

Communication Networks: Technology & Protocols



**University of California
Berkeley**

Course Objectives & Structure



- Explain Internet and related networks
- Compare solutions, identify trends
- Technology:
 - Links (ADSL, Optical, Cable); LANs (Ethernet)
 - Routers, Switches
- Protocols:
 - Routing, Transport
 - Applications

Today: Introduction



- Web
- Voice over IP

Web



- Example
- Locating Resource: DNS
- Connection
- End-to-end
- Packets
- Bits
- Points to remember

Web: Example



- Click -> get page
- page from local or remote computer
- link:
<http://cnn.com>

specifies

- protocol (http)
- location (cnn.com)

The screenshot shows a web browser window with the following elements:

- Browser Interface:** Menu bar (File, Edit, View, Go, Favorites, Help), navigation buttons (Back, Forward, Stop, Refresh, Home, Search, Favorites, History, Channels, Fullscreen), and address bar (http://www.cnn.com/).
- Advertisements:** A blue 'mail' button, an 'About.com Expert Guide' for J.D. Tuccille, and a yellow 'About.com's user survey' asking 'Should all guns be outlawed?' with 'Yes' and 'No' radio buttons.
- Navigation:** 'CNN.com' logo, a search bar, and a menu with links: MAIN PAGE, myCNN, Video, Audio, Headline News Brief, Free E-mail, Feedback.
- Left Sidebar:** A vertical list of category links: WORLD, U.S., LOCAL, POLITICS, WEATHER, BUSINESS, SPORTS, SCI-TECH, NATURE, ENTERTAINMENT, BOOKS, TRAVEL, FOOD, HEALTH, STYLE.
- Main Content:** A large photo of a man standing in front of a massive pile of rubble from a destroyed building. Below the photo is the headline: **Stunned Turks dig for earthquake survivors**.
- Right Sidebar:** A section titled 'In Other News:' containing links: 'Drug survey: Teen use down; young adults up' and 'McCain picks up Sen. Thompson's endorsement'. There is also a small image of LL Cool J with the text 'LL Cool J: Beauty in 'abrasive' new film?'.

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- Browser Menu:** File, Edit, View, Go, Favorites, Help.
- Navigation Bar:** Back, Forward, Stop, Refresh, Home, Search, Favorites, History, Channels, Fullscreen.
- Address Bar:** <http://www.cnn.com/WORLD/europe/9908/18/turkey.quake.02/>
- Advertisements:**
 - CNNemPortuguês: Do you speak Portuguese? Click Here
 - About.com Expert Guide: J.D. Tuccille, Civil Liberties
 - About.com's user survey: Should all guns be outlawed? (Yes/No buttons, Go and Vote button, Paid Banner Ad)
- Page Header:** world > europe > story page
- Navigation Menu:** MAIN PAGE, WORLD (selected), africa, americas, asia pacific, europe, middle east, U.S., LOCAL, POLITICS, WEATHER, BUSINESS, SPORTS, SCI-TECH, NATURE.
- Article Title:** Stunned Turks dig for earthquake survivors
- Article Subtitle:** Death toll nears 3,500, likely to rise more
- Article Date/Time:** August 18, 1999, Web posted at: 2:34 p.m. EDT (1834 GMT)
- Article Content:** In this story: Papers blame contractors
- Image:** A photograph showing rescue workers in orange shirts and hard hats working in a rubble-filled area, likely after an earthquake. A woman is visible in the center, looking distressed.

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File Edit View Go Favorites Help

Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen

Address <http://www.cnn.com/US/9908/18/drug.use.survey.02/>

Health *What's happening here, here,* [Click Here](#) [What's happening in your local area?](#)

CNN interactive CNN.com

MAIN PAGE
WORLD
U.S. ←
LOCAL
POLITICS
WEATHER
BUSINESS
SPORTS
SCI-TECH
NATURE
ENTERTAINMENT
BOOKS
TRAVEL
FOOD
HEALTH

U.S. > story page

Drug survey: Teen use down; young adults up

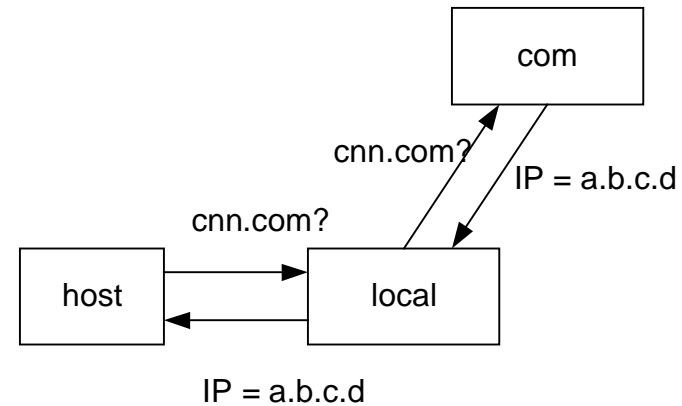
August 18, 1999
Web posted at: 12:16 p.m. EDT (1616 GMT)

In this story:

- [Drug use by minorities up](#)
- ['Statistically significant decline'](#)
- ['Meth use a disaster'](#)

Web: Locating Resource

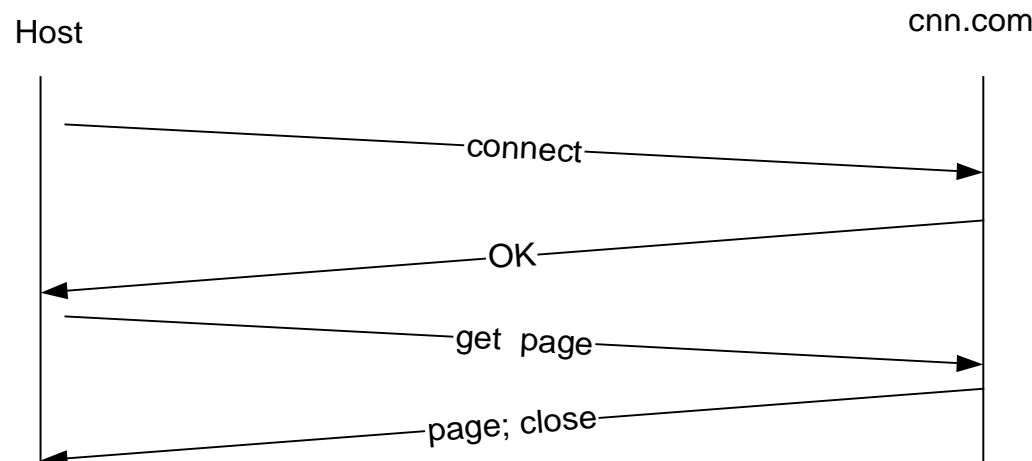
- cnn.com is the **name** of a computer (and, implicitly, of a file in that computer)
- To find the address, the application uses a hierarchical directory service called the **Domain Name System**



Web: Connection



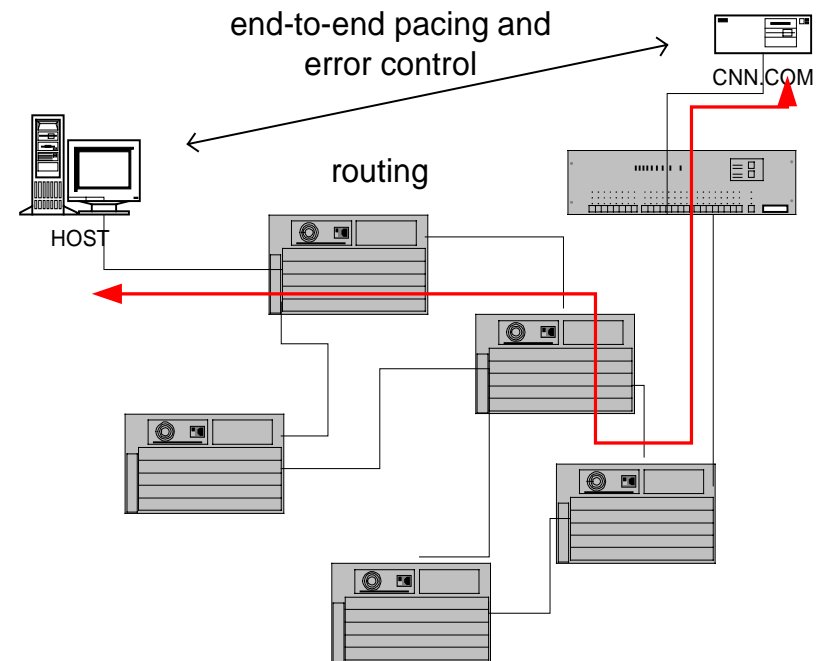
- The protocol (http) sets up a **connection** between the host and cnn.com to transfer the page
- The connection transfers the page as a byte stream, without errors: **pacing + error control**



Web: End-to-end



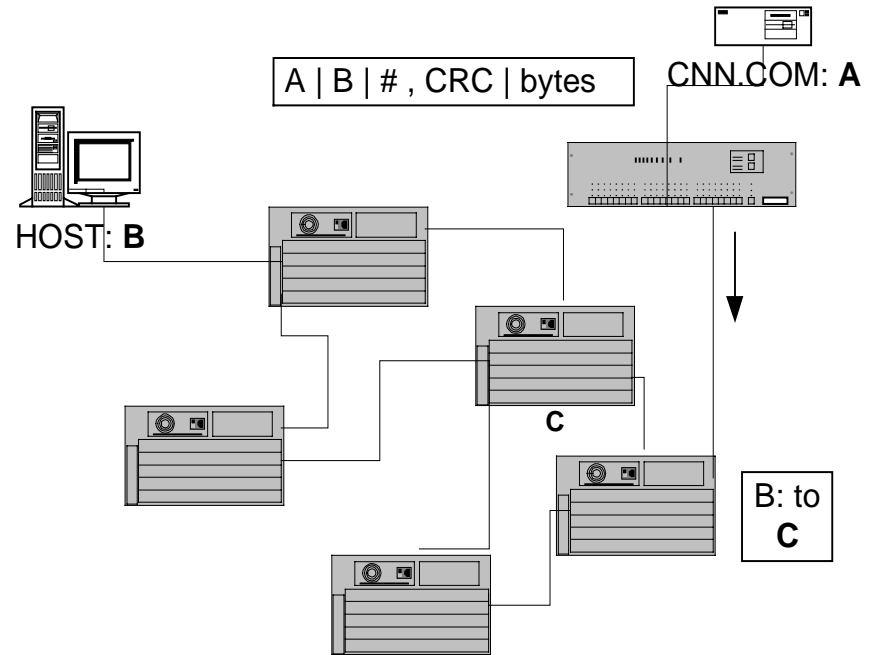
- The byte stream flows from end to end across many links and switches: **routing (+ addressing)**
- That stream is regulated and controlled by both ends: **retransmission** of erroneous or missing bytes; **pacing**



Web: Packets



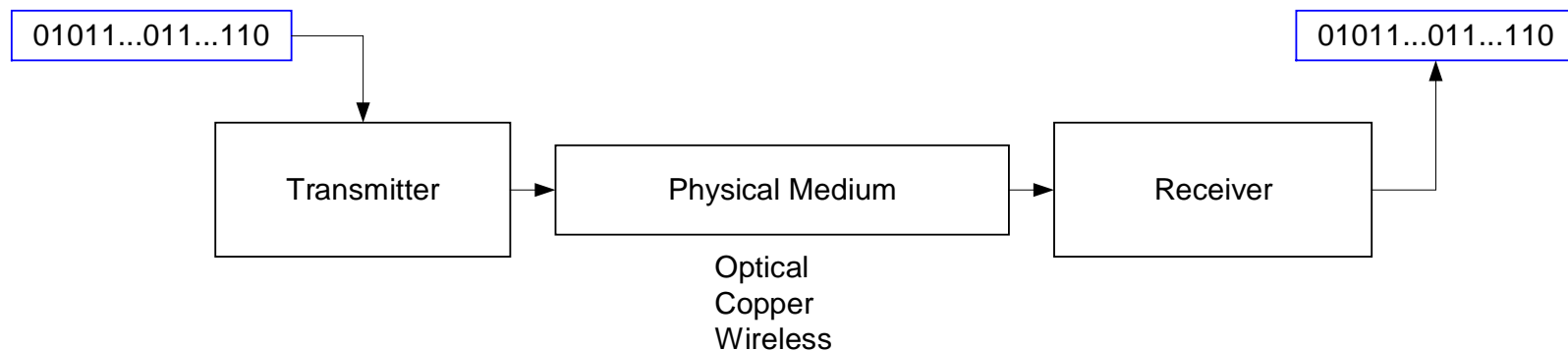
- The network transports bytes grouped into packets
- The packets are “self-contained” and routers handle them one by one
- The end hosts worry about errors and pacing:
Destination sends ACKs
Source checks losses



Web: Bits



- Equipment in each node sends the packets as a string of bits
- That equipment is not aware of the meaning of the bits



Web: Points to remember



■ Separation of tasks

- send bits on a link: transmitter/receiver [clock, modulation,...]
- send packet on each hop [framing, error detection,...]
- send packet end to end [addressing, routing]
- pace transmissions [detect congestion]
- retransmit erroneous or missing packets [acks, timeout]
- find destination address from name [DNS]

■ Scalability

- routers don't know about connections
- names and addresses are hierarchical



Voice Over IP: VoIP



- General Operations

VoIP: General Operations

- Gateways must reproduce the signaling and voice
- Signaling: dialed digits, dial tone, ringing
- Voice: Packetize and absorb delay jitter
- Note: Routing problem

