NFSv4.1/pNFS
Ready for Prime Time Deployment

December 7, 2011
Usenix LISA ’11 - Boston

NFSv4.1 pNFS product community

Value of NFSv4.1 / pNFS

- Industry Standard
- Secure
- Performance and Scale
  - Throughput
  - Increased Storage Capacity (pNFS)
- Manageable
  - Separates namespace (metadata) from data
  - Allows for data movement, tiering, manipulation while providing direct access to the client

pNFS Vendors Status

- EMC
- NetApp
- Panasas
- IBM
- BlueArc
- Microsoft
- dCache
- Tonian
- RedHat
- Novell
- Oracle (Solaris)

Linux Client

- Linux has the first commercial implementation of NFSv4.1 client
- Basic client implementation of NFSv4.1 and pNFS in the upstream mainline kernel
  - Supports all 3 pNFS layouts
  - Emphasis on scalability and feature stability
    - More performance optimisations to come
    - Some features still missing:
      - O_DIRECT over pNFS (coming soon!)

Linux Client

- Client supported in 2 distributions:
  - Fedora 16 has support for all 3 pNFS layout types (files, objects, blocks)
  - Red Hat Enterprise Linux 6.2 has support for the files pNFS client

Linux Server

- Linux pNFS project is actively maintained by Tonian.
  - Development tree: git://linux-nfs.org/projects/bhalevy/linux-pnfs.git
  - http://wiki.linux-nfs.org/wiki/index.php/PNFS_prototype_design
- The project includes the reference implementation of the pnfs server for:
  - files: Exporting GFS2 and OCFS2 (DLM based clustered file system)
    - supporting parallel I/O for read access
  - objects: Exporting the EXOFS file system.
  - blocks: Exporting block-based file systems, such as ext4, xfs, btrfs, etc.
- Development appears to be accelerating now that the client is done
- Server code to be submitted to the kernel in the coming months

RHEL 6.2 - pNFS

- Client support only
- pNFS file layout
- Insert module into kernel
  - Create /etc/modprobe.d/dist-nfs41.conf
  - Add ‘alias nfs-layouttype4-1 nfs_layout_nfsv41_files‘
  - Reboot
  - Note: with RHEL6.3 above will not be needed
- Mount the file system with “minorversion” mount option
  - E.g. mount –o minorversion=1 server:/export /mnt

SLES 11 SP2 - pNFS

- Client support only
- GA end of February 2012

EMC pNFS Block Server Status

- Support for pNFS block server since 2010 – first GA product
- Next EMC VNX release will include pNFS server optimized for performance

pNFS block server performance (from multiple clients with iSCSI) – 900MB/sec

EMC pNFS Block Client Status

- Funding CITI to implement Linux pNFS block client
- New pNFS block client patches by EMC developers provide optimizations for performance in Linux Kernel 3.2

pNFS block client performance over iSCSI – read-100MB/sec; write-90MB/sec

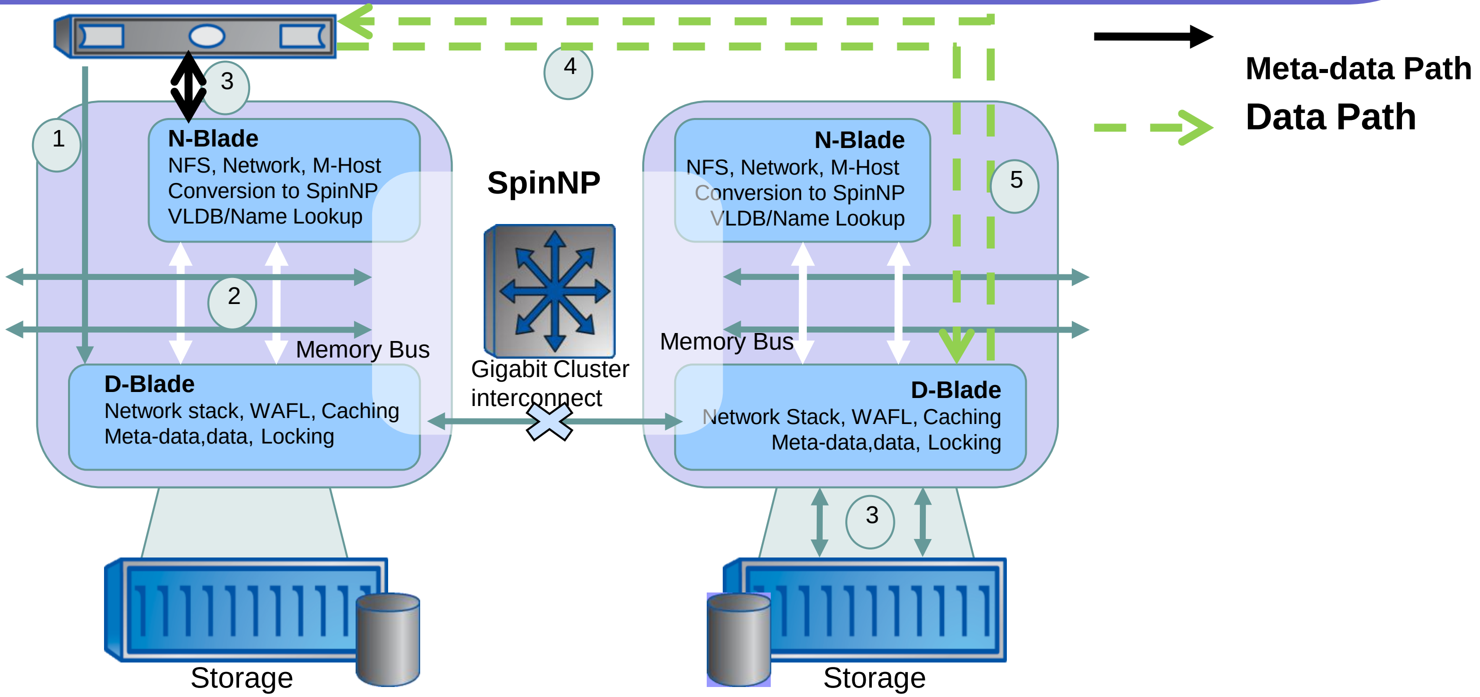
NetApp NFS Support Matrix

Announced 21 Nov; ONTAP 8.1 RC2

- http://nfsworld.blogspot.com/2011/11/netapp-has-shipped-its-pnfs-server.html

	7.3.x	8.1 7-mode	8.1 C-Mode
NFS v3	Yes	Yes	Yes
NFS v4.0	Yes	Yes	Yes
NFS v4.0 with Delegations	Yes	Yes	Yes
NFS v4.0 with Referrals	No	No	Yes
NFS v4.1	No	No	Yes
NFS v4.1 with pNFS	No	No	Yes
NFS v4.1 with Referrals	No	No	Yes
NFS v4.1 with Delegations	No	No	No
NFS v4.1 with pNFS and Delegations	No	No	No

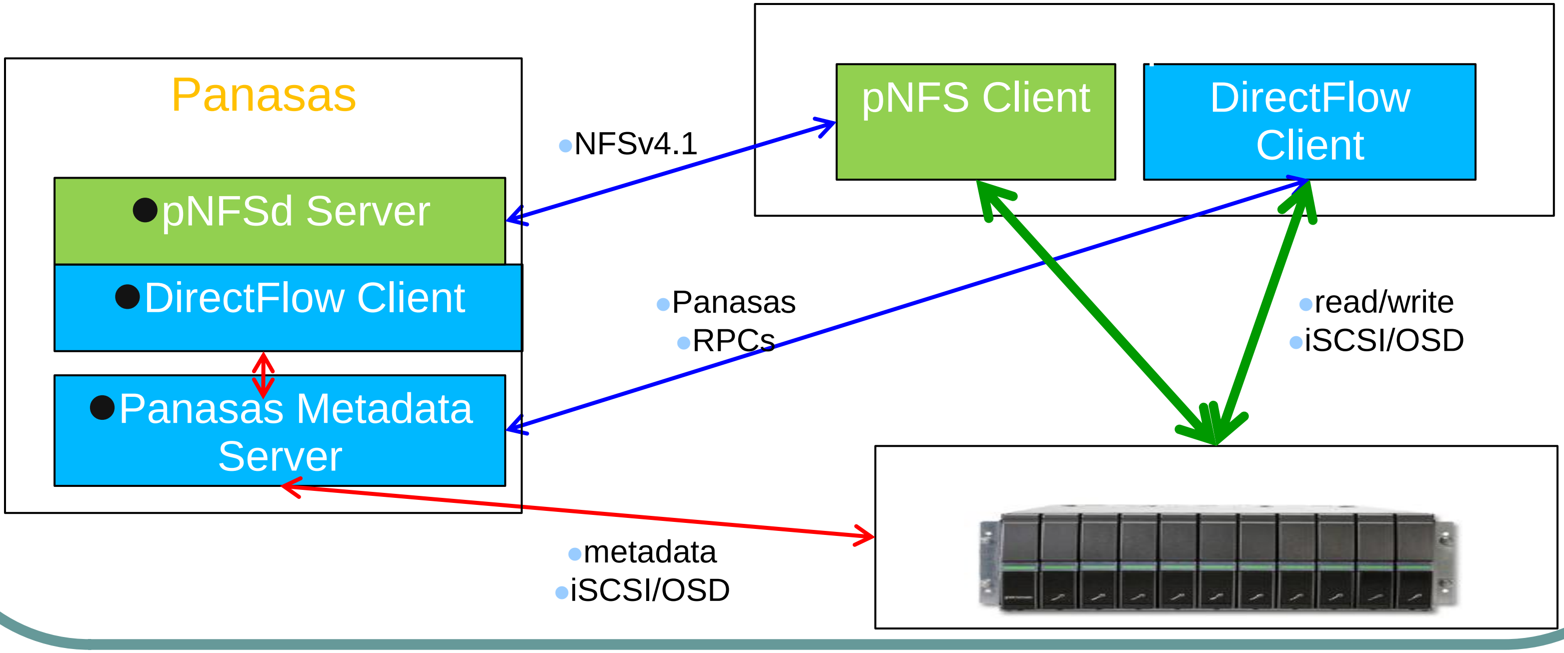
Cluster-Mode – Optimized Data Path with pNFS



- Direct network path to volume
- Layout recalls trigger new network path computation
- Automatic provisioning
- Minimum cluster traffic between nodes
- Faster response time

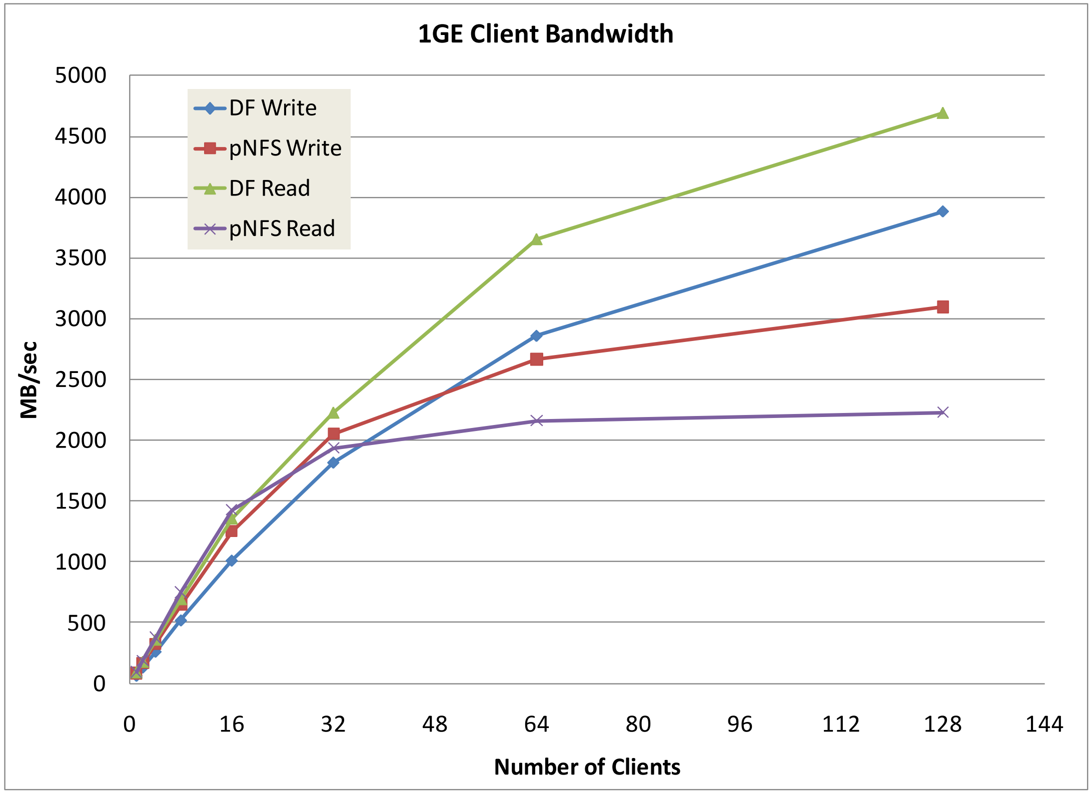
Panasas to ship pNFS in 2012

- Panasas a founding advocate of pNFS standards process, has contributed to Linux client & server code, especially object layout code
- Panasas systems designed from the ground up, anticipating pNFS
  - True scale-out architecture backed by high-performance PanFS file system
  - Today shipping with DirectFlow, precursor to pNFS with 8 years of production use
  - pNFS Objects will be ideal for high throughput applications

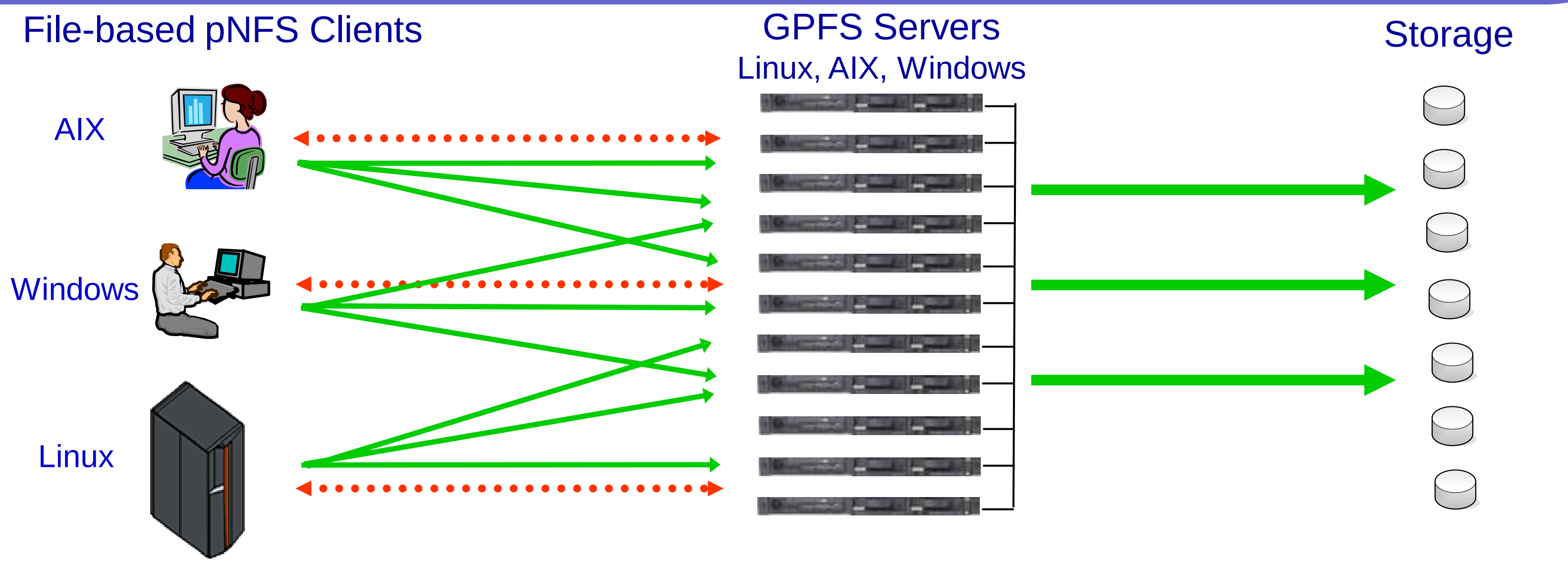


Panasas pNFS Scaling

- Panasas has already demonstrated pNFS scaling to 128 clients at multiple gigabytes per second



IBM GPFS



- Fully-symmetric GPFS architecture - scalable data and metadata
  - pNFS client can mount and retrieve layout from any GPFS node
  - Metadata requests load balanced across cluster
  - Direct data access from any GPFS server
- pNFS server and native GPFS clients can share the same file system
  - Backup, deduplication, and other management functions don’t need to be done over NFS
- Beyond client access, will be key part of SONAS Active Cloud Engine

Windows NFSv4.1/pNFS Client

CITI – University of Michigan

Feature support (not native Windows)

- ✓ NFSv4.1 sessions
- ✓ Mandatory and named attributes
- ✓ Security: RPCSEC-GSS, SECINFO, ACLs
- ✓ Referrals
- ✓ Reboot recovery
- ✓ Locking
- ✓ Delegations
- ✓ pNFS sparse and dense layouts

Client GbE performance:

100 MB/sec read, 80 MB/sec write

Windows NFSv4.1/pNFS Client

- Features missing
  - Session security
    - Machine creds or SSV
  - Segmented layouts (whole file only)
  - Session trunking on client

Windows Server 8 (native server)

- Base NFSv4.1 only
  - Mandatory aspects of RFC 5661
- Integrated with Windows Failover clustering
- Identity Mapping Support
  - Passwd/group file mapping
  - Active Directory
  - ADLDS or 3rd party LDAP stores (RFC 2307 compliant)
  - User name mapping (legacy)
- RPCSEC_GSS support
  - Krb5, Krb5i, and Krb5p
- Multiprotocol access (SMB / NFS) to same share
- Volume Mount Point Support

Oracle (Solaris) Status

"Oracle strongly supports NFSv4.1 and pNFS file and will deliver implementations of both in future releases of Solaris."

Tonian (new vendor) Status

- Tonian is a VC-backed start up founded in 2011 (Charles River Ventures and Cedar Fund)
- Tonian is developing a pNFS-based products for the enterprise market.
- For more information: Benny Halevy <bhalevy@tonian.com>

Getting Started with NFSv4.1/pNFS

Assist user community as NFSv4.1 is tested and deployed

Gather NFSv4.1 practical deployment information on a shared web site

E.g. Opensource toolset for evaluation