Networking and Internet Services

Presented by
Omid Panahi

Champlain
COLLEGE SAINT-LAMBERT

Introduction to the Course

Welcome!

About the Course

- **Course code**:
  - 420-N32-LA (2 Credits)
- **Length**:
  - 60 hours, 2 hours twice a week.
- **Evaluation**:
  - Project: 25%
  - Labs and Activities: 15%
  - Quizzes: 15%
  - Mid-Term Exam: 20%
  - Final Exam: 25%

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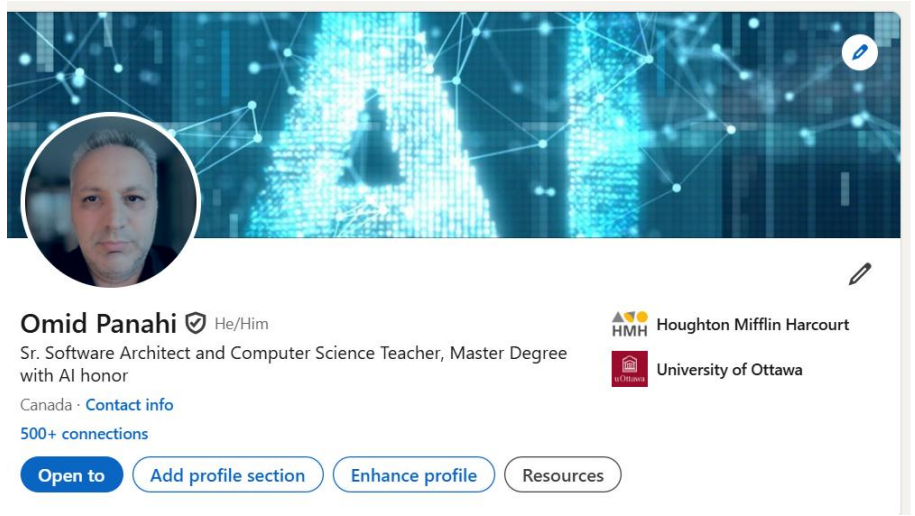
Teacher Details

- Name:
  - Omid Panahi
- e-mail:
  - opanahi@champlaincollege.qc.ca
- Office number:
  - F-250
- Office Hours:
  - Posted on instructors' door, and Omnivox



Basic Classroom Rules

- No prolonged cellphone use during a lecture. If you MUST receive a call, sit near the door please.
- Laptops are welcome, and should be used for study purposes, labs, research and communicating with peers.
- Extended social media use and especially gaming is not permitted once class starts, after a warning, you will be politely asked to leave the class.
- If you need to leave for the washroom or for a refreshment, there is no problem if done quietly.
- All other rules are common sense.

Introduction to Networking

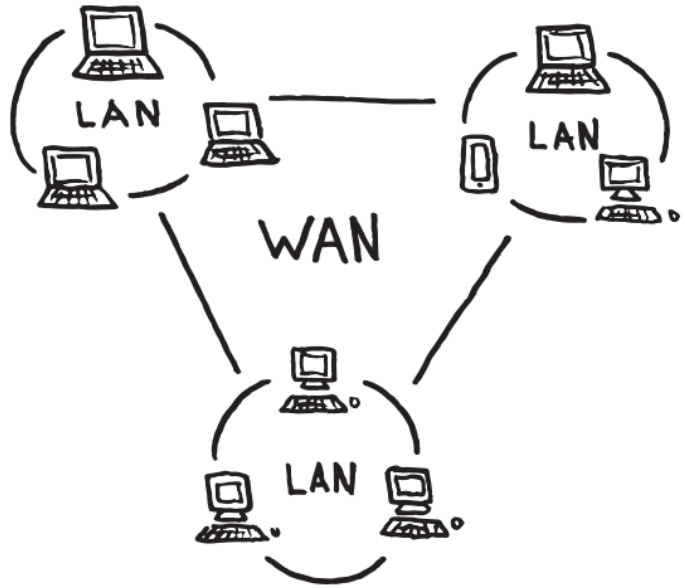
A summary of networking in general.

Definition of Computer Networking

- Computer network, two or more computers or devices that are connected with one another for the purpose of communicating data electronically.
- Academically speaking, networking is the practice of transporting and exchanging data between nodes over a shared medium in an information system.
- Interconnections can be over wire, wireless, satellite and via short and long distance fibre-optic (light/laser).

Computer Network Functions

- Computer networking enables devices and endpoints to be connected to each other on a local area network (LAN) or to a larger network, such as the internet or a private wide area network (WAN). This is an essential function for service providers, businesses and consumers worldwide to share resources, use or offer services, and communicate.
- Networking facilitates everything from telephone calls to text messaging to streaming video to the internet of things (IoT).



Network Complexity

- The level of skill required to operate a network directly correlates to the complexity of a given network.

- For example, a large enterprise may have thousands of nodes and rigorous security requirements, such as end-to-end encryption, requiring specialized network administrators to oversee the network.

Examples of Networks

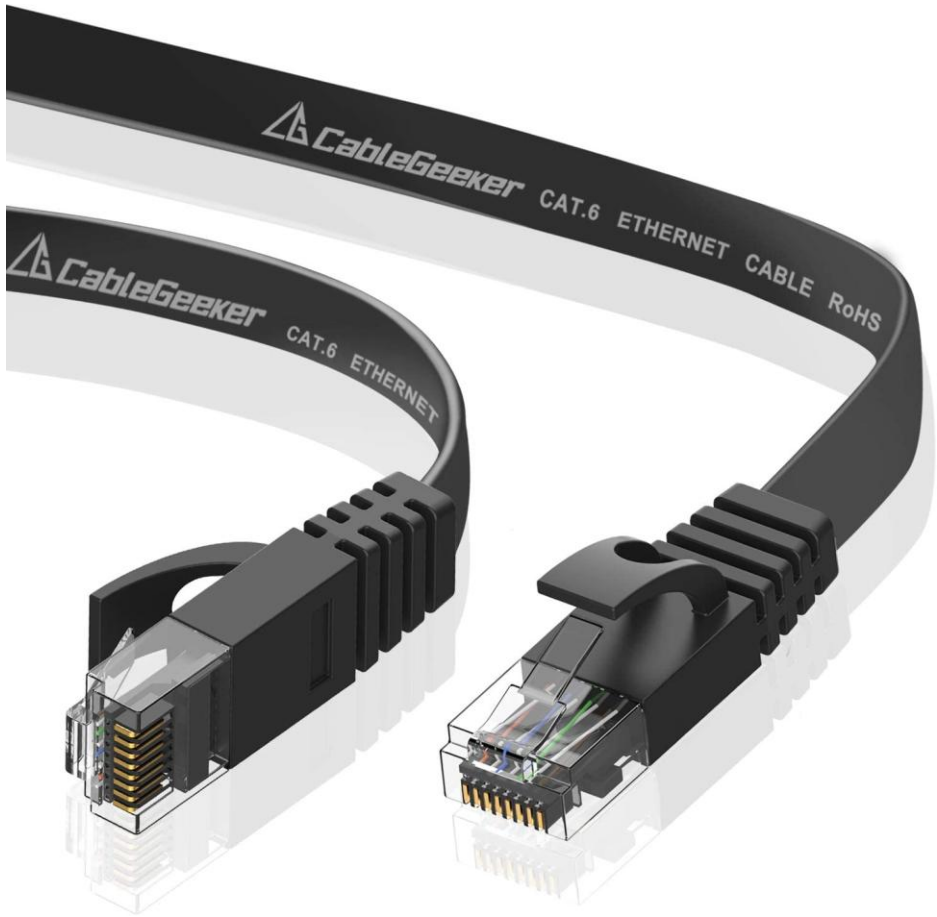
- The Internet is a network – it's the biggest network of them all.
- Anything in your home, behind your telephone or cable jack is your private network.
- The 4g and 5g cell networks are networks themselves (they then connect to the internet)
- Bluetooth and wifi private connections are isolated networks (eg: 2 people playing MarioKart on the Switch directly connected to each other).

Network Hardware

Breakdown of the different hardware components.

Ethernet (Cables)

- An Ethernet cable is something that will connect your electronic device (computer, tablet, gaming console, etc.) to a network, which, in turn, will allow you to have internet access and interact with shared network resources.
- Generally, you can get MUCH faster speeds over a cable than you can with a Wireless connection.
- Cables are categorized for their speed capability via a “CAT” rating (cat 5, cat 5a, cat 6, cat 7)



Modem

- Your modem is a box that connects your home network to the wider Internet.
- Often, your Internet service provider will give you one box that serves as both modem and router, but they're still different technologies; not all modems include routers and not all routers have modems.
- A modem modulates and demodulates electrical signals sent through phone lines, coaxial cables, or other types of wiring; it transforms digital information from your computer into analog signals that can transmit over wires, and it can translate incoming analog signals back into digital data that your computer can understand.

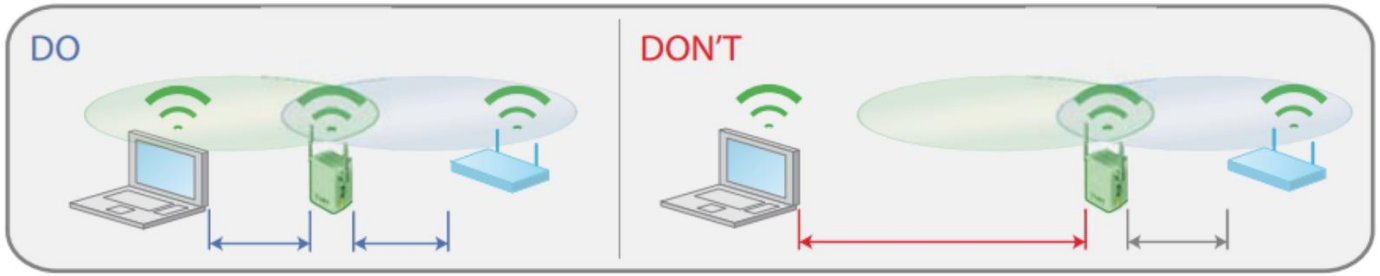
Most modems have two ports: One for the phone-line (or the cable connection) and one for the internal network.

Router

- A router generally serves the purpose to bridge two networks together and route traffic from one network to the other.
- A router usually connects your home LAN to the Internet (WAN)
- Routers can apply rules to the incoming and outgoing traffic to allow or block certain messages from specific ports.
- Without a router, you can only connect ONE device to the internet from your home (pretty useless?)

Repeater (Range Extender)

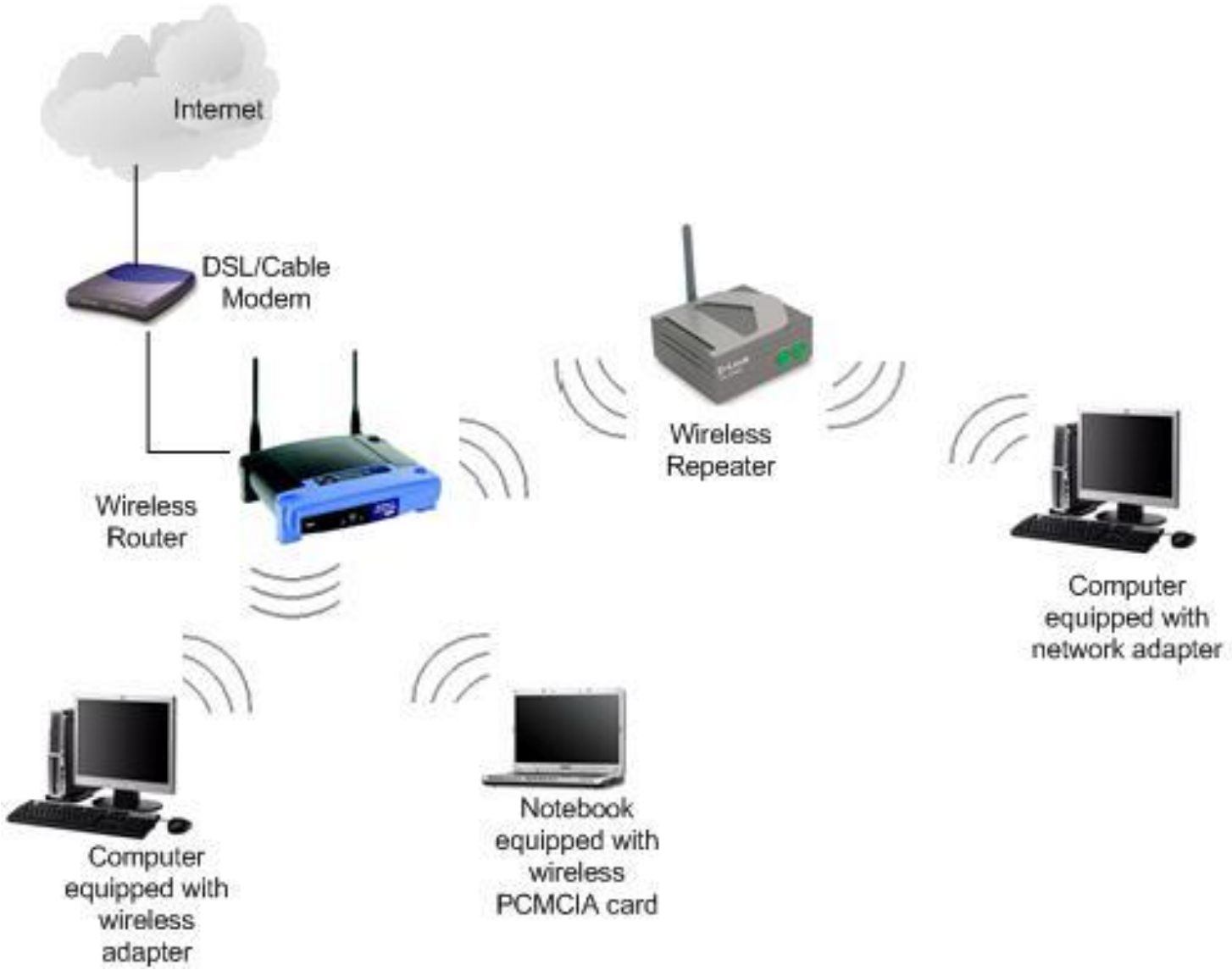
- A range extender or repeater will connect to a wireless network and create a secondary network which gives longer coverage.
- Warning: When an extender repeats, the speed is **usually cut in half.** (benefit of distance over speed).
- Use a repeater only if necessary!



Switch

- A switch allows you to connect all your devices together.
- A switch can also be “smart” and can control other “virtual” networks which may be required for phones.
- Some switches can even supply power over the connection so that you can plug in a camera without the need for an adapter (called PoE).

A Modem, Router, and Repeater



Wireless Access Point

- An AP is a device (normally attached to a switch) which gives wireless access to your wired network.
- This one here is an independent WAP, but sometimes it’s built into your router (all in one).
- WAP’s can also be programmed to be hotspots so that people must log in or they must accept a legal agreement before using it (like a coffee shop).

Bridge

- A bridge is a box which bridges two networks.
- This can be confusing because a router is a type of bridge (WAN and LAN).
- Bridges are different, they usually bridge different types of networks (your LAN and your HUE lights) for example.
- Bridges are not common in home environments.

Gateway

- A gateway (or a residential gateway) is a combination device. Some people refer to it as a router, or a modem, but that's not really the case.
- This Bell device is actually 4 devices – A modem, a router, a WAP, and a gateway (for IP phone).
- For non-tech people this is wonderful and easy to manage.
- For techs like us, it removes most ability to configure your network and sometimes needs to be bypassed.

https://videotron.com/en/internet/equipments/helix-fi-gateway

Hub

- Similar to a switch, a hub interconnects more than one PC together.
- Hubs take the incoming messages and distribute them to all the other connections.
- A switch is different – it sends messages to the intended port – not ALL ports.
- This method slows down the network due to redundant communications.
- Hubs are no longer used – for the most part.

Hub vs. Switch vs. Router

- Terminology:
  - MAC address
    - A unique address for each network device.
  - IP address
    - An address assigned to any device connected to your network. It is not guaranteed to be unique but SHOULD.

Network Interface Card (NIC)

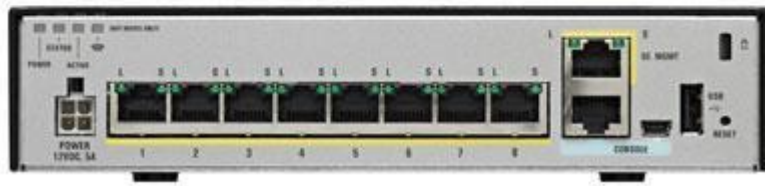
- A NIC is your interface to the LAN on your computer.
- They come in different speeds such as 100mbps, Gigabut, 2.5 gigabit and some are even 10 gigabit.
- Usually, they are built into your motherboard – no supplemental purchase necessary.
- The one to the right is an ADD-ON nic.
- Sometimes we might need to have more than one network port so we might need this card.

Wireless NICs

- IF your motherboard does not have wireless features, or the WIFI on your motherboard is very slow – consider this wireless nic.
- They can be PCI-E (pictured here)
  - Antennas can be built onto the card, or via a wire extension (pictured).
- They can be USB.
- USB nics have a speed limit, usually AC1300 max.

Firewall

- Firewalls are routers – but they have extra capabilities.
- Capabilities include
  - Most importantly - detecting attacks and stopping them
  - Providing better cryptographic services like VPN’s
  - Can detect viruses at network level
  - Filtering IP’s (for example, banning a country)
  - Provides redundant networking (load balancing)
- Firewalls tend to be **very expensive**. A basic unit costs approx. 500$ and requires yearly contracts over 200$ to run.



Open-Source Firewalls (and Firewall Software)

- Good news, you can build your own firewall and use free software to run it.
  - Method 1: Old PC with several NIC cards. (not expensive)
  - Method 2: A small form factor PC with built-in switch (pictured here) (cost from 350-1500, one time purchase).
- Popular (free) software include:
  - pfSense
  - OpenWRT

Powerline Networking

- Sometimes it's difficult to bring a wire to another area in the building.
- Also, the walls may sometimes block a good wireless signal.
- Powerline networking creates a network connection over the power-line. (plug 2 units in and sync).
- Cons:
  - Sometimes slow. Advertised gigabit speed but rarely get better than wireless.
  - Undependable. IF you run the microwave oven or pass the vacuum, it actually affects the speed throughput.

Networked Cameras

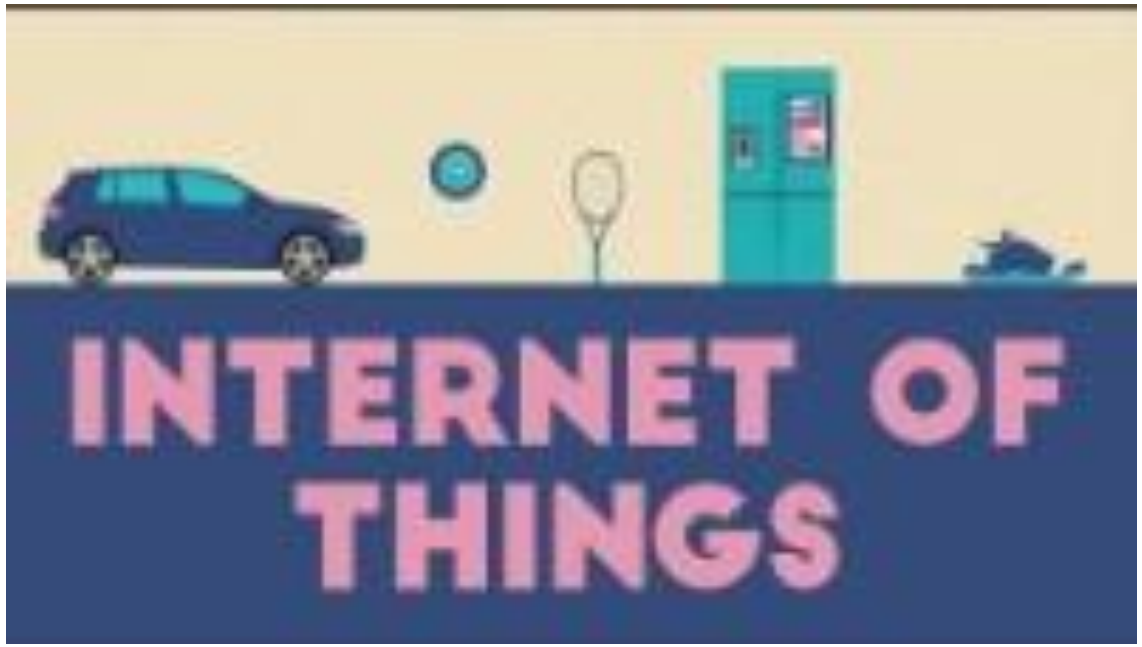
- Don’t confuse this with a webcam. This is a cam that is connected to Ethernet or Wireless NOT usb.
- The camera can be accessed from any web page.
- The video can be recorded and store on a “NAS” a networked storage unit.
- Can be powered with an AC adapter.
- Even better, can be powered over the Ethernet cable, if your switch delivers “PoE”.

What Else?

- Can you name or describe some other device(s) which may be networked?
- Group up and give me at least one device (that we didn’t speak about yet) that connects to the internet.

Networks enable IOT. What is IOT?

- Just a little preview of what is to come.
- IOT is called “The Internet of Things”.
- Things like Fridges, Cars, etc can be connected to the Internet.
- The devices generate a LOT of data for companies to monitor devices.
- This is all possible with 4g/5g networks and wireless networking.



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