JEREMY'S IT LAB

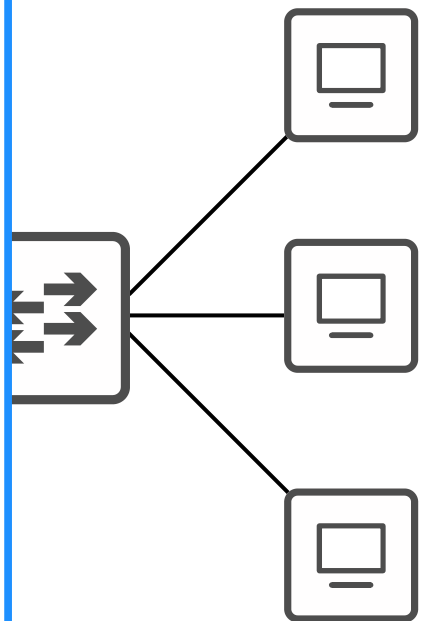
CCNA Day 43

FTP & TFTP

1.0 Network Fundamentals	20%
2.0 Network Access	20%
3.0 IP Connectivity	25%
4.0 IP Services	10%

4.1 Configure and verify inside source NAT using static and pools
4.2 Configure and verify NTP operating in a client and server mode
4.3 Explain the role of DHCP and DNS within the network
4.4 Explain the function of SNMP in network operations
4.5 Describe the use of syslog features including facilities and levels
4.6 Configure and verify DHCP client and relay
4.7 Explain the forwarding per-hop behavior (PHB) for QoS such as classification, marking, queuing, congestion, policing, shaping
4.8 Configure network devices for remote access using SSH
4.9 Describe the capabilities and function of TFTP/FTP in the network

5.0 Security Fundamentals	15%
6.0 Automation and Programmability	10%



Things we'll cover

- The purpose of FTP/TFTP
- FTP/TFTP functions & differences
- IOS File Systems
- Using FTP/TFTP in IOS

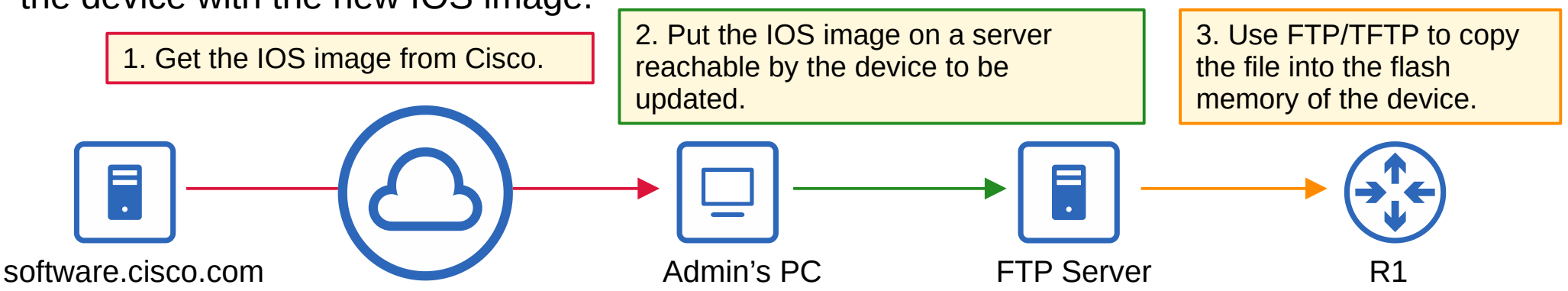
FTP & TFTP

- FTP (File Transfer Protocol) and TFTP (Trivial File Transfer Protocol) are industry standard protocols used to transfer files over a network.

- They both use a client-server model.
  → Clients can use FTP or TFTP to copy files from a server.
  → Clients can use FTP or TFTP to copy files to a server.

- As a network engineer, the most common use for FTP/TFTP is in the process of upgrading the operating system of a network device.

- You can use FTP/TFTP to download the newer version of IOS from a server, and then reboot the device with the new IOS image.



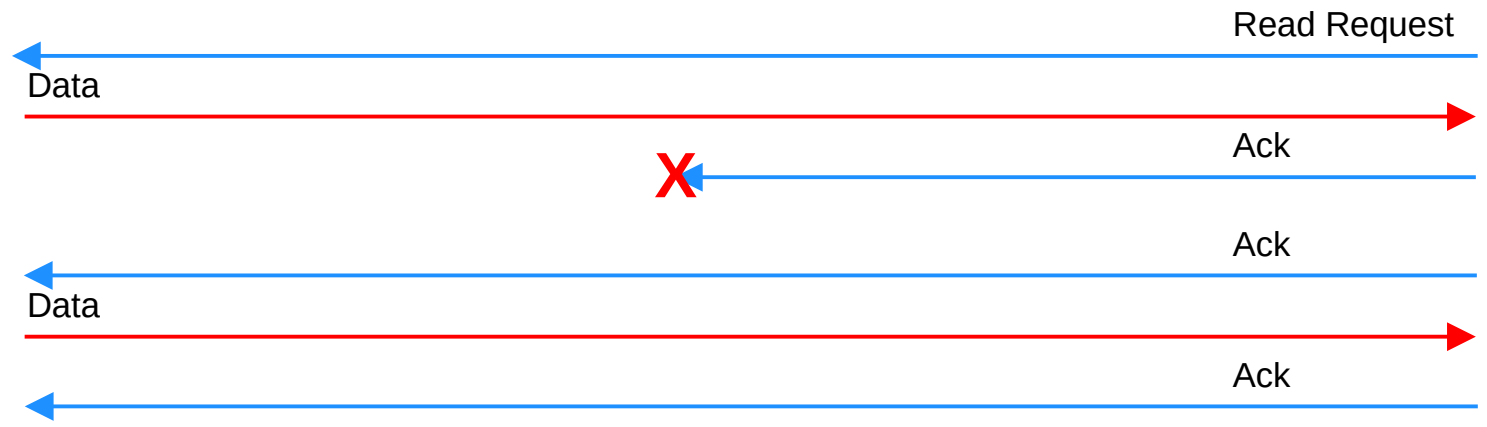
Trivial File Transfer Protocol

- TFTP was first standardized in 1981.
- Named ‘Trivial’ because it is simple and has only basic features compared to FTP.
  → Only allows a client to copy a file to or from a server.
- Was released after FTP, but is not a replacement for FTP. It is another tool to use when lightweight simplicity is more important than functionality.
- No authentication (username/PW), so servers will respond to all TFTP requests.
- No encryption, so all data is sent in plain text.
- Best used in a controlled environment to transfer small files quickly.
- TFTP servers listen on **UDP port 69**.
- UDP is connectionless and doesn’t provide reliability with retransmissions.
- However, TFTP has similar built-in features within the protocol itself.

TFTP Reliability

- Every TFTP data message is acknowledged.
  → If the client is transferring a file to the server, the server will send Ack messages.
  → If the server is transferring a file to the client, the client will send Ack messages.

- Timers are used, and if an expected message isn't received in time, the waiting device will re-send its previous message.



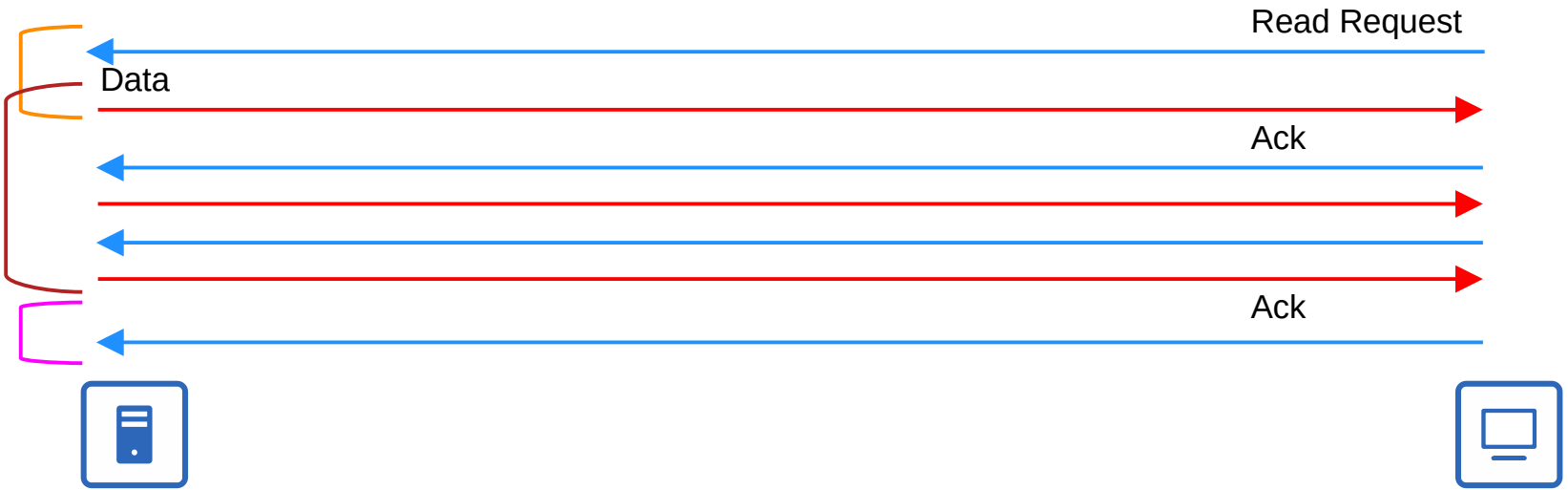
TFTP uses 'lock-step' communication. The client and server alternately send a message and then wait for a reply. (+retransmissions are sent as needed)

TFTP 'Connections'

- TFTP file transfers have three phases:
  1: **Connection**: TFTP client sends a request to the server, and the server responds back, initializing the connection.

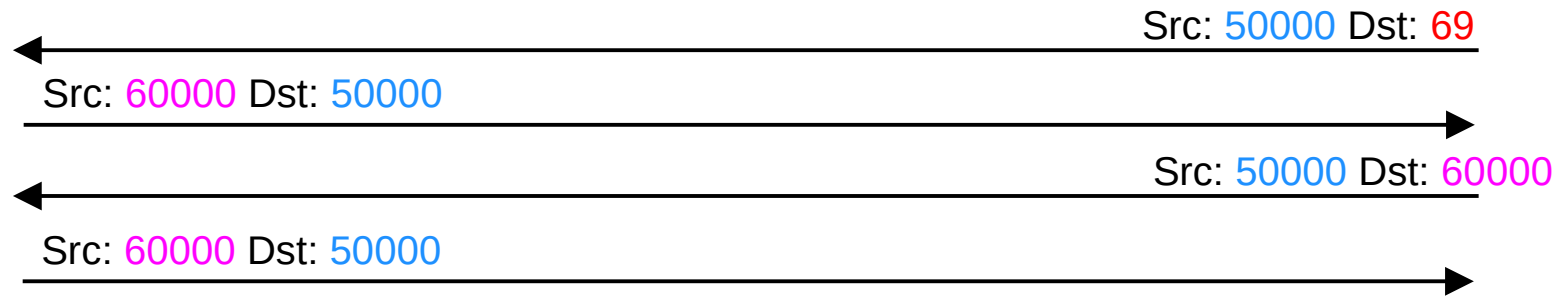
  2: **Data Transfer**: The client and server exchange TFTP messages. One sends data and the other sends acknowledgments.

  3: **Connection Termination**: After the last data message has been sent, a final acknowledgment is sent to terminate the connection.



TFTP TID

- When the client sends the first message to the server, the destination port is UDP 69 and the source is a random ephemeral port.
- This random port is called a 'Transfer Identifier' (TID) and identifies the data transfer.
- The server then also selects a random TID to use as the source port when it replies, **not 69**.
- When the client sends the next message, the destination port will be the server's TID, **not 69**.



*This is beyond the scope of the CCNA, but is an interesting part of TFTP's operation.

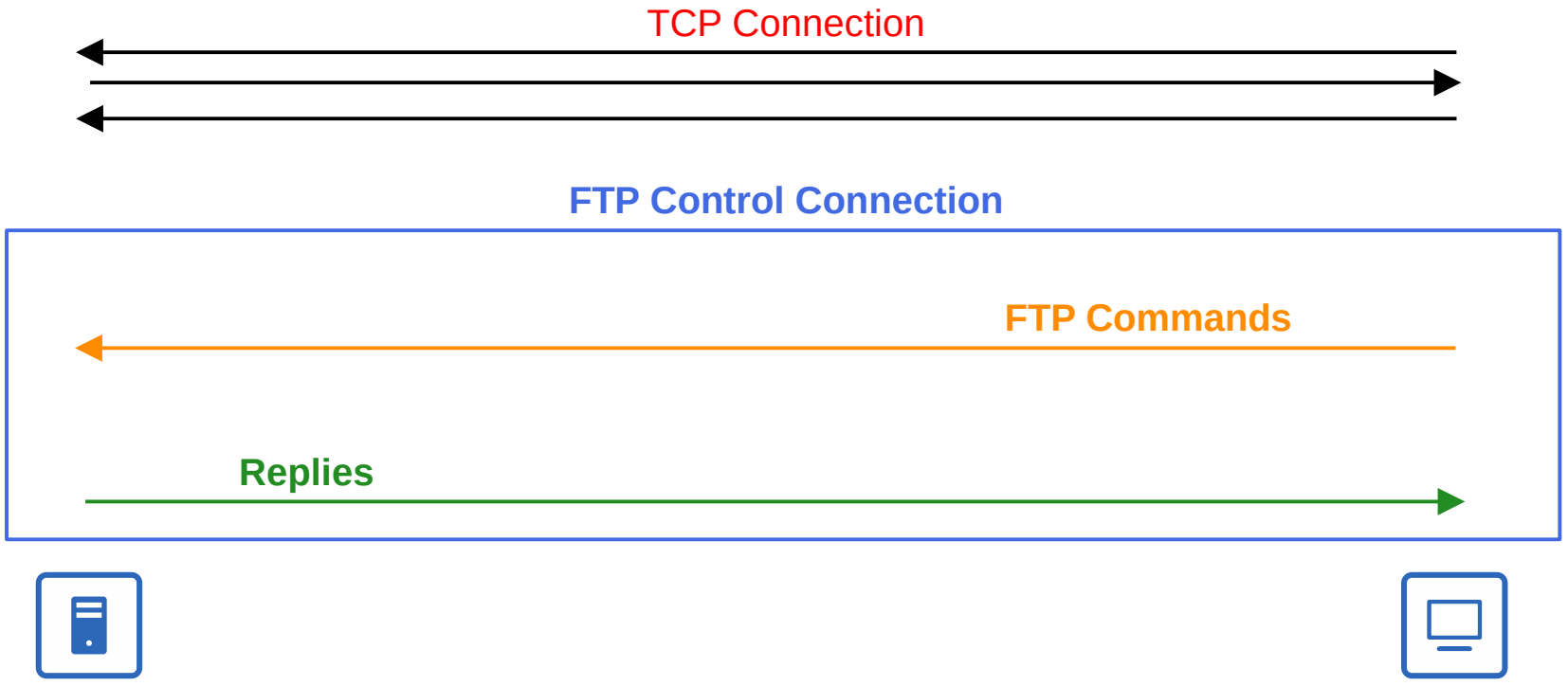
File Transfer Protocol

- FTP was first standardized in 1971.
- FTP uses **TCP ports 20 and 21**.
- Usernames and passwords are used for authentication, however there is no encryption.
- For greater security, FTPS (FTP over SSL/TLS) can be used. ← Upgrade to FTP
- SSH File Transfer Protocol (SFTP) can also be used for greater security. ← New protocol
- FTP is more complex than TFTP and allows not only file transfers, but clients can also navigate file directories, add and remove directories, list files, etc.
- The client sends *FTP commands* to the server to perform these functions.

https://en.wikipedia.org/wiki/List_of_FTP_commands

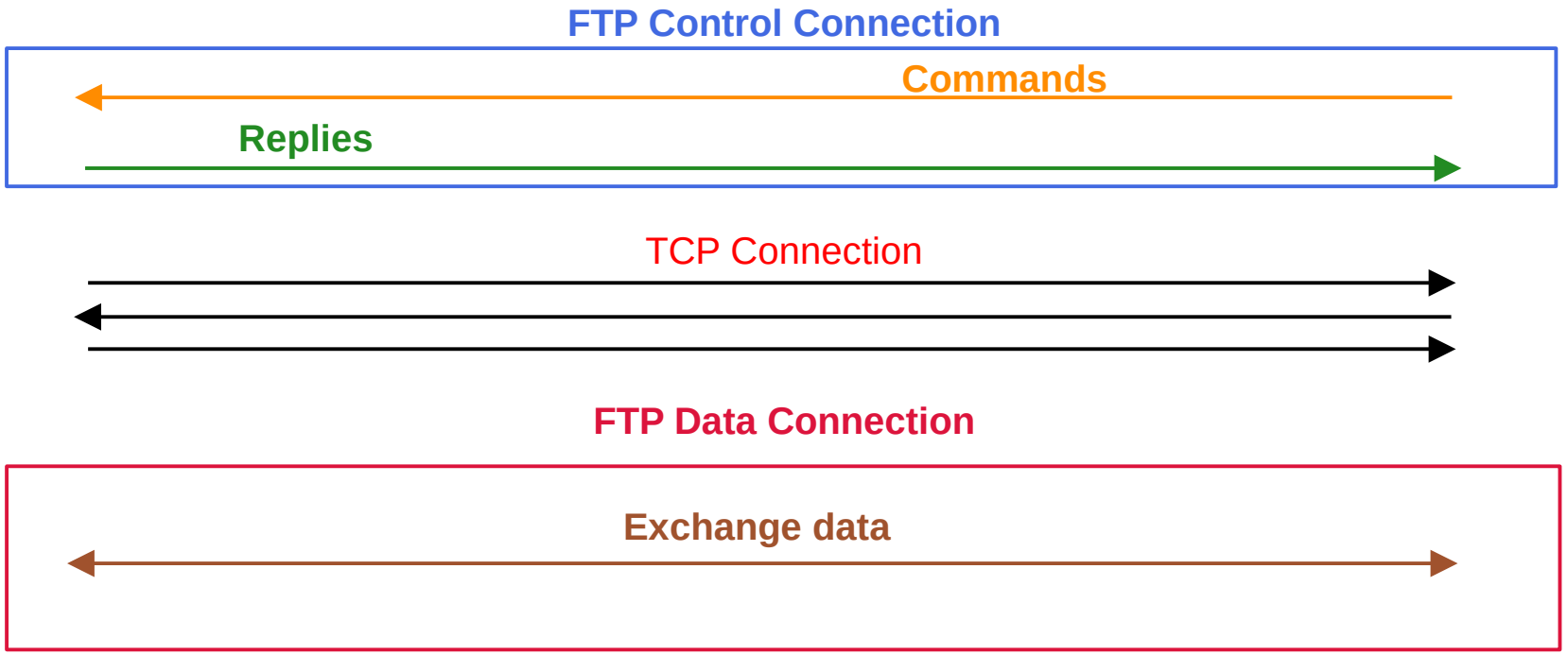
FTP Control Connections

- FTP uses two types of connections:
  → An **FTP control** connection (**TCP 21**) is established and used to send FTP commands and replies.
  → When files or data are to be transferred, separate **FTP data** (**TCP 20**) connections are established and terminated as needed.



Active Mode FTP Data Connections

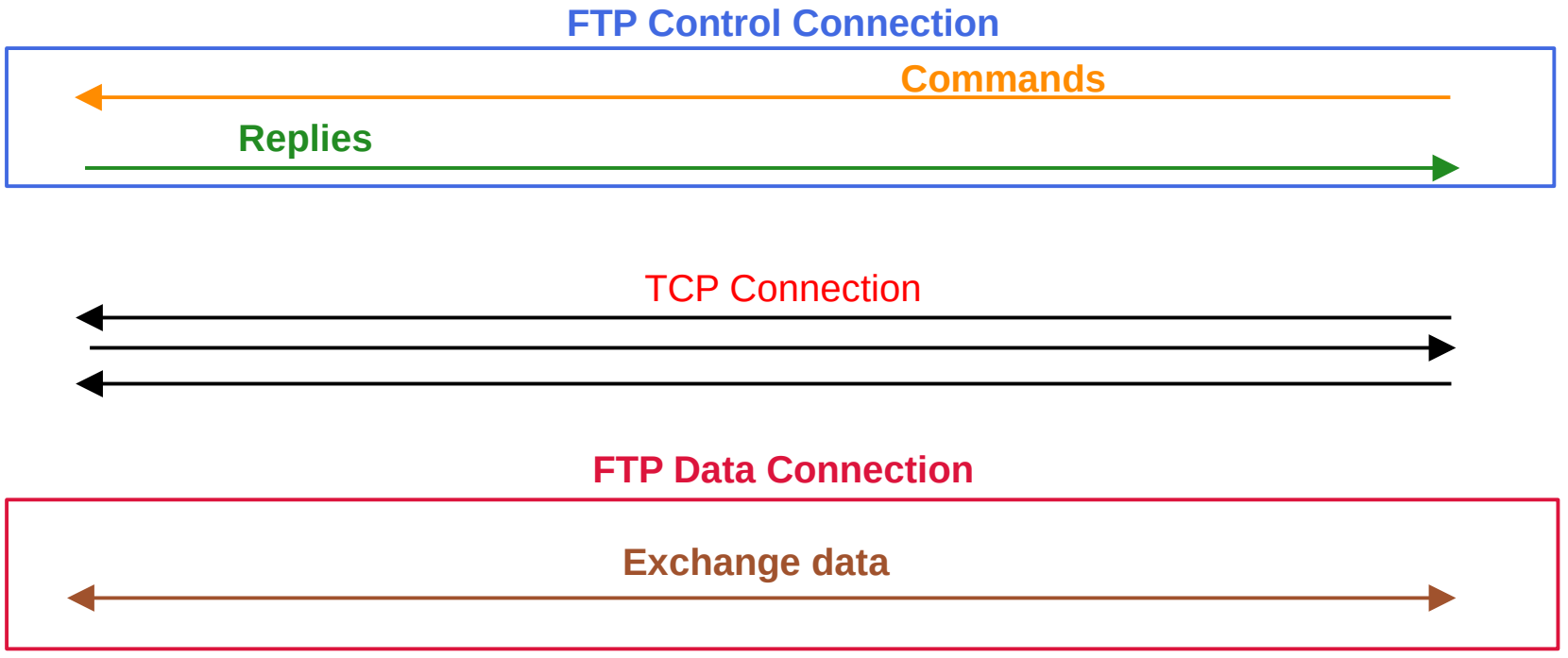
- The default method of establishing FTP data connections is **active mode**, in which the server initiates the TCP connection.



In FTP **active mode**, the server initiates the data connection.

Passive Mode FTP Data Connections

- In FTP **passive mode**, the client initiates the data connection. This is often necessary when the client is behind a firewall, which could block the incoming connection from the server.



FTP vs TFTP

FTP

-Uses TCP (20 for data, 21 for control) for connection-based communication

-Clients can use FTP commands to perform various actions, not just copy files

-Username/PW authentication

-More complex

TFTP

-Uses UDP (69) for connectionless communication (although a basic form of ‘connection’ is used within the protocol itself)

-Clients can only copy files to or from the server

-No authentication

-Simpler

IOS File Systems

- A file system is a way of controlling how data is stored and retrieved.
- You can view the file systems of a Cisco IOS device with **`show file systems`**

```
Router#show file systems
File Systems:

      Size(b)       Free(b)      Type  Flags  Prefixes
*   2142715904    1994403840      disk     rw   flash0: flash:#
          -             -         disk     rw   flash1:
     966656        962560         disk     rw   flash2:#
          -             -         disk     rw   flash3:
          -             -       opaque     rw   archive:
          -             -       opaque     rw   system:
     262144        256791        nvram     rw   nvram:
          -             -       opaque     rw   tmpsys:
          -             -      network     rw   snmp:
          -             -       opaque     rw   null:
          -             -      network     rw   tftp:
          -             -       opaque     ro   xmodem:
          -             -       opaque     ro   ymodem:
          -             -       opaque     wo   syslog:
          -             -      network     rw   rcp:
          -             -      network     rw   pram:
          -             -      network     rw   ftp:
[output omitted]
```

`disk`: Storage devices such as flash memory.

`opaque`: Used for internal functions

`nvram`: Internal NVRAM. The startup-config file is stored here.

`network`: Represents external file systems, for example external FTP/TFTP servers.

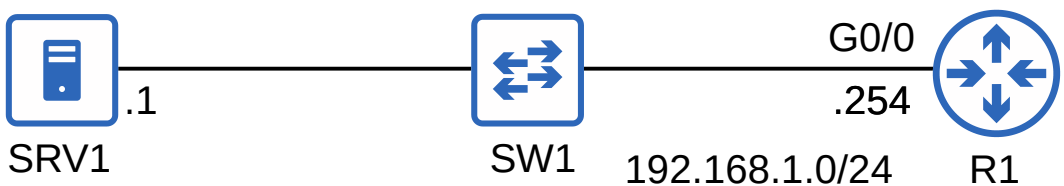
Upgrading Cisco IOS

- You can view the current version of IOS with **show version**

```
R1#show version
Cisco IOS Software, C2900 Software (C2900-UNIVERSALK9-M), Version 15.1(4)M4, RELEASE SOFTWARE
(fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Thurs 5-Jan-12 15:41 by pt_team
[output omitted]
```

- You can view the contents of flash with **show flash**

```
R1#show flash
System flash directory:
File  Length   Name/status
  3   33591768 c2900-universalk9-mz.SPA.151-4.M4.bin
  2   28282    sigdef-category.xml
  1   227537   sigdef-default.xml
[33847587 bytes used, 221896413 available, 255744000 total]
249856K bytes of processor board System flash (Read/Write)
```



Copying Files (TFTP)

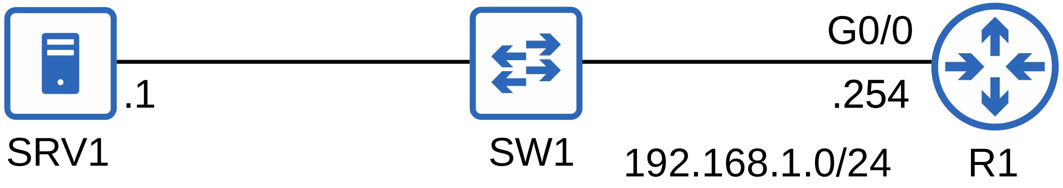
copy *source destination*

```
R1#copy tftp: flash:
Address or name of remote host []? 192.168.1.1
Source filename []? c2900-universalk9-mz.SPA.155-3.M4a.bin
Destination filename [c2900-universalk9-mz.SPA.155-3.M4a.bin]?

Accessing tftp://192.168.1.1/c2900-universalk9-mz.SPA.155-3.M4a.bin....
Loading c2900-universalk9-mz.SPA.155-3.M4a.bin from
192.168.1.1: !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 33591768 bytes]

33591768 bytes copied in 4.01 secs (879550 bytes/sec)
```

Enter the TFTP server IP.

Enter the file name on the server

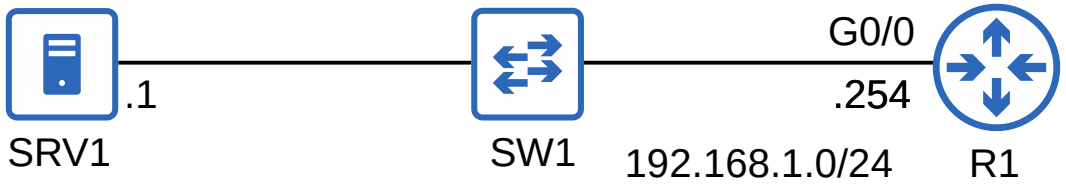
Enter the name you want to save it as on flash (hit enter to accept the default)



Upgrading Cisco IOS

```
R1#show flash

System flash directory:
File  Length   Name/status
  3   33591768 c2900-universalk9-mz.SPA.151-4.M4.bin
  4   33591768 c2900-universalk9-mz.SPA.155-3.M4a.bin
  2   28282    sigdef-category.xml
  1   227537   sigdef-default.xml
[67439355 bytes used, 188304645 available, 255744000 total]
249856K bytes of processor board System flash (Read/Write)


R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#boot system flash:c2900-universalk9-mz.SPA.155-3.M4a.bin
R1(config)#exit
R1#write memory
Building configuration...
[OK]
R1#reload
Proceed with reload? [confirm]
```

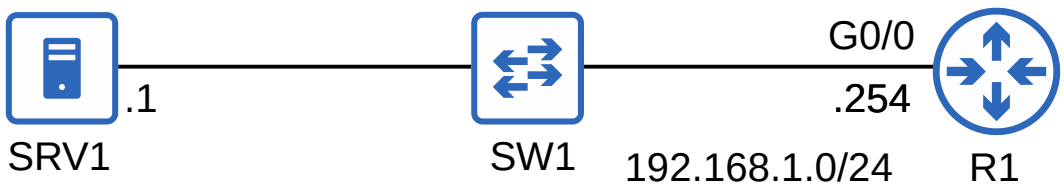
boot system *filepath*
*If you don't use this command, the router will use the first IOS file it finds in flash



Upgrading Cisco IOS

```
R1#show version
Cisco IOS Software, C2900 Software (C2900-UNIVERSALK9-M), Version 15.5(3)M4a, RELEASE SOFTWARE(fc1)
[output omitted]

R1#delete flash:c2900-universalk9-mz.SPA.151-4.M4.bin
Delete filename [c2900-universalk9-mz.SPA.151-4.M4.bin]?
Delete flash:/c2900-universalk9-mz.SPA.151-4.M4.bin? [confirm]

R1#show flash

System flash directory:
File  Length    Name/status
  4   33591768 c2900-universalk9-mz.SPA.155-3.M4a.bin
  2   28282    sigdef-category.xml
  1   227537   sigdef-default.xml
[33847587 bytes used, 221896413 available, 255744000 total]
249856K bytes of processor board System flash (Read/Write)
```

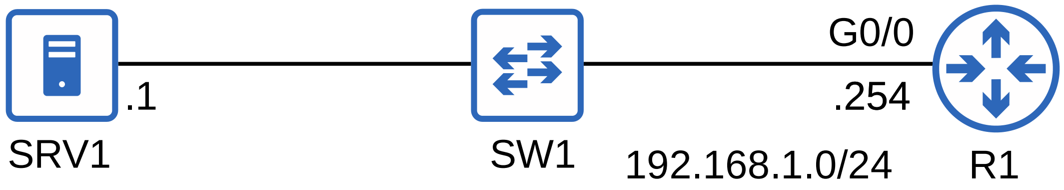
delete *filepath*



Copying Files (FTP)

```
R1(config)#ip ftp username cisco

R1(config)#ip ftp password cisco

R1(config)#exit

R1#copy ftp: flash:
Address or name of remote host []? 192.168.1.1
Source filename []? c2900-universalk9-mz.SPA.155-3.M4a.bin
Destination filename [c2900-universalk9-mz.SPA.155-3.M4a.bin]?

Accessing ftp://192.168.1.1/c2900-universalk9-mz.SPA.155-3.M4a.bin…
Loading c2900-universalk9-mz.SPA.155-3.M4a.bin from
192.168.1.1: !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[output omitted]
```

Configure the FTP username/password that the device will use when connecting to an FTP server.



Command Review

```
R1# show file systems
R1# show version
R1# show flash
R1# copy source destination
R1(config)# boot system filepath
R1(config)# ip ftp username username
R1(config)# ip ftp password password
```

Things we covered

- The purpose of FTP/TFTP
- FTP/TFTP functions & differences
- IOS File Systems
- Using FTP/TFTP in IOS

Quiz 1

Which of the following statements about FTP are true? (select two)

a) FTP control connections use TCP port 20.

b) FTP control connections use TCP port 21.

c) FTP control connections use TCP port 69.

d) FTP data connections use TCP port 20.

e) FTP data connections use TCP port 21.

f) FTP data connections use TCP port 69.

Quiz 2

Which of the following commands can be used to transfer a file from an external TFTP server to the local device's flash storage?

a) **copy tftp: flash:**

b) **copy flash: tftp:**

c) **move tftp: flash:**

d) **move flash: tftp:**

Quiz 3

R1 is behind a firewall and wants to connect to an external FTP server. Which of the following statements is true?

a) R1 should use FTP passive mode for the control connection.

b) R1 should use FTP active mode for the control connection.

c) R1 should use FTP passive mode for the data connection.

d) R1 should use FTP active mode for the data connection.

Quiz 4

Which type of file system is used to store the startup-config of a device running Cisco IOS?

a) Opaque

b) Disk

c) Network

d) NVRAM

Quiz 5

Which of the following functions are NOT possible when using TFTP? (select two)

a) Copy a file from a server.

b) Create a new directory on a server.

c) List the contents of a server.

d) Copy a file to a server.