

# Azure HPC

Rob Futrick, Principal PM, Azure  
Compute

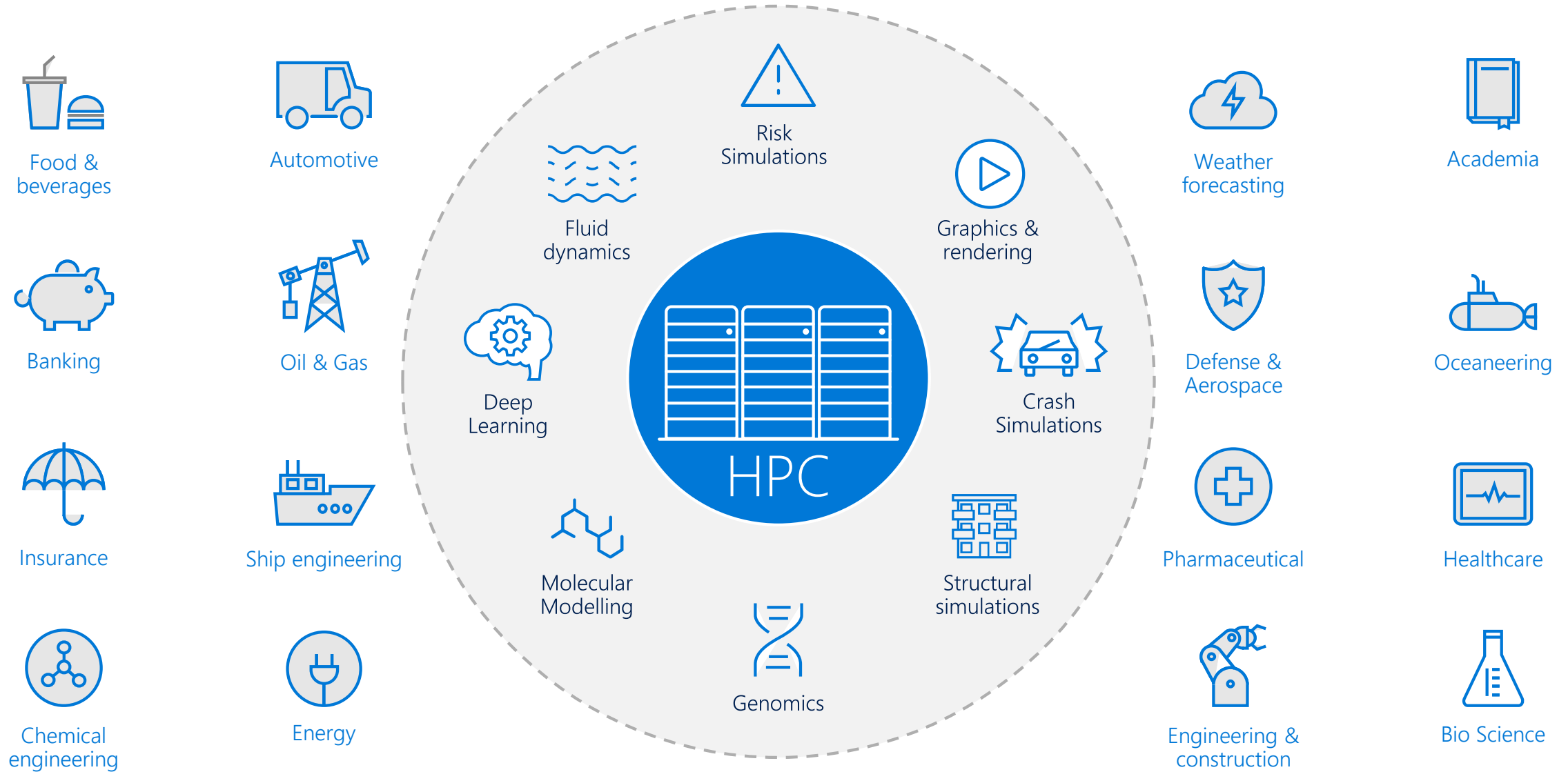


# HPC: Modern View

1. A tool to design and drive better decisions and products, faster.
2. A new way to compete with established leaders
3. A competitive necessity for established leaders
4. A solution that requires a partner:  
End of Moore's Law, Hardware Diversity



# The Wide Reach of HPC



# On-Premise Compute Challenges



Keeping up with production demands



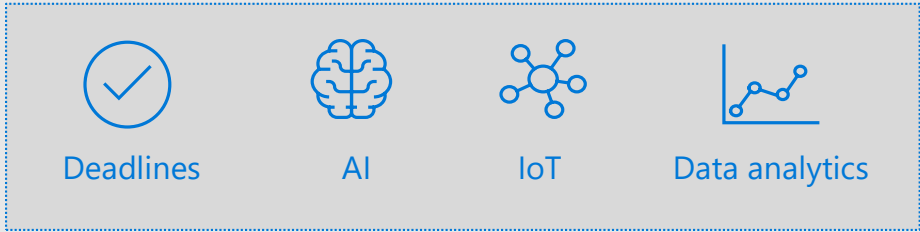
Maximizing your investment



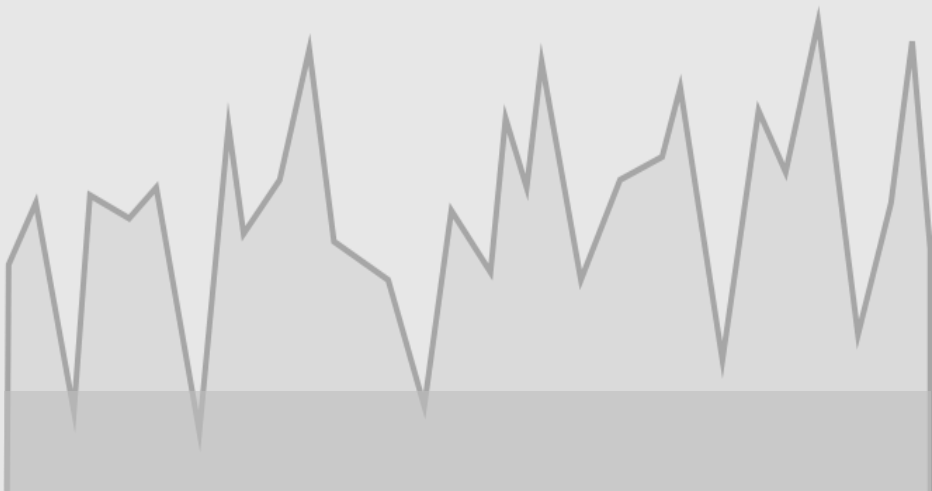
Scalability and Compatibility



On-premises



New business demands



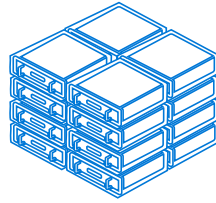
Demand for infrastructure



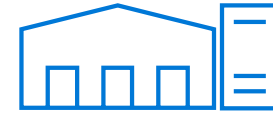
# Why do HPC customers look to Cloud?



Agility  
/  
Speed



Scale



Datacenter  
Shutdown

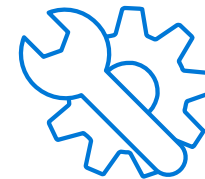
Why don't they always migrate HPC? (among others)



Historical Cloud  
Cost-performance



Simple,  
Performant Hybrid  
File Access



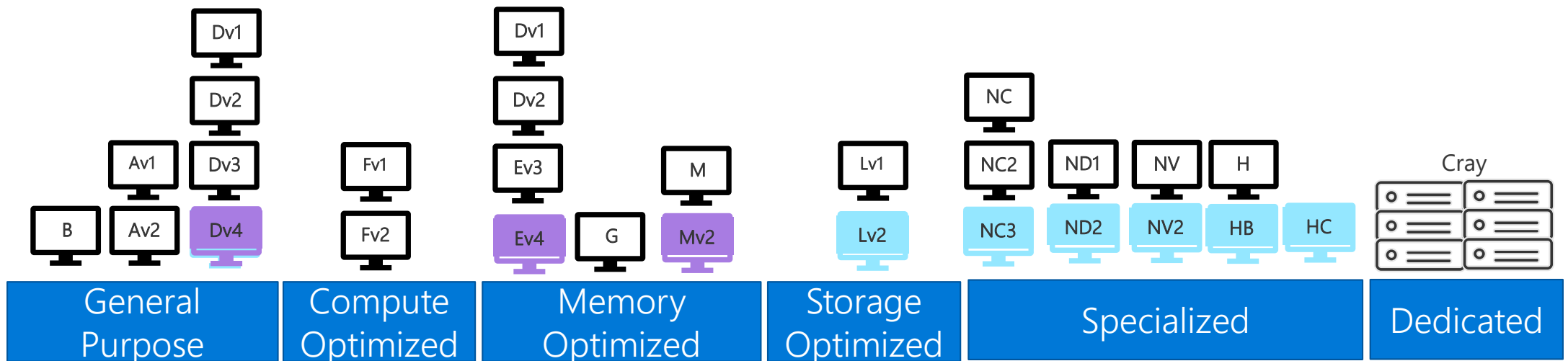
Hard to Migrate,  
Manage & Control  
Cloud/Hybrid

**Azure enables  
these benefits,  
Through product  
focus on these  
needs**

# Price Performance via Workload Focus



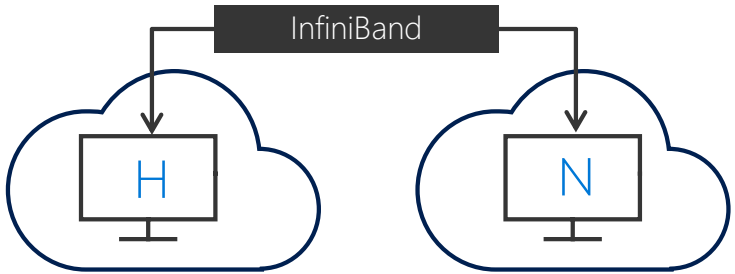
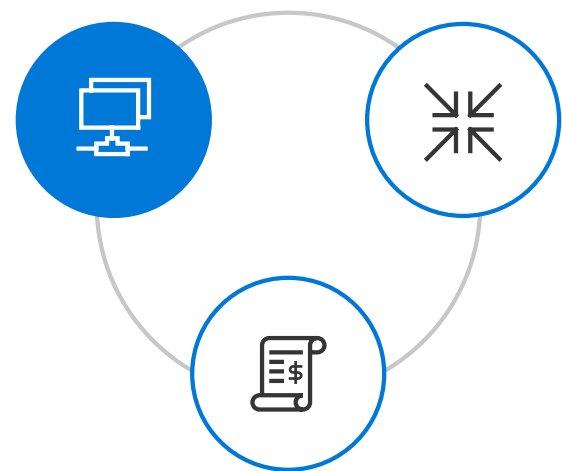
# Broad Compute Platform



## Rapidly Developing VM Offerings

# Most performant infrastructure

## Azure Specialized infrastructure for HPC and AI



High-performance VMs  
Tightly coupled parallel jobs

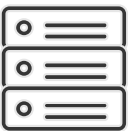
GPU-enabled VMs  
NV—Graphic-based applications  
NC—Advanced simulation  
ND—Artificial Intelligence (Deep Learning)



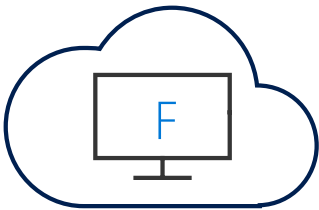
Cray in Azure  
Managed, Custom Bare-metal  
HPC or Supercomputing  
On the Azure Network



>80,000 IOPs  
Premium Storage  
Low latency, high throughput apps



FPGA  
PGA  
Microservices—AI/Edge



Compute-optimized VMs  
Batch processing, Monte Carlo simulations



Large memory VMs  
Large databases



# Cray in Azure: A Unique Offering

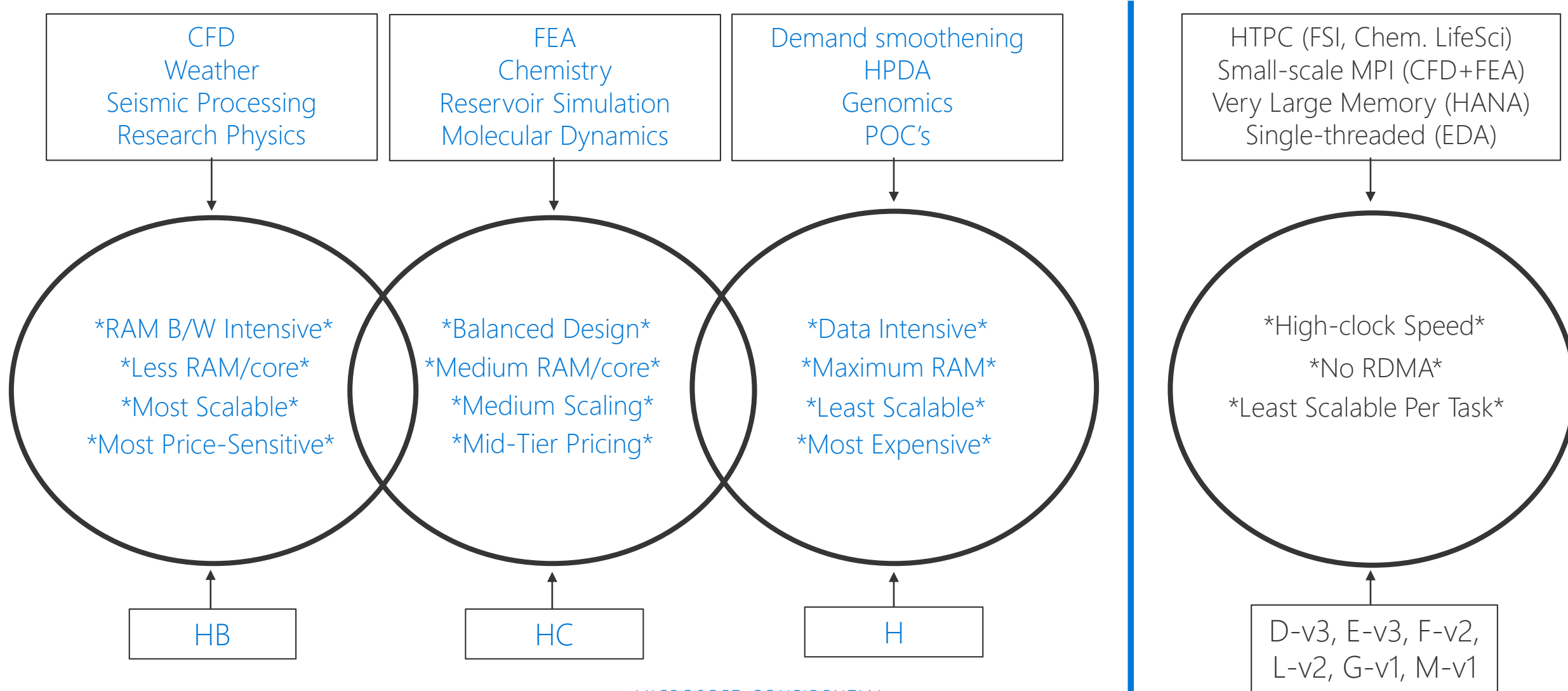
## **Dedicated & customized Cray**, directly connected to Azure:

- Mission-critical Supercomputing directly connected to your data in Azure
- Custom-configured, bare-metal HPC cluster to supercomputer scale in Azure
- Solve today's simulation needs, while future-proofing for AI, IOT challenges
- Scale with Cray beyond anything else available in the cloud
- No Data movement! Your Cray HPC storage is on the same Azure network as elastic Azure RDMA, GPU, FPGA VMs
- Gain capital efficiencies, get more agility, capacity, science per pound
- Reduce risk with Cray administered & managed system leveraging Microsoft engineering & resources

**Sentinel Pilot System** for Private Invite-only Preview



# HPC Targets by Workload



# Simulation and HPC – Lowering costs, increasing agility

Meet **on-premise** needs/costs, with consumption models to meet all HPC needs

## Scale: Burst using On-Demand & Low Priority

BURST TO LARGE SCALE CAPACITY  
FOR WORKLOADS BEYOND  
INTERNAL DATA CENTERS

## HPC Agility: 1-Yr Reservation & On-Demand

ABILITY TO TAKE ADVANTAGE OF NEW  
COMPUTE TECHNOLOGIES AS THEY BECOME  
AVAILABLE, EVERY YEAR

## High-Utilization or Datacenter Move:

**Cray CS & 3-yr Reservation**  
IT STRATEGY TO SIMPLIFY OPERATIONS,  
BEST PRICE-PERF FOR DEDICATED USE  
MOVING ON-PREMISE HPC TO CLOUD

## H, Nc Series

INFINIBAND CONNECTED,  
HIGH GHZ CPU /GPU,  
HIGH MEMORY BANDWIDTH

## D, E, F, L, G, M

WIDE RAM RATIOS:  
4-60GB PER PHYSICAL CORE  
MAX SERVER MEMORY: 4TB

## Cray CS/XC

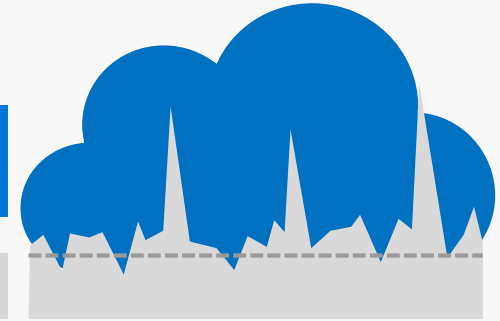
**BARE METAL CLUSTERS:**  
HIGH GHZ CPUS (4.5 GHZ)  
CUSTOM CONFIGURATIONS

## Cray ClusterStor

**HIGH PERFORMANCE  
STORAGE  
FOR EXTREME SCALE**

Variable  
Use

Fixed Use



## Fortune 100 User

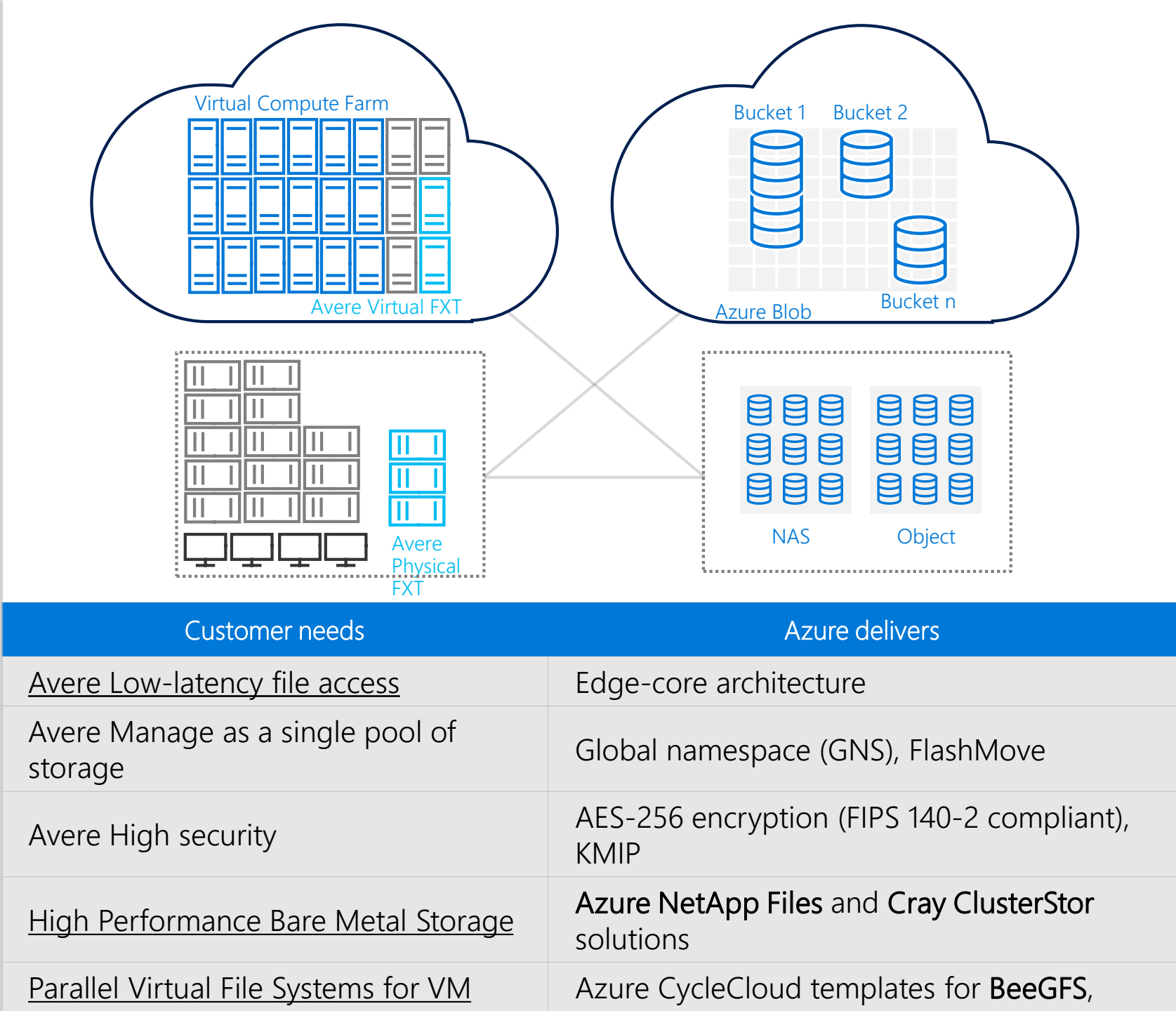
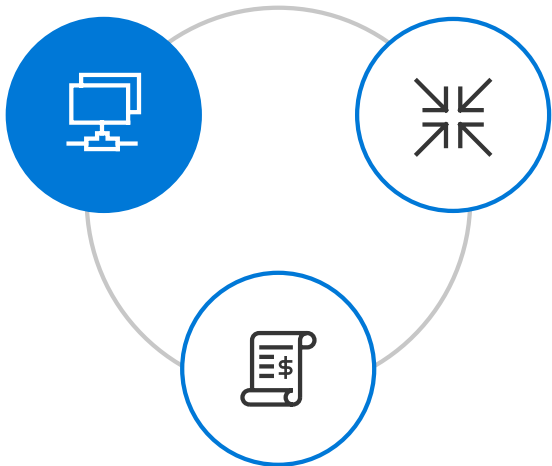
Blended Cost: Cores & Data	
Customer-measured On-premise HPC Costs	<b>3.92 cents</b>
Cray CS	<b>3.1 cents</b>
VM-Based 3-yr reserved	<b>3.4 cents</b>
VM-Based 1-yr reserved	<b>4.1 cents</b>
On-Demand Burst	<b>4.7 cents</b>

# Hybrid File Access & Cloud File Systems



# Performant Hybrid Storage:

Avere, NetApp Files, Cray ClusterStor, VM Parallel FS Templates





# Simplifying Cloud Complexity



# Azure Big Compute Platform

App Users

Developers

HPC End-users, IT Staff, Line of Business Mgr

Parallel R

VFX Plug-Ins

SaaS / Client  
Solution

Azure  
Batch AI

Cluster templates to run *existing, on-prem* HPC applications on Azure



Azure Batch

VM Management & Job Scheduling

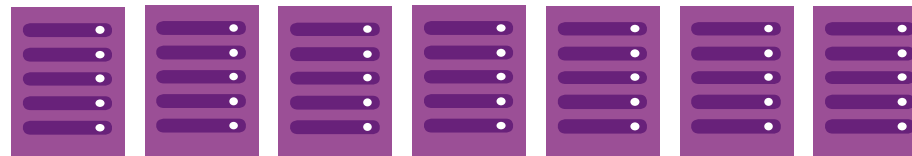


Azure CycleCloud

Hybrid & Cluster Manager for HPC/AI

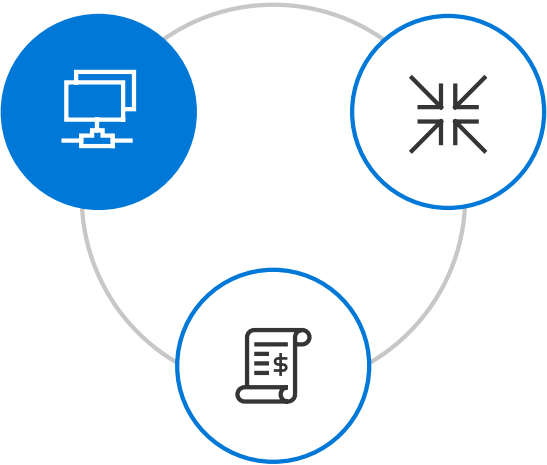


Cloud Services,  
VMs, VMSS



Hardware

# Services for Workload Mgmt



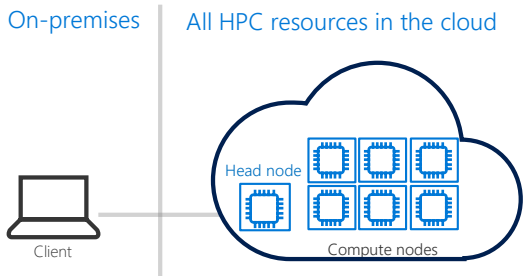
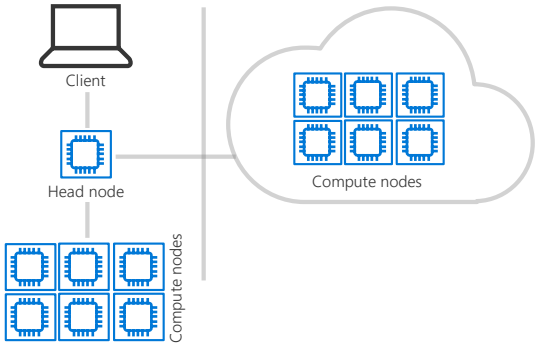
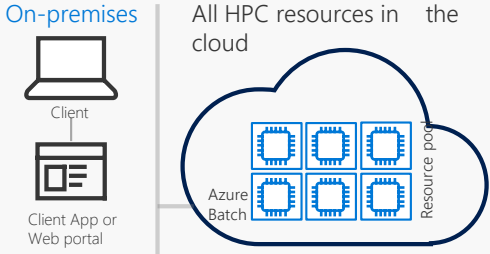
Azure Batch  
running jobs

Azure CycleCloud  
running clusters

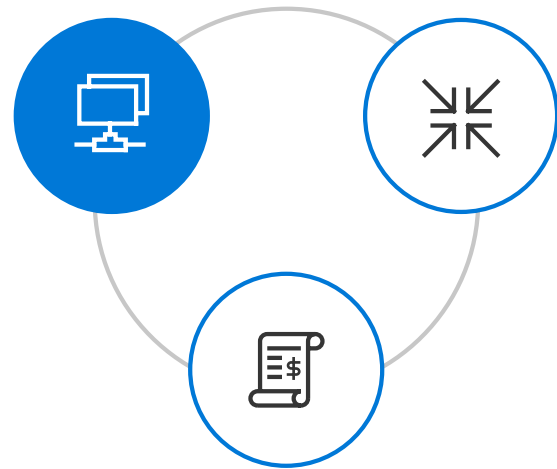
HPC as a service

Hybrid/burst

Azure cluster



# Azure Batch



## Batch pools



Configure and create VMs to cater for any scale: tens to thousands



Automatically scale the number of VMs to maximize utilization



Easy low-priority and VM sizing, suited to your application

## Batch jobs and tasks

Task is a unit of execution; task = application command line (EXE, BAT, CMD, PS1, etc.)

Jobs are created and tasks are submitted to a pool. Next, tasks are queued and assigned to VMs

Any application, any execution time; run applications unchanged

Automatic detection and retry of frozen or failing tasks

# Azure CycleCloud



## User empowerment

Able to cloud-enable existing workflows and schedulers

## Enable instant access to resources

Provide auto-scaling, error handling



## IT management

## Link workflows for internal and external clouds

## Use Active Directory for authentication and authorization

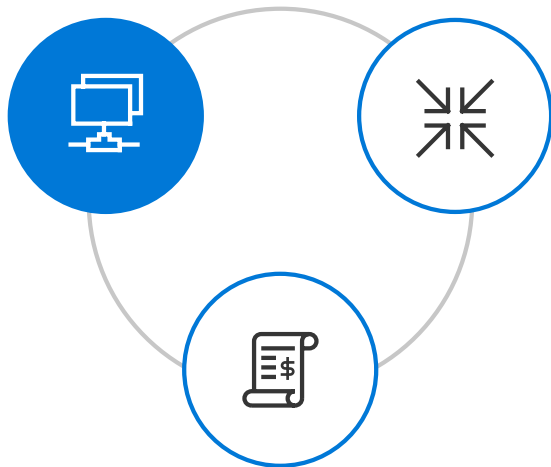
Provide secure and consistent access



## Business management

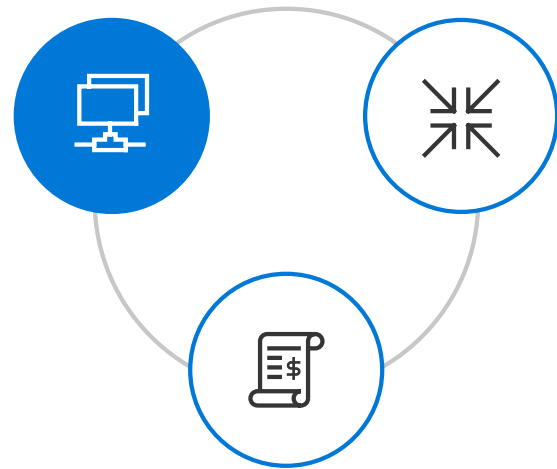
Able to link usage to spend

Provide tools to manage and control costs

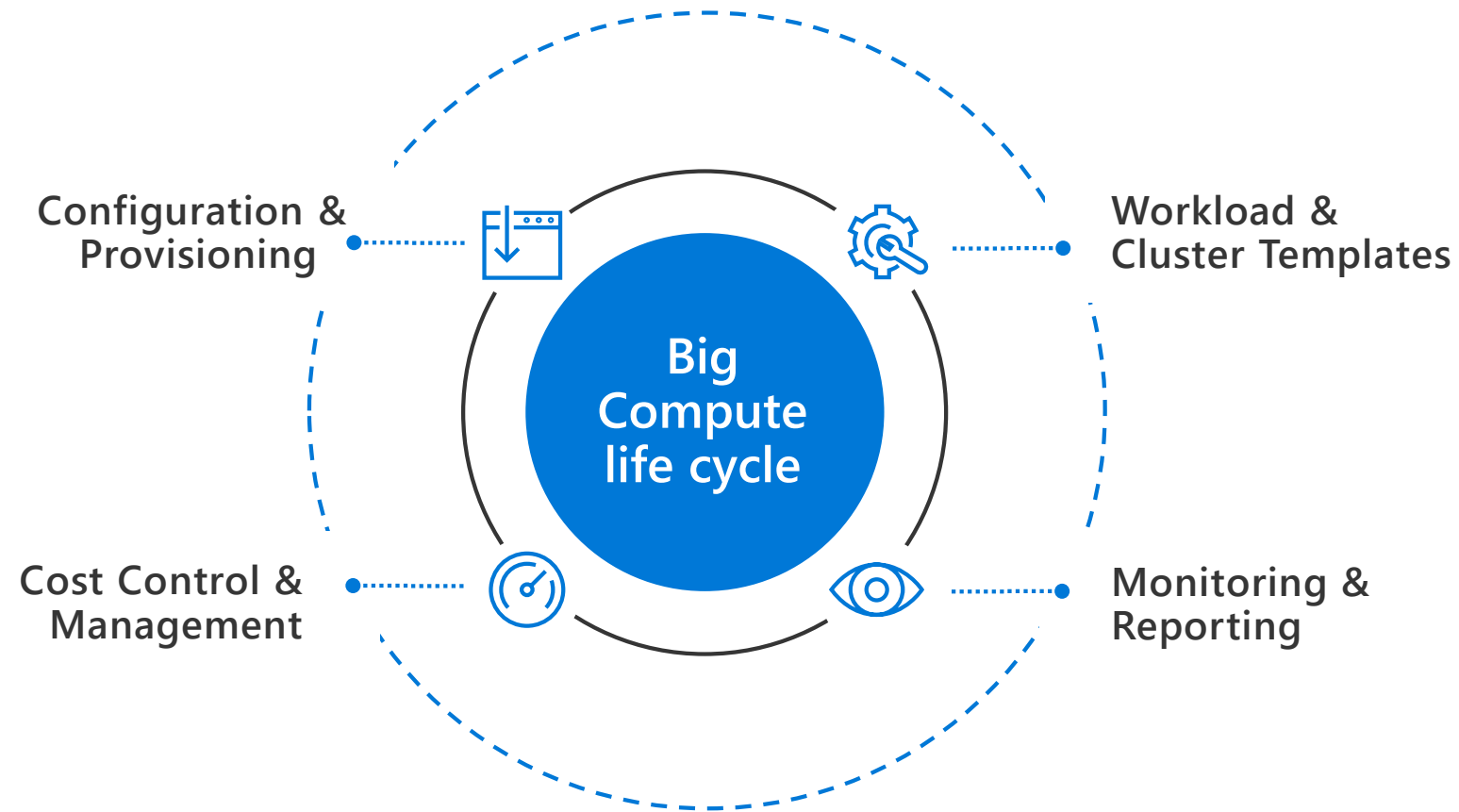




# Azure CycleCloud



## Hybrid/Clustered Big Compute life cycle



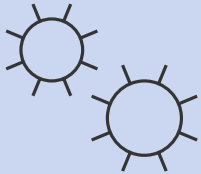
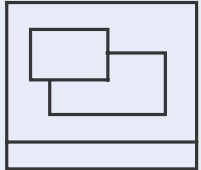

# Azure CycleCloud Roadmap

## **Simplified HPC cluster migration, management, and orchestration**

- Advanced autoscaling functionality to support complex orchestration scenarios
- Templated, deployable HPC solutions for file systems and applications
- Simplified HPC cluster user and access management
- Improved Hybrid support for extending and/or bursting on-prem HPC clusters to Azure
- Improved cluster operational capabilities
- HPC Application ISV + Partner Integrations
- Deep integrations with industry standard HPC job schedulers, including support for resource connector architectures
- Improved Azure portal integration
- Updated cluster, user, and job monitoring
- Improved cost monitoring, reporting, and controls



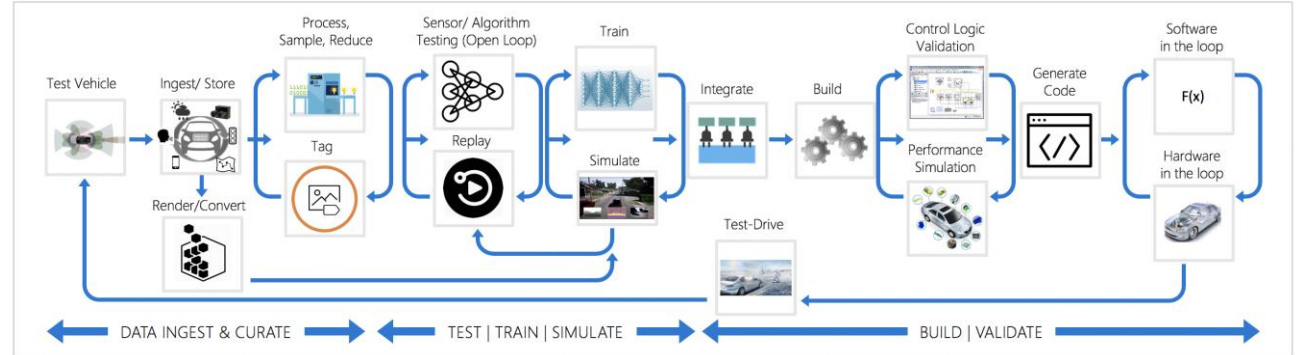
# Azure CycleCloud Roadmap

	Q1 + Q2 CY19	Q3 + Q4 CY19
 <b>Features</b>	<ul style="list-style-type: none"><li>• Advanced cluster autoscaling</li><li>• Simplified user &amp; access management</li><li>• Improved operational capabilities</li></ul>	<ul style="list-style-type: none"><li>• Advanced monitoring + cost reporting</li><li>• Updated cluster and workload monitoring</li><li>• Improved hybrid cluster-extension support</li></ul>
 <b>Workloads + Solutions</b>	<ul style="list-style-type: none"><li>• Targeted Industry workloads:<ul style="list-style-type: none"><li>• Ex: Reservoir Simulation, CFD, ML/DL, Analytics, etc.</li></ul></li><li>• HPC optimized storage solutions for targeted workloads</li><li>• Avere vFXT integration</li></ul>	<ul style="list-style-type: none"><li>• Additional HPC optimized storage solutions</li><li>• Additional targeted industry workloads</li></ul>
 <b>ISV/Partner Integrations</b>	<ul style="list-style-type: none"><li>• Integrations with/for HPC job schedulers<ul style="list-style-type: none"><li>• Spectrum LSF</li><li>• HPC Pack</li><li>• PBS Pro</li></ul></li><li>• HPC ISV integrations</li></ul>	<ul style="list-style-type: none"><li>• Integrations with/for additional HPC job schedulers</li><li>• HPC ISV integrations</li></ul>

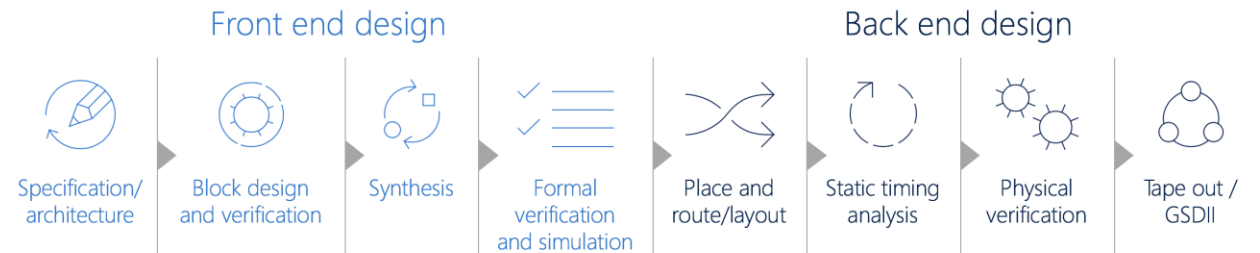
# Optimizing Infrastructure & Enabling Workloads

- Create a packaged end-to-end workload solutions with detailed product characteristics
- Focused reference architectures with compelling end-to-end experiences
- Partner with ISVs, MSPs, SIs
- Creating new infrastructure/HPC offerings that are workload optimized

Autonomous Driving = GPU, CFD, FEA, AI



## Silicon design – Understanding Workload Needs



### Azure compute mapping

HB-Series 4:1 Mem to Core, up to 100 Gbps high perf bandwidth

F-Series 2:1 Mem to Core, up to 12 Gbps bandwidth

HC-Series 8:1 Mem to Core, up to 100 Gbps high perf bandwidth

H-Series up to 16:1 Mem to Core, low core count, turbo

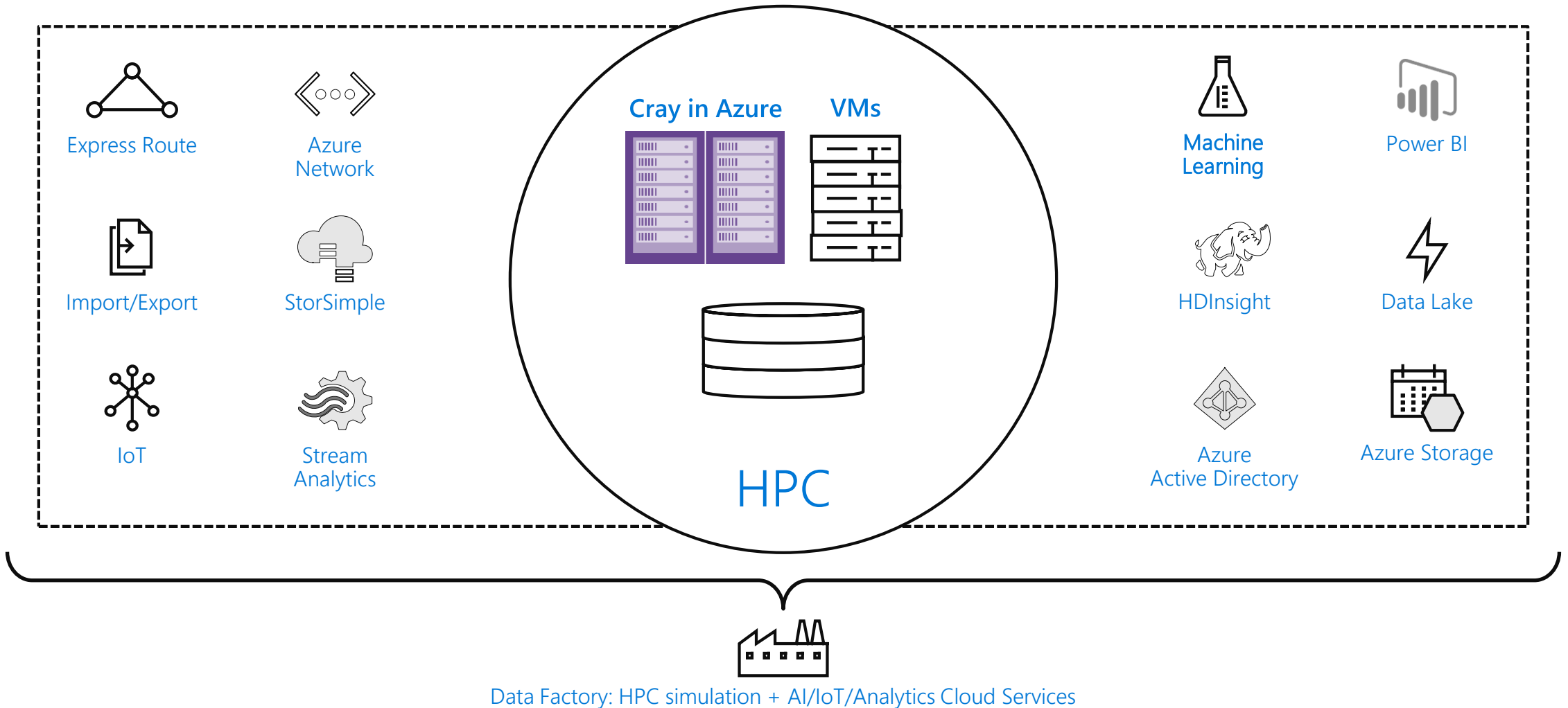
M-Series up to 28:1 Mem to Core, up to 4 TiB, up to 30 Gbps

Scheduling – Industry Scheduling Tools

High Performance Resource Management and Provisioning – Azure CycleCloud, VM Scale Sets

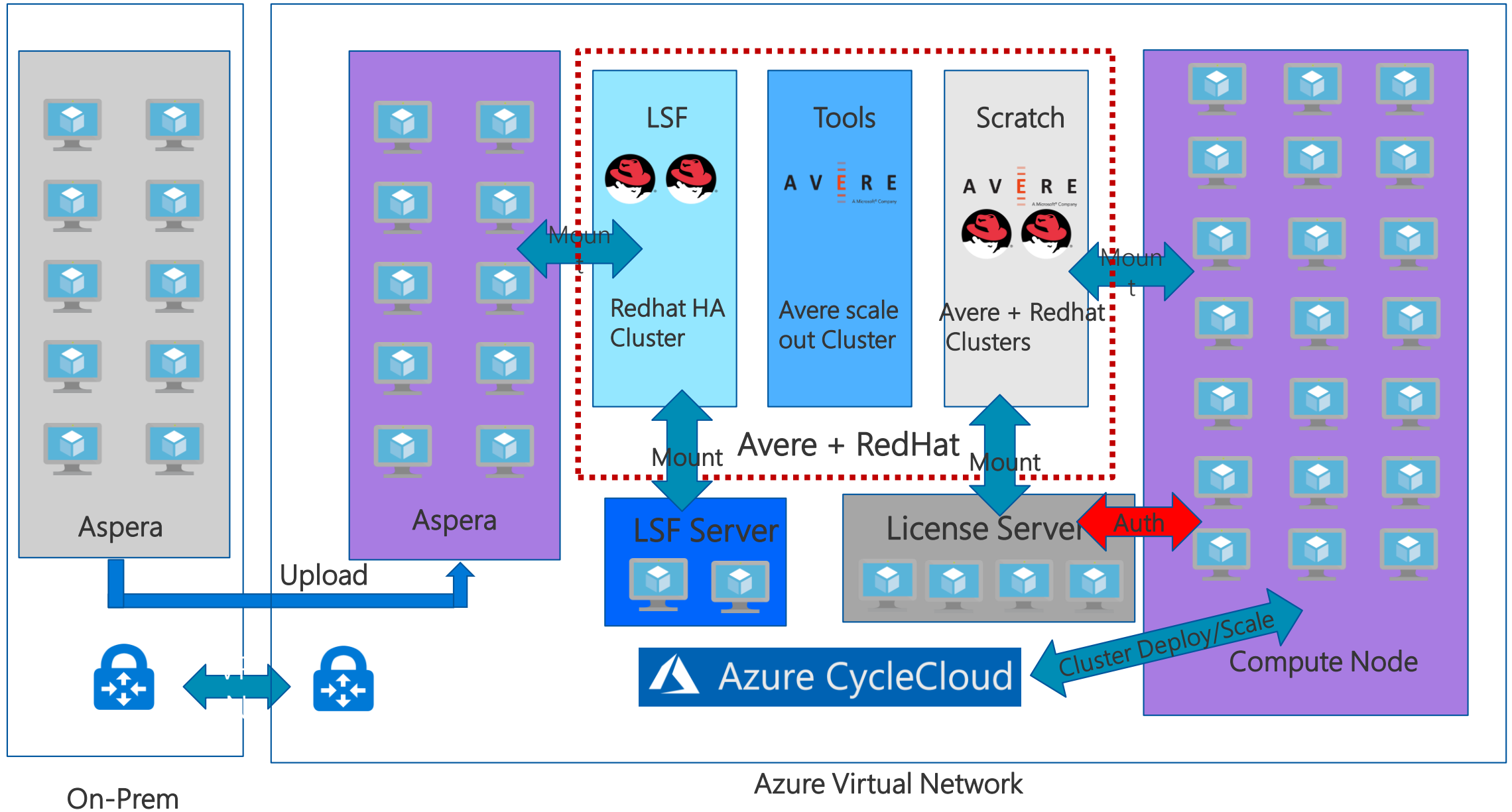
# Leverage HPC data sets with Cognitive Services & IoT

Full network connectivity to high level Azure services





# EDA System Architecture





# Autonomous Driving Dev/Test: End-to-End Processing & Workflow

