Test #2, Wednesday, April 8

Coverage:	Problem sets 5, 6, 7, and related reading assignments and slides.
Type:	Open book, open notes, an Internet connected computer and/or smartphone with ability to print and scan or take a picture is required. You will be required to be present in a zoom meeting during the testing interval. The test will be made avalable 15 minutes before class. Print it, work it, scan or photograph it, and turn it in by uploading it within a 75 minute period.
Study Aid:	A link to a file of all classroom slides for Test #2 will appear on Canvas.

On Wednesday. . .

1.) About 30 minutes before the test hour I will get the Zoom meeting going. You should log sometime before the hour as usual. Also, turn on you video camera so that I can supervise the test as I would if we were face-to-face.

2.) At about 10 minutes to the hour I will send out the test as an MS-Word file attached to e-mail. You should print the test immediately and then go to work on it in front of the camera.

3.) When finished, scan, photograph or somehow get your work in a file. Upload it to the canvas link that I will show you. The link will become inactive about 15 after the hour so you will have at least 60 minutes for work on the test.

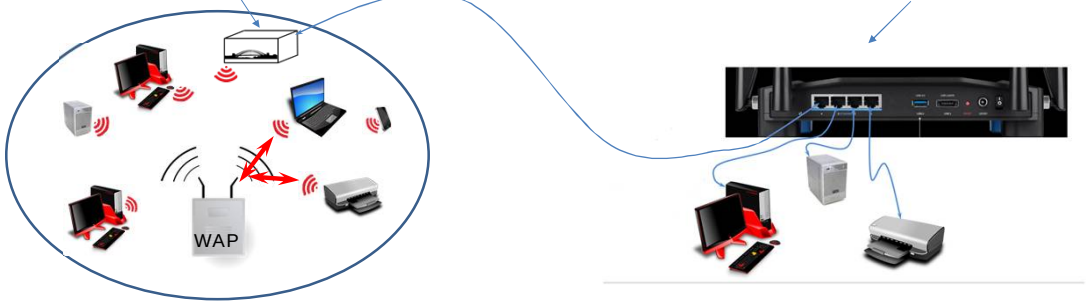
1

A *bridge* is a device that connects two disparate networks and makes them look like one.
A bridge repeats the traffic of one network onto the other and vice versa.
To the WAP the bridge just looks like another device on the network.
To the switch, the bridge just looks like another device on the network.

This bridge is Wi-Fi on one side and Ethernet on the other side.

In the OSI model, the bridge operates on the data-link layer, relying intact frames from one physical connection to the other.

switch

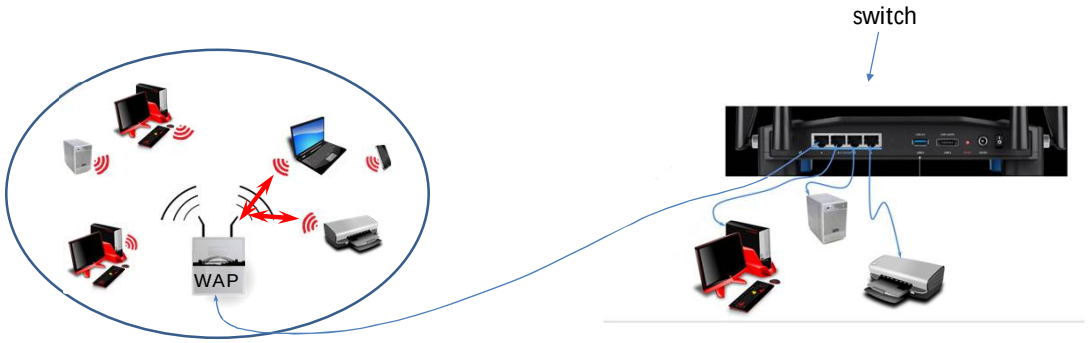


Wireless Access Point (WAP)
Creates Wi-Fi connections at the physical layer.

2

A *bridge* is a device that connects two disparate networks and makes them look like one.
A bridge repeats the traffic of one network onto the other and vice versa.
To the WAP the bridge just looks like another device on the network.
To the switch, the bridge just looks like another device on the network.

To reduce Wi-Fi traffic most WAPs have a bridge built right into them.
Thus all the Wi-Fi bandwidth can be devoted to traffic with the devices and none to traffic with the switch.

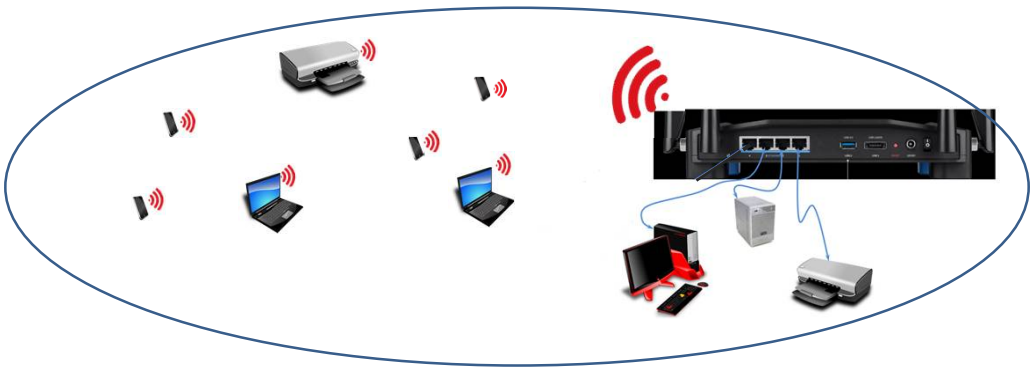


Wireless Access Point (WAP)
Creates Wi-Fi connections at the physical layer.

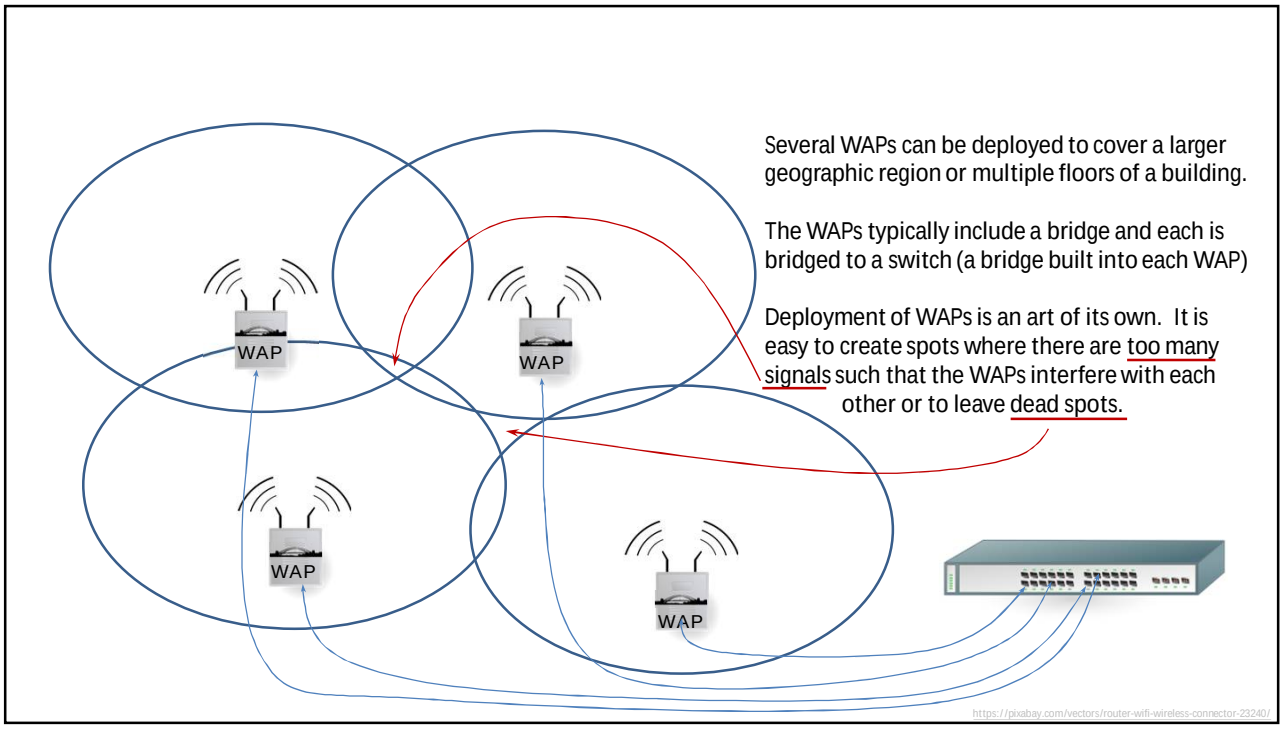
3

A *bridge* is a device that connects two disparate networks and makes them look like one.
A bridge repeats the traffic of one network onto the other and vice versa.
To the WAP the bridge just looks like another device on the network.
To the switch, the bridge just looks like another device on the network.

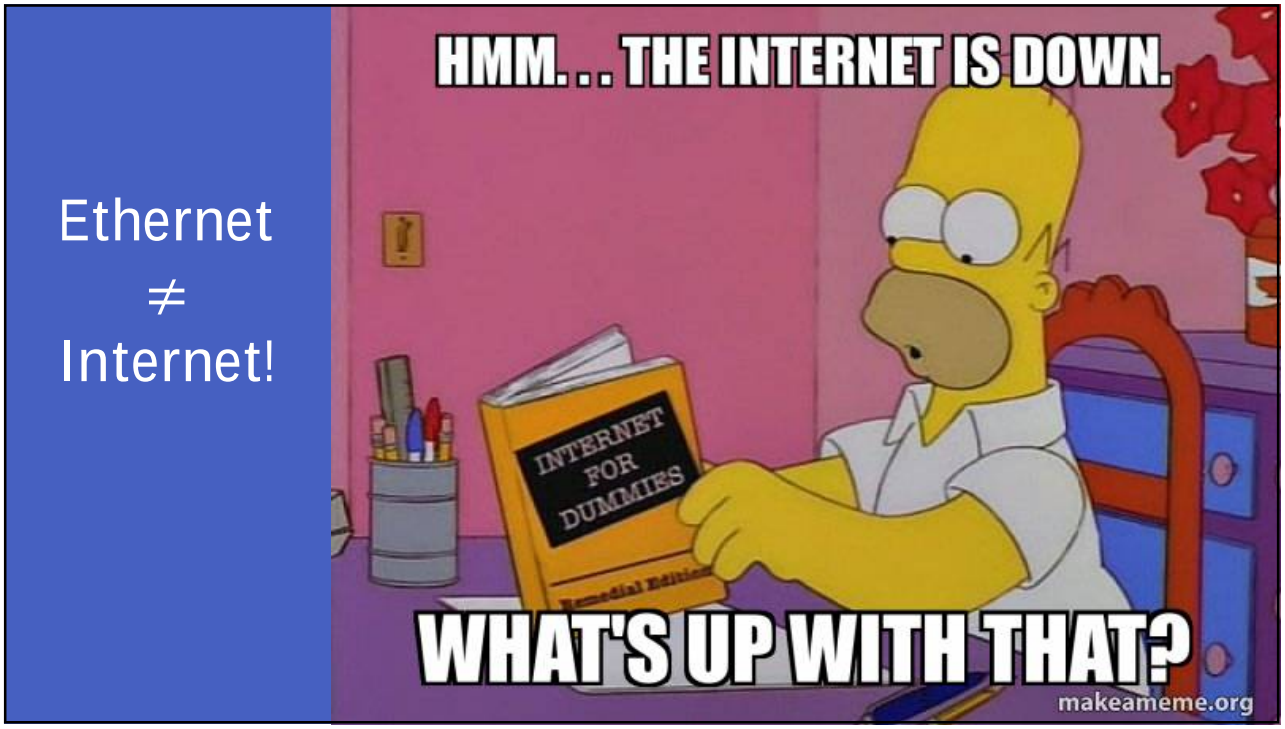
Most routers built for the "small-office home-office" market (SOHO routers)
have the WAP and bridge built directly into them.



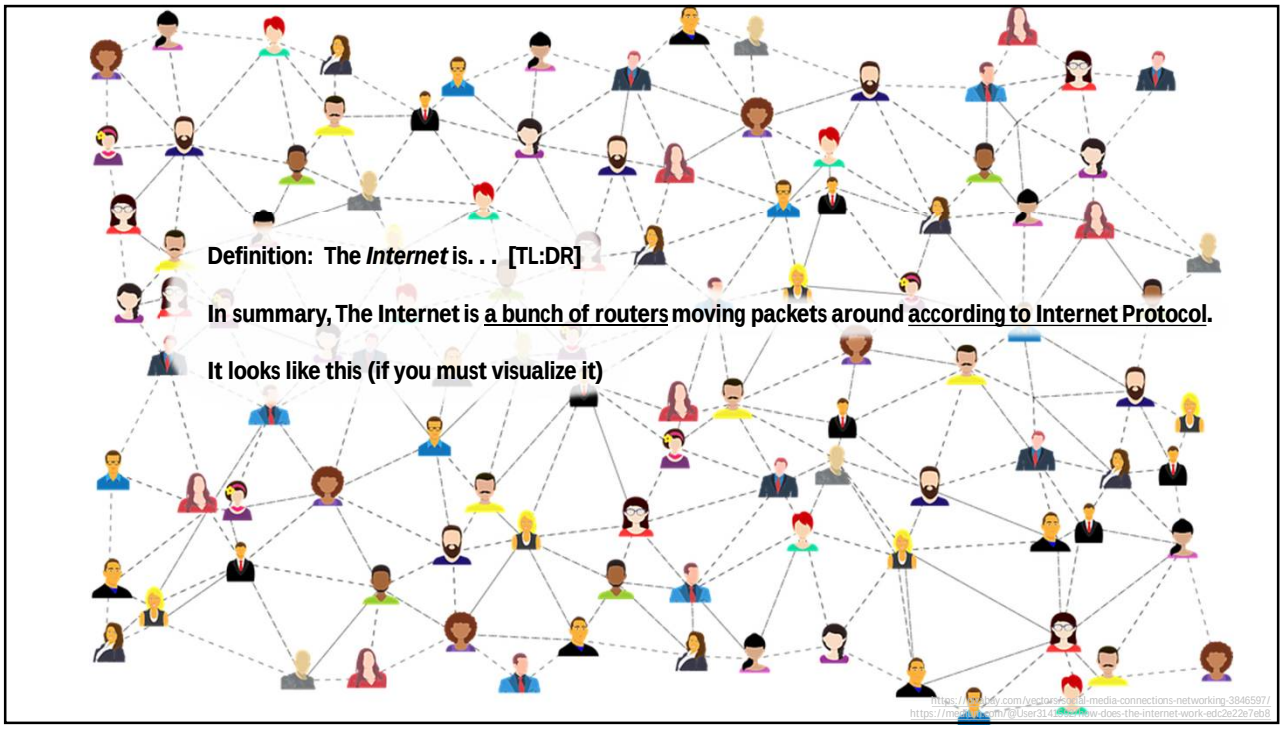
4


WAP
WAP
WAP
WAP
Several WAPs can be deployed to cover a larger geographic region or multiple floors of a building.
The WAPs typically include a bridge and each is bridged to a switch (a bridge built into each WAP)
Deployment of WAPs is an art of its own. It is easy to create spots where there are too many signals such that the WAPs interfere with each other or to leave dead spots.
https://pixabay.com/vectors/router-wifi-wireless-connector-23240/

5

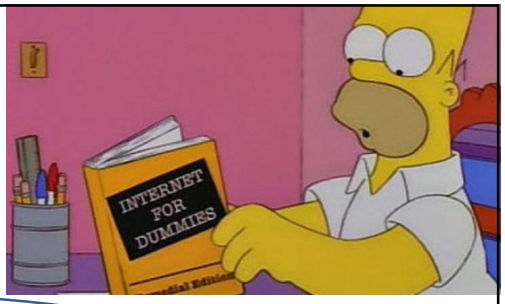

Ethernet
≠
Internet!
HMM. . . THE INTERNET IS DOWN.
INTERNET FOR DUMMIES
WHAT'S UP WITH THAT?
makeameme.org

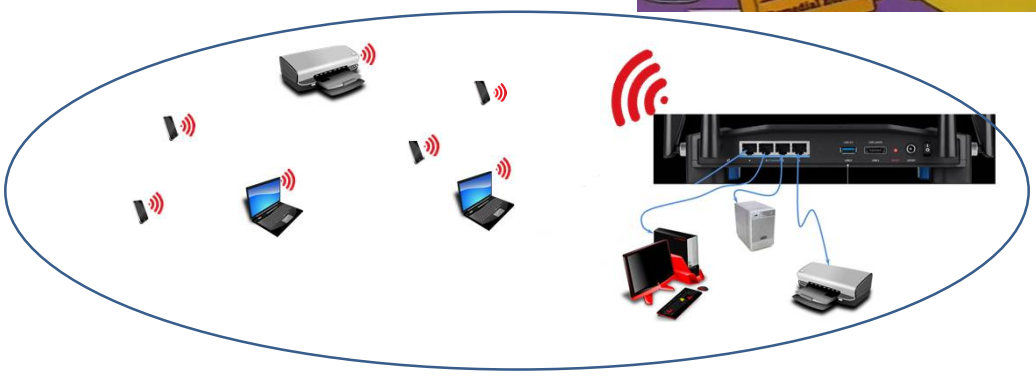
6



7

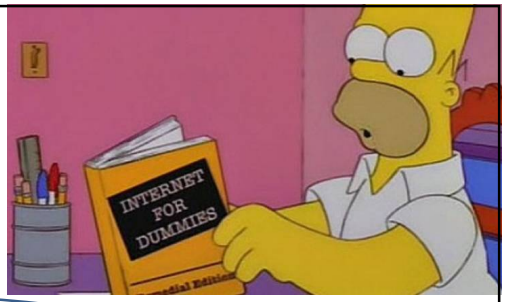
Still, no internet. What about that?





8

There—all fixed!



9

There—all fixed!

Ethernet ≠ Internet

10

There—all fixed!

The Internet is a bunch of routers moving packets of data according to Internet Protocol.

Ethernet ≠ Internet

Ethernet is an OSI layer 1 and layer 2 standard for connecting devices.
Wi-Fi is another layer 1 and 2 standard for connecting devices.

11

Ethernet-to-Internet on R-pi platforms. (All other platforms are somewhat similar.)

During the boot time the OS will configure the Ethernet port.
if there is no operating system (as in Arduino for example) then. . .
in the "setup" you must initialize the Ethernet port in your code to make it connect to your network.
If the OS configured the Ethernet port, you may need to know its parameters for various tasks.

```
mac, ip, dns, gateway, subnet
```

`mac` is the Medium Access Control address, used only at the physical layer. It is a 6-byte address (48 bits).
(`ip` addresses get translated to mac addresses within a local network.)

If things are done properly, the interface card has a unique (in the whole world) `mac` address encoded in it.
That address is used by default in Ethernet frames. (most NIC's but all)

Some Ethernet devices have a `mac` address assigned, but it is only recorded on a sticker on the board, on the packaging box, or in the instruction manual. This includes some older Arduino shields.
In this case you may insert that known-good `mac` address into your code. (Awkward, but that's life.)

In most cases you don't need to use the built-in or assigned `mac` address. You can make up your own, at your own risk. This is mainly to facilitate service. Network interface hardware can be replaced without changing the `mac` address if you configure things manually. This is also a security vulnerability since it allows intruders to spoof a `mac` address.

Some network interfaces (inexpensive—hobby built) do not have a `mac` address assigned at the factory.
In this case, make one up on your own, at your own risk. Best: If you know the `mac` address of a network card that has been removed from service, you might use that. (Not very practical though.)

12

The programming interface for Ethernet on Arduino platforms. (All other platforms are somewhat similar.)

```
mac, ip, dns, gateway, subnet
```

`ip` is the Internet Protocol address. On a LAN this is usually automatically assigned by the network server software in the router. Often this software is the "Dynamic Host Configuration Protocol" (DHCP) but other methods also exist including manually assigning static `ip` addresses. This address is (or better be!) unique within the LAN.
A WAN-side connection exposed to the Internet needs a unique `ip` within the entire Internet! These days the internet is getting rather large! IPv4 uses 4-byte `ip` addresses, IPv6 uses 16-byte `ip` addresses.
Each router generally has a unique `ip` address exposed to the Internet.
The router uses a local DHCP server and a NAT (network address translator) to assign `ip` addresses on the LAN.
Most routers also allow manual management of static `ip` addresses on the LAN side and on the WAN side.
Most ISP providers can supply a static `ip` address for your WAN connection (usually at extra cost).

`dns` is the `ip` address of the Internet Domain Name Server for your network. This server translates domain names like "dordt.edu" to `ip` addresses. (Security vulnerabilities here if someone can change your `dns`.)

`gateway` is the `ip` address used on the LAN side of the router to give you Internet access. (Provided by your ISP.)

`subnet` (better: subnet mask) helps the router translate addresses.
Typically used to distinguish LAN addresses from host addresses.
Not used at all with IPv6.

13