RSC Part I: Introduction

- Circuit switching vs packet switching
- Protocols and protocols stacks
- What is the Internet
- Network structure
- ISPs and Internet Backbones
What’s the Internet: “nuts and bolts” view

- millions of connected computing devices: *hosts = end systems*
  - running *network apps*
- communication links
  - fiber, copper, radio, satellite
  - transmission rate = *bandwidth*
- routers: forward packets (chunks of data)

What’s the Internet: “nuts and bolts” view

- *protocols* control sending, receiving of msgs
  - e.g., TCP, IP, HTTP, Skype, Ethernet
- Internet: “network of networks”
  - loosely hierarchical
  - public Internet versus private intranet
- Internet standards
  - RFC: Request for comments
  - IETF: Internet Engineering Task Force
What's the Internet: a service view

- Communication infrastructure enables distributed applications:
  - Web, VoIP, email, games, e-commerce, file sharing

- Communication services provided to apps:
  - Reliable data delivery from source to destination
  - "Best effort" (unreliable) data delivery

A closer look at network structure:

- Network edge: applications and hosts
- Access networks, physical media: wired, wireless communication links
- Network core:
  - Interconnected routers
  - Network of networks
The network edge:

- **end systems (hosts):**
  - run application programs
  - e.g. Web, email
  - at "edge of network"

- **client/server model**
  - client host requests, receives service from always-on server
  - e.g. Web browser/server; email client/server

- **peer-peer model:**
  - minimal (or no) use of dedicated servers
  - e.g. Skype, BitTorrent

Access networks and physical media

**Q: How to connect end systems to edge router?**

- residential access nets
- institutional access networks (school, company)
- mobile access networks

**Keep in mind:**

- bandwidth (bits per second) of access network?
- shared or dedicated?
Home networks

Typical home network components:
- DSL or cable modem
- router/firewall/NAT
- Ethernet
- wireless access point

Internet structure: network of networks
Internet structure: network of networks

- roughly hierarchical
- at center: “tier-1” ISPs (e.g., Verizon, Sprint, AT&T, Cable and Wireless), national/international coverage
  - treat each other as equals

Tier-1 providers interconnect (peer) privately

Tier-1 ISP: e.g., Sprint

POP: point-of-presence

to/from backbone

peering

to/from customers
Internet structure: network of networks

- "Tier-2" ISPs: smaller (often regional) ISPs
  - Connect to one or more tier-1 ISPs, possibly other tier-2 ISPs

  Tier-2 ISP pays tier-1 ISP for connectivity to rest of Internet
  - tier-2 ISP is customer of tier-1 provider

  Tier-2 ISPs also peer privately with each other.

Internet structure: network of networks

- "Tier-3" ISPs and local ISPs
  - last hop ("access") network (closest to end systems)

  Local and tier-3 ISPs are customers of higher tier ISPs connecting them to rest of Internet
Internet structure: network of networks

- a packet passes through many networks!