Comp 346 / Comp 446

Telecommunications
OSI and Internet Protocol Models
Common Channel Signaling

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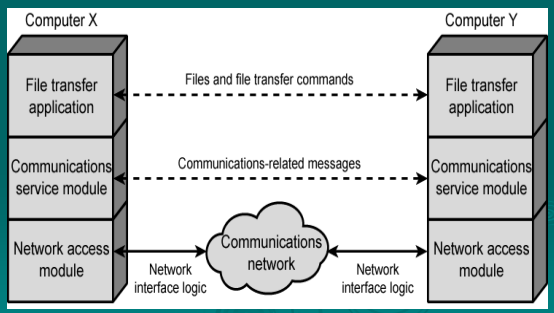
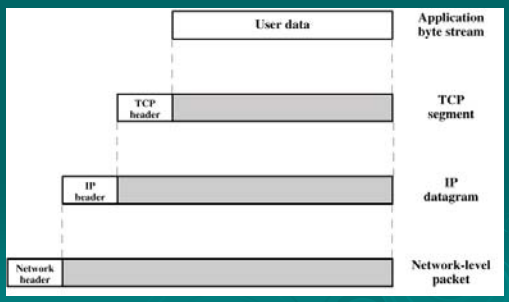
Protocol Stacks

- Protocols have to work together
  - Often in layers
  - Sometimes mix and match between layers
  - Reuse between systems
- Protocol layers support the Application
  - Perform services
  - Things application does not want to worry about
- Eliminate or Prevent Application from Certain Things
  - Device and Network Control
  - Security

Simplified Network Architecture



Operation of TCP/IP



OSI

- Open Systems Interconnection
- developed by the International Organization for Standardization (ISO)
- has seven layers
- is a theoretical system delivered too late!
- TCP/IP is the de facto standard

OSI Layers

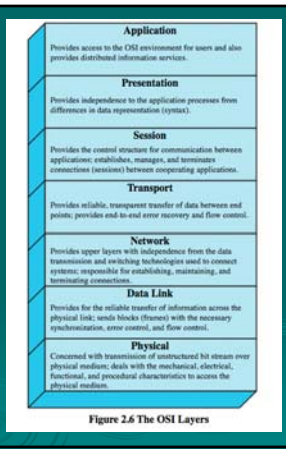
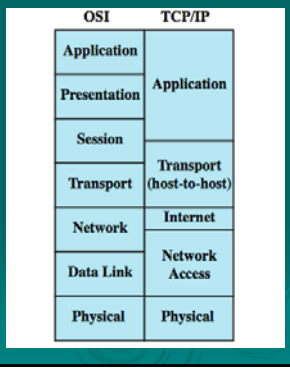
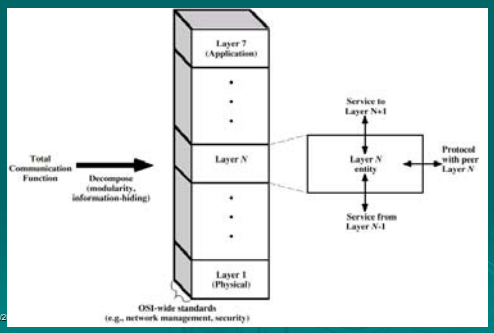


Figure 2.6 The OSI Layers

OSI v TCP/IP

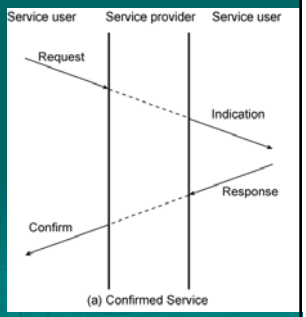


Standardized Protocol Architectures



Service Primitives and Parameters

- define services between adjacent layers using:
- primitives to specify function performed
- parameters to pass data and control info



Primitive Types

REQUEST	A primitive issued by a service user to invoke some service and to pass the parameters needed to specify fully the requested service
INDICATION	A primitive issued by a service provider either to: indicate that a procedure has been invoked by the peer service user on the connection and to provide the associated parameters, or notify the service user of a provider-initiated action
RESPONSE	A primitive issued by a service user to acknowledge or complete some procedure previously invoked by an indication to that user
CONFIRM	A primitive issued by a service provider to acknowledge or complete some procedure previously invoked by a request by the service user

Example Telecoms Network and Application

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- Common Channel Signaling
  - Aka Signaling System 7, CCIS
- Advanced application the telecom industry did for itself
  - Multiple Companies; Global
  - Used Latest Technology

Adding Common Channel Signaling

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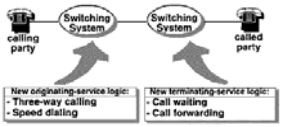
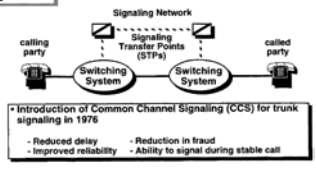
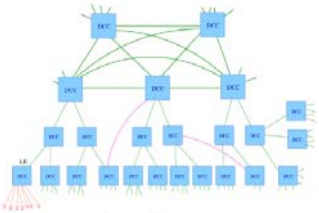




Figures from International Engineering Consortium www.iec.org

Topology



- Basic structure is tree-like
- The core network more fully connected
- Direct links for some special busy routes

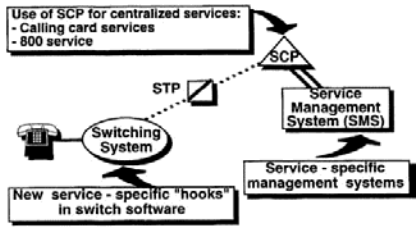
Reference connection

- ITU-T E.830
- The longest possible international telephone connection model
- LE = Local Exchange, ISC = International Switching Center
- Delay of more than 20ms requires echo cancellation

Telephone numbers (ITU-T E.164)

- A telephone number can point to a subscriber or to a service
- A telephone number of a subscriber is also an address for routing of the call
  - Area code, city areas
- Number portability breaks this connection
- Service numbers are "logical" and require number translation for use as routing addresses
  - 112, 118 etc.
- The user must be able to deduce the expected cost of the call from the telephone number. Thus, the number allocation is tied to geography and network topology

Adding Data Services



Signaling

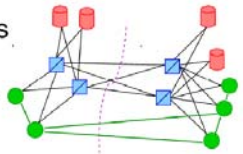
- The network made of exchanges and links must be co-ordinated in order to make calls possible
- The purpose of signaling is just to do this: it
  - establishes calls,
  - monitors the calls, and
  - tears down the calls.
- In-band signaling was used earlier
  - MF tones waste of resources
  - Security problems
- A new signaling system was created:
  - Common Channel Signaling Subsystem #7

Common Channel Signaling Subsystem #7

- SS#7 is a packet switched network on top of the telephone network
- It is used to transport signaling information
  - It **controls** the trunk connections
  - SS#7 does **not** transport user data
- SS#7 packets use either a dedicated 56 or 64kbps channel (such as E1 TS16) or dedicated links.
- If signaling does not work, the whole telephone network is "dead". Thus, stringent reliability requirements.
  - There is a lot of redundancy; every part of the signaling system has at least one spare

SS#7 elements

SS#7 overlay network:



- The actual telephone exchanges switching the actual telephone traffic are called Signal Switching Points (SSP) (circles).
- The packet switches (routers) of the SS#7 network are called Signal Transfer Points (STP) (squares with a diagonal).
- The databases for advanced call-processing capabilities are called Signal Control Points (SCP) (cylinders).

SS#7 Protocol Stack

- SS#7 uses a packet switched protocol set to carry its mission.
- The protocol stack generates a packet switched network over a circuit switched one
- MTP-x protocols (Message Transfer Part) protocols provide transport of SS#7 messages
  - MTP-2 is the link level protocol
  - MTP-3 provides network level functionality
    - Routing to specific elements

SS#7 Protocol Stack

TUP	DUP	BISUP	ISUP	OMAP
				TCAP
				SCCP
MTP-3				
MTP-2				
MTP-1				
PDH/SDH/ATM				
Twisted pair / fiber				

- The upper parts (layers) provide functions for call management
  - Telephone User Part (TUP) for traditional telephone signaling
  - Data User Part (DUP) for datacom users
  - ISDN User Part (ISUP) and Broadband ISDN User Part (BISUP) for ISDN and ATM users.

The Network and Data Is Useful!

- Initial Use
  - Area 800 or FreeCall Implementation
  - AND Prevent Fraud
- Advanced Applications
  - Pay per use, calling cards
  - Caller Identification (name and number)
  - Information Services
  - Number Portability
- Related network and Data used for Mobile Phone Service