XAAS: ACCELERATION AS A SERVICE TO ENABLE PRODUCTIVE HIGH-PERFORMANCE CLOUD COMPUTING
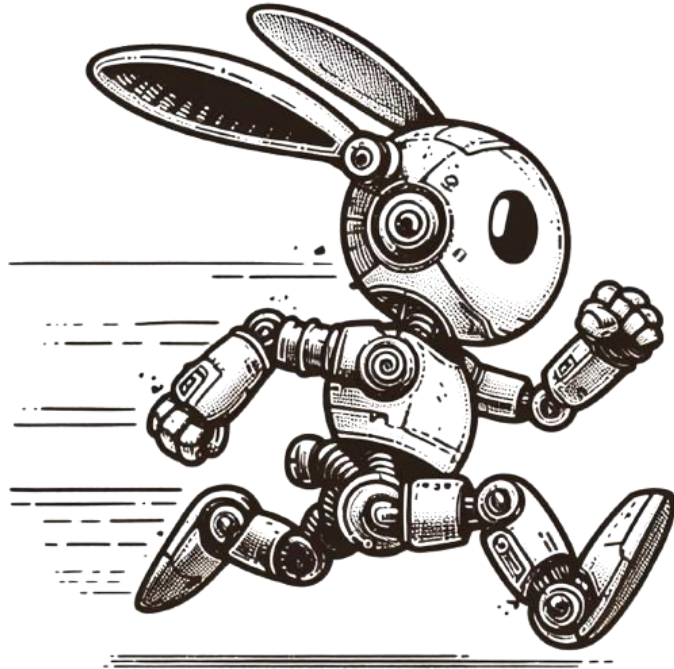
Panelists:

- Dan Ernst (NVIDIA)
- Ian Foster (Argonne National Laboratory)
- Torsten Hoefler (ETH Zurich)
- Thomas C. Schulthess (CSCS)

Moderated by Marcin Copik (ETH Zurich)

SC24
Atlanta, GA | hpc creates.

What is Axeleration as a Service?

Paper

Theme Article: Converged Computing: A Best-of-Both Worlds of HPC and Cloud

XaaS: Acceleration as a Service to Enable Productive High-Performance Cloud Computing

Torsten Hoefler, *ETH Zurich & Swiss National Supercomputing Centre (CSCS), Switzerland*

Marcin Copik, *ETH Zurich, Switzerland*

Pete Beckman, *Argonne National Laboratory, USA*

Andrew Jones, *Microsoft, United Kingdom*

Ian Foster, *Argonne National Laboratory, USA*

Manish Parashar, *Utah University, USA*

Daniel Reed, *Utah University, USA*

Matthias Troyer, *Microsoft, USA*

Thomas Schulthess, *Swiss National Supercomputing Centre (CSCS), Switzerland*

Dan Ernst, *NVIDIA, USA*

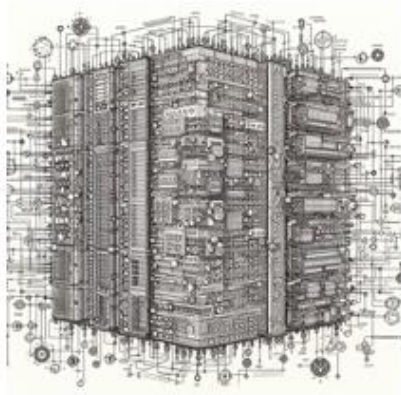Jack Dongarra, *University of Tennessee, USA*

Performance Portable Containers

cloud computing

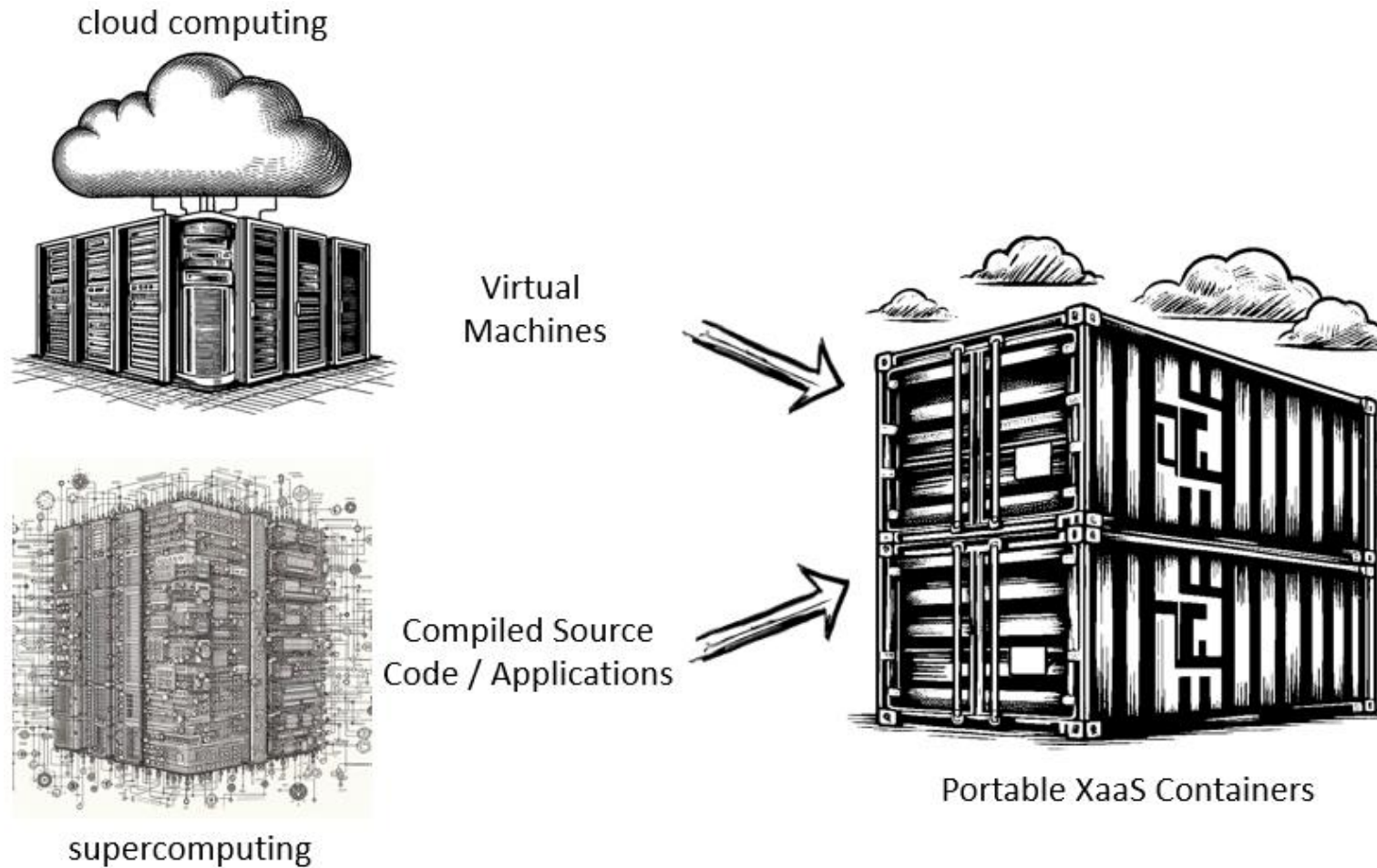Virtual Machines

Compiled Source Code / Applications

supercomputing
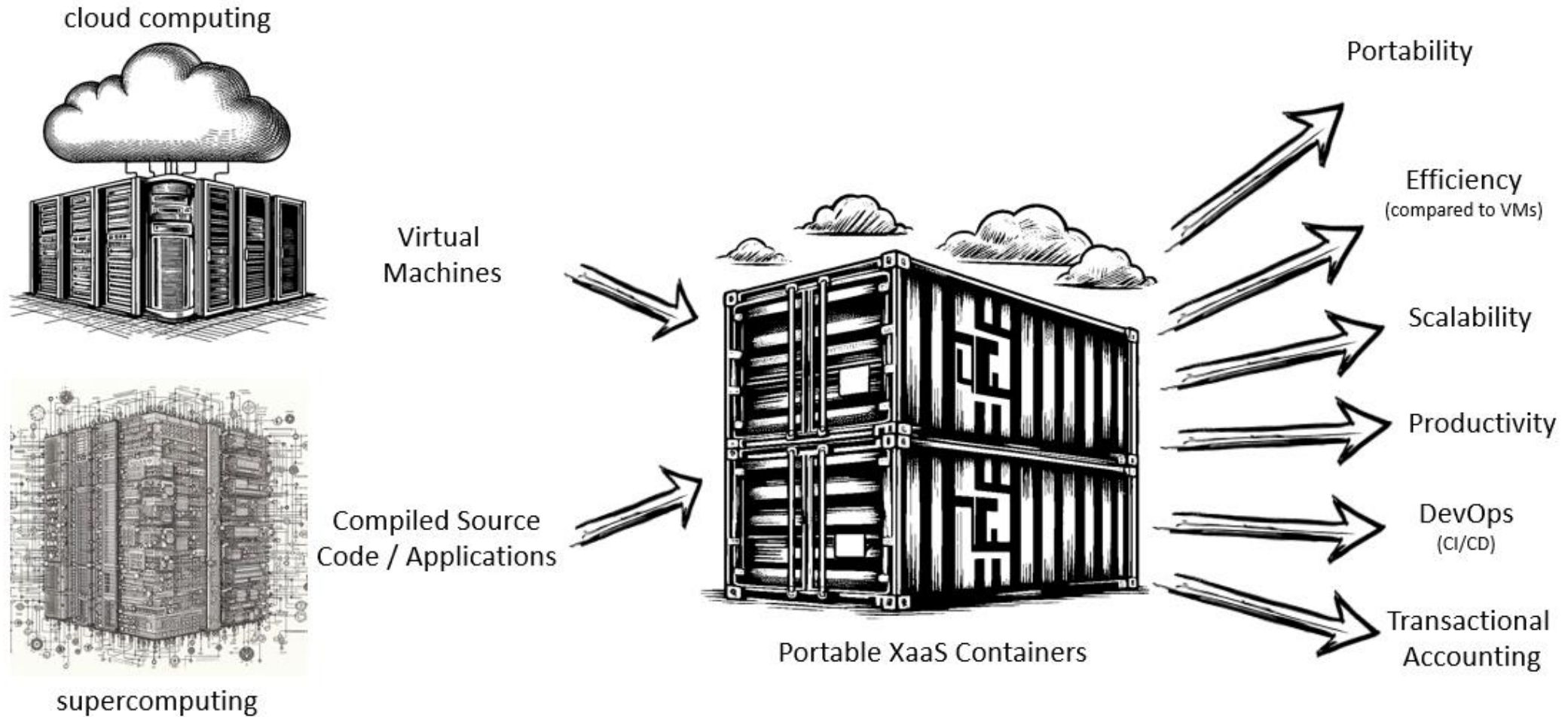
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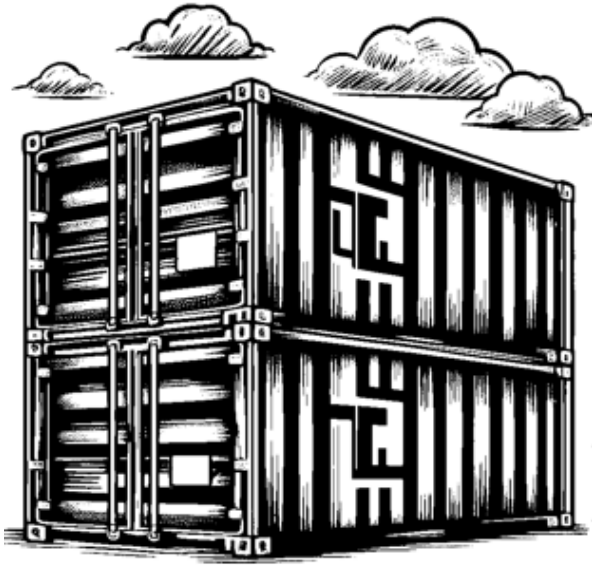
Portable XaaS Containers
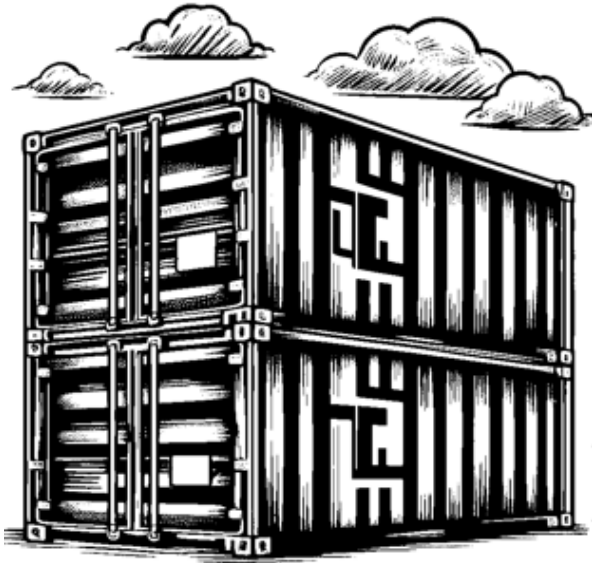
Performance Portable Containers

Three Building Blocks of XaaS

Portable XaaS Containers

Three Building Blocks of XaaS

Portable XaaS Containers

High-Performance I/O

- Data storage managed by system provider
- Communication between XaaS containers
- Specialization to network fabric

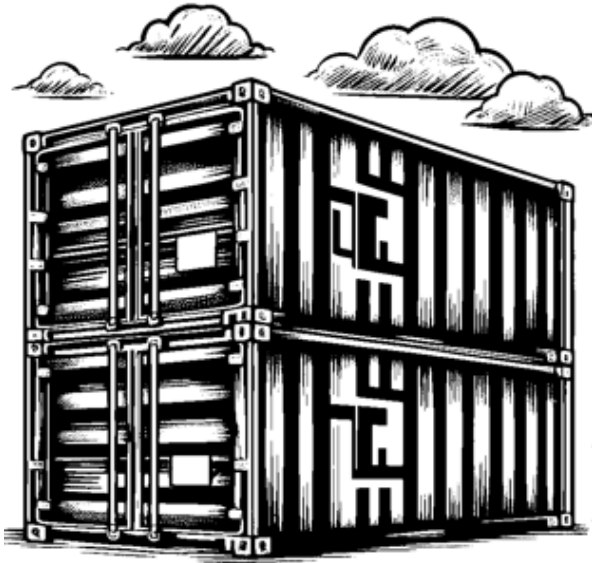# Three Building Blocks of XaaS

Portable XaaS Containers

High-Performance I/O

- Data storage managed by system provider
- Communication between XaaS containers
- Specialization to network fabric

Scheduling & Invocations

- Flexible scheduling to reduce wait times
- Balance between batch and interactive workloads
- High-level control plane API, e.g., REST

XaaS System Architecture

Commercial Cloud Providers — AWS, Azure, GCP ...

HPC Service Providers — ALCF (Argonne National Laboratory), NeRSC, CSCS, R-CCS ...

Market / Policy-Specific
(e.g., public vs. private)

XaaS System Architecture

Standard Portable Container API (e.g., OCI)

Market / Policy-Specific (e.g., public vs. private)

Commercial Cloud Providers
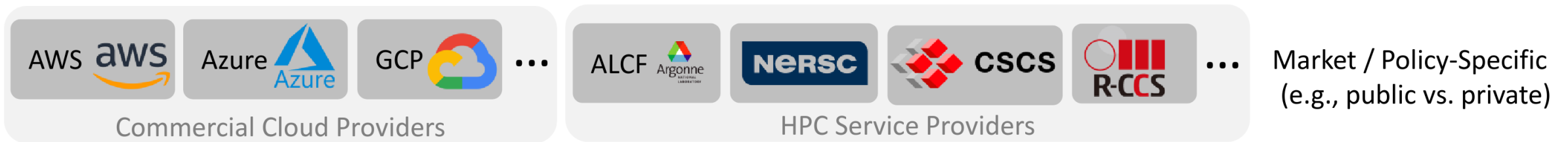
HPC Service Providers
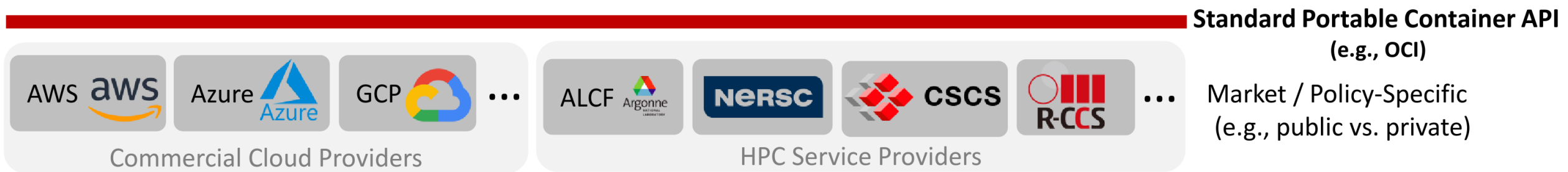
XaaS System Architecture

Base Operating System Layer (e.g., Ubuntu/Debian/… - POSIX)

Generic Container
(e.g., docker)

Standard Portable Container API
(e.g., OCI)

AWS — Azure — GCP — …

Commercial Cloud Providers

ALCF — NeRSC — CSCS — R-CCS — …

HPC Service Providers

Market / Policy-Specific
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XaaS System Architecture

XaaS Accelerated Compute, Communication, I/O libraries, and APIs — System-Specific (e.g., HPE, Intel)

Base Operating System Layer (e.g., Ubuntu/Debian/... - POSIX) — Generic Container (e.g., docker)

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Commercial Cloud Providers   HPC Service Providers

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Maintained by Provider

Standard Portable Container API
(e.g., OCI)

AWS · Azure · GCP · ···

Commercial Cloud Providers

ALCF · NeRSC · CSCS · R-CCS · ···

HPC Service Providers

Market / Policy-Specific
(e.g., public vs. private)

XaaS System Architecture

XaaS Simulation Platform

| Climate 🌑 | QCD ⚛ | Materials ⚙ | ... |

XaaS Service Platform

| Climate Data 🌑 | Materials Data ⚙ | ... |

XaaS Accelerated Compute, Communication, I/O libraries, and APIs

Base Operating System Layer (e.g., Ubuntu/Debian/... - POSIX)

Standard Portable Container API (e.g., OCI)

AWS	Azure	GCP	...

Commercial Cloud Providers

| ALCF Argonne | NeRSC | CSCS | R-CCS | ... |

HPC Service Providers

Domain-Specific (e.g., Climate)

System-Specific (e.g., HPE, Intel)

Generic Containers (e.g., docker)

Maintained by Community

Maintained by Provider

Market / Policy-Specific (e.g., public vs. private)
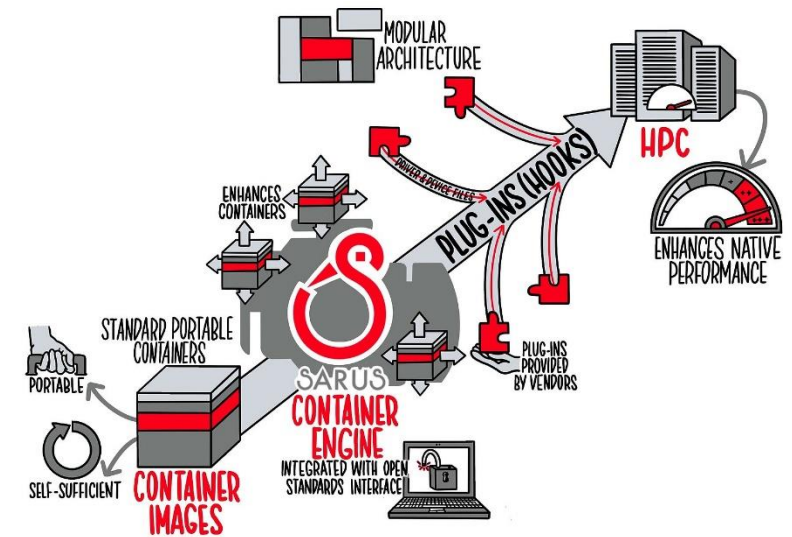
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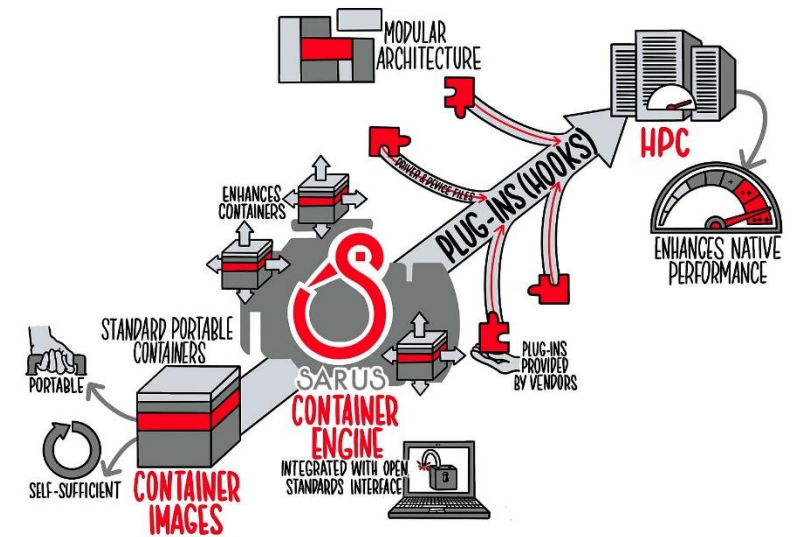# XaaS in Practice

Spack

Full Build & Specialization

XaaS in Practice

Spack

Full Build & Specialization

Flexible Library Hooks

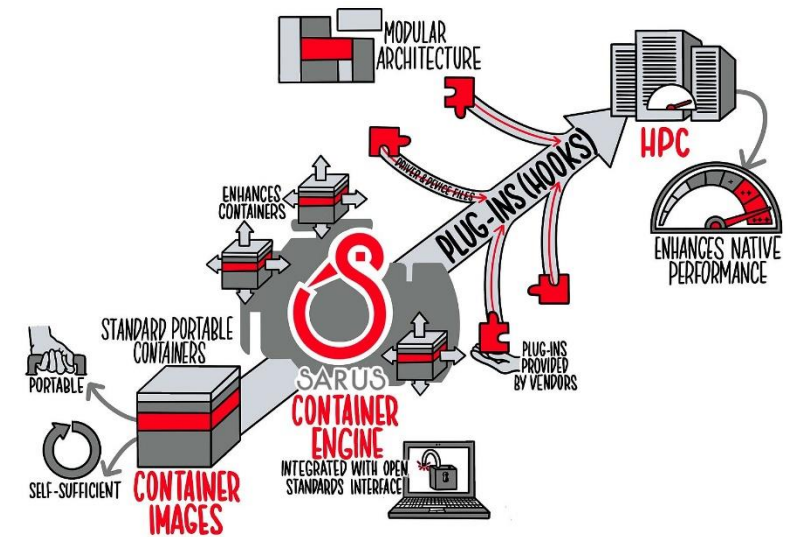# XaaS in Practice
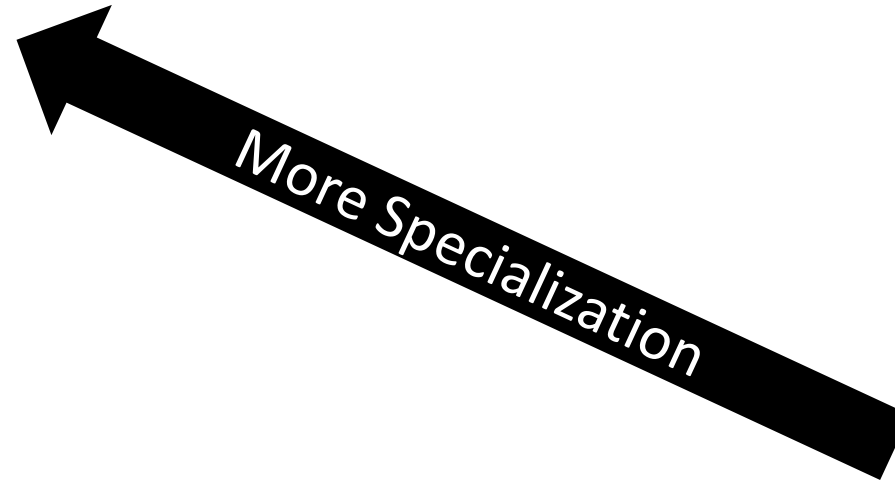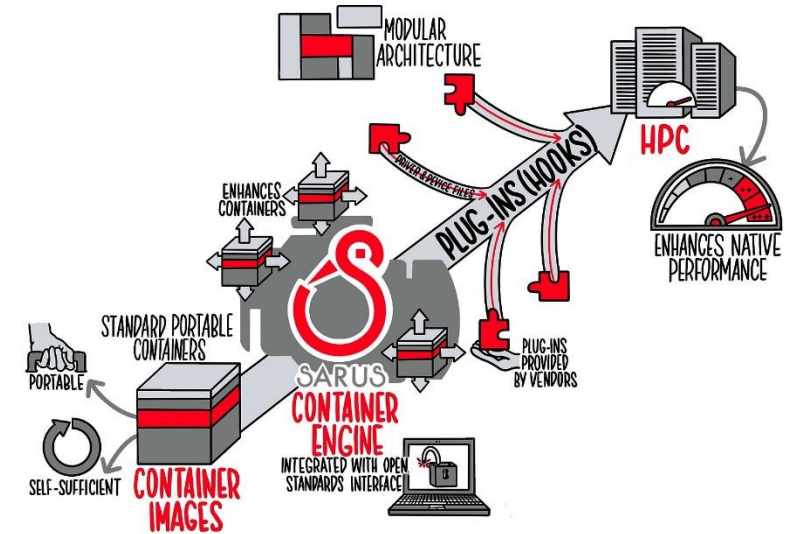

Spack

Full Build & Specialization

More Productivity

Flexible Library Hooks

XaaS in Practice

Spack

Full Build & Specialization

More Specialization

More Productivity

Flexible Library Hooks

XaaS in Practice

Spack

Full Build & Specialization

DaCe

Partial Recompilation

More Specialization
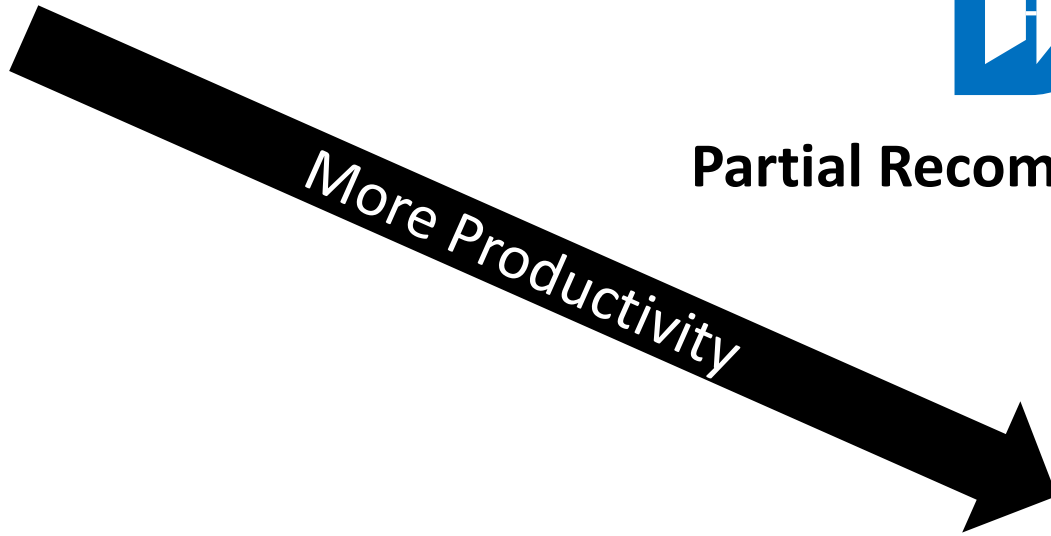
More Productivity

Flexible Library Hooks

What XaaS Can Offer Us?

What XaaS Can Offer Us?

Cloud
Productivity

What XaaS Can Offer Us?

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Cloud Productivity

</div>

<div style="border: 2px solid #6b7a2e; background-color: #e2eacd; border-radius: 12px; text-align: center;">

Performance Portability

</div>

What XaaS Can Offer Us?

Cloud Productivity

Performance Portability

Unified Interface

What XaaS Can Offer Us?

Cloud Productivity

Performance Portability

Unified Interface
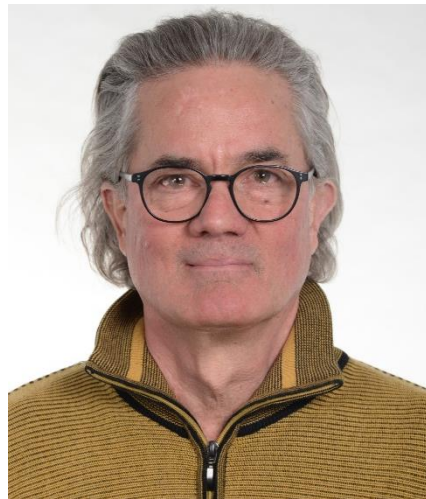
Flexible Scheduling

Q&A

Dan Ernst
NVIDIA

Ian Foster
Argonne National Laboratory

Torsten Hoefler
ETH Zurich

Thomas Schulthess
Swiss National Supercomputing
Centre (CSCS)

Marcin Copik
ETH Zurich