Computer Communication

An introduction

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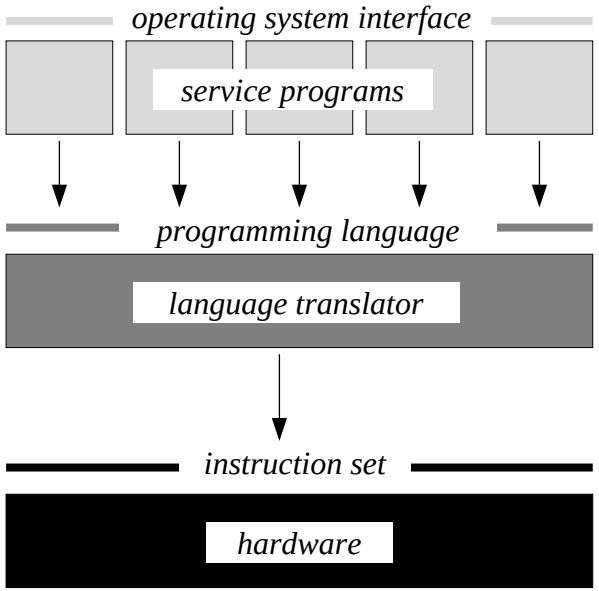
Structure of the introduction

- **Part 1**, "light" intro; focus:
  - Issues, problems in computer communication
  - A "flavour" of solutions
  - The "structure" of study in the field

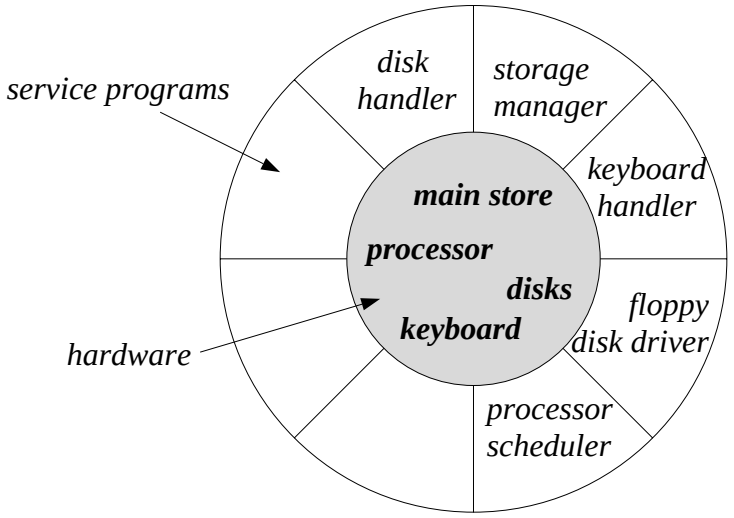
- **Part 2**, more "technical" intro; focus:
  - taxonomy, internet context
  - overview
  - terminology

Starting from computers: the principles



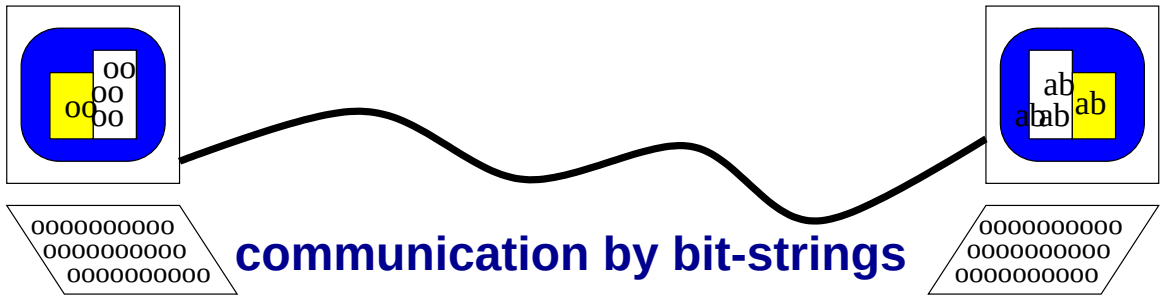
A computer: virtual, multi-*layered* machine[a]

[a]unlabeled figs are from "Computer and Network Organization" by van Steen, Sisps, Pr. Hall, 1996



Operating system: collection of service programs; resource manager, *shield* between user and hardware

A very simple "network"



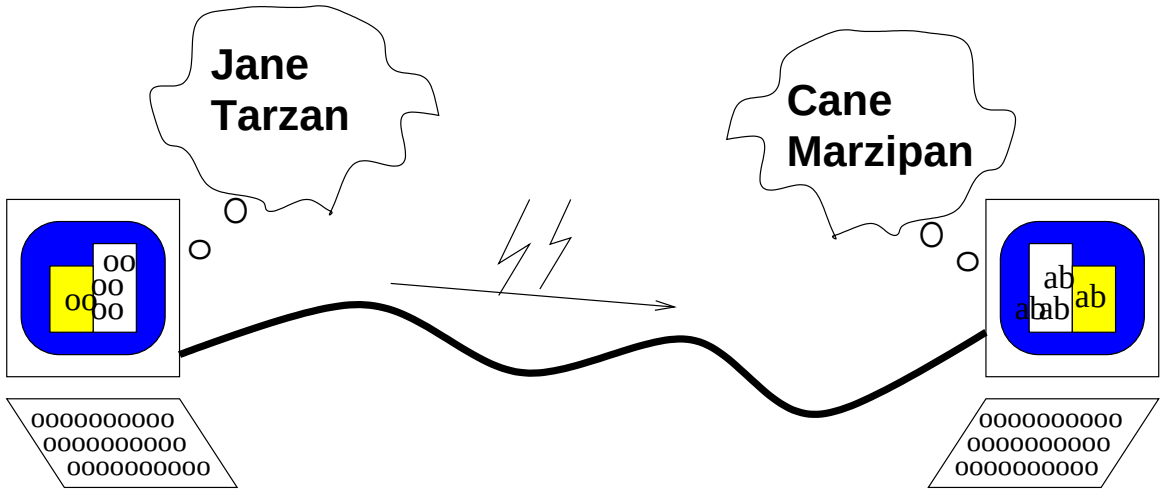
two computers linked through some transmission medium

The transmission can be
(a) **wired** (e.g. by electrical/optical wire), or
(b) **wireless** (e.g. by radio/satellite connection)

Assume we programmed interface/drivers to take care of bit transfers

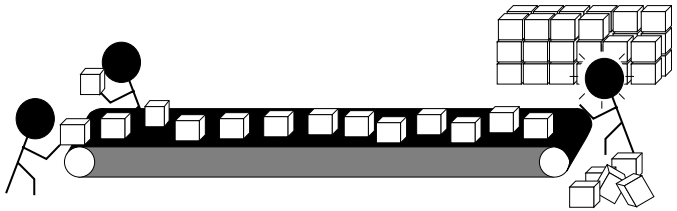
First problems...

1. Transmission Errors (Unreliable links)

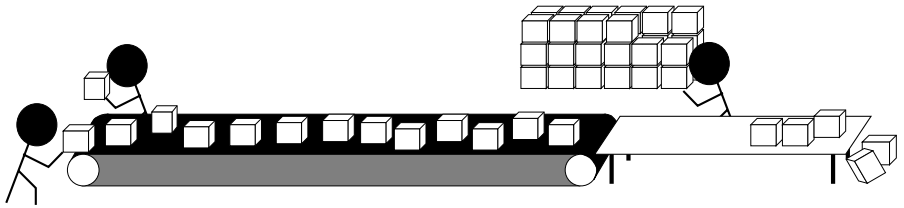


Need for error detection & correction methods (parity, error-correcting codes, ...)

2. "Producer-Consumer" problems



similar to the effect of e.g. not properly balancing the work on a conveyor belt



Using a **buffering** area to assist removal of boxes

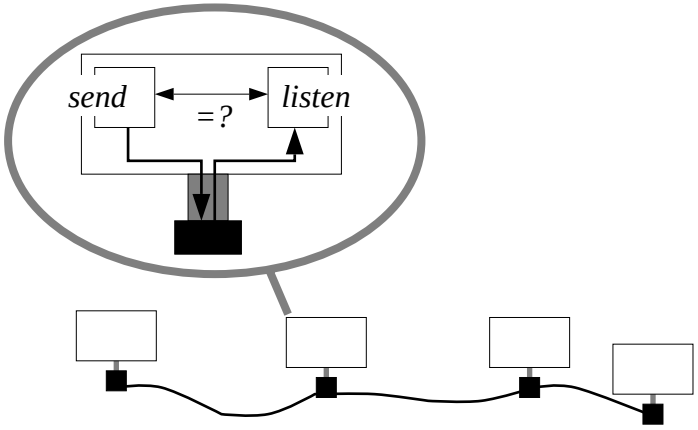
... BUT STILL boxes can get lost, i.e. we have an **unreliable network**.

Need for methods to make it reliable (ack's, retransmission, seq. numbers, ...)

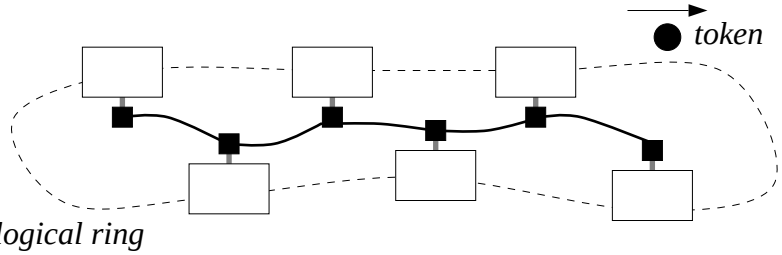
Expanding the network

1. Sharing a single transmission medium (e.g. bus, ...)

i.e. need to cope with **message collisions**



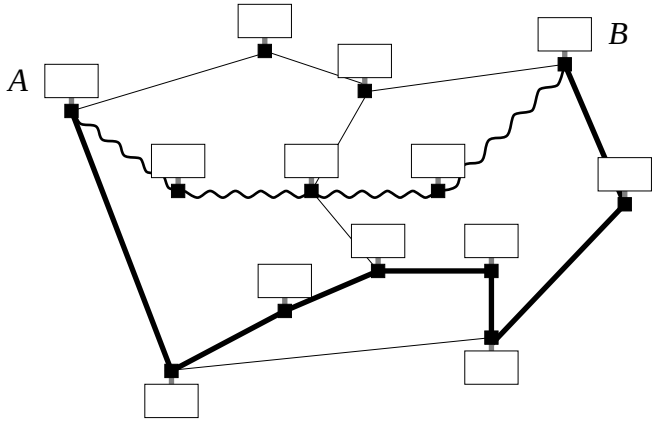
detect collisions & retry



avoid collisions (e.g. use a token for exclusion)

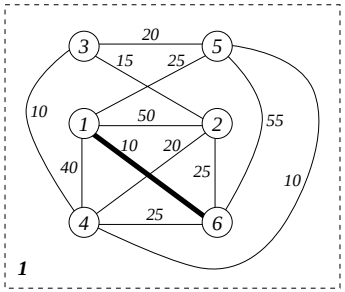
Expanding the network (cnt)

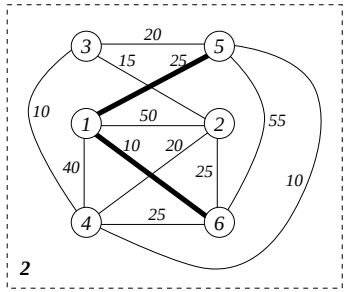
2. Point-to-point transmission

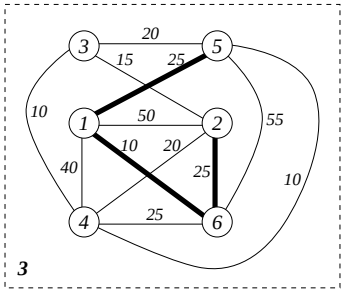


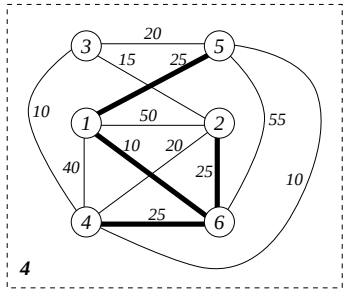
must do **routing**

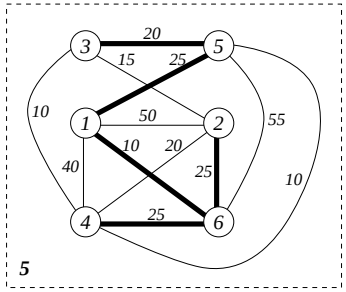
e.g. least-cost, a la Dijkstra; issues: static routing vs. dynamic, centralised vs. distributed, routing devices, etc; related with ...





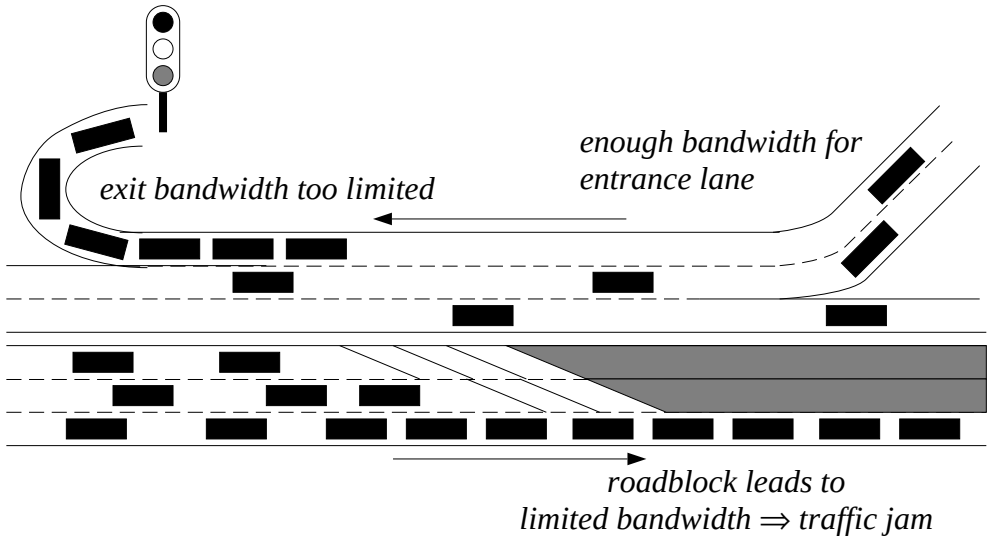






Expanding the NW: Point-to-point transmission (cnt.)

... congestion and flow-control



dependent on the **bandwidth** available (recall also the buffering discussed earlier)

Connecting networks

From *LAN* to *WAN* to *inter-networking* (or internet-working)
... *"Information superhighway"* or *"Information dirt road"*?

- **Sizes** increasing exponentially
- Different "**protocols, standards**" in different networks
- Different traffic (e.g. voice, data, ...) with different **requirements** in the same (inter)network
- Many new problems due to **mobility** (naming & locating hosts, bandwidth allocation, ...)

An example with humans

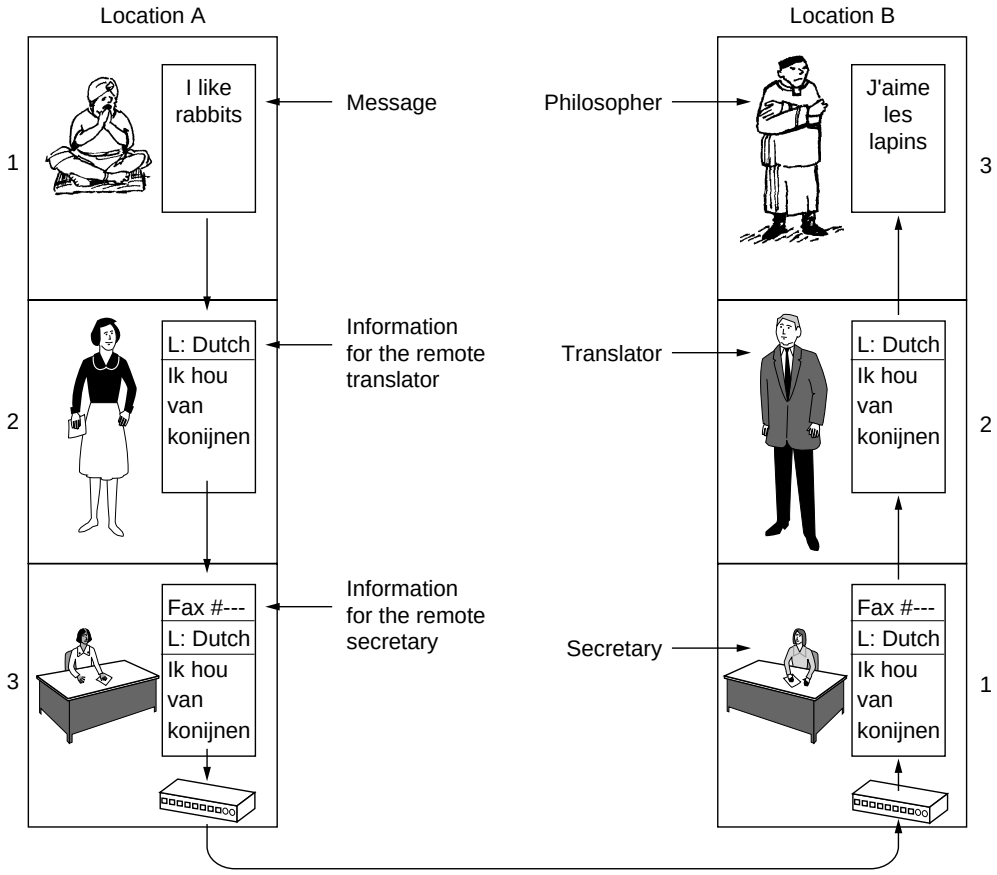
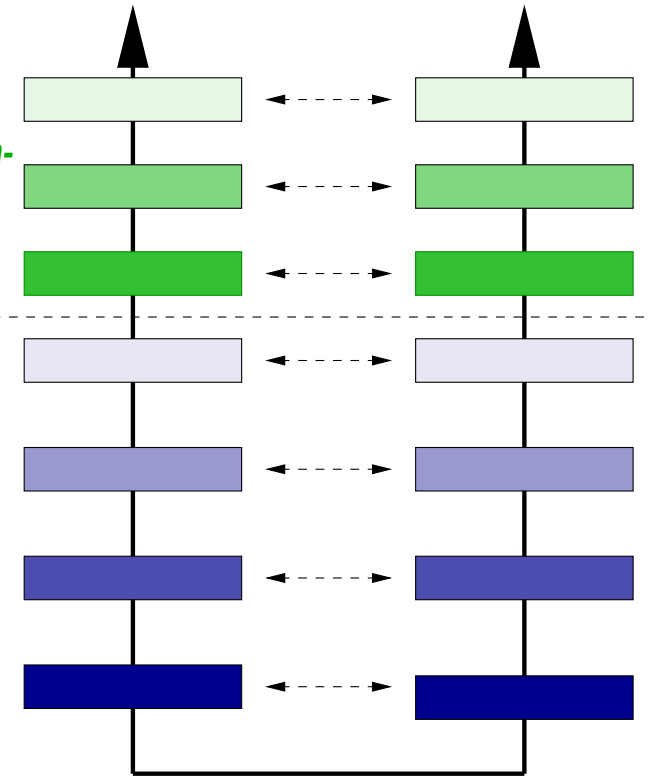


Fig. 1-10. The philosopher-translator-secretary architecture.

Studying & managing computer communication:

... layering (again): ISO standard



Application-oriented layers

Application layer (e-mail, ftp, telnet, DB systems, ...)

Presentation layer (compression, encryption, ...)

Session layer (session management, ...)

Network-oriented layers

Transport layer
make network comm. reliable (ack's, seq. num's, retransmit, ...)

Network layer
provide network communication (routing, resource allocation, ...)

Data-link layer
make physical comm. reliable (transmission-error detection/correction, ...)

Physical layer
provide physical communication (signals, bit-streams, ...)

This class ...

- **... is** about
  - problems, issues in networking
  - possible solutions
  - (possible) solutions within the existing context (Internet, ATM perspectives)

- We have a lot of material to cover...

- ... of diverse character:
  - algo+math-oriented
  - architecture-oriented
  - (some) 3-5-letters-initials-oriented

Some advice ...

- ... to be able to put things in persective:
  - come to classes (if you miss some, speak with people who came)
  - read on-line (don't wait until last weeks)
  - do the labs in time (don't wait until last weeks)
  - excercises, questions, www-site of book+course, practice using protocols following the hints in the book