EEN 1043/EE452 Wireless and Mobile Communication

Introduction

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About Me!

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PhD (Wireless Communication) from University of Hong Kong

Learning outcomes of the course

- Explain various wireless communication networks, identify critical limitations and issues, and compare various wireless communication networks.
- Calculate and compare the signal loss models, performance of various signal modulation techniques, spread spectrum techniques and codes.
- Explain the evolution of cellular networks, data transmission, and handover techniques. Calculate signal loss, network traffic congestion and grade of service of a cellular network.
- Explain and compare various wireless network standards and plan a suitable wireless network for a given application. Troubleshoot network problems and performance monitoring.
- Design wireless sensor networks for IoT applications using a variety of low-power, short-range and long-range wireless networks.

Course details

- Lectures: 12weeks x 3 hrs/week = 36 hrs
- Day and Time: Wednesday, 1400 hrs – 1700 hrs
- Lecture hall: HG19
- CA: 25%
  - Assignment 1: 6th week (10%)
    - Loop submission
    - Quiz (after assignment submission)
  - Assignment 2: 12th week (15%)
    - Loop submission
    - Quiz (last week)
- Final Exam: 75%

Course Material

- All announcements will be done through loop
- All slides will be uploaded on loop before the lecture.
- The assignment will be uploaded and submitted through loop
- Assignment 1
  - Calculate various numerical problems related to bandwidth calculation, loss of signals, encoding techniques, error detection/correction, and channel access. Design and implement a small-scale wireless network.
- Assignment 2
  - Plan a wireless network and network technology for a given application or environment. Conduct a case study for wireless communication networks using wireless communication, cellular network and low-power wireless LAN. Demonstrate a network and test its suitability for the given scenario using simulation software.

History of Wireless Communication

Smoke Signals and fire beacons; around 150BC

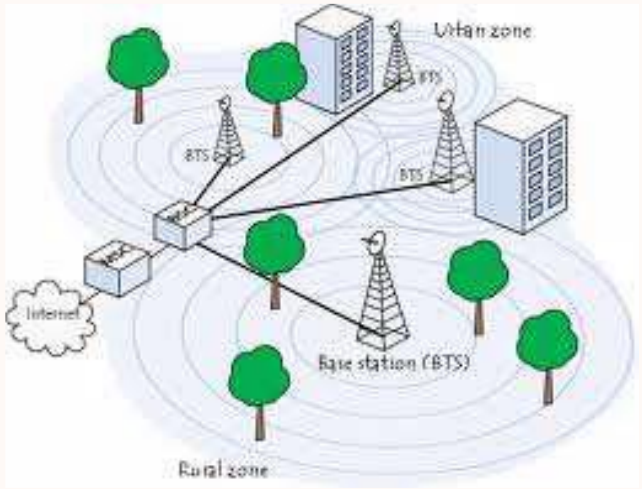
Wireless Technology

- First Radio Telegraphy system
  - Marconi
  - Sent telegraphic signals across the Atlantic ocean
  - Communication by encoding alphanumeric characters in analog signals

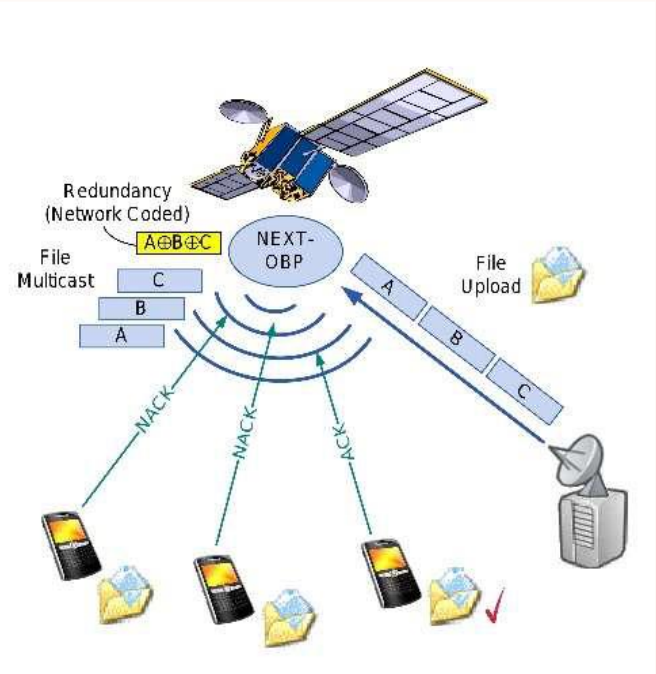
What is the biggest and most advanced engineering feat of the humanity?

Global Telecommunication Network (GTN)

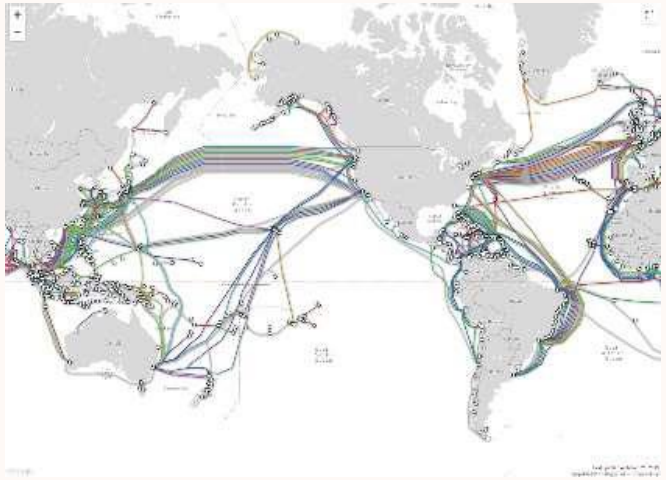
Cellular Network

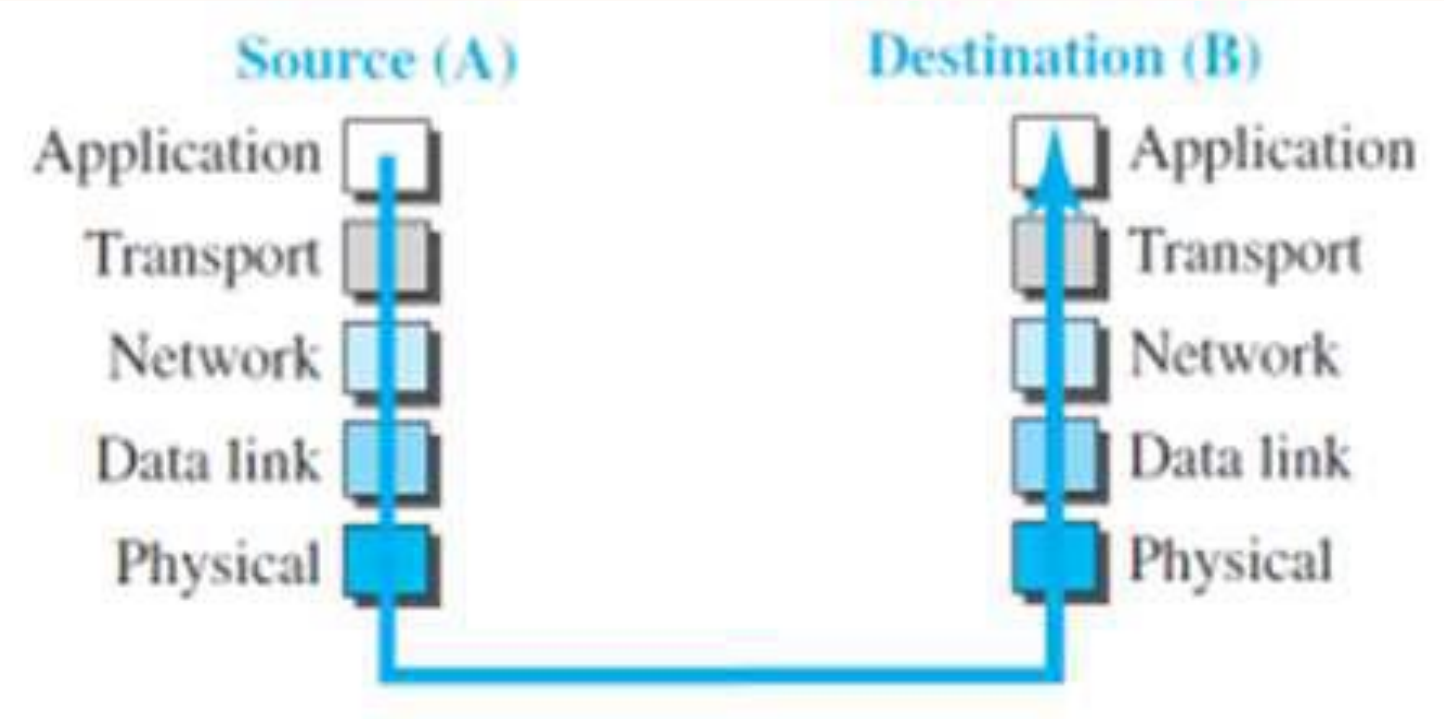


Satellite Network



Submarine Network





This course will mainly focus on the Physical layer

The Physical layer is the foundation on which the network is built

What is Wireless Communication

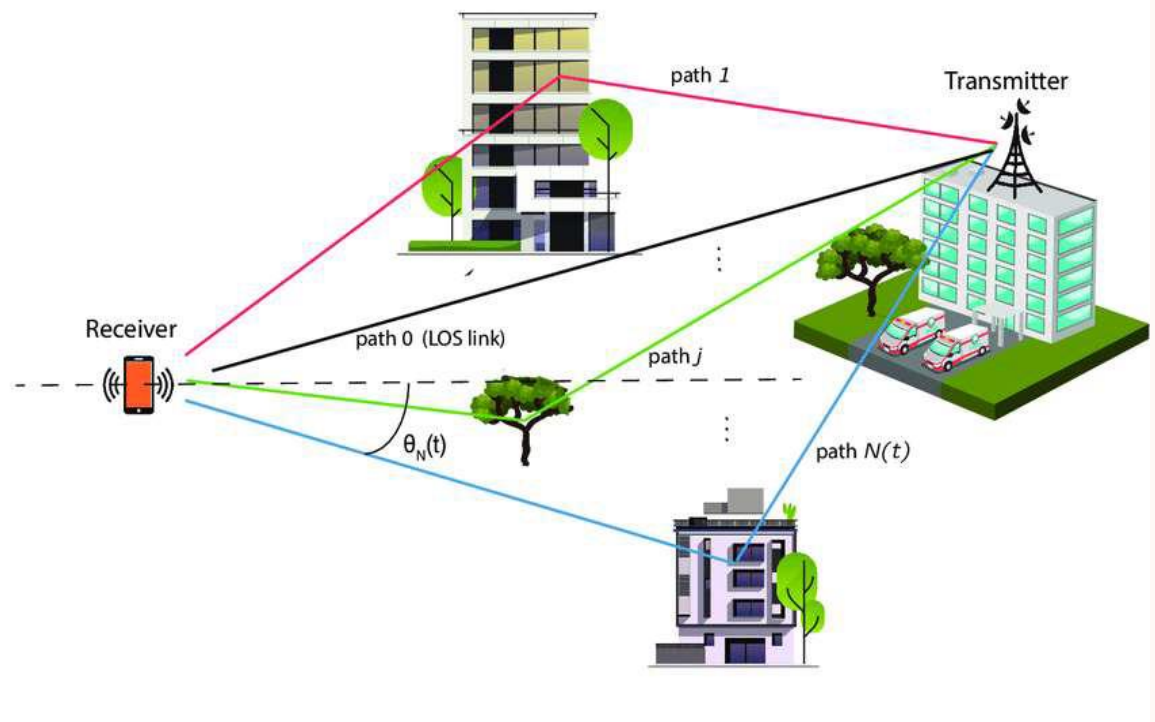
- Transmitting/ Receiving information using electromagnetic in open space
- The information from sender to receiver is carried over a well-defined frequency band

Wireless Communication

- How the design of a wired network differs from wireless network?
- **Radio Spectrum is a scarce resource**
  - Spectrum is controlled by regulatory bodies both regionally and globally. Systems operating in a given frequency band must obey the restrictions for that band.
- **Wireless channel is random in nature**
  - As a signal propagates through a wireless channel, it experiences random fluctuations in time if the transmitter, receiver, or surrounding objects are moving because of changing reflections and attenuation. Hence the characteristics of the channel appear to change randomly with time, which makes it difficult to design reliable systems with guaranteed performance

Wireless link

- Wireless RX receives signals from different paths, which significantly complicates the signal reception.



Wireless Network

- There are two types of wireless networks
  - Infrastructure based wireless networks
  - Ad hoc wireless

Fig. 1. Infrastructure based wireless networks

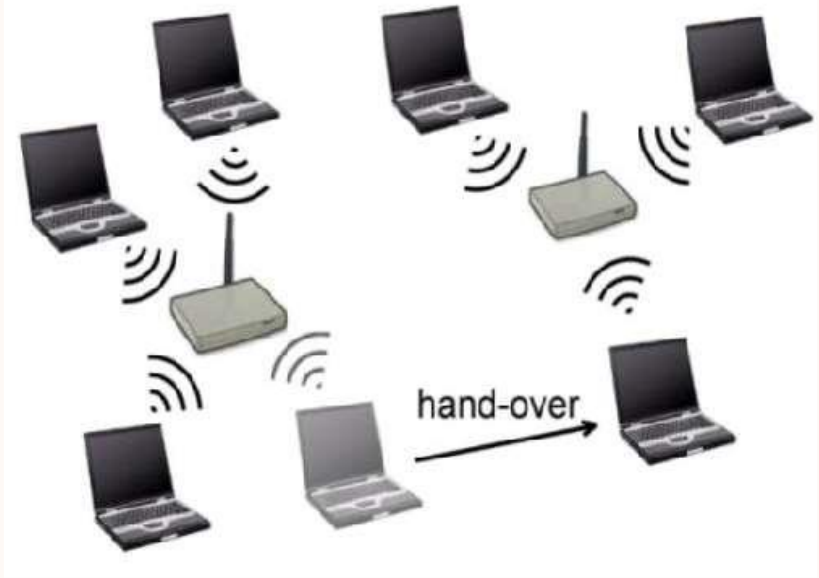
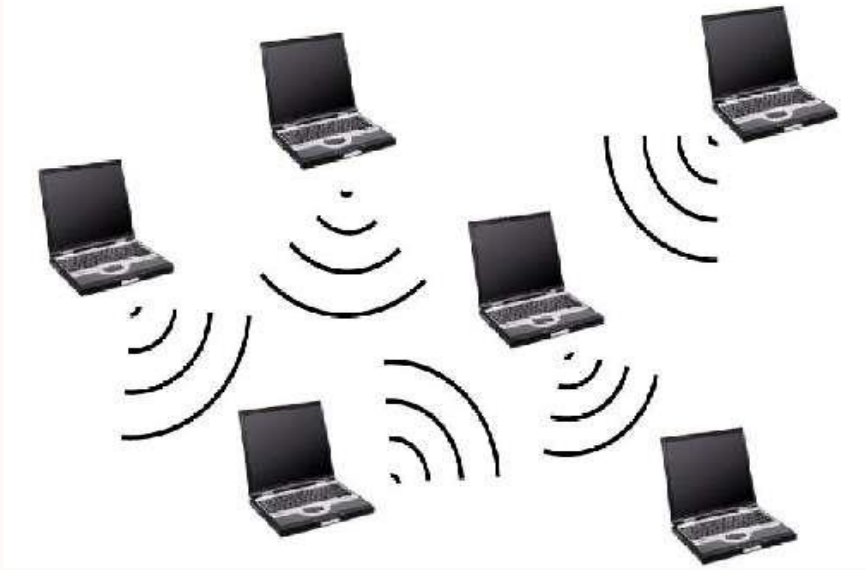
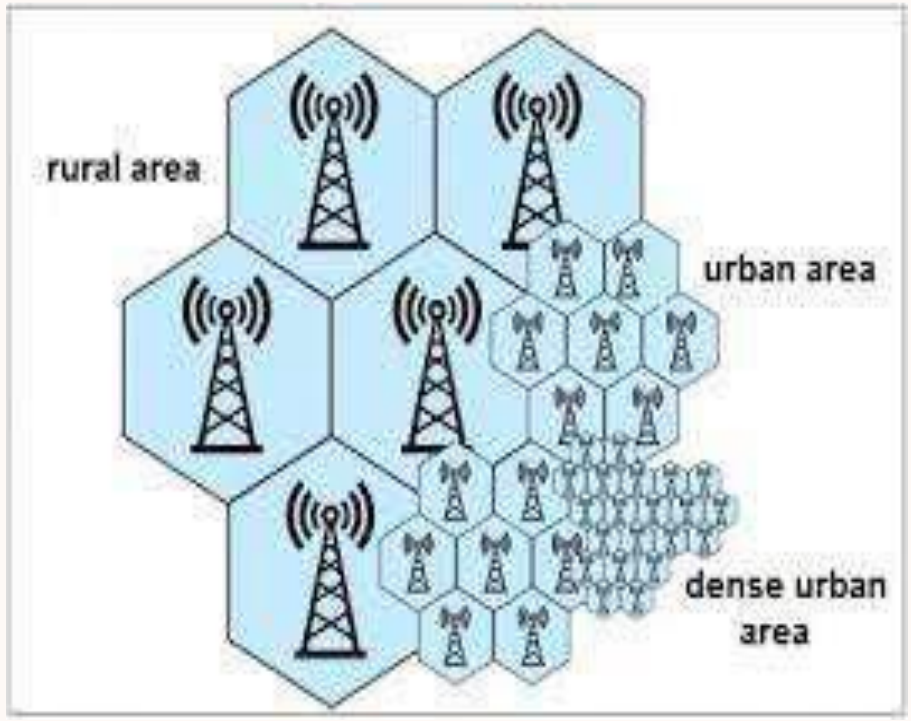


Fig. 2. Ad hoc wireless.

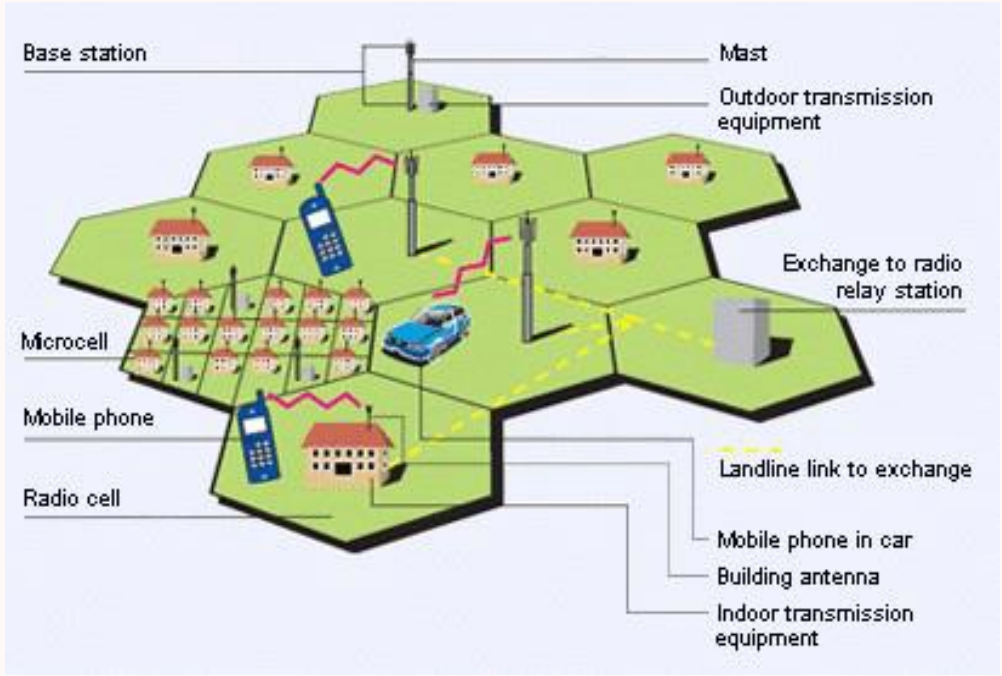


Wireless Network: Cellular Network

- The cellular wireless communication system is the most successful wireless network.
  - What is cellular system?
  - Why it is important?
  - How it works?
  - The basic principles of cellular communication system



Cellular Network



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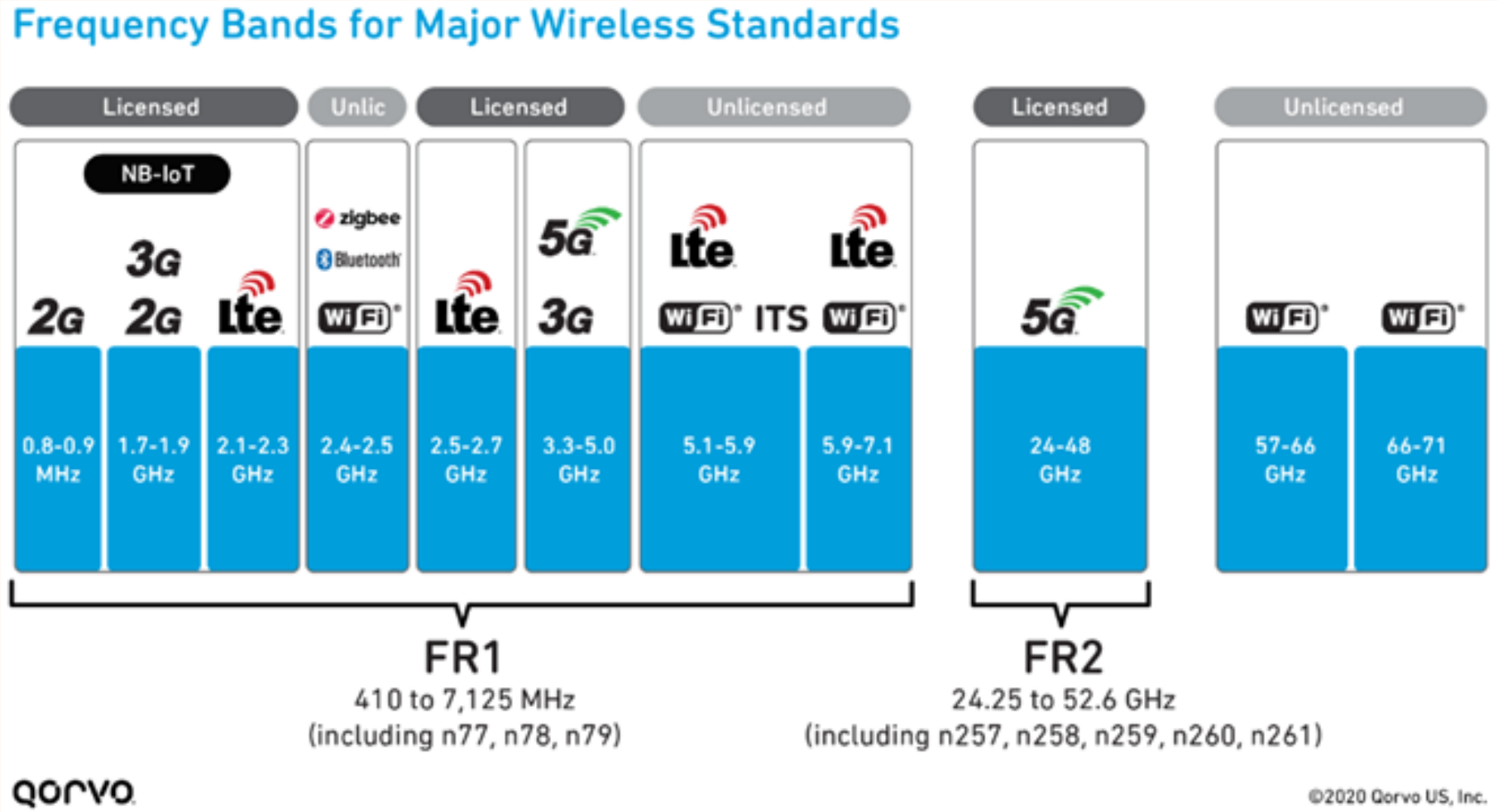
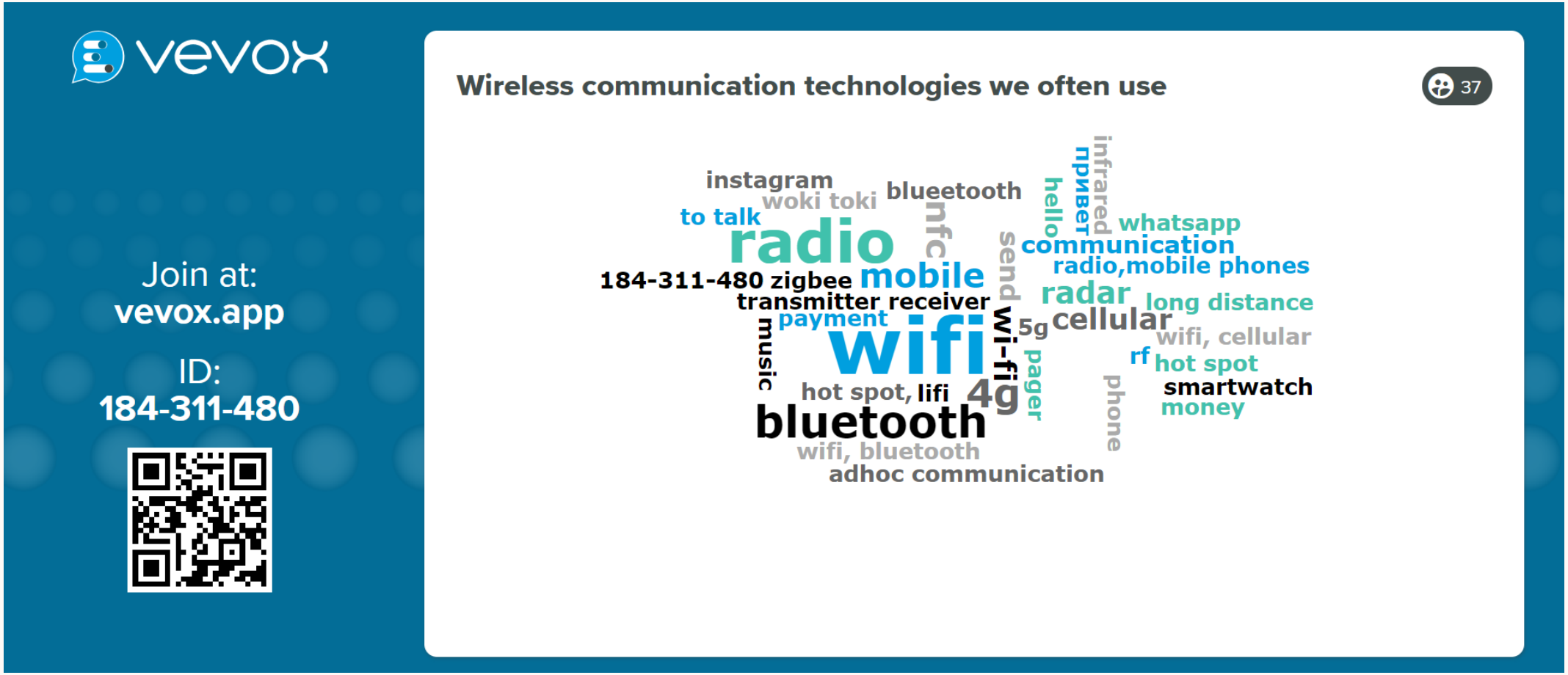
Wireless Standards



Course breakdown

- Wireless Link (i.e., one TX and one RX scenario)
- Wireless Network (i.e., more than two nodes)
- Wireless Standards (e.g. Wi-Fi, 5G, etc)

List down the wireless communication technologies we often use.



How do you see wireless technologies evolving in next 10 years