NFS INDUSTRY CONFERENCE

Global Storage Architecture

Scalable NFS service using off the shelf components

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Global Storage Architecture

Background

GSA Objectives

- Replace legacy file systems infrastructure
  - AFS/DFS
  - OS/2 and Windows
  - Standalone NFS/NAS
- Support varied user population
  - Hardware design
  - Software development
  - Office productivity

GSA Requirements

- Highly scalable

  Some legacy sites support over 1 billion transactions per day

- Highly reliable

  Even brief outages impact design work

- Less expensive than legacy environments
- Consistent service and policies

  Same user experience world wide

GSA Requirements

- Future proof architecture
  - No more migrations
- Same or better performance
  - Custom benchmarks designed by GSA users
- Use industry standards
  - Wherever possible

GSA Requirements

- Customers and administrators expect features from AFS/DFS
  - Global namespace
  - Location independence
- We wanted to avoid
  - Thousands of file system mounts
  - Excessive use of symbolic links
  - Fragmented userid space

Global Storage Architecture

Architecture

GSA Architecture

- NFS and SMB/CIFS obvious choices for file system protocols
  - Industry Standard/Ubiquitous
  - No proprietary client software required
- How do we deliver on requirements and expectations with NFS and CIFS?

GSA Architecture

- Clustered design gives many benefits of legacy systems while using commodity components
  - Scalability
  - Reliability
  - Location independence
  - Global namespace
  - Replication

GSA Architecture

- A scalable, robust fileserver using off the shelf components
  - General Parallel File System (GPFS)
    - Clustered file system
  - AIX pSeries servers
    - NFS file service
  - WebSphere Edge Server/Network Dispatcher
    - Load balancer

GSA Architecture

- off the shelf components (Cont.)
  - Apache
    - Web access to file system
    - Management tools
  - Samba
    - Windows access
  - OpenLDAP
    - Directory software
  - ProFTPD
    - FTP access to file system

General Parallel File System

- GPFS is the core file system in GSA
- Designed for multimedia services
  - Massive throughput
  - High reliability
- Cluster file system
  - Shared device file system
  - Exploits SAN attached storage devices
- Provides read/write data replication
- Runs on AIX and Linux

Service Delivery Agents

- Most of the servers in GSA are SDAs
- pSeries servers running AIX
- Client systems connect to SDAs
  - Connect with client system's native protocol
  - The SDA connects to GPFS
- All SDAs are exactly alike
  - GSA cells can survive SDA failures
  - GSA cells can scale up or down seamlessly by adding or removing SDAs and SAN storage

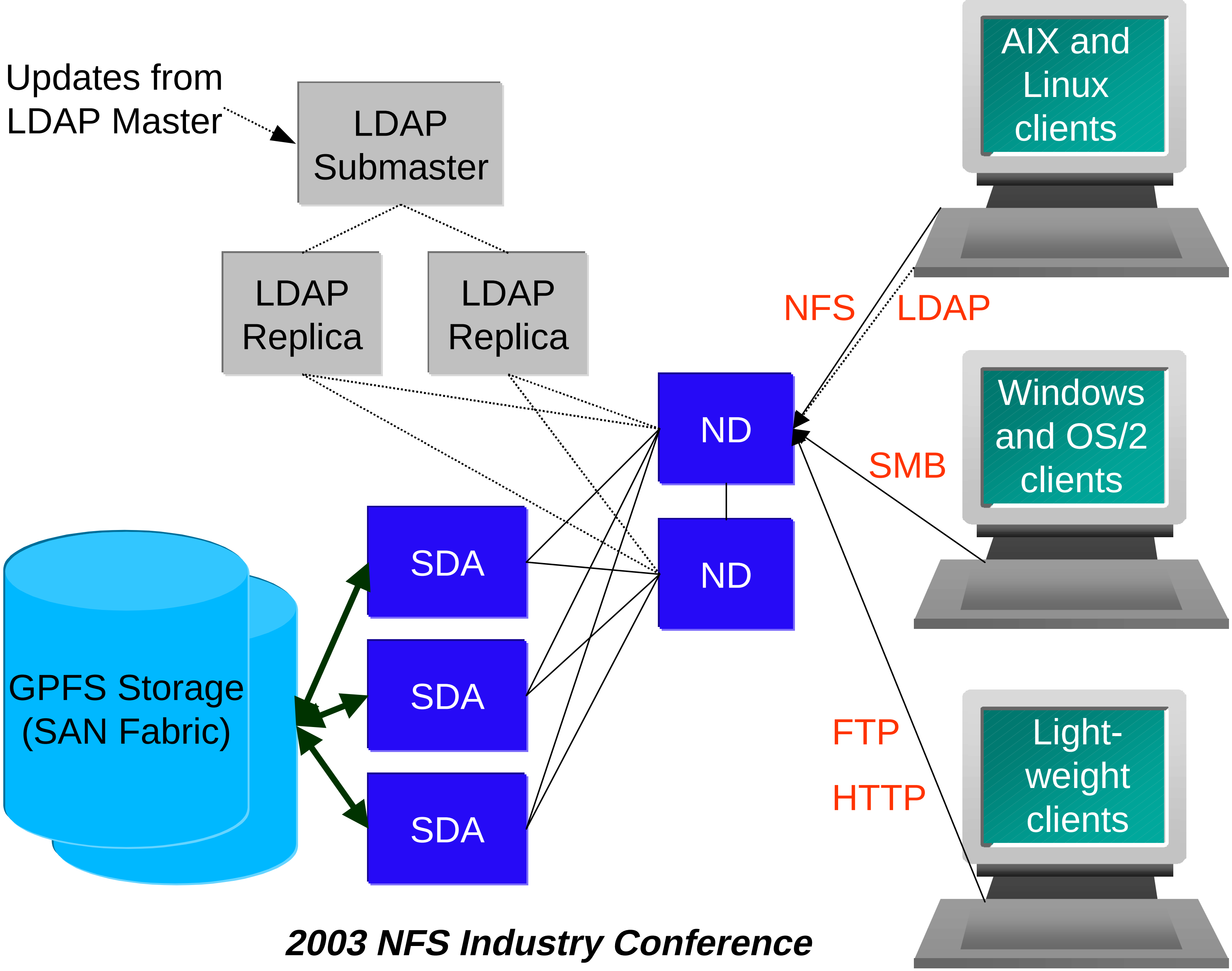
Directory Servers

- Keep common information across cells
  - Users and user information
  - Groups and group membership
  - Automount maps and cell information
- xSeries servers running Linux
- Directory is replicated world wide
  - Single master server accepts all updates
  - Updates are pushed through a replication hierarchy to replicas in every cell

Network Dispatchers

- Load balancing component of WebSphere Edge Server
- Manages all network access to GSA
  - Inbound packets go through network dispatchers
  - Outbound packets bypass dispatchers
- New connections routed to best server
  - LDAP or SDA back end as appropriate
  - Choose the most responsive server
- Mask server failures and maintenance

GSA Cell Architecture



Updates from LDAP Master

LDAP Submaster

LDAP Replica

LDAP Replica

ND

ND

SDA

SDA

SDA

GPFS Storage (SAN Fabric)

NFS

LDAP

SMB

FTP

HTTP

AIX and Linux clients

Windows and OS/2 clients

Light-weight clients

GSA Global Namespace

- Cells all share common LDAP directory
  - Users have the same ID in every cell
  - All groups exist in every cell
- No need for intercell constructs
- Cells are addressable consistently
  - Web: http://<region>gsa.ibm.com/<path>
  - FTP: ftp://<region>gsa.ibm.com/<path>
  - Windows: \\<region>gsa.ibm.com\<path>
  - NFS: /gsa/<region>gsa/<path>

GSA File System Layout

- Each GSA cell contains four top level directories where users can request space:
  - /home
  - /projects
  - /system (shared tools)
  - /tdisk (temporary space)
- Hash trees minimize the number of subdirectories per directory
  - /home/<letter>/<letter>/
  - /projects/<letter>/
  - /tdisk/<date stamp>/

GSA File system Exports

/gsa/pokgsa	Hash trees and system
/gsa/pokgsa-h1	Home directories
/gsa/pokgsa-h2	Home directories
/gsa/pokgsa-p1	Project directories
/gsa/pokgsa-p2	Project directories
/gsa/pokgsa-t1	Temporary directories

GSA Space Management

- Physical Space
  - GPFS supports up to 32 file systems per cluster
  - Each file system can grow to many terabytes
  - File systems can grow and shrink dynamically
  - Automated processes adjust file system sizes
- Quotas
  - GPFS supports quotas per user or group
  - GSA uses groups and group quotas to assign quotas to each project and home directory
  - Users are charged monthly for their average daily space usage

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Status

GSA Performance

- GSA is performing on par with legacy services
  - Home grown performance tests
  - Better than AFS and DFS on 3 of 4 cases
- Additional work underway to improve performance
  - Overall tuning
  - Enhancements to GSA components
  - Expect to beat legacy systems in future

GSA Resources

- GSA is proving less costly to operate than the legacy services
  - Space rates down about 30%
  - Fewer admins required per gigabyte
  - Less floor space/gigabyte
- Results from
  - Greater automation
  - Ability to manage space in larger pools
  - Operating servers closer to capacity

GSA Status

- GSA entered pilot late in 2001
- Saw limited production in 2002
- Became a rated service in 2003
- GSA space and growth
  - 13 TB of used space in September 2003
  - Just over 1% of total IBM file system space
  - Monthly growth rate around 20%
  - 23,000 active user accounts

GSA Status

- 12 GSA cells in production

– Austin, TX	ausgsa.ibm.com
– Beaverton, OR	bvrgsa.ibm.com
– Burlington, VT	btvgsa.ibm.com
– Ehningen, Germany	ehngsa.ibm.com
– La Gaude, France	lgegsa.ibm.com
– North Harbor, UK	nhbgsa.ibm.com
– Poughkeepsie, NY	pokgsa.ibm.com
– Raleigh, NC	rtpgsa.ibm.com
– Rochester, MN	rchgsa.ibm.com
– San Jose, CA	snjgsa.ibm.com
– Yamato, Japan	jpngsa.ibm.com
– Yorktown Heights, NY	watgsa.ibm.com

GSA Status

- New cell deployments underway
  - Armonk
  - Dublin
  - Rome
- . . . with more to follow . . .
  - Boulder
  - Haifa
  - Toronto
  - et. al.

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Questions?