

CSc 450/550 Computer Networks Internet Access

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Internet access through phone line

- Analog dialup
 - computer w/ ISA, PCI, serial, USB
 - modem w/ RJ11
 - telephone line
 - unshielded twisted pair (UTP)
 - up to 56Kbps downstream
- Digital access
 - ISDN: 2x64Kbps



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More on modems

- Nyquist limit (noiseless channel)
 - $2 H \log_2 V$ bps
 - bandwidth (Hz), baud, symbol, bit-per-second
- Shannon limit (noisy channel)
 - $H \log_2 (1+S/N)$ bps
 - telephone local loop: $H=3000\text{Hz}$; $S/N=30\text{db}$
- Modulation: amplitude/frequency/phase
 - more bits / symbol * 2.4K symbol / second

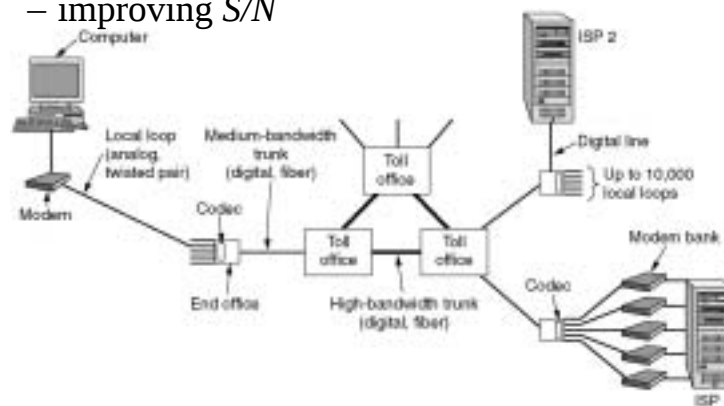
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Dialup ISP

- 56Kbps?
 - improving S/N



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Digital subscriber lines

- Asymmetric DSL (ADSL)
 - free up more H
 - frequency division multiplexing (FDM)
 - or discrete multi-tone (DMT)
 - telephone: filter for regular phones
 - upstream: small bandwidth
 - downstream: larger bandwidth
 - DSL modem
 - Ethernet or USB connection to computer/router



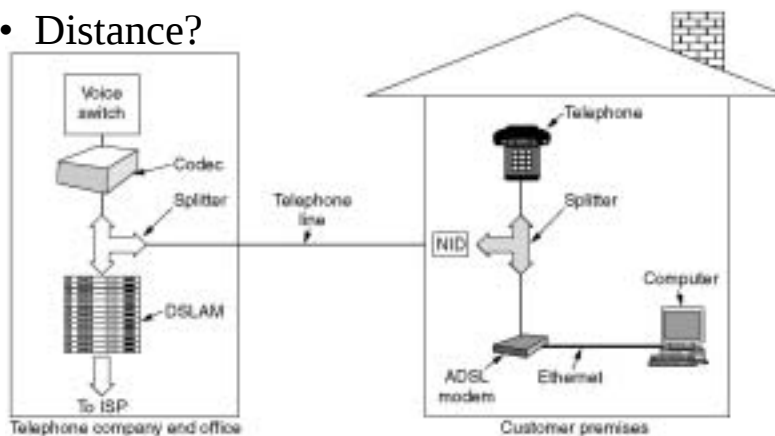
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DSL ISP

- Distance?



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Internet access through cable line

- Traditionally, cable TV is 1-way broadcast
 - one-way amplifier
 - shared coaxial cable
- Internet access through HFC (DOCSIS)
 - two-way communication channels
 - small upstream bandwidth
 - larger downstream bandwidth
 - smaller (shared) cable segment
 - security

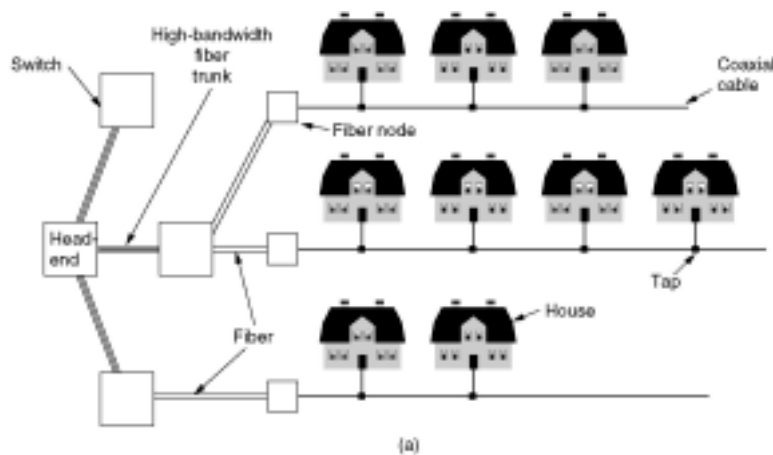


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Cable ISP



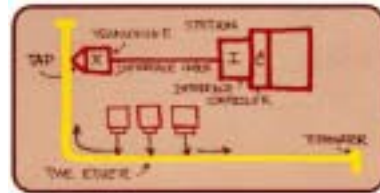
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Internet access through LAN

- UVicNet: 10/100Mbps switched Ethernet
 - RJ45
 - old days: AUI, BNC w/ coaxial shared
 - UTP Cat3: 10Mbps
 - UTP Cat5: 100Mbps
 - more twists per inch
- ResNet: 10Mbps switched
 - was 10Mbps shared



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Internet access through WLAN

- WiFi (e.g., UVic AirNet)
 - 802.11b: 2.4GHz, 100ft@11Mbps
 - direct sequence spread spectrum
 - 11 overlapping channels
 - channel 1, 6, 11 independent
 - 802.11a: 5GHz, 54Mbps
 - orthogonal frequency division multiplexing
 - 802.11g: 2.4GHz, 54Mbps
- Security



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Internet access over the air

- Wireless MAN (metropolitan area network)
 - MMDS: 198MHz@2.5GHz
 - range: 25~50km; 3Mbps downstream 200Kbps up
 - LMDS: 1.3GHz@28~31GHz
 - range: 2~5km, line-of-sight!
 - wireless DSL: 36Gbps downstream 1Mbps up/sector
- IEEE 802.16: WiMax
 - 10~66GHz (802.11a: 2-11GHz NLOS), OFDM

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Wireless*AN

- Personal area network
 - range: up to 10m
 - Bluetooth (802.15.1): 1Mbps; headset-to-phone
 - UWB (802.15.3): 400Mbps; wireless USB
- Local area network (802.11)
 - range: up to 100m
- Metropolitan area network (802.16)
 - range: up to 50km

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Internet access through cellular

- Cellular systems
 - 1st generation (80's): analog voice (9.6Kbps)
 - AMPS: cells, frequency reuse, cell split; FDMA
 - base station, mobile switching center, handoff
 - 2G (90's): digital voice (14.4Kbps)
 - TDMA, GSM, CDMA
 - 2.5G (~100Kbps): GPRS, EDGE, EV-DO, EV-DV
 - 3G: digital voice and data (384Kbps, 2Mbps)
 - WCDMA, CDMA2000, TD-SCDMA

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This lecture

- Internet access
 - phone line: dialup, DSL
 - cable line
 - LAN: Ethernet
 - wireless: WiFi, WiMax, cellular
- Explore further
 - compare your Internet access with your friend's
 - FTTH: fiber to the home!

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Next lecture

- Internet backbone
 - read CN Chapter 2