B211 Internet Computing

Access Networks

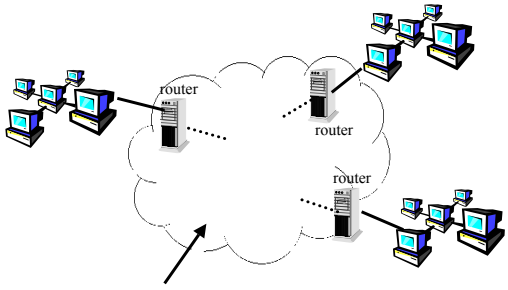
Learning Objectives

1. Understand how users can be connected to the global network through access network mechanisms.
2. Understand the relationship between these access networks and the long-haul backbones that connect the global network.

Lecture Outline

- LANs and Access Networks
- Access Network technologies
- The last mile problem

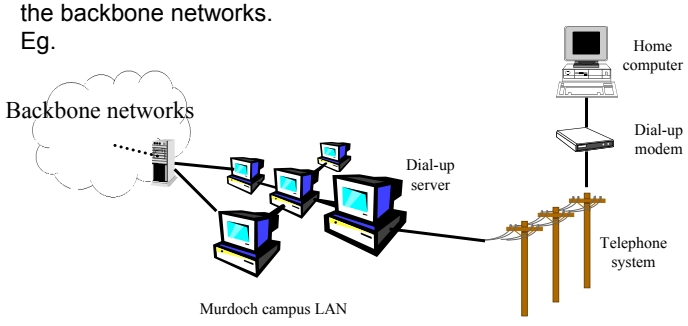
A diagram from week 1...



We talked about how these are physically connected in the last lecture on backbone networks.

Another diagram from week 1...

Today we will talk about how to connect users to the backbone networks.
Eg.



The LAN (Local Area Network)

- The LAN is basically a set of hardware (hubs, switches, cables, etc) and their controlling software, which allows a whole set of users within one organization to
  - connect to each other
  - connect to the rest of the world by having the LAN connect to backbone networks.
- Due to its relatively short distances, twisted-pair copper wire is a viable option for cabling LANs.
  - Most current LANs are connected via copper wires for short distances, and fibers over longer distances.

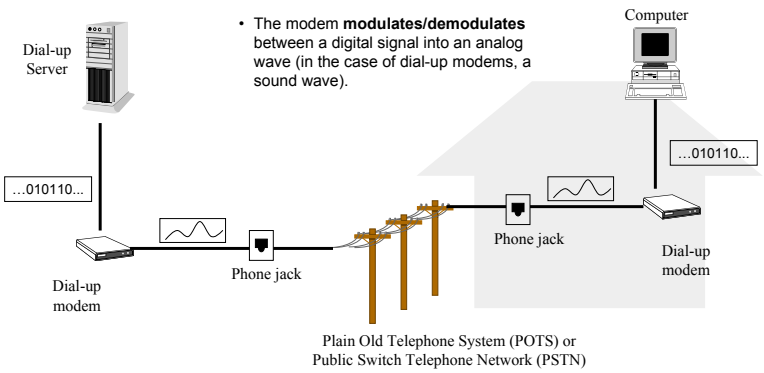
LAN Software

- LANs are controlled by software following a protocol for communication
  - Ethernet (IEEE 802.3) is a very popular networking protocol for LANs.
  - Other examples are Token Ring, ARCNet, Token Bus.
- Today, we are also venturing into *wireless* LANs
  - Eg. IEEE 802.11, HyperLAN, HomeRF.

Some Common Methods to Connect to an ISP's LAN

- Dial-up modems through telephone network
- Cable modems
- ISDN (Integrated Service Digital Network)
- xDSL (Digital Subscriber Lines)
  - ADSL (Asynchronous DSL)
  - HDSL (High-rate DSL)
  - VDSL (Very-high-rate DSL)
- Satellite

Dial-up Modems



Dial-up Modems

- The dial-up modem takes advantage of the fact that there is existing telephone local-loops connecting to almost every home and office.
  - More cost effective to use that system for data communication than to install new lines.
- Unfortunately, the telephone system uses analog sounds, but computers uses digital bits.
- Therefore we use modems to convert between the two.

Dial-up Modem Bandwidth

- Theoretical maximum speeds for dial-up modems:
  - 56Kbps **downstream** (from ISP to user - usually the content and data users are after).
  - 48Kbps **upstream** (from user to ISP - usually control information sent by software).
- Actual possible speeds depends on the a lot of equipment:
  - Type of modem user has
  - ISP's connection to the PSTN switching centers
  - Server equipment at the ISP's end
  - Noise and interference on the lines
    - actual communication speeds are negotiated automatically between user's modem software and the server when they first connect.

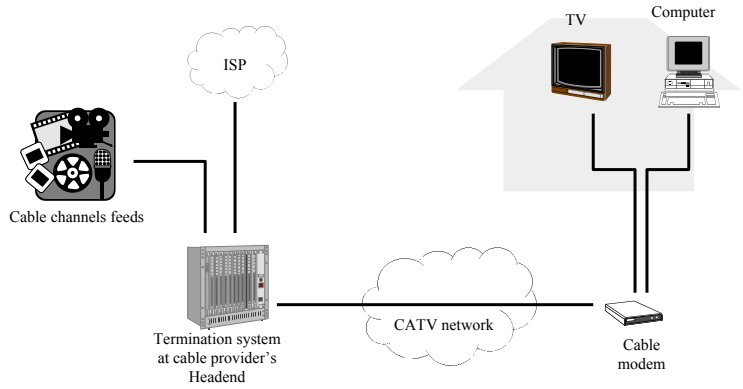
Dial-up Modem Bandwidth

- As a **very rough** guide: average dial-up modem download speeds on an average ISP on average traffic during an average day in Australia is about 4KBps (kiloBYTEs per second).
  - 8Kb = 1 KB

Dial-up Modem Standards

Standard	Speed	Year
V.32	9.6 Kbps	1984
V.32bis	14.4 Kbps	1991
V.34	28.8 Kbps	1995
V.90	56 Kbps (33.6 Kbps upstream)	1997-1998
V.92	56 Kbps (48 Kbps upstream)	2000-2001

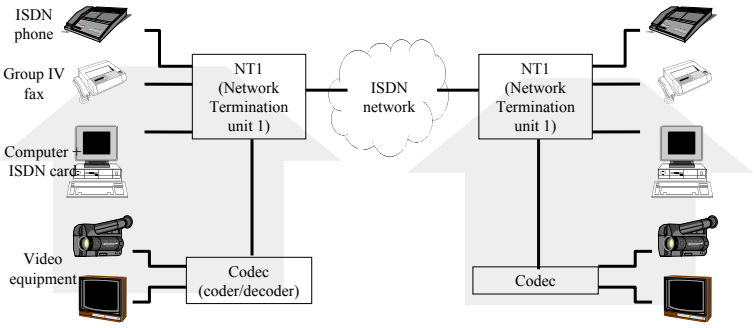
Cable Modems



Cable Modems

- Take advantage of existing cable television (CATV) lines.
  - CATV's coaxial cables have much higher capacity than the twisted pair cables used in PSTN.
- Possible maximum speeds:
  - 30Mbps downstream
  - 768Kbps upstream
  - The reason for this big difference is that the cable system was originally designed to support uni-directional TV transmission from provider down to subscribers only.

Integrated System Digital Network (ISDN)



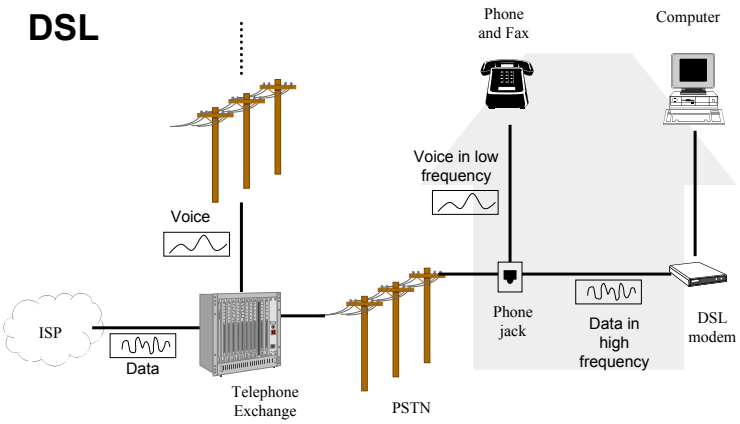
ISDN

- ISDN (or Narrowband ISDN) was created to provide a telephone system that can integrate more services than just voice, and at a higher quality.
  - Another category of ISDN, called Broadband ISDN, is a different technology, and not a common option to homes/small offices.
- Possible maximum speeds:
  - 64Kbps for single channel ISDN
  - 128Kbps for dual channel ISDN

Digital Subscriber Lines

- The point of having DSL technologies is to make use of existing PSTN local loop, but provide better service than dial-up modems can.
  - Higher bandwidth
  - Always-on connection
  - No disruption to phone service
- It requires only modems and filters at the users end, and upgrades to equipment at the telephone exchanges, but still makes use of the same (supposedly low-bandwidth) telephone lines.

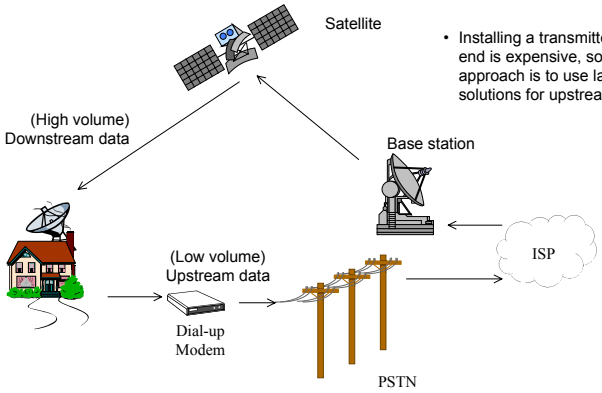
DSL



Asymmetric DSL (ADSL)

- One of the widely deployed DSL technologies in Australia and many parts of the word is ADSL, which uses lower upstream speed to get better downstream speed.
- Possible maximum speeds:
  - 640Kbps bi-directional
  - 9Mbps for downstream only
  - Current commercially deployed ASDL set-up does not go near this maximum speed.
    - Commonly deployed speeds are 64-256Kbps upstream and 256-1500Kbps downstream.
- The reason why the “asymmetry” makes sense is because most users download content a lot more than upload.

Using Satellites and mini-dishes



- Installing a transmitter in the users end is expensive, so a common approach is to use land-based solutions for upstream data.

Access Networks

- The ISPs LAN, coupled with the mechanism that homes and offices connect to them, forms **access networks**.
- ISPs provides **points of presence (PoP)** to allow users and subscribers to connect to them.
  - Eg. dial-up servers at local locations so users can connect using a local number.

The Last-Mile Problem

- This refers to the bottleneck involved in getting data from the main backbones (which has VERY HIGH capacity) to users in access networks (which has relatively LOW capacity).
- This is the principle problem we need to address if we are to have proper high-speed broadband network access, and rich multimedia content on the Internet.

The Move to Broadband

- *Broadband* Internet access generally refers to access with speeds higher than dial-up modems.
  - In Australia, the technologies used to support this are mainly cable, ADSL and satellite.
- Due to the increased bandwidth requirements of most Internet content today, having widely accessible broadband access is almost essential to any online activities.
  - The government’s Broadband Advisory Group is currently accepting submissions to decide on the recommendations for developments to broadband in Australia (http://www.noie.gov.au/Projects/consult/BAG/index.htm).

The Move to Broadband

- The much taunted (also over-hyped) 3G technologies is to provide broadband to wireless devices directly.

Some extra references:

- Some useful sites:
  - Broadband developments, guides and news in Australia
    - http://whirlpool.net.au/
  - Brief Internet connection technology descriptions
    - http://www.howstuffworks.com/category.htm?cat=Connect