Walking On The Edge
The path to seamless, hybrid-cloud environments

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CTO Automation Products Group

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make possible
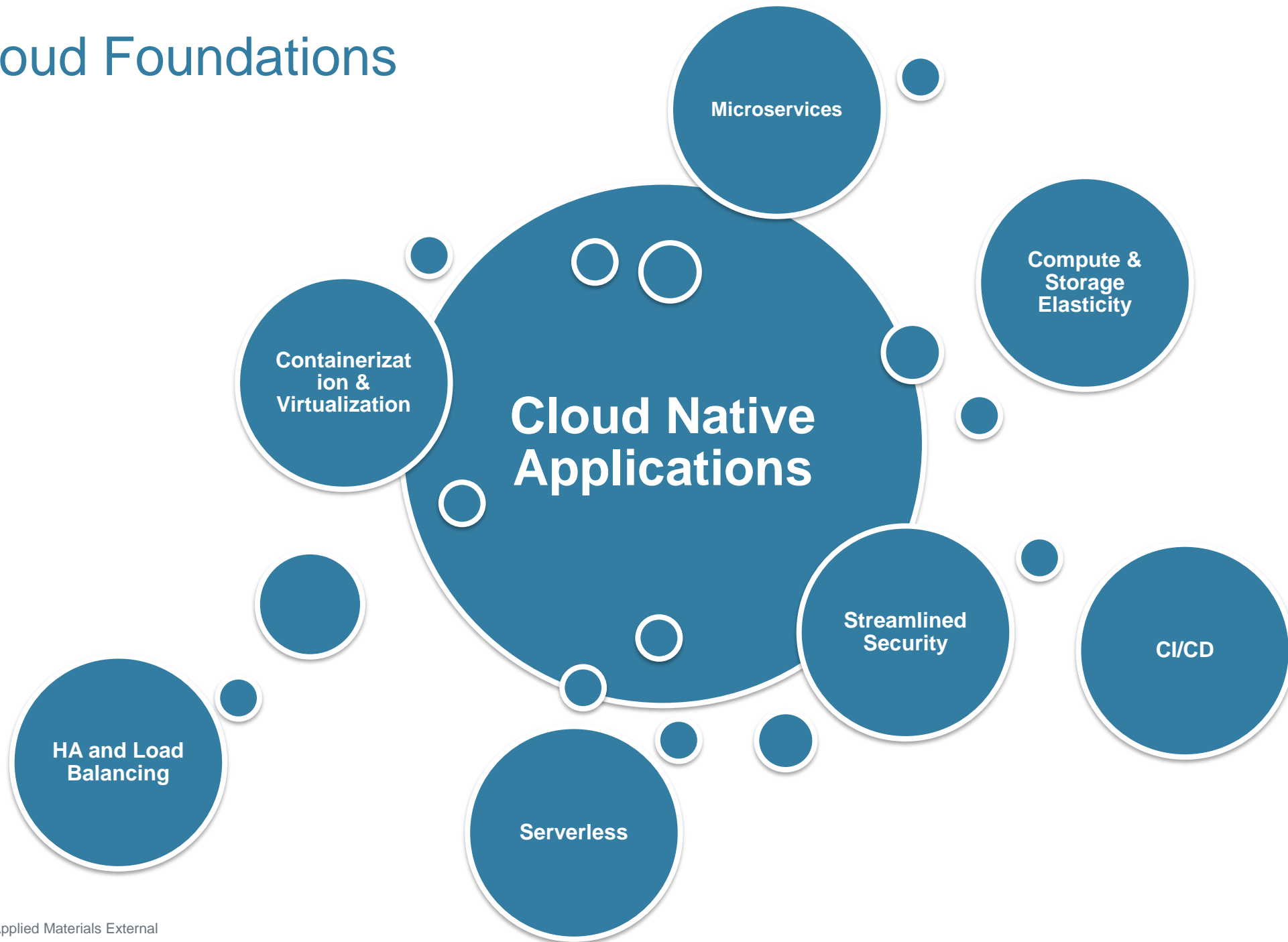
Let's address the cloud in the room

Seamless Hybrid-Cloud

Simulation Modeling Case-Study

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THERE IS NO CLOUD

IT'S JUST SOMEONE ELSE'S COMPUTER

THE CLOUD IS NOT ABOUT THE "WHERE"
IT'S ABOUT THE "HOW"

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Cloud Foundations

Microservices

Compute & Storage Elasticity

Containerization & Virtualization

Cloud Native Applications

Streamlined Security
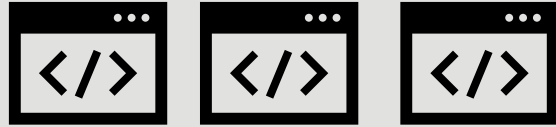
CI/CD

HA and Load Balancing

Serverless

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Hybrid Cloud Computing Model

PUBLIC CLOUD

Dynamic cloud apps served as SaaS in many cases

Data selectively shared for public cloud apps

SECURE DATA BRIDGE

PRIVATE CLOUD

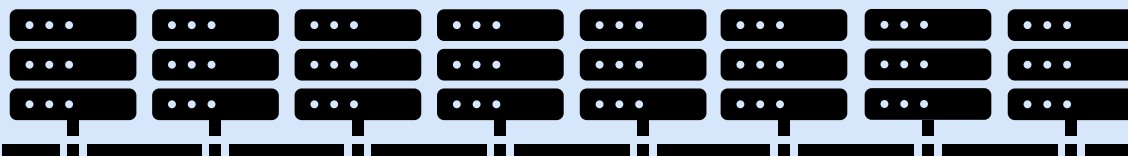Managed and elastically scaling "private" network\storage\compute resources

Corp Managed data stores

ON PREMISE (EDGE)

Edge compute for Real Time\High Bandwidth functionality

On-prem, mission critical data stores

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Simulation Modeling Case Study

Production Planning and Scheduling Goal

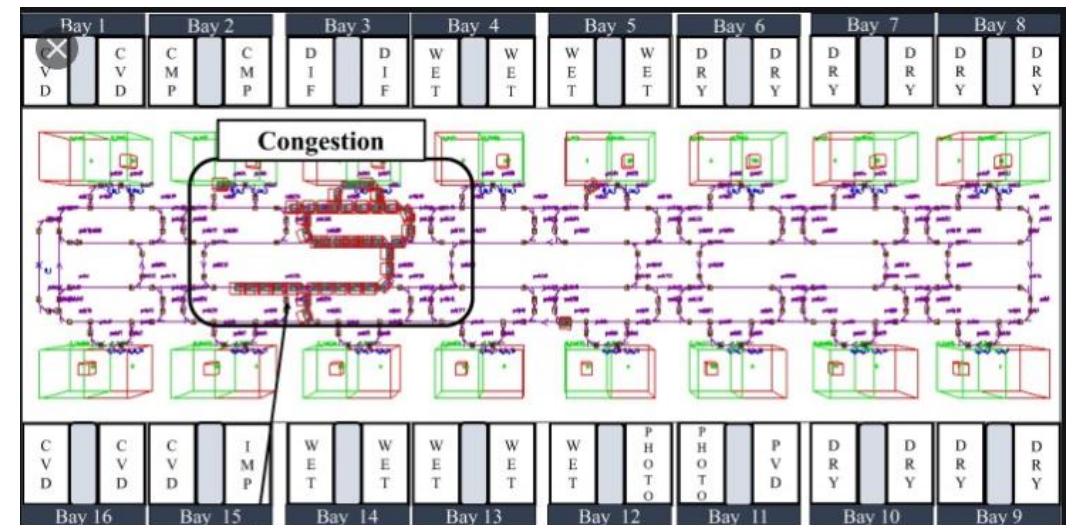Bridging the gap between factory capacity and customer delivery commitments.

How is this achieved?

Applying simulation models to explore "what-if" scenarios to identify opportunities for improving throughput and capacity utilization

The Challenge

Simulations are CPU/Memory/Storage intensive and potentially, depending on the use case, scenario complexity and server hardware availability, <mark>TAKE FOREVER TO COMPLETE!</mark>

Semi Conductor FAB layout design

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Simulation Modeling Scenarios

Enterprise Planning

Long-term
6 months to 2 years+

Factory Planning

Mid-term
Up to 6 months

Production Control

Tactical
Real-time (0-14 days)

Tactical
- WIP Flush / lot completions
- WIP bubble analysis
- Reticle availability
- Down equipment

Mid-term
- WIP Flush / lot completions
- Product-mix analysis
- WIP bubble analysis
- Reticle availability
- Lot priorities
- Shutdown schedules

Long-term
- Ramp-up / ramp-down conditions
- Tool Planning / Equipment count
- Cycle Time Planning
- Lot transport / storage planning
- Test wafer requirements

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Extending Simulation Modeling From On-prem Into The Corporate Private Cloud

CORPORATE PRIVATE CLOUD

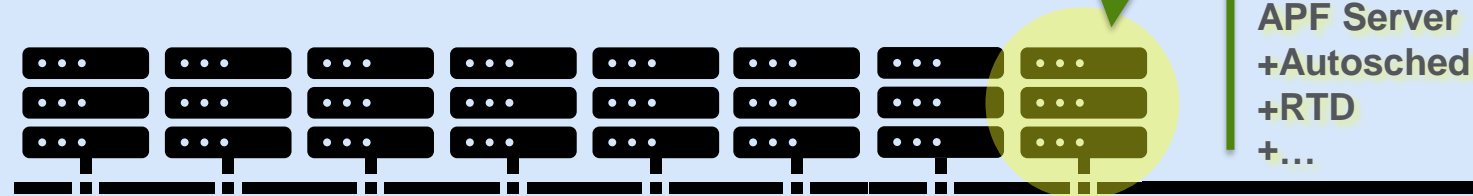Managed and elastically scaling "private" network\storage\compute resources
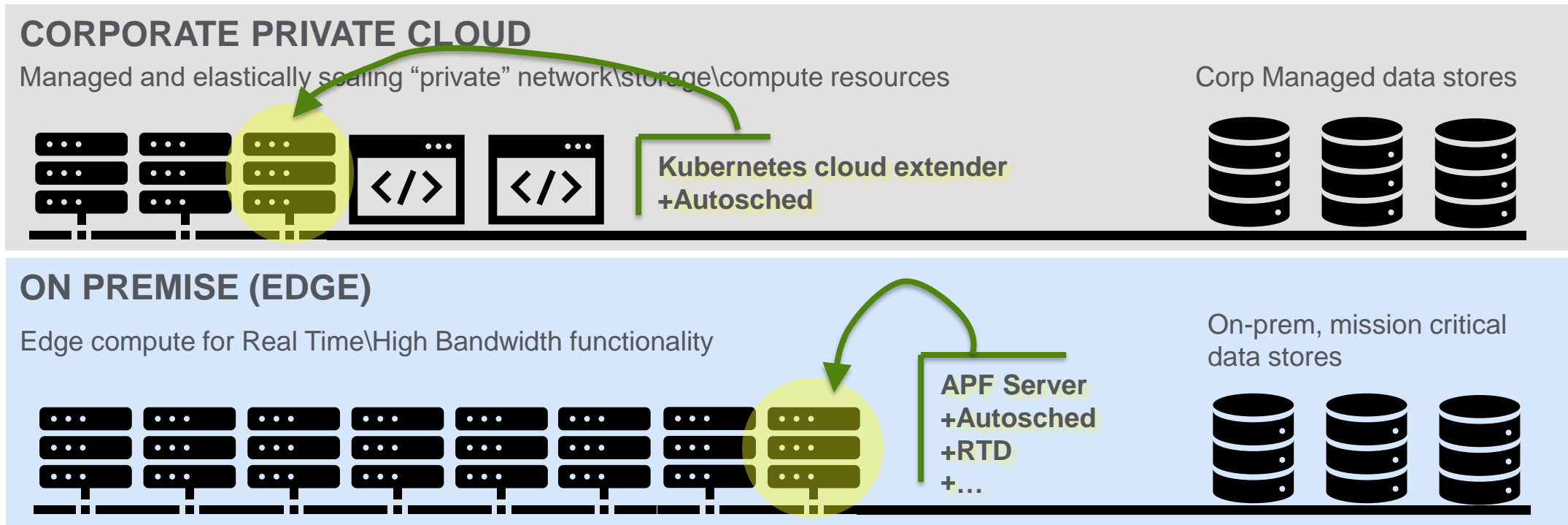
Corp Managed data stores

ON PREMISE (EDGE)

Edge compute for Real Time\High Bandwidth functionality
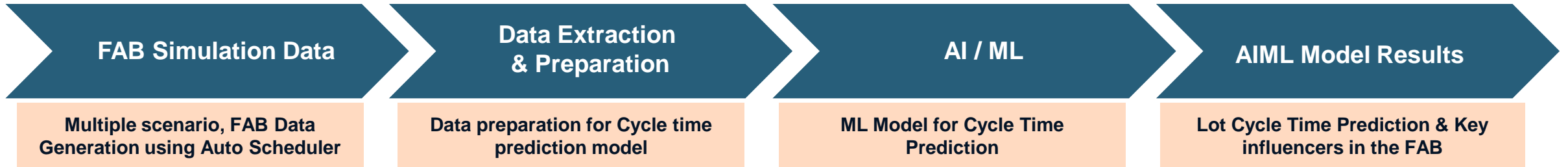
On-prem, mission critical data stores

APF Server
+Autosched
+RTD
+...

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Extending Simulation Modeling From On-prem Into The Corporate Private Cloud

CORPORATE PRIVATE CLOUD

Managed and elastically scaling "private" network\storage\compute resources

Kubernetes cloud extender +Autosched

Corp Managed data stores

ON PREMISE (EDGE)

Edge compute for Real Time\High Bandwidth functionality

APF Server +Autosched +RTD +...

On-prem, mission critical data stores

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Cycle Time Prediction – Simulation modeling + ML
Predict Cycle Time and Identify Impactful Steps and Equipment

| FAB Simulation Data	Data Extraction & Preparation	AI / ML	AIML Model Results
Multiple scenario, FAB Data Generation using Auto Scheduler	Data preparation for Cycle time prediction model	ML Model for Cycle Time Prediction	Lot Cycle Time Prediction & Key influencers in the FAB

FAB Station / Tool	ML Feature Importance	AVG Station Util%	Station Family
EQP1	56.88	99.77	EQPS1
EQP2	39.10	91.09	EQPS2
EQP3	25.06	99.91	EQPS3
EQP4	19.82	81.82	EQPS4
EQP5	19.80	78.86	EQPS5
	19.03	67.20	
	18.90	98.70	
	18.85	97.55	
	16.54	96.70	
	16.07	83.78	

- Simulation Time Span - 90 days FAB execution days
- 4000 simulation model runs
- Runs can be parallelized into discrete threads
- Lot cycle time predicted with an accuracy of ~98%
- Key FAB stations / tools identified which are bottlenecks in the FAB. Prediction accuracy > 90%

Cycle Time Prediction – Simulation modeling + ML
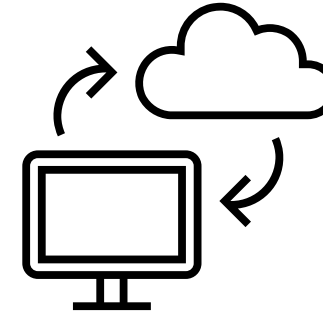## On Prem Vs. Seamless Hybrid-Cloud

On Prem (Non-Containerized)

Seamless Hybrid-Cloud (Containerized)
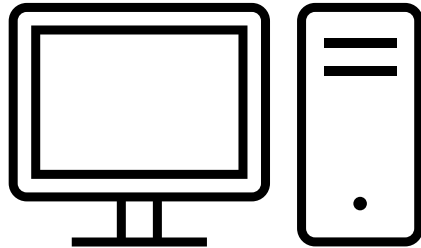
48 Core machine on-premise

Seamless cloud extension with Kubernetes (Openshift)

1600 worker nodes

RUN TIME: 5 DAYS

RUN TIME: 5 HOURS

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make possible

Contact me
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