Network Services and Applications

1 Network Services and Applications

1.1 File Transfer

1.1.1 FTP

1.1.1.1 Overview

- **FTP** and **TFTP** were key file transfer protocols in the early internet era.
- They are used for transferring files between hosts on IP networks.

1.1.1.2 FTP Basics

1.1.1.2.1 Transfer Modes

- **ASCII Mode:** For text files (.txt, .log, .cfg)
  - Converts characters to ASCII code for efficient transfer.
  - Recommended for network device config files and logs.

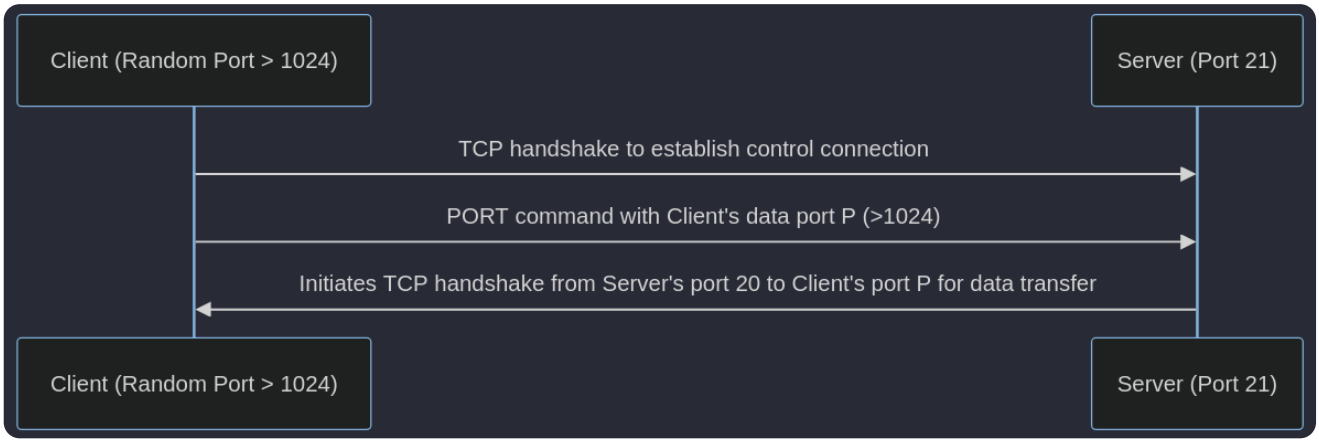
- **Binary Mode:** For non-text files (.cc, .bin, .exe, .png)
  - Transfers data without conversion.
  - Recommended for executable programs and images.

1.1.1.2.2 Client/Server Architecture

- FTP operates on a client/server model.
- A TCP connection is established between the FTP client and server to upload or download files.

1.1.1.3 FTP Transfer Process

1.1.1.3.1 Active Mode (PORT)

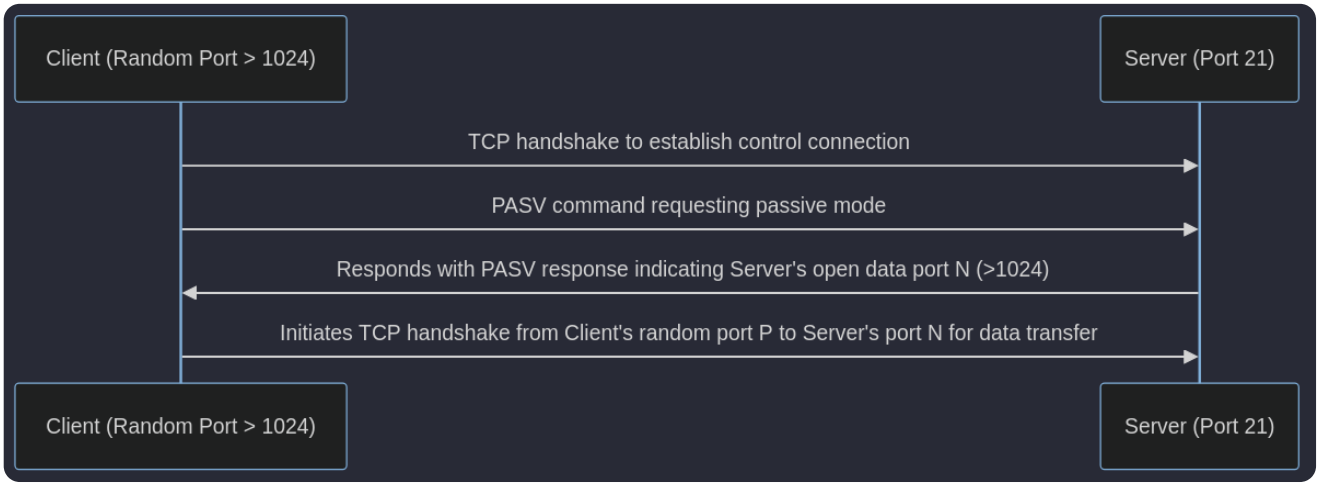


- The client informs the server of its listening data port using the PORT command.
- The server connects back to this port from its data port (20) to establish a data connection.

> **Port greater than** 1024**:** dynamic/private ports, can generally be used

without any restrictions or need for IANA registration.

1.1.1.3.2 Passive Mode (PASV)



- The server informs the client of its listening data port using the PASV response.
- The client connects to this open server port to start transferring data.

Modes

- **In active mode,** issues may arise with NAT devices blocking incoming connections from the server.
  - Issues can arise if the client is behind a NAT (Network Address Translation) device, like a router, which assigns a different IP address to your machine than the one visible on the internet. Because of this, when the server tries to connect back to the client's data port, the NAT device may not know how to route this incoming connection from an outside source and could block it.
- **In passive mode,** firewall restrictions may prevent outgoing connections from the client.
  - issues might occur if there are strict firewall settings at the client side that prevent outgoing connections to random high-numbered ports that servers typically use in passive mode.

1.1.1.4 Configuration Commands

1.1.1.4.1 As FTP Server

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1. **Enable FTP Server**
    - **Command:** `ftp <ipv6> server enable`

> By default, disabled.

2. **Configure Local User**

```Markdown
[Huawei]aaa
[Huawei]local-user <user-name> password irreversible-cipher <password>
[Huawei]local-user <user-name> privilege level <level>
[Huawei]local-user <user-name> service-type ftp
[Huawei]local-user <user-name> ftp-directory <directory>
```

> Setting up local users on an FTP server helps control who can get in, what they can do, where they go, and keeps things safe and tidy.

> The `ftp-directory` command assigns a specific starting folder for a user's FTP session on a Huawei device.

> Level must be at least level 3.

1.1.1.4.2 As FTP Client

1. **Accessing FTP Server**

```Markdown
<FTP Client>   ftp <server IP>
```

2. **Common Commands**

Command	Description
ascii	Set file transfer type to ASCII
binary	Set file transfer type for binary images
ls	List directory contents
passive	Toggle passive mode; default is on
get	Download remote file
put	Upload local file

1.1.2 TFTP

1.1.2.1 Overview

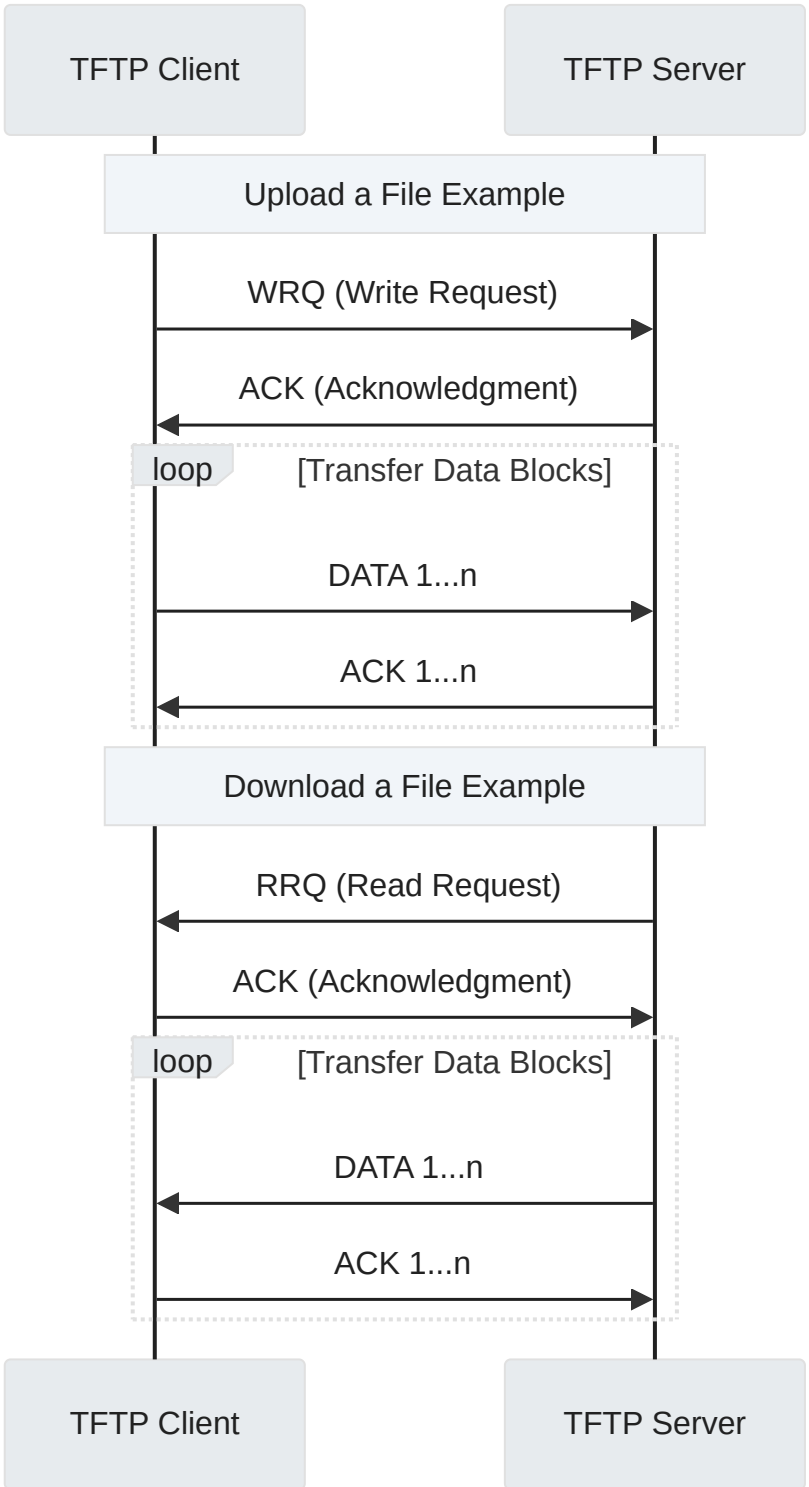
- TFTP is simpler than FTP; designed for transferring small files.
- It uses UDP on port 69, which makes it less reliable but faster for small transfers.
- No authentication is necessary to transfer files.
- Users can upload or download files but cannot see the server's file directory.

> See specefic files or folder like sharing in onedrive

1.1.2.2 Key Differences from FTP

- `Authentication` : TFTP does not require user authentication.
- `Protocol` : Uses UDP instead of TCP.
- `Complexity` : Easier implementation with fewer features.

1.1.2.3 How TFTP Works



1.1.2.3.1 Packet Formats

Type	Description
RRQ	Read Request Packet
WRQ	Write Request Packet
DATA	Data Transmission Packet
ACK	Acknowledgment Packet
ERROR	Error Control Packet

1.1.2.4 Configuration Commands

When using a Huawei VRP device as a TFTP client:

1.1.2.4.1 Downloading Files

```Markdown
<HUAWEI> tftp <tftp_server> get <filename>
```

1.1.2.4.2 Uploading Files

```Markdown
<HUAWEI> tftp <tftp_server> put <filename>
```

> Note that VRP devices(Huawei) only function as TFTP clients.

1.2 Telnet

1.2.1 Overview

- Telnet allows **device management using commands**.
- **No dedicated cable** needed; operates over IP networks on TCP port 23.

1.2.2 Devices

- Devices managed through Telnet are called **Telnet servers**.
- Devices connecting to these are **Telnet clients**.
- Network devices like ACs, APs, firewalls, routers, switches can be both server and client.

1.2.3 VTY User Interface

1.2.3.1 Purpose

- Allocates a user interface for managing sessions when logged in via console port or Telnet.

1.2.3.2 Configuration Parameters

- Authentication mode
- User privilege level after login

1.2.3.3 Configuration Commands

1.2.3.3.1 Enabling Telnet Server Function

```
[Huawei] telnet server enable
```

> By default, the Telnet server function is disabled.

1.2.3.3.2 Creating virtual interface

```
[Huawei] user-interface vty <first-ui-number> <last-ui-number>
```

> The `first-ui-number` and `last-ui-number` specify the starting and ending VTY line numbers, respectively, for configuring remote access on a Huawei device.

1.2.3.3.3 Configuring Protocols

```
[Huawei-ui-vty0-4] protocol inbound <all>||<telnet>||<ssh>
```

> **Default:** Supports SSH and Telnet.

1.2.3.3.4 Setting Authentication Mode and Password

```
[Huawei-ui-vty0-4] authentication-mode <aaa>||<non>||<password>
[Huawei-ui-vty0-4] set authentication password cipher <password>
```

> By default, no default authentication mode is available.

1.2.3.3.5 Connect via telnet

```
<Host>telnet <ip-address>
```

- `<ip-address>` : ip address of telnet server

1.3 DHCP

1.3.1 Key Issues with Manual Network Configuration

- **Complex Parameters**: Not user-friendly; leads to misconfigurations.
- **Workload**: Administrators face repetitive tasks and heavy workloads.
- **Utilization**: Fixed IP addresses lead to low utilization as some remain unused.
- **Flexibility**: Lack of flexibility when moving between networks or offices.

1.3.2 DHCP Overview

1.3.2.1 Working Principle

- **Dynamic Host Configuration Protocol (DHCP)** automates IP address assignment.
- Uses a client/server model for host plug-and-play connectivity.

1.3.2.2 Advantages of DHCP

Feature	Description
Unified Management	Centralized IP address assignment and management.
IP Address Lease	Temporary allocation with defined lease time improves utilizations.

1.3.2.3 DHCP Process Explained

1. `DHCP Discover` **(Broadcast):** Client searches for a server.
2. `DHCP Offer` **(Unicast):** Server offers an IP address to the client.
3. `DHCP Request` **(Broadcast):** Client accepts the offer and informs all servers.
4. `DHCP ACK` **(Unicast):** Server acknowledges the client's use of the IP address.

1.3.2.4 Lease Renewal

- At 50% of lease time (`T1`), client tries to renew the lease unicastly with original server.
- At 87.5% of lease time (`T2`), client broadcasts request for any server's response if no previous acknowledgment received.

1.3.3 Configuration Commands Overview

1.3.3.1 To Enable DHCP:

```Markdown
[Huawei] dhcp enable
```

1.3.3.2 Interface Address Pool Commands:

```Markdown
[Huawei-Gigabitthernet0/0/0]dhcp select interface
[Huawei-Gigabitthernet0/0/0]dhcp server dns-list <ip-address>
[Huawei-Gigabitthernet0/0/0]dhcp server excluded-ip-address <start-ip-address> <end-ip-address>
[Huawei-Gigabitthernet0/0/0]dhcp server lease day <day> hour <hour> minute <minute> || unlimited
```

> Enable the interface to use the interface address pool to provide the DHCP server function.

> By default, the IP address lease is one day.

1.3.3.3 Global Address Pool Commands:

```Markdown
[Huawei]ip pool <ip-pool-name>
```

```
[Huawei-ip-pool-name]network ip-address mask <mask>|| <mask-length>
[Huawei-ip-pool-name]gateway-list <ip-address>
[Huawei-ip-pool-name]dns-list <ip-address>
[Huawei-ip-pool-name]lease day <day>  hour <hour> minute <minute> || unlimited
[Huawei-Gigabitthernet0/0/0]dhcp select global
```

> When you set `dhcp select global` on a Huawei router interface, it can assign IP addresses from any available pool that fits the network of the device asking for an IP.

> range of IP addresses that can be assigned dynamically in the global address pool.

1.4 HTTP

1.4.1 Overview

- The browser communicates with web servers using the HTTP protocol.
- A URL is entered into a browser to locate and request resources from a server.

1.4.2 Key Concepts

1.4.2.1 HTTP Protocol

- **HTTP**: Application layer protocol for communication between clients and servers.
  - Uses TCP/IP for transmission.
  - Operates in a client/server model.

1.4.2.2 URL Structure

- **URL (Uniform Resource Locator)**: Uniquely identifies the location of resources on the Internet.
  - Example: `www.huawei.com`

1.4.2.3 WWW Components

- **WWW**: World Wide Web, a system for accessing and sharing documents over the Internet.
- Comprised of:
  - **HTML** (Hypertext Markup Language): For document content display in browsers.
  - **HTTP** (Hypertext Transfer Protocol): For document transmission on the network.

- **URL** (Uniform Resource Locator): For specifying document locations on the network.

1.5 DNS

1.5.1 Overview of DNS

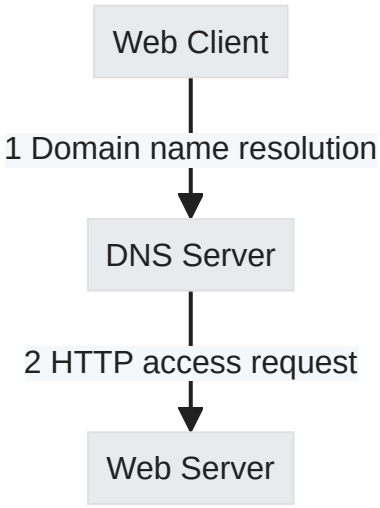
> **DNS** stands for Domain Name System, which is the protocol used for resolving domain names to IP addresses. It's essential for converting human-friendly domain names like `www.example.com` into machine-readable IP addresses like `192.168.1.1`.

1.5.2 Birth of DNS

DNS was created because the early internet, called ARPANET, got too big. Before DNS, there was a file (Host.txt) that listed all the computers on the network, but as more people started using the network, it became too hard to keep that file up to date and to make sure everyone's computer names were unique. DNS made it easier by automating this process.

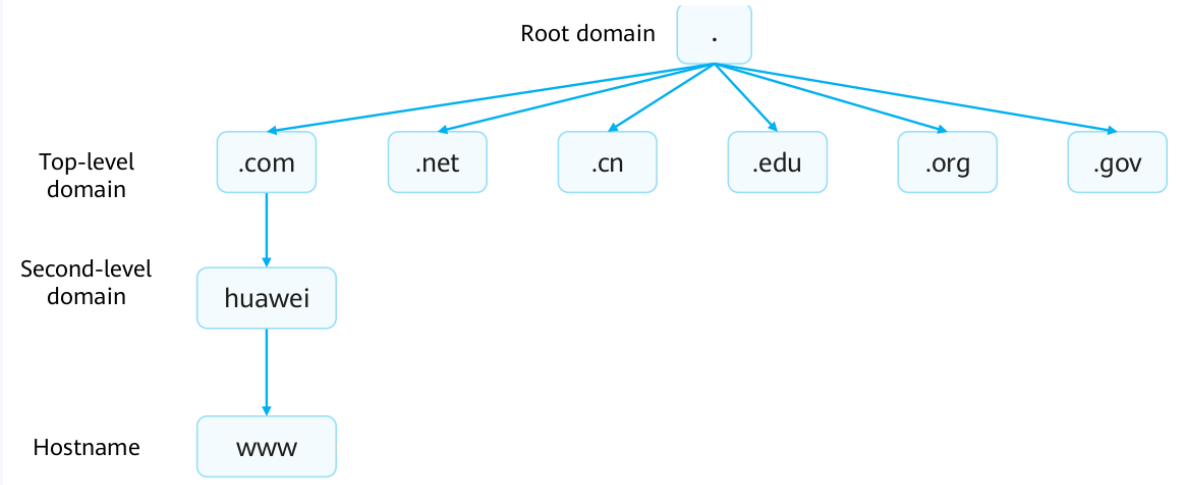
1.5.3 DNS Components

- **Domain Name**: A string used to identify hosts (e.g., www.huawei.com (http://www.huawei.com)).
- **DNS Server**: Manages mappings between domain names and IP addresses.



1.5.4 Domain Name Format

A domain name consists of multiple parts: `hostname.second-level domain.top-level domain.root domain`. The root domain is represented by a dot (`.`).

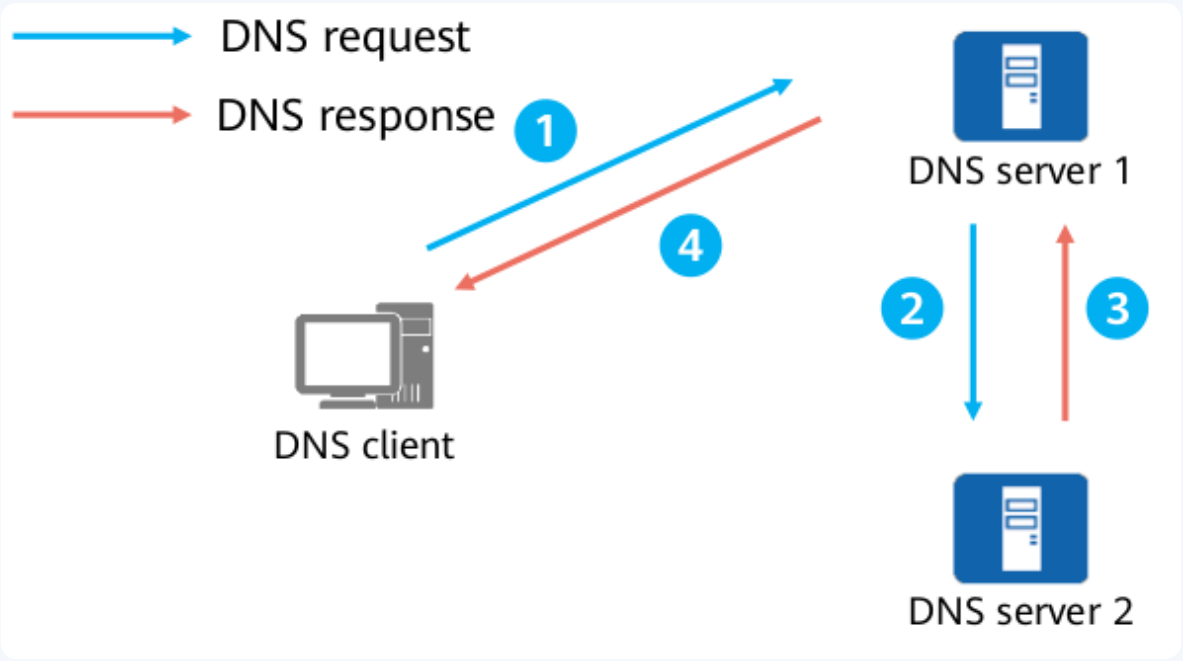


> Example: For `www.huawei.com`, `www` is the hostname, `huawei` is the second-level domain, and `.com` is the top-level domain.

1.5.5 DNS Query Modes

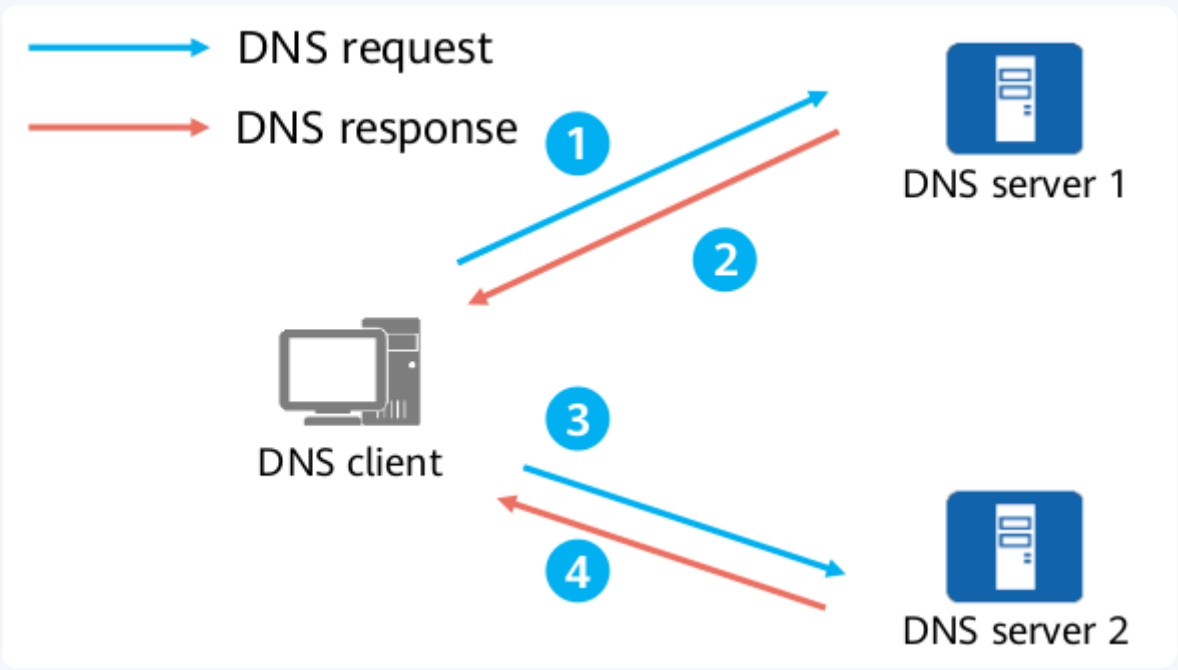
There are two query modes when a client needs to resolve a domain name:

1.5.5.1 Recursive Query



> 🔄 **Recursive Query**: The client requests a DNS server; if that server doesn't have the answer, the server queries other servers until it finds it.

1.5.5.2 Iterative Query



🔀 **Iterative Query**: The client requests a DNS server; if that server doesn't have the answer, it refers the client to another server.

In recursive queries, each server in chain resolves part of the address until reaching a result. In iterative queries, each server points to another one without doing extra work itself.

1.6 NTP

1.6.1 Time Synchronization Requirements

1.6.1.1 Network Management

- Logs/debug messages analysis requires consistent timestamps.

1.6.1.2 Charging System

- Devices must have synchronized clocks for accurate billing.

1.6.1.3 Collaborative Systems

- Ensures proper sequence for events handled by multiple systems.

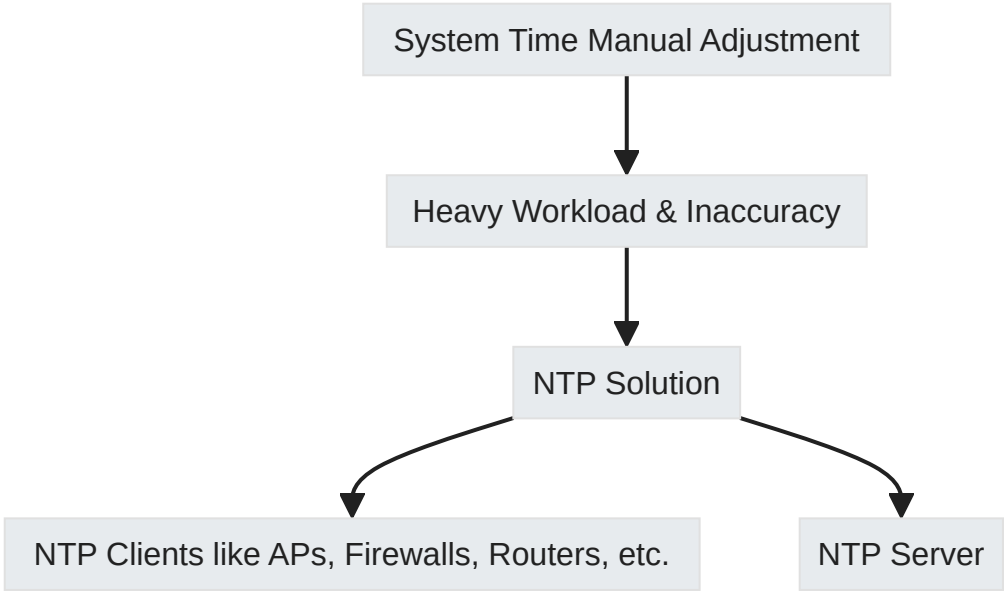
1.6.1.4 Incremental Backup

- Synchronization between backup server and clients is crucial.

1.6.1.5 System Time

- Timestamps needed for user login and file modification tracking.

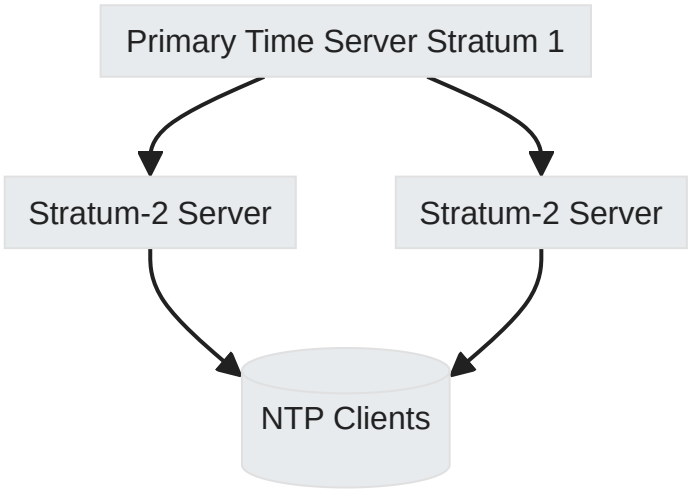
1.6.2 Overview



- **Protocol Layer**: Application layer of TCP/IP suite.
- **Transport**: Uses IP and UDP on port `123`.
- **Function**: Synchronizes time across devices.

> **Note**
>
> Manual adjustments are inefficient. NTP automates clock synchronization with high accuracy.

1.6.3 NTP Network Structure



Stratum Level	Description
1	Highest precision; uses a reference clock (e.g., GPS)
2	Syncs with Stratum 1 or other Stratum 2 servers
3 to 15	Lower precision; higher number indicates less precision

Tip

Smaller stratum value means higher precision for time synchronization.