

Introduction to Data Communications

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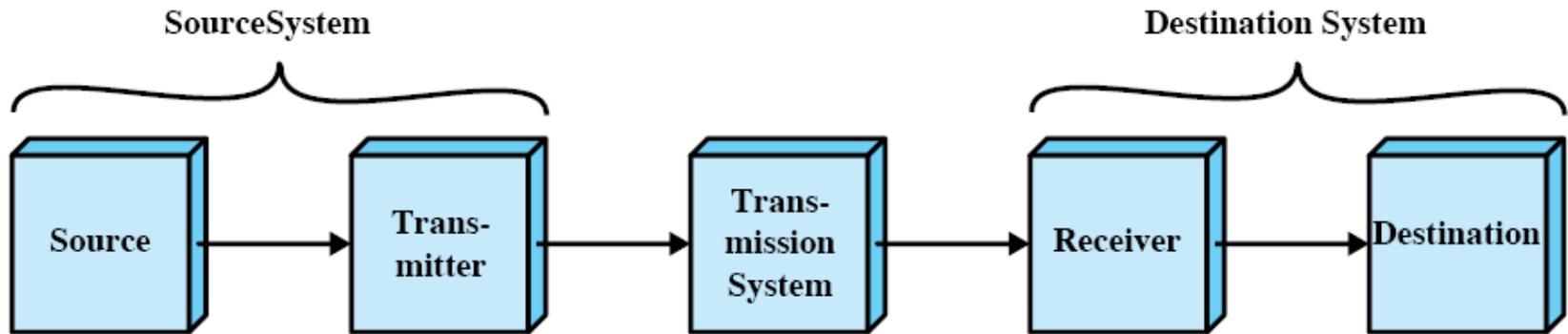
What is Data Communications?

- When we communicate, we are sharing information
 - Local sharing. E.g. face to face communications
 - Remote sharing. E.g. over some distance
 - A side note: ‘tele’ means ‘far’ in Greek. Telecommunications: communicate over a large distance. Telephony, telegraphy, television, ...
- Data
 - Refers to the information that is shared
 - Information/data comes in various forms: text, numbers, images, audio, video.
- Data Communications
 - Exchange of data between two devices via some transmission medium
- An effective data communications system depends on:
 - Delivery: the data must be delivered to the correct destination
 - Accuracy: the data received must be accurate representations of the data sent
 - Timeliness: the data should be delivered within a reasonable time



Simplified Communications Model

Fundamental purpose of communications system is the exchange of data between two parties



- Source - Device that generates data to be transmitted, e.g. telephone, PC
- Transmitter - Converts data from source into transmittable signals
 - E.g. Modem takes bits (0's and 1's) and converts into analog signal
- Transmission System - Carries data from source to destination
 - Maybe a single physical line or complex set of networks
- Receiver - Converts received signal into data; dual of transmitter
- Destination - Takes incoming data (dual of source)



Communications Tasks

*Communications model makes it look easy!
But many tasks must be performed ...*

Transmission system utilization	Addressing
Interfacing	Routing
Signal generation	Recovery
Synchronization	Message formatting
Exchange management	Security
Error detection and correction	Network management
Flow control	



Communications Tasks

- **Transmission system utilization** - need to make efficient use of transmission facilities typically shared among a number of communicating devices
- a device must **interface** with the transmission system
- once an interface is established, **signal generation** is required for communication
- there must be **synchronization** between transmitter and receiver, to determine when a signal begins to arrive and when it ends
- there is a variety of requirements for communication between two parties that might be collected under the term **exchange management**
- **Error detection and correction** are required in circumstances where errors cannot be tolerated
- **Flow control** is required to assure that the source does not overwhelm the destination by sending data faster than they can be processed and absorbed
- **addressing** and **routing**, so a source system can indicate the identity of the intended destination, and can choose a specific route through this network
- **Recovery** allows an interrupted transaction to resume activity at the point of interruption or to condition prior to the beginning of the exchange
- **Message formatting** has to do with an agreement between two parties as to the form of the data to be exchanged or transmitted
- Frequently need to provide some measure of **security** in a data communications system
- **Network management** capabilities are needed to configure the system, monitor its status, react to failures and overloads, and plan intelligently for future growth



Communication Systems

- Two important parts of a communication system are:
 - Transmission Medium
 - The physical technique for getting information from transmitter to receiver
 - Networking
 - Communications between two entities is not sufficient for many tasks
 - Many different transmission systems can be utilised to form a communications network
 - Allowing any user on the network to communicate with any other users, independent of medium and technology they use
- An example communications network is the Internet
- Terminology:
 - An internet (lowercase 'i'): a set of interconnected networks
 - The Internet (uppercase 'I'): a specific internet, the one we use everyday, which uses the Internet Protocol (IP)



Transmission Medium

- Transmission line is building block of a communications facility
 - The “link” between a transmitter and receiver
 - (It may not be a physical link, e.g. in the case of wireless)
- What medium should be used for the link?
 - It often depends on who owns the link and the amount of traffic to carry
 - E.g. A link for internal use, the choose is entirely up to business (e.g. end-user, company). Long-distance links between cities and countries are controlled by other companies, telecommunication companies like TOT, CAT
- Many different technologies to choose from:
 - Copper
 - Fiber optic
 - Wireless
- Although fiber optics provide very large capacity, transmission costs still high
 - Hence interest in efficiency improvements

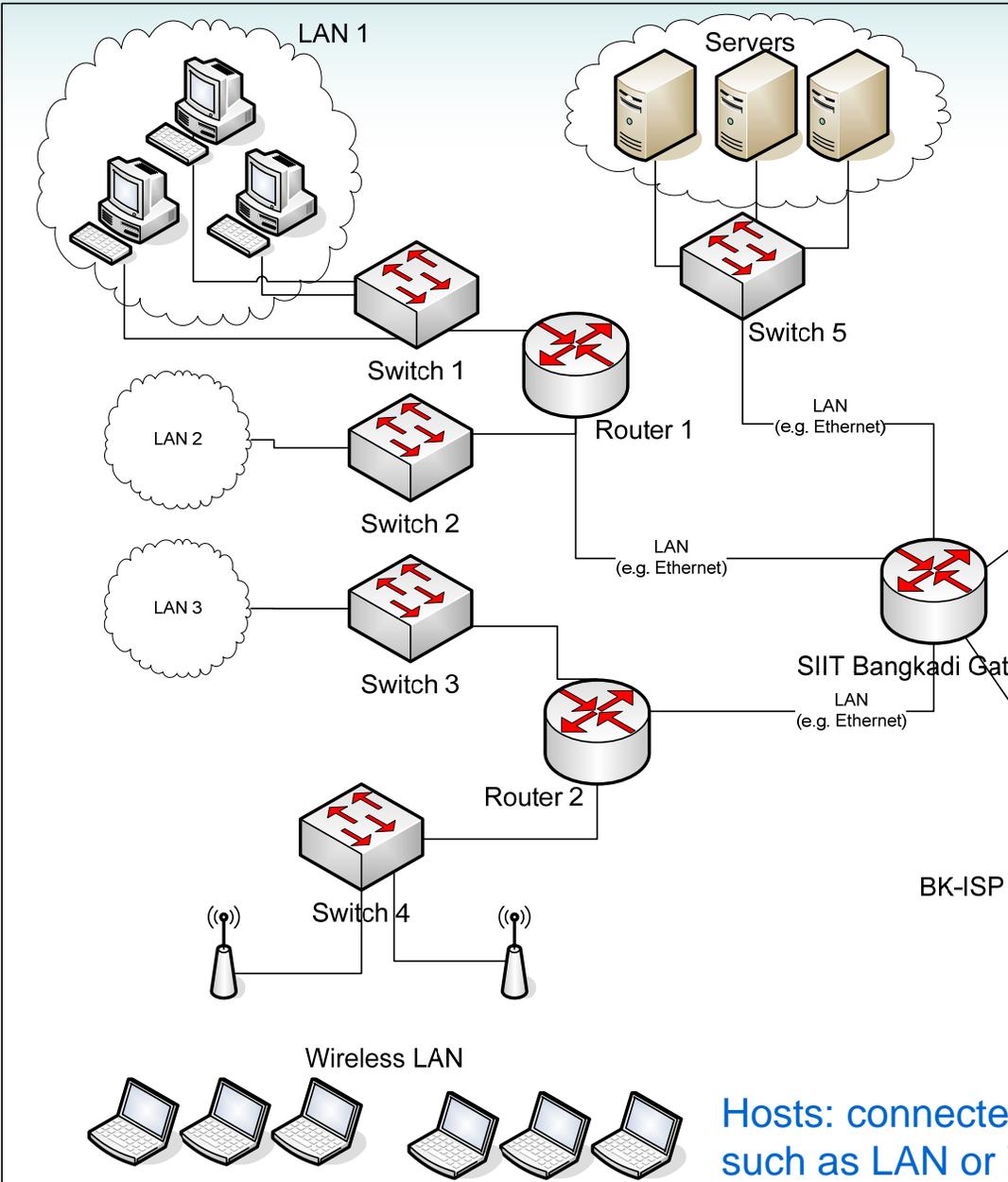


Networking

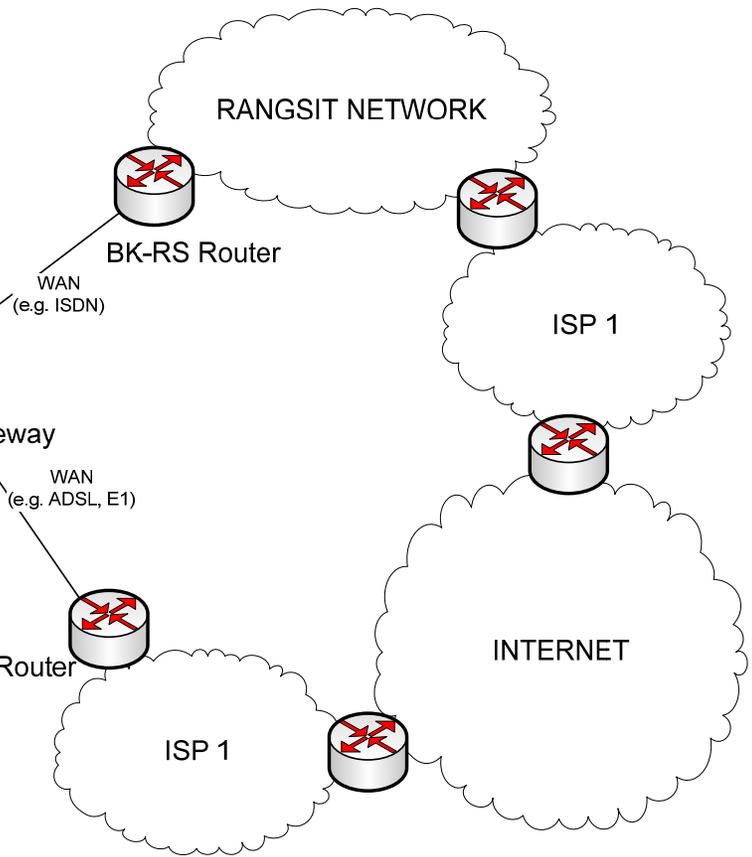
- Growth of number and power of computers is driving need for interconnection
 - Users want to be able to communicate with any other user
- Need communication software (e.g. Internet protocols) as well as communication network technologies
- Rapid integration of voice, data, image and video technologies
- Two broad categories of communications networks:
 - Wide Area Network (WAN)
 - Cover large geographical area (cities, countries)
 - Operated by carriers
 - Local Area Network (LAN)
 - Cover buildings, homes and small campuses
 - Usually owned and operated by organization that owns end devices
 - High end-user data rates than WAN
- An internet interconnects different WANs and LANs



SIIT BANGKADI LOCAL AREA NETWORK



This is a fictional example of the SIIT Bangkokadi network. Although it has a similar structure, the *real* Bangkokadi network is different.



Hosts: connected to networks such as LAN or WAN

Routers: connect networks together



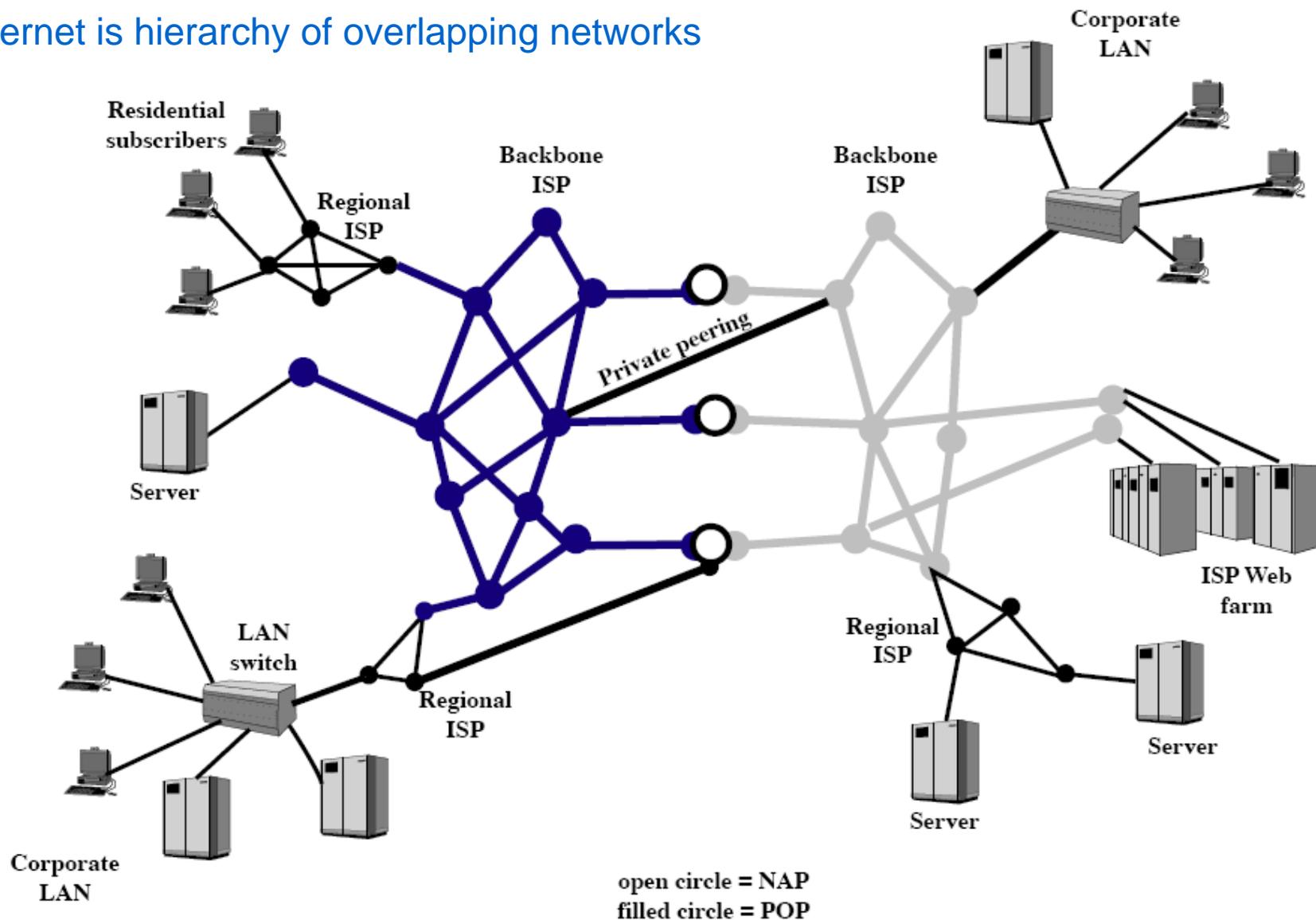
The Internet

- The Internet evolved from a US Department of Defence research network: ARPANET, developed in 1969
 - Used packet switching technology
 - Same technology was also applied to packet radio and satellite communication used by US DoD
 - Development and standardization of the Internet suite of protocols: TCP/IP
- What is the Internet?
 - Collection of networks connected together using common software: Internet Protocol (IP)
 - Although network technologies differ, any computer can communicate with any other computer (providing they are using IP)



Internet Architecture

Internet is hierarchy of overlapping networks



NECTEC Thai Internet Map

- Graphical map of Internet exchanges and gateways in Thailand
 - Latest map available from <http://internet.nectec.or.th/>
- International Internet Gateways (IIG)
 - Connect networks within Thailand to ISPs in other countries
 - Some Content Providers: Google, Microsoft, Yahoo, ...
 - Total capacity to/from Thailand: 62Gb/s
- National Internet Exchanges (NIX)
 - Connect ISPs within Thailand
- Academic and Research Networks
 - NECTEC, UniNet, ThaiSarn, ...

