Referrals in Clustered ONTAP

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Agenda

- Clustered ONTAP
- Scope of Referral
- Where does Referral occur
- How does Referral occur
- Client issues
- Federated FS in Clustered ONTAP

Clustered ONTAP

- Vserver
  - Provides a single file system namespace
  - Can span multiple physical nodes
  - Has one or more virtual interfaces
- Junction
  - Mount point of volume
  - Used to stitch the namespace
- NBlade
  - Network blade that handles all client facing protocols
- DBlade
  - Data blade that handles all file and block storage

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Clustered ONTAP
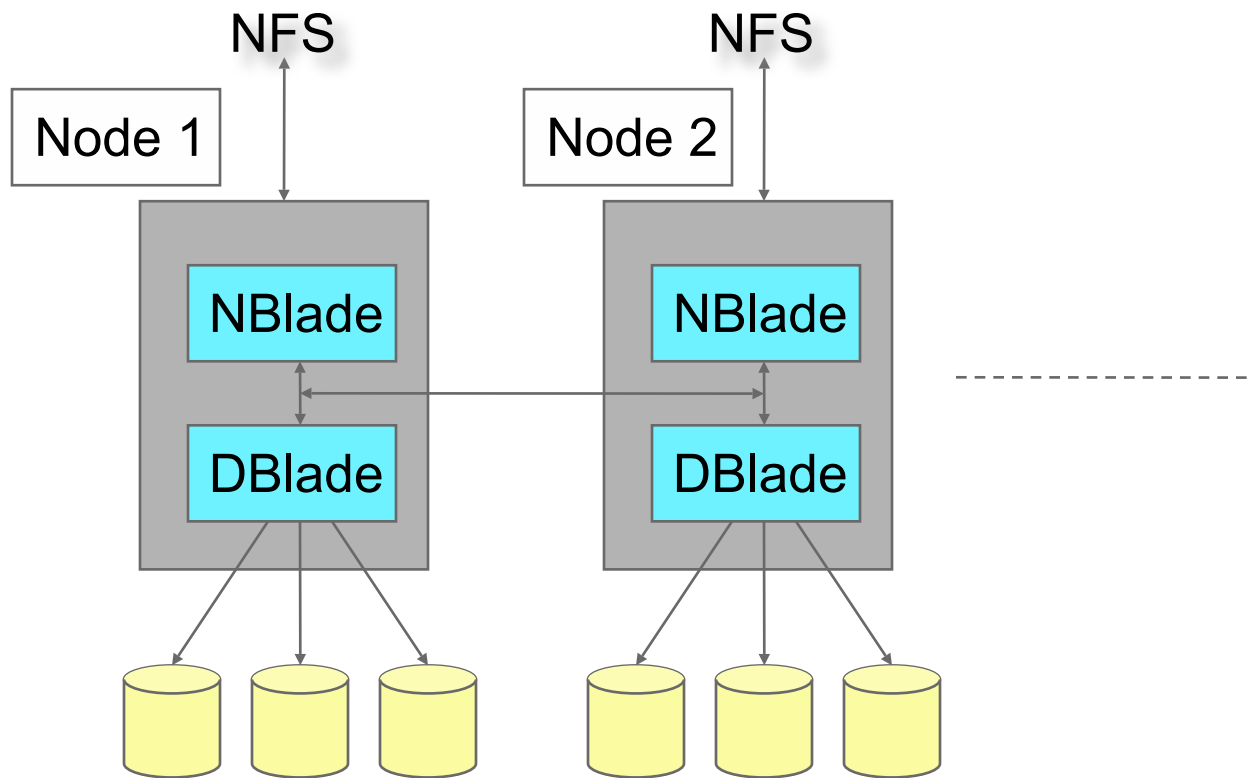
Scope of Referral

- **Intra-vserver only for now**
  - NFSv4 client coming through one virtual interface to the vserver is redirected to another virtual interface within the vserver
- **Criteria for intra-vserver referral**
  - Existence of another virtual interface in the vserver that has greater proximity to the volume that the client is getting to
- **Advantage of intra-vserver referral**
  - no administrative setup for referrals is needed
  - we could defer all decisions on administrative setup for referrals and wait for Federated Filesystems protocols

Where does Referral occur

- At junction crossing; volume boundaries
- Client issues LOOKUP op
  - Looking up a junction
  - Target volume at the junction is closer to another virtual interface within the vserver
- Client issues READDIR op
  - Entry in directory is junction
  - Target volume at the junction is closer to another virtual interface within the vserver
  - Attributes requested beyond a limited set that includes mounted_on_fileid, fsid, fs_locations,

How does Referral occur

```
Client                    Nblade                        Dblade
======                    ======                        ======
Compound ------------>    Process PUTFH
PUTFH,LOOKUP,GETFH        (cfh is set)


                          Current Op is LOOKUP
                          component is junction
                          SpinNP lookup request ---------------->
                                      SpinNP lookup response <--

          JUNCTION–
                          Vldb Junction Lookup
                          Target Dblade is local? NO
                          Target Dblade has local VIF? YES.
                          cfh, compound tagged for Referral
                          Lookup Response NFS_OK


                          GETFH
                          cfh, compound tagged for Referral? YES
<-NFS4ERR_MOVED-----
```

How does Referral occur (contd)

Client   Nblade   Dblade

======   ======   ======

Compound ------------>   Process PUTFH

PUTFH,LOOKUP,GETATTR(fs_ocations) (cfh is set)

Current Op is LOOKUP

component is junction

SpinNP lookup request ---------------->

SpinNP lookup response <--

JUNCTION–

Vldb Junction Lookup

Target Dblade is local? NO.

Target Dblade has local VIF? YES.

cfh, compound tagged for Referral

Lookup Response NFS_OK

GETATTR (fs_locations)

Getattr Response with fs_locations attribute info

<-NFS4_OK--------------

Client Issues

- Some clients see ERR_MOVED and fail with
    - EIO
    - EPROTO
- Need all clients to support referrals to enable Referrals
- Clients can't resolve fs_location.hostname
- Clients can't handle ERR_MOVED during mount

Federated FS in Clustered ONTAP

- Extend referrals outside the vserver into the Federated namespace
- Create junctions with junctionKey and nsdbName
- Lookup NSDB server for the FSL information of a FSN

References

- Implementation Guide for Referrals in NFSv4
  - http://www.citi.umich.edu/projects/nfsv4/rfc/draft-ietf-nfsv4-referrals-00.txt
- Data ONTAP GX: A Scalable Storage Cluster http://www.eisler.com/fast2007/
- Requirements for Federated File Systems
  - http://www.ietf.org/internet-drafts/draft-ellard-nfsv4-federated-fs-01.txt
- NSDB Protocol for Federated Filesystems
  - http://www.ietf.org/internet-drafts/draft-tewari-nfsv4-federated-fs-protocol-01.txt