Outline
of
CS 356: Computer Networks

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Architecture of Internet

- Computers + subnetworks:

  1st hop  2nd hop  3rd hop

- Types of computers:
  - Router:
  - Client host:
  - Server host:

- Types of subnetwork technologies:
  - LANs (switched Ethernets)
  - Wireless LANs
  - Phone lines
  - TV cables
  - Satellite links
Example: Enterprise Network

Switch  \(\text{Rest of Internet}\)  switch

router  \(\text{Rest of Internet}\)  router

base station  mobile hosts

server switched  \(\text{Ethernet}\)

client switched  \(\text{Ethernet}\)
Internet Service Providers (ISPs) 3

- to navigate a msg from a first router to a last router, the msg needs to go through a sequence of ISPs.

- each ISP is a set of inter-connected routers

- the ISPs are organized in a tree of 3 levels.
The ISP Tree

- has 4 levels:
  - L1: Tier 1 ISP
  - L2: Regional ISPs
  - L3: Local ISPs
  - L4: Access Networks (ANs)

- if Li ISP is connected to L(i+1) ISP then Li ISP is a provider for L(i+1) ISP and L(i+1) ISP is a customer for Li ISP
ISP Tree Is Not Perfect

- there is a dozen Tier-1 ISPs: AT&T, Sprint, NTT

- there are multiple regional ISPs for same region

- multihoming:
  an ISP in level $i$ can be connected to 2 or more ISPs in level $(i-1)$

- peering:
  two Access Networks can be connected on settlement-free basis

- shortcut:
  an Access Network or an ISP in level 3 can be connected directly to Tier-1 ISP
A network protocol specifies:
- formats of exchanged msgs
- order in which msgs are sent and rcvd
- actions that need to be executed when a msg is sent or rcvd
Four Protocol Layers in Internet

- 2 types of communications:
  - virtual
  - physical
<table>
<thead>
<tr>
<th>Functions of Protocol Layers in Internet</th>
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<tbody>
<tr>
<td><strong>application layer:</strong> allows human user to execute desired applications, e.g. web, email, ...</td>
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<tr>
<td><strong>transport layer:</strong> ensures that communication between original src and ultimate dst satisfies some end-to-end properties, e.g. reliable data transfer, flow control, ...</td>
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<td><strong>network layer:</strong> routes a msg through several hops from original src and ultimate dst</td>
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<td><strong>link layer:</strong> transmits a msg one hop from one computer to another over one subnetwork</td>
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**Msg Encapsulation**

```
http, ...

msg:
  AH text

UDP, TCP
  transport

segment
  TH AH text

IP
  network

packet
  NH TH AH text

switched Ethernet

Frame
  LH NH TH AH text
```

AH : application header
TH : transport header
NH : network header
LH : link header