

An Introduction to HPC

Is it really relevant to me?

TechU

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IBM Systems

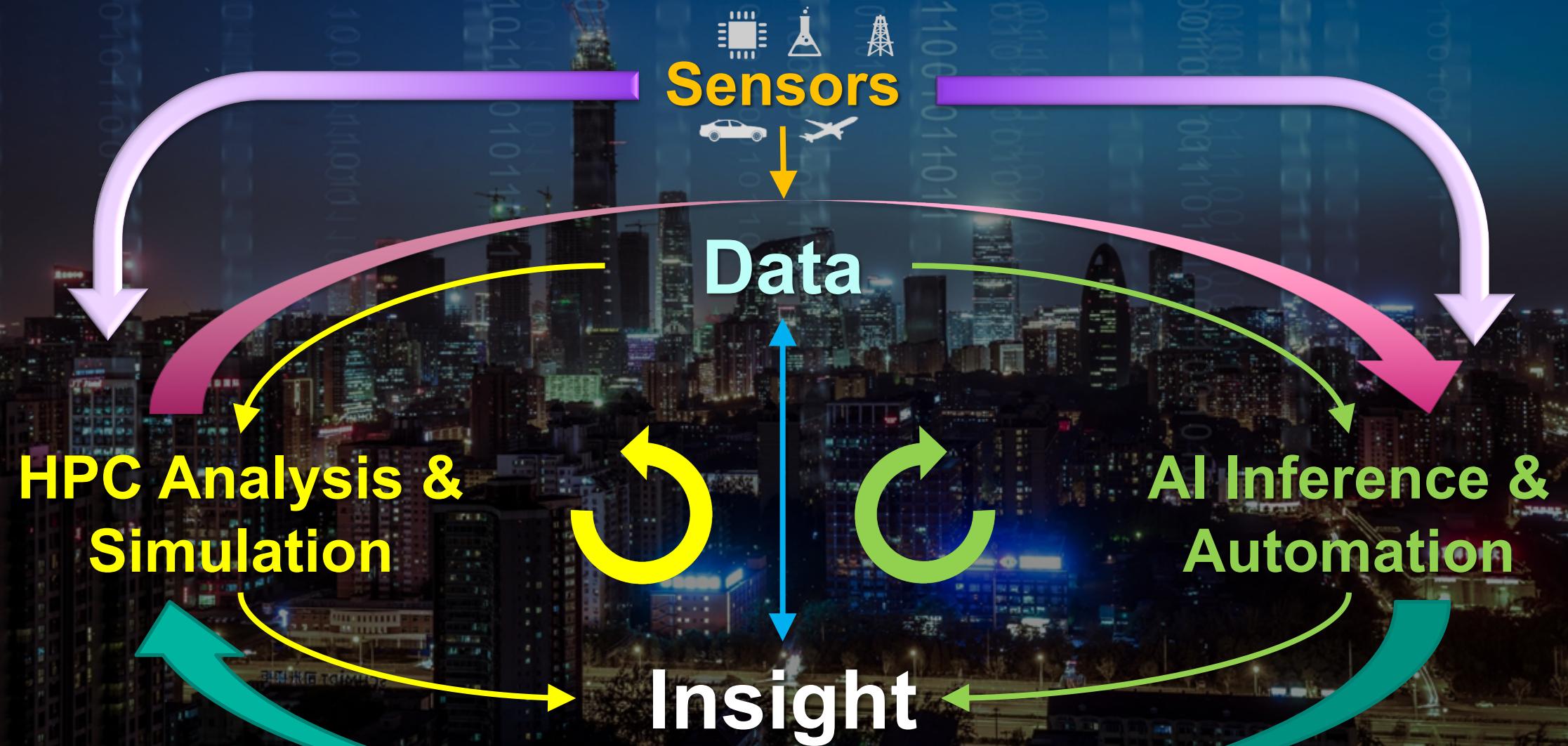
Cognitive Systems



IBM®

IBM Spectrum Computing

Using IoT to enrich HPC and AI





IBM
Spectrum
Computing

Industry Examples

Semiconductor manufacturer running inference workload for wafer inspection in the same cluster running EDA design (> 100x faster)

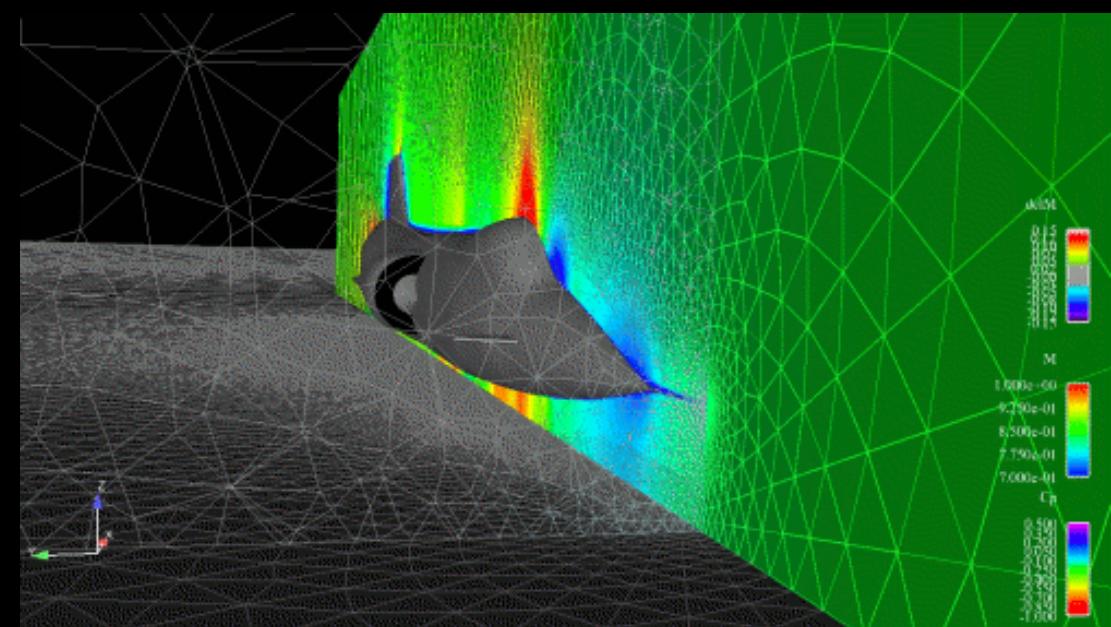
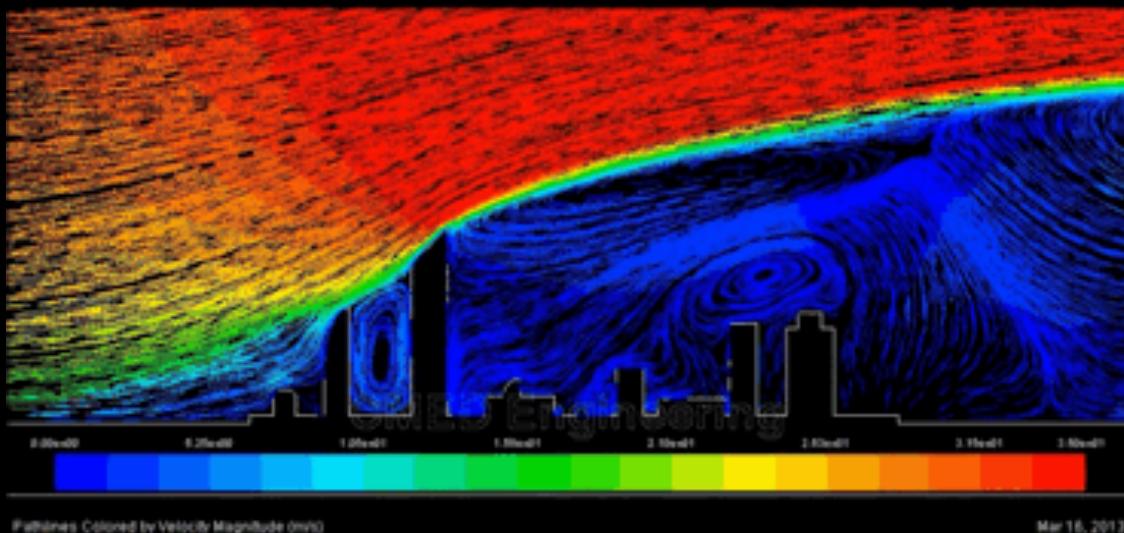
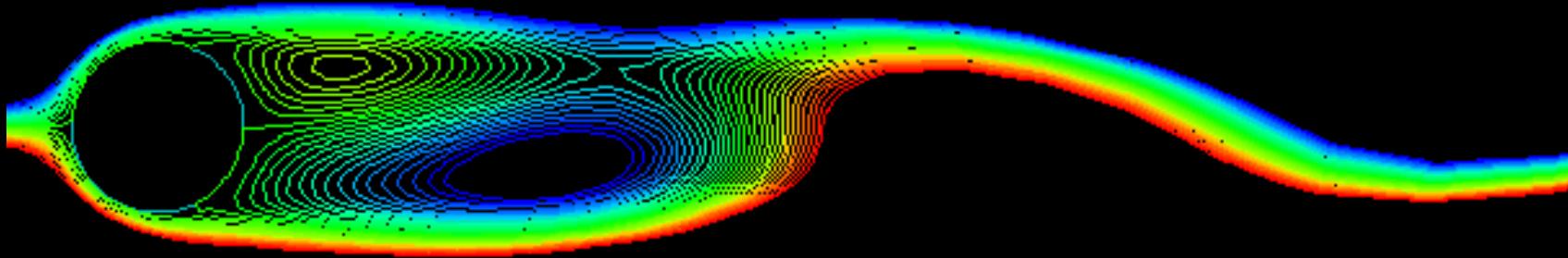
In Automotive, using the outputs from classical CFD simulation to build AI models to predict CFD results, reducing the volume of future classical simulations (> 250x faster)

In Material Science using AI to reduce the number of compounds that need to be classically simulated. (> 50x faster)

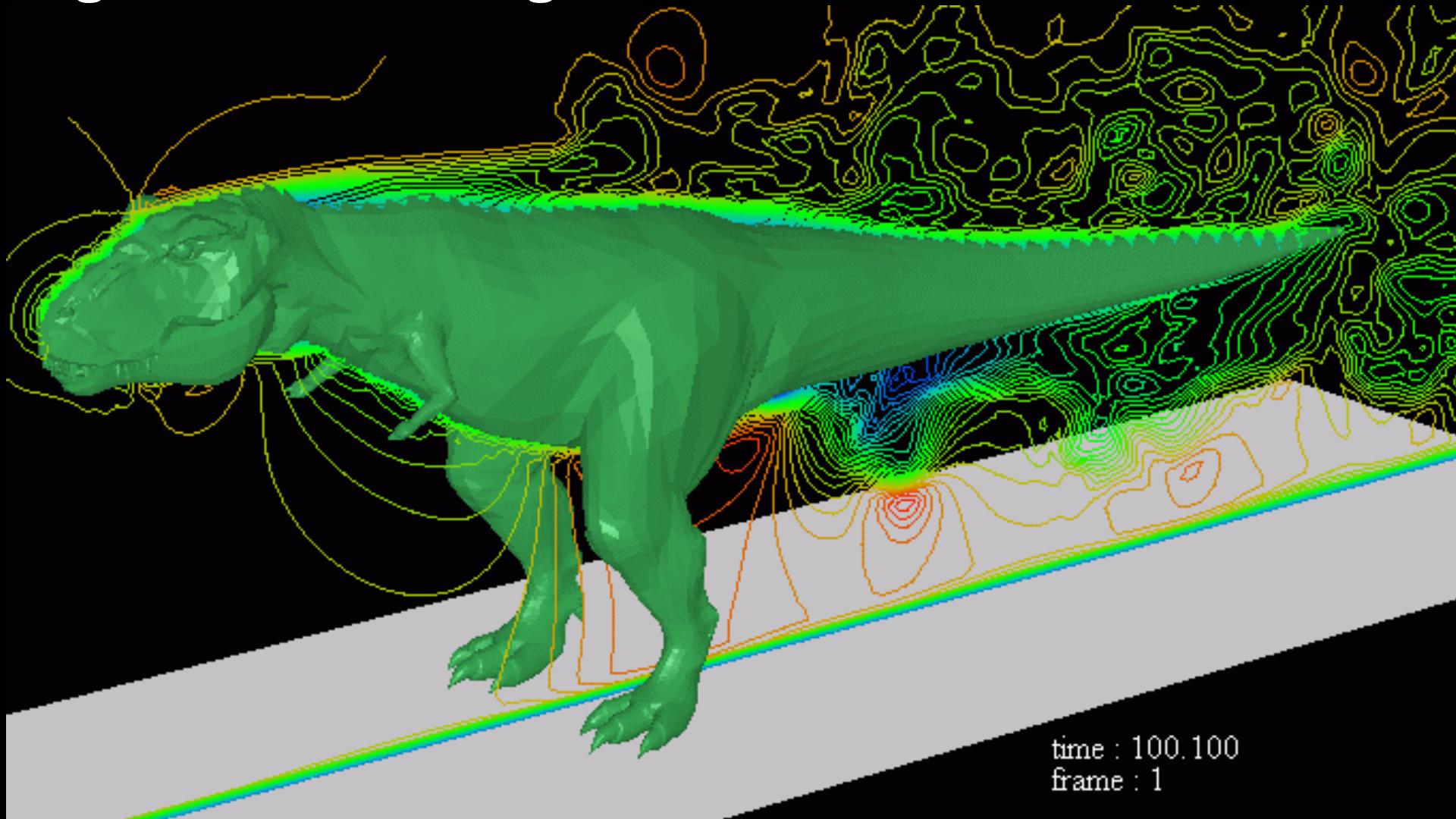


Computational Fluid Dynamics

Simulating the flow around complex objects takes a lot of compute power.



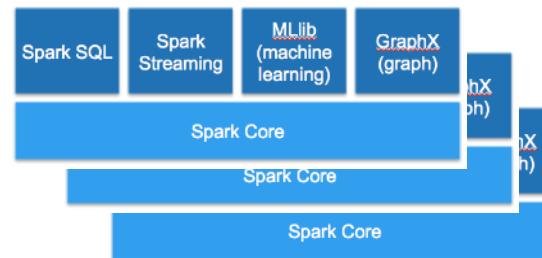
It's not always obvious what is aerodynamic
Small changes can make a big difference



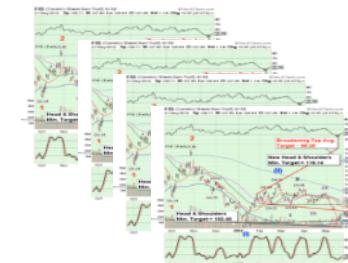
Key Requirement: Diverse Users and Applications



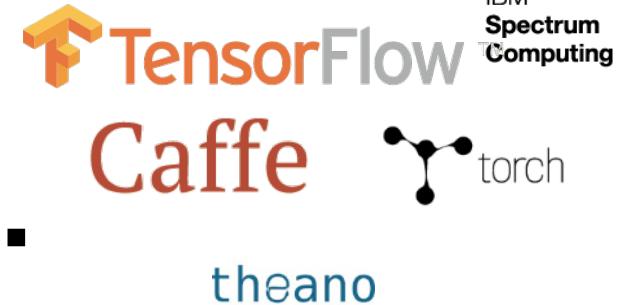
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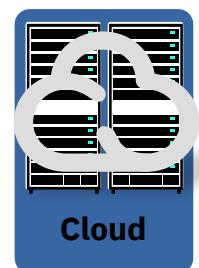
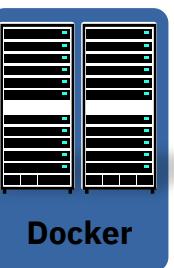
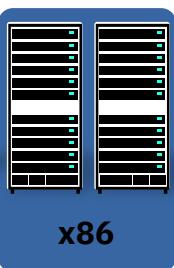
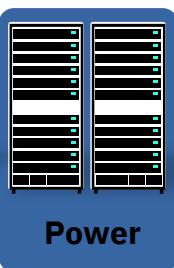
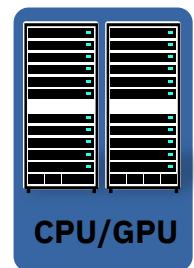


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Shared Simulation, Computation, Data Science and AI Infrastructure

Heterogeneous Infrastructure



- Multiple groups and lines of business with diverse range of engineers, research, analysts, end users and data scientists
- Different application types (Simulations, streaming, batch, interactive, model training, inference,)

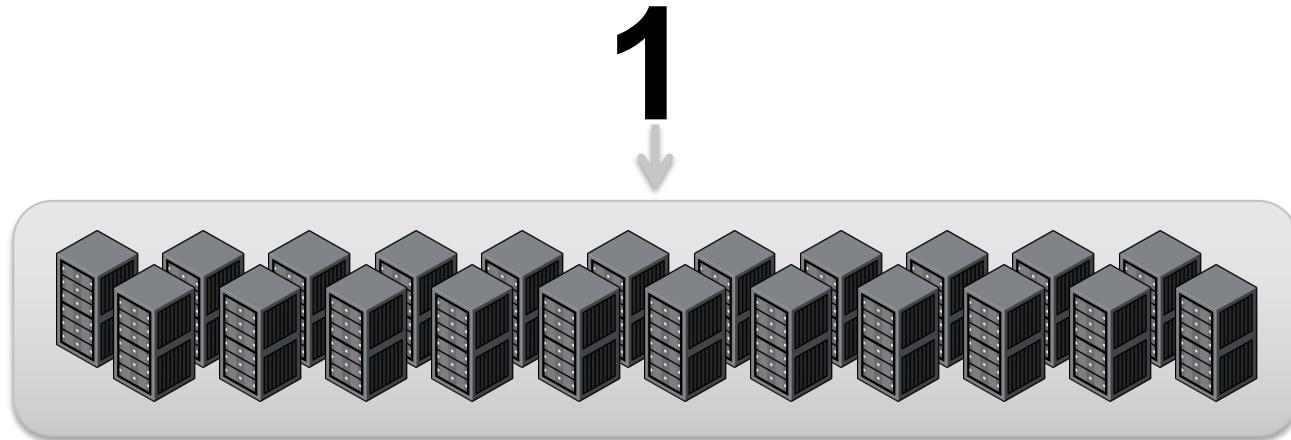
There is strength in numbers....

Mainframes, VMware are
Virtualization



Makes 1 Resource Look Like Many

IBM Spectrum Computing is
Software Defined Compute



Makes 1000s of Resources Look Like One

IBM Spectrum Computing
software offerings are used by 23 of
the 30 largest commercial
enterprises in the world including ...



**15 of top 20
Financial Services
Companies**



**10 of top 12
Automotive
Companies**



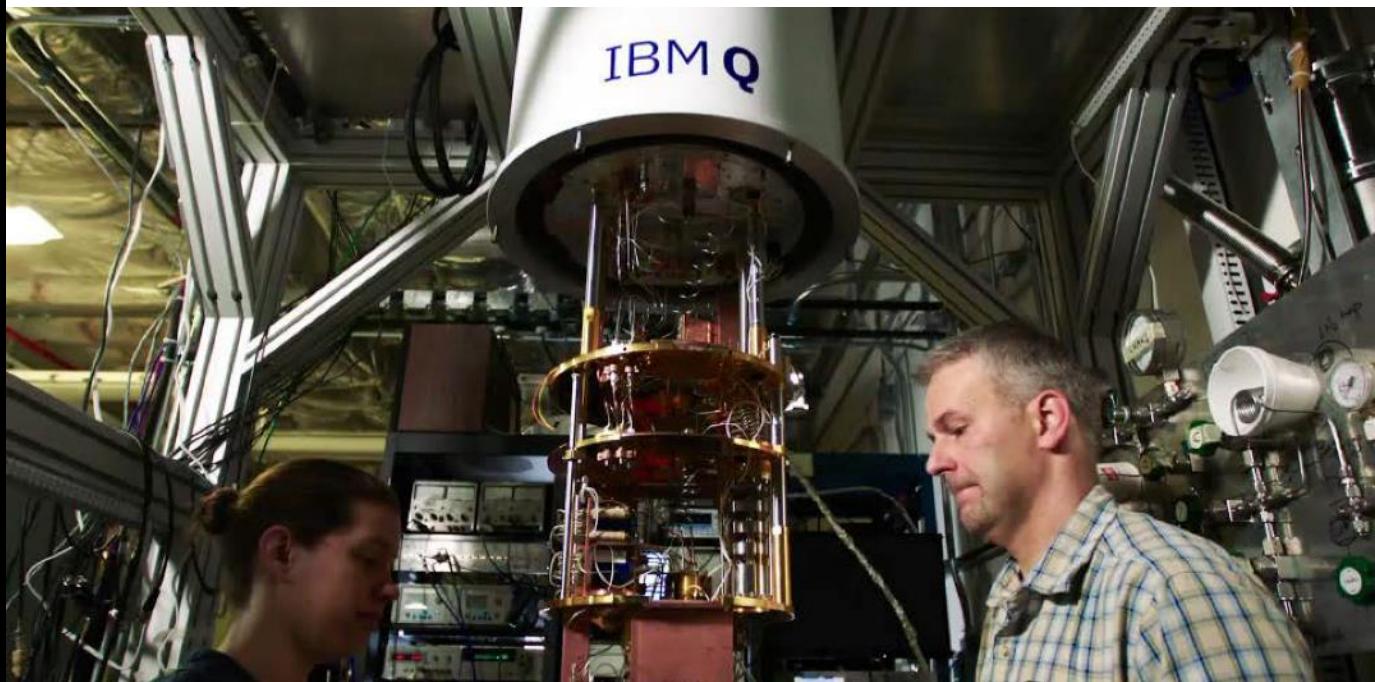
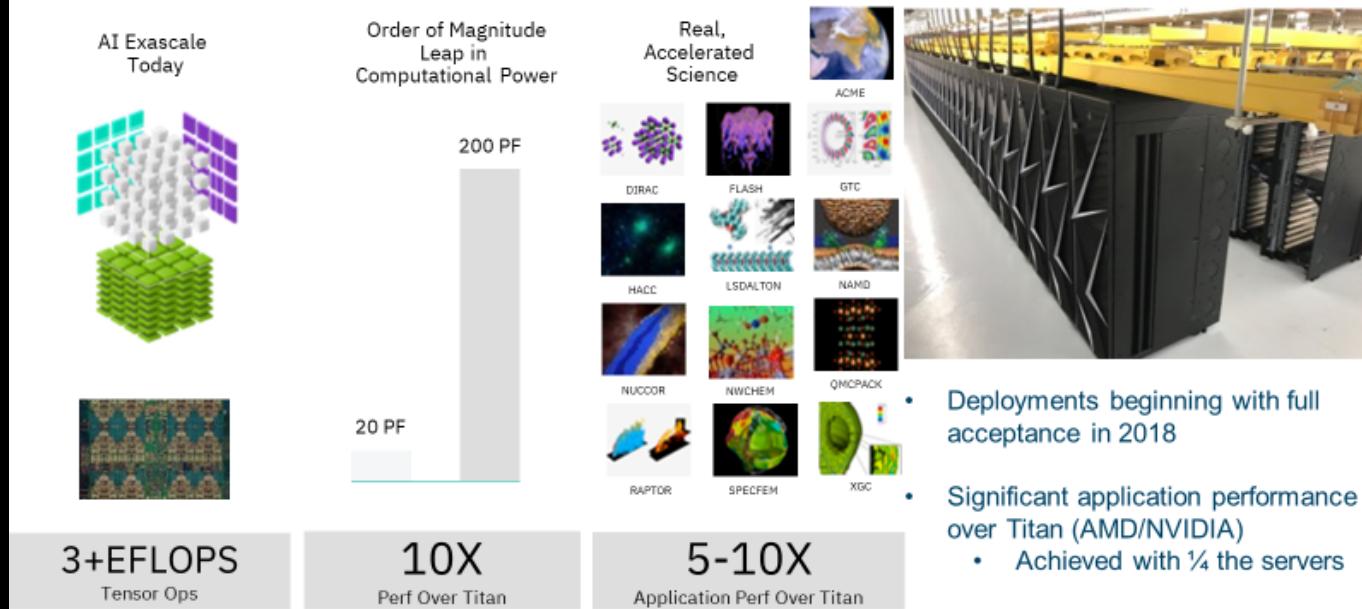
**23 of top 25
Electronic
Companies**



**7 of top 10
Aero & Defense
Companies**

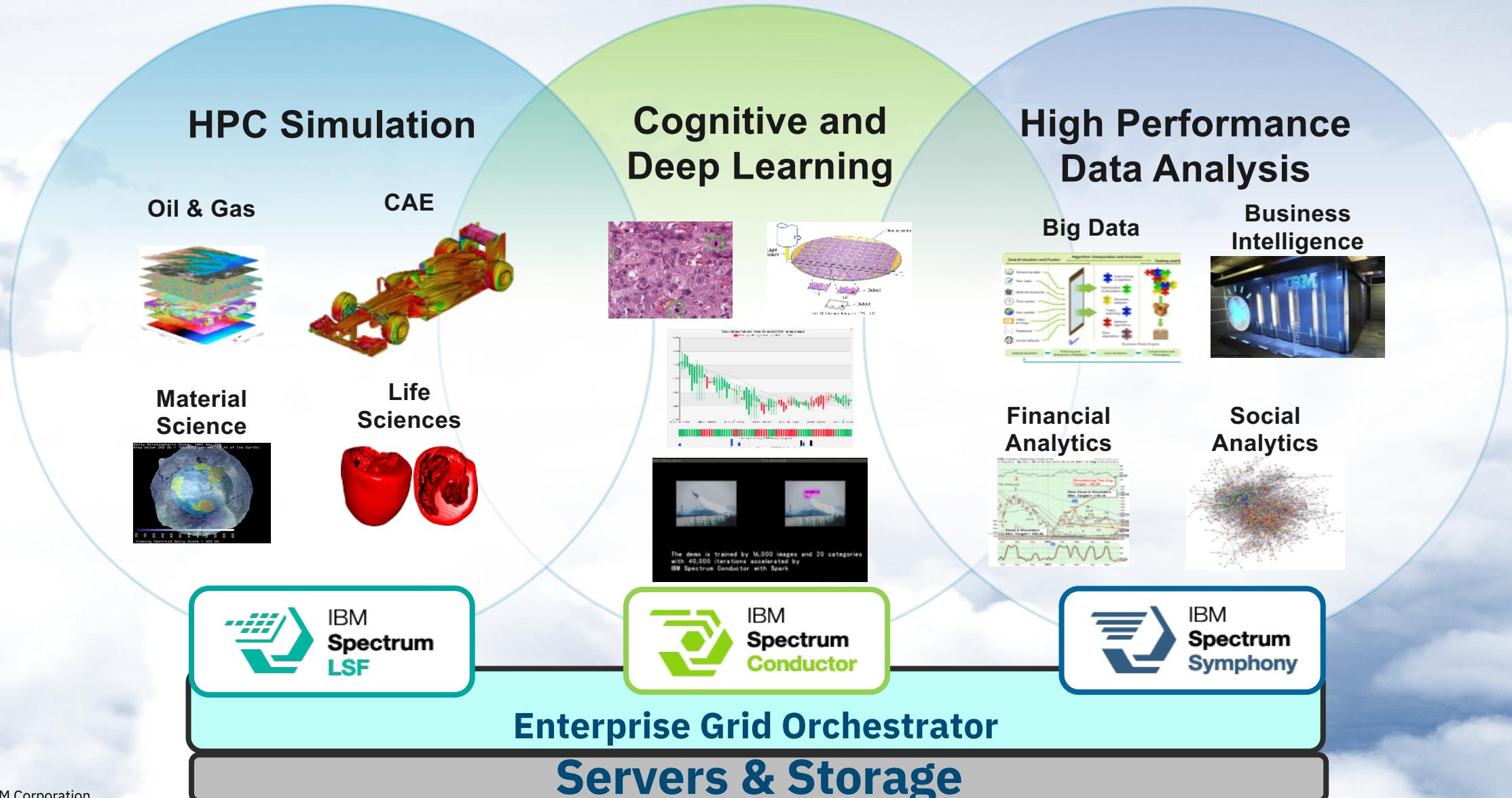
IBM Spectrum LSF is used as the scheduler on the CORAL systems and IBM Q

CORAL – IBM Delivers Summit and Sierra



IBM Spectrum Computing Portfolio for Workload Management

Schedulers Optimised for Different Workloads



The LSF Scheduler provides a huge amount of functionality



- ✓ Unmatched Performance
- ✓ Control Groups and Affinity
- ✓ **Container Support (Docker, etc.)**
- ✓ Compute Units & Job Packing
- ✓ Event/Relaxed Scheduling
- ✓ **5th Generation GPU Support**
- ✓ Spectrum LSF RTM
- ✓ Spectrum LSF Data Manager
- ✓ Global Fairshare
- ✓ Multi Cluster
- ✓ **Hybrid Cloud Support**
- ✓ Block Scheduling
- ✓ Multi-Pass Resource Requirements
- ✓ Start Time Prediction
- ✓ Application Portal
- ✓ Computational Workflow
- ✓ Role Based Access Control and Delegation of Administration
- ✓ Guaranteed Resources
- ✓ Multi-threaded Dispatch
- ✓ Key Pending Reasons
- ✓ Dynamic Resource Scheduling
- ✓ Resource Preemption
- ✓ License Scheduling
- ✓ Resizable Jobs
- ✓ Backfill Scheduling
- ✓ Alternative Resource Requirements
- ✓ Application Profiles

IBM Power HPC Stack

Power HPC Stack V1.1 delivers a complete end-to-end solution for the IBM Power Systems HPC Cluster offerings.

Contains

- IBM Spectrum LSF Suite
- IBM Spectrum MPI
- IBM XL C/C++ and XL Fortran compilers
- IBM Parallel Performance Toolkit,
- IBM Engineering and Scientific Subroutine Library (ESSL), Parallel ESSL
- IBM Spectrum Scale client
- xcat



IBM Spectrum Symphony

Powerful management software for distributed applications & big data analytics

Accelerated diverse compute- and data-intensive applications

- ISV applications (typically FS Risk Analytics).
- In-house developed applications (C/C++, C#/.NET, Java, Excel, R etc).
- Optimized low-latency Hadoop compatible runtime.
- Can be used to launch, persist and manage non-grid aware application services.



IBM Spectrum Conductor with Spark

Apache Spark is an open source framework for large-scale data processing

- Up to 100x faster than Hadoop MapReduce in memory

Challenges with Apache Spark deployments...

- Investment in new expertise, tools and workflows
- Multiplicity of ad hoc Spark clusters
- Spark lifecycle management

Require an enterprise-grade multi-tenant solution

- Improved time to results through efficient resource scheduling
- Spark multitenancy for multiple instances and versions
- Superior workload management, monitoring, and reporting
- Enterprise class security with role-based access control
- Can optionally be run under LSF control.
- **Supports & Extends IBM DSX Local**

**41% greater throughput
than Spark with YARN,
57% greater throughput
than Spark with Mesos**

Source: [STAC Report: Spark Resource Managers, Phase 1](#) (March 28, 2016)



IBM Spectrum Conductor Deep Learning Impact

- Distributed deep learning architecture with highly efficient scaling
- Data management leveraging Spark
 - » Data set ingestion, transformation, and management
 - » Accelerated data pre-processing
- Hyper-parameter search and optimization
- Training visualization & runtime monitoring for accuracy
- Elastic allocation of resources
- Fine grain, dynamic resource allocation
- Elastic workload allocation for long running deep learning jobs
- Multitenancy for deep learning – Shared services model for multiple users and lines of business
- Support for deep learning and high performance analytics running simultaneously on a common set of shared resources.
- **IBM PowerAI Enterprise**
= IBM PowerAI + Conductor/DLI



Sharing Between LSF, Conductor/DLI and PowerAI/AIE (1)

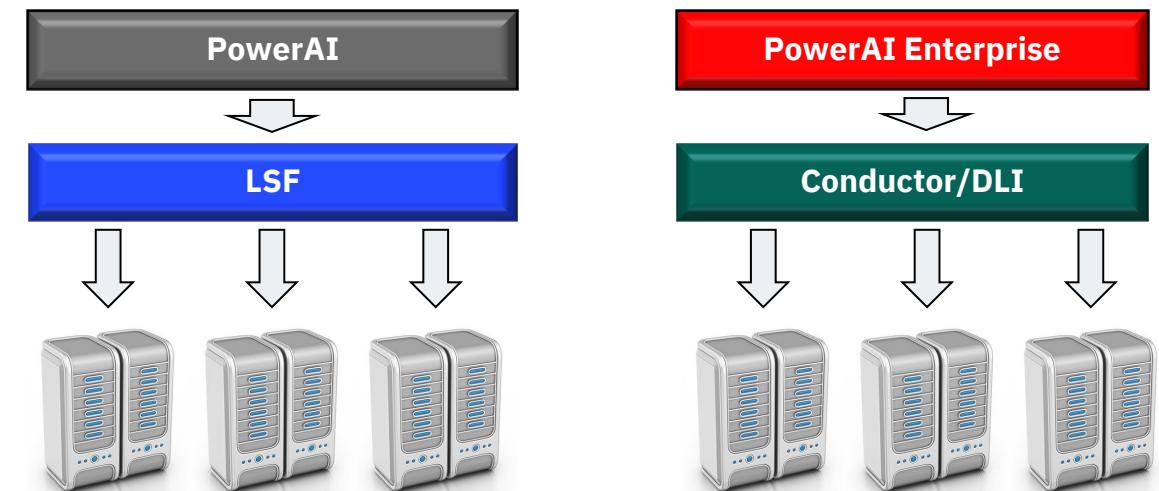


LSF and Conductor manage resources in different ways.

PowerAI and any AI framework can be used with LSF...

....while PowerAI Enterprise includes Conductor/DLI.

How do we combine these environments?



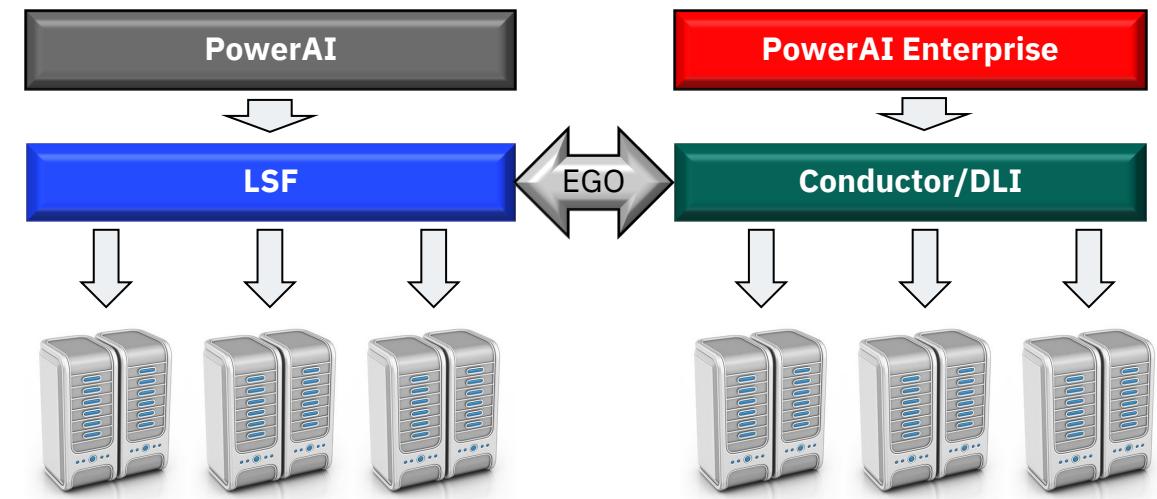
Sharing Between LSF, Conductor/DLI and PowerAI/AIE (2)



The underlying EGO components in LSF and Conductor can be enabled.

This approach will allow lend and borrow of resources between the two schedulers.

But it has the limitation of disabling many LSF policies and capabilities.

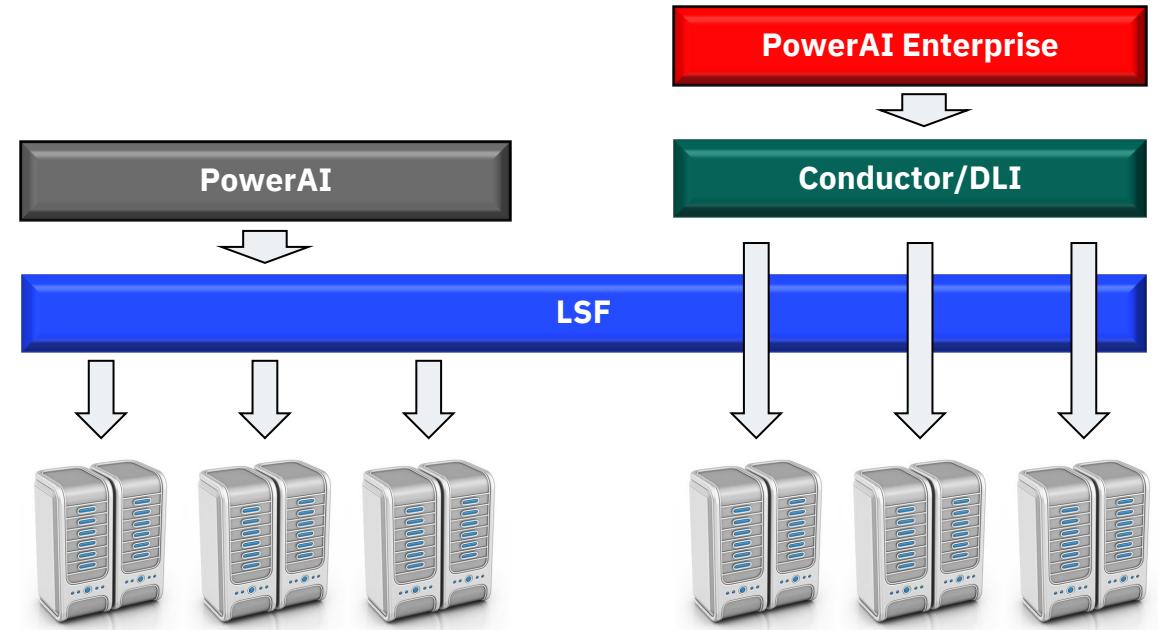


Sharing Between LSF, Conductor/DLI and PowerAI/AIE (3)



The alternate approach is to run C/DLI as an application on top of LSF.

This currently requires hosts to be dedicated to C/DLI, thus it is not really that different to two separate clusters.



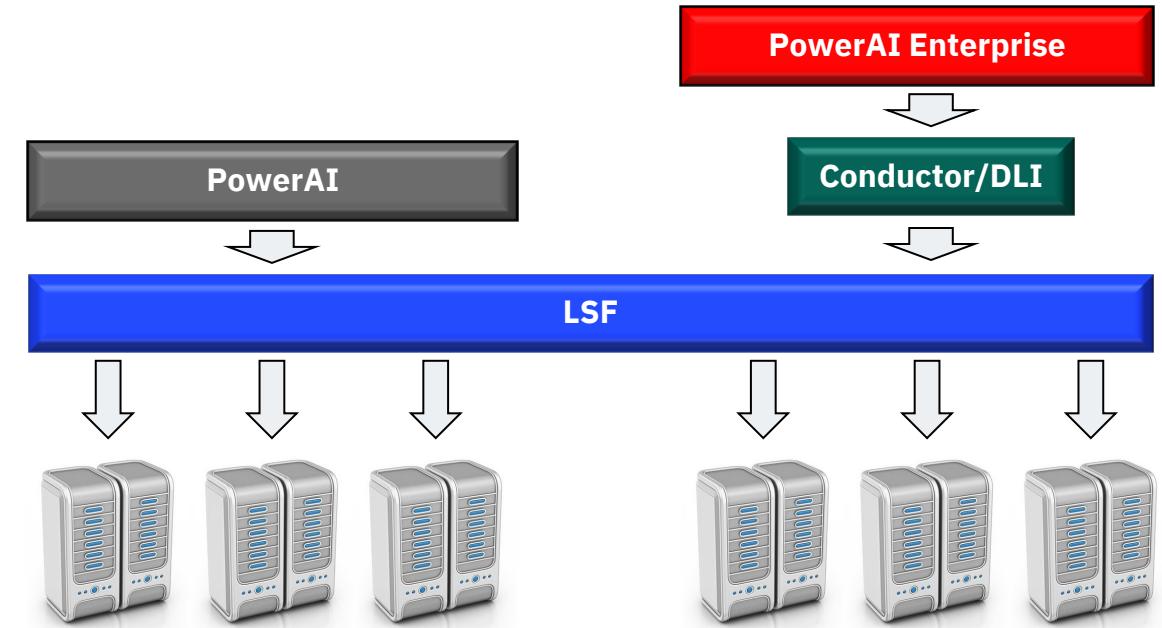
Sharing Between LSF, Conductor/DLI and PowerAI/AIE (4)



In 1Q2019, we intend to release an enhanced integration where C/DLI, and thus PowerAI Enterprise, truly runs as an application on LSF.

Resources will be dynamically allocated to C/DLI & PAIE workloads.

It will still have some limitations, but these are not insurmountable.

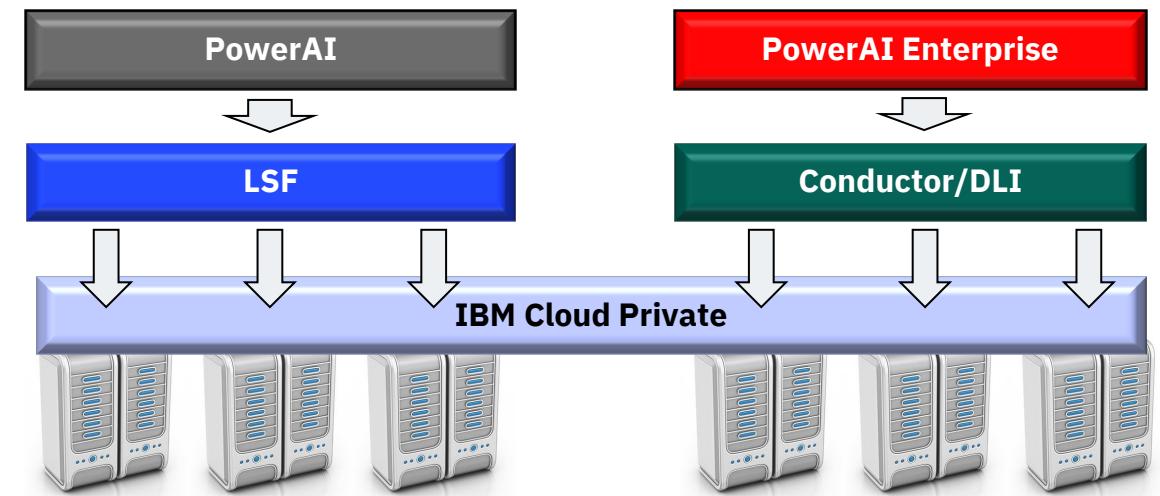


Sharing Between LSF, Conductor/DLI and PowerAI/AIE (5)



An alternative approach, would be to use ICP as a common layer, where appropriate.

Which approach to take will depend on your client and their workloads.



The Cloud Journey

On Premise → Hybrid Cloud → On the Cloud → Cloud Native

Traditional applications running on a cluster on premise.

Applications rely on traditional file systems.

Data is on premise.

Cluster spans on-premise and cloud, and flexes up and down on demand.

Data needs to be shared between file systems on premise and cloud.

May be multi-cloud.

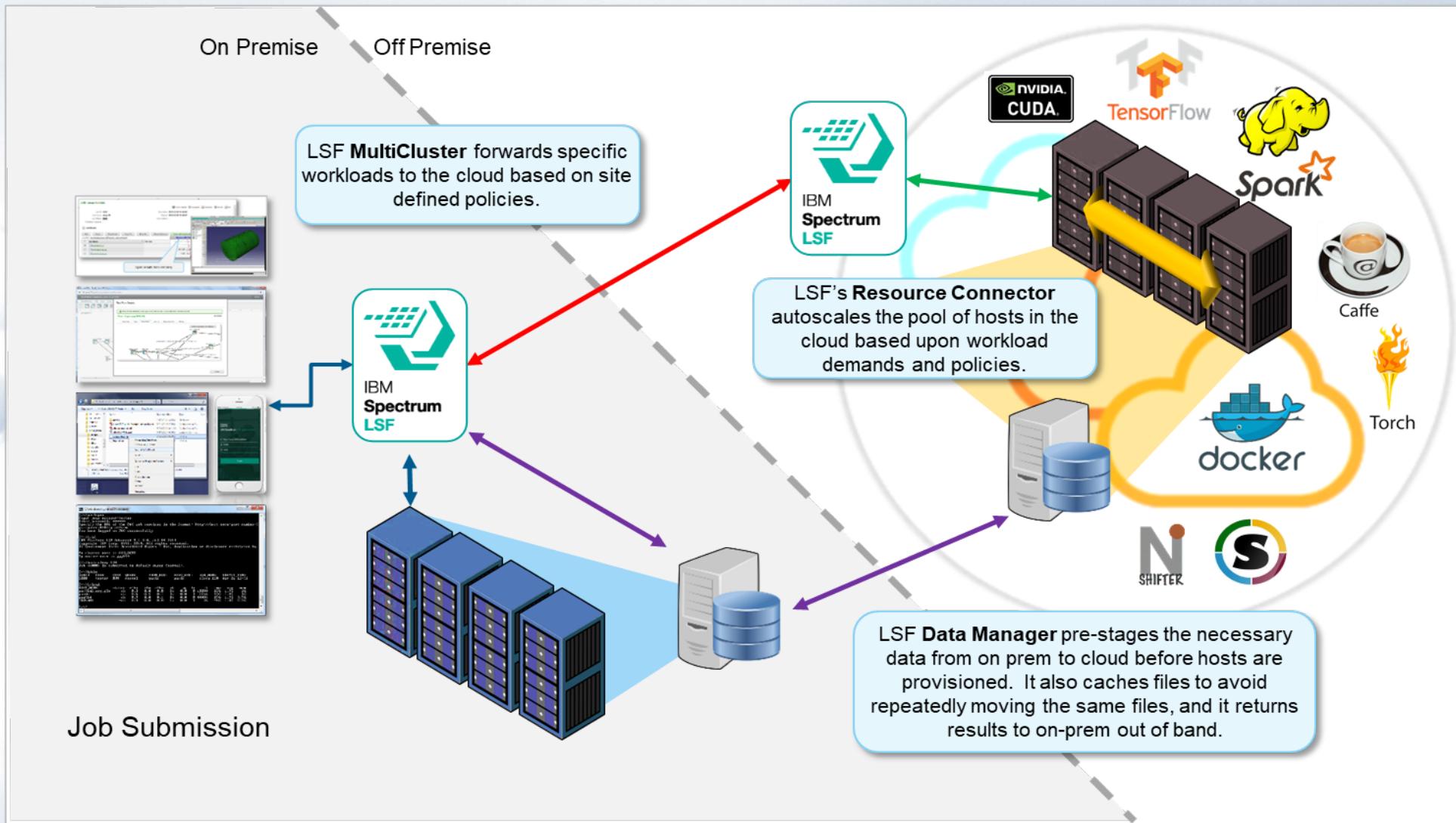
Traditional cluster hosted on the cloud. Cluster can flex up and down on demand.

Data primarily in the cloud but still on a traditional file system.

Can have multiple instances in different clouds.

Application (re-) written to be totally cloud native and not reliant on traditional file systems etc

A closer look at HPC Hybrid Cloud



 openstack.

 Amazon

 IBM Cloud

 Microsoft

 Google