Network-Attached Storage

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1 Network Attached Storage

NAS allows storage to be shared over a LAN at the filesystem level.

This contrasts to SAN where block level storage is provided.

It is assumed in a NAS environment that any number of clients can simultaneously connect to the share.

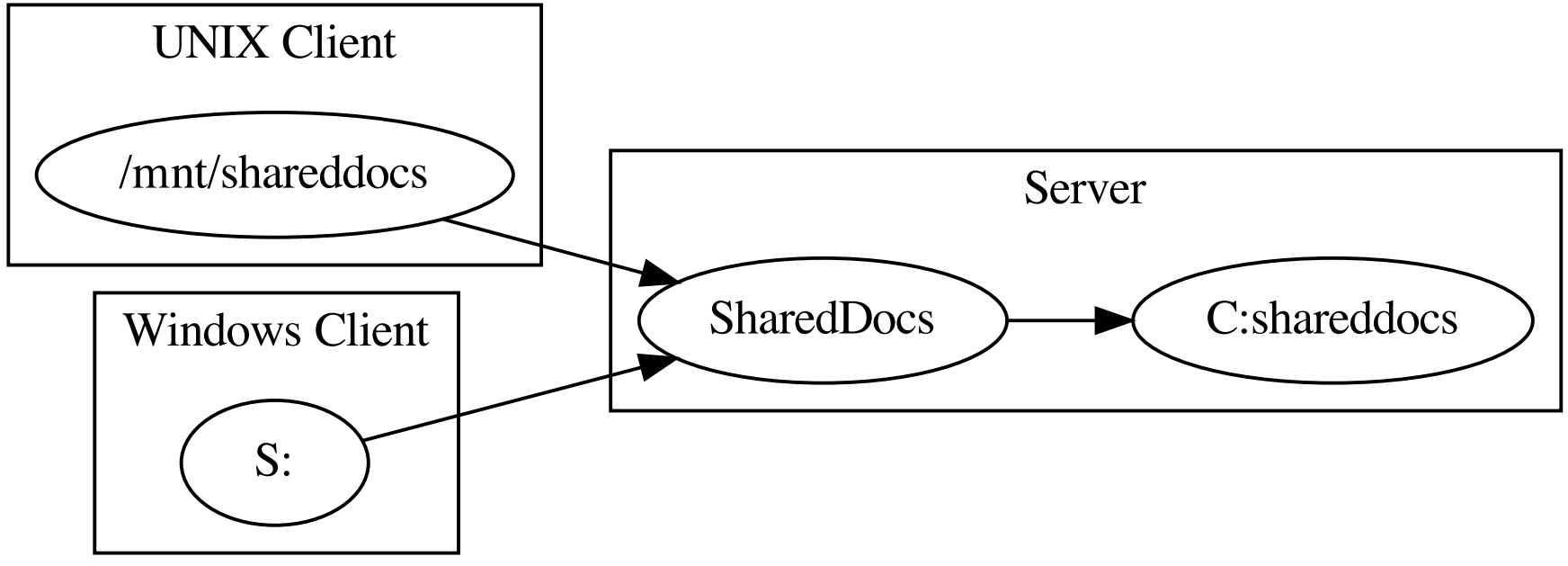
UNIX Client
/mnt/shareddocs
Windows Client
S:
Server
SharedDocs
C:shareddocs

Figure 1: NAS

1.1 NAS protocols

Table 1 summarises the NAS protocols commonly encountered.

Points to note:

1. Some protocols like SMB/CIFS and NCP were designed for more than file sharing. Print sharing, domain and interprocess communication were also facilitated. We won't be dealing with these uses here.
2. Most NAS protocols run over TCP/IP. Historically other transports were used like NetBIOS for SMB and IPX for NCP. Some idiosyncrancies remain.
3. Although technically routable over WAN links, NAS protocols tended to be designed with LAN usage in mind. Often had poor/no security.
4. If they need to be used off-site, best to use a VPN link. Tuning the configuration can help performance greatly when used over WAN or VPN links.

Protocol		Port	Remarks
Server Message Block	SMB	135,137-139,445	Windows-centric but cross-platform. Samba and CIFSd for Linux.
Common Internet File System	CIFS		Attempted re-name of SMB by Microsoft
Network File System	NFS		UNIX centric but cross-platform. Multiple versions, currently NFSv4. NFS client on Windows.
Apple Filing Protocol	AFP	548	Developed from earlier AppleShare protocol. Not often encountered.
Netware Core Protocol	NCP	524	Like SMB has support for print and other sharing as well.

Table 1: NAS protocols

1.2 Access pattern

Network attached storage is normally utilised via a virtual filesystem. This allows the network filesystem to be mounted (Unix) / mapped as a drive letter (Windows): Points to note:

- Client sees filesystem of the NAS protocol (SMB, NFS).
- Client is unaware of the underlying filesystem (NTFS, ext4, etc) on the server. Also unaware of what block device (local, SAN etc) the filesystem resides on.
- Share may be mounted read-only or read-write.
- Permissions are a complex compound of:
  1. Server filesystem permissions
  2. Permissions defined within the share server
  3. Client-side permissions

  Often issues when a Linux/UNIX client connects to an SMB share and multiple users on

the UNIX client attempt to use the shared drive. Configuration can become very tricky!

As an alternative there are tools that can connect directly to the shares like an FTP client, such as `smbclient` for Linux. Mobile apps tend to work similarly.

2 Provisioning

2.1 General-purpose server

General-purpose servers running standard operating systems have server software installed for most common protocols. General arrangement:

1. One or more shares configured. Each share points to a directory on the server's filesystem.
2. Server software configured to start on boot.
3. Shares on UNIX-like OS are normally configured in the appropriate configuration file for the server program. Common examples:
   (a) `/etc/exports` file defines NFS exports (shares)
   (b) `exportfs` command can be used to manage NFS exports
   (c) `/etc/smb.conf` or similar Samba configuration file sets up SMB shares

4. Windows OS allows configuration of shares from file explorer view or PowerShell.
5. Storage may be provisioned on a local disk or may be on a LUN from a SAN.

2.2 Storage appliance

A number of vendors supply NAS devices that can, as a minimum provide SMB and/or NFS services. Often support many other services. Key vendors: Synology, QNAP. Points to note:

- Often 2 and 4-bay disk setup with RAID and/or LVM.
- Usually built on Linux or FreeBSD internally with a custom web-based management application on top.
- Some NAS-type devices also contain iSCSI Target Servers allowing SAN-type LUNs to be configured. These are normally backed either by LVM volumes or disk images.
- May be possible to connect to a LUN as if it were an internal disk.
- Low-power, quiet and useful in domestic (music, backup, video sharing) and light-commercial settings.

2.3 NAS gateway

A NAS gateway / NAS head / protocol converter delivers NAS shares from SAN volumes:

High-performance embedded dedicated storage appliance that may have hardware acceleration.

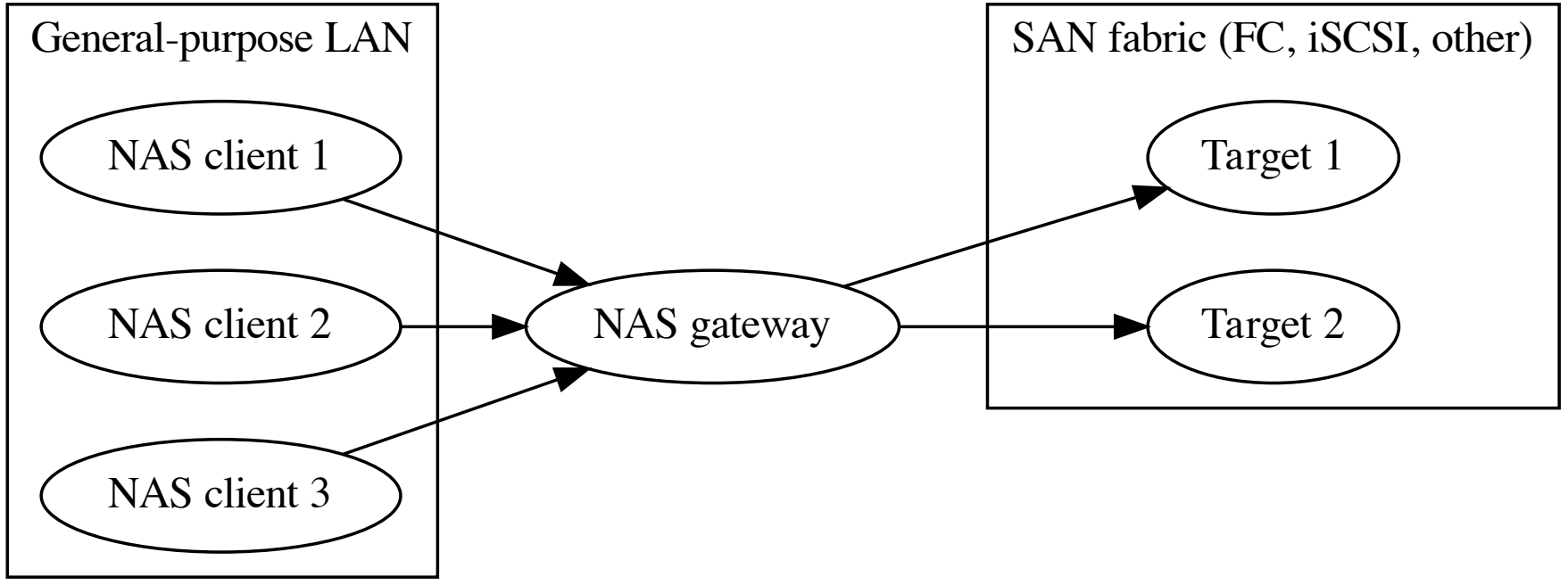

Figure 2: NAS head