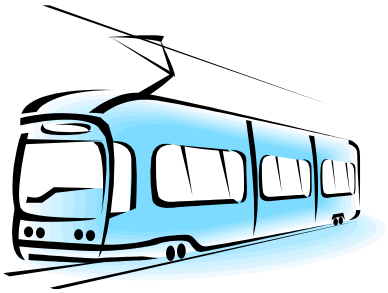
Computer Networks

- We use computer networks almost every second of everyday; becoming ubiquitous

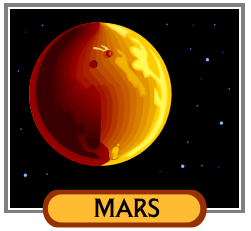



What Is a Network?

- Depends on perspective:
  - user - way to share/access data across the world
  - application programmer - list of services
  - network designer- cost effective design
  - network provider – something to charge for
- Public networks, private networks (intranets)
- The Internet, world-wide and beyond



end systems hosts

Computer Networks: User View

- Infrastructure that provides services to applications


p2p file sharing

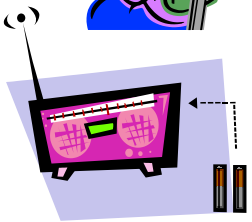
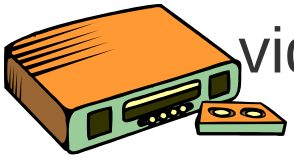

web browsing



on-line banking


email



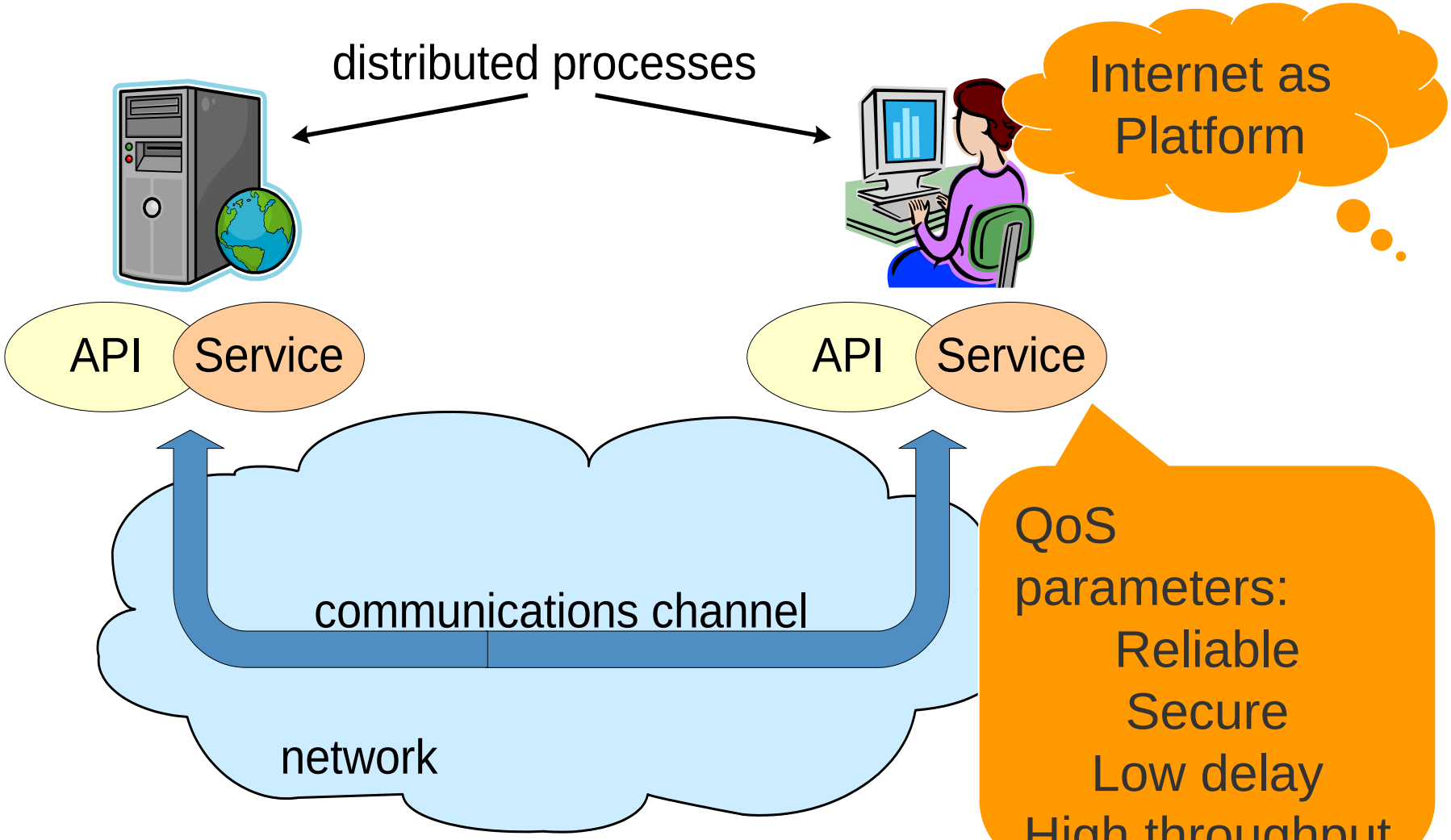
Internet radio


video streaming



Voice-over-IP


Instant messaging, games, …

Computer Networks: Applications View



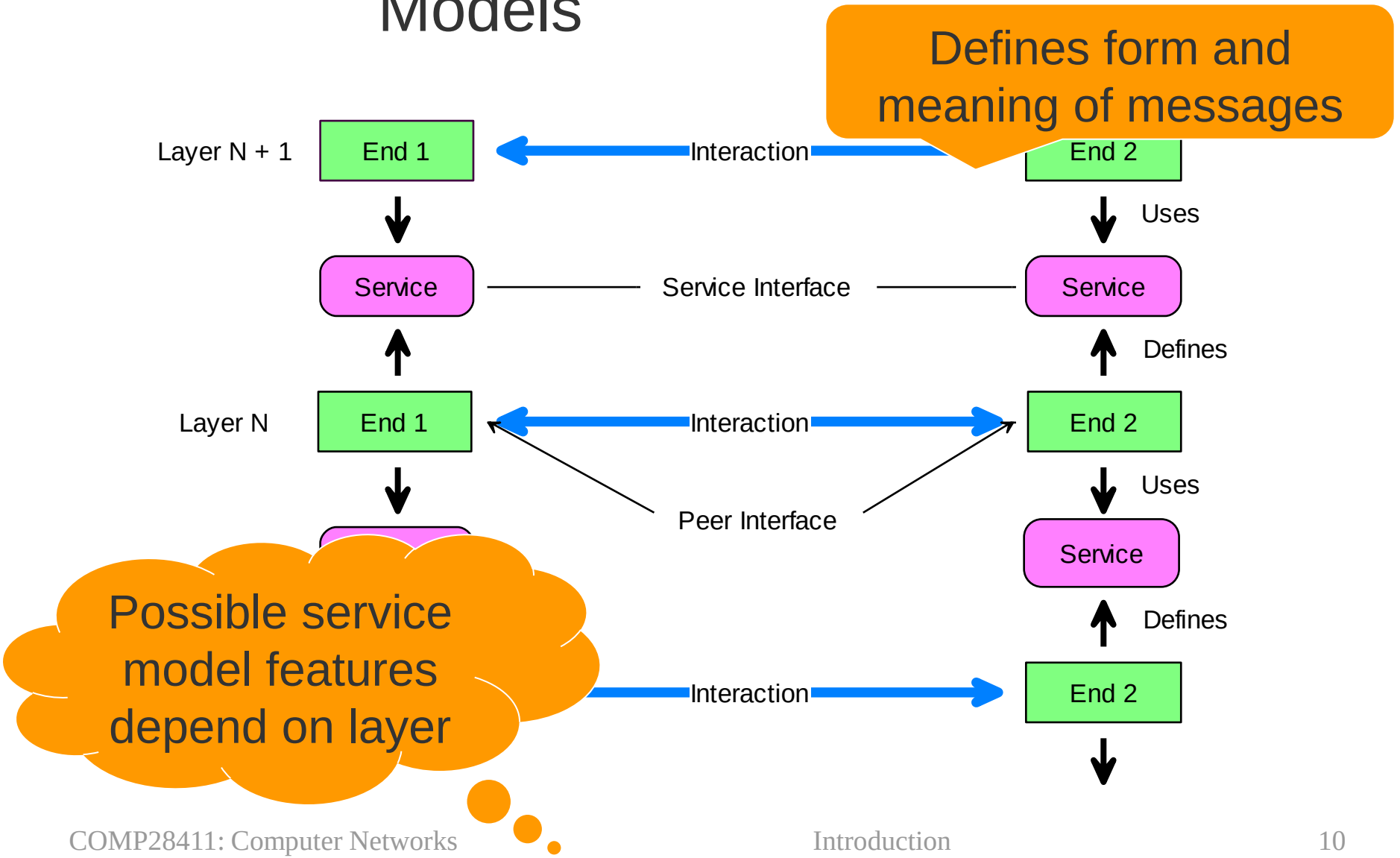
Computer Networks: Protocols

- API is like connection socket
  - defines shape of connector
  - does not define what passes through
- Protocol defines:
  - API, service model offered
  - valid sequences of API calls (interactions)
  - way ends interact to achieve service

Protocols, Layers and Service Models

- Protocols define interactions, but many elements:
  - links, switches, end-hosts, processes
  - software applications, caches
- Control complexity by structuring into layers
  - a protocol is within a single layer
  - access underlying layer using interface (service)
  - a protocol provides a service to higher layers
- To understand role of individual layers
  - use ‘standard’ reference models

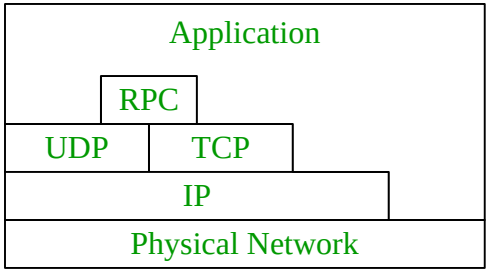
Protocols, Layers and Service Models



Reference Model: OSI 7 Layer

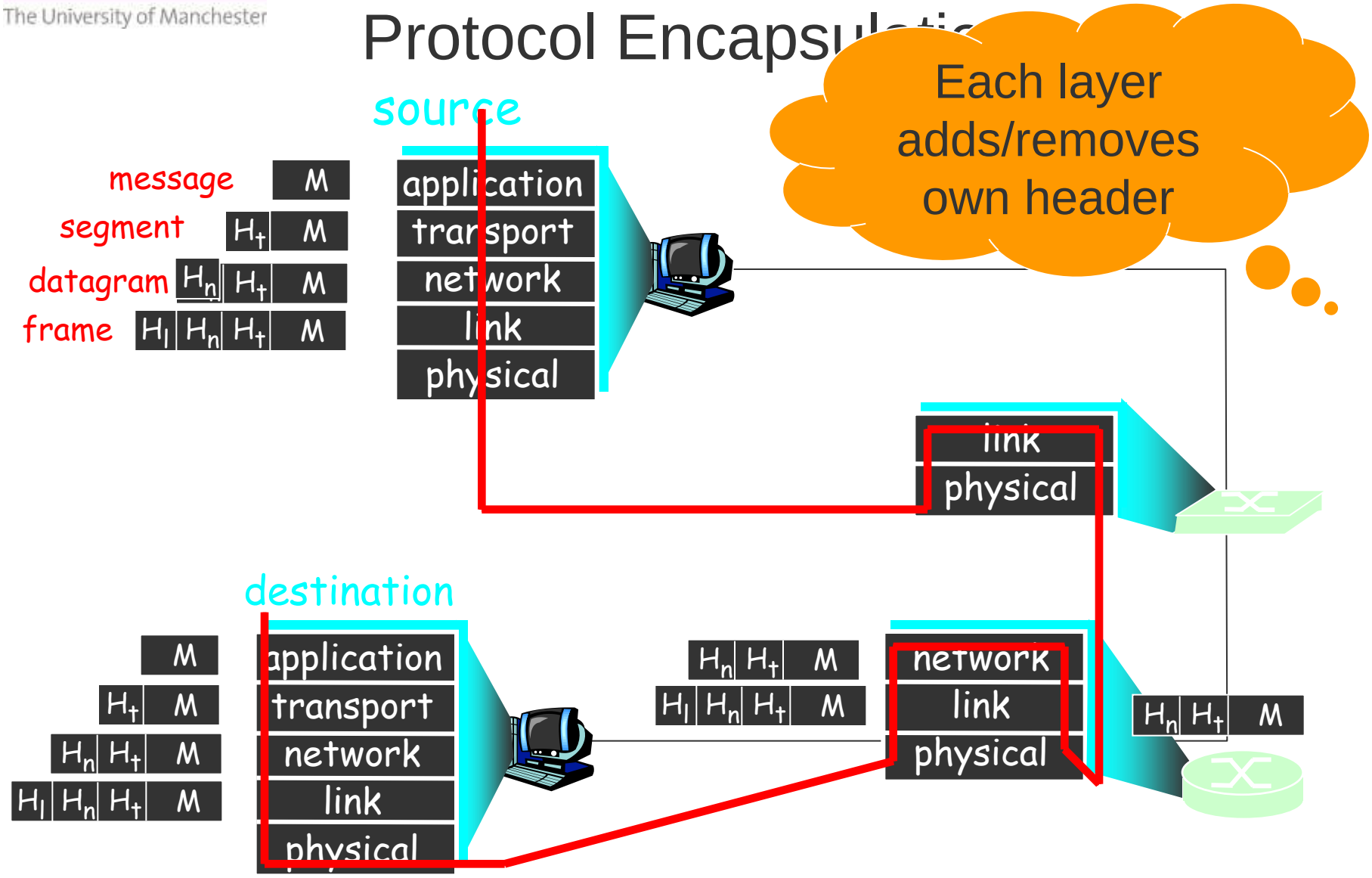
- **Application**: ultimate source and destination of data
- **Presentation**: meaning of data, e.g.:
  - encryption, compression, size of integers
  - machine specific conversions (e.g. endian)
- **Session**: links aspects of an application together e.g.
  - synchronising video and audio streams
  - check pointing, recovery of data
- **Transport**: sends data process-to-process
- **Network**: routes data (packets) to destination node
- **Data link**: collect bits into structures (frames)
- **Physical**: transmission

Reference Model: Internet

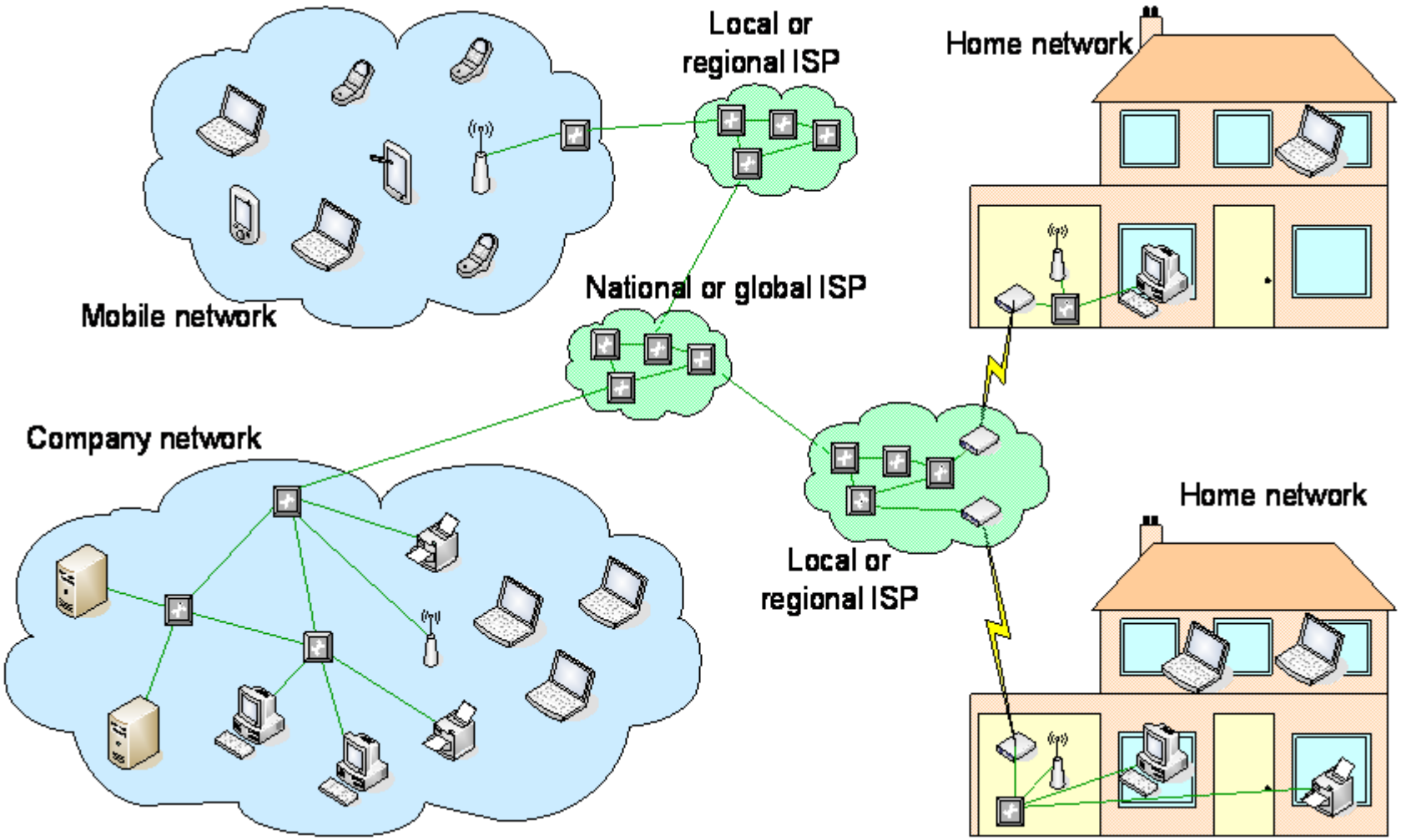


- Less layers than OSI architecture
- IP joins different physical networks together
- Transport protocols with different service models:
  - TCP: reliable, connection-oriented
  - UDP: unreliable, connectionless

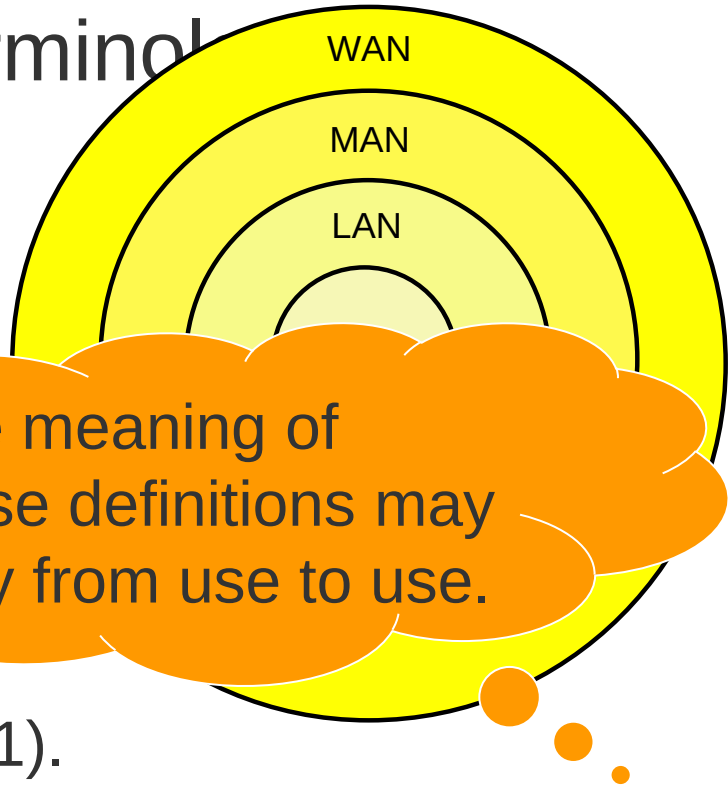
Protocol Encapsulation



Computer Networks: Structural View



Network Area Terminol



The meaning of these definitions may vary from use to use.

Area Size

- **Personal Area Network**
  - Bluetooth phone, PDA.

System Area Network (SAN)

- printer, disk …

Local Area Network (LAN)

- typically single technology
- Ethernet (802.3), WLANs (802.11).

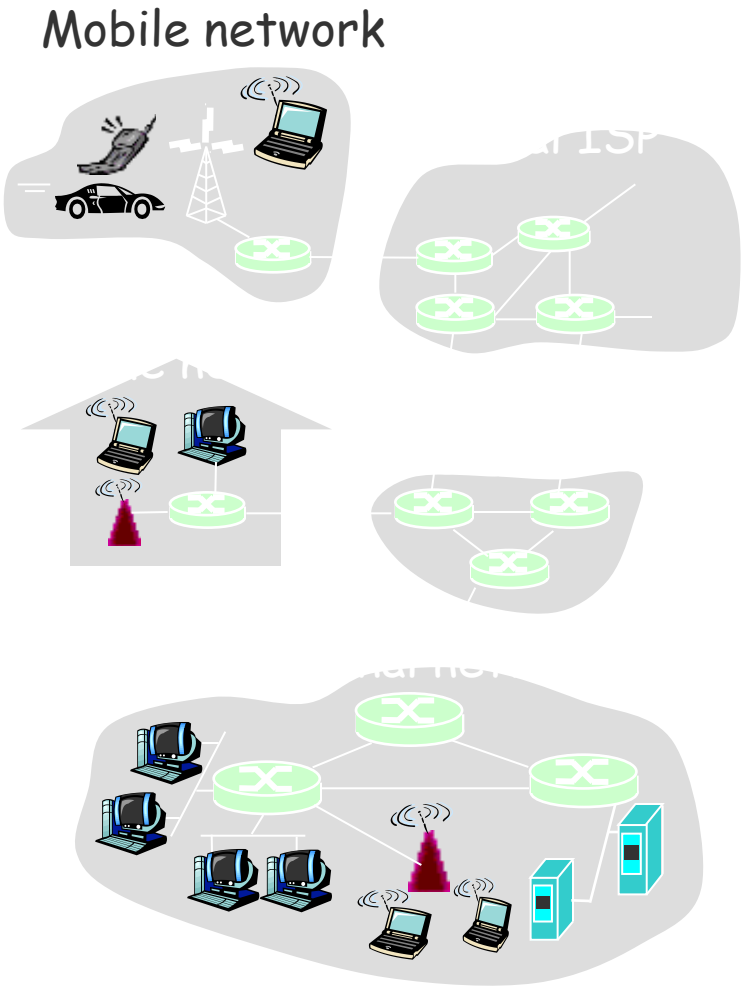
Metropolitan Area Network (MAN)

- complete city, or an internetwork of LANs

- **Wide Area network (WAN)**
  - multiple technologies, large geographical areas

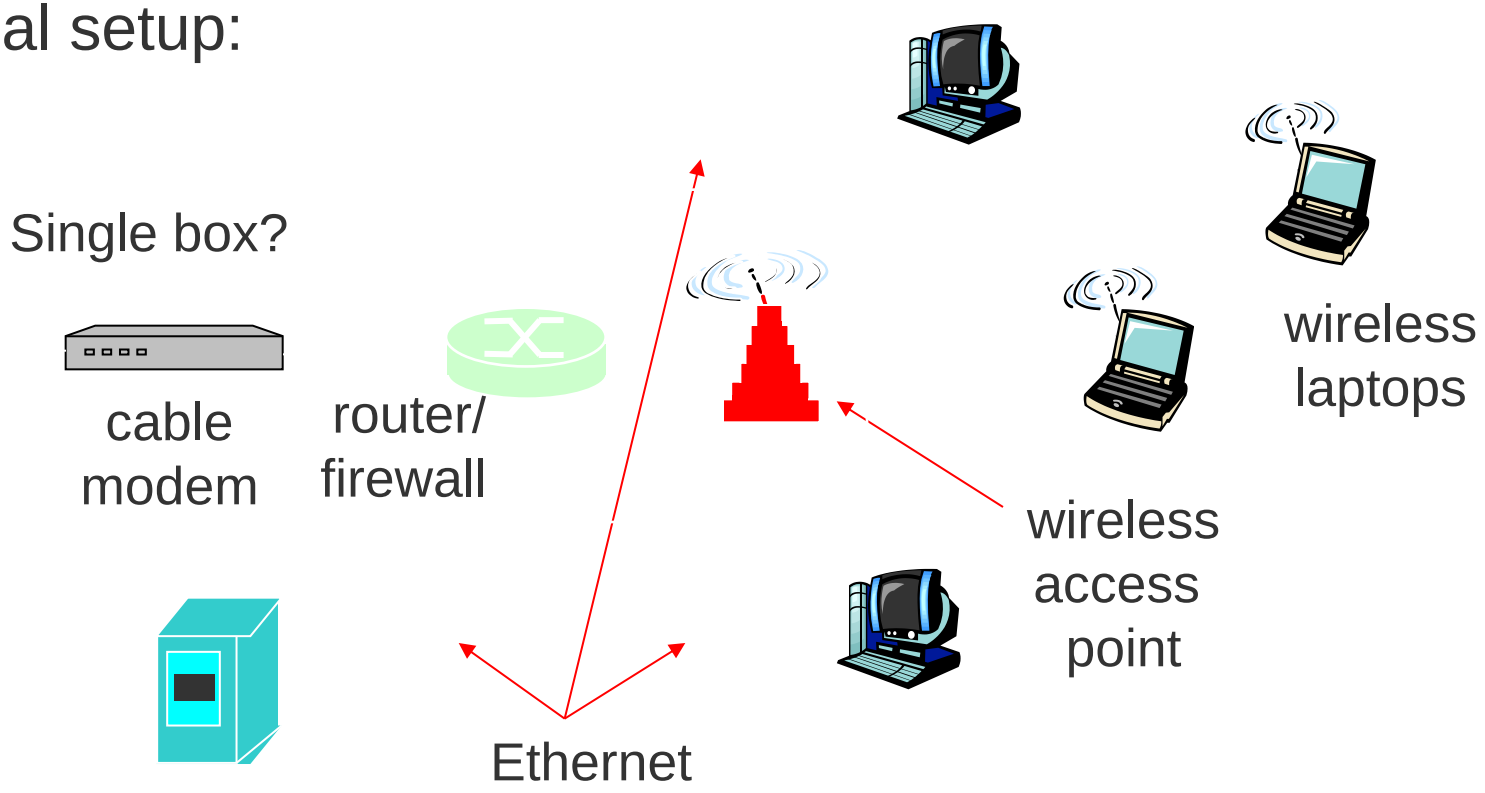
Network Connectivity

- Edge
  - applications and hosts
  - home networks
  - wireless networks
  - corporate networks
- Core
  - interconnected routers
  - network of networks
- Physical media
  - bandwidth
  - shared or dedicated

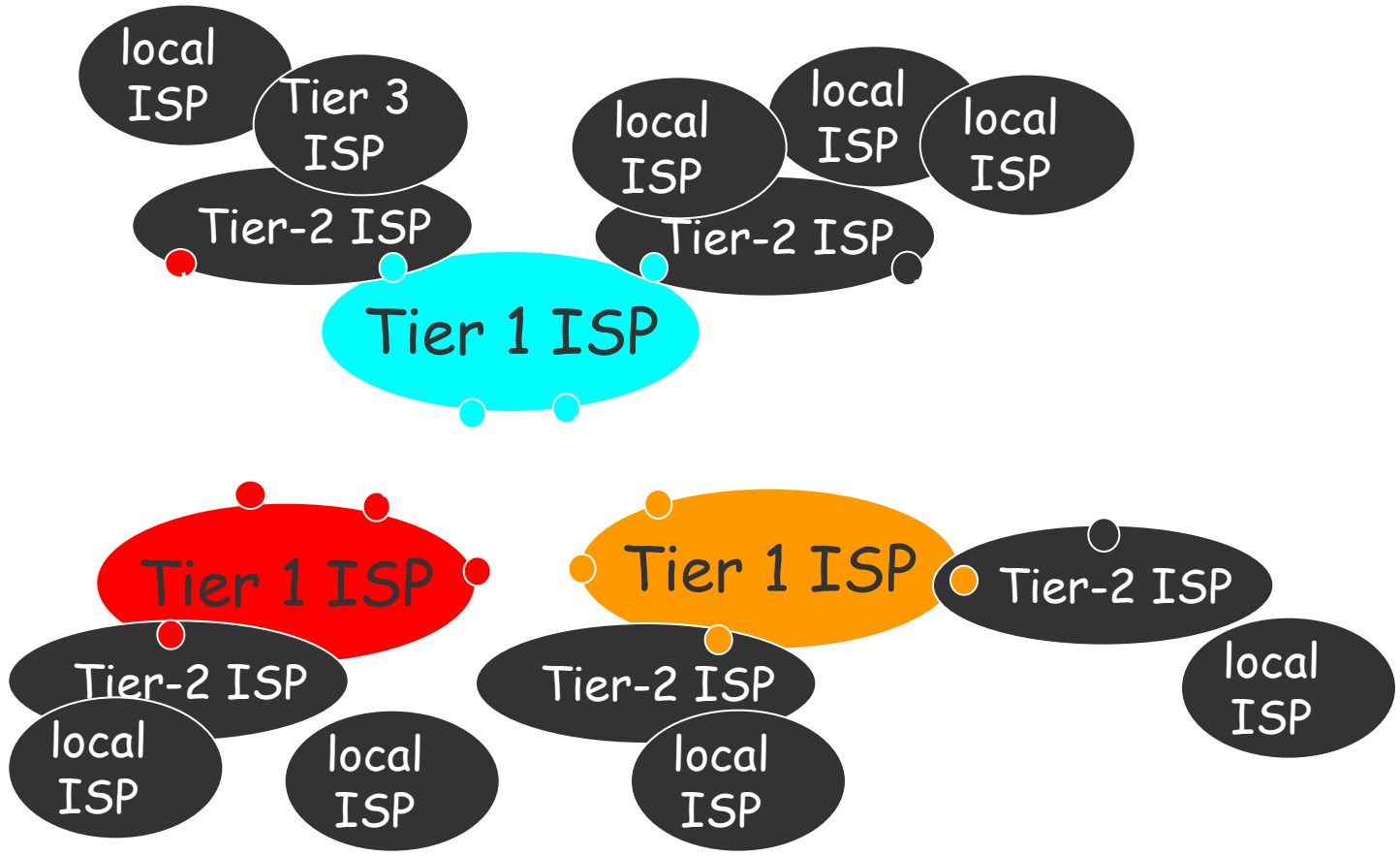


Network Edge Connectivity: Home

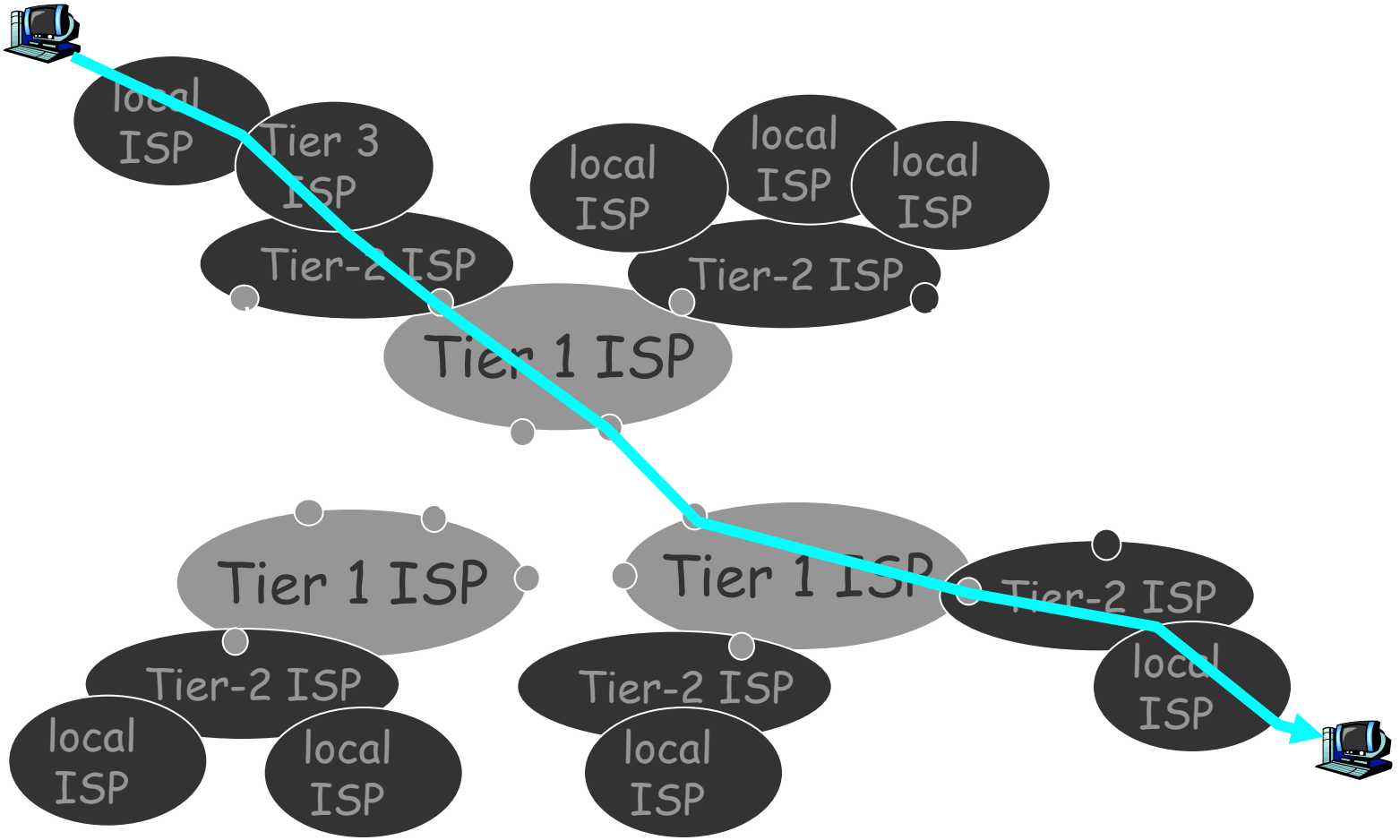
- Typical setup:



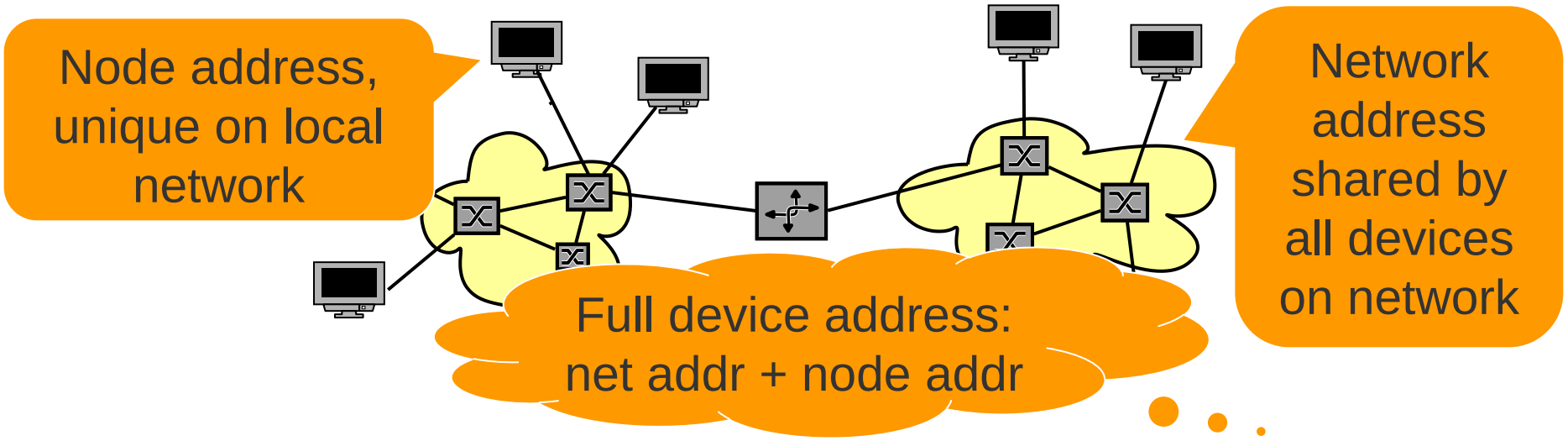
Network Core Connectivity



Network Core Connectivity: Forwarding



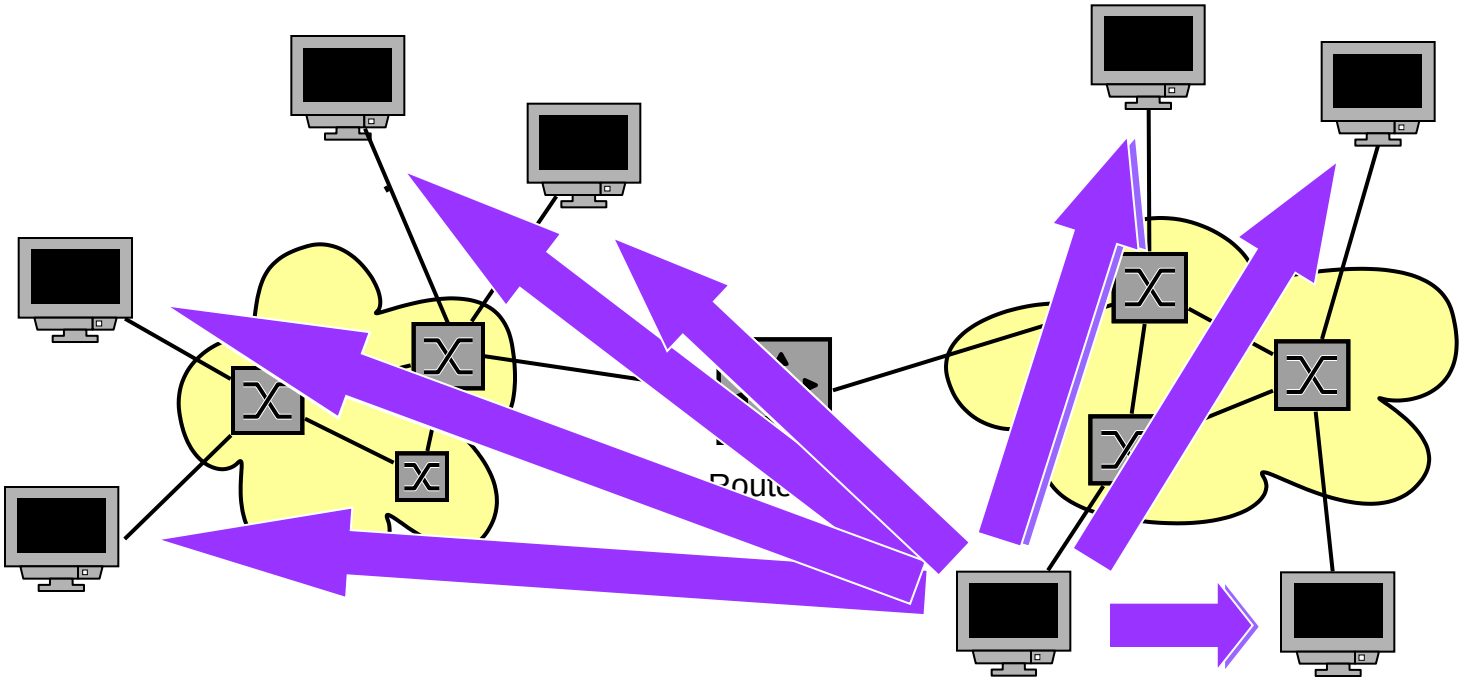
Network Connectivity: Addressing



port

Network Connectivity: Transmissions

- Types of destinations:
  - single (**unicast**), all nodes (**broadcast**)
  - multiple nodes, but subset of all nodes (**multicast**)



Network Reliability

- Possible failures within a network include:
  - machines crash, fibres cut, electrical interference
  - switches run out of buffer space, routing problems
- Checking codes inserted into data can detect errors
- Acknowledgements confirm delivery
- Negative acknowledgements request retransmission
- Timeouts detect missing expected data
- By using these can:
  - mask (hide) some kinds of network failure
  - make network appear more reliable than is

Networking Issues for Good Design

- Global coordination; universal understanding
- Minimise manual setup
- Minimise volume of information at any point
- Distribute information capture and management
- Extensibility
- Integration/interoperation of heterogeneous systems
- Error detection
- Error recovery (reliability)
- Scalability

Summary

- Review of basic networking
- View: applications vs physical structure
- Fundaments of way connectivity is achieved
- Protocols
  - purpose, service models
  - interactions, messages
- Layering and reference models
- Application place QoS needs on infrastructure