

Computing Systems and Networks!

Fran Trees (fran.trees@cs.rutgers.edu)



Computing Systems and Networks!

- Networks-how computing devices connect and communicate
- The Internet and Communication



Computing devices and how they communicate

- List as many computing devices as you can.
- A computing system is a group of computing devices and programs working together for a common purpose.
 - Personal computer
 - Super computer
 - **Computing network**



Computing Network

The more the merrier!

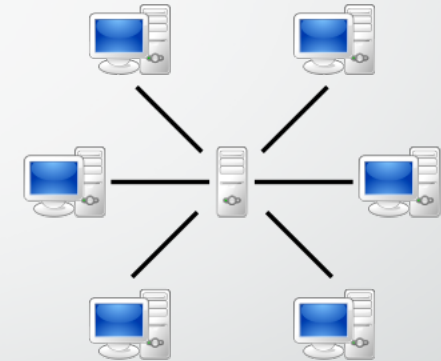
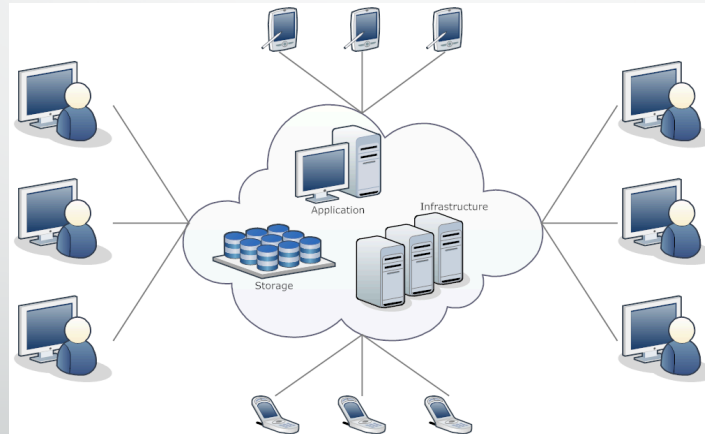
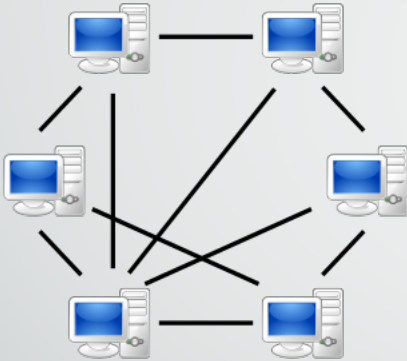
- **Computer network**

- Type of computing system
- Connect 2 or more computers to each other
- Facilitate communications
- Enable the sharing of hardware
- Enable the sharing of data
- Facilitate information preservation



The more the merrier!

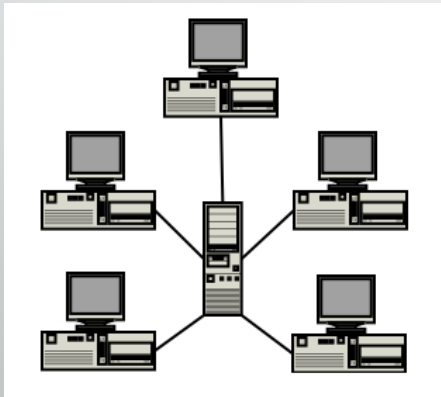
- Computer networks



Networks

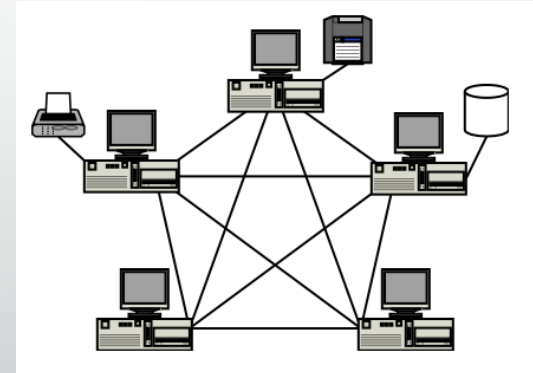
Client Server

- Security easy
- Information control easy
- Setup price costly
- One source for information-what if it fails?



Peer-to-peer

- Cheap to implement
- Difficult to secure
- Difficult to backup
- Each computer stores its own files and applications



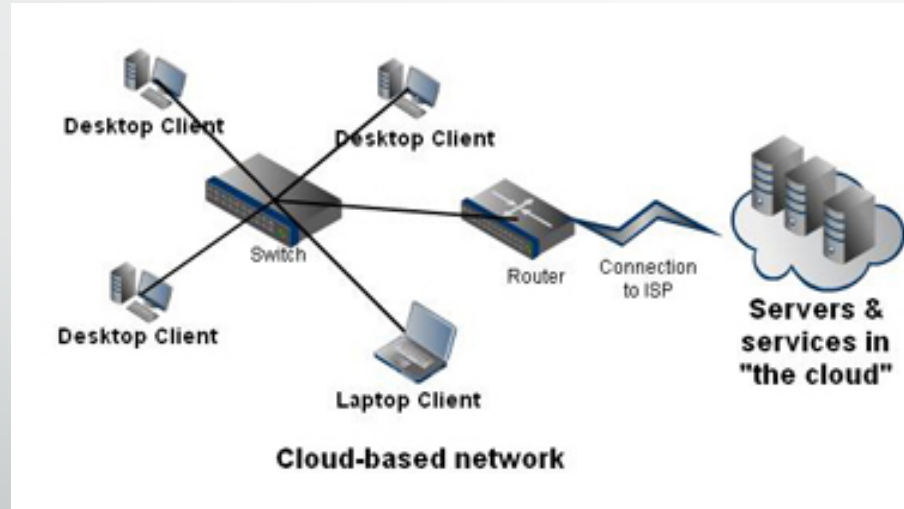
http://www.pcc-services.com/network_types.html



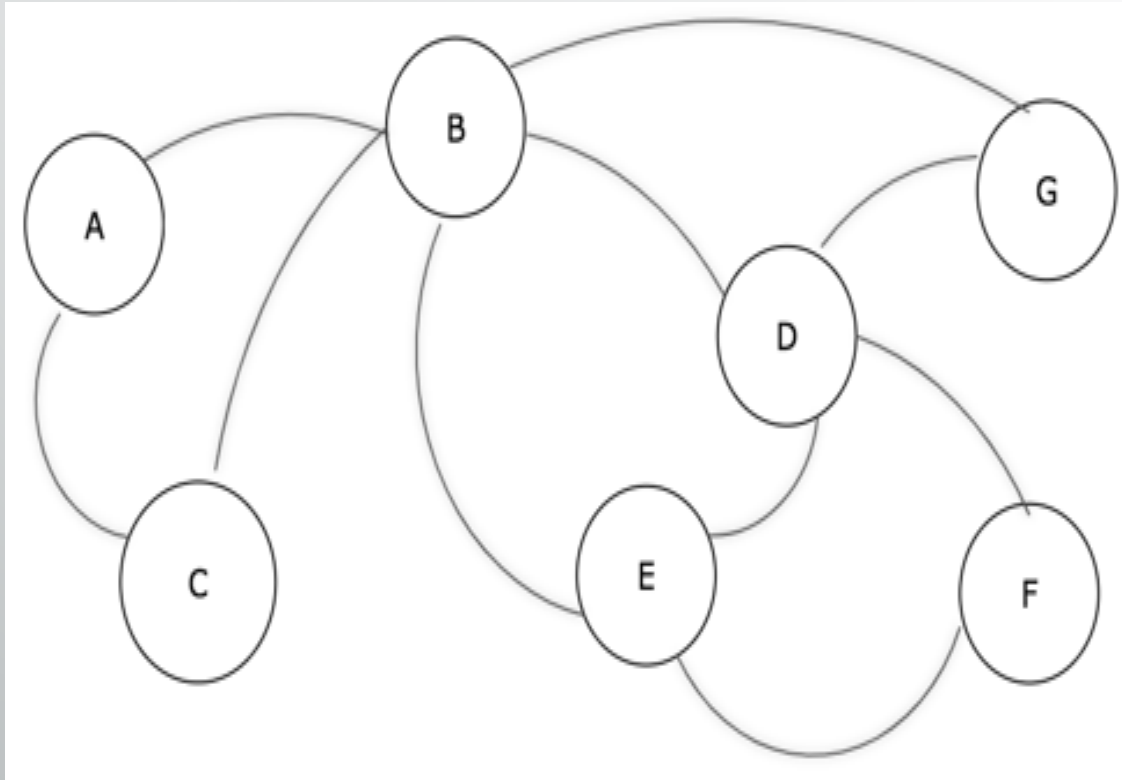
Networks

Cloud-based network (goals)

- Scalable
- Efficient
- Maintenance free



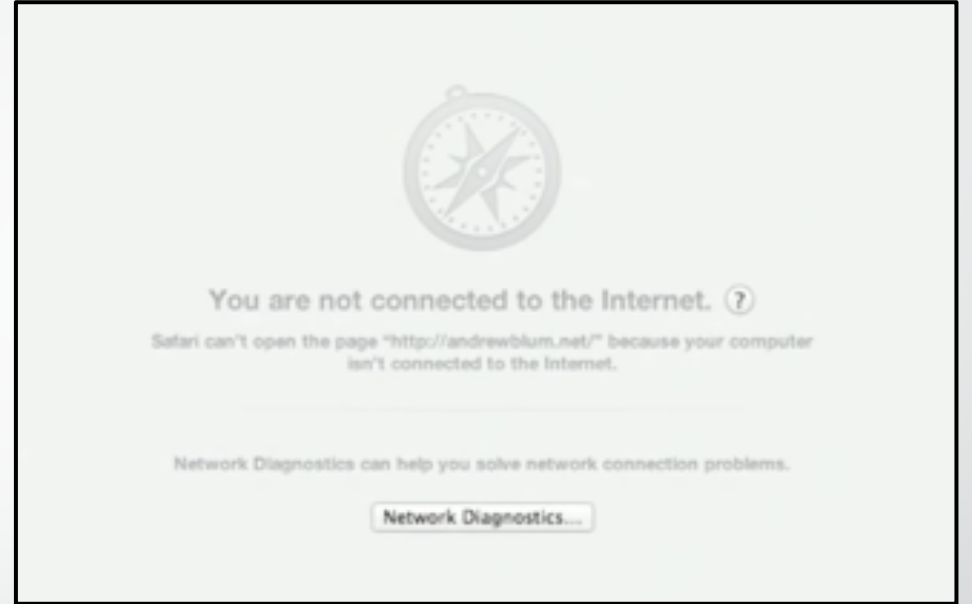
Networks



- A path between two computing devices on a computer network (a sender or a receiver) is a sequence of directly-connected computing devices beginning at the sender and ending at the receiver .
- <https://centralops.net/co/>



What is the Internet anyway?



- Ted talk with Andrew Blum that shows the PHYSICAL side of the Internet.



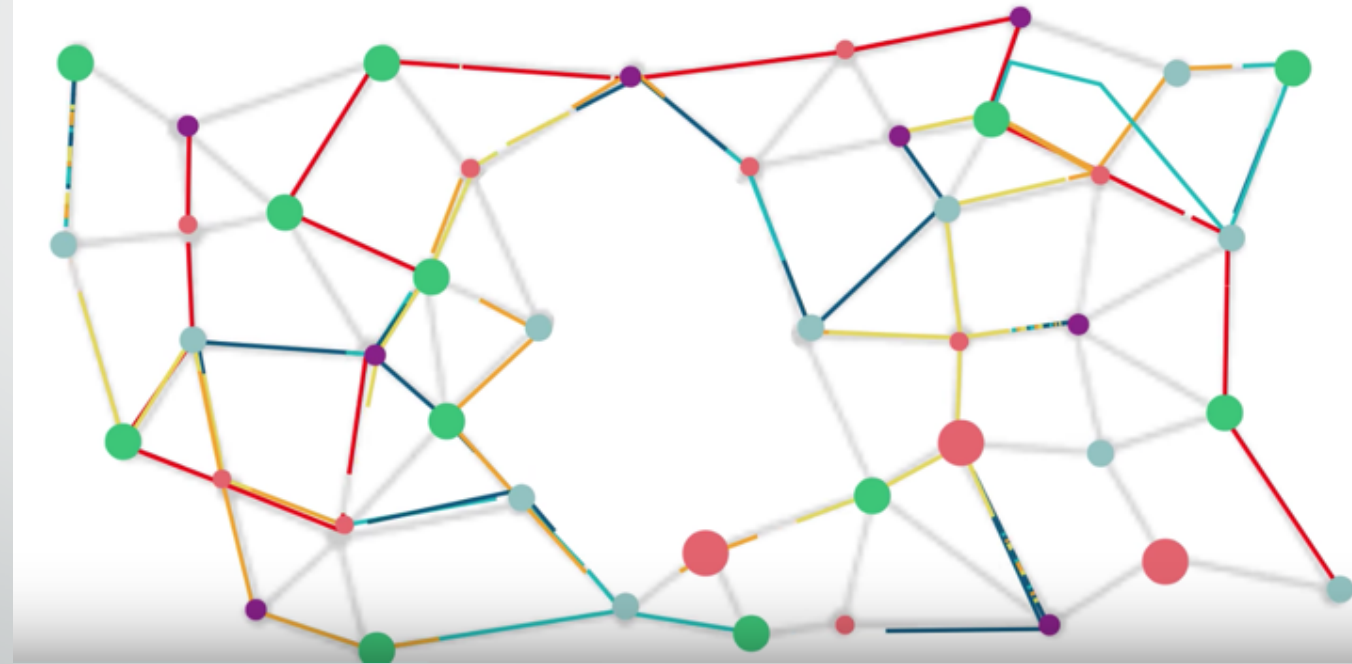
Internet

- The Internet is a massive network of networks, a networking infrastructure. It connects millions of computers together globally, forming a network in which any computer can communicate with any other computer as long as they are both connected to the Internet.
- Information that travels over the Internet does so via a variety of languages and rules known as protocols.

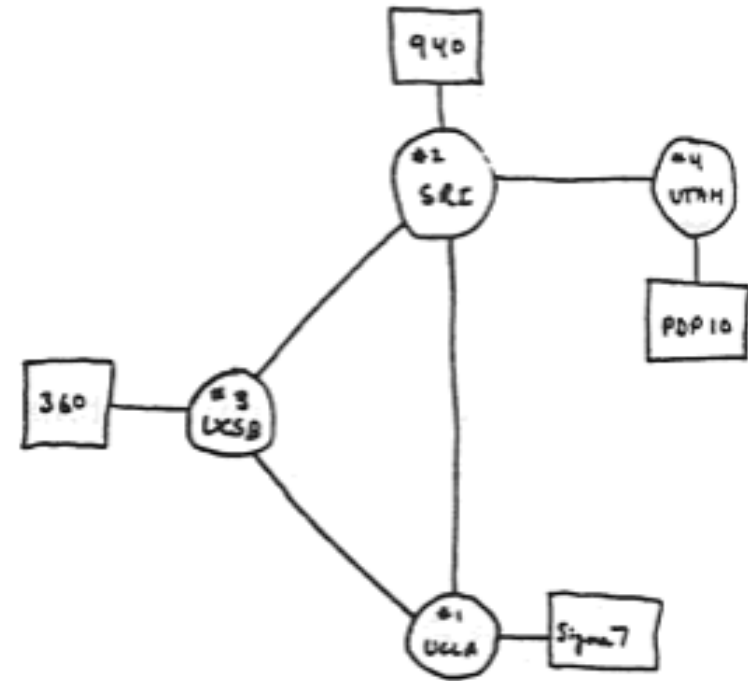


What is the Internet?

A DISTRIBUTED PACKET-SWITCHED NETWORK[©]



The beginning: ArpaNet



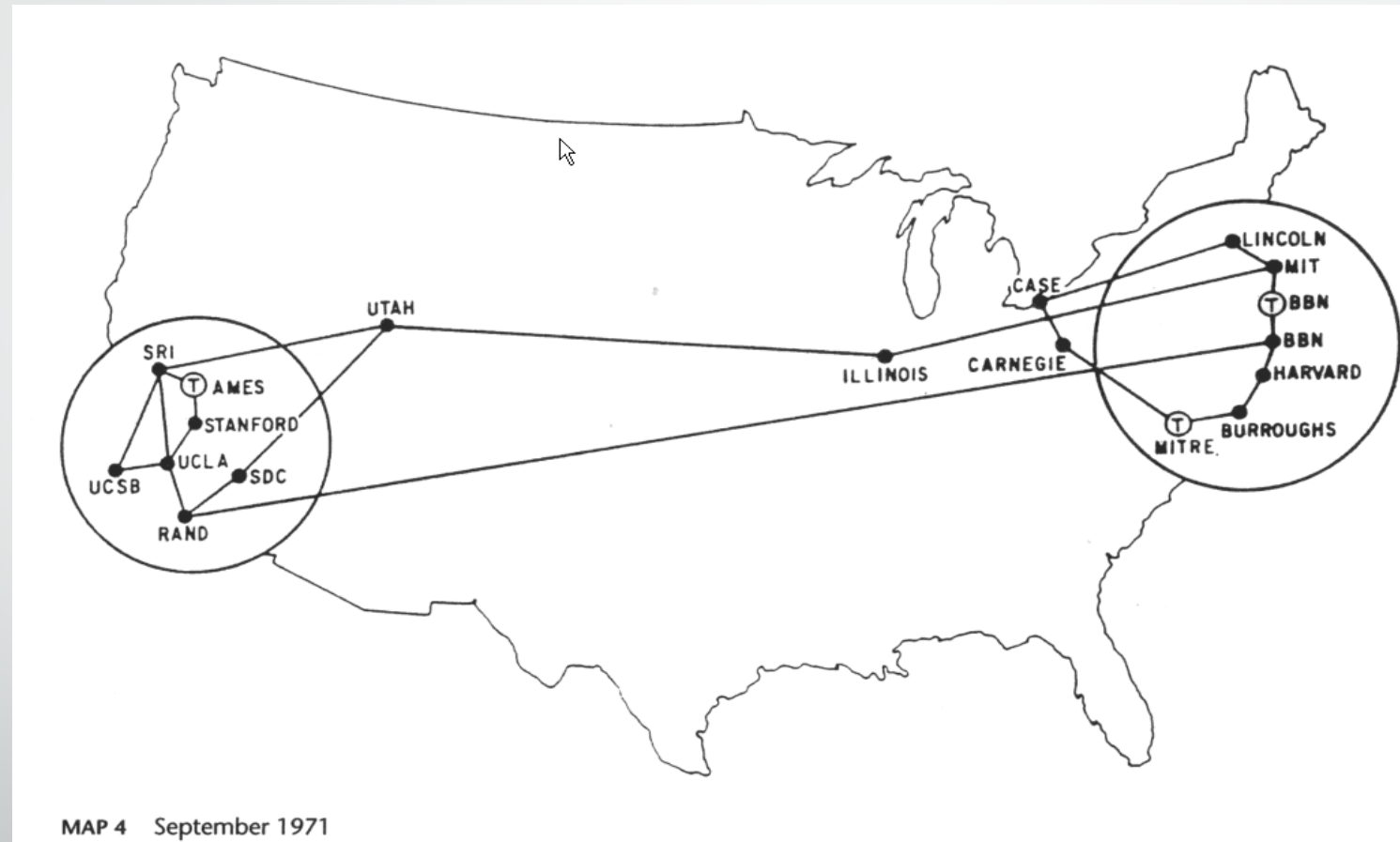
THE ARPA NETWORK

DEC 1969

4 NODES

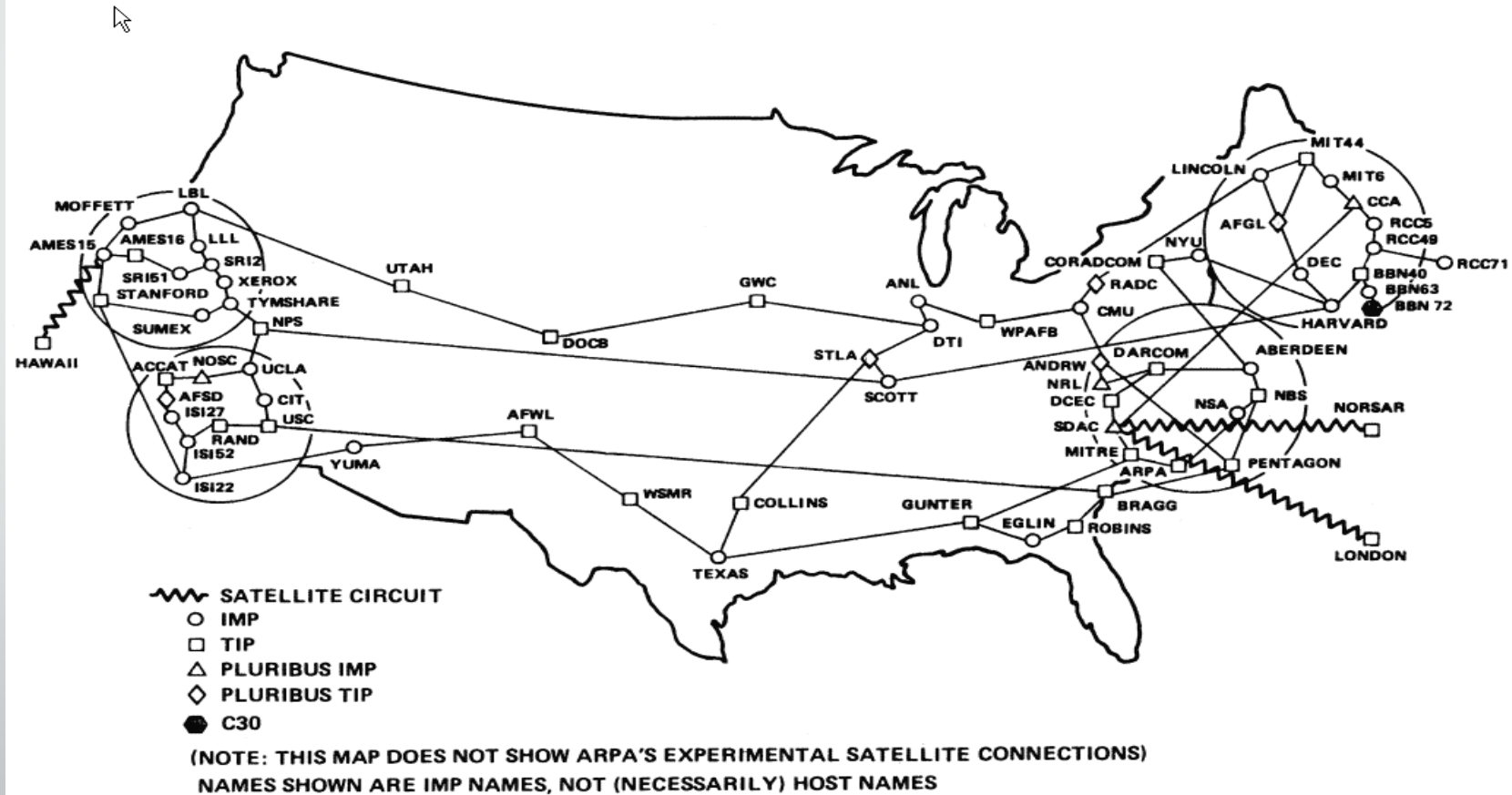
FIGURE 6.2 Drawing of 4 Node Network
(Courtesy of Alex McKenzie)

The Growth

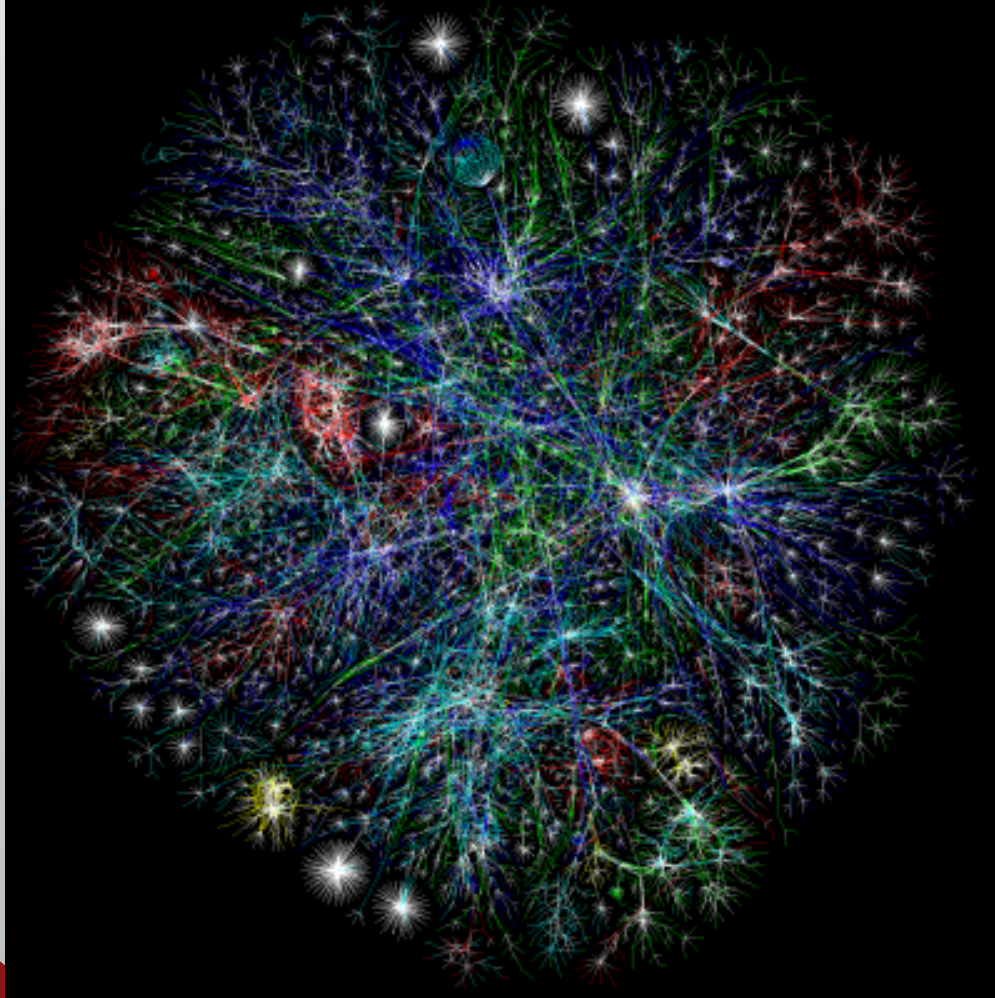


The Growth

ARPANET GEOGRAPHIC MAP, OCTOBER 1980



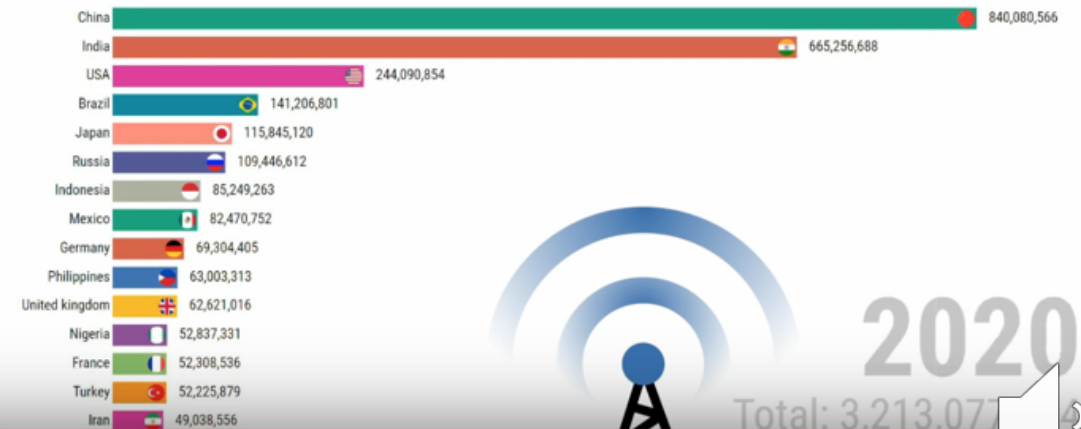
The Growth



INTERNET USERS IN THE WORLD



INTERNET USERS IN THE WORLD



Packets, Routing, and Reliability

THE INTERNET
PACKETS, ROUTING
&
RELIABILITY



Tablets of Stone

- In an ancient city there are a number of very important Governors. These Governors decide how the city is run and make very important decisions. They each live in different houses all over the city.
- The Governors often want to communicate, they need to send and receive messages all over the city. Governors are identified by their house number and they all have access to a group of messengers whose job it is to deliver the messages.
- The only way to send messages is by writing them on large rectangular stone tablets, which the messengers carry to their destination. The stone tablets are of a fixed size and can only fit 6 pieces of information on them.
- One piece of information can be one letter or one number.
- Messages are often split over a number of tablets, and as these tablets are very heavy they can only be carried one at a time.



Network Protocols

Deliver this tablet now	Deliver this message after the next one
Deliver this tablet now	Deliver this message after the next one
Deliver this tablet now	Deliver this message after the next one
Deliver this tablet now	Don't deliver this message
Deliver this tablet now	Don't deliver this message

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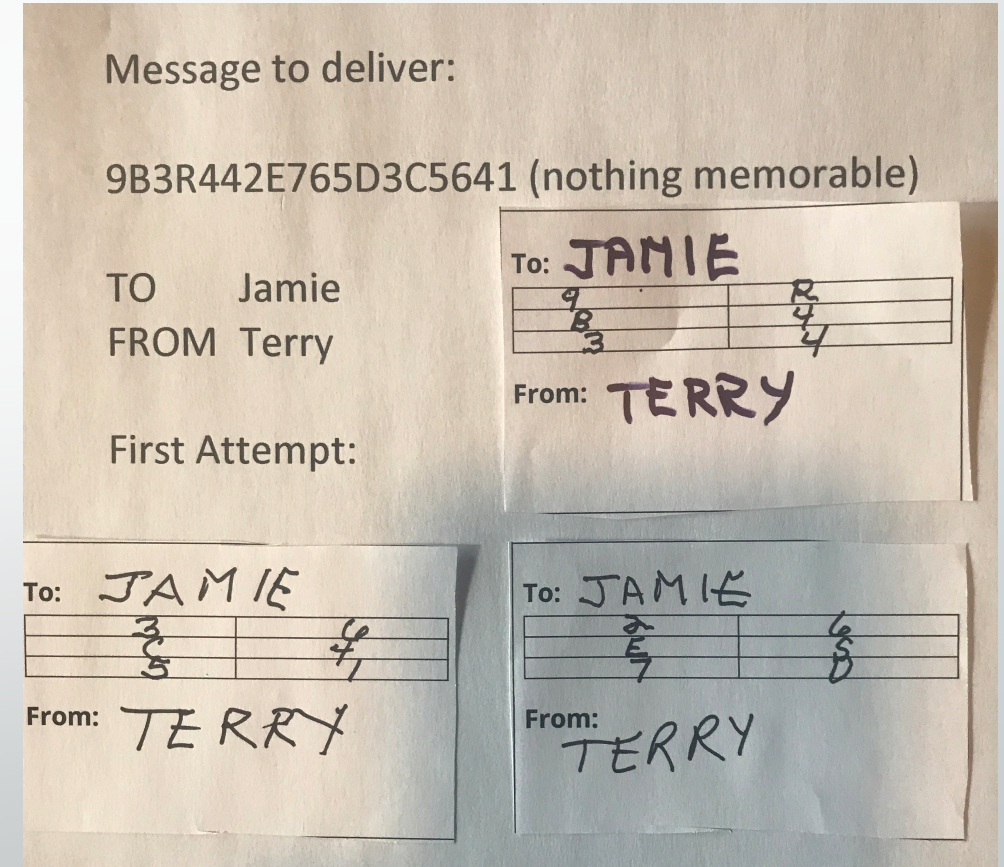
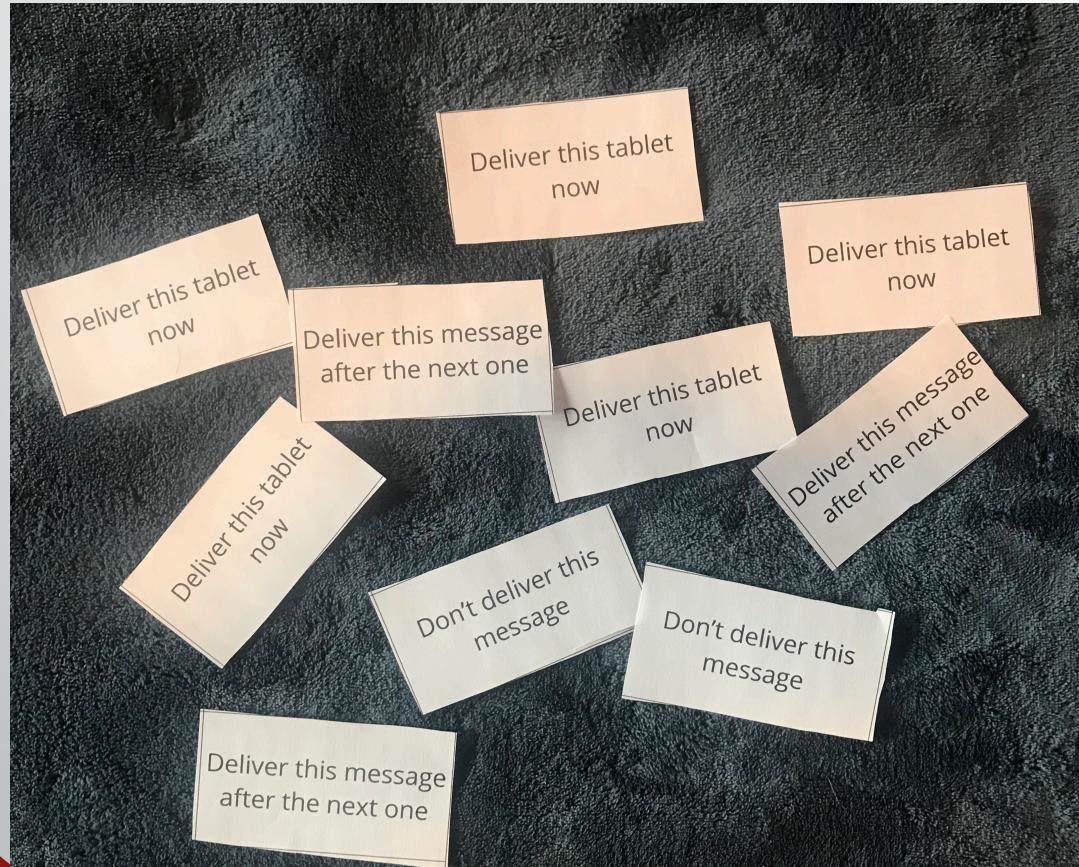


Instructions/Rules

- 1 - 3 students designated as messengers
- Students are in pairs...one designated sender and one designated receiver...not physically near each other in the classroom.
- Sender is given a message and lots of tablets.
- Messenger can carry one tablet at a time.
- Messenger takes a random tablet from sender; Goes to Internet box and retrieves a protocol; follows what the protocol says.
- Messengers must deliver all tablets of all senders.
- Receivers put together the message and compare it to the sender's original message.



Tablets of Stone: The activity



Tablets of Stone: The activity

Message to deliver:

9B3R442E765D3C5641 (nothing memorable)

TO Jamie
FROM Terry

First Attempt:

To: JAMIE	
9	R
B	4
3	4
From: TERRY	

To: JAMIE	
3	4
5	7
From: TERRY	

To: JAMIE	
2	6
7	5
From: TERRY	

Message to deliver:

9B3R442E765D3C5641 (nothing memorable)

TO Jamie
FROM Terry

To: JAMIE	
1	3
9	R
B	4
From: TERRY	

To: JAMIE	
3	3
5	5
D	5
From: TERRY	

To: JAMIE	
2	5
2	4
From: TERRY	

To: JAMIE	
4	1
4	
From: TERRY	



Tablets of Stone: The activity

Message to deliver:

9B3R442E765D3C5641 (nothing memorable)

TO Jamie
FROM Terry

To: JAMIE

1	3
9	2
B	7

From: TERRY

To: JAMIE

3	3
5	
D	5

From: TERRY

To: JAMIE

2	5
4	7
2	6

From: TERRY

To: JAMIE

4	1
4	
4	

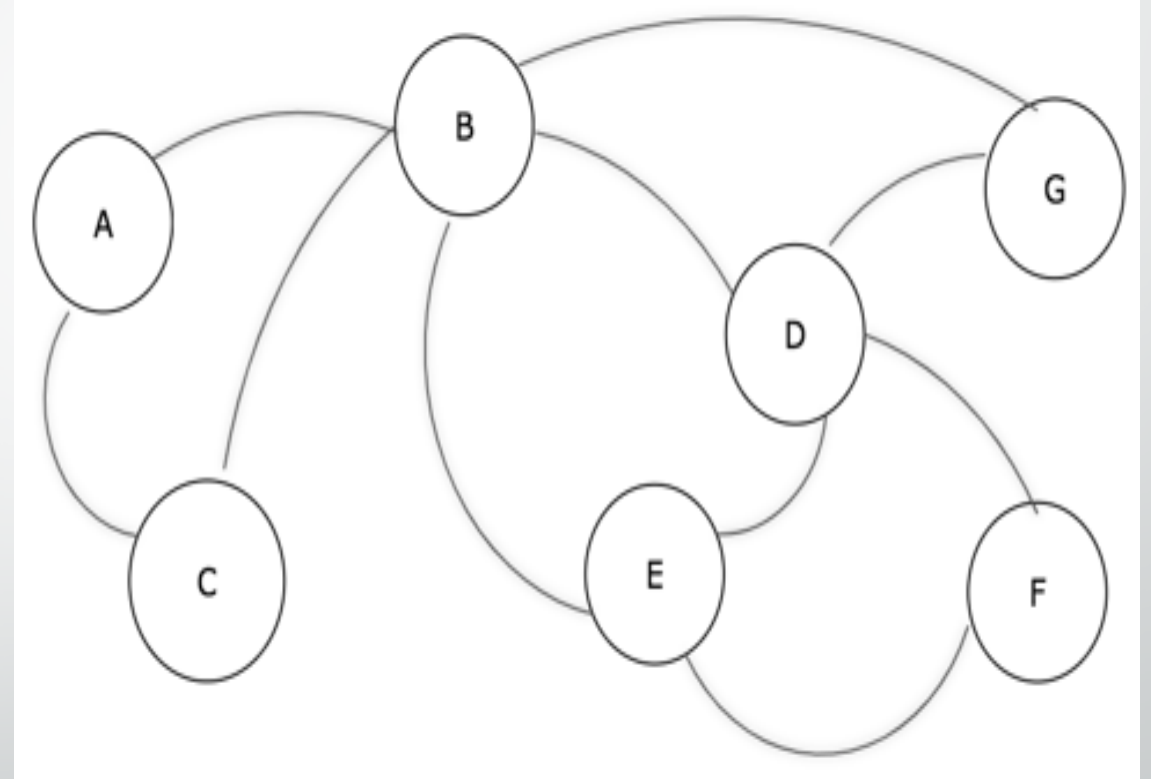
From: TERRY

- DEBRIEF, DEBRIEF, DEBRIEF!!!



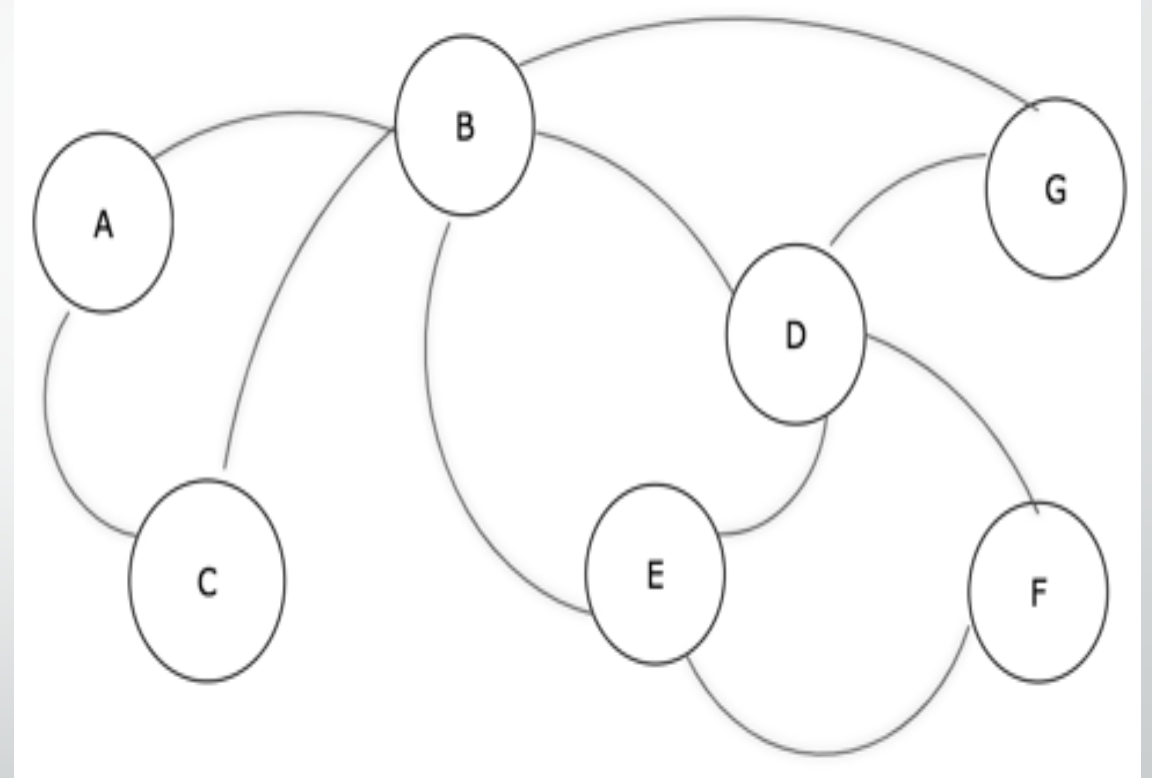
Redundancy

- The Internet has been engineered to be fault-tolerant.



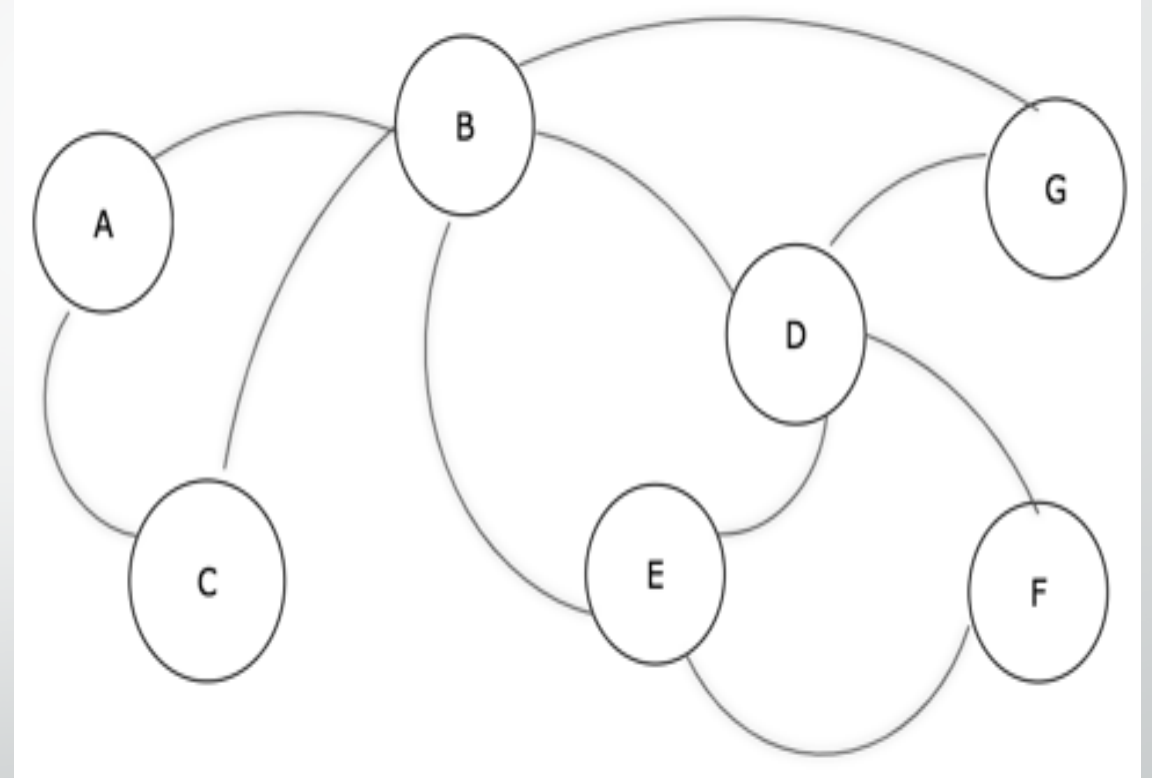
Redundancy

- If the path between G and D were broken, how could G communicate with D?
- How many total paths are there between G and D without visiting any node more than once? (Name them)
- What is the minimum number of links (lines) need to be broken before G can no longer communicate with D?



Redundancy

- What is the minimum number of links (lines) need to be broken before G can no longer communicate with D but could still communicate with F?
- What is the minimum number of nodes that are visited in sending a packet from G to A (not including G and A)?



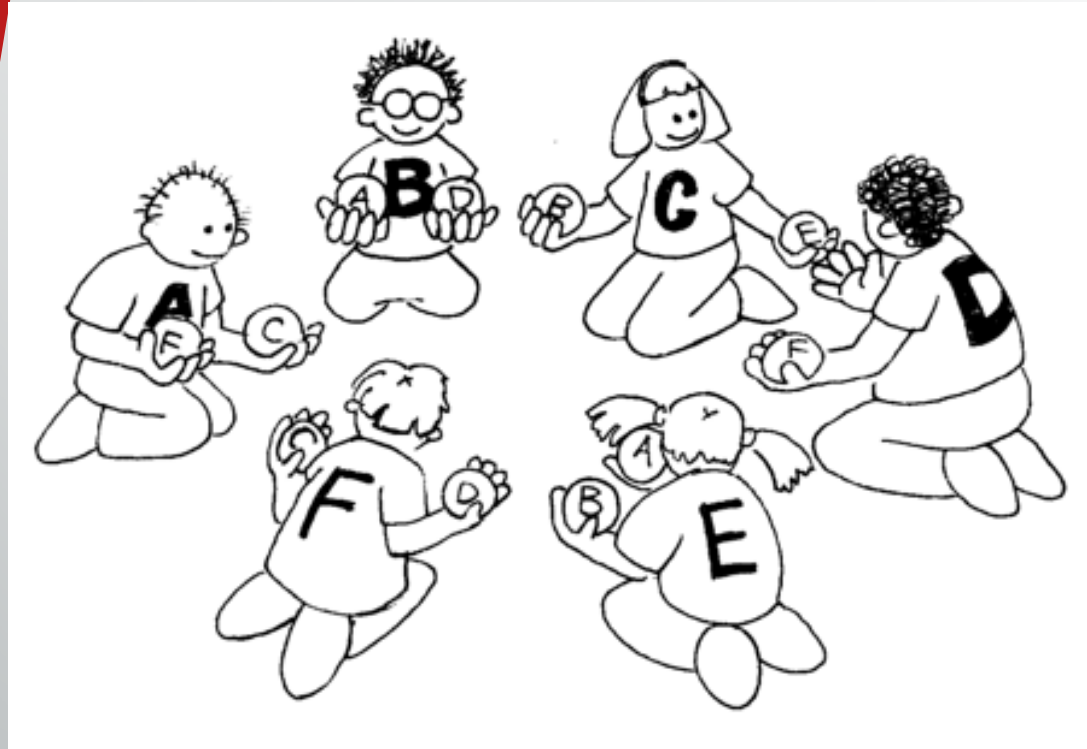
Routing and Deadlock

The Orange Game

- Routing and deadlock are problems in many networks, such as road systems, telephone and computer systems. Engineers spend a lot of time figuring out how to solve these problems—and how to design networks that make the problems easier to solve.
- Routing, congestion and deadlock can present frustrating problems in many different networks.
- Sometimes when the computers are “down” in businesses (such as banks) the problem is caused by a communication network deadlock.
- Designing networks so that routing is easy and efficient and congestion is minimized is a difficult problem faced by many kinds of engineers.



The Orange Game-collaborative problem solving



The Orange Game- collaborative problem solving

- Target dollar shelves (\$1-\$3)
- Name tags



The Orange Game: Instructions

- Groups of 5 (or more if need be)
 - Label yourselves (description of your objects) on name tags and REMEMBER **YOUR** objects.
 - Place objects in center of table. Take two **DIFFERENT** objects that are not your original objects. One person in the group has only one object...teacher takes one object from each group.
- **GAME RULES**
 - Only one object can be held in a hand.
 - An object can be passed only to an empty hand of an immediate neighbor.
- **GOAL: pass objects around until you have your two original objects!**

The Orange Game

- Debrief....Debrief....Debrief !!!



Networks and the Internet

Thanks for joining me!

- Have FUN!!!!

- Fran Trees (fran.trees@cs.rutgers.edu)



Resources

- [Ted Talk by Andrew Blum](#): 12 minutes
- Code.org Videos
 - [What is the Internet?](#)
 - [The Internet: Packets, Routing, and Reliability](#)
- [Growth of the Internet](#) (timeline)
- CS Unplugged Activities
 - [Network Protocols](#): Tablets of Stone
 - [Routing and Deadlock](#): The Orange Game

