Distributed Computing (2021)

Distributed File System

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Features of a Good File System

- Transparency: Network (access), Location, replication, Migration, Concurrency, Failure
- User Mobility:
- Performance Measurements:
- Heterogeneity
- Scalability:

File Access Models

Files which are available on servers can be made available to the users using two file models:

Upload/download model or caching model: In this, the operation of read() would fetch the entire file from the server and a write() operation copies the file back to the server disk.

Disadvantages:

• Even if small amount of data is required from the client, it would still require DFS to fetch the entire file, thus wasting client resources and network bandwidth.

• Concurrent access to the file requires to be handled, increasing the complexity.

• If client cache does not have the space for the large server file, this also requires to be dealt with.

2. Remote access or Remote service model: In this, the file system uses remote operations such as

Open, close, read, write, get attributes, etc. The copy of the file resides on the server only.

Disadvantages:

• The server is continuously being accessed for the entire duration of file access.

• The server resources are used.

File Sharing Semantics

- Unix Sequential Semantics
- Session Semantics
- Immutable Shared File semantics
- Transaction Like Semantics

Unix File Sharing Semantics

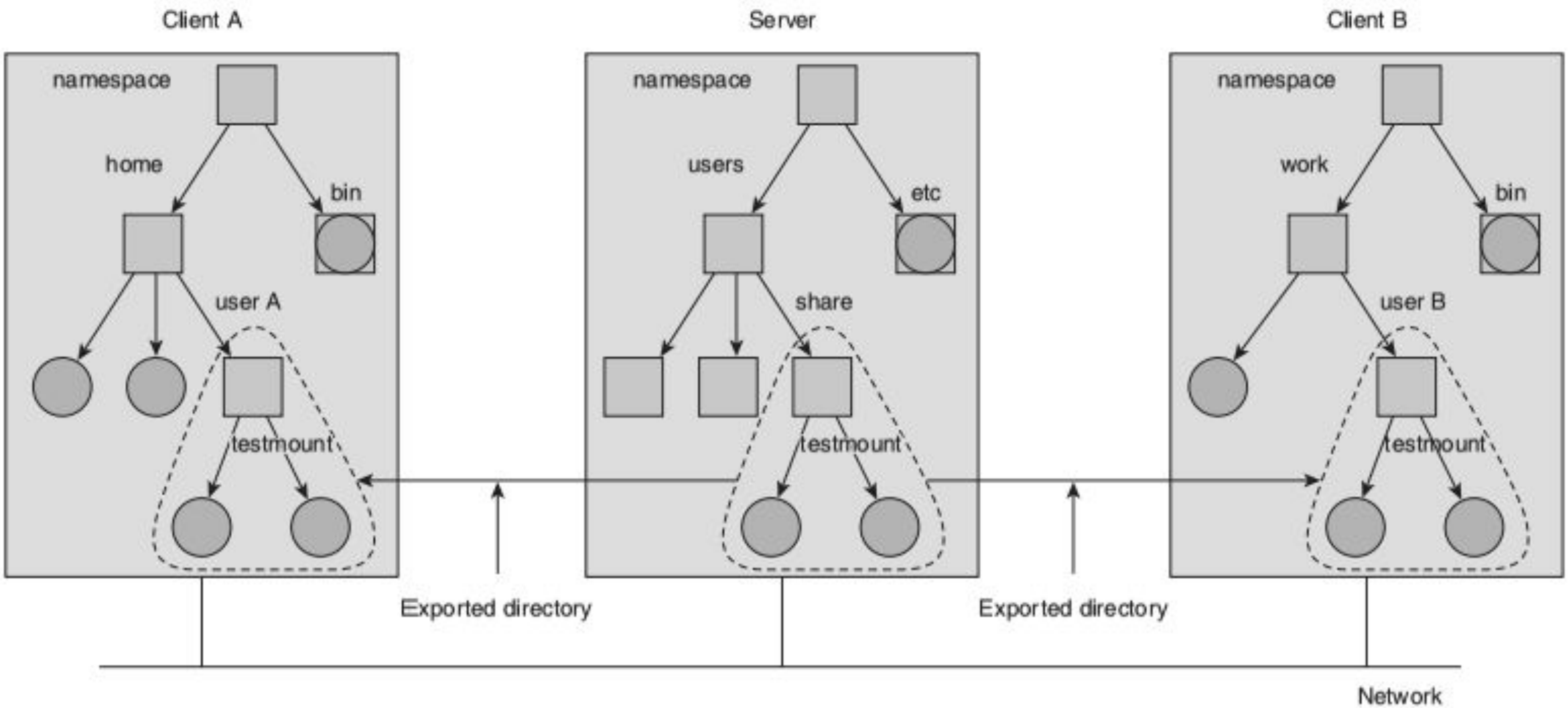
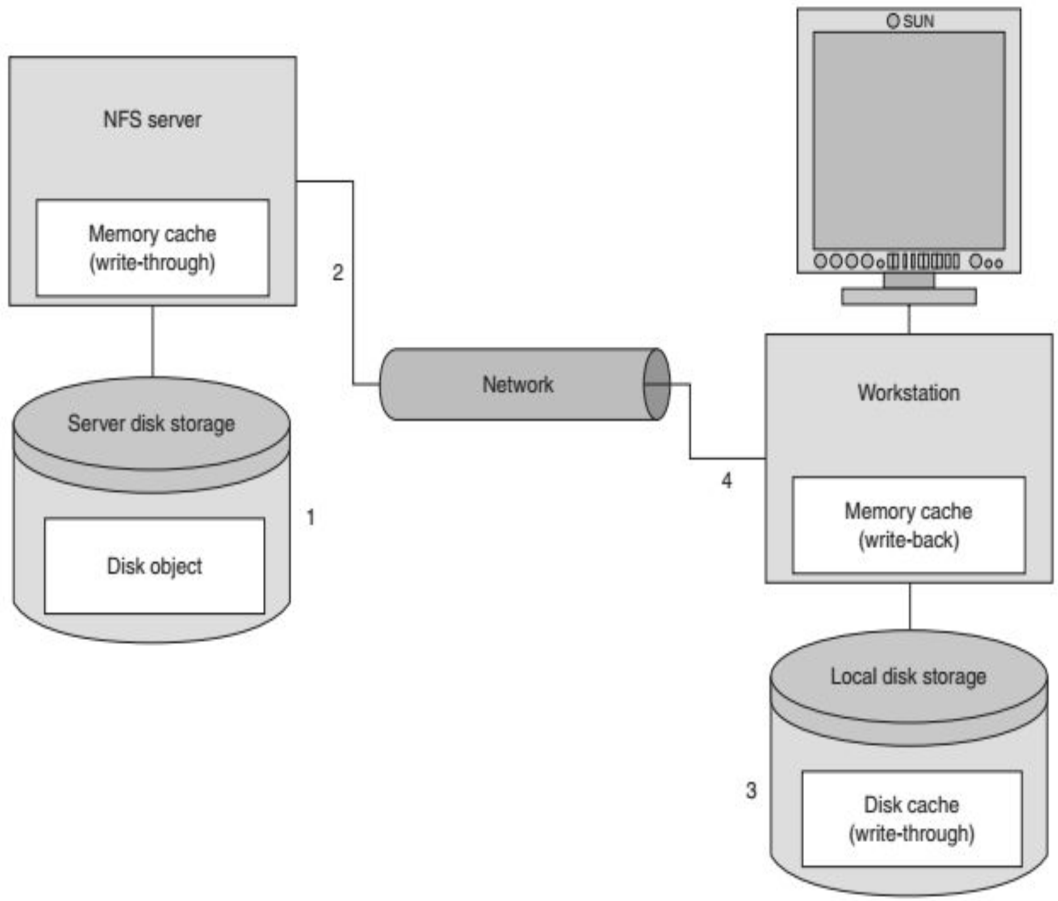


Figure 8.14 Name Space: Unix Mount Semantics.

```
mount -t type device destination_dir
```

Caching

- Cache Granularity
- Location of the client's cache:
- Modification propagation:
  - Write-through:
  - Delayed writes:
  - Write on close:
  - Centralized control
- Cache validation:
  - Client-initiated approach:
  - Server-initiated approach:



Distributed File System

1. **Transparency:**
    (a) **Network transparency:** It means that client uses the same operations to access the local as well as remote files. The client interface of a DFS does not distinguish between local and remote files. This is also known as access transparency.

    (b) **Location transparency:** A consistent name space exists for local and remote files. The name of a file does reveal its location.

    (c) **Replication transparency:** To support scalability and fault tolerance, files may be replicated across multiple servers. Clients should not be aware which replica has been used.

    (d) **Migration transparency:** It means that files should be able to move from one machine to another and DFS should support fine-grained distribution of data as required.

    (e) **Concurrency transparency:** This means that all process accessing the file see modifications in coherent fashion. All clients have the same view of the file system.

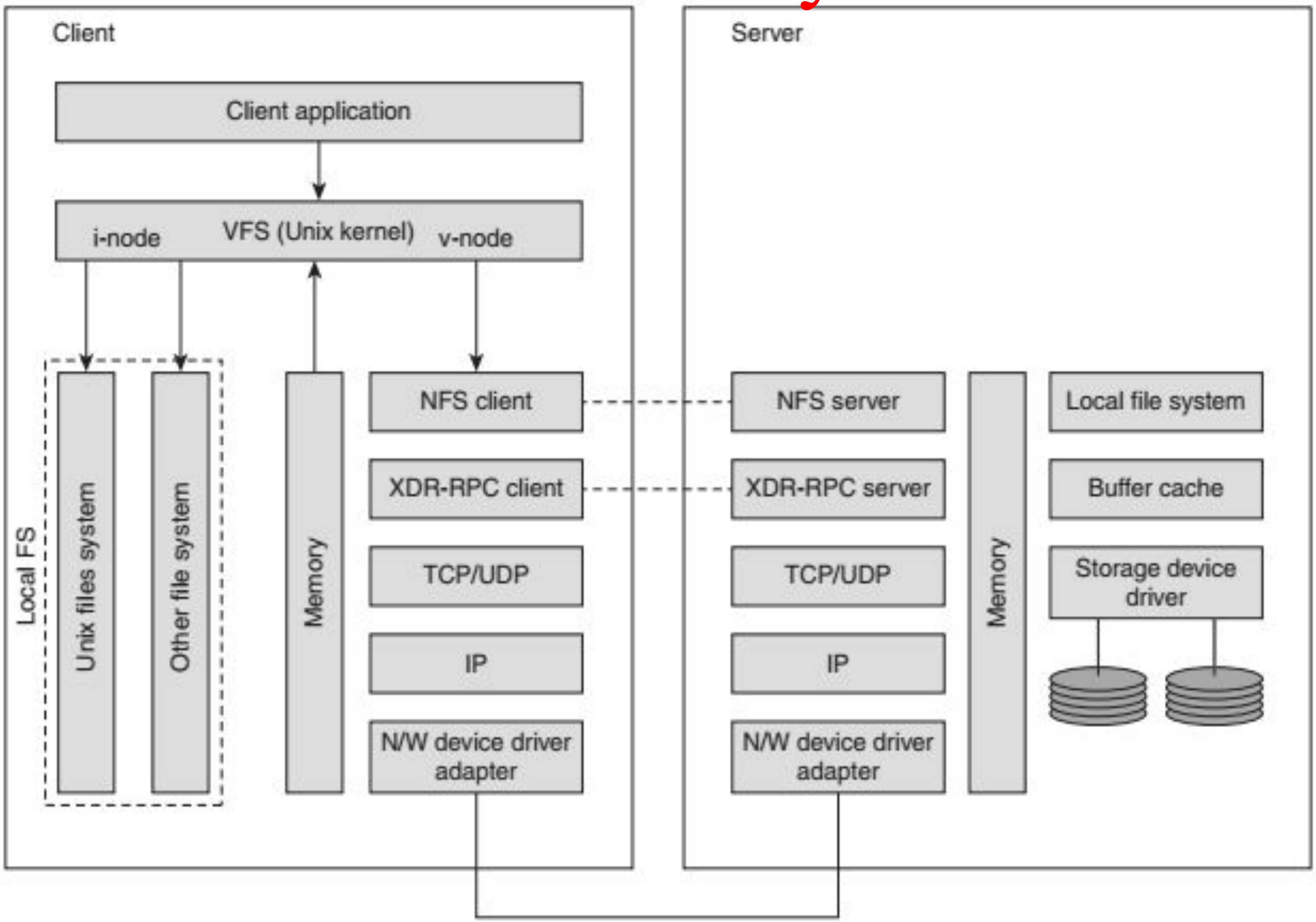
    (f) **Failure transparency:** DFS should be fault tolerant, that is client program should operate correctly after a server failure, communication faults, storage device crashes.

2. **User mobility:** User should be able to access the file from any machine. The DFS should facilitate this by bringing the user's environment (e.g., home dir) to whichever machine he logs in from.

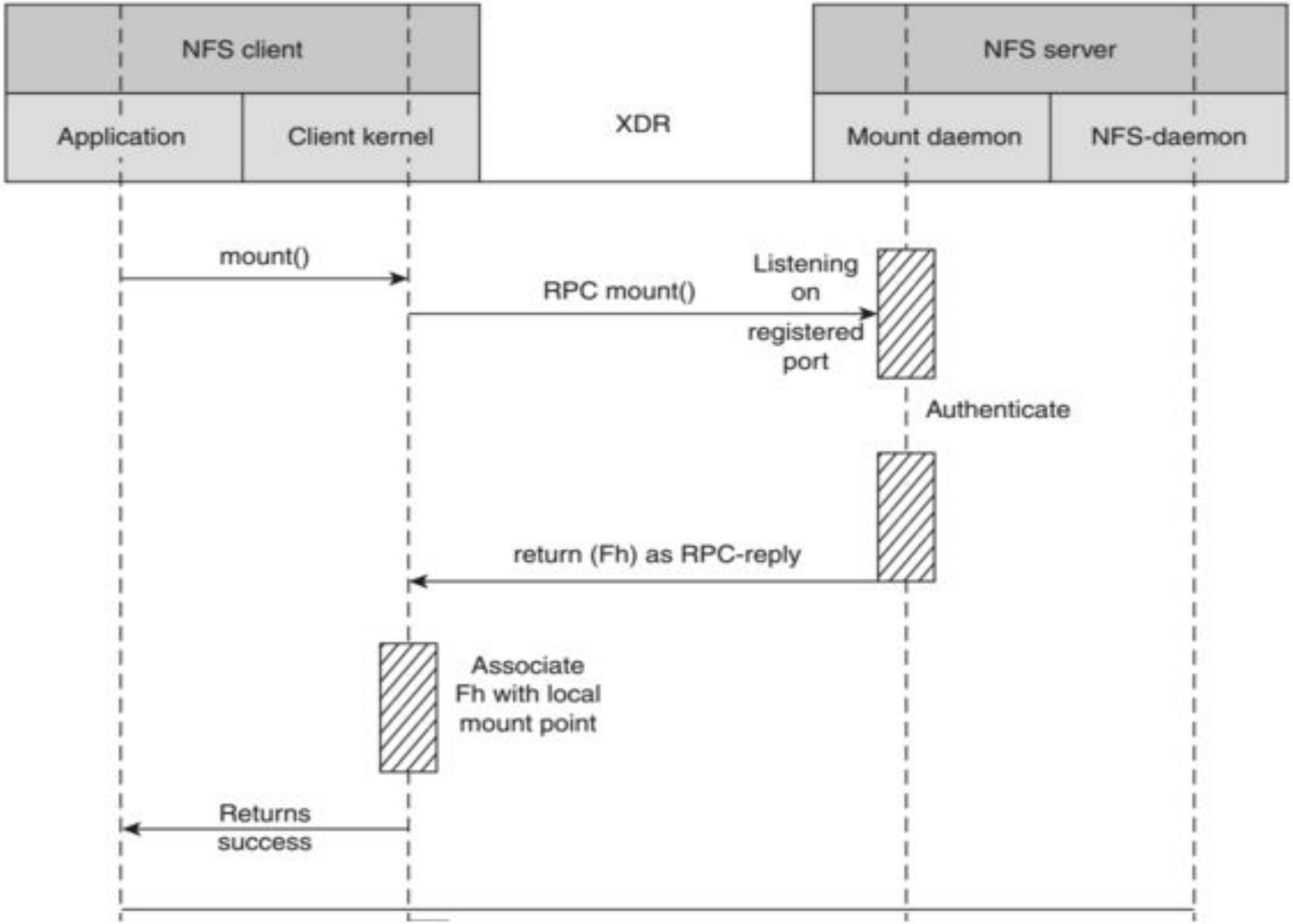
3. **Performance measurement:** The time to service a file access request of a DFS should be comparable to that of conventional file system.

4. **Heterogeneity:** File services should be provided across different operating systems and hardware platforms.

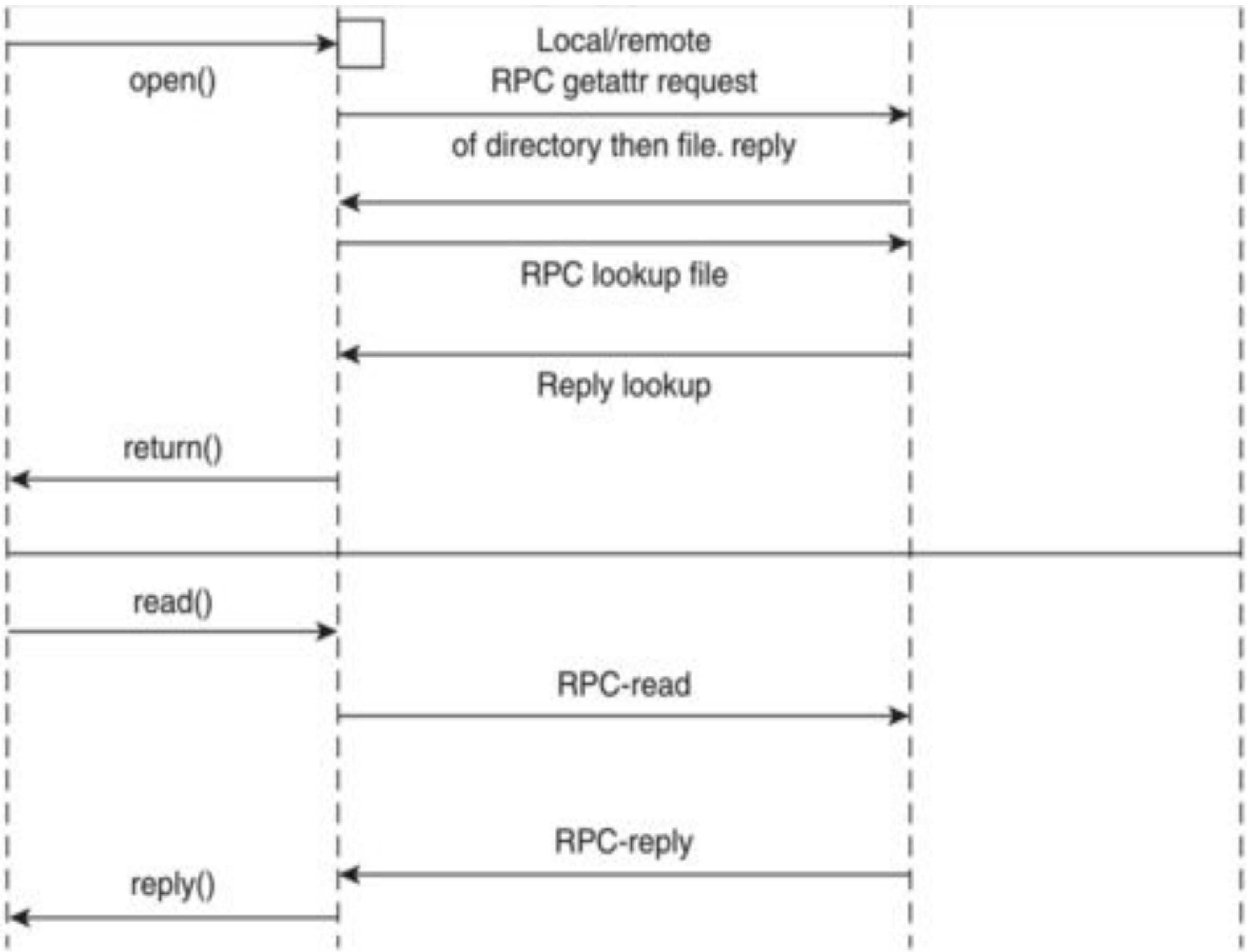
Network File System



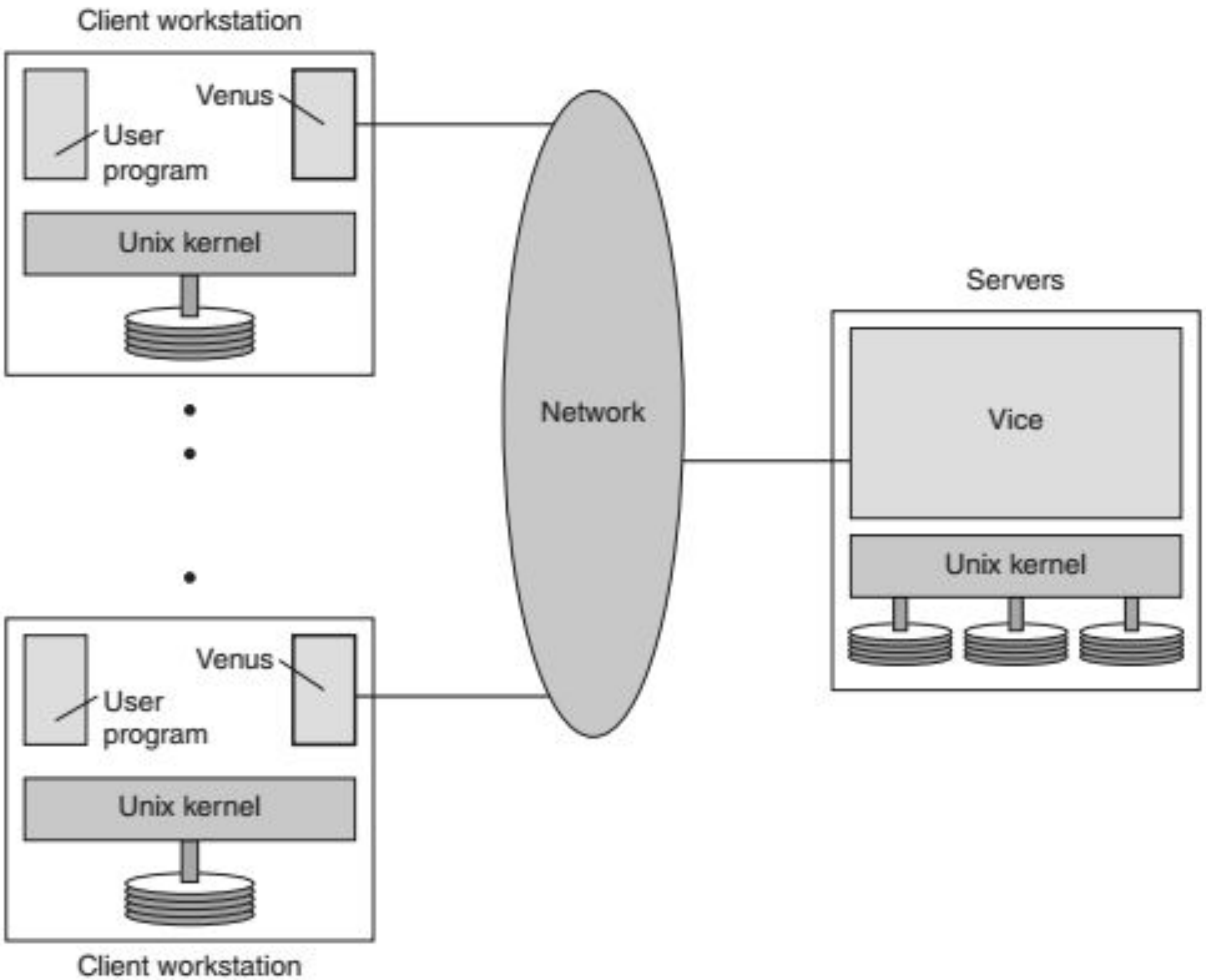
Network File System



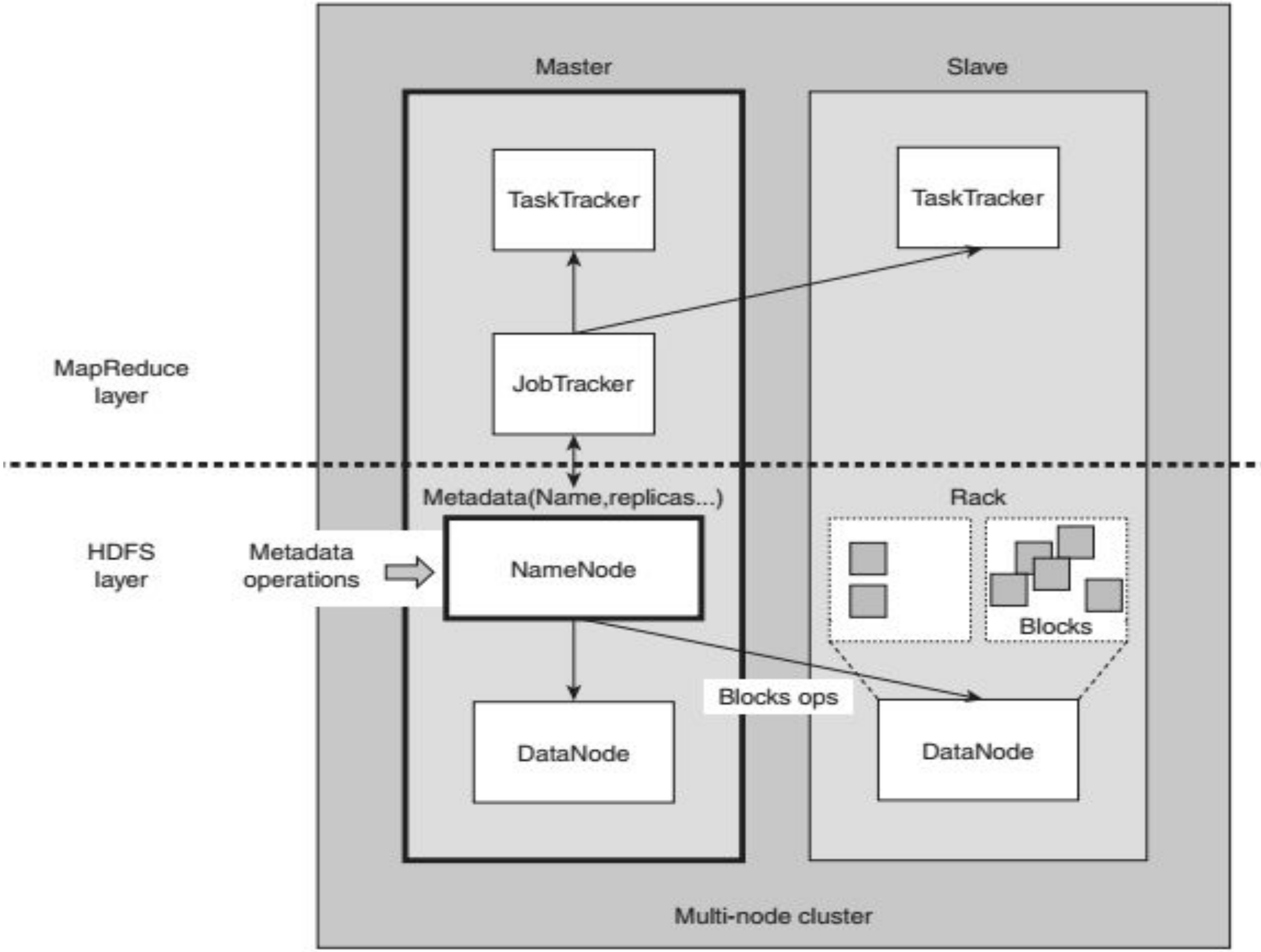
Network File System



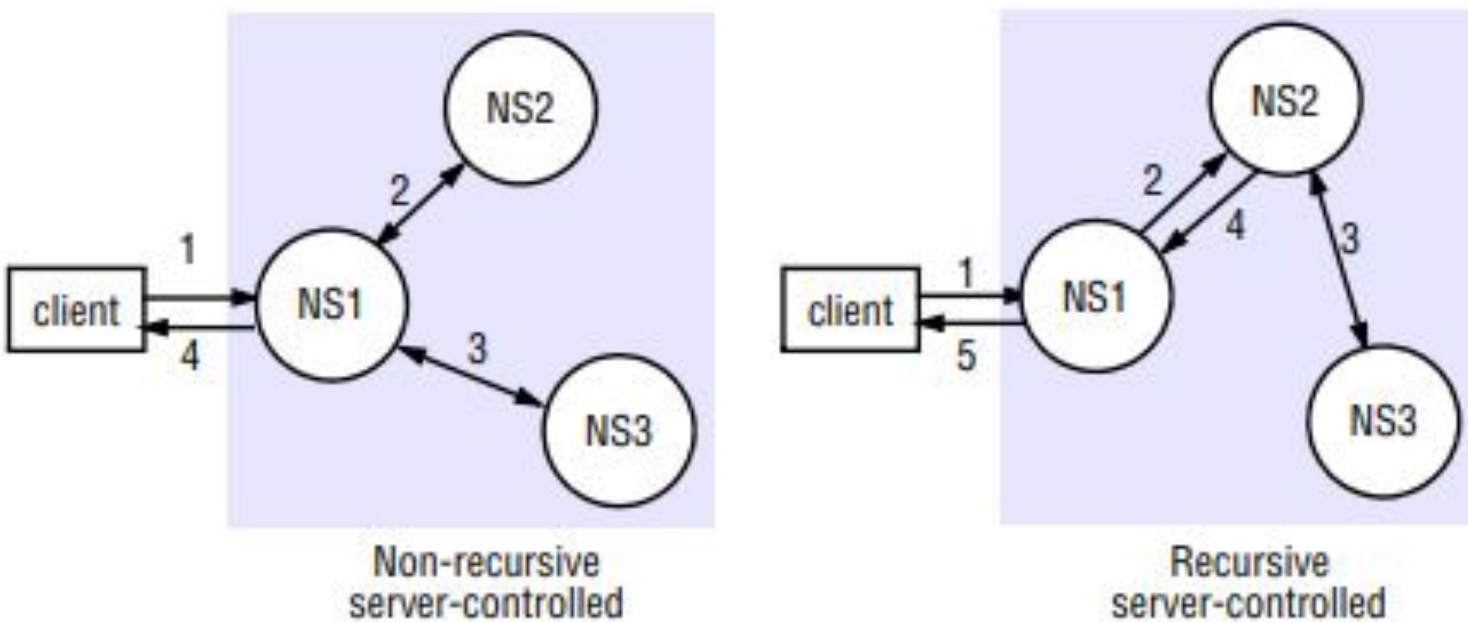
Andrew File System



Hadoop Distributred File System



Naming

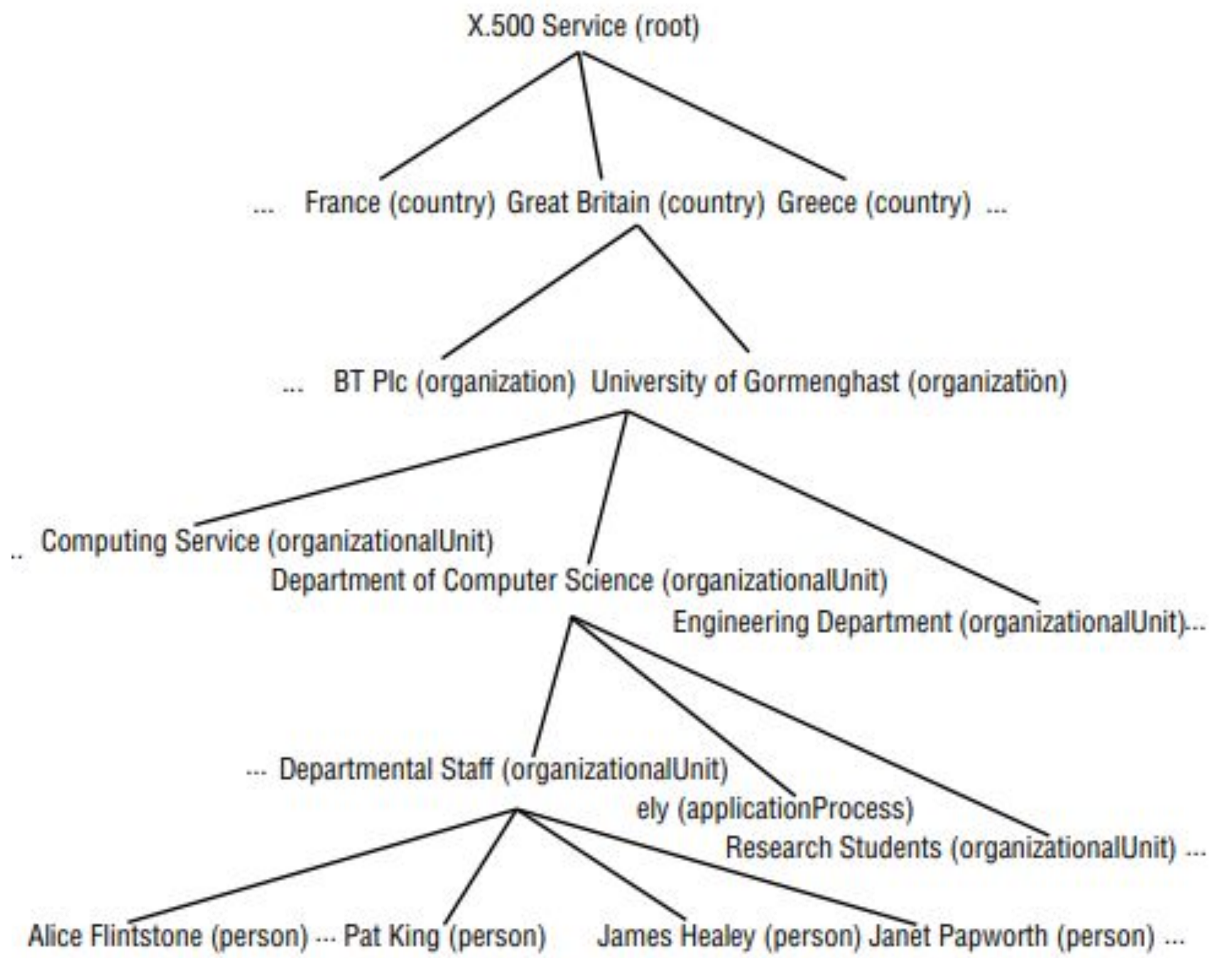


A name server NS1 communicates with other name servers on behalf of a client

DNS:RR

Record type	*Meaning*	*Main contents*
A	A computer address (IPv4)	IPv4 number
AAAA	A computer address (IPv6)	IPv6 number
NS	An authoritative name server	Domain name for server
CNAME	The canonical name for an alias	Domain name for alias
SOA	Marks the start of data for a zone	Parameters governing the zone
PTR	Domain name pointer (reverse lookups)	Domain name
HINFO	Host information	Machine architecture and operating system
MX	Mail exchange	List of <*preference*, *host*> pairs
TXT	Text string	Arbitrary text

X.500



X.500 Service (root)
... France (country) Great Britain (country) Greece (country) ...
... BT Plc (organization) University of Gormenghast (organization)
.. Computing Service (organizationalUnit)
Department of Computer Science (organizationalUnit)
Engineering Department (organizationalUnit)...
... Departmental Staff (organizationalUnit)
ely (applicationProcess)
Research Students (organizationalUnit) ...
Alice Flintstone (person) ... Pat King (person) James Healey (person) Janet Papworth (person) ...