DataDirect™
N E T W O R K S
I N F O R M A T I O N   I N   M O T I O N ™

ECMWF HPC Workshop:
Accelerating Data Management

Massively-Scalable Platforms and Solutions
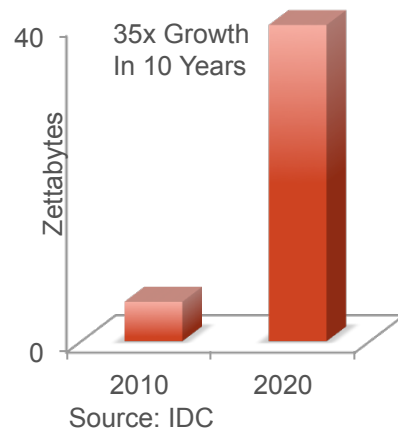Engineered for the Big Data and Cloud Era

Glenn Wright

Systems Architect, DDN

Data-Driven Paradigm Shift

![DataDirect NETWORKS — INFORMATION IN MOTION]

Massive Data
Growth

40
Zettabytes
0

35x Growth
In 10 Years

2010   2020

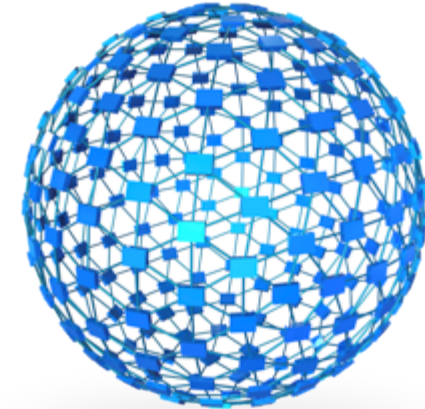Source: IDC

Storing over
100PB of
content[1]

33x Sensor
Data Growth Over
Just Two Years[2]

Cloud & Web
Ubiquity

**Information, Today's
Global Currency, is Shared &
Distributed Globally via Cloud**

Big Data
Processing

Gartner

*"Information managers
must fundamentally
rethink their approach
to data."*

[1] Facebook: 2012 Form S-1 Registration Statement   [2] Defense Industry Daily: Too Much Information

ddn.com

DDN Big Data Leadership | Validated

DataDirect
NETWORKS
INFORMATION IN MOTION™

> " *If any company is well poised to take on the challenges of EXAScale computing and big data, it's DDN, since this is its heritage.* "

the (451) group

February 2012

> " Strategic Big Data HW Supplier "
> DDN Ranks #2 in 2012 CIO Survey

#1 = IBM | #2 = DDN | #3 = EMC | #4+ = NTAP, FIO, Dell

24% of Respondents Identify **DDN** as Their **Top** Choice for Big Data

PACIFICCREST
The Technology Authority

June 2012

ddn.com

DDN | Designed for Big Data & Cloud

Massively Scalable Storage Technology

HyperScale, High Performance Platform

► DDN's Massively Scalable SFA™:S/W Engine on Enhanced H/W Platforms
► Over 1TB/s In Only 25 Systems, Millions of IOPS

Cloud Storage & Computing Infrastructure

Peer to Peer Cloud Infrastructure

► DDN's WOS™ Cloud-Based Data Delivery
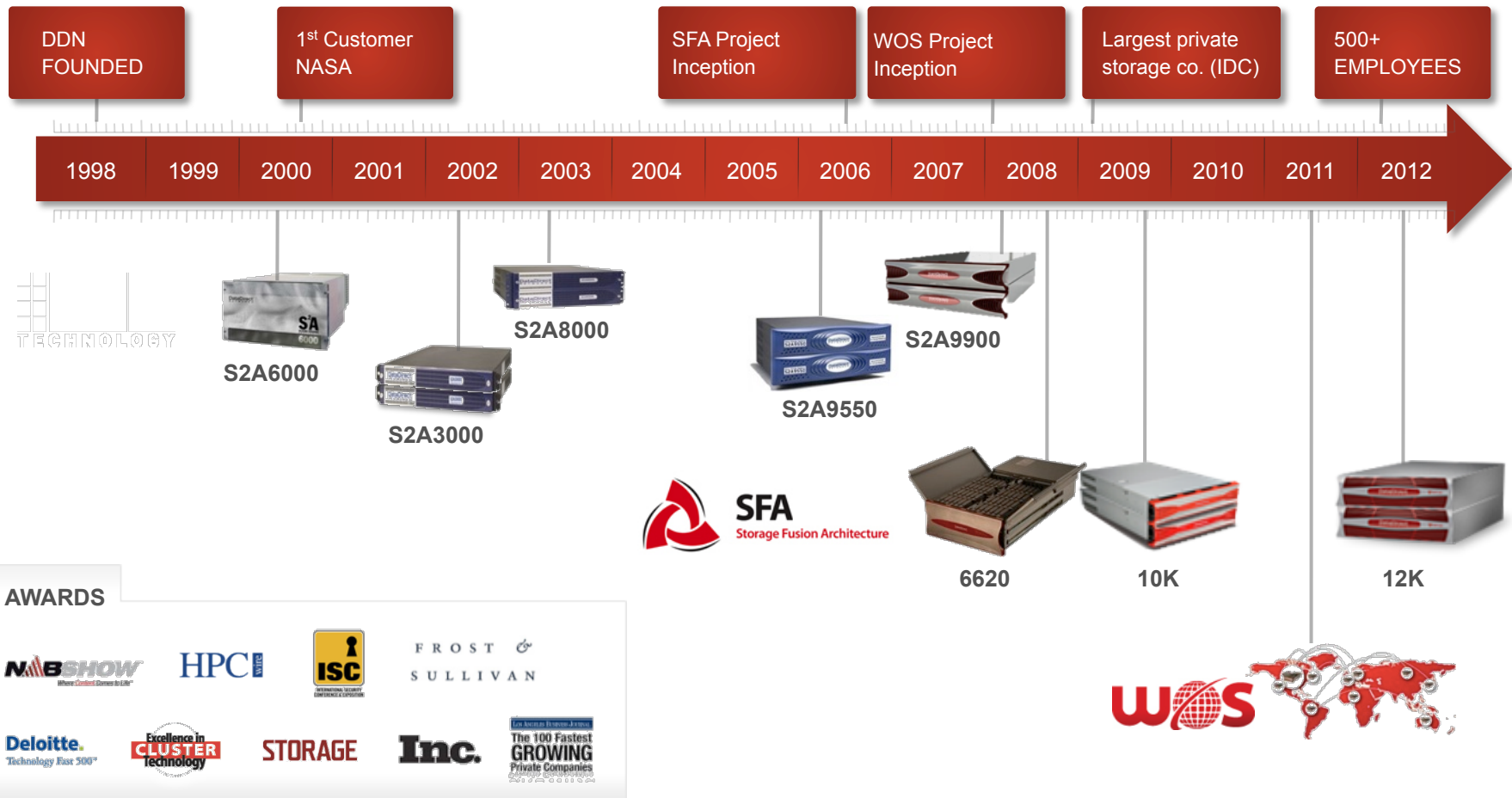► 55 Billion Objects Per Day, 100+ Locations

Big Data Processing for Actionable Insight

Big Data Processing System

► DDN's SFA In-Storage Processing™
► Nanosecond Latency, 16 Virtual Machines

DDN | A Decade+ Investment In Scale

DataDirect™
NETWORKS
INFORMATION IN MOTION™

| DDN FOUNDED | 1st Customer NASA | SFA Project Inception | WOS Project Inception | Largest private storage co. (IDC) | 500+ EMPLOYEES |

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012

S2A6000

S2A3000

S2A8000

S2A9550

S2A9900

SFA
Storage Fusion Architecture

6620

10K

12K

WOS

AWARDS

NABSHOW
HPCwire
ISC
FROST & SULLIVAN
Deloitte. Technology Fast 500™
Excellence in CLUSTER Technology
STORAGE
Inc.
The 100 Fastest GROWING Private Companies

The Broadest Big Data Portfolio

DataDirect™
N E T W O R K S
INFORMATION IN MOTION™
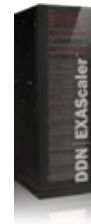
File Storage

Object Storage

SAN File Storage

xSTREAMScaler™
100s SAN/LAN Clients
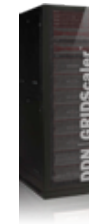HSM Capable
Streaming Optimized

Enterprise NAS

NAS Scaler™
1-16 NAS Servers
Fully-Featured
High Performance

Parallel File Storage

EXAScaler™
10Ks of Clients
1TB/s+

GRIDScaler™
1Ks of Clients
1TB/s+
Scale-Out NAS

Storage Engines

Silicon Storage Architecture

9900

6GB/s in Real-Time
1,200 Drives: 2 Racks

Storage Fusion Architecture

6620

2GB/s, 350K IOPS
120 Drives in 8U

10K

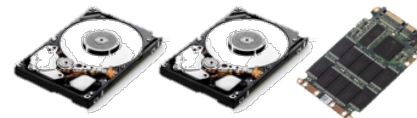15GB/s, 1.2M IOPS
1,200 Drives: 2 Racks
Embedded Computing

12K

40GB/s/1.7M IOPS
1,680 Drives: 2 Racks
Embedded Computing

WOS®
256 Billion Objects
GeoReplicated
Cloud Foundation
Mobile Cloud Access

Platforms Support Any Drive Technology
to Optimize Data Intense Workflows

SAS   SATA   SSD

ddn.com

DDN | Storage Fusion Architecture (SFA)

DataDirect™
N E T W O R K S
INFORMATION IN MOTION™

Accelerating Big Data and Cloud, Optimizing TCO

Over 1 Million Lines of S/W Code – First Customer Shipped 2008
Designed Specifically for Big Data and Cloud Workloads

DirectMon™: Infrastructure Management

'Scaler File System Family

In-Storage Processing™ Engine & DMA Driver

Storage Fusion Architecture™
[Core Storage S/W Engine]

Low-Latency Connect: FC, IB, Memory

Interrupt-Free Storage Processing

ReACT™ Adaptive Cache Technology

DirectProtect™ Data Integrity Management

Quality of Service Engine

Storage Fusion Fabric™

Parallel State-Machine Design
Maximum Performance, Lowest Latency

Virtualized Processing
Optimized Environment for Big Data Application Hosting
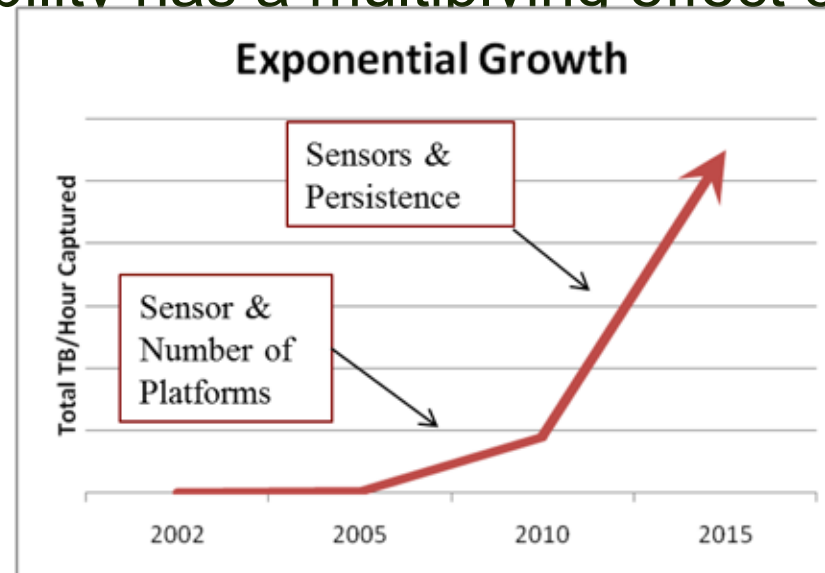
Robust Data Protection
Quality of Service and Performance Without Compromise

Flexible & Massively Scalable
Best-In-Class Scalability and Density

Data Sensors: The Challenge

- Increasing amount of data captured per hour by the next generation sensors.

- Increasing number of multi-sensor, ISR platforms being developed and deployed.

- Increasing linger capability has a multiplying effect on the amount of data

Exponential Growth

Sensors & Persistence

Sensor & Number of Platforms

Total TB/Hour Captured

2002   2005   2010   2015
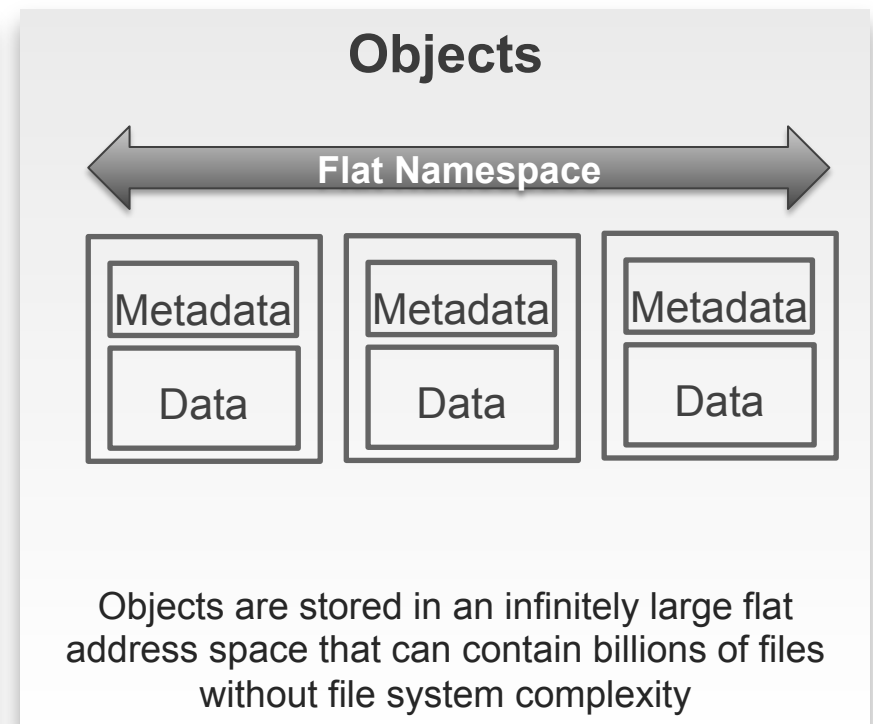
Conventional Storage

Well understood, but stretched to its limits for unstructured data cloud storage

- Introduced in the 90's
  - With 16TB file system sizes that many still have

- Management intensive
  - LUNs, Volumes, Aggregates,...
  - Heroically management intensive at scale

- Antiquated resiliency techniques that don't scale
  - RAID
  - Cluster failover, "standby" replication, backup
  - File Allocation Tables, Extent Lists

- Inefficient usable space utilization

- Focused on structured data transactions (IOPS)
  - File locking overhead adds cost and complexity

- Prohibitively expensive at cloud scale
  - To purchase, run, manage, protect and expand

     ddn.com

Object Storage | Explained

- 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

Traversals
Extent Lists
File Allocations

File systems were not designed to store billions of files on a global scale

Objects

Flat Namespace

Metadata	Metadata	Metadata
Data	Data	Data

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

DDN | WOS®
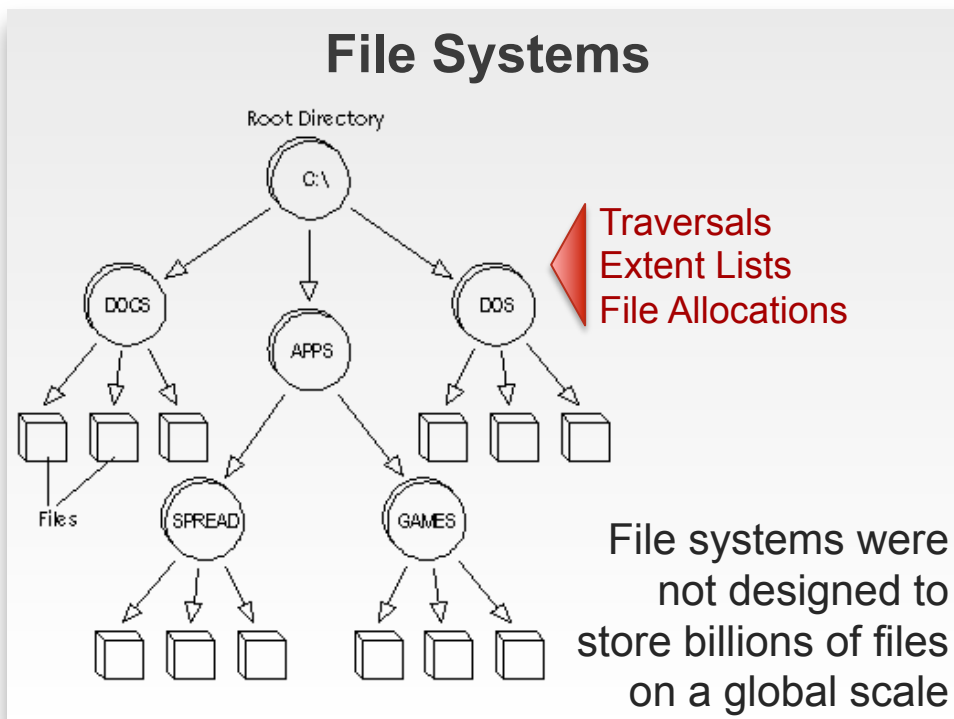
Enabling Real-Time Global Collaboration

Web-Scale, High-Performance Cloud Storage Appliances
99% Efficiency, Petabyte-Class Peer:Peer Technology

Connectors

WOS API HTTP, C++, Java	Android & iOS Client	API: S3 Client
	WOS NAS Access	Desktop Client
	WOS Cloud™ Multi-Tenancy	

WOS Cluster Management

WOS Core
[Peer:Peer Object Storage]

- Latency-Aware Access Manager
- Self-Healing Object Storage Clustering
- WOS Policy Engine
- Replication Engine | ObjectAssure™ Erasure Coding
- De-clustered Data Management
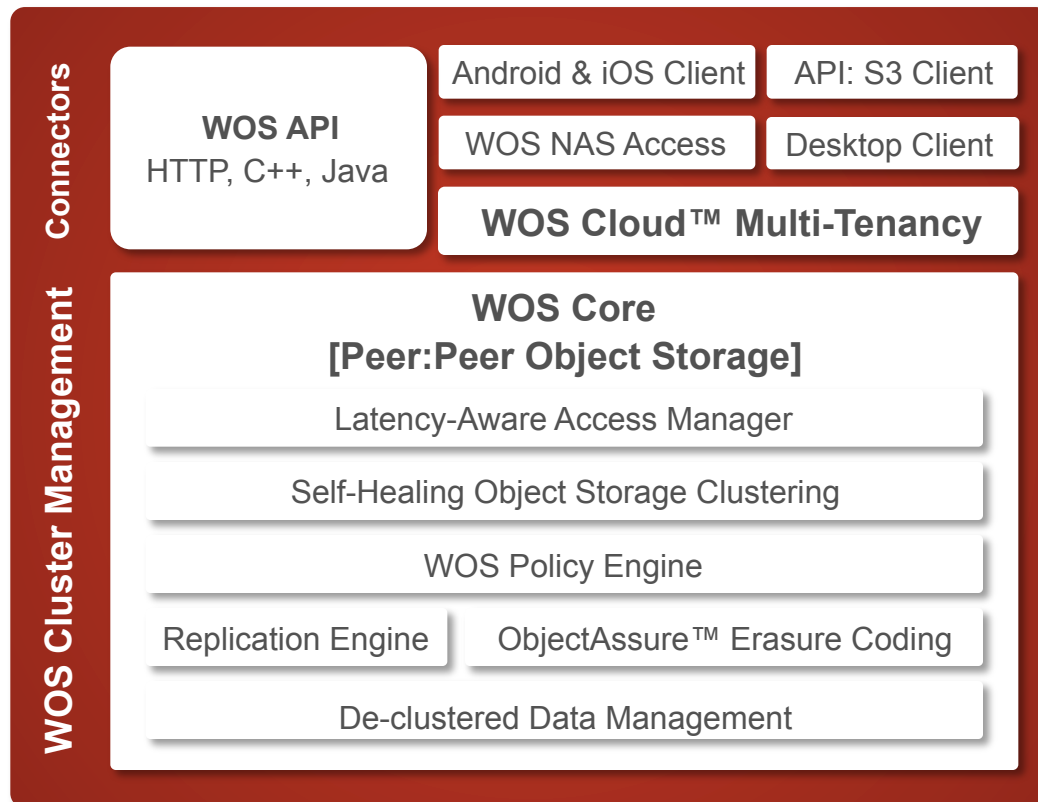
Limitless Scalability
Eliminates the limitations of traditional file systems
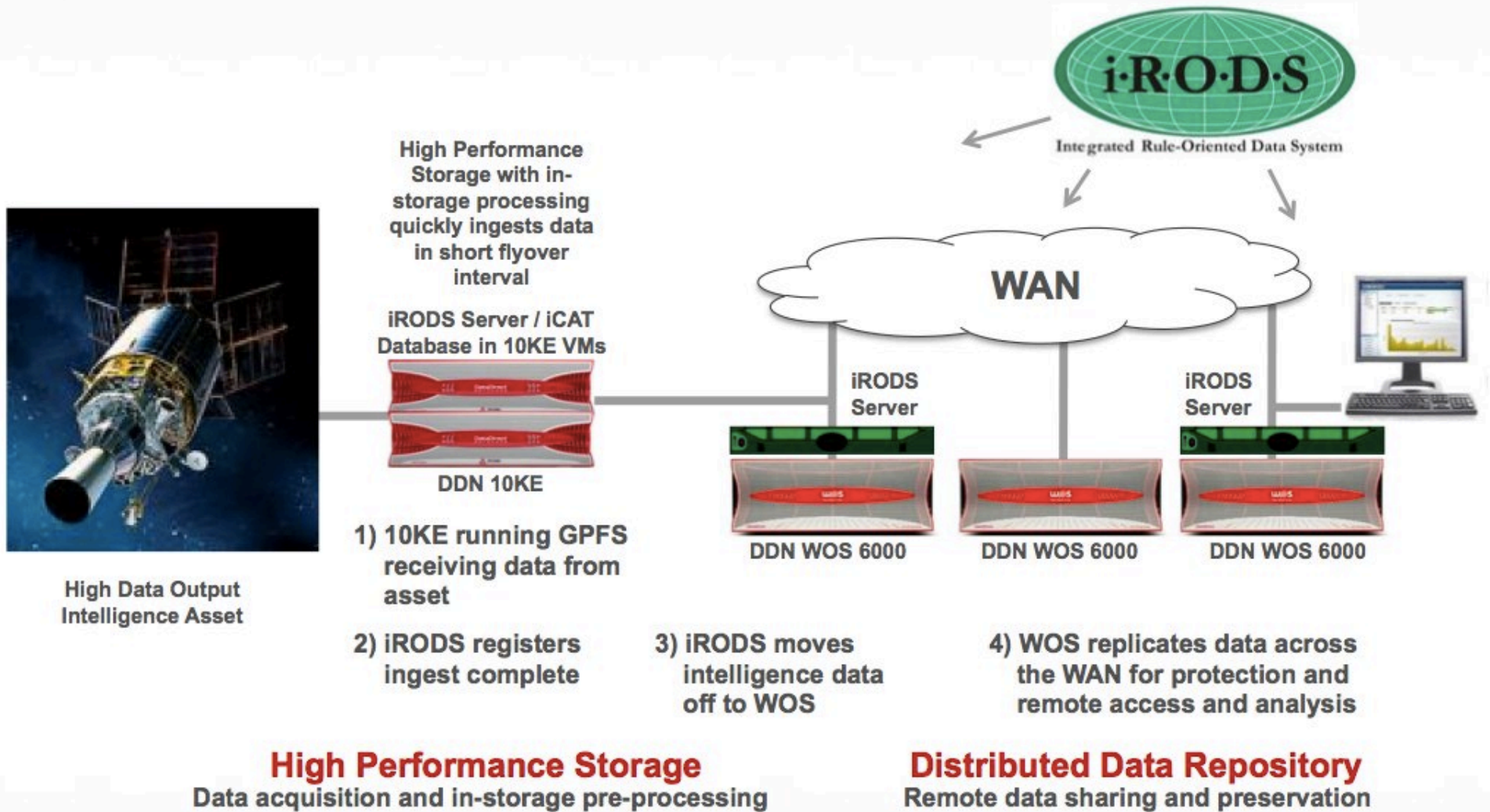
Store Objects Intelligently
User-Defined Metadata allows customers to understand their data

Global, Peer:Peer
Distribute data across 100s of sites in one namespace

Self-Healing
Intelligent Data Management system recovers from failures rapidly and autonomously

ddn.com

DDN | iRODS

i·R·O·D·S
Integrated Rule-Oriented Data System

WAN

High Performance Storage with in-storage processing quickly ingests data in short flyover interval

iRODS Server / iCAT Database in 10KE VMs

DDN 10KE

iRODS Server

iRODS Server

DDN WOS 6000

DDN WOS 6000

DDN WOS 6000

High Data Output Intelligence Asset

1) 10KE running GPFS receiving data from asset

2) iRODS registers ingest complete

3) iRODS moves intelligence data off to WOS

4) WOS replicates data across the WAN for protection and remote access and analysis

High Performance Storage
Data acquisition and in-storage pre-processing

Distributed Data Repository
Remote data sharing and preservation

DDN | The "Big" In Big Data

DataDirect™ NETWORKS
INFORMATION IN MOTION™

98%
Fortune 500

▶ Customers of Online File Service

▶ PBs of Cloud Storage

yousendit™

768
Thousand

▶ # of Supercomputer CPUs

▶ 35PB Storage Processing System

Argonne NATIONAL LABORATORY

23
Million

▶ Broadcast Viewers

▶ 9PB of Real-Time Play-To-Air Systems

MEDIASET

> *If any company is well poised to take on the challenges of exascale computing and big data, it's DDN, since this is its heritage.*
>
> **451 Group**

DataDirect™
N E T W O R K S
I N F O R M A T I O N   I N   M O T I O N ™

Accelerated Data !

Massively-Scalable Platforms and Solutions
Engineered for the Big Data and Cloud Era

Thank You

---

ddn.com