

Today: History of home networking

- Level 0: terminals (in 1970s)
  - USB (universal serial bus)
  - In 1970s, each computer has several serial ports, and transmit bytes on each serial lines
    - E.g. the computer is connected to a teletype machine (tty) through a serial port
    - There is no backspace or edit what you wrote in on teletype machines
    - Later teletype machines were replaced by glass terminals (or glass tty). And glass terminals would allow editing and erasing
    - Glass terminals — serial port — computers

(Sections in color red are newly added in that level)

- Level 0.1: terminals + modems
  - Then, people started to want to have glass terminals at their home. Anything input into the glass terminals was transmitted to a computer at a different location through telephone lines
  - Glass terminals — serial port — **modulator/demodulator — telephone lines — modulator/demodulator** — serial port — computers
  - modulator/demodulator => modem (transform between bits and telephone signals)
  - (modem — telephone lines — modem) is an interposing (x-in-the-middle), and the glass terminals and computers on the two sides are not aware of these modems and telephone lines and consider they are directly connected to each other through a serial port.
- Level 1: Internet at home
  - Glass terminals were replaced by computers (PC) in home, and PCs were speaking TCP/IP.
  - **PC — TCP/IP — SLIP — serial port — modem — telephone lines — modem — serial port — SLIP — TCP/IP — PC**
  - SLIP tags a length on each IP datagrams so that given bytestreams, SLIP can cut them into datagrams
  - SLIP was later replaced by PPP
- Given level 1, if we abstract modems/computers on the path between a PC and the destination it want to talk to, it becomes this:
  - PC — TCP/IP — modem — **ISP (which is actually — modem — (PPP7) — router — other network interfaces (e.g. eth0)) — Internet** — router — remote network (reddit)
  - Each part of this graph needs to keep some states for having a TCP connection between PC and reddit:
    - PC and reddit each needs a TCP Socket
    - And the routers of ISP and reddit need to know next hops for datagrams
  - Then the PC would need to keep:
    - TCP Socket:
      - 18.1.2.7:55000 (src address:src port)
      - 151.3.2.9:443 (dst address:dst port)

- And reddit has:
  - TCP Socket:
    - 151.3.2.9:443 (src address:src port)
    - 18.1.2.7:55000 (dst address:dst port)
  - ISP needs to track how IP addresses should be routed:
    - ISP: (to the home PC) — modem — ppp7 — router — eth0 — internet
    - In the routing table:
      - 0/0: eth0 via 8.7.6.5 (8.7.6.5 is the address of its ISP)
      - 18.1.2.7/32: ppp7
  - Reddit's router's routing table:
    - 0/0: eth0 via 14.14.14.14 (14.14.14.14 is the address of reddit's ISP)
    - 151.3/16: eth1
- Level 2: cable modem
  - modem also speaks Ethernet instead of SLIP/PPP7
  - ISP: (to the home PC) — modem — **eth1** — router — eth0 — internet
  - And in the routing table of ISP's route (with address 18.1.0.1)r:
    - In the routing table:
      - 0/0: eth0 via 8.7.6.5 (8.7.6.5 is the address of its ISP)
      - **18.1.2.7/32: eth1**
      - 18.1.0.1/32: is me
- Level 3: home network
  - Multiple PCs are connected to the same modem. All PCs are connected to different ports of a switch and the switch is connected to the modem. **A switch keeps an ethernet to port mapping. (A switch does not look at IP headers).**
  - PC1: 18.1.2.7 and PC2: 18.1.2.8 are connected to the same switch
    - PC1 — switch — modem
    - PC2 — switch — modem
  - And at the ISP's routing table:
    - 0/0: eth0 via 8.7.6.5 (8.7.6.5 is the address of its ISP)
    - **18.1.2.7/32: eth1**
    - 18.1.0.1/32: is me
    - **18.1.2.8/32: eth1**
- Level 4: home subnet
  - Level 3 is annoying because the ISP's routing table has an entry for both PC1 and PC2, and a "delegation" would make this easier.
  - At the home, there is a router between switch and modem:
    - PC1(18.1.2.7) — switch — **(eth0) — router(18.1.2.2) — (eth1)** — modem — (to ISP)
    - PC2(18.1.2.8) — switch — **(eth0) — router(18.1.2.2) — (eth1)** — modem — (to ISP)
  - At the home router's routing table:
    - 0/0: eth1 via 18.1.0.1 (ISP address)
    - **18.1.2.0/24: eth0 (home network)**
  - At the ISP's routing table:

- 0/0: eth0 via 8.7.6.5
  - 18.1.2.0/24: eth1 via 18.1.2.2
  - 18.1.0.1/32: is me
- Level 5: home wireless network
  - The home switch is replaced by Wi-Fi (AP)
  - And then it gets harder for an ISP to assign an IP address to every device connected to the Wi-Fi in every its customers' home