TCP/IP Architecture
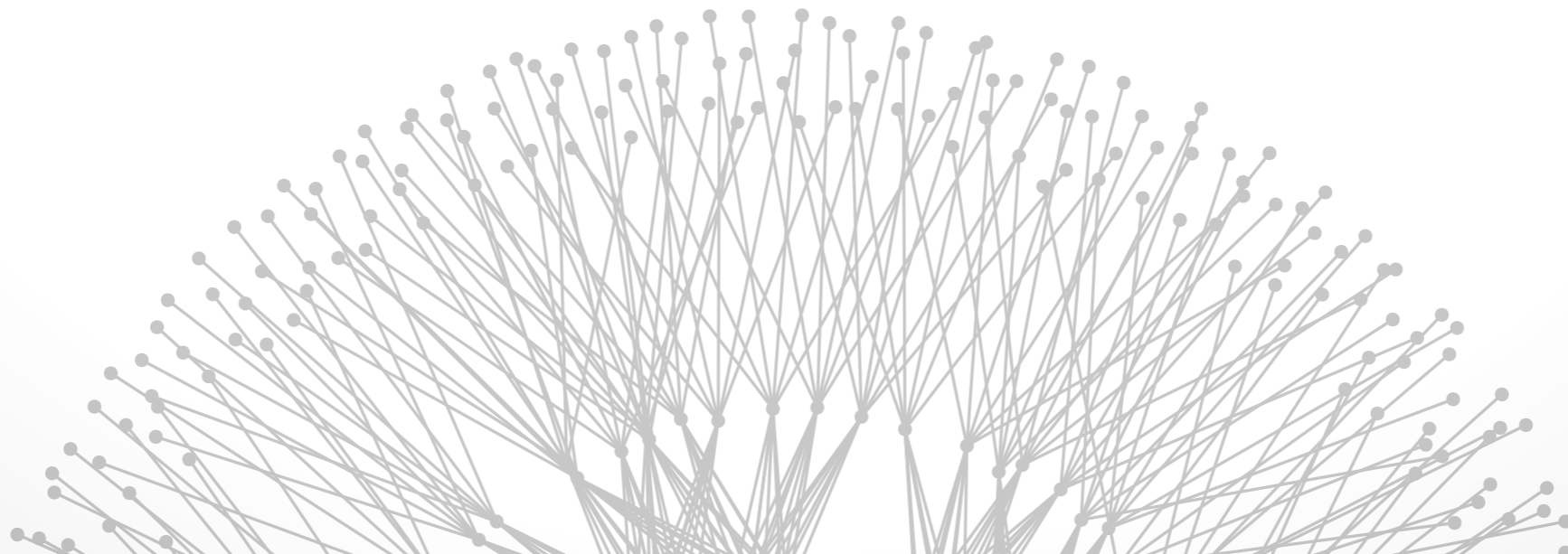
Brighten Godfrey
CS 538 September 4, 2012

Cerf and Kahn: TCP/IP

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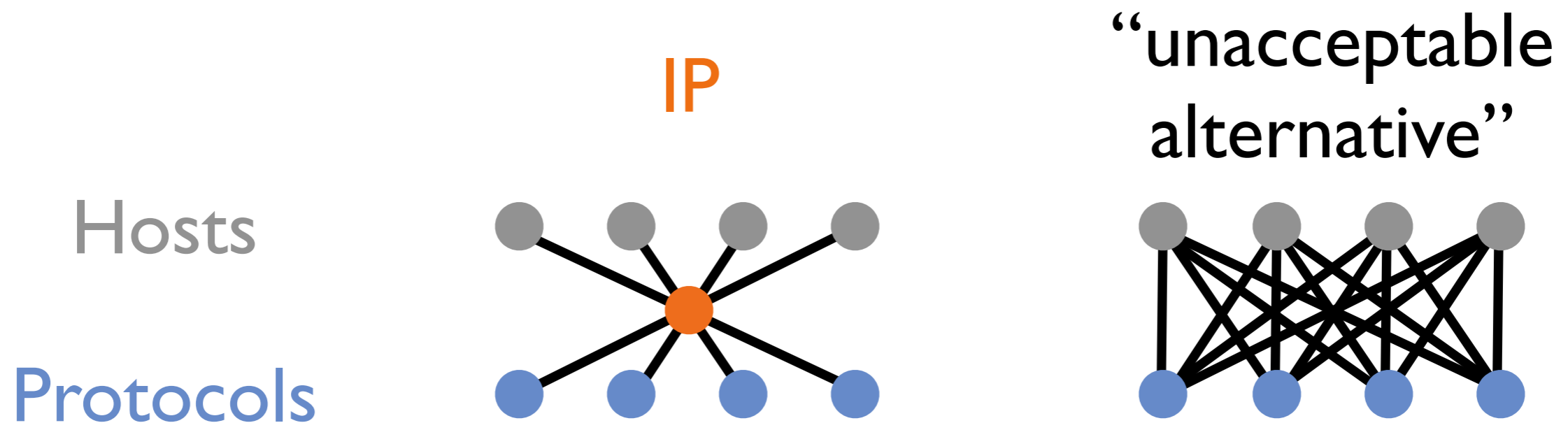| today	design decisions
thursday	architectural principles

Heterogeneity

- Different addressing, supported packet lengths, reliability mechanism, latency, status information, routing

Must let each network operate independently

Solution:

IP

"unacceptable alternative"

Hosts

Protocols

Gateways sit at interface between networks

packet from
process x
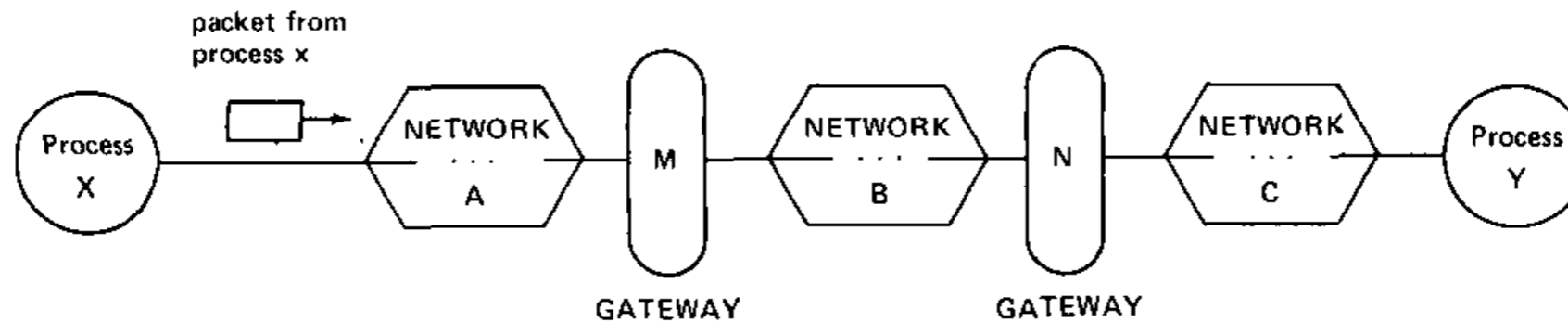
Fig. 2. Three networks interconnected by two GATEWAYS.

...and speak an Internetworking protocol

(may be null) ◄————— Internetwork Header —————►

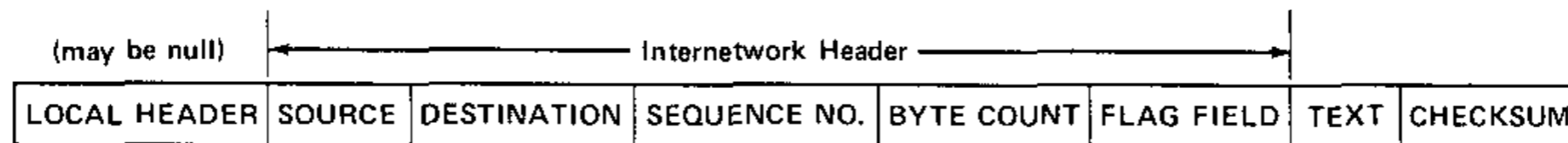| LOCAL HEADER | SOURCE | DESTINATION | SEQUENCE NO. | BYTE COUNT | FLAG FIELD | TEXT | CHECKSUM |

Fig. 3. Internetwork packet format (fields not shown to scale).

IP packet fragmentation

Allow maximum packet size to evolve

Protocol mechanisms to split packets in-transit

- byte-level sequence numbers

Reassemble at end-hosts

- Why not gateways?

Unreliable datagrams

No need for reliability in underlying network

Greatly simplifies design

- Exception handling always adds complexity
- But in IP: Any problem? Just drop the packet
  - examples?

What's not a stated reason for datagrams?

- Statistical multiplexing

Routing unspecified—but constrained!

Fig. 4. TCP address.

- Hierarchical (network, host) address
- Route computed within network, hop-by-hop
- 8 bits for network: *"This size seems sufficient for the foreseeable future."*
- Later: 32 bits in three size classes (A,B,C), and then CIDR.

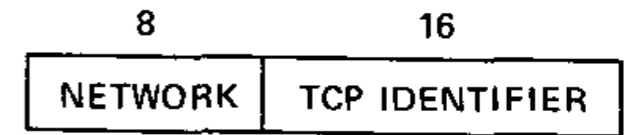Many new routing/forwarding designs need to change this address format

Ports

Associated with a process on a host

Identify endpoints of a connection ("association")

Rejected design:

- connection at host level
- packet may include bytes for multiple processes

What's the difference between a port and an address?

Window-based scheme

Fig. 10. The window concept.

Provides reliability, ordering, flow control

- Even though you might want only some of these

What else does it do today?
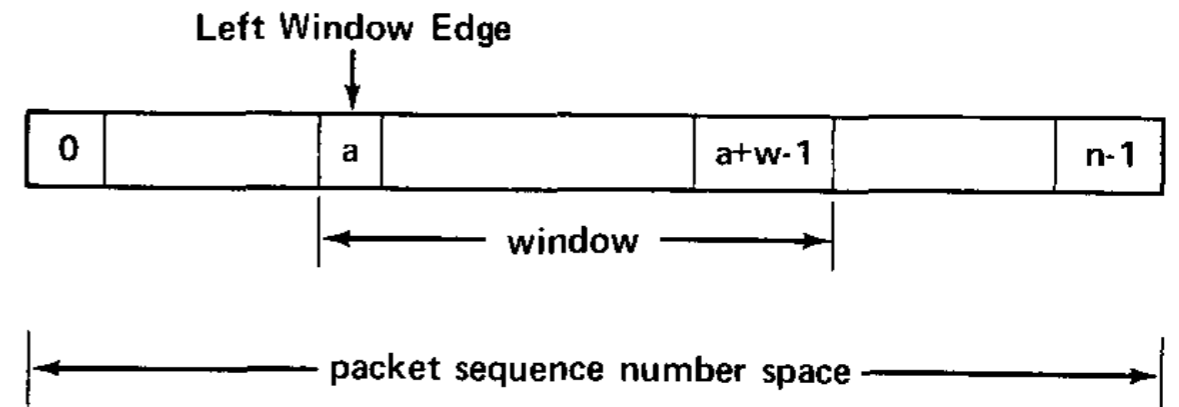
- Congestion control
- Three-way handshake

> " *It is our expectation that the host level retransmission mechanism ... will not be called upon very often in practice. Evidence already exists* [ARPANET] *that individual networks can be effectively constructed without this feature.* "

Why did they write this? Is it true now?

No congestion control in this early version!

- Congestion control introduces losses intentionally

Project suggestions

see separate document

Announcements

Read over syllabus

Review due Thursday:

- End-to-end arguments in system design (Saltzer et al, 1984)