NFS-Ganesha
Why is it a better NFS server for Enterprise NAS?

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Outline

- What is NFS-Ganesha
- Enterprise NAS
- Kernel vrs User-Space Server
- Clustering with NFS-Ganesha
- Failover/IP move and recovery
- New improvements
- Conclusions.

What is NFS-Ganesha?

- User-level implementation of NFS server
  - Supports V2, V3, V4, v4.1, v4.2
- Can manage huge meta-data and data caches
- Able to provide access to different sets of data
- Provision to exploit FS specific features.
- Can serve multiple types of File Systems at the same time.
- Can serve multiple protocols at the same time.
- Can act as a Proxy server and export a remote NFSv4 server.
- Cluster Manager agnostic.

- Small but growing community.
- Active participants - IBM, Panasas, Redhat, LinuxBox, CES

Enterprise NAS

- Reliable, Redundant and Fail-safe through clustered configuration.
- Serve structured and unstructured data over multiple protocols.
- Scalable in capacity and performance.
  - Flexible to Scale-up and/or Scale-out.
  - Capable of supporting large number of clients.
- Enterprise features – tiering, de-dup, multi-tenancy, multi-protocol etc.
- Flexible to run on various platforms and serve heterogeneous sets of data.
- Support complex security configurations.
- QoS – Quality of Service.

Kernel vs User Space Server

- Kernel Server need to make many up-calls
  - Mountd and exportfs info
  - ID mapping
  - GSSAPI
  - Client ID tracking (future?)
  - Statd interaction.
  - Cluster Related.

- One would question why do we need this in the kernel? (well it seemed like a good idea at that time)

Kernel vs User Space Server

- What is so great about user-space?
  - User Space is more flexible than kernel.
  - Easy restarts, failover, failback implementation.
  - System calls don't need to get in the way.
  - No up-calls to interact with user space services.
  - Clustering becomes natural and easy.
  - Targeted and aggressive caching capabilities.
  - Flexible and Plug-able FSAL
    - FS Specific features can be exploited.
  - Can support multi-Protocol with common DLM
  - Easy to achieve multi-tenancy
  - Easy to monitor and control resource consumption and even extend to enforcing QoS.
  - Manageability and debug-ability are major plus.

Kernel vs User Space Server

- No merits for kernel server? Yes there are.
  - Filehandles – Major advantage until recently; Now we have open-by-handle support.
  - Performance – User mode can be slow – but can be offset by Clustered FS, Aggressive Caching, Customized RPC, and aggressive threading/parallel execution
  - Ownership/permissions – workaround setfsuid per process. But others may need to do multiple system calls or special FS interface. VFS,Lustre,GPFS but CEPH, Gluster libraries can accept
  - Multiple syscalls may be needed to perform, write/getattr for WCC reasons.
  - No duplicate cache and Zero-Copy read/write is less complex.

Clustering with NFS-Ganesha

- Proposed **C**luster **M**anager **A**bstraction **L**ayer (CMAL) makes it cluster agnostic.
- Fail-over and IP move handling
- Cluster aware DRC
- DLM across cluster
- Cluster wide Grace period is manged.

Cluster Manager Abstraction Layer (CMAL)

- Provides an abstraction for cluster manager support.
- Manages intra-node communication among cluster nodes.
- Generic enough to implement many clustering interactions for cDRC, DLM etc features.
- Cluster manager agnostic. Easy to plug any cluster manager.
- Modeled after FSAL (File System Abstract Layer).
- CMAL layer would have function pointers based on the Cluster Manger.
- Can provide cluster communication between DS and MDS nodes in pNFS configuration.

Cluster DRC

- DRC helps the server to identify duplicate requests of non-idempotent operations and process accordingly.
- Identify a back-up node to backup the DRC or backup on all nodes of the cluster/central location
- Store and fetch DRC entries through CMAL.
- Interfaces
  - init_drc_cmal(server-ip): Initialize the CMAL interface. Set up backup node for the server-ip.
  - add_drc_entry(xid, entry, server-ip): Stores the DRC entry in the cluster.
  - retrieve_drc_entries(server-ip): Retrieve all the DRC entries for a particular sever node.
  - shutdown_drc_cmal(server-ip): Shutdown the CMAL interface for the given server-ip.

Failover/IP Move

- NLM makes it very complex but NFS-Ganesha architecture is up for the challenge. :)
- On the first lock/last unlock, Ganesha calls Cluster Manager provided interface to register(monitor)/unregister(unmonitor) the client-ip, server-ip pair.
- When the ip is moved (manual/failover), CM sends sm_notify to clients of the affected service-ip.
- CM generates events, release-ip and take-ip for corresponding server nodes, so that state shall be released from the source node, and acquired by the destination node.
- Depending on the lock granularity, corresponding locks/file systems or entire cluster should enter grace.

Distributed Lock manager

- The NFS-Ganesha architecture supports DLM.
  - DLM can be implemented in different ways.
- Allowing to manage cluster wide locks.
- Shared state management across protocols - NFS and CIFS and other.
- Ability to minimize the impact of failures.
  - Targeted Grace.

FSAL Enhancements and new features

- Dynamic Exports
- Delegations
- FSAL enhancements
  - ACL support.
  - Open upgrade support.
  - Working around POSIX semantics.
  - User libraries can be plugged easily.
    - ProtecTIER, GlusterFS.
  - Stackable FSALs.
  - PseudoFS as first class FSAL.
- LTTng Integration.
- RDMA support through libmooshika.

NFS-Ganesha links

- NFS-Ganesha is available under the terms of the LGPLv3 license.
- NFS-Ganesha Project homepage on github
  - https://github.com/nfs-ganesha/nfs-ganesha/wiki
- Github:
  - https://github.com/nfs-ganesha/nfs-ganesh
- Download page
  - http://sourceforge.net/projects/nfs-ganesha/files
- Mailing lists
  - nfs-ganesha-devel@lists.sourceforge.net
  - nfs-ganesha-support@lists.sourceforge.net
  - nfs-ganesha-announce@lists.sourceforge.net

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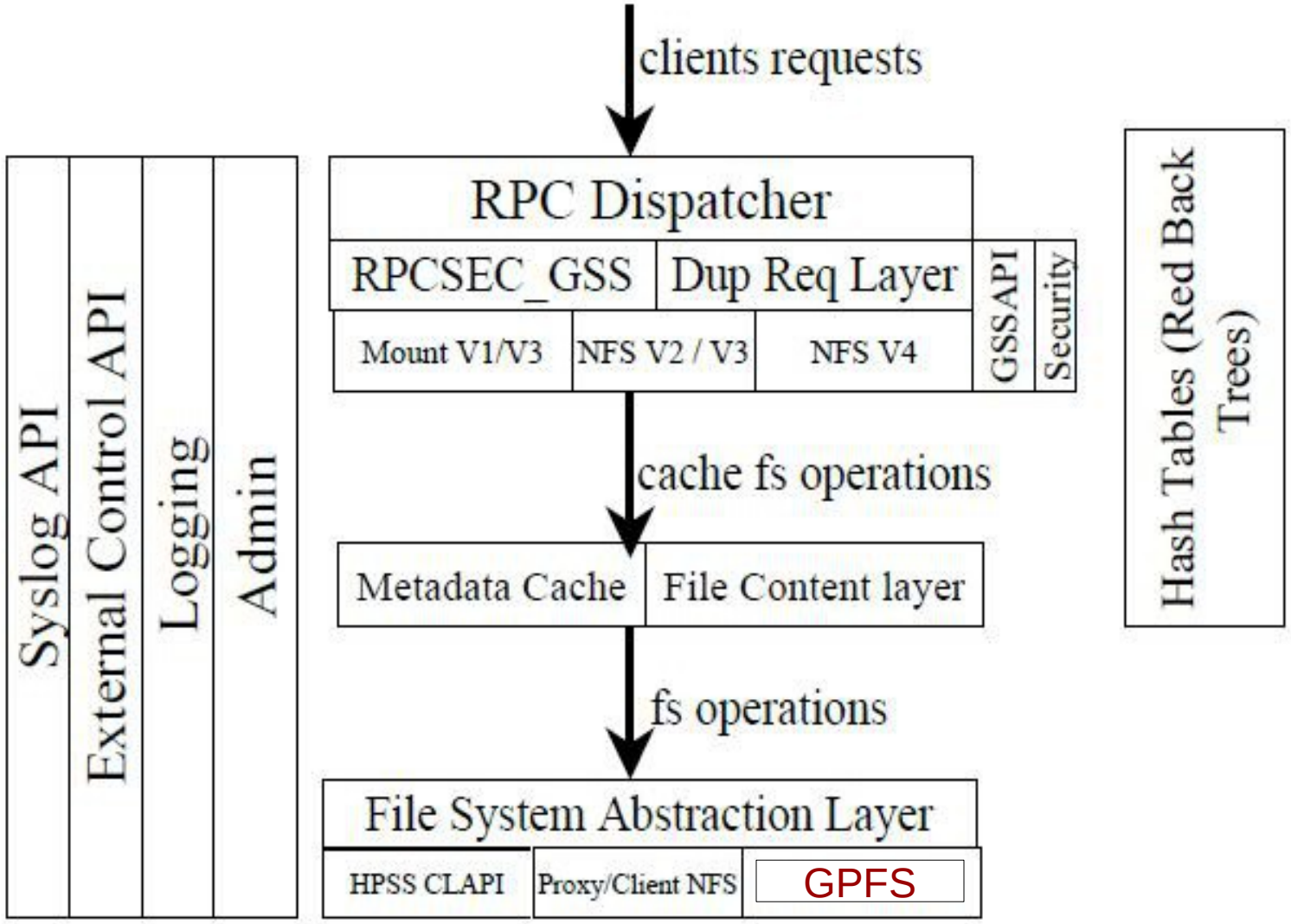
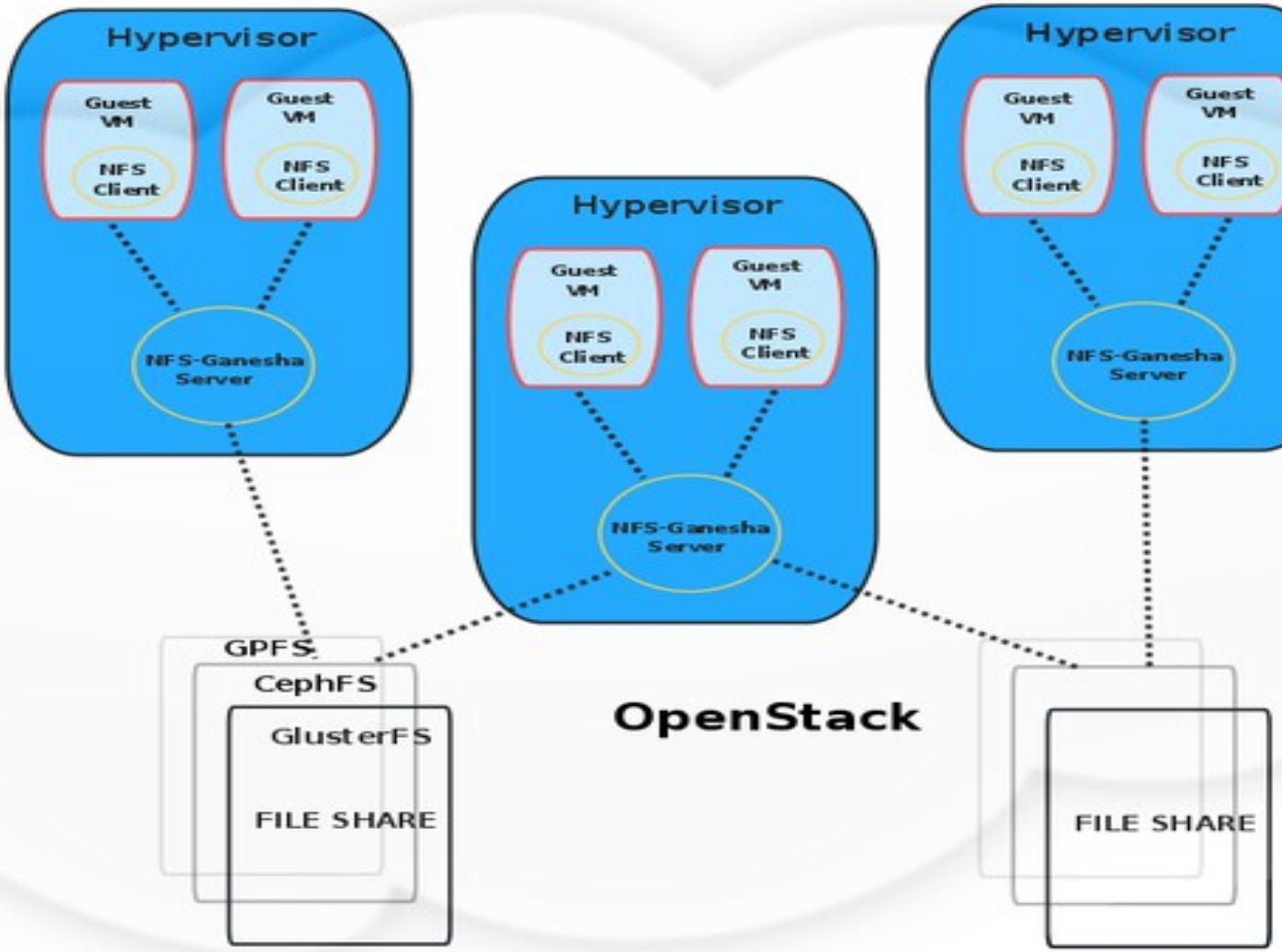
BACKUP

Architecture

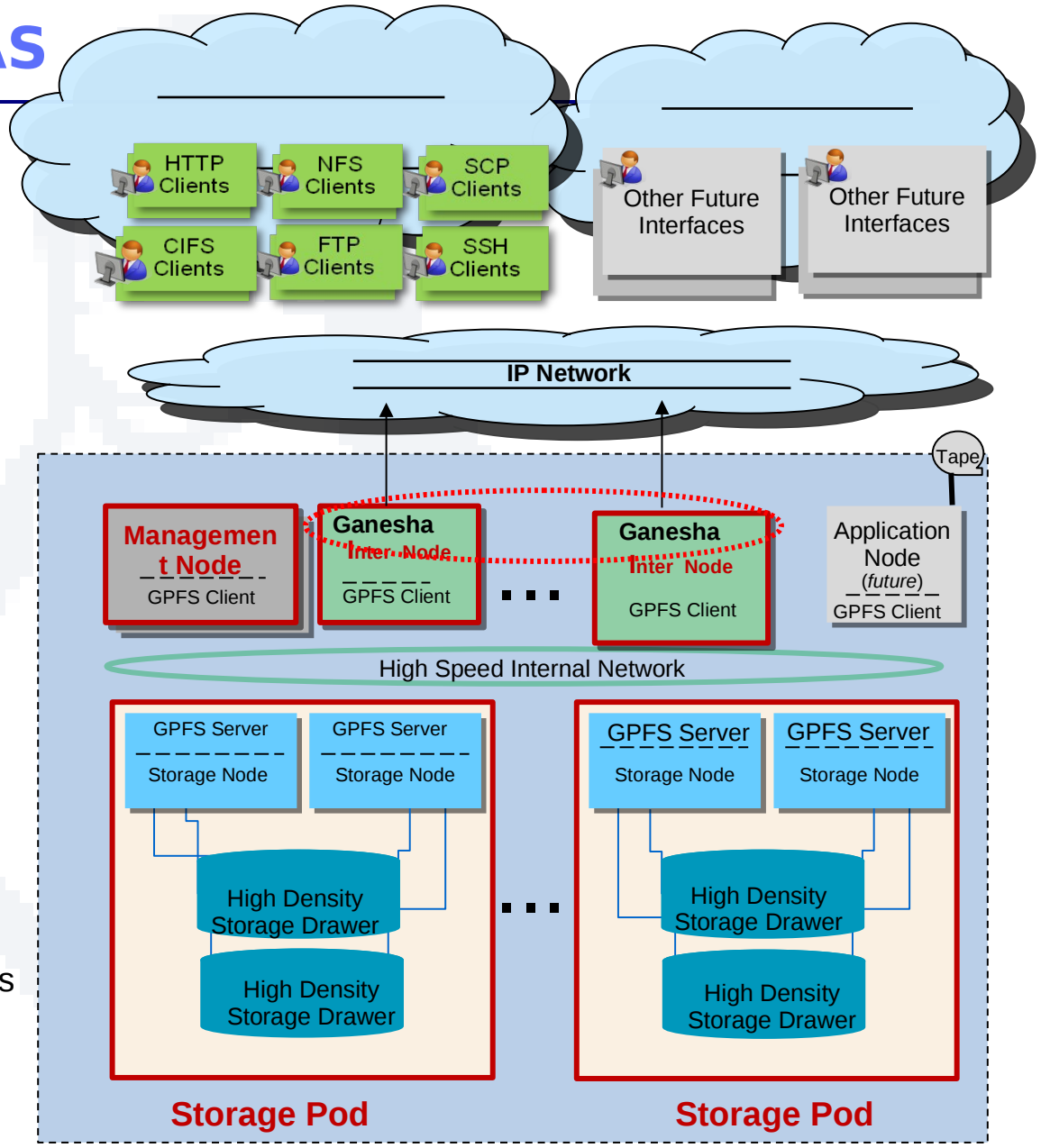


Manila Open-Stack using NFS-Ganesha (Gateway mediated)



Use Cases - SoNAS

High level design of Cloud Storage infrastructure

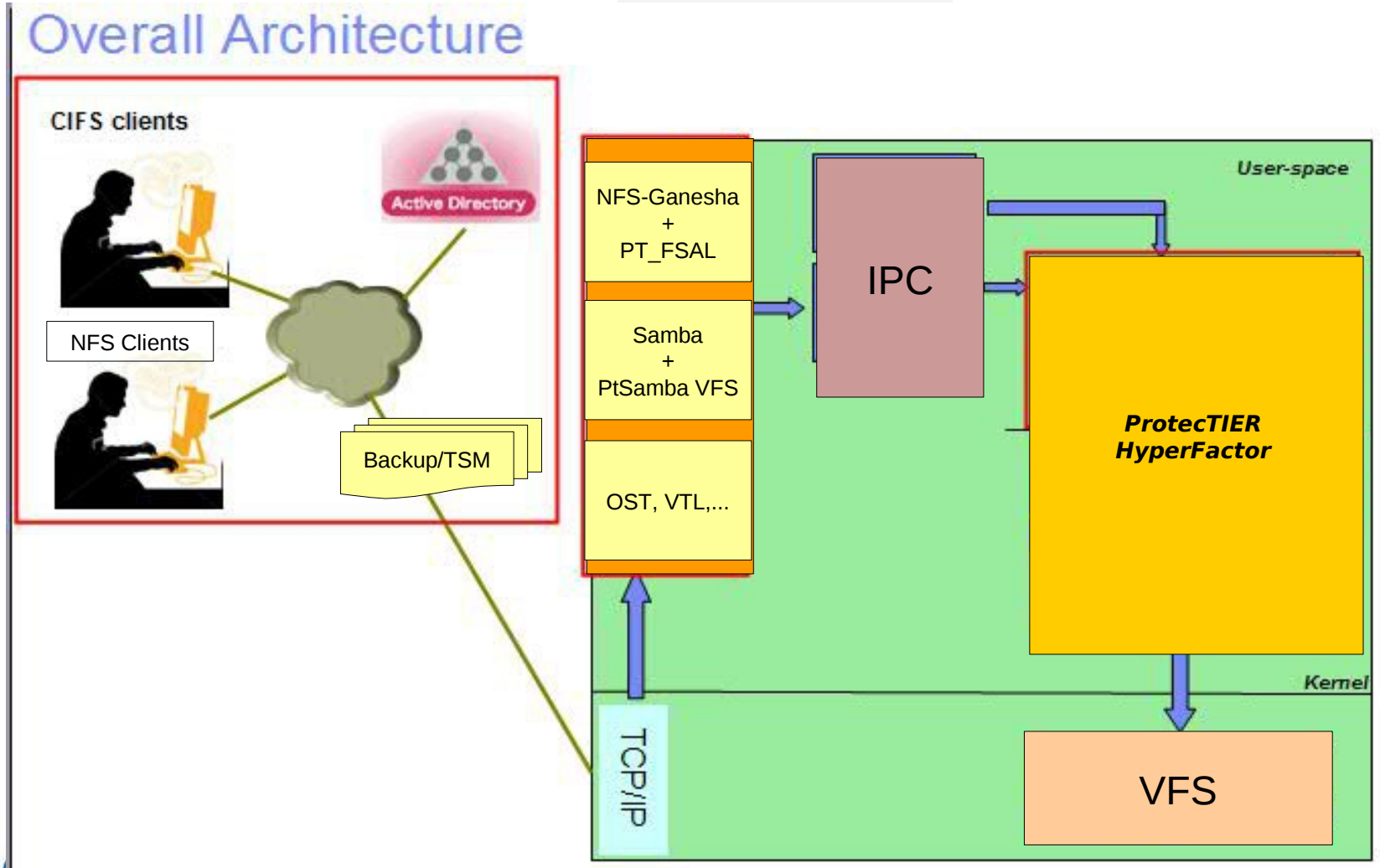


Simple: Only 3 basic parts:

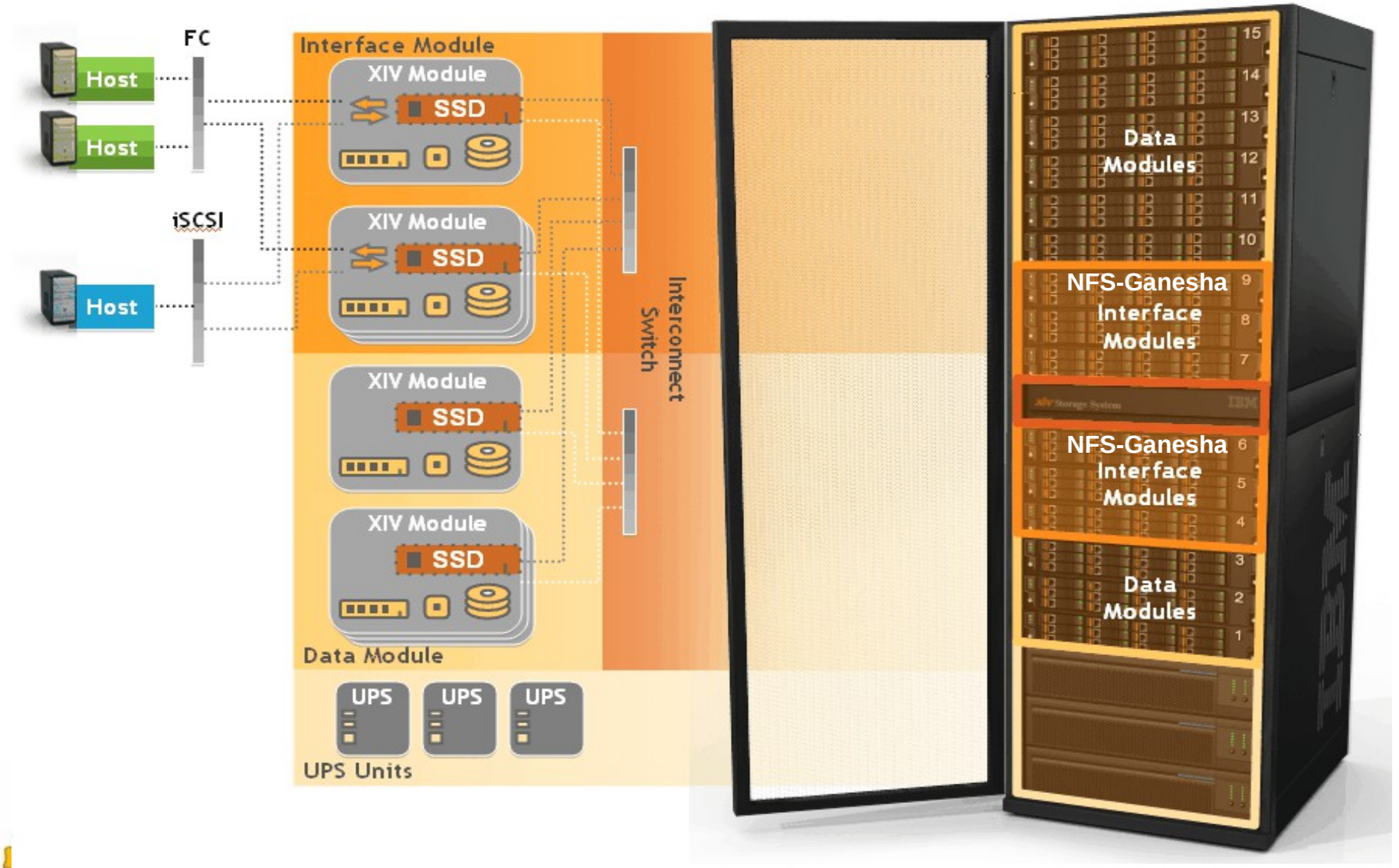
- ✓ **Interface Nodes**
- ✓ **Management Nodes**
- ✓ **Storage Pods**

'Lego-like' modular design allows online independent scaling of I/O capacity and Storage capacity

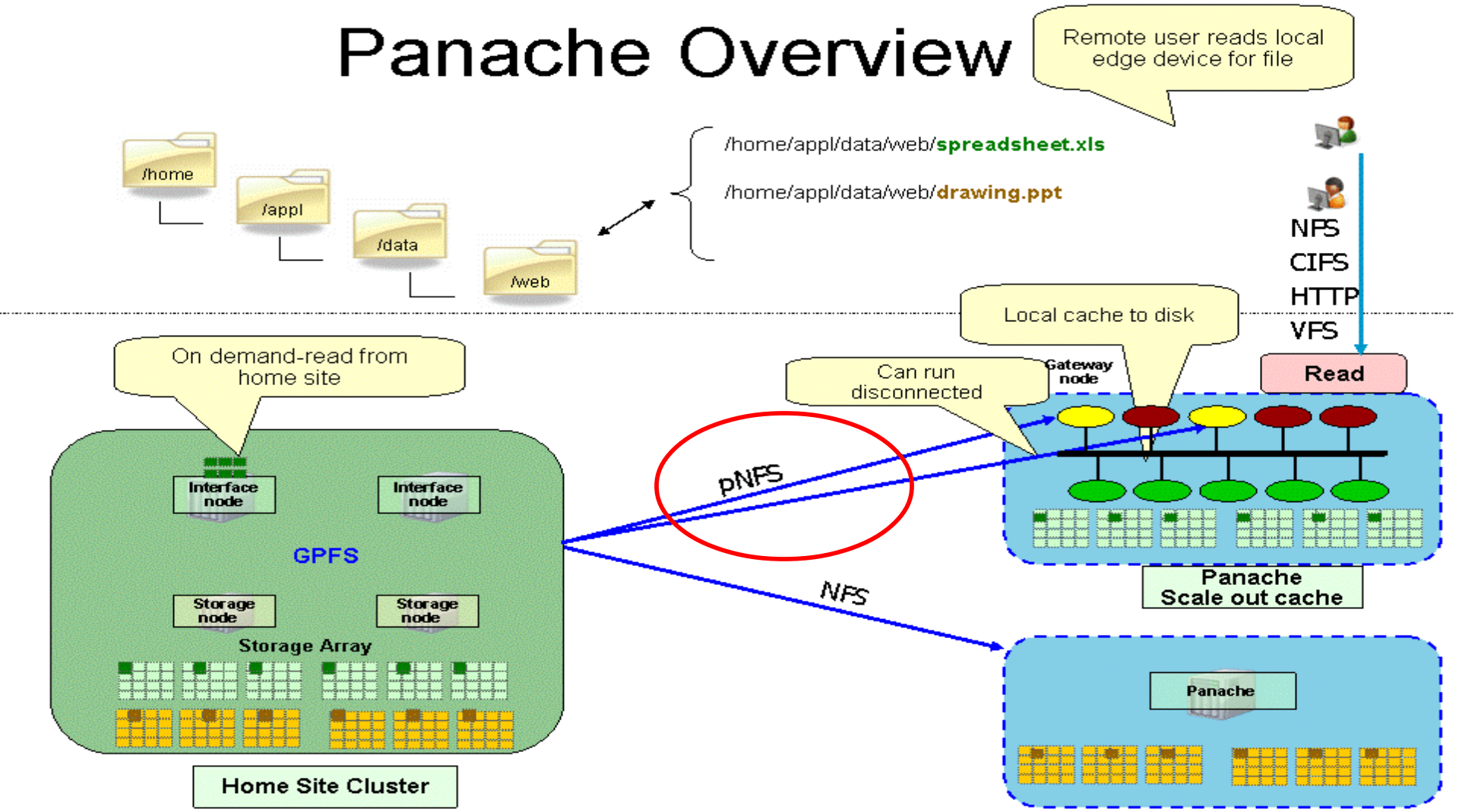
Use Cases - ProtecTIER



XIV Architecture

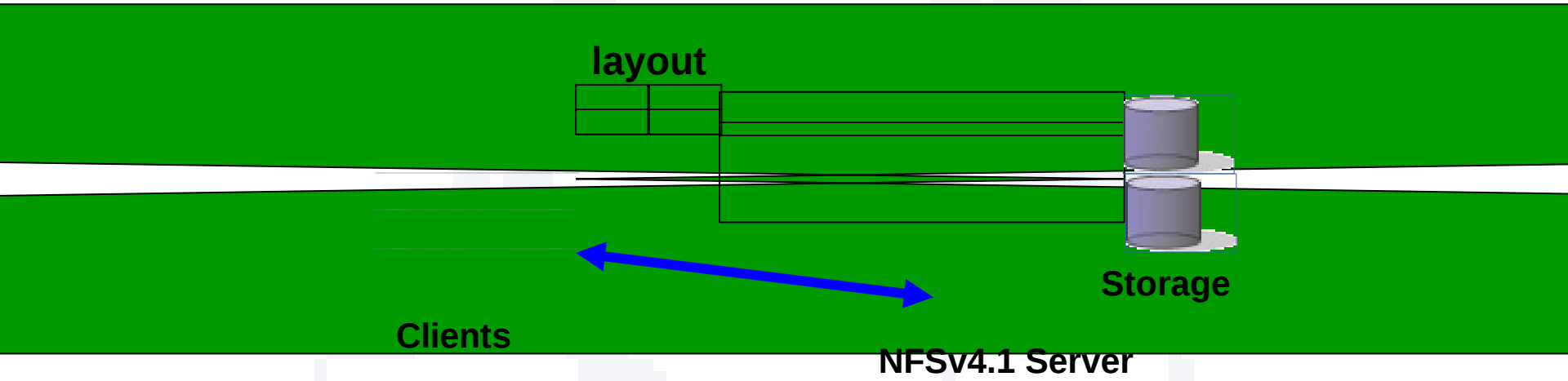


Panache UseCase



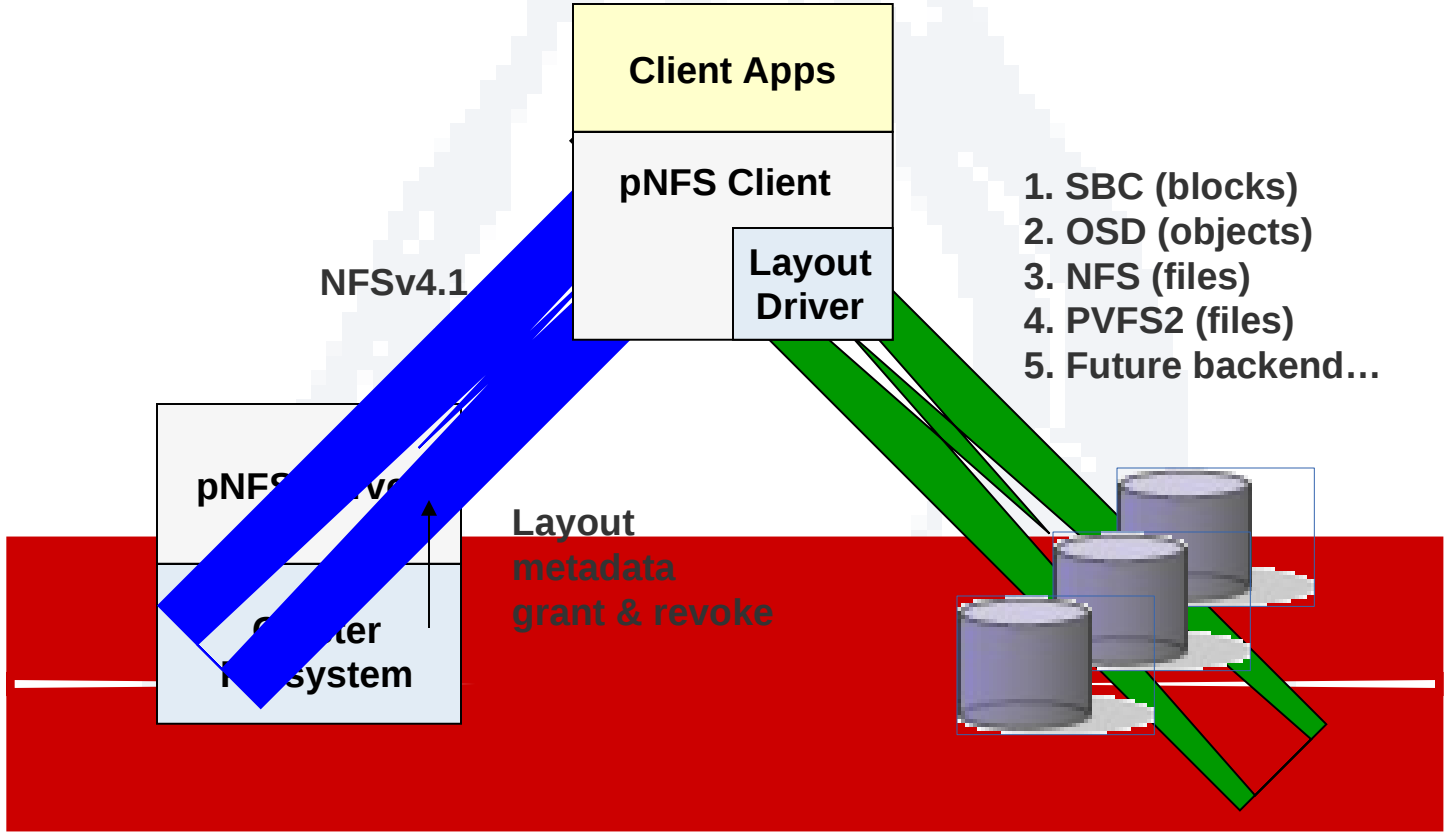
pNFS Layouts

- Client gets a *layout* from the NFS Server
- The layout maps the file onto storage devices and addresses
- The client uses the layout to perform direct I/O to storage
- At any time the server can recall the layout
- Client commits changes and returns the layout when it's done
- pNFS is optional, the client can always use regular NFSv4 I/O

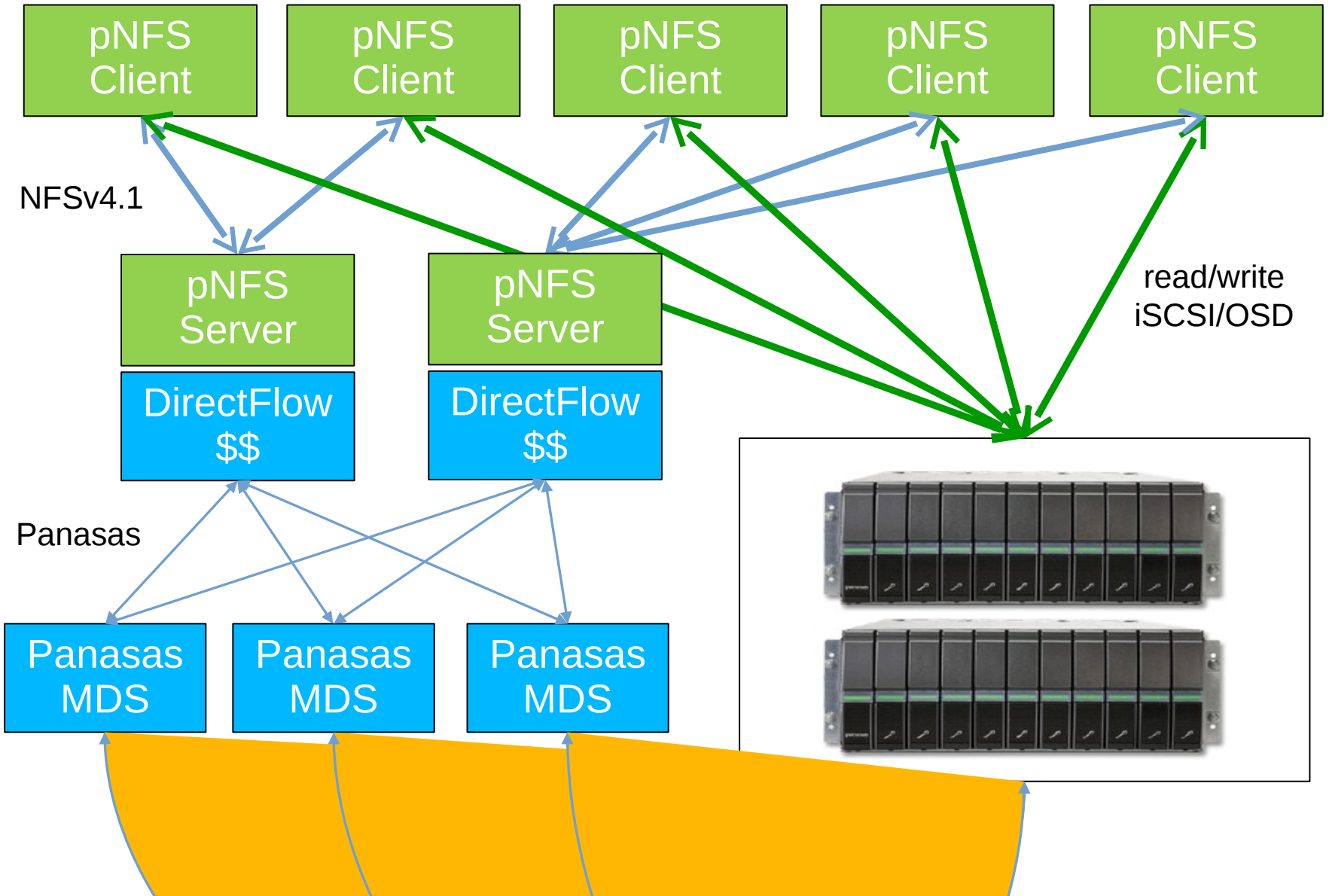


pNFS Client

- Common client for different storage back ends
- Wider availability across operating systems
- Fewer support issues for storage vendors



Scaling pNFS metadata service



UseCase - CohortFS(LinuxBox)