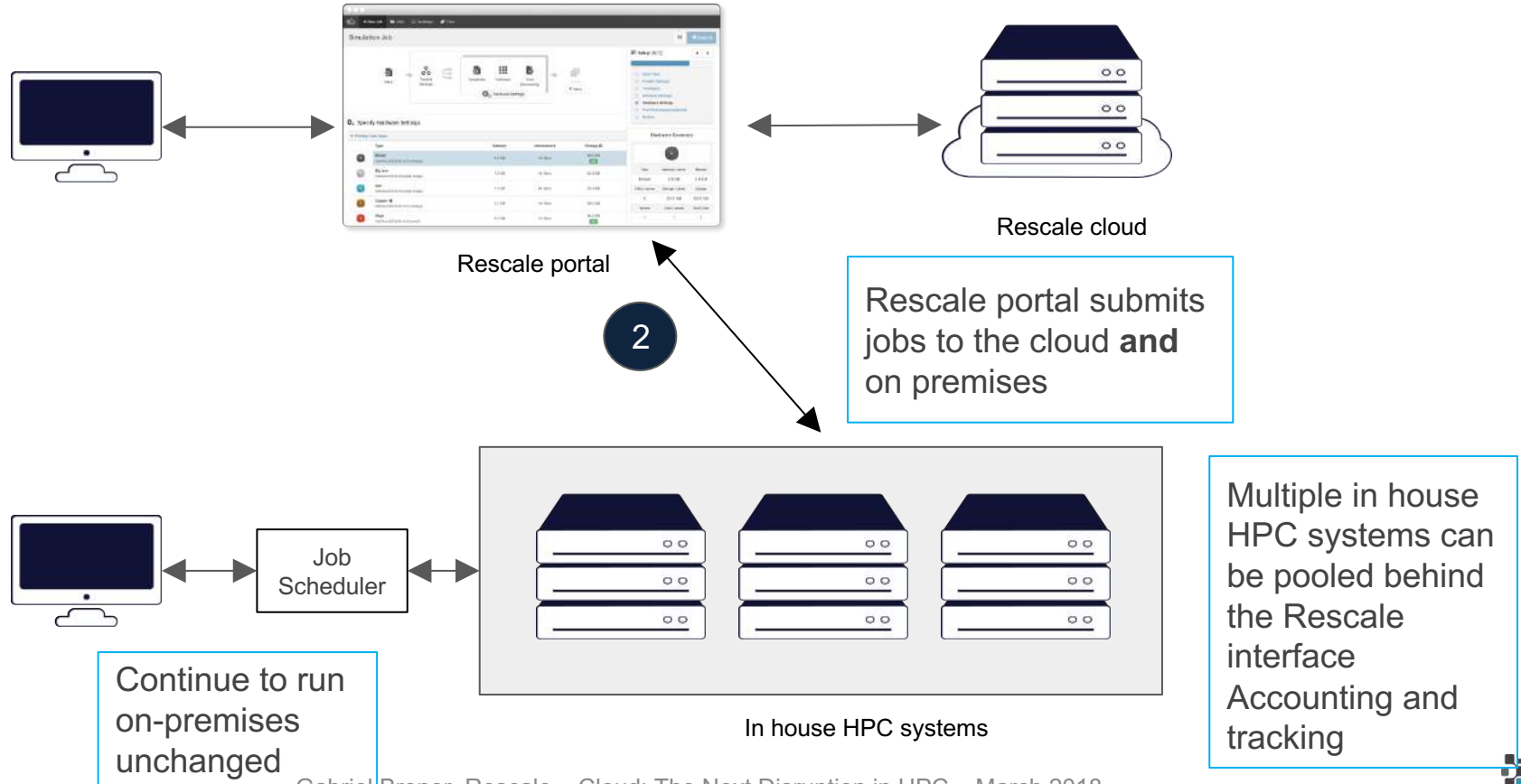
Incorporating Cloud in HPC

Cloud and on-premise systems offered through the Rescale portal

Rescale portal

Cloud

On Premise

Rescale cloud

In house HPC systems

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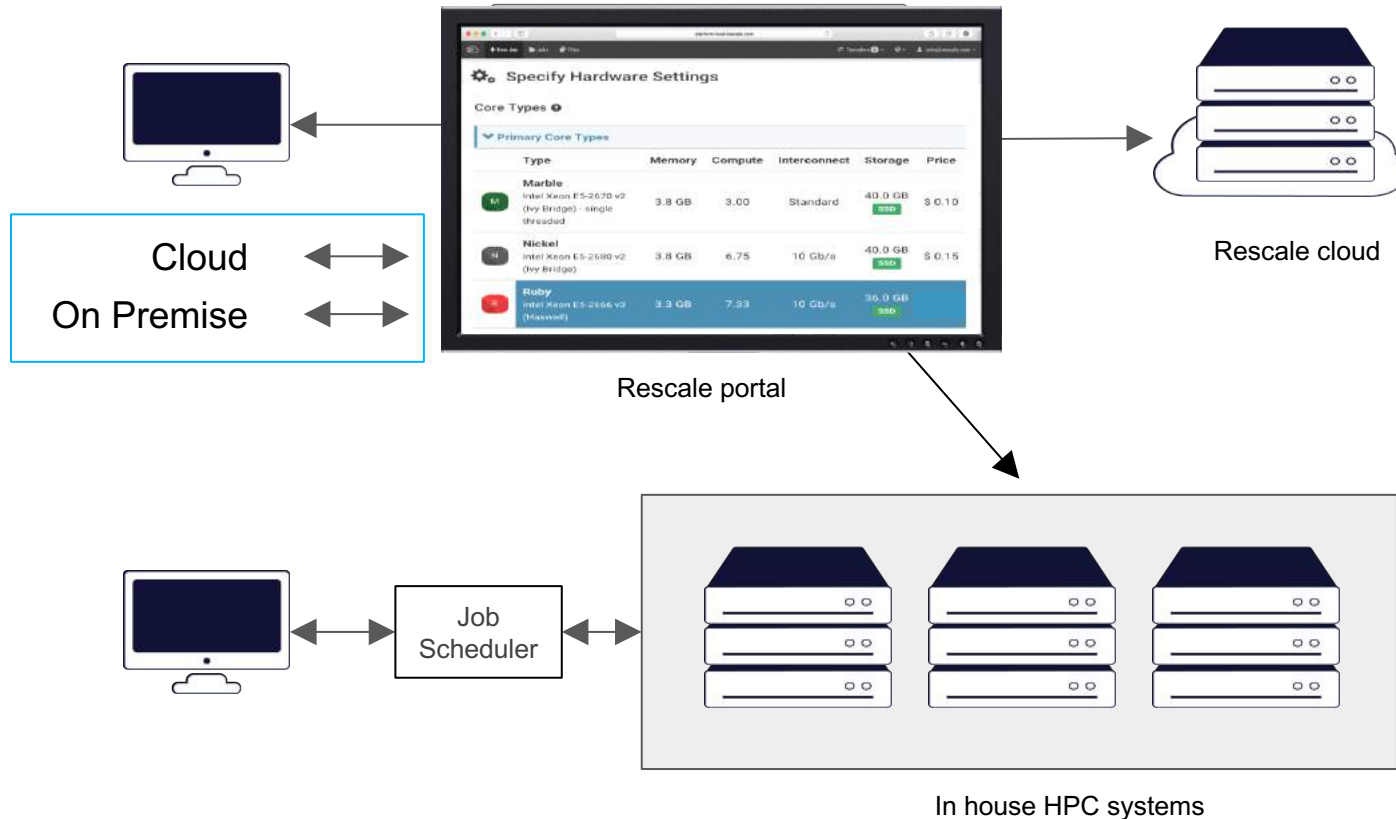
Incorporating Cloud in HPC

3. Offer in-house systems in the external cloud

Rescale portal

Rescale cloud

Offer in-house systems in the cloud
Control access

Job Scheduler

In house HPC systems

Get Rescale credit dollars
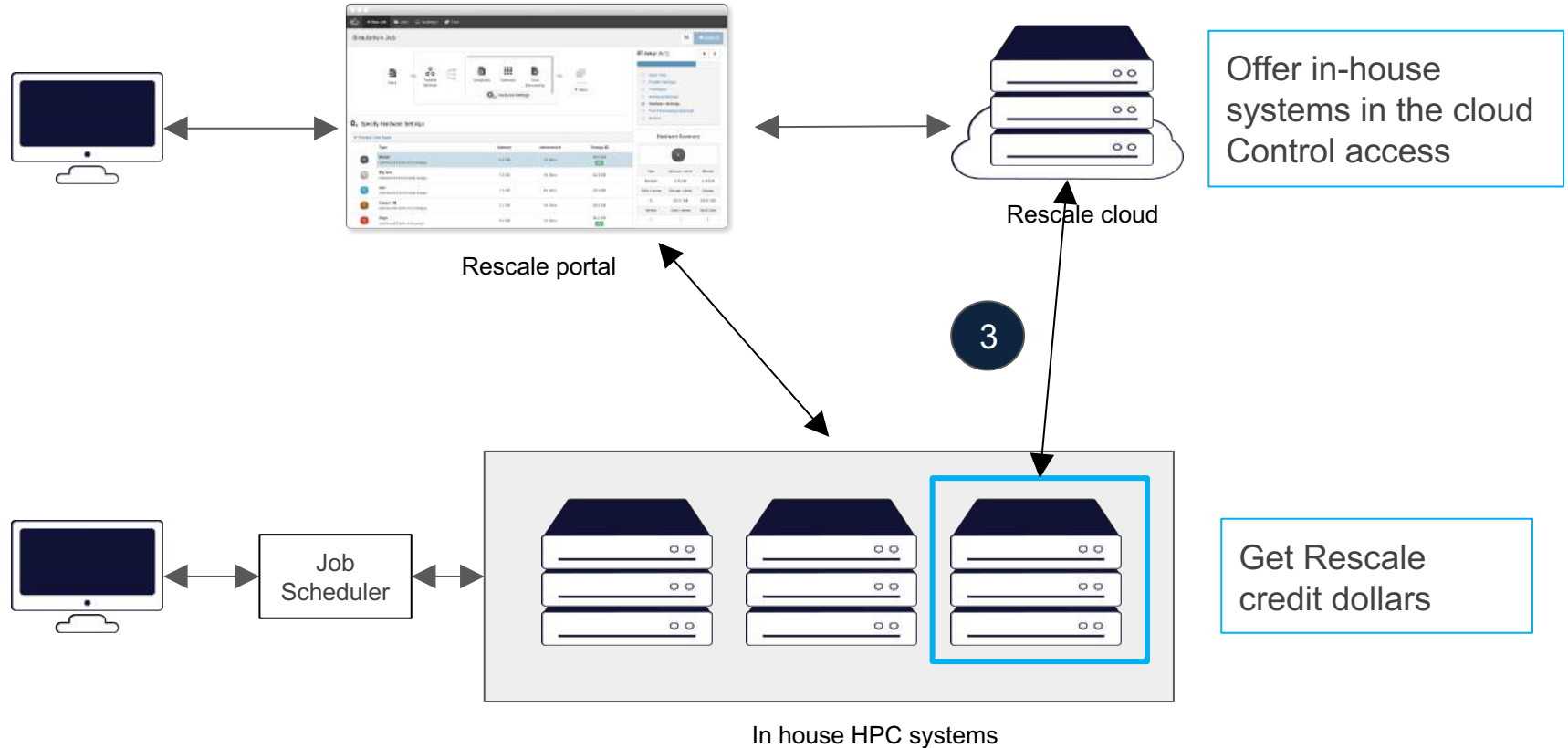
Incorporating Cloud in HPC

Future State

Rescale portal
GUI and API

Rescale cloud

Flexibly use on premise and cloud

In house HPC systems

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Big Compute

Deep Learning SaaS

NVIDIA

Link:
Rescale Deep Learning

Intelligent Algorithms

Real-Time IoT at F1

Formula 1

Big Data & IoT

Specialized Hardware

ScaleX Labs with Intel

intel inside
Xeon Phi

intel

Video:
Formula 1 Real-Time IoT Simulation

Link:
Intel ScaleX Labs

Simulation & Digital Twin

UI LABS

boom

Digital Mfg with DMDII   **Simulation at Boom Supersonic**

Video:
Rescale Night Boom Keynote

![inside HPC logo]

Industry Perspectives

Gabriel Broner on Why Cloud is the Next Disruption in HPC

August 22, 2017 by staff | Leave a Comment

"Like the previous disruptions of clusters vs. monolithic systems or Linux vs. proprietary operating systems, cloud changes the status quo, takes us out of our comfort zone, and gives us a sense of lack of control. But the effect of price, the flexibility to dynamically change your system size and choose the best architecture for the job, the availability of applications, the ability to select system cost based on the needs of a particular workload, and the ability to provision and run immediately, will prove very attractive for HPC users."
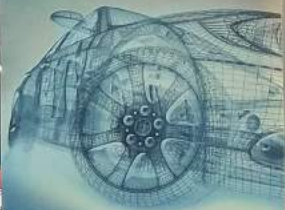

Gabriel Broner is VP & GM of HPC at Rescale

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Gracias   Thanks   Gràcies