Extending Storage to the Edge, How It Should Affect Your Storage Strategy

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Today’s Presenters

Moderator:
Jim Fister
Principal
The Decision Place

Presenter:
Erin Farr
Senior Technical Staff Member
Storage CTO Office
IBM

Presenter:
Vincent Hsu
VP, IBM Fellow, and CTO for Storage and Software Defined Infrastructure
IBM
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Agenda

- Edge Computing use cases are driving additional patterns of data movement
  - Challenges associated with these use cases
  - Considerations for distributed cloud storage architectures
Edge Computing
Data movement pattern #1
For Today’s Discussion…

- **Edge**
  - Where data is being generated
  - Examples include:
    - Branch offices
    - Retail stores
    - Research Labs
    - Industry/Manufacturing sites
    - Automobiles

- **Core**
  - Centralized location for data and business workloads
  - Examples include:
    - Hybrid, Public and Private clouds
    - IT Datacenters

[Diagram showing edge, hybrid cloud, and core]
What’s Driving Compute to the Edge?

- **Data gravity**
  - Easier to move the compute than the large amounts of data

- **Regulations/Compliance**
  - Some data can’t cross national or state borders

- **Security**
  - Less copies reduce the attack surface

- **Cost**
  - Moving data and making copies of data is expensive

- **Performance**
  - Faster response times where you need it

- **Unreliable connectivity**
  - Remote or portable environments can’t rely on connectivity to core
Familiar Patterns for Edge

New workloads are being created to gain insights from dark data

Existing workloads on the core where data is sent from the edge... are getting migrated to the edge to avoid data movement
But What Happens When…

- Your data scientist wants to use deep learning against data at the edge site
- DL requires a GPU for faster training
- You don’t have a GPU on the edge site
- It is cost prohibitive to put GPUs in all of your edge sites

She decides to do training on the core site

Data is here

compute
GPU

storage

dataset

Inferencing needs to remain on the edge

GPU is here

compute
GPU

storage

edge

core

hybrid cloud
So, She Copies the Dataset Herself

But first, she needs to talk to three different teams

- **May I make a copy of this data?**
  - **Data governance team**
    - Manage permission and access to data
    - Data replica management

- **Where can I run my workload?**
  - **Cluster management team**
    - Manage the compute backbone
    - Resource management
    - Host compute tenants from different business units

- **Where can I put my dataset?**
  - **Storage management team**
    - Manage the central storage
    - Provision storage to compute cluster
Data Management is Manual and Error-prone

- Over time, this creates data sprawl
- Data scientist has trouble recreating results because she can’t find the correct dataset used.

Keeps track of which datasets were used in a spreadsheet

Performs training (8x faster)

Over time, there are multiple copies of data

Some copies are deleted to free space

Over time, this creates data sprawl

Data scientist has trouble recreating results because she can’t find the correct dataset used.
Cloud Bursting

- An application running in a data center, private cloud or edge environment can rapidly scale compute, storage or memory by “bursting” into a public cloud if it needs more resources.

- Can burst for performance or additional capacity.

Advantages

- Performance
- Cost
  - only pay when there is a demand
- Availability
  - avoids interruption of services
How Can Storage Help with Cloud Bursting?

- Single source of truth for your data
- Data scientist can focus on data science work

Get approvals and resources for a cluster (one time)

Train model (8x faster)

Storage evicts data

Create cluster with single namespace

Storage prefetches data across single namespace
Cloud Bursting – Data and Storage Considerations

- Data Replication
  - Move the data with the applications seamlessly
  - Still need to consider data locality and compliance

- Data Consistency
  - If application is stateful, need to ensure data consistency

- Data Protection
  - The data needs secured across locations

- Data Eviction
  - Once data is used and no longer needed, clean it up

- Efficiency
  - How to do everything above with the least amount of human effort?
Edge Computing
Data movement pattern #2
Machine Learning with Data from Multiple Edge Sites

What usually happens today...

Inference occurs on new data with new model

Push new model to edges

Copy data from each edge site

Machine Learning model is trained at the core
Federated Learning

Models are retrained on the edge

TRAINING and INFERENCE

Inference occurs on new data with new model

push new model to edges

request retrain

pull models from edge

(not raw data)

Machine Learning model is trained on the core

Aggregator collects models from each edge site, retrains, and redistributes new models

edge

hybrid cloud

core
Value of Federated Learning

- Improve model training across locations
- Address data privacy, locality and security
- Adhere to regulatory compliance
- Tackle data volumes at lower cost and risk (e.g., minimize egress charges)

- Application spans both Edge and Core
  - Most data management is handled at the application layer today
  - If handled at the storage layer, that can simplify application complexity and improve time to market
Federated Applications – How Can Storage Help?

- Move data with the applications seamlessly
- Provide access to data regardless of how it’s stored

Application itself contains logic to
- Move data across sites
- Support heterogeneous data (multiple protocols)

Instead, provide that support in the storage layer
- Virtualize multiple protocol access

Instead of having the applications handle
- Move data across sites
- Support heterogeneous data (multiple protocols)

POSIX, NFS, SMB, HDFS, S3, CSI, CDMI, etc.

Virtualize multiple protocol access

Single namespace
Edge Computing

Data movement pattern #3
Data is Everywhere

Query engine runs on the edge so the data can stay there

However, you also want to use data located on the core site

Different data sources have different performance characteristics

Query engine has to wait

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How Can Storage help?

• Provide fast access to data regardless of where it lives

Accelerate data access from multiple, heterogeneous sources

Intelligent data caching and virtualization

Make heterogeneous data appear homogeneous to the application
Summary of Edge Use Cases

**Cloud Bursting**
Move app from edge to core and back

**Federated Learning**
App spans both edge and core

**Query Engine**
App runs anywhere but can quickly access data everywhere
Summary of Storage Considerations for Edge Data Patterns

- Provide a single source of truth for the data
- Fast access to data regardless of how it’s stored and where it lives

Deployment Considerations
Storage features that are containerized are more likely to be portable across edge and core

Intelligent data caching and virtualization
Virtualization across multiple protocols
Single namespace for unified data fabric
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