

# LAB 04 Transport Layer

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CMPS1192 Networking Fundamentals  
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# Setting Up the Linksys WRT54GL

Step 1: Set a Static IP for your device



Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

☐ Obtain an IP address automatically

☒ Use the following IP address:

IP address:	192 . 168 . 1 . 10
Subnet mask:	255 . 255 . 255 . 0
Default gateway:	192 . 168 . 1 . 1

# Setting Up the Linksys WRT54GL

## Step 2: Access the Web Interface

### Sign in to 192.168.1.1

Your connection to this site is not private.

Username

Password

Firmware: DD-WRT v24-sp2 (08/12/10) std  
Time: 00:01:50 up 1 min, load average: 0.20, 0.15, 0.06  
WAN IP: 0.0.0.0

dd-wrt.com ... control panel

Setup | Wireless | Services | Security | Access Restrictions | NAT / QoS | Administration | Status

Basic Setup | DDNS | MAC Address Clone | Advanced Routing | VLANs | Networking | **EoIP Tunnel**

### WAN Setup

**WAN Connection Type**

Connection Type: Automatic Configuration - DHCP

STP: ☐ Enable ☒ Disable

**Optional Settings**

Router Name:

Host Name:

Domain Name:

MTU: Auto

### Network Setup

**Router IP**

Local IP Address	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="1"/>	<input type="text" value="1"/>
Subnet Mask	<input type="text" value="255"/>	<input type="text" value="255"/>	<input type="text" value="255"/>	<input type="text" value="0"/>
Gateway	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Local DNS	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="0"/>

**Network Address Server Settings (DHCP)**

DHCP Type: DHCP Server

DHCP Server: ☒ Enable ☐ Disable

### Help

**Automatic Configuration - DHCP:**  
This setting is most commonly used by Cable operators.

**Host Name:**  
Enter the host name provided by your ISP.

**Domain Name:**  
Enter the domain name provided by your ISP.

**Local IP Address:**  
This is the address of the router.

**Subnet Mask:**  
This is the subnet mask of the router.

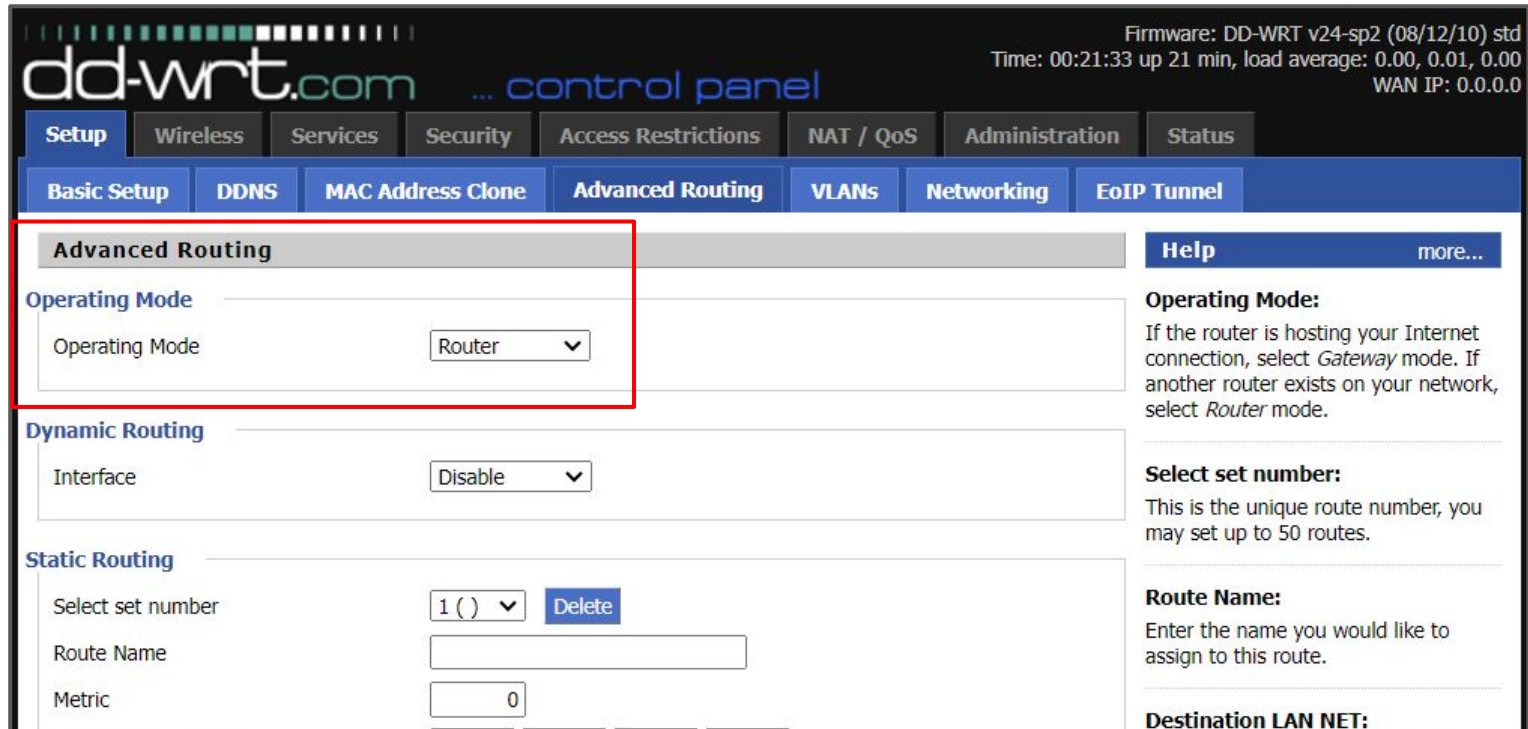
**DHCP Server:**  
Allows the router to manage your IP addresses.

**Start IP Address:**  
The address you would like to start with.

**Maximum DHCP Users:**  
You may limit the number of addresses your router hands out. 0

# Setting Up the Linksys WRT54GL

## Step 3: Set Operating Mode from Gateway to Router



The screenshot shows the dd-wrt.com control panel. At the top, there's a status bar with the dd-wrt.com logo, a progress bar, and system information: Firmware: DD-WRT v24-sp2 (08/12/10) std, Time: 00:21:33 up 21 min, load average: 0.00, 0.01, 0.00, and WAN IP: 0.0.0.0. Below this is a navigation menu with tabs: Setup, Wireless, Services, Security, Access Restrictions, NAT / QoS, Administration, and Status. Under the Setup tab, there are sub-tabs: Basic Setup, DDNS, MAC Address Clone, Advanced Routing, VLANs, Networking, and EoIP Tunnel. The Advanced Routing tab is selected and highlighted with a red box. Inside this tab, the 'Operating Mode' section shows a dropdown menu set to 'Router'. Below this is the 'Dynamic Routing' section with an 'Interface' dropdown set to 'Disable'. At the bottom is the 'Static Routing' section with a table for adding routes. The table has columns for 'Select set number', 'Route Name', and 'Metric'. The first row shows '1 ( )' in the set number column, an empty text box for the route name, and '0' in the metric column. There is a 'Delete' button next to the first row. On the right side of the page, there is a 'Help' section with a 'more...' link. The 'Help' section contains three subsections: 'Operating Mode:' which explains that Gateway mode is for hosting an Internet connection and Router mode is for when another router exists; 'Select set number:' which explains that this is a unique route number up to 50; and 'Route Name:' which explains that this is the name assigned to the route. The 'Destination LAN NET:' section is partially visible at the bottom.

dd-wrt.com ... control panel

Firmware: DD-WRT v24-sp2 (08/12/10) std  
Time: 00:21:33 up 21 min, load average: 0.00, 0.01, 0.00  
WAN IP: 0.0.0.0

Setup Wireless Services Security Access Restrictions NAT / QoS Administration Status

Basic Setup DDNS MAC Address Clone **Advanced Routing** VLANs Networking EoIP Tunnel

**Advanced Routing**

**Operating Mode**

Operating Mode Router

**Dynamic Routing**

Interface Disable

**Static Routing**

Select set number 1 ( ) Delete

Route Name

Metric 0

**Help** more...

**Operating Mode:**  
If the router is hosting your Internet connection, select *Gateway* mode. If another router exists on your network, select *Router* mode.

**Select set number:**  
This is the unique route number, you may set up to 50 routes.

**Route Name:**  
Enter the name you would like to assign to this route.

**Destination LAN NET:**

# Setting Up the Linksys WRT54GL

## Step 4: Set the VLANs of the Ports

### Setup > VLANs

Virtual Local Area Network (VLAN)						
VLAN	Port					Assigned To Bridge
	W	1	2	3	4	
0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	LAN ▾
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾
2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	LAN ▾
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾
4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾
6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾
7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾
8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾
9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾
10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾
11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	None ▾

### Setup > Networking

Port Setup	
WAN Port Assignment <span>vlan1 ▾</span>	
Network Configuration eth0	<input type="radio"/> Unbridged <input checked="" type="radio"/> Default
Network Configuration eth1	<input type="radio"/> Unbridged <input checked="" type="radio"/> Default
Network Configuration etherip0	<input type="radio"/> Unbridged <input checked="" type="radio"/> Default
Network Configuration vlan0	<input type="radio"/> Unbridged <input checked="" type="radio"/> Default
Network Configuration vlan2	<input checked="" type="radio"/> Unbridged <input type="radio"/> Default
MTU	<input type="text" value="1500"/>
Multicast forwarding	<input type="radio"/> Enable <input checked="" type="radio"/> Disable
IP Address	<input type="text" value="192"/> <input type="text" value="168"/> <input type="text" value="4"/> <input type="text" value="1"/>
Subnet Mask	<input type="text" value="255"/> <input type="text" value="255"/> <input type="text" value="255"/> <input type="text" value="248"/>

# Setting Up the Linksys WRT54GL

## Step 5: Set the Static Routes

### Setup > Advanced Routing

**Advanced Routing**

**Operating Mode**  
Operating Mode Router

**Dynamic Routing**  
Interface Both

**Static Routing**  
Select set number 1 (VLAN0\_to\_VLAN2) Delete  
Route Name VLAN0\_to\_VLAN2  
Metric 0  
Destination LAN NET 192 168 4 0  
Subnet Mask 255 255 255 248  
Gateway 192 168 4 1  
Interface vlan0  
Show Routing Table

Save Apply Settings Cancel Changes

**Advanced Routing**

**Operating Mode**  
Operating Mode Gateway

**Static Routing**  
Select set number 1 (VLAN2\_to\_VLAN0) Delete  
Route Name VLAN2\_to\_VLAN0  
Metric 0  
Destination LAN NET 192 168 1 0  
Subnet Mask 255 255 255 0  
Gateway 192 168 1 1  
Interface vlan2  
Show Routing Table

Save Apply Settings Cancel Changes

# Setting Up the Linksys WRT54GL

## Step 6: Testing

### Administration > Commands

Diagnostics

Command Shell

Commands

ping 192.168.1.10

PING 192.168.1.10 (192.168.1.10): 56 data bytes  
64 bytes from 192.168.1.10: seq=0 ttl=128 time=18.429 ms  
64 bytes from 192.168.1.10: seq=1 ttl=128 time=1.667 ms  
64 bytes from 192.168.1.10: seq=2 ttl=128 time=2.233 ms  
--- 192.168.1.10 ping statistics ---  
3 packets transmitted, 3 packets received, 0% packet loss  
round-trip min/avg/max = 1.667/7.443/18.429 ms

Router successfully pinged Host A

HOSTS			
Host A	Jennessa	VLAN0	192.168.1.10
Host B	Andres	VLAN2	192.168.4.2
Host C	Tysha	VLAN2	192.168.4.3

# Setting Up the Linksys WRT54GL

## Step 6: Testing (Ping & Traceroute)

Host A  Host B

```
PowerShell
jennx ~ @ v20.11.1 10:01 took 21s
> tracert 192.168.4.2

Tracing route to AHM1A [192.168.4.2]
over a maximum of 30 hops:

  1  *           1 ms      *       192.168.1.1
  2  2 ms        1 ms      1 ms    AHM1A [192.168.4.2]

Trace complete.

jennx ~ @ v20.11.1 10:01 took 22s
> ping 192.168.4.2

Pinging 192.168.4.2 with 32 bytes of data:
Reply from 192.168.4.2: bytes=32 time=1ms TTL=63
Reply from 192.168.4.2: bytes=32 time=1ms TTL=63
Reply from 192.168.4.2: bytes=32 time=2ms TTL=63
Reply from 192.168.4.2: bytes=32 time=1ms TTL=63

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

jennx ~ @ v20.11.1 10:02 took 3s
```

Host A  Host C

```
PowerShell
jennx ~ @ v20.11.1 10:25
> tracert 192.168.4.3

Tracing route to LAPTOP-QQD03BG3 [192.168.4.3]
over a maximum of 30 hops:

  1  1 ms      *           1 ms    192.168.1.1
  2  7 ms      2 ms        2 ms    LAPTOP-QQD03BG3 [192.168.4.3]

Trace complete.

jennx ~ @ v20.11.1 10:25 took 19s
> ping 192.168.4.3

Pinging 192.168.4.3 with 32 bytes of data:
Reply from 192.168.4.3: bytes=32 time=2ms TTL=127
Reply from 192.168.4.3: bytes=32 time=6ms TTL=127
Reply from 192.168.4.3: bytes=32 time=2ms TTL=127
Reply from 192.168.4.3: bytes=32 time=4ms TTL=127

Ping statistics for 192.168.4.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 6ms, Average = 3ms

jennx ~ @ v20.11.1 10:26 took 3s
```



# Setting Up the Linksys WRT54GL

## Step 6: Testing (Wireshark)

### Network Traffic between Hosts

icmp				
No.	Time	Delta	Source	Destination
1361	155.381...	0.947589	192.168.4.1	192.168.4.2
1371	156.387...	1.005160	192.168.4.1	192.168.4.2
1374	157.389...	1.002272	192.168.4.1	192.168.4.2
1385	158.393...	1.004494	192.168.4.1	192.168.4.2
1395	159.396...	1.002159	192.168.4.1	192.168.4.2
1411	160.435...	1.039920	192.168.4.1	192.168.4.2
1419	161.437...	1.001285	192.168.4.1	192.168.4.2
1420	162.048...	0.611269	192.168.1.10	192.168.4.2
1421	162.048...	0.000209	192.168.4.2	192.168.1.10
1425	163.057...	1.008504	192.168.1.10	192.168.4.2
1426	163.057...	0.000347	192.168.4.2	192.168.1.10
1428	163.149...	0.091501	192.168.4.1	192.168.4.2
1435	163.435...	0.286189	192.168.4.1	192.168.4.2
1436	164.066...	0.631692	192.168.1.10	192.168.4.2
1437	164.067...	0.000317	192.168.4.2	192.168.1.10
1446	164.436...	0.368783	192.168.4.1	192.168.4.2

Ethernet II, Src: BelkinIntern\_44:b0:28 (58:ef:68:44:b0:28), Dst: ASIXElectron\_02:40:29 (f8:e4:3b:b2:4d:29)

- Destination: ASIXElectron\_b2:4d:29 (f8:e4:3b:b2:4d:29)
  - .... .. = LG bit: Globally unique address (factory default)
  - .... .. = IG bit: Individual address (unicast)
- Source: BelkinIntern\_44:b0:28 (58:ef:68:44:b0:28)
  - .... .. = LG bit: Globally unique address (factory default)
  - .... .. = IG bit: Individual address (unicast)
- Type: IPv4 (0x0800)
- [Stream index: 0]
- Internet Protocol Version 4, Src: 192.168.1.10 (192.168.1.10), Dst: 192.168.4.2 (192.168.4.2)
  - 0100 .... = Version: 4
  - .... 0101 = Header Length: 20 bytes (5)
  - > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
  - Total Length: 60
  - Identification: 0x2926 (10534)
  - > 000. .... = Flags: 0x0
  - ...0 0000 0000 0000 = Fragment Offset: 0
  - Time to Live: 127
  - Protocol: ICMP (1)
  - Header Checksum: 0x8c3e [validation disabled]
  - [Header checksum status: Unverified]
  - Source Address: 192.168.1.10 (192.168.1.10)
  - Destination Address: 192.168.4.2 (192.168.4.2)
  - [Stream index: 0]
- Internet Control Message Protocol

Destination Hardware Address (eth.dst), 6 bytes

# How Routing Works (Layer 3 Review)

- Router maintains a Routing Table, mapping IP Addresses to interfaces.
- Network to network hops

## 3 Types

- Direct Connection
- Static Routing
- Dynamic Routing



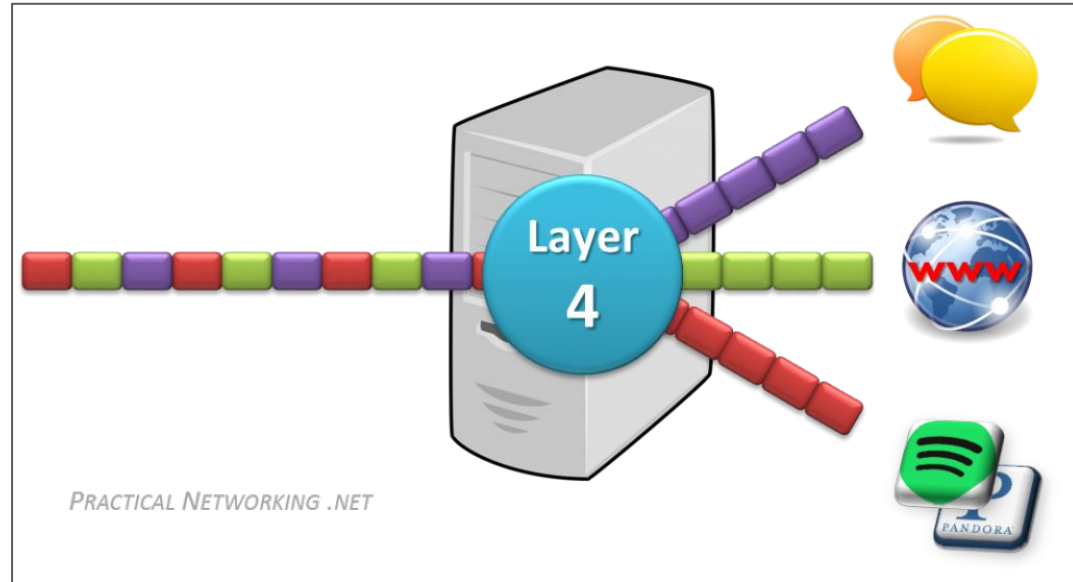
**R1's Routing Table**

<u>Method</u>	<u>Network</u>	<u>Interface/Next-Hop</u>
DC	11.11.11.x	Left
DC	22.22.22.x	Right
Static	33.33.33.x	22.22.22.2

*PRAC NET .NET*

# Why the Transport Layer (Layer 4)

- IP is a connectionless protocol.
- Need a guarantee that data is not lost, cannot be duplicated, and assembled in right order.
- Transmission Control Protocol (TCP)
- User Datagram Protocol (UDP)
- Distinguishes network streams and uses Ports.



# Transmission Control Protocol (TCP)

- Connection oriented (logical connection established first and stops when done).
- Reliable protocol (achieved through resending datagrams, window mechanisms, and three-way handshake.)

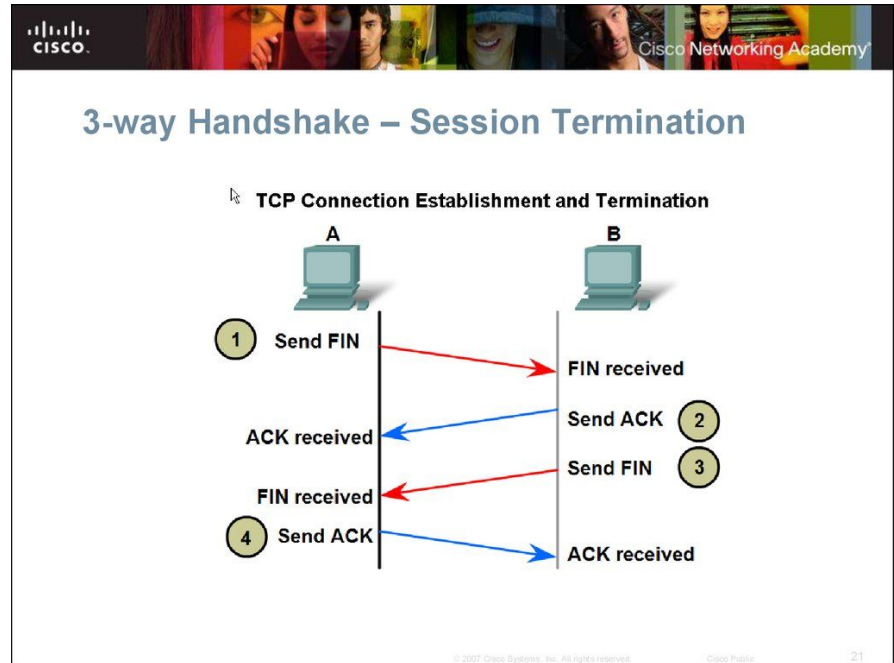
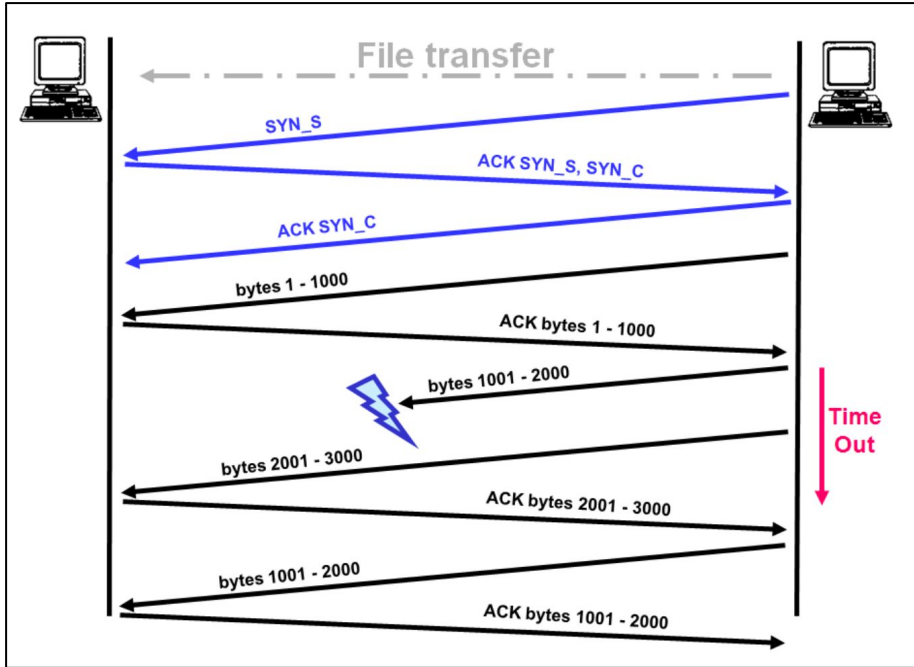
## Examples

- HTTP (Port 80)
- HTTPS (Port 443)
- FTP (Ports 20/21)

## TCP header (min. 20 bytes)

source port	dest. port	sequence number	acknowledge number	code bits	window	check-sum	urgent point
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# Three-way Handshake (TCP)



# User Datagram Protocol (UDP)

- Connectionless
- Just a simple checksum
- Great where reliability is not important.
- E.g. streaming, videoconferencing, etc.

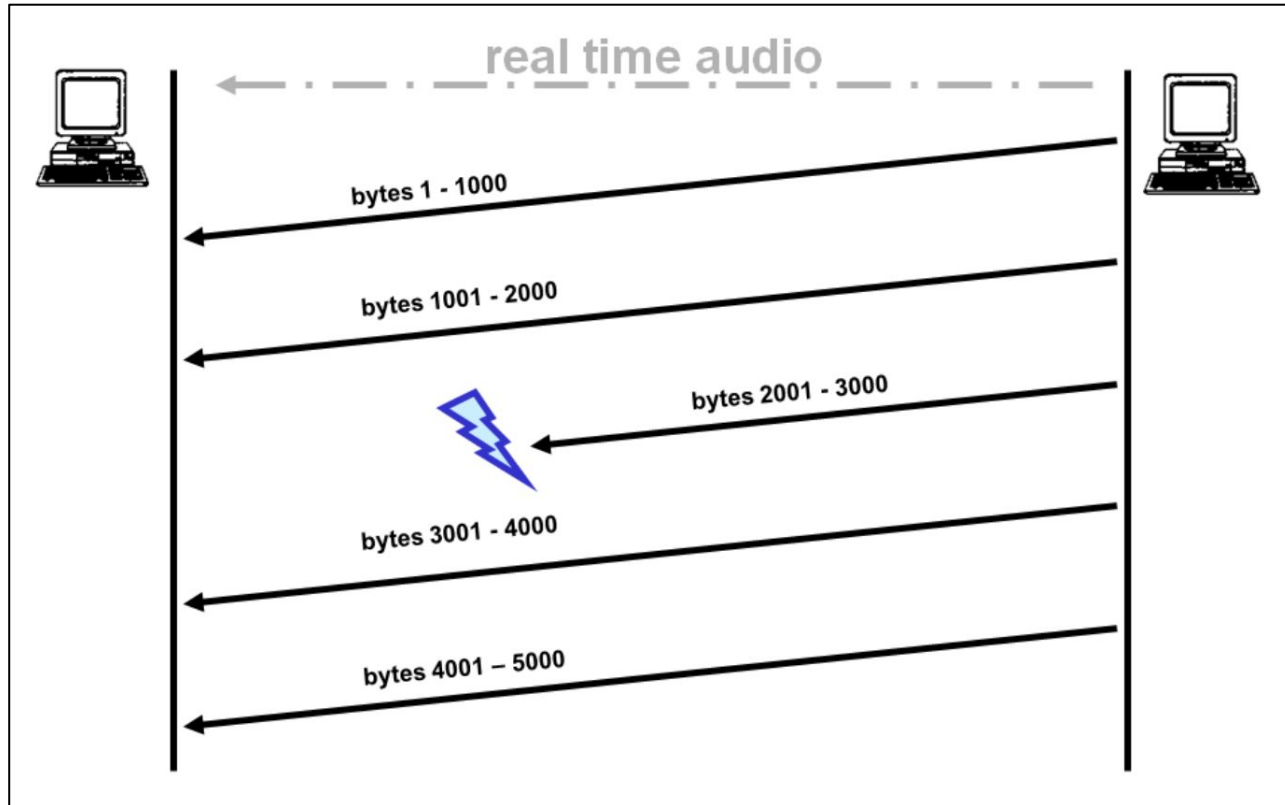
## Examples

- NTP (Port 123)
- DHCP (Ports 67/68)
- TFTP (Ports 69)

## UDP header (8 bytes)



# UDP Visual



## Layer 4 in action: Client Server Model

