

# Computación en Internet I

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## 1 Wireless networks

- Wireless standards
- Wireless topologies

## 2 Network topologies

- Logical versus physical topology
- Bus topology
- Ring topology
- Star topology
- Token ring topology
- Mesh topology
- Hybrid topology

## 3 Workshop

## 1 Wireless networks

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## 3 Workshop

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## What are the wireless standards?

- They are a set of standards that allows devices from different manufacturers to communicate with each other.
- Such as:
  - ▶ IEEE 802.11 wireless standards (or Wi-Fi).
  - ▶ IEEE 802.15 (Bluetooth).
  - ▶ IEEE 802.16 (WiMAX).

**How did the IEEE 802.11 started?**



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- In July 1990, the IEEE, announced that their 802 project was forming a working group to investigate and develop wireless standards.
- This working group was named 802.11.
- The 802.11 has created several wireless standards that are in operation in various environments.

## What is CSMA/CA?

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- Carrier Sense Multiple Access/Collision Avoidance is the access method used in Wi-Fi networks.
  - ▶ Carrier sense means it listens to what is happening on the carrier, in this case, the airwaves.
  - ▶ Multiple access simply means that the carrier is available to multiple devices.
  - ▶ Collision avoidance means that there is a mechanism in place to avoid collisions.

**What is the RTS/CTS process the CSMA/CA follows?**

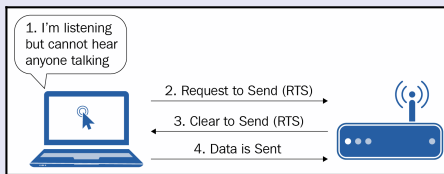
## What is the RTS/CTS process the CSMA/CA follows?

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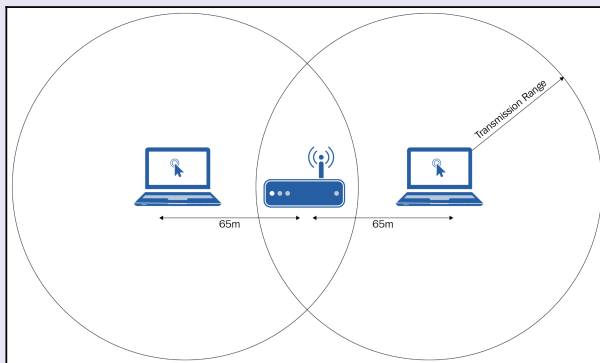
## What is the RTS/CTS process the CSMA/CA follows?

- It is a simple process called Ready To Send/Clear To Send.
- It consists of four steps:
  - 1 The sending device listens out for any transmissions.
  - 2 If no transmissions are heard, it sends an RTS message to the access point advising it has data that it wants to transmit.
  - 3 If the access point is free, it will send a CTS message to the device.
  - 4 The sending device transmits the data



**What is the hidden station problem?**

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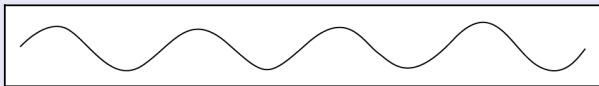


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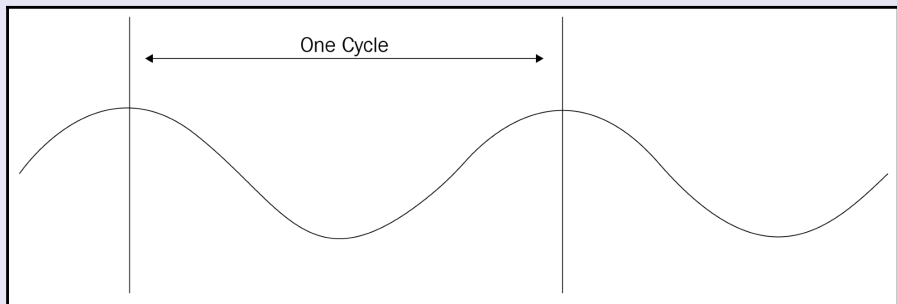
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- The higher the frequency, the more data can be transmitted per second.
- Higher frequencies tend to have a shorter wavelength
  - ▶ Over distance, the signal becomes too weak to be received.



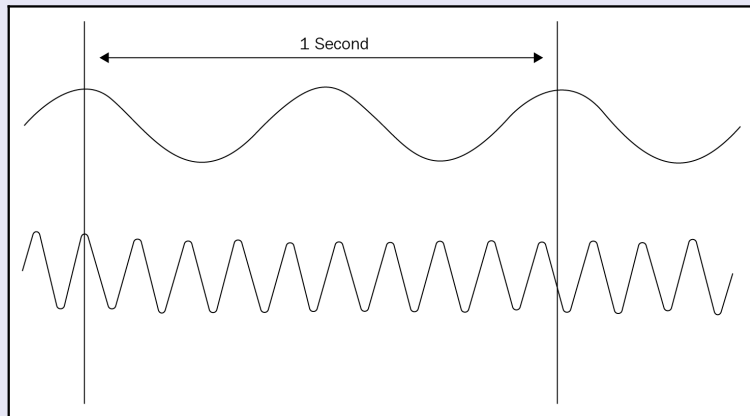
**How does an RF signal cycle look like?**

## How does an RF signal cycle look like?



**How different frequencies compare to each other?**

## How different frequencies compare to each other?



**What are the set of prefixes to identify the frequency?**

## What are the set of prefixes to identify the frequency?

- 1,000 Hz = 1 Kilohertz (1 KHz)
- 1,000 KHz = 1 Megahertz (1 MHz)
- 1,000 MHz = 1 Gigahertz (1 GHz)

**Which are the most common frequencies used in WiFi communication?**

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- The 2.4 GHz and 5 GHz ranges.
- Both are classed as unlicensed frequency ranges.
  - ▶ Anyone can use them without requiring a permit.
  - ▶ Avoids every user of a wireless computing device seeking a license
  - ▶ There is an abundance of them out there, which can lead to unexpected Radio Frequency Interference (RFI).

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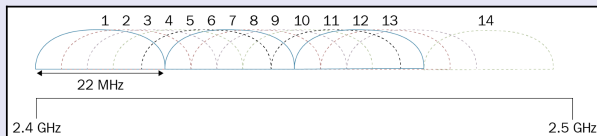
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- The 2.4 GHz frequency band is broken down into up to 14 overlapping channels.
  - ▶ In the US and Canada, there are 11 channels available.
  - ▶ Most of Europe has 13.
  - ▶ Japan has 14 channels available.
  - ▶ Ideally to implement a wireless network, you will look to see what channels are available to use and, where possible, spot an unused channel that does not overlap with any channels in use.



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- This range is split into channels, however, they are non-overlapping and there are 23 of them of 20 MHz each.
- Any devices that support both frequencies are referred to as dual-band.

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- By modulating the signal, there is a more efficient use of the available bandwidth offered by the channel.



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- A standard released in September 1999 which supported devices using the 5 GHz range.
- Had a speed of 54 Mbps.
- Had an indoor range of 35 m.
- Utilized a modulation technology called Orthogonal Frequency Distribution Multiplexing (OFDM).
  - ▶ This technique broke the 20 MHz channels used by this frequency range into 52 sub-carriers per channel.
  - ▶ Each sub-carrier had a bandwidth of 312.5 KHz, and therefore had a lower data rate than a full channel.
  - ▶ It worked quite efficiently as the number of sub-carriers meant the overall data rate was better.

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- This disparity in frequency between the two standards meant that there was no compatibility between the devices in each of the standards.
- It has a maximum indoor range of 35 m.
- Uses a technique called Direct Sequence Spread Spectrum (DSSS).
  - ▶ If a radio signal is corrupted in transit between devices it would likely be discarded and the original transmission would have to be re-sent. T
  - ▶ To overcome this obstacle, additional data would be transmitted that would allow for errors occurring in the transmission.
  - ▶ When DSSS is used, rather than sending the data over as a single bit, a representative set of bit values is sent (known as chips).
  - ▶ If one of the bits in the stream is corrupted, then we can still calculate the original value of the bit being transmitted

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- It supported both 2.4 GHz and 5 GHz, therefore, devices supporting it were usually dual-band.
- It introduced the concept of Multiple-Input Multiple-Output (MIMO) antennas.
  - ▶ 802.11n devices usually had multiple antennas.
  - ▶ It may have some antennas transmitting or some receiving.
  - ▶ All of these antennas could be used for communication with one or other or multiple devices.
  - ▶ Some antennas could work on one frequency, while the remainder could work on the other frequency.

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- However, the indoor range dropped back down to 35 m.

**How can all this standards be summarized?**

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Category	Speed	Frequency	Indoor distance	Modulation
B	11 Mbps	2.4 GHz	35 m	DSSS
G	54 Mbps	2.4 GHz	38 m	OFDM
A	54 Mbps	5 GHz	35 m	OFDM
N	Up to 600 Mbps	2.4 GHz & 5 GHz	70 m	OFDM
AC	1.3 Gbps	5 GHz	35 m	QAM



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## How is a Wi-Fi network identified?

- It is identified by its Service Set Identifier (SSID).
- A human-readable name usually created by the network administrator and broadcast out by the WAPs.

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  - ▶ The IBSSID is a pseudorandom identifier similar to a MAC address generated by the device creating the ad hoc network.

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- The SSID will be the same for all WAPs.

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- A collection of BSSes using the same SSID form an Extended Service Set (ESS).
- Identified by an Extended Service Set Identifier (ESSID), which is usually the SSID of the network.
- It is the main type of wireless network implemented within an organization and at home.

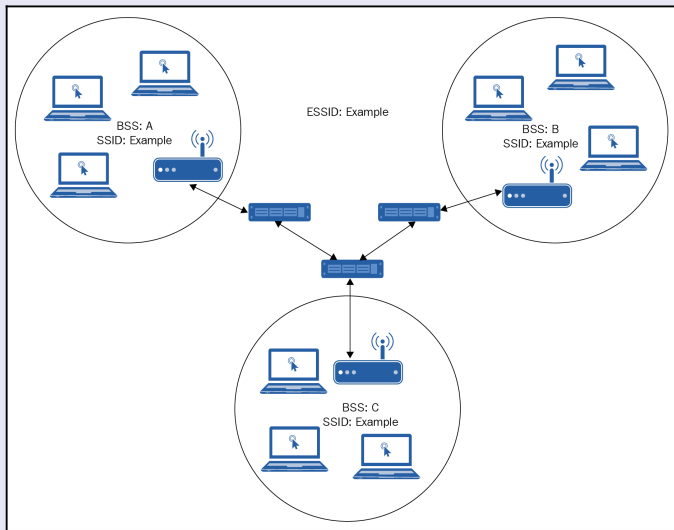
## Wireless topologies

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# Wireless topologies

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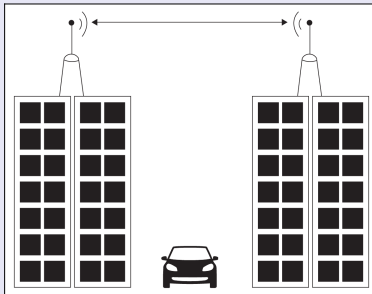
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- A relay base station receives data from main and remote base stations and forwards it to another base station.

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- A physical topology describes how the devices are connected together.
- A logical topology describes how the data travels from device to device.

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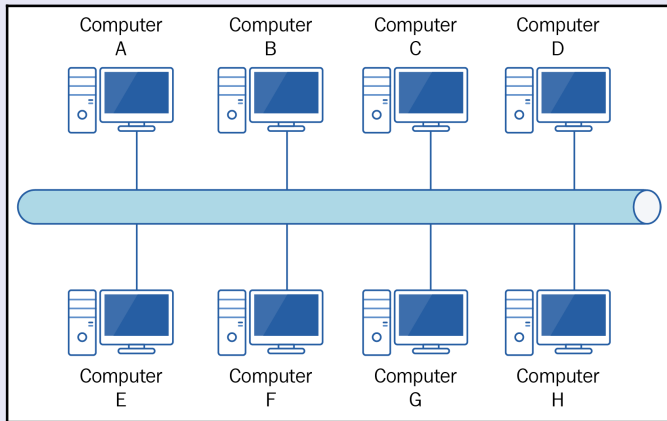
- Logical versus physical topology
- **Bus topology**
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- Mesh topology
- Hybrid topology

## 3 Workshop

**How can a bus topology be described?**

# Bus topology

## How can a bus topology be described?



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- If a device is already transmitting, the device wishing to send data will wait a random amount of back off time, before repeating the process.

**What are the advantages of a bus topology?**

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- It can be quite difficult to troubleshoot.

## 1 Wireless networks

- Wireless standards
- Wireless topologies

## 2 Network topologies

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## 3 Workshop

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## How can a ring topology be described?

- Each device is connected to two devices.

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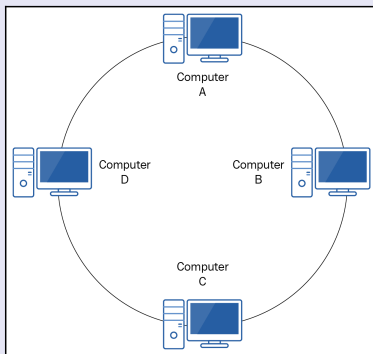
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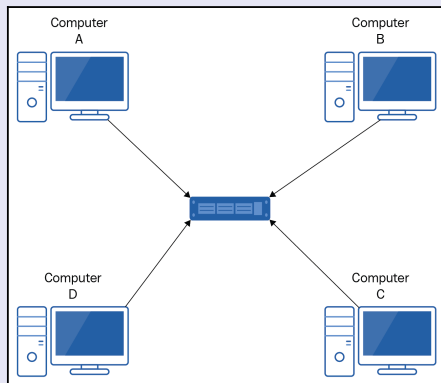
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## 3 Workshop

**How can a star topology be described?**

## How can a star topology be described?

- A network where all devices connect to a central point.



**What are the advantages of a star topology?**

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- The central device is a single point of failure.
- It can be quite expensive.

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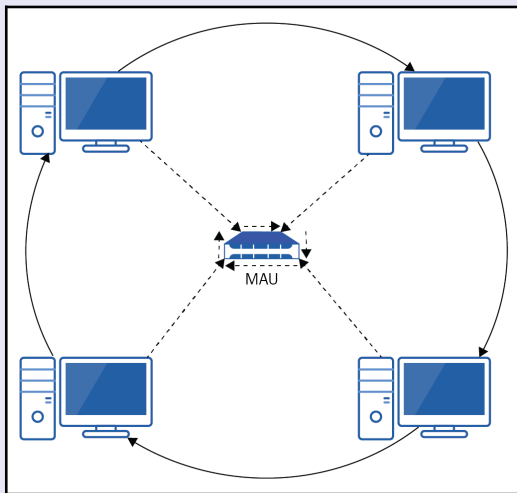
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- A token ring network has a physical star topology and a logical ring topology.
- Physically, the devices connect to a central device called a media access unit or multiple access unit (MAU).
- As far as the data is concerned, it goes from device to device and the MAU is ignored.

# Token ring topology

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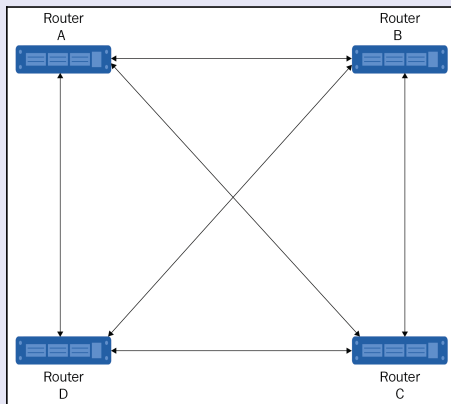
## How can a mesh topology be described?

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## 3 Workshop



How can a hybrid topology be described?

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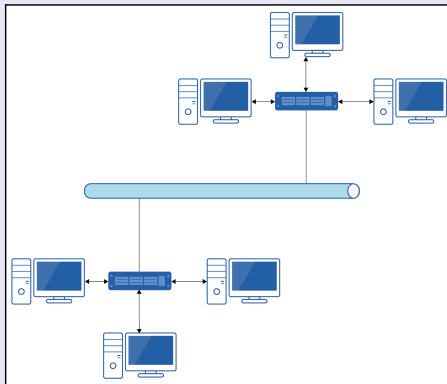
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## How can a hybrid topology be described?

- Something consisting of mixed components.
- A network topology that connects two or more different network topologies together.

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**What are the advantages of a hybrid topology?**

## What are the advantages of a hybrid topology?

- Leveraging the benefits of the component topologies.

## What are the advantages of a hybrid topology?

- Leveraging the benefits of the component topologies.
- Minimizing the disadvantages of the component topologies.

## Workshop

Complete workshop for today's class. To be handed in the next class.