

# **Building a Scalable Data Grid for Collaborative Research**

**David Martin**  
**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

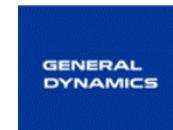


Best HPC Storage Product



Best Practice for Digital Media

## World Class Set of Global Customers

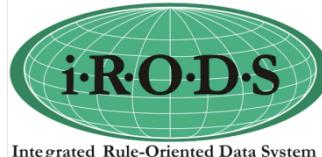
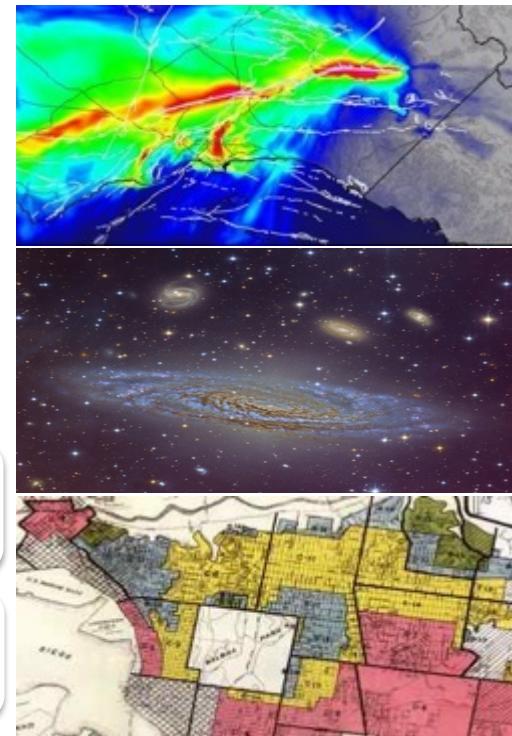


# IRODS Data Grid & WOS Made for Big Data

DataDirect  
NETWORKS



- Hyperscale
- Distributed
- Collaborative
- Accessible
- Secure
- Flexible



= Managed Collaboration

# Building a World-Class Data Grid

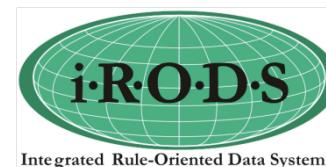
DDN is partnering with DICE & RENCI to create a hardened, performance optimized iRODS/WOS distributed, collaborative data grid



+



+



# 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?

## Much Richer Metadata Capabilities

- » Metadata contained in object, not separate DB

## Separation of “Data” and “View”

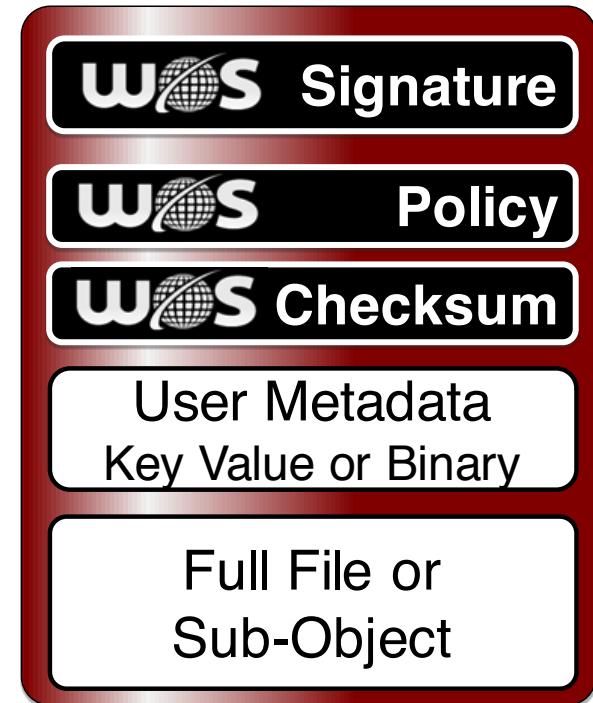
- » View manages who sees what
- » Data deals with physical storage locations

## 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

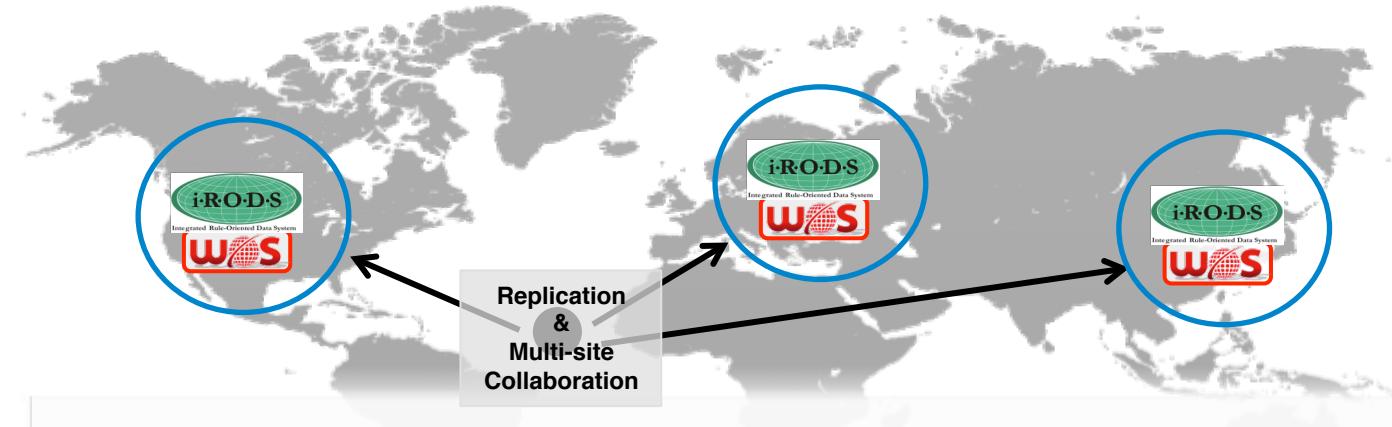
## Simplicity reduces management effort & costs

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



# Introducing: DDN Web Object Scaler

- 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

**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



## Performance Efficiency:

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

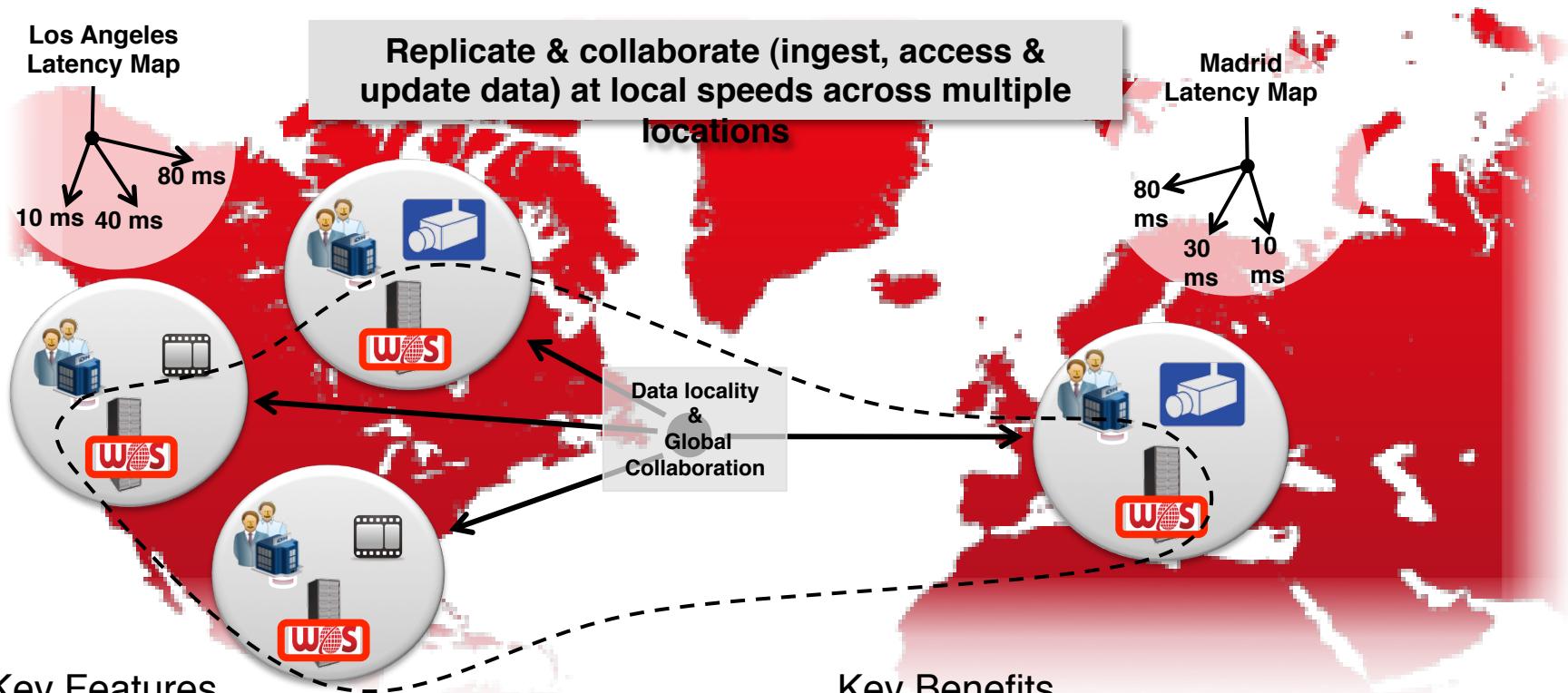
## Management Efficiency:

- 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 simplifies management and extends reach
- » Policy-driven automation minimizes manual intervention and disaster recovery complexity
- » iOSS handles most media from disk failure

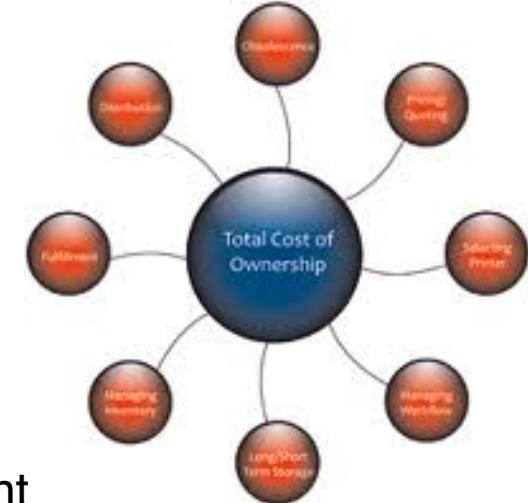
**Muti-petabyte WOS deployments  
require less than 1 FTE to manage**

Eliminates operational complexity with expected graceful degradations



# 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

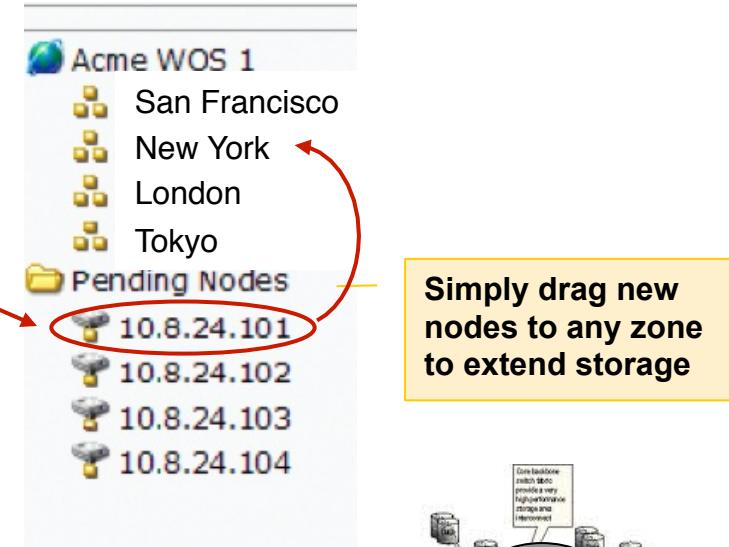


# WOS Deployment & Provisioning

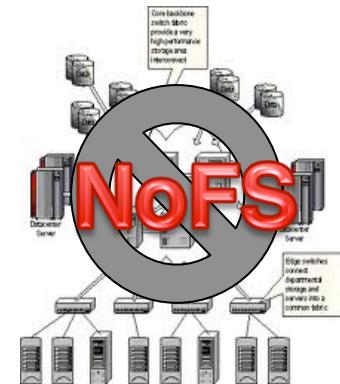
## Start Small, Build-Out Seamlessly

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)

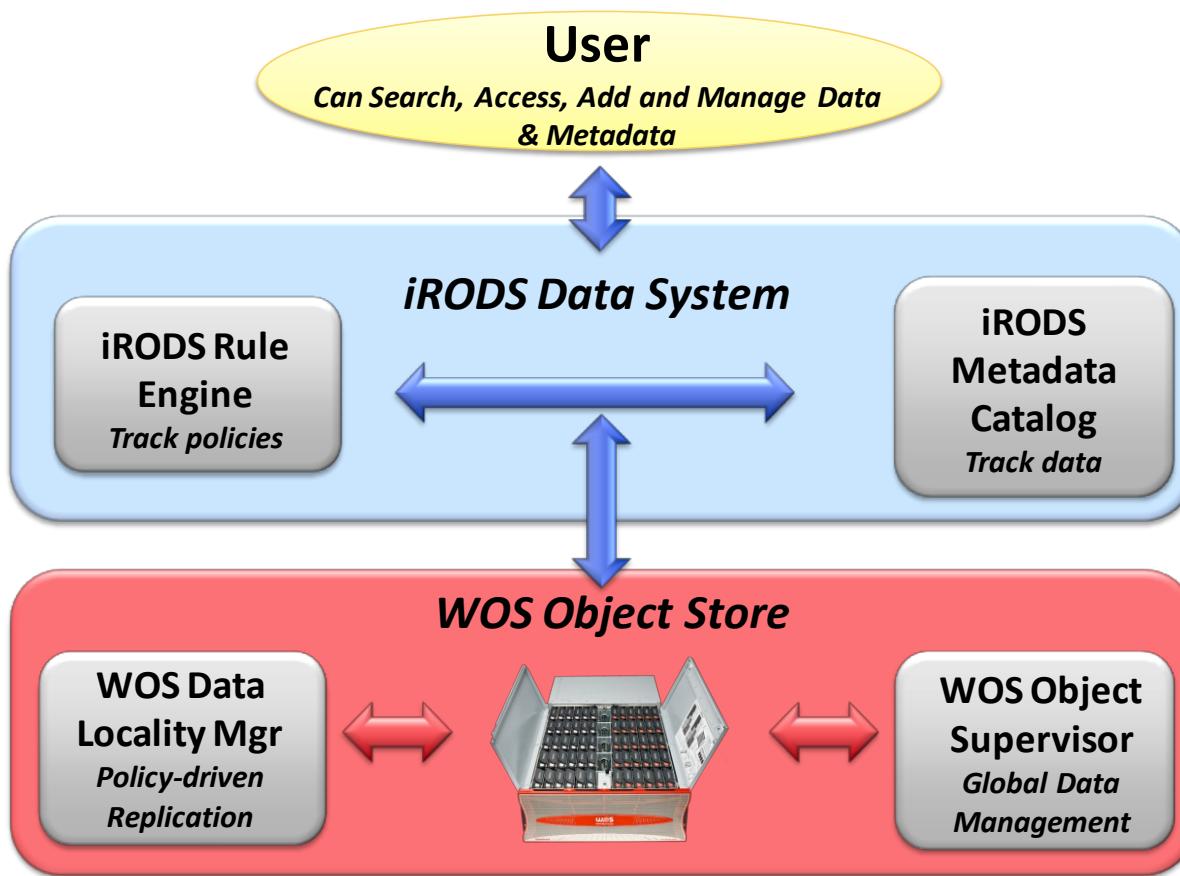


Congratulations! You have just added 180TB to your WOS cluster with NO impact on operations



# Summary WOS & iRODS

DataDirect  
NETWORKS™



## WOS – iRODS Integration

- **Petabyte scalability:** Scale out by simply adding storage modules
- **Unrivaled 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

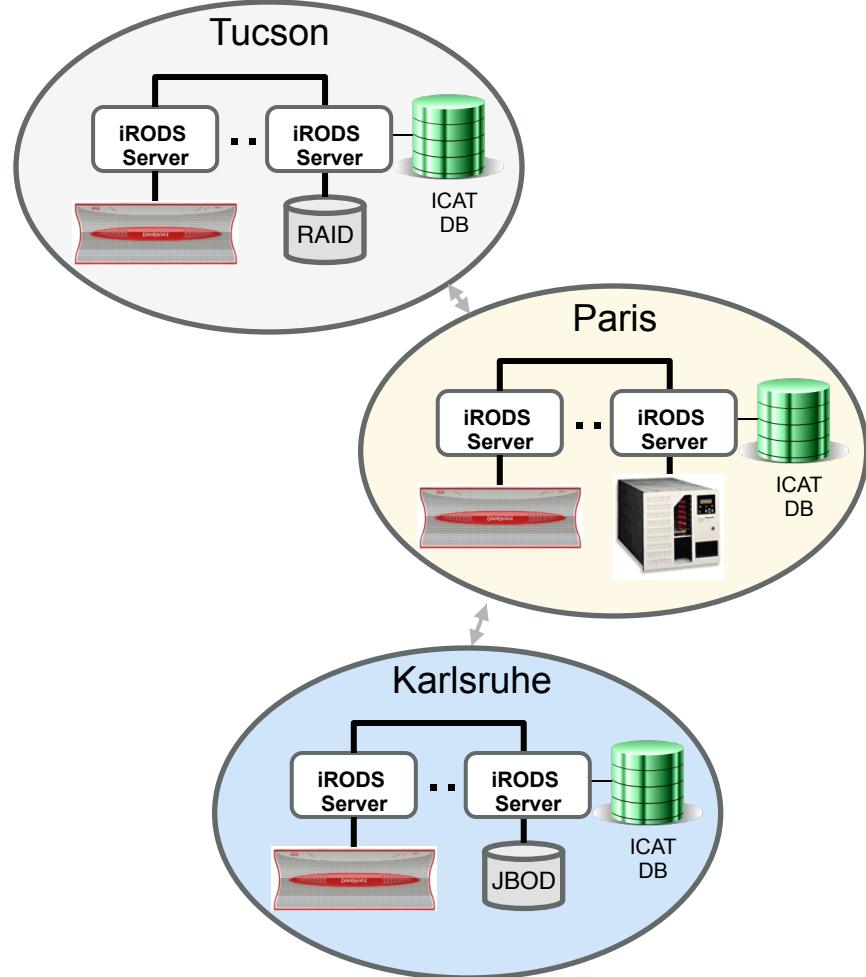
### WOS + iRODS – TCO, Performance & Lifecycle Management

- 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



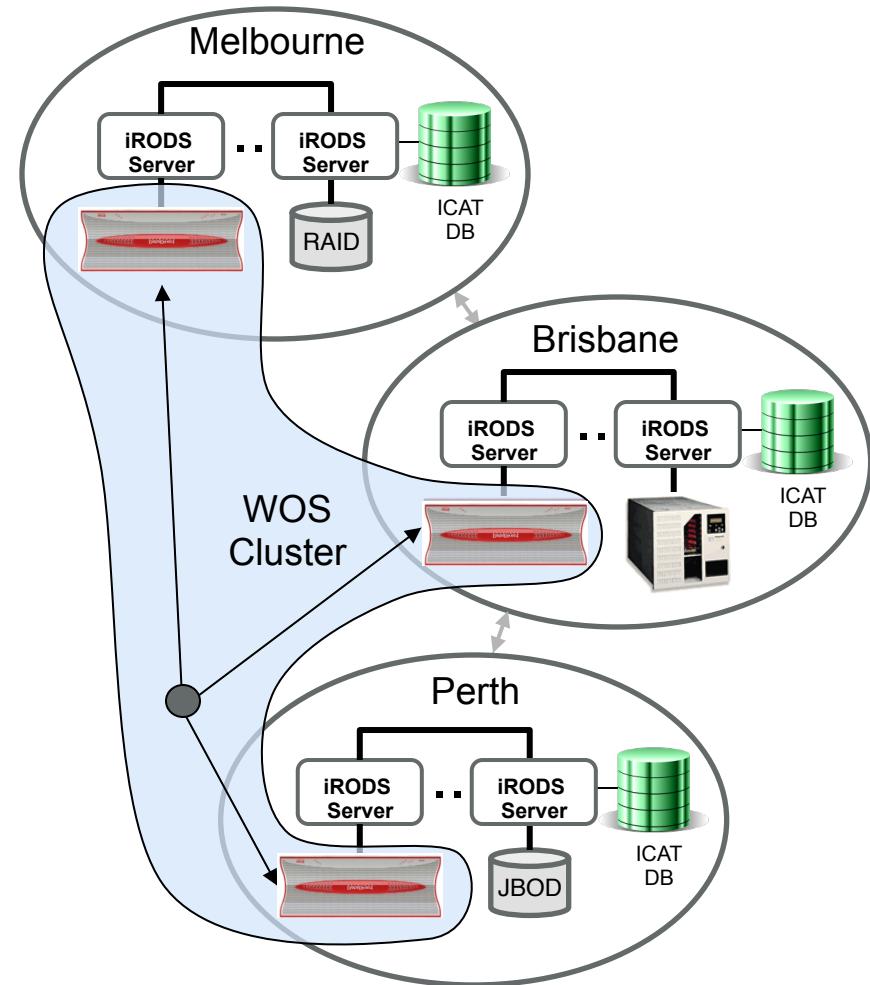
## Clustered WOS + iRODS

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

## Additional Deployment Benefits

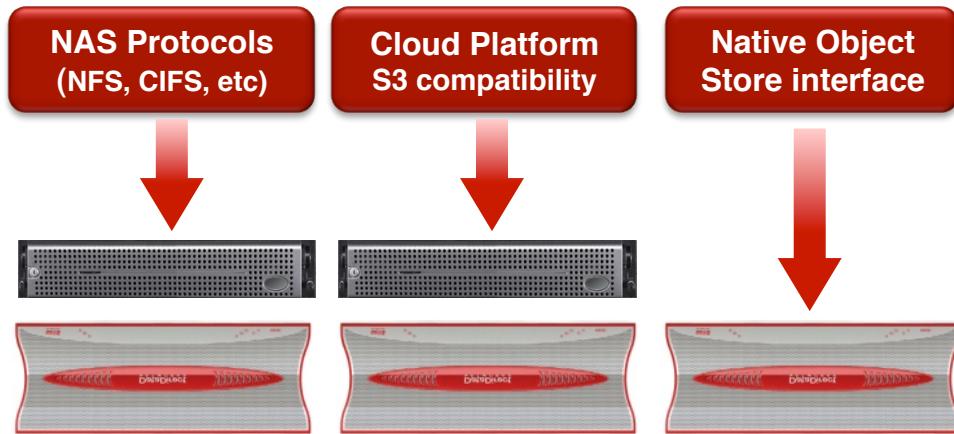
- Site specific policy definition -Sites still maintain total location & QOS control over their data
- Maximizes performance – local users always access local iRODS data
- Improved storage utilization
- Single pane of glass management
- Automatic data protection + DR for free
- Self healing & fast rebuilds

## iRODS Zones



# WOS Accessibility

DataDirect  
NETWORKS



## 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

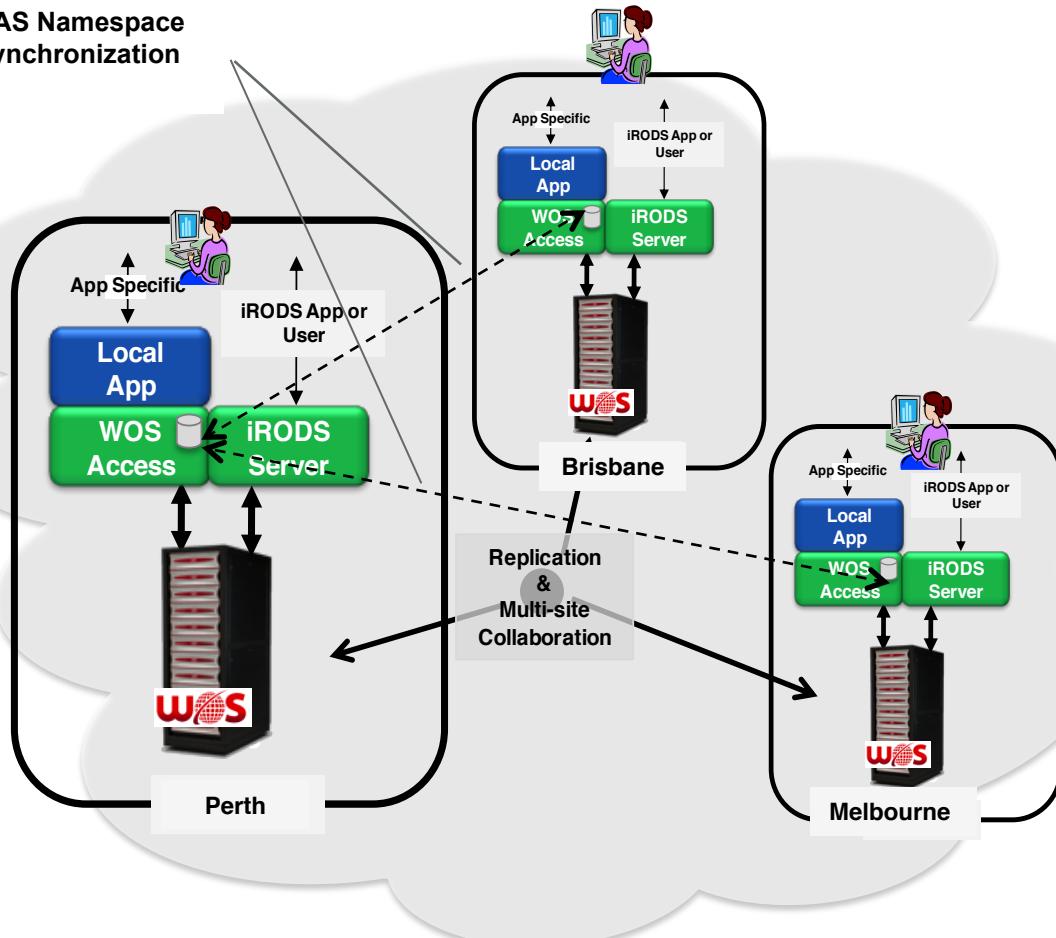
## • WOS Cloud

- 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

DataDirect  
NETWORKS

NAS Namespace  
Synchronization

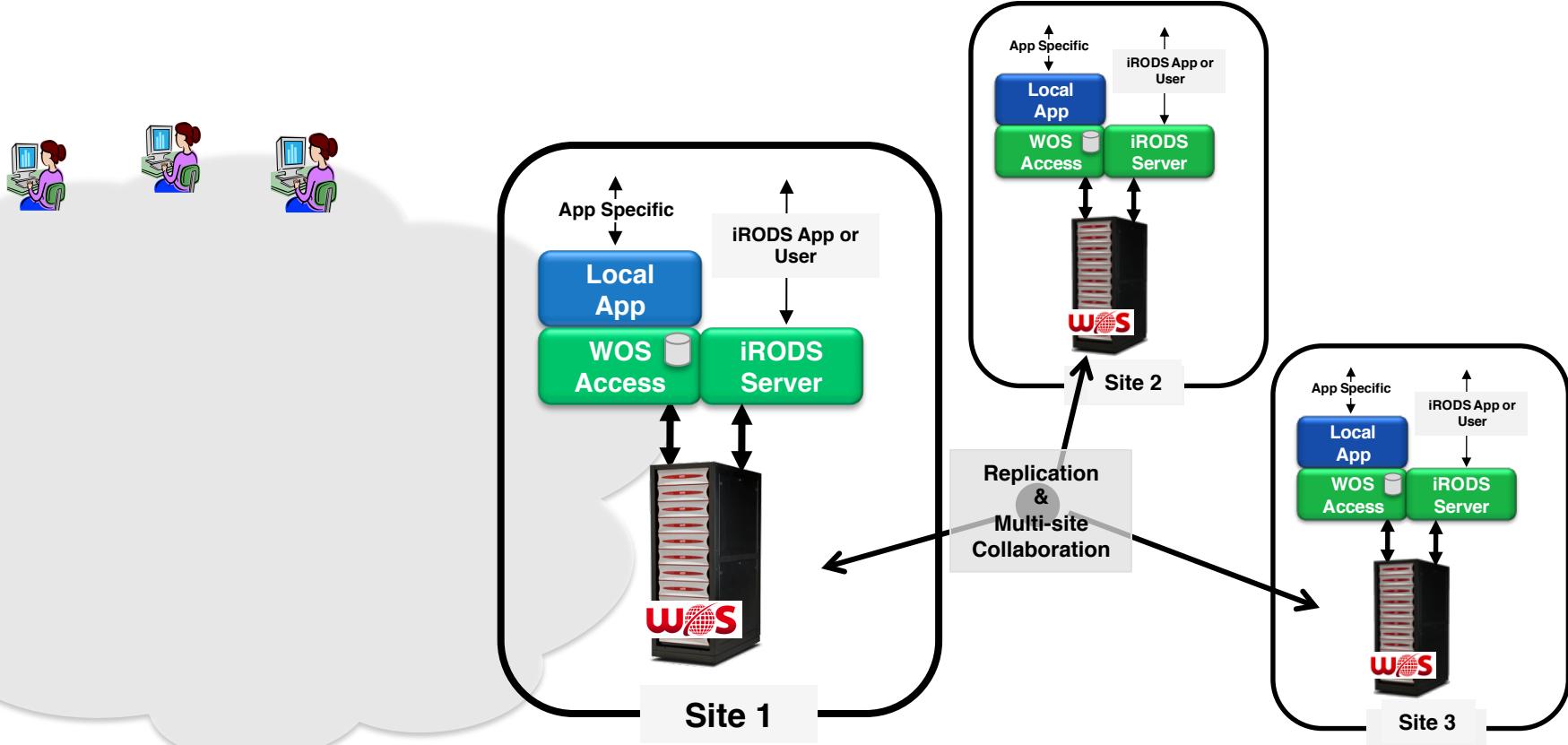


## WOS iRODS, Cloud & NAS Compatibility

- 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

# WOS NASCloud Gateway

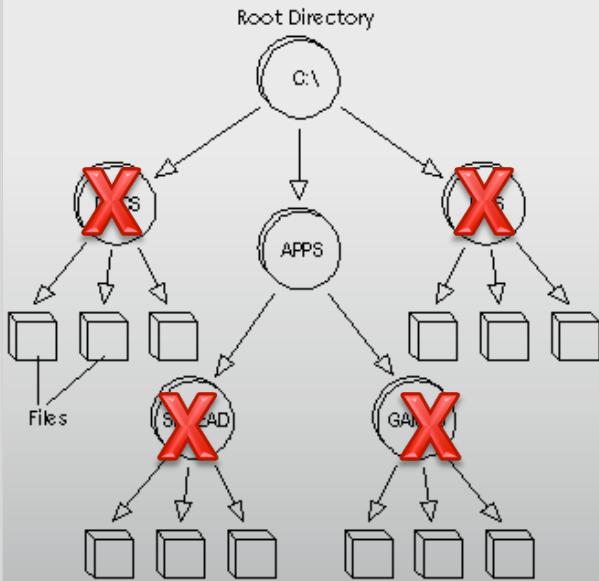


# Where file systems fail

DataDirect  
NETWORKS

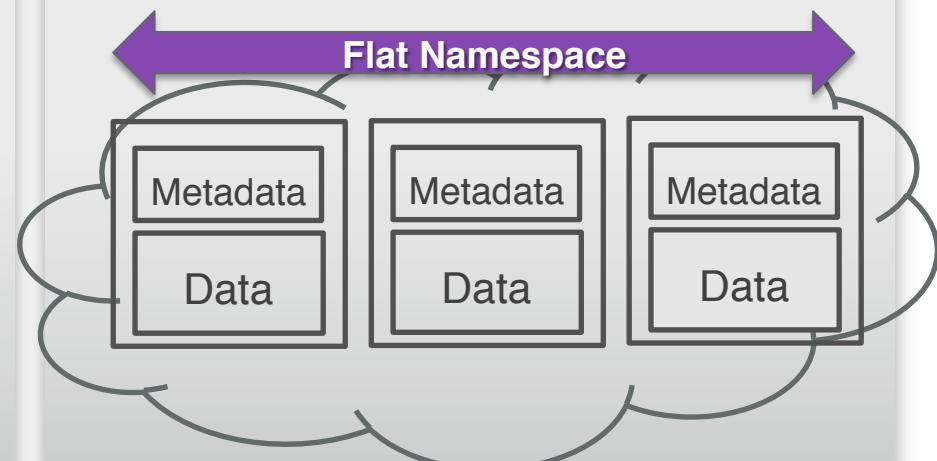
- » Object storage stores data into containers, called objects
- » Each object has both data and user defined and system defined metadata (a set of attributes describing the object)

## 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