

Building a Scalable Data Grid for Collaborative Research

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WOS Product Line Manager

DDN is the World's Largest Privately Held Data Storage Company

Key Statistics

Overview:

Providing the data backbone for the world's most extreme, data-intensive environments – enabling organizations across multiple industries to maximize the value of their information globally.

- Established: 1998
- Headquarters: Chatsworth, California USA
- Over 1,000 Customers in 5 Continents

Key Industries:

- High Performance Computing & Life Science
- Cloud & Web Content
- Rich Media
- Intelligence/Federal

Go To Market:

- Global Partners, VARs, Resellers

Industry Validation



World's Largest Privately-Held Storage Co.



Fast500 Technology Company

Inc. 500|5000 High-Growth Company

Best HPC Storage Product



Best Practice for Digital Media

World Class Set of Global Customers

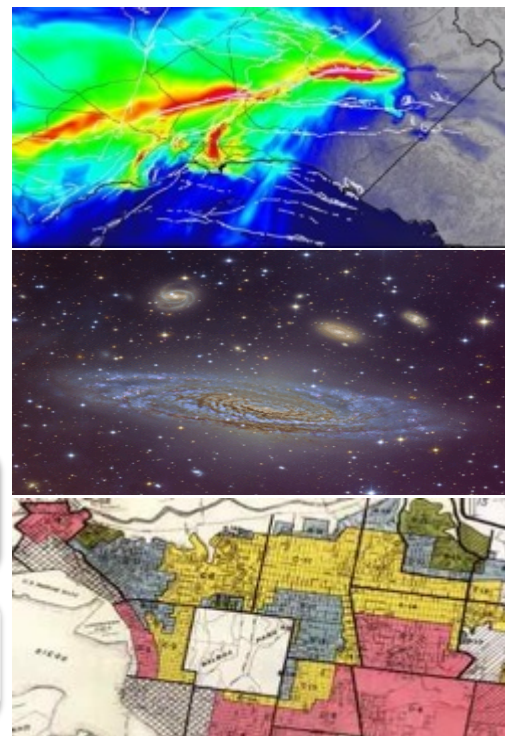
IRODS Data Grid & WOS Made for Big Data

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- Hyperscale
- Distributed
- Collaborative

- Accessible
- Secure
- Flexible



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= Managed Collaboration

Building a World-Class Data Grid

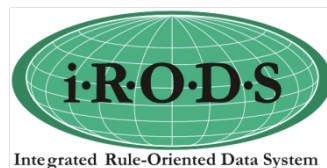
DDN is partnering with DICE & RENCi to create a hardened, performance optimized iRODS/WOS distributed, collaborative data grid



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Storage should improve collaboration

... Not make it harder

- Distributed, not centralized
- Minutes to install, not hours
- Milliseconds to retrieve data, not seconds
- Replication built in, not added on
- Instantaneous recovery from disk failure, not days
- Built in data integrity, not silent data corruption



Why WOS Object Storage?

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Much Richer Metadata Capabilities

- » Metadata contained in object, not separate DB

Separation of “Data” and “View”

- » View manages who sees what
- » Data deals with physical storage locations

Replication, Data & disaster protection is built-in

- » No wasteful idle “Standby” DR sites
- » All WOS storage is productive
- » Don’t have to deal with cost & complexity of backup

Simplicity reduces management effort & costs

- » Large #s of objects cause performance & scalability problems with traditional systems
- » Single global namespace is easy to configure and extend

WOS Signature

WOS Policy

WOS Checksum

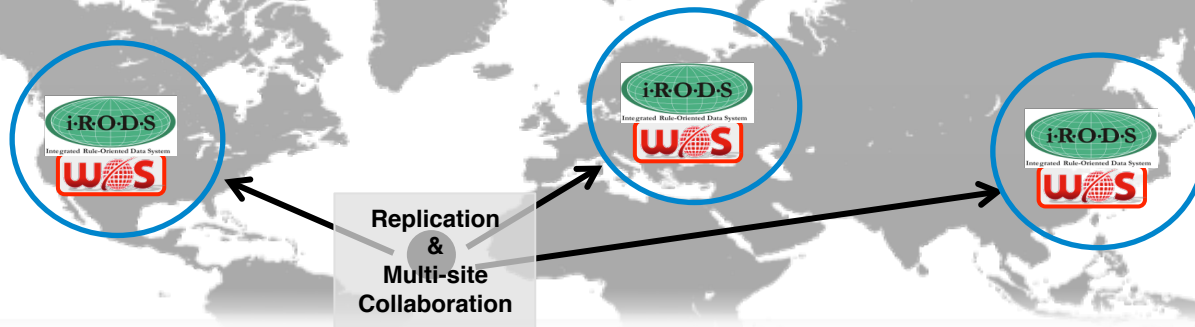
User Metadata
Key Value or Binary

Full File or
Sub-Object

Introducing: DDN Web Object Scaler

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- Content Storage Building Block for Big Data Infrastructure
 - » Industry's leading scale-out object storage appliance
 - » Unprecedented performance & efficiency
 - » Built-in single namespace & global content distribution
- Optimized for Collaborative Environments
 - » Geographic location intelligence optimizes access latency
 - » Just-in-time provisioning
- Lowest TCO in the Industry
 - » Simple, near zero administration
 - » Automated "Continuity of Operations" architecture



WOS Building Blocks

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WOS 6000 - 4U high density 60-drive

WOS 1600 - 3U high-performance 16-drive

Key Metrics

- » **Built on the DDN industry leading high performance storage platforms**
- » **4-1 Gige or 1-10 Gige (redundant) network connections per node**
- » **Highest density and scalability in the market**
 - 1.98PB per rack, Up to 23PB per cluster
 - 660 spindles per rack
 - 22B objects per rack, 128B objects per cluster
 - 99% storage efficiency for any mix of file sizes between 512 bytes to 500GB
- » **Linear cluster performance scaling**
- » **Low latency**
 - One disk I/O per read or write for objects < 1MB

WOS 6000



**4U, 60-drive WOS
Node (SAS/SATA)**



**2PB / 11 Units
per Rack**

WOS 1600



**3U, 16-drive WOS
Node (SAS/SATA)**



**544TB / 15 Units
per Rack**

WOS NoFS | Efficiency Defined

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Performance Efficiency:

- Extremely low latency -1 Seek/Operation, 10X speedup/HDD
- Linear Global Scale-Out (Performance, Capacity, # Objects)
- Optimized for small objects

Management Efficiency:

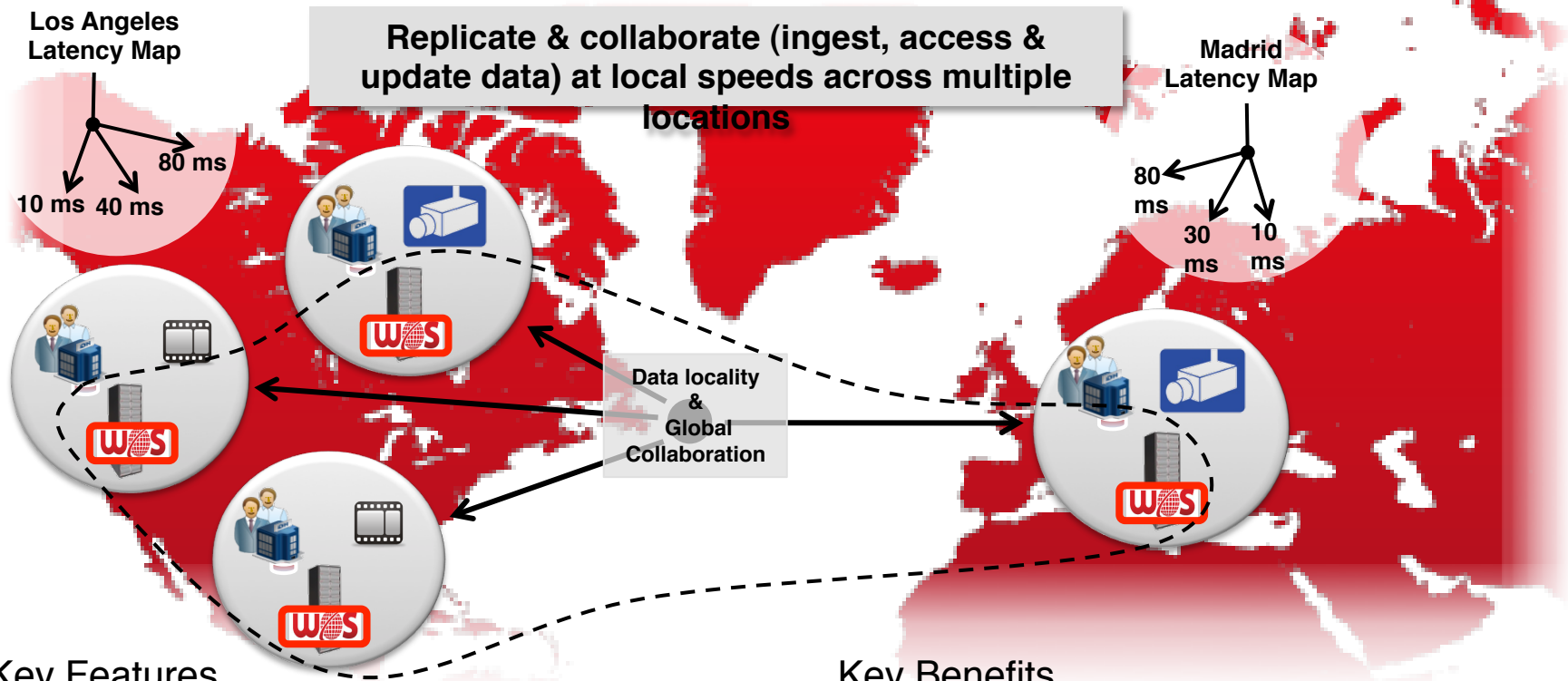
- Single Pane of Glass, Global System
- Fail-In-Place, Zero-Intervention
- Less than admin FTE for multi-petabytes of storage

Data Center Efficiency:

- Utilizes 99% of disk platter
- 660 HDDs / Rack, Low Power/Cooling

Distributed Hyperscale Collaborative Storage

Global View, Local Access



Key Features

- Asynchronous or Synchronous Replication across up to 4 sites
- Geographic, location, & latency intelligence
- NAS data access @ LAN speeds
- Data and DR protected

Key Benefits

- Users can access and update data simultaneously across multiple sites
- Increases performance & optimizes access latency
- No risk of data loss

WOS vs File Systems in iRODS Grid

Minimizing Management Costs

The Problem With File Systems

- Large numbers of small objects cause performance & scalability problems with traditional file systems
- File systems require more headcount while iRODS headcount costs must be extremely low



WOS Cloud - the TCO leader

» Deploy additional WOS nodes in 10 minutes or less

» Single, global namespace that can be extended

» Policy-driven disaster protection and automatic healing

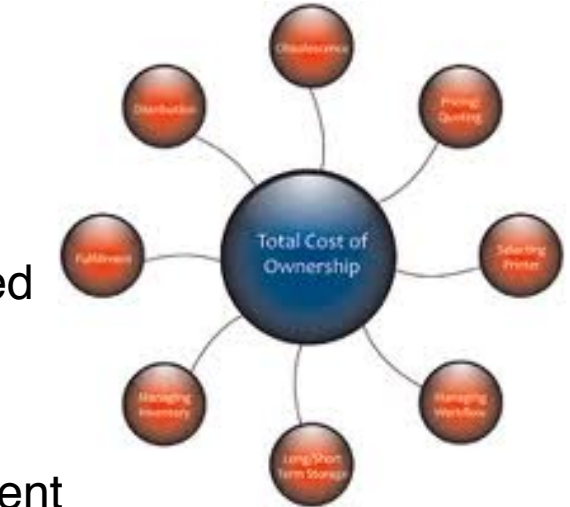
» WOS \$/TB heals from disk failure

» Eliminates operational complexity with expected graceful degradation

Multi-petabyte WOS deployments require less than 1FTE to manage



WOS Dramatically Lowers iRODS TCO



- WOS optimizes storage efficiency
 - WOS utilizes 99% of the disk platter vs 65-70% for FS/NAS implementations
 - Eliminates the stranded capacity problem exhibited in standard file systems
- WOS data and disaster protection is built-in
 - Policy-driven replication is automatic and transparent
 - Eliminate management and infrastructure costs for backup & DR
- WOS reduces management headcount
 - With WOS single, global namespace is easy to configure and extend
 - IRODS with NAS / SAN file systems forces customers to create and manage many file systems under IRODS which bloats management headcount and overhead.

WOS Optimizes iRODS Performance & Data Availability

- Lowest latency file access
 - NoFS – 1 disk seek per file access
 - WOS always returns closest instance of file
- Highest data availability
 - Immediate access - If the closest instance of an object isn't available, WOS will automatically & transparently return the next closest instance
 - Self healing - WOS automatically corrects disk failures & data corruption problems that iRODS doesn't even know exist
- Self healing from disk failure in minutes, not days
- Built in data integrity, no silent data corruption
- Replication built in, not added on

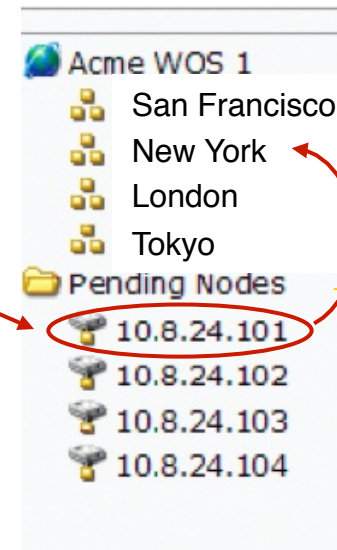


WOS Deployment & Provisioning

Start Small, Build-Out Seamlessly

WOS building blocks are easy to deploy & provision – in 10 minutes or less

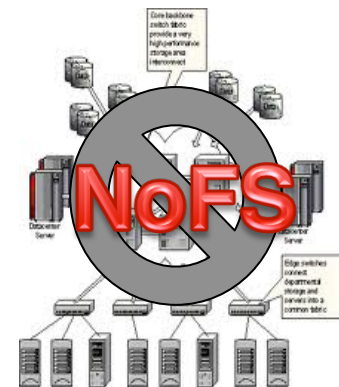
- » Provide power & network for the WOS Node
- » Assign IP address to WOS Node
- » Go to WOS Admin UI. WOS Node appears in “Pending Nodes” List for that cluster
- » Drag & Drop the node into the desired zone
- » Assign replication policy (if needed)



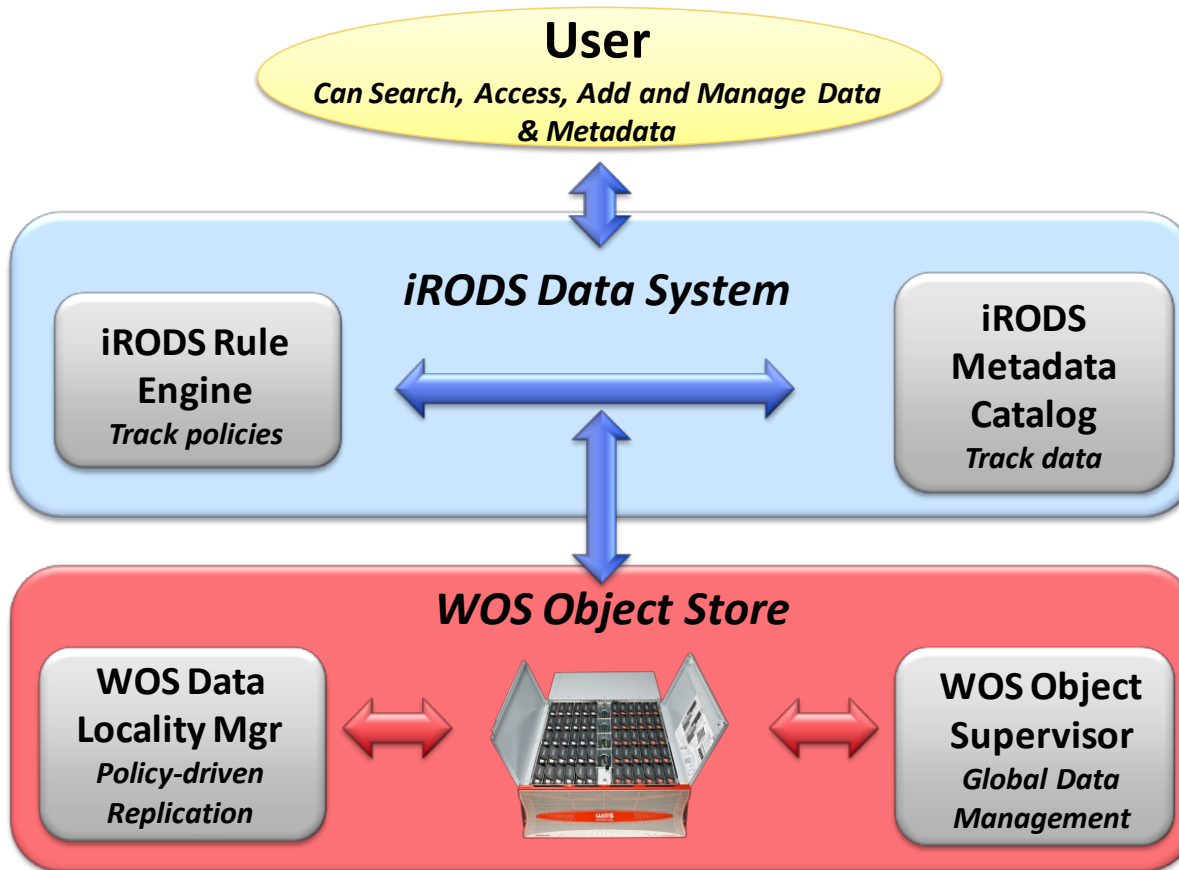
Simply drag new nodes to any zone to extend storage

Policies		
Policy Name (ID)	Zone Replication	
Policy Name: UnitedStates	Zone	Replica Count
Create Policy	San Francisco	1
Cancel	New York	1
	London	0
	Tokyo	0

Congratulations! You have just added 180TB to your WOS cluster with NO impact on operations



Summary WOS & iRODS



WOS – iRODS Integration

- **Petabyte scalability:** Scale out by simply adding storage modules
- **Unrivaed Simplicity:** Management simplicity translates directly to lower cost of ownership
- **Self-Healing:** Zero intervention required for failures, automatically recovers from lost drives
- **Rapid Rebuilds:** Fully recover from lost drives in moments
- **Replication Ready:** Ingest & distribute data globally
- **Disaster Recoverable:** For uninterrupted transactions no matter what type of disaster occurs
- **File Layout:** Capacity and performance optimized
- **Object Metadata:** User-defined metadata makes files smarter

WOS + iRODS: the Division of Labor

Discrete WOS Zones

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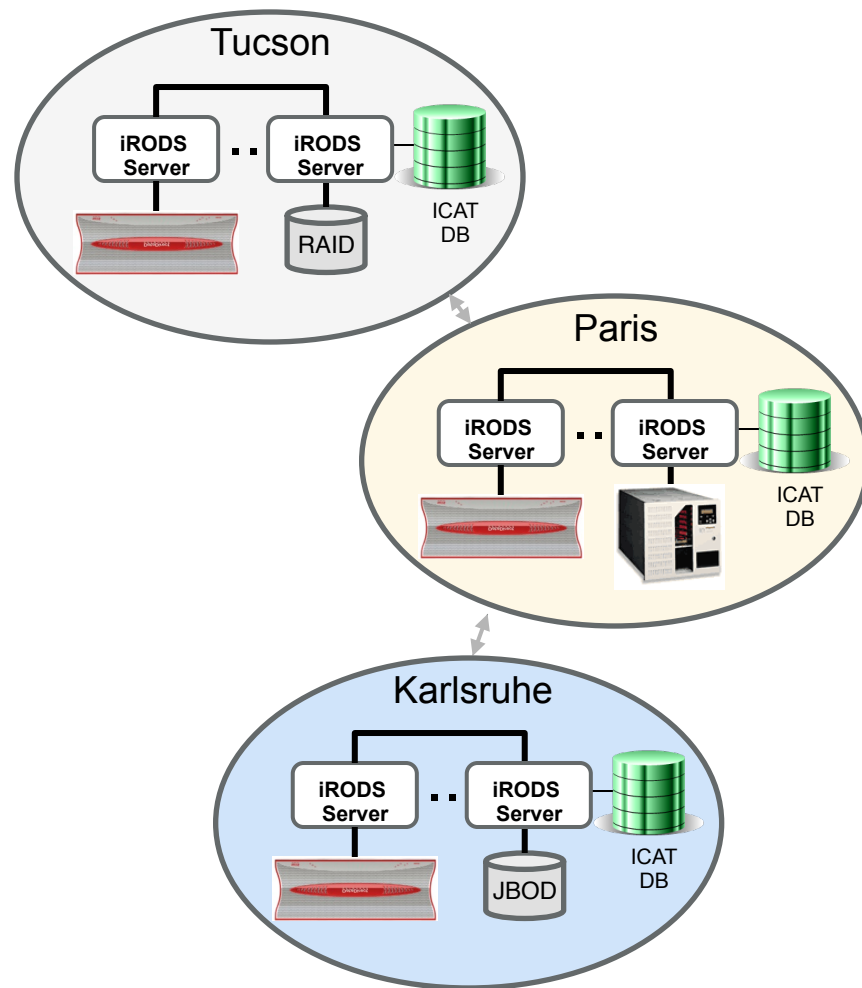
WOS + iRODS – TCO, Performance & Lifecycle Management

- WOS delivers lowest TCO & highest data availability, integrity & protection
- iRODS supplies federation & lifecycle management

Deployment Benefits

- Complete Local control over storage resources
- Plays well with existing storage environment
- Optimizes performance, availability, & data placement flexibility
- Simple Lego™ build out
- Available today

iRODS Zones



WOS + iRODS: the Division of Labor

Clustered WOS Nodes

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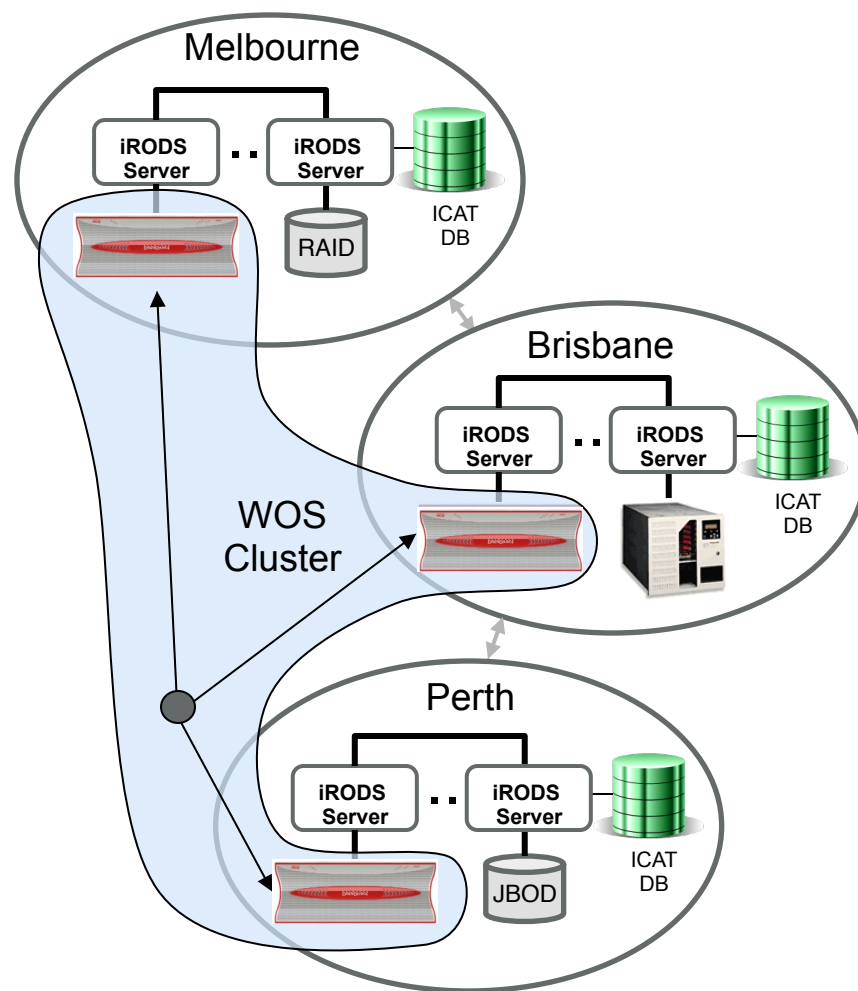
Clustered WOS + iRODS

- WOS operates as distributed clustered storage resource for iRODS
- iRODS utilizes WOS data location intelligence

Additional Deployment Benefits

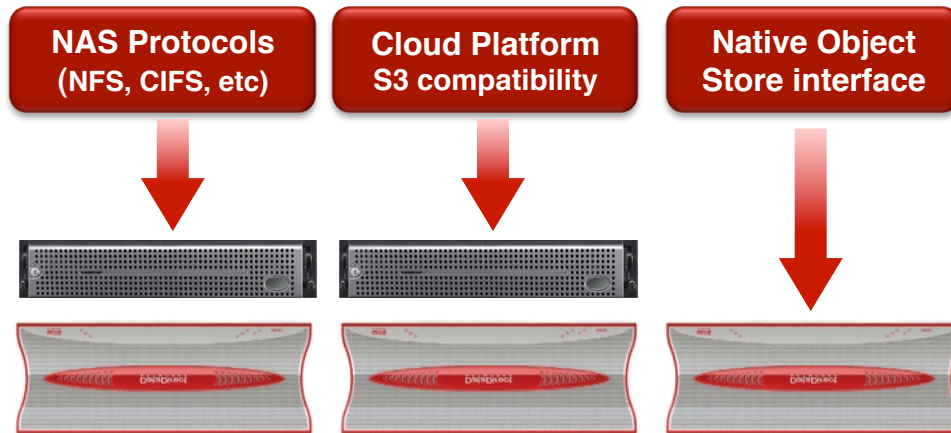
- Site specific policy definition - Sites still maintain total location & QOS control over their data
- Maximizes performance – local users always access local iRODS data
- Improved storage utilization
- Single pane of glass management
- Automatic data protection + DR for free
- Self healing & fast rebuilds

iRODS Zones



WOS Accessibility

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WOS Access Gateway

- NFS protocol
- Access Controls
- Scalable to multiple gateways across multiple sites
- HA & DR Protected

Cloud Store Platform

- S3-Compatible & WebDAV APIs
- Multi-tenancy
- Reporting & Billing
- Remote storage, file sharing, and backup agents

Native Object Store

- C++, Python, Java, PHP, HTTP REST interfaces
- PUT, GET, DELETE object, RESERVE ObjectID, etc

• WOS Access NFS Gateway

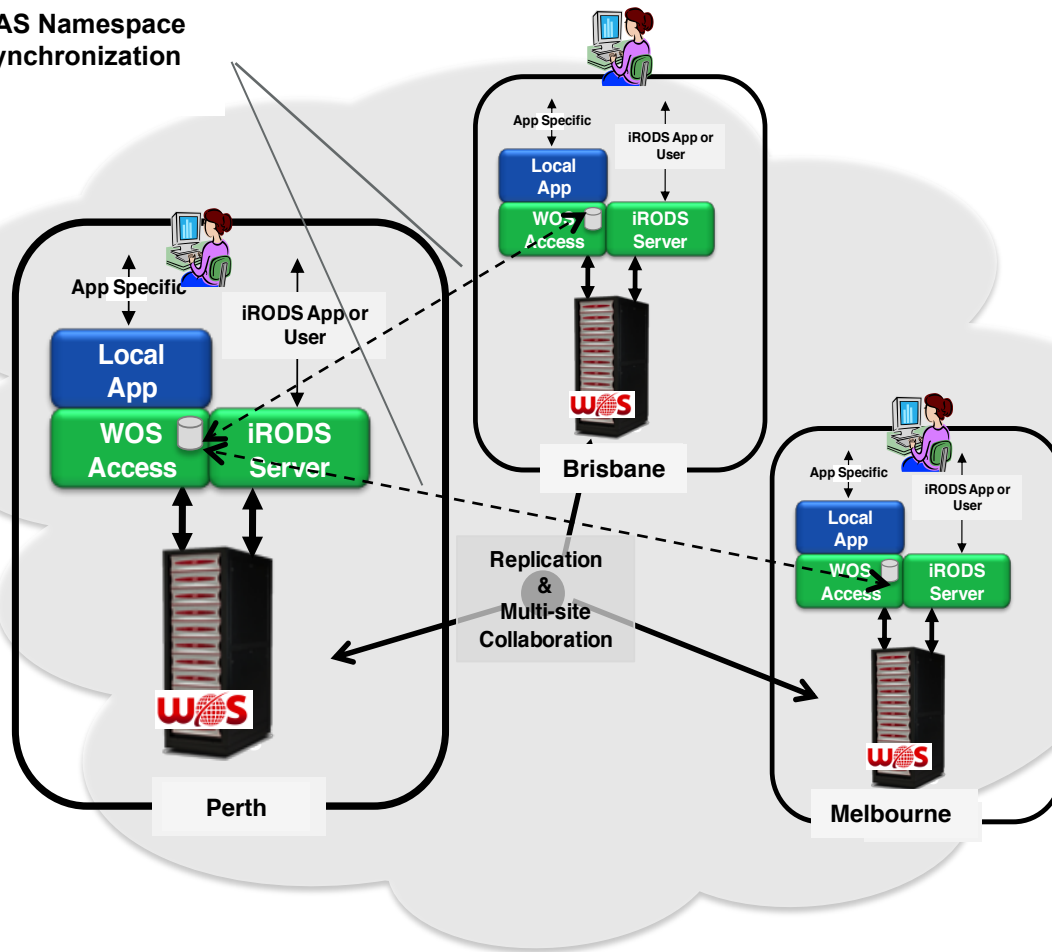
- Scalable to multiple gateways
- DR protected & HA Failover
- Synchronized database across remote sites
- Local read & write cache
- LAN or WAN access to WOS

• WOS Cloud

- Targeted at cloud service providers or private clouds
- Enables S3-enabled apps to use WOS storage at a fraction of the price
- Supports full multi-tenancy, bill-back, and per-tenant reporting

Shared Storage Environment

NAS Namespace
Synchronization



WOS iRODS, Cloud & NAS Compatibility

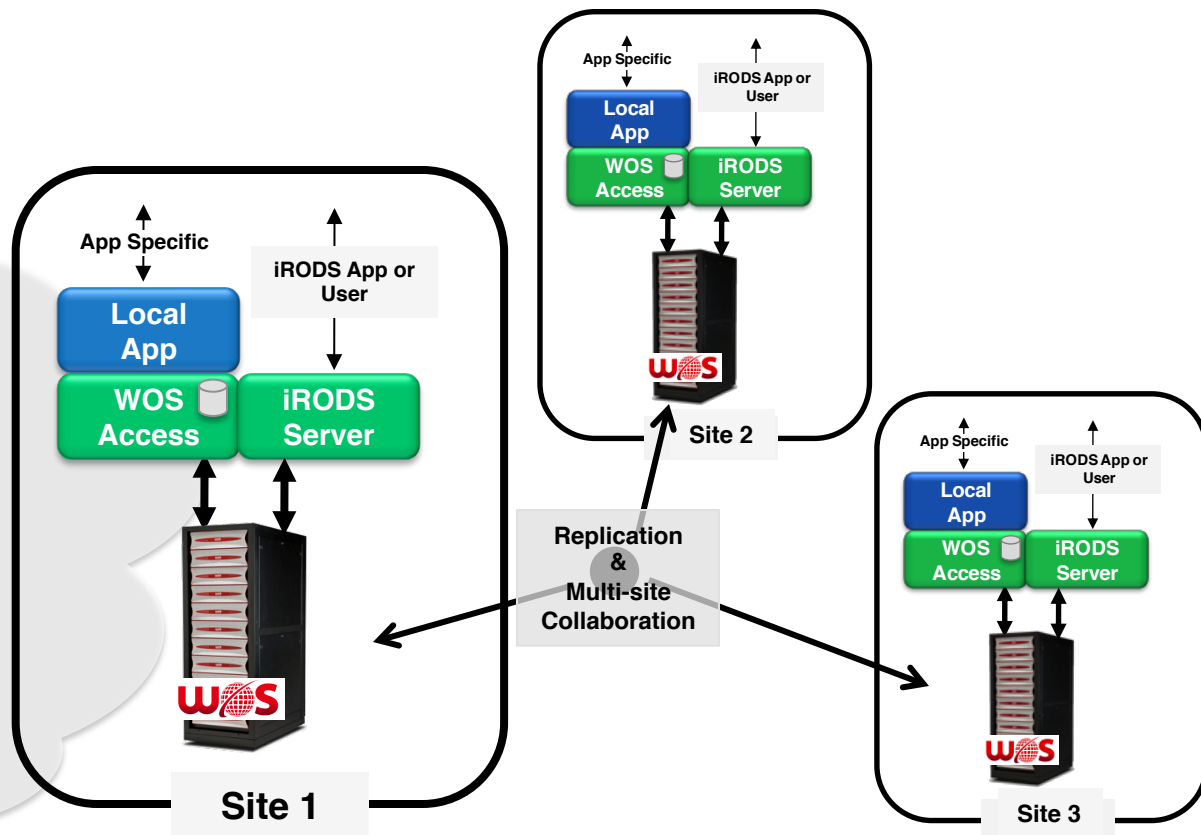
- Enables iRODS, internal POSIX & Cloud applications to co-exist
- iRODS users can share data ingested with NAS or native WOS API applications
- S3/SaaS applications provide access directly to internet users
- Data could potentially be shared with other applications

Thank You

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INFORMATION IN MOTION[™]

WOS NASCloud Gateway

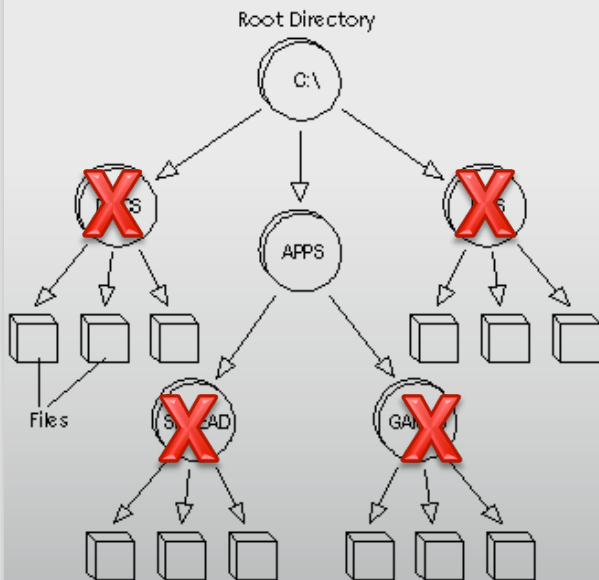
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Where file systems fail

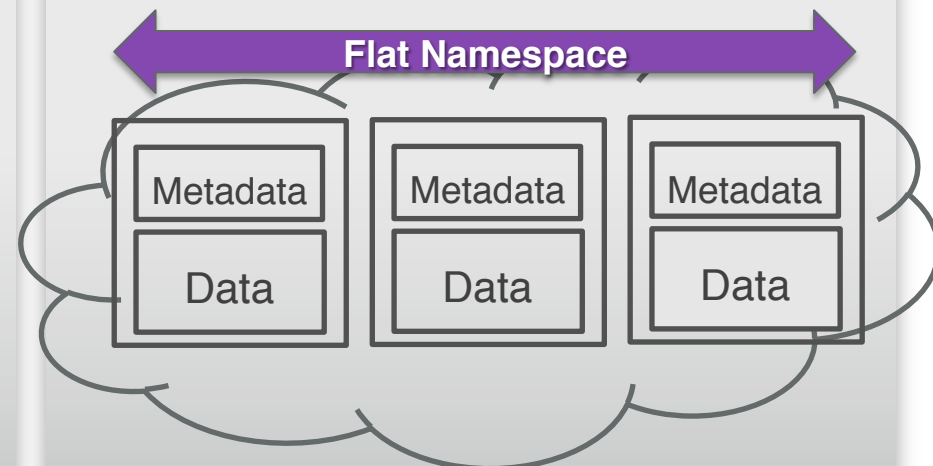
- » Object storage stores data into containers, called objects
- » Each object has both data and user defined and system defined metadata (a set of attributes describing the object)

File Systems



File Systems were designed to run individual computers, then limited shared concurrent access, not to store billions of files globally

Objects



Objects are stored in an infinitely large flat address space that can contain billions of files without file system complexity