Introduction to Wireless and the course

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Welcome to the Course

- Welcome to
  - CSC8360: Wireless Networking

Course Team

- Examiner
  - Lectures, Tutorials, Marking, Consultations.
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Lectures

- Tuesday Toowoomba T125
  - 1pm-2pm
  - 10 minute break.
  - 2pm-3pm
- recorded and placed on the study desk.

Prac

- Monday 11am - 12pm
  - Toowoomba D112 (I will be located there)
  - Springfield A408 (By Zoom video conferencing)
  - Your Home PC or Laptop (by Zoom - see later slides)
- Thursday 1pm - 2pm
  - Toowoomba D113

History of Wireless Communication

- Chronology
- Mobile telephony
- Wireless LANs
- Where next

Chronology 1

Year	Discovery / Development
1804	Joseph Fourier discovers all signals can be decomposed into frequencies
1820	Hans Christian Orsted discovers electromagnetic fields
1831	Michael Faraday discovers electromagnetic induction
1864	James Clerk Maxwell discovers the equations for electromagnetic waves (light)

Wireless Chronology Part 1 (Microwave Journal (`microwavejournal.com`)

Chronology 2

Year	Discovery / Development
1888	Hertz produces, transmits, and receives electromagnetic waves
1895	Marconi transmits and receives a coded message at a distance of 1.75 miles
1899	Marconi sends the first international wireless message from England to France
1923	The decibel (1/10th of a bel, after A. G. Bell, inventor of the telephone) used to express loss (of power)
1924	The mobile telephone invented by Bell Telephone and introduced to NYC police

Wireless Chronology Part 2 (Microwave Journal (`microwavejournal.com`))

Chronology 3

Year	Discovery / Development
1932	The International Telecommunications Union (ITU) formed
1948	Branttain, Bardeen and Shockley build the junction transistor
1948	Claude Shannon develops the theoretical foundations of digital communications
1974	The beginning of TCP/IP
1978	AT&T Bell Labs test a mobile telephone system based on cells
1985	The FCC allows unlicensed use of the ISM band (enabling wifi)
1990	WWW developed
1997	First 802.11 standard for wifi released by IEEE

Wireless Chronology Part 2 (Microwave Journal (`microwavejournal.com`))

Mobile Telephony

As mentioned in the chronology, above, mobile phones were first used in 1924. However, it was not till much later, around 1978, that they became widespread.

Wireless signals lose strength approximately according to the inverse square law, which means that the loss (in power) over a certain distance is a factor of 4 greater if that distance is doubled. More generally, if the distance is increased by the factor a, the loss will be greater by the factor $\frac{1}{a^2}$.

Mobile Telephony (cont)

Inverse-square loss means that the signals of our neighours, and fellow citizens, cause less interference, so long as they are distant.

So, we subdivide the domain where communication is taking place into *cells*. The frequencies in use can then be *re-used* in cells that are not too close.

Wireless LANs

Let's call the history of wireless since the introduction of the Internet *modern*.

In 1985, the idea that some wireless spectrum can be *unlicensed* was introduced.

The only regulation is that no transmitter should use more than ≈ 10 milliamps.

The wifi standards: 802.11a, b, ...

Channel Capacity

Shannon gives the maximum data rate in the presence of noise, as follows:

$$C \leq B \log_2(1 + S/N)$$

where C is the channel capacity (transmission speed in bits/s), B is the bandwidth, and S/N is the signal-to-noise ratio (SNR), which is the ratio of the power levels of the signal and the noise.

Shared Spectrum

As the density of users of wireless spectrum goes up, we can achieve better efficiency by closer spacing of transmitters and receivers.

This occurs naturally, as the number of base stations or wireless access points increase.

Shared use of spectrum is much more efficient than allocated or regulated use. Star-link is a great example of this.

Where Next

Higher frequencies are more in use. More subject to interference by obstacles, or the atmosphere.

Aerial designs need to be more complex.

However, the *quantity* of bandwidth becomes dramatically larger.