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Faculty of Information Technology

31268 Web Systems

Week 7

The Internet 1

Web Systems

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- **REMINDER**

- QUIZ today
- 8 questions multi-choice, work 0.5 marks each
- 2 questions from each week
- 30 minutes
- Closed Book, no talking or communication

Quiz notes

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- Open a separate window, use F11 (Kiosk mode)
- Do NOT backspace or use the back arrow
- You can reattempt questions
- No peeking at the lecture notes!!

Web applications

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- ***Web page development***
  - *HTML/XHTML*
  - *CSS: Cascading Style Sheets*
- **Web Infrastructure**
  - **Internet Infrastructure**
  - **Web servers**
- ***Web Applications***
  - *Online media and file sharing*
  - *Communications*
  - *Search engines*
- ***Human Computer Interaction***
  - *History of the Internet*

The Web …

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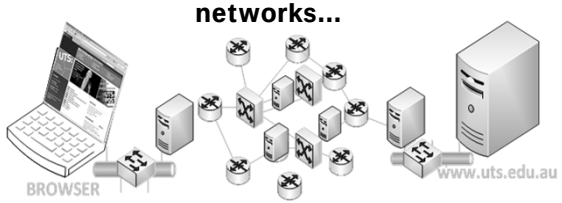
- Is it…

A bunch of computers and a network of networks…



5

The web…

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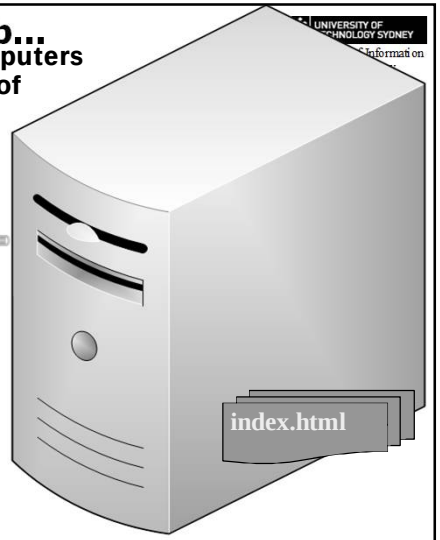
- Is It …

A bunch of computers and a network of networks…

… and a whacking **big** computer running the web site?



6

Internet Infrastructure

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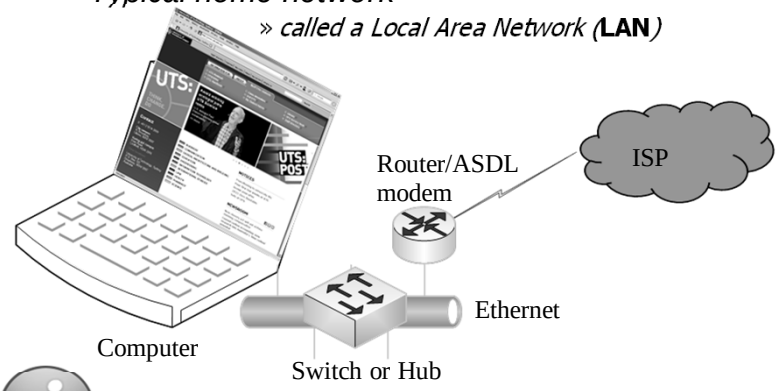
– *Typical home network*
  » *called a Local Area Network (**LAN**)*



7

Definition of Network

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A network is a collection of computers and devices connected together to allow sharing of resources between users.

- Example 1: **Network File System**
  – Part of a remote disk can be made to appear as another hard drive on the local PC.
  – The physical location of disk storage is transparent to users.
- Example 2: **Printer Sharing**
  – One printer used by several PCs

8

Device Types on the Network

- Host: Just another name for computer
- Modem: Converts between analog signals and digital signals in dialup access
- NIC (Network Interface Card): Direct connection to local area network
- Hub
- Switch
- Wireless Access Point
- Router

9

Device: Hub

- A hub can **connect** more than 2 hosts.
- Strengthens the signal.
- Not concerned with the meaning of data.
- Broadcasts the message to all of its ports.

10

Device: Switch

- More intelligent than a hub, because a switch looks at the MAC addresses (burned-in physical address of the Network Interface Card) in the messages.
- Provides a **direct physical connection** between hosts when they want to communicate.

11

Device: Wireless Access Point

- Operates on the 2.4 or 5 GHz bandwidth
- Several versions - a, b, g, n
- Setting up is something of an art
- Is becoming increasingly popular

12

Small Network Structure: LAN

- A local area network (LAN) is a network that connects computers and devices in a geographically limited area.
- LAN examples:
  - School computer laboratory.
  - Office buildings ("Campus")

13

Network Topology

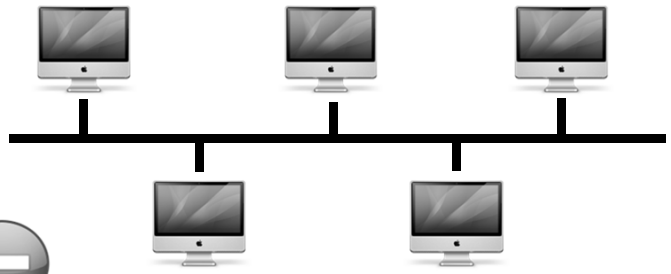
- Network topology refers to structure of the network.
- Two types of topologies are:
  - **Physical topology** (how the data actually is transmitted)
  - **Logical topology** (only concerned about where the data ends up – the "black box" analogy)
- Physical network topologies include:
  - Bus, Ring, Star.
- Logical network topologies include:
  - Bus, Ring

14

Physical Topology: Bus

Physical topology **types:** Bus, Ring, Star

- **Bus:** all the computers or devices directly connect to a common communication medium.



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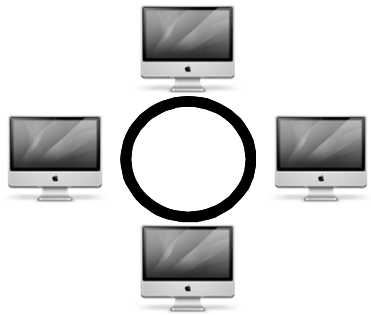
Physical Topology: Ring

- **Ring:**

  all the computers or devices in the network form a closed ring or loop.



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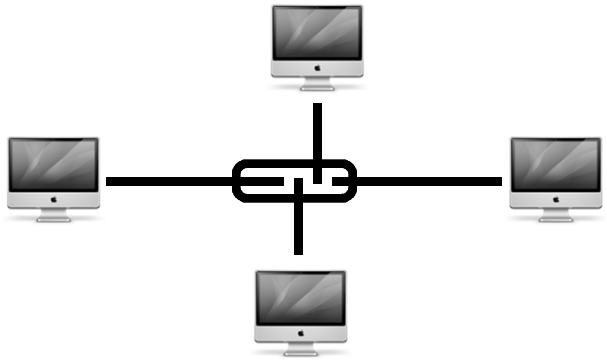
Physical Topology: Star

–**Star:**
all the computers or devices in a network connect to a **central** computer or hub.



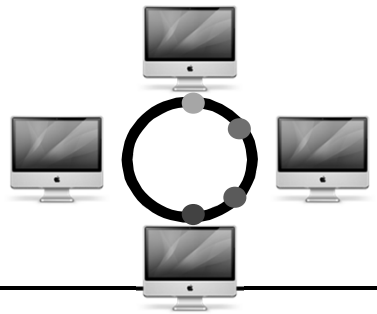
Logical Topology

Logical topology **types:** Bus, Ring

- Logical topology dictates how the hosts share access to the network avoiding collisions - the problem of two hosts transmitting data at the same time.
- Physical topology and logical topology are **often different.**
- e.g. A LAN with **bus** physical topology can have **sequential(ring)** logical topology.

Logical topology: Token Ring

- To avoid collision, **hosts** take **turns** to transmit data.
- Permission to transmit is called a **token**. The token is passed from one host to another according to a set of rules.
- Often, connected physically in a bus or star topology
- But computers see this logical topology as a "ring"

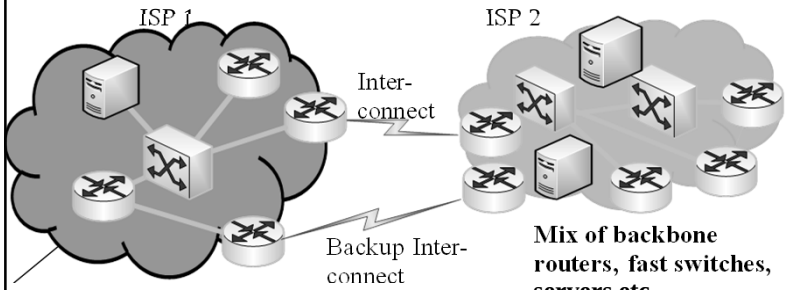


Logical topology: Bus (ethernet)

- All hosts have permission to transmit all the time.
- When a collision occurs, wait a random amount of time and try again.
- If a collision occurs again, double the wait and try again.
- As is typical of Ethernet - the network often has a star physical topology.
- Reference: http://www.webopedia.com/TERM/C/CSMA_CD.html

Internet Infrastructure

– *Typical ISP network (called a Wide Area Network (**WAN**) or Metropolitan Area Network (MAN)*

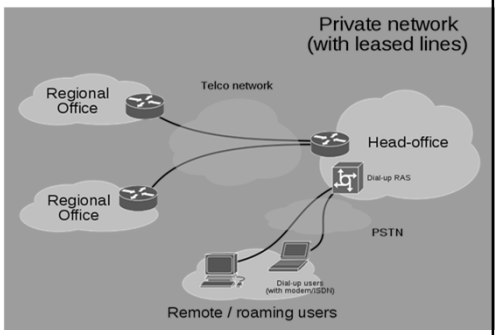


Big Network Structure: WAN/MAN

- A wide area network (WAN) is a network that covers a large geographic area.
- WAN could cover a geographic region like:
  - A country e.g. Australia
  - The world eg: the Internet
- Uses **Routers** to inter-connect
- Uses **Modems** to connect to service provider
- Uses leased lines, circuit switching, packet switching, wireless, broadband networks

Network: WAN connectivity

- Typical users: ISP, companies
- Common tech:
  - leased lines
    - E.g. HDSL, T1/E1
  - packet switching
    - E.g. Frame relay, ISDN
  - Wireless
    - E.g. 4G, wifi, satellite
  - Broadband
    - E.g. ADSL, Cable,
  - Optical
    - E.g. NBN, fibre optics



wikipedia/leased_line

Device: Router

- More intelligent than other devices because it looks at the IP address in the messages.
- A Router decides on the **next destination** of a message(a packet)
- A simple router could be your home ADSL router (which is technically a router + a modem)
- Larger routers can be found in ISP's

How do routers work?

- Routers use **routing** rules to decide how to forward/transmit the messages
- Various algorithms & standards (Routing protocols) exist
  - Eg: RIP, BGP & so on
- The Unix command "traceroute" will trace the route to the destination host.
  e.g traceroute www.smh.com.au
  - On windows use the tracert.exe command)

Web applications

- ***Web page development***
  - *HTML/XHTML*
  - *CSS: Cascading Style Sheets*
- **Web Infrastructure**
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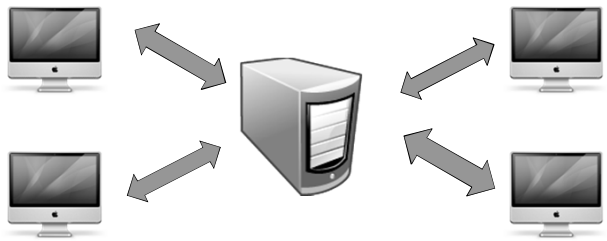
  - **Web servers**
- ***Web Applications***
  - *Online media and file sharing*
  - *Communications*
  - *Search engines*
- ***Human Computer Interaction***
  - *History of the Internet*

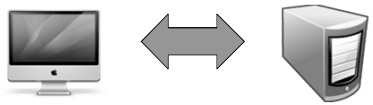
Web servers: Client-Server

- Typically many clients make use of a server.
- The server provides some shared resource. e.g. powerful processing, large disk, database.



Two-Tier: Client-Server

- **Fat client**: where most of the processing is done at the client side. Just the data is on the server.
  - E.g. Microsoft Access → SQL server
- **Thin client**: where just the presentation is done at the client and the processing is at the server side.
  - E.g.Browser → Web Server



Three-tier architecture

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- Sometimes add a middle tier
  - more scalable
  - more security (eg: behind firewall)
  - Often used for dynamic web sites
- E.g. Shopping website:
  - 1st Tier: Client: The HTML/Javascript
  - 2nd Tier: Web server running PHP
  - 3rd Tier: Database server storing orders, inventory

29

The 3-Tier Model – an Example

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Client Presentation/ User Interface

Processing/ Business Logic

Database

PC running a browser (IE, Firefox etc)

Web Server/ Application Server (Apache webserer with PHP)

Database Server (Oracle, MySQL, file system)

30

Three-Tier Web Site

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- Not just retrieval of static HTML pages
- Typically the HTML page is generated dynamically when the HTTP request comes.
- This dynamic generation is done in the processing tier – or business logic.
- Generally some of the content of the dynamically generated pages is drawn from a database.

31

Three-Tier (cont.)

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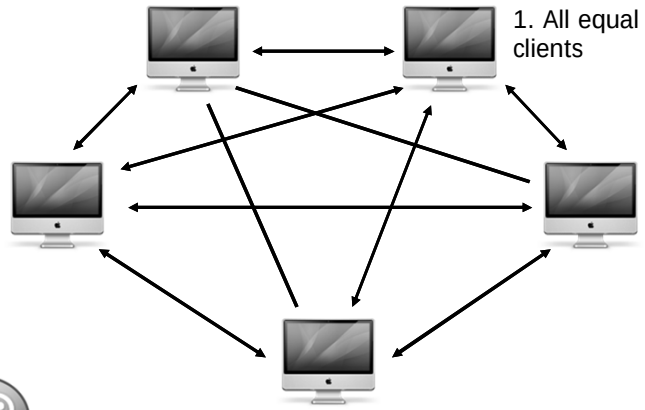
- The second and third tier may or may not be on different computers.
- Three tier applications don't always involve Web sites.
- Advantages:
  - Modularization
  - Can make different user interfaces without altering the underlying processing

32

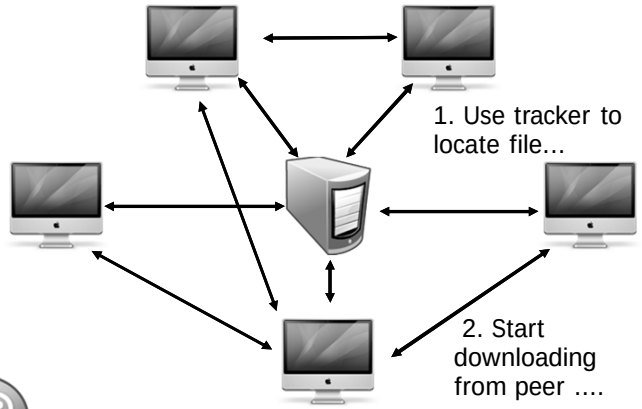
Peer-to-Peer Architecture

- Alternative to Client/Server
- Clients can also be servers!
- Examples:
  – Skype, Bittorrent, Gnutella, SETI@Home

Peer-to-Peer Architectures - Basic Model



Peer-to-Peer Architectures - Hybrid Model



P2P: Distributed Processing

- Idle computers on the Internet are a powerful processing resource.
- Emerging move to use this resource for carrying out many (important) computations.
- A processing task is broken up into many parts and distributed to participating computers.
- SETI@home, Google compute, Community Grid

http://www.worldcommunitygrid.org/

http://en.wikipedia.org/wiki/World_Community_Grid

Web applications

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Web Applications

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- World Wide Web == network + applications + people
- Having a network by itself is pretty useless
- We use applications on top of the network every day
  → Web browser !!
- But, web applications are **more** than just **browsing**.

Example 1: Online media

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- Example http://www.smh.com.au
- Content continually changing
- Monitoring visitors
- Targeting advertisements according to pages visited.
- Generic browser interaction - HTTP+HTML/CSS...

Example 2: file sharing

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- FTP : started 1971, along with Unix
- Napster (1999), Gnutella, Bittorrent:

  Music and video being transferred between PCs
- Complex technology – not just HTTP

Example 3: Peer-to-Peer

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- Recent surge in interest due to some popular/notorious file swapping apps.
- Three common categories of peer-to-peer:
  1. **File swapping**
     e.g. Bittorrent, Napster, Gnutella, Infrasearch
  2. **Instant messaging** e.g. AOL Instant Messenger, MSN Messenger, IRC, twitter
  3. **Distributed processing** e.g. SETI@Home

P2P: File Swapping

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- Some protocols published, some not.
- Incompatible protocols –> separate file swapping communities.
  - Gnutella protocol is published
  - Leads to many independently written peer programs that are interoperable e.g. LimeWire, Bearshare, ToadNode
  - **Bittorrent** is now more popular
  - → solves privacy issues with Gnuetta & Napster

P2P: Searching for Files

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- Sometimes search is done by contacting central search server e.g. Napster, Bittorrent **tracker** portals.
- Sometimes search is distributed:
  - Search request is **forwarded** to neighbouring peers.
  - These peers **check** if they have the requested file.
  - If not, these neighbours subsequently forward request to their neighbours.
  - The request stops via a "time to live" field.
- Once the desired file is found there is direct peer-to-peer communication to retrieve it.

Communications

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- Oldest: Email
  - Established 1972 (Unix)
  - 2006 - 2.5 billion emails/day
    - http://ask.yahoo.com/20060324.html
  - 2010 – 294 billion/day ie: 90 trillion/year!
    - http://email.about.com/od/emailtrivia/f/emails_per_day.htm
    - About 2.8 million/second!
    - Estimated 90% spam
    - Approx 1.9 Billion users

Email takes 28% of workers time..

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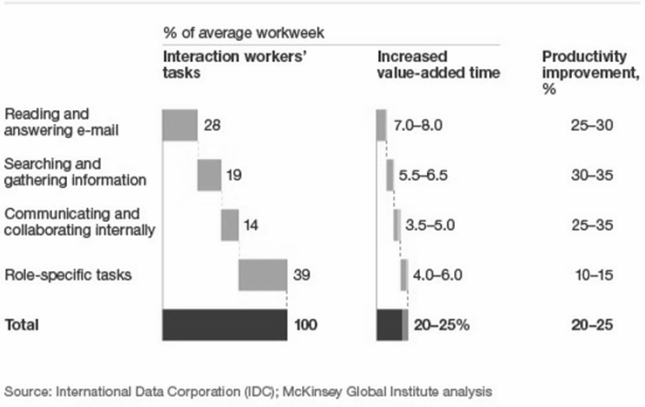

Source: International Data Corporation (IDC); McKinsey Global Institute analysis

Communications

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- Newest: VoIP – Internet telephone
  - Computer to Computer
  - Computer to/from telephone
  - Voice
  - Video
  - Text messages, Chat
  - Skype have 500+ million user accounts!
  - **Over 14% of telephone calls**
  - Also many calling card providers use VoIP between cities

P2P: Instant Messaging

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- These protocols are also typically text protocols (like HTTP, POP3).
- Different vendors e.g. AOL, Microsoft Live, Yahoo use different instant messaging protocols
  → mostly not interoperable!!
  → Users of different companies' products can't talk to each other.
  → some communications possible (eg: Yahoo & AIM)
  → 2.7 billion accounts 2012 *(radicali group)*
- Standards work is happening eg: SIP, XMPP protocol

Search engines

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Example: Google

- Google's computer visits web sites , and follows their links - "Web crawling"
  – Creates an index matching combinations of words with the URL (http addresses)
  – For each search, it ranks web sites according to other website's links to them.
  – Earns revenue by displaying advertisements aligned with the user's search
- *Microsoft **bing** is catching up market share!!*

Web applications

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History of the Internet

http://www.fcc.gov/omd/history/internet/

Computers and Communication

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- Originally the computer was a sophisticated calculator.
  - Very costly, → each computer needed to be shared by more than one person.
- Email – 1972: When Unix was developed, it became an acknowledged function of the computer to be used for communication.
- The effectiveness of computers is a result of the architecture of the Internet.

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Defense Department APRA

- 1957 US Defense Department thinks academics in USSR are **more successful** than academics in USA.
- Defense Dept pays ARPA to fix the problem.
- ARPA decides to use computers for communication instead of just for computation.
- Note: ARPA = Advanced Research Projects Agency

RAND corporation

- See http://www.rand.org/ National Security research organization
- 1960's Paul Baran decides that a network will only survive an atomic bomb if:
  1. Data between computers has many paths – Routing
  2. Data is cut up in little blocks, each of which goes on its own journey - Packet Switching

Paul Baran's Research

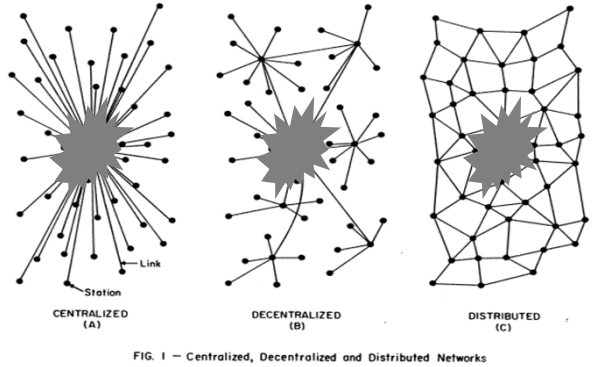
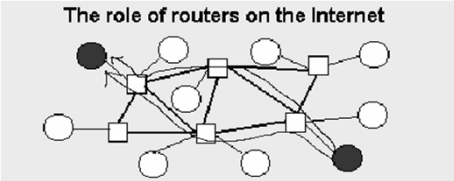


FIG. 1 — Centralized, Decentralized and Distributed Networks

"On Distributed Communications: 1. Introduction to Distributed Communications Network" suggests a *distributed communication network* is most likely to survive atomic bombs.

Internet Routing

- Data going from one IP address to another.
- Router forwards packets from one network to another.
- Packets of the same file can take different paths.



What kind of network is it?

Small World or Six Degrees of Separation

- The world has **6.9 billion people**
  - (April 11 estimate)
- Harvard psychologist Stanley Milgram shows by experiment that any two people are *at most* 6 friends apart…

6 degrees of separation

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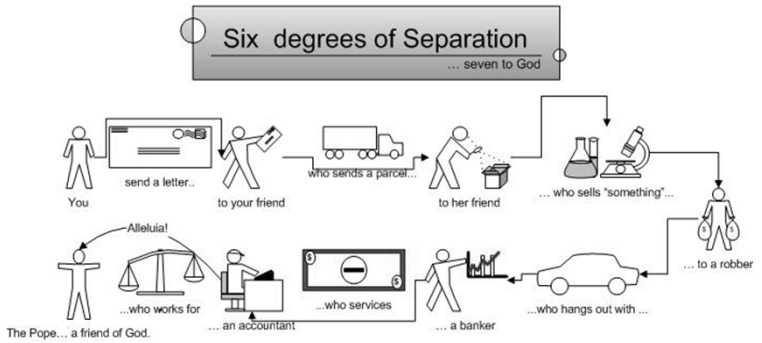

See: www.linkedin.com or facebook.com

Relationship Graph

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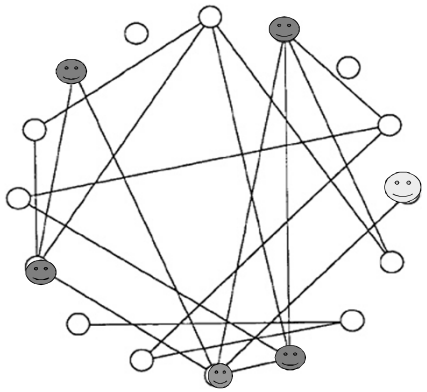
- Assume we only directly know **friends**, and indirectly **friends-of-friend** & so on...
- Relationship graph should look random
- .... After all, how can we know 6.8 Billion people????



BUT! Regular Friendship Clustering

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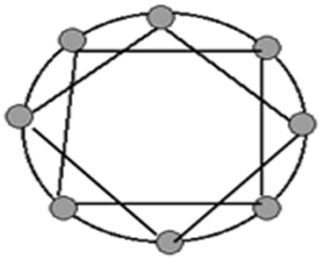
- Clustering: you just know your friends, and *their* friends.
- If everyone on earth has 100 friends distance between two people on earth would be 68 million??.

Graph from: http://www.ascusc.org/jcmc/vol8/issue4/scharnhorst.html



Regular network

Small World Graph

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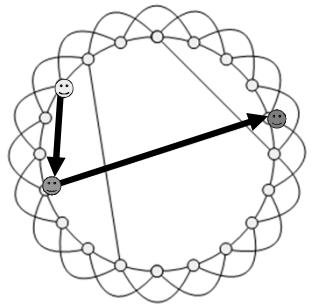
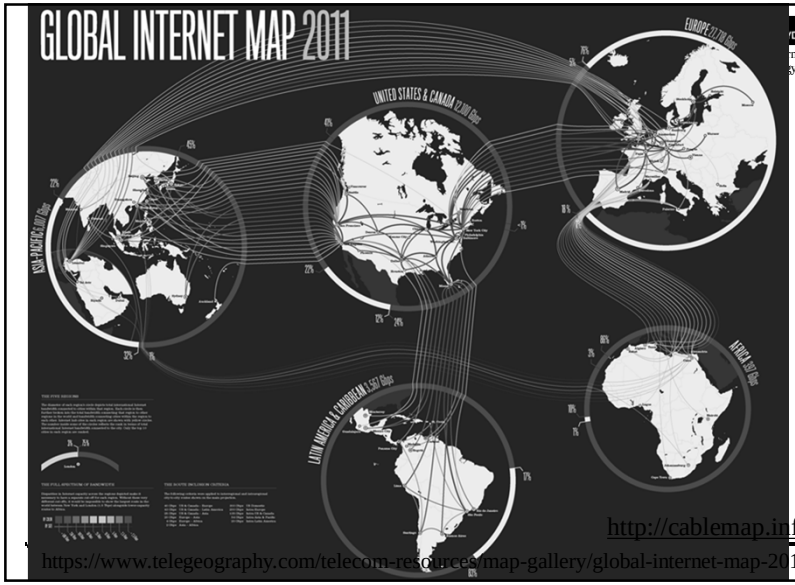
In the real world:

- Some people have a few friends far away.
- Some people have a lot of friends.
- Even this small randomness can be shown to bring the distance from 60 million down to 6.



http://getoutfoxed.com/node/62



https://www.telegeography.com/telecom-resources/map-gallery/global-internet-map-2011/

The Internet is a Small World

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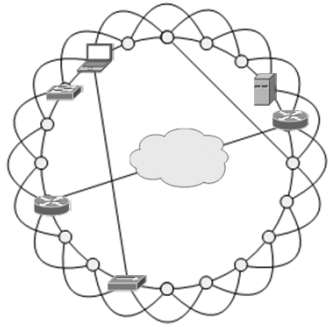
- Instead of friends….
- **Nodes** are hosts, hubs, switches…
- **Lines** are Ethernet, ADSL, cable…
- We communicate over the lines using a **networking protocol e.g TCP/IP**



Conclusion

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- We've provided a teaser about networking in the last 2 lectures.
- Learn more in 31270 Network Essentials
- Do MAJ03445 Internetworking for far more learning