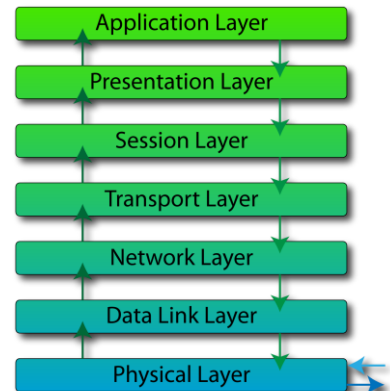


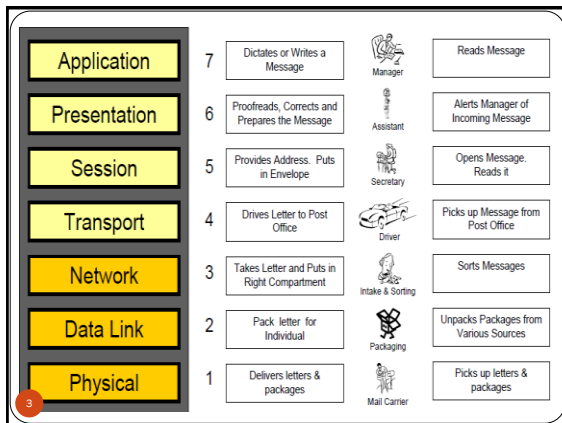
OSI LAYER 5 - Session Layer

Fatih SÜRER
2010514060

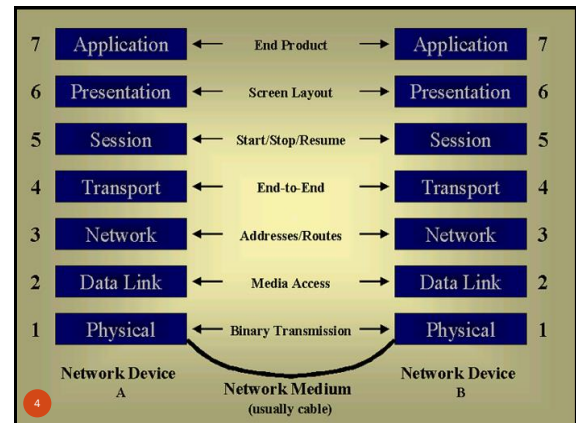
OSI
Reference
Model



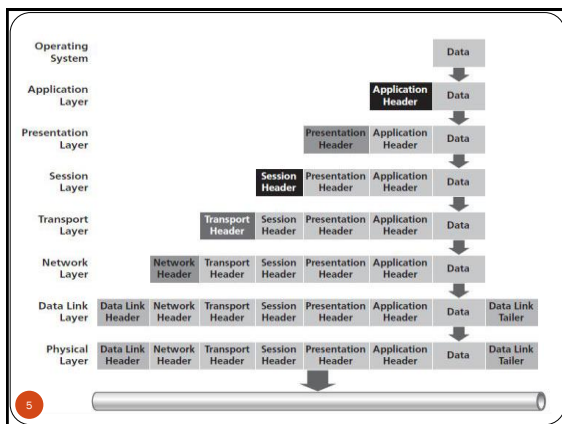
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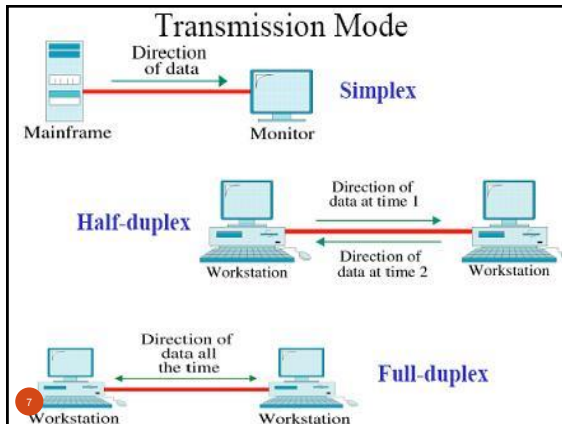
5

Session Layer

In the seven-layer OSI model of computer networking , the session layer is layer 5.

- This layer is primarily concerned with coordinating applications as they interact on different hosts.
- Support the dialog between cooperating application programs
- The session layer offers provisions for efficient data transfer.
- The session layer decides when to turn communication on and off between two computer
- Provides duplex, half-duplex, or simplex communications between devices.

6



Session Layer Cont.

- The Session Layer provides services that allow to establish/manage/terminate a session-connection, to support orderly data exchange, to organize and to synchronize the dialogue and to release the connection in an orderly manner.
- The session's layer objective is to hide the possible failures of transport-level connections to the upper layer higher.

Session Layer Cont.

- Sessions offer various services, including dialog control (keeping track of whose turn it is to transmit), token management (preventing two parties from attempting the same critical operation simultaneously), and synchronization (checkpointing long transmissions to allow them to pick up from where they left off in the event of a crash and subsequent recovery).
- In case of a connection loss this layer try to recover the connection.

Session Layer Cont.

- Session layer provides a name space that is used to tie together the potentially different transport streams that are part of a single application. For example, it might manage an audio stream and a video stream that are being combined in a teleconferencing application. long story short, principal task of the session layer is to connect two processes together into a session.
- The session layer whose overall function is to ensure the end to end integrity of the applications that are being supported.
- Manages who can transmit data at a certain time and for how long.
- The ISO OSI Reference Model is stating only that the session layer connects "presentation-entities" and that the transport layer connects "session-entities."
- Some networks ignore the session layer altogether and maintain transport connections between specific processes.
- It is the thinnest layer in the OSI model.

Session Layer Cont.

The Session layer should provide the following functionality to the Presentation layer.

- Session-connection establishment
- Session-connection release
- Normal data transfer
- Token management
- Session-connection synchronization
- Exception reporting
- Activity management

Session Layer Cont.

• Session-connection establishment

The Session Layer should enable two presentation-entities to establish a session-connection between them. The presentation-entities are identified by session-addresses, and both sides negotiate session parameters.

• Session-connection release

The session-connection release service allows presentation-entities to release a session-connection without loss of data.

• Normal data transfer

The ability to send data between presentation-entities.

• Token management

Allows the presentation-entities to control explicitly whose turn it is to carry out certain control functions.

Session Layer Cont.

- **Session-connection synchronization**

The presentation-entities should be able to define and identify synchronization points and to reset the session-connection to a defined state and agree on a resynchronization point.

The Session Layer is not responsible for any associated checkpointing or commitment action associated with synchronization.

- **Exception reporting**

The Session Layer should provide exception reporting to inform the presentation-entities of exceptional situations.

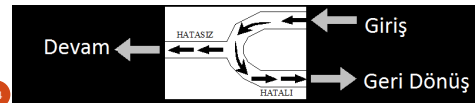
- **Activity management**

The user of the Session Layer should be able to divide logical pieces of work into activities. A session could span several activities, and these activities can be interrupted and then resumed.

13

Session Layer Functionality Includes

- Virtual connection between application entities
- Synchronization of data flow
- Creation of dialog units
- Connection parameter negotiations
- Partitioning of services into functional groups
- Acknowledgements of data received during a session
- Retransmission of data if it is not received by a device



14

Session Services

The session layer must provide

For endpoints

- Creation of endpoints.
- Destruction of endpoints.
- Provide one or several default endpoints which can be used by e.g. clients.
- Rebinding of endpoints, e.g. change interface.
- Load endpoints from disk.
- Save endpoints to disk.

15

Session Services Cont.

For services

- Creation of services.
- Destruction of services.
- Accepting a client on a service.

For sessions

- Connect to a service.
- Suspend a session.
- Resume a session.
- Close a session.

16

Session Services Cont.

Session objects can only be created out of a connection to a service. With BSD (Berkeley) sockets, firstly create the socket object, then use it to connect to another host. This is an important difference and it is also an important design decision. A session does not have a meaning unless it has been established between two endpoints. A socket on the other hand might be connectionless.

17

The Session Layer functions

- Session takes multimedia data objects such as video, data, voice, image from multiple users and creates a conversational and collaborative environment for the users
- Session Applications Development Environment, ADE, allows developers a common interface to "feed" multimedia data objects into the network and ensure that they are coordinated.
- Whereas TCP (Transmission Control Protocol) ensures a one to one connection, Session ensures a many to many connection; many users to many users with many multimedia objects

18

Flow Management

Flow management is a high level session function which assures that all of the users and all of the elements are transported in a manner and quality as specified. It sits a top TCP and does what TCP does for multimedia objects in the fully distributed environment controlled by the session layer.

- **Media Selection:**

This control elements is set to ensure quality of the media element being sent.

19

User Management

User management is simply the session function which controls the user entry, control, and exit from a session. The following details the key functions covered by user management.

- **Listing:** A listing of all users by IP address. This is a dynamically reconfigurable list.
- **Change List:** To minimize user identification the list is updated by adds and drops.
- **Verification and Authentication:** Each user is verified and authenticated.
- **Security:** There is a security level on a per users and per group basis.
- **Priority:** Each user has a priority level.
- **Type:** This specifies the type of user

20

Layer Controls

Layer control is the function which may be considered a bit different for this session layer protocol. It also provides data up to the service layer stack for the management and control of the network.

These controls are TCP Control , IP Control and MAC Layer Control

- **1. TCP Control:**

This controls flow to TCP (Transmission Control Protokol) elements to manage delays and thruput which may be media dependent.

- a. Push
- b. Urgent
- c. Flags
- d. Delay Control

21

Layer Controls Cont.

- **2. IP Control:**

This is the IP element which also controls router features and functions such as QoS (Quality of Service) and routing tables.

- a. Header Compression
- b. MPLS (Multiprotocol Label Switching) Control
- c. Router Table Control

- **3. MAC Layer Control:**

The MAC layers can be controlled via Session layer such as RTS/CTS suppression.

- a. RTS/CTS (Request to Send / Clear to Send)
- b. others

22

Resource Management

Resource management control is a higher layer management control function. It manages three key elements; media, router and events. They are described as following:

- **1. Media Flow Control:** Multimedia flow control at the session layer for multiple media elements can be managed via this mechanism.
- **2. Router Management:** The ongoing router management can be controlled via Session layer control elements.
- **3. Event Management:** The monitoring of performance, isolation of problems, and restoration of service is a key element of the session service.

The session layer functions are key to supporting the overall needs of a multimedia communications environment.

23

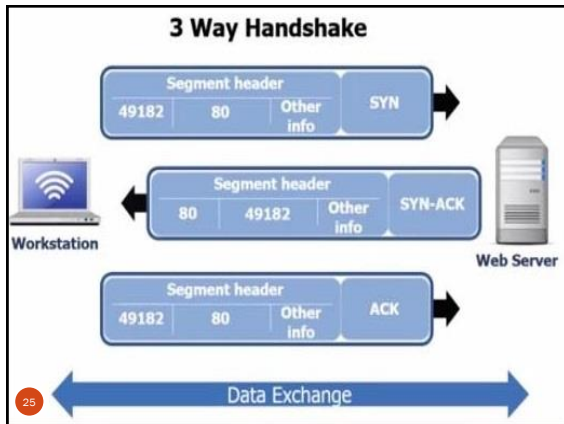
Creating a connection

- Session/communication session between an APPLICATION in one computer and another APPLICATION in another computer
- THREE-WAY-HANDSHAKE:**

- A method widely used to establish and end connection
- Sender sends SYN message to request a session to the receiver
- Receiver replies by sending ACK message to acknowledge the SYN message sent by the sender, and SYN message to request a session to the sender
- Sender replies by sending ACK message to acknowledge the SYN message sent by the receiver



24



Managing Multiple Sessions

A computer can establish multiple sessions with several other computers

- session 1: exchanging information over the World Wide Web with www.yahoo.com
- session 2: exchanging information over the World Wide Web with www.google.com
- session 3: exchanging information over the World Wide Web with www.espn.com

Two computers can also establish multiple sessions,

- function 1: exchanging information over the World Wide Web;
- function 2: exchanging information over the FTP;
- function 3: exchanging information over the email

Multiple Sessions with Several Other Computers

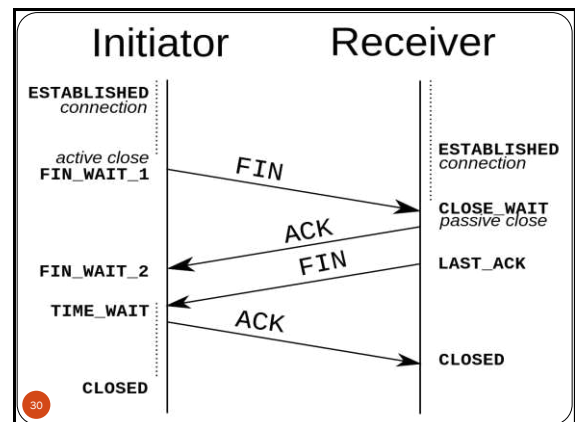


Two Computers Can Establish Multiple Sessions



Ending a Session

- **THREE-WAY-HANDSHAKE:** a method widely used to establish and end connection
- Sender sends **FIN** message to close a session to the receiver
- Receiver replies by sending **ACK** message to acknowledge the **FIN** message sent by the sender, and **FIN** message to close a session to the sender
- Sender replies by sending **ACK** message to acknowledge the **FIN** message sent by the receiver

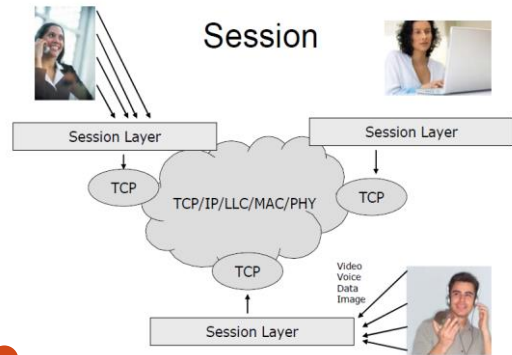


Session Layer Mobility

- Session Layer mobility has the same advantages over network mobility as transport layer mobility.
- It can also assure that we do not change the underlying transport protocols.
- On the other hand, inserting a new layer between application and transport layer will need every application to be modified and recompiled.

31

Session



32

Session Layer Protocols

- ADSP, AppleTalk Data Stream Protocol
- ASP, AppleTalk Session Protocol
- DNA SCP, Digital Network Architecture Session Control Protocol
- H.245, Call Control Protocol for Multimedia Communication
- ISO-SP, OSI Session Layer Protocol (X.225, ISO 8327)
- ISNS, Internet Storage Name Service
- L2F, Layer 2 Forwarding Protocol
- L2F, Layer 2 Forwarding Protocol
- L2TP, Layer 2 Tunneling Protocol
- NetBIOS, Network Basic Input Output System
- NetBEUI, NetBIOS Enhanced User Interface
- NFS, Network File System
- NCP, NetWare Core Protocol

33

Session Layer Protocols

- PAP, Password Authentication Protocol
- PPTP, Point-to-Point Tunneling Protocol
- RPC, Remote Procedure Call Protocol
- RTCP, Real-time Transport Control Protocol
- SMB, Server Message Block
- SMPP, Short Message Peer-to-Peer
- SCP, Session Control Protocol
- SCP, Secure Copy Protocol
- SDP, Sockets Direct Protocol
- SIP, Session Initiation Protocol
- SOCKS, "SOCKets" the SOCKS internet protocol
- SQL, Structured Query Language
- SSH, Secure Shell
- ZIP, Zone Information Protocol
- X Window System

34

Apple Talk Protocols

The AppleTalk Protocol suite includes the following protocols:

- AARP AppleTalk Address Resolution Protocol
- DDP Datagram Delivery Protocol
- RTMP Routing Table Maintenance Protocol
- AEP AppleTalk Echo Protocol
- ATP AppleTalk Transaction Protocol
- NBP Name-Binding Protocol
- ZIP Zone Information Protocol
- ASP AppleTalk Session Protocol
- PAP Printer Access Protocol
- ADSP AppleTalk Data Stream Protocol
- AFP AppleTalk Filing Protocol

35

Apple Talk Protocols Cont.

- Apple Computer developed the AppleTalk protocol suite to implement file transfer, printer sharing, and mail service among Apple systems using the LocalTalk interface built into Apple hardware.
- AppleTalk ports to other network media such as Ethernet by the use of LocalTalk to Ethernet bridges or by Ethernet add-in boards for Apple machines.
- AppleTalk is a multi-layered protocol providing internetwork routing, transaction and data stream service, naming service, and comprehensive file and print sharing.
- In addition, many third-party applications exist for the AppleTalk protocols.

36

Apple Talk Protocols Cont.

ASP

- The AppleTalk Session Protocol (ASP) manages sessions for higher layer protocols.
- ASP issues a unique session identifier for each logical connection and continuously monitors the status of each connection.
- It maintains idle sessions by periodically exchanging keep alive frames in order to verify the session status.

ADSP

- The AppleTalk Data Stream Protocol (ADSP) provides a data channel for the hosts. It is a connection-oriented protocol that guarantees in-sequence data delivery with flow control.

ZIP

- The AppleTalk Zone Information Protocol (ZIP) manages the relationship between network numbers and zone names.
- AppleTalk networks primarily implement ZIP in routers that gather network number information by monitoring RTMP (RealTime Messaging Protocol) frames.

37

Session Layer Protocols Cont.

SCP

- The Session Control Protocol (SCP) manages logical links for DECnet (DECnet is a suite of network protocols created by Digital Equipment Corporation) connections.

PAP

- Password Authentication Protocol (PAP) provides a simple method for the peer to establish its identity.
- This is done only upon initial link establishment.

38

Session Layer Protocols Cont.

NetBIOS

- NetBIOS (Network Basic Input/Output System) provides a communication interface between the application program and the attached medium.
- It is file sharing and name resolution protocol and the basis of file sharing with Windows.
- All communication functions from the physical layer through the session layer are handled by NetBIOS
- A NetBIOS session is a logical connection between any two names on the network.
- It is described in IBM - Local Area Network Technical Reference 1990 DA-30/31 Protocol Operating Manual.

39

Session Layer Protocols Cont.

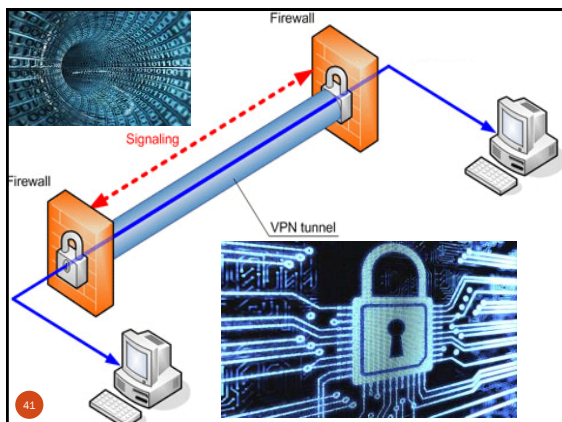
L2F

- The Layer 2 Forwarding protocol (L2F) permits the tunneling of the link layer of higher layer protocols.

L2TP

- The L2TP (Layer 2 Tunneling Protocol) Protocol is used for integrating multi-protocol dial-up services into existing Internet Service Providers Point of Presence.
- Used to support virtual private networks (VPNs)

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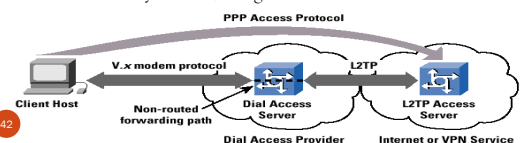


41

Session Layer Protocols Cont.

PPP

- PPP (Point-to-Point Protocol) is designed for simple links which transport packets between two peers.
- These links provide full-duplex simultaneous bi-directional operation and are assumed to deliver packets in order.
- PPP provides a common solution for the easy connection of a wide variety of hosts, bridges and routers.



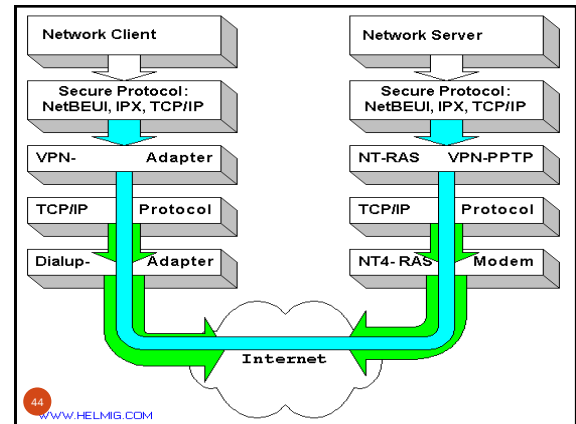
42

Session Layer Protocols Cont.

PPTP

- PPTP (Point to Point Tunneling Protocol) allows PPP to be channeled through an IP network.
- It uses a client-server architecture to decouple functions which exist in current Network Access Servers and support Virtual Private Networks.
- PPTP uses a GRE-like (Generic Routing Encapsulation) mechanism to provide a flow- and congestion-controlled encapsulated datagram service for carrying PPP packets.

43



44

Session Layer Protocols Cont.

SDCP

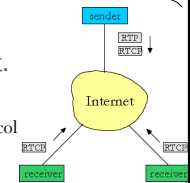
- The PPP Serial Data Control Protocol (SDCP) is responsible for configuring, enabling and disabling the SDTP (Serial Data Transport Protocol) modules on both ends of the point-to-point link.
- SDCP packets may not be exchanged until PPP has reached the Network-Layer Protocol phase.

45

Session Layer Protocols Cont.

RTCP

- The Real-time Transport Control Protocol (RTCP) is based on the periodic transmission of control packets to all participants in the session, using the same distribution mechanism as the data packets.
- The underlying protocol must provide multiplexing of the data and control packets, for example using separate port numbers with UDP.



46

Session Layer Protocols Cont.

RTSP

- The Real-Time Streaming Protocol (RTSP) is an application level protocols for control over the delivery of data with real-time properties.
- RTSP provides an extensible framework to enable controlled, on-demand delivery of real-time data, such as audio and video.
- Sources of data can include both live data feeds and stored clips.
- This protocol is intended to control multiple data delivery sessions.
- Both an RTSP server and client can issue requests.
- Data is carried out-of-band by a different protocol. (There is an exception to this.)

47

ISO-SP: OSI Session Layer Protocol (X.225, ISO 8327)

The ISO-SP protocol specifies procedures for a single protocol for the transfer of data and control information from one session entity to a peer session entity.

- Provides session management, e.g. opening and closing of sessions. In case of a connection loss it tries to recover the connection.
- If a connection is not used for a longer period, the session layer may close it down and re-open it for next use. This happens transparently to the higher layers.
- These protocol exchanges are effected using the services of the transport layer.
- The Session layer provides synchronization points in the stream of exchanged packets.
- The functions in the Session Layer are concerned with dialogue management, data flow synchronization, and data flow resynchronization.
- These functions are connection establishment phase, the data transfer phase, and the release phase.

48

ISO-SP: OSI Session Layer Protocol Cont.

- The Session protocol data units are transferred using the Transport Data Transfer Service.
- The TSDU (Transport Service Data Unit) is comprised of number of SPDU's (Session Protocol Data Units)
- There can be up to 4 SPDUs depending on the concatenation method that is being used and on the SPDU type

49

SPDU Structure

SI	LI	Parameter field	User information field
----	----	-----------------	------------------------

SPDU structure

- SI: (SPDU Indicator) This fields indicates the type of SPDU.
- LI: (Lenght Indicator) signifies the lenght of the associated parameter field.
- Parameter Field: In the SPDU the parameter field contains the PGI or PI units defined for SPDU.
- User information filed : contain segments.

50

SPDU Structure Cont.

The structure of PGI unit is

PGI	LI	Parameter field
-----	----	-----------------

Parameter field: PGI structure

The structure of PI unit is

PI	LI	Parameter field
----	----	-----------------

Parameter field: PI structure

PGI : Parameter Group Identifier

PI : Parameter Identifier

51

X Window

- An X server is a program that runs on a user's desktop to manage a video system including "interactive" I/O devices such as mice, keyboards, and some more unusual devices. The key functions are:
 - 1) displays drawing requests on the screen.
 - 2) replies to information requests.
 - 3) reports an error in a request.
 - 4) manages the keyboard, mouse and display device.
 - 5) multiplexes keyboard and mouse input onto the network (or via local IPC) to the respective X clients. (X events)
 - 6) creates, maps and destroys windows
 - 7) writes and draws in windows.
- X client is an application program that often runs on another host which connect to an X Server in order to display things. The client is often "server." The key functions are:
 - 1) sends requests to the server.
 - 2) receives events from server.
 - 3) receives errors from the server.

52

NFS - Network File System

- NFS was designed by Sun Microsystems in the early 1980s.
- NFS is a stateless protocol: no client or server can go into a state that depends on further information
- A file system is a way of storing data on a medium: the way it is organized and managed.
- As NFS is a open standard it is not just limited to UNIX systems but can also be run on multiple platforms.
- NFS allows us to access remote directories and files as if they were located in our local machine.

53

NFS - Network File System Cont.

NFS is built from 4 distinct protocols: ☐

- **nfs** ☐
File creation, searching, reading, writing ☐ Authentication and statistics ☐
- **mountd** ☐
Mounting of "exported" systems for access via nfs
- **nsm** ☐
Network Status Monitor ☐
Monitors a client or server machine's status ☐
- **nlm** ☐
Network Lock Manager ☐
Avoid simultaneous data modification by multiple clients

54

Structured Query Language (SQL)

- SQL (Structured Query Language) is a Session Layer application that manages multiple queries to the SQL database.
- SQL is a database computer language designed for managing data in relational database management systems (RDBMS).
- Many database applications offer analyses and utilities to summarize data. In order to summarize data beyond these programs and maintain the database, SQL is required.
- Although many databases allow for generating queries through the use of a point-and-click tool, this is often time consuming. Once the basic SQL statements are understood, summarizing and maintaining the data will become easier and faster.
- SQL, is a standardized computer language that was originally developed by IBM for querying, altering and defining relational databases, using declarative statements.

55

What can SQL do?

- SQL can execute queries against a database
- SQL can retrieve data from a database
- SQL can insert records in a database
- SQL can update records in a database
- SQL can delete records from a database
- SQL can create new databases
- SQL can create new tables in a database
- SQL can create stored procedures in a database
- SQL can create views in a database
- SQL can set permissions on tables, procedures, and views

56

SQL Cont.

There are lots of different database systems, or DBMS (Database Management Systems), such as:

- **Microsoft SQL Server**
Enterprise, Developer versions, etc.
Express version is free of charge
- **Oracle**
- **MySQL** (Oracle, previously Sun Microsystems)
MySQL can be used free of charge (open source license),
Web sites that use MySQL: YouTube, Wikipedia, Facebook
- **Microsoft Access**
- **IBM DB2**
- **Sybase**
...lots of other systems

57

Syntax Diagrams of SQL

- Text between brackets, "[]", are optional SQL components
- Normal text between braces, "{ }", contains a list of required elements, only one of the elements listed is required
- Italic text represents a generic place holder, for example, table name denotes a table name should be entered at that location
- Bold text are key words



58

Query Examples:

- insert into STUDENT (Name , Number, SchoolId)
values ('John Smith', '100005', 1)
- select SchoolId, Name from SCHOOL
- select * from SCHOOL where SchoolId > 100
- update STUDENT set Name='John Wayne' where StudentId=2
- delete from STUDENT where SchoolId=3

We have 4 different Query Types: **INSERT, SELECT, UPDATE and DELETE**

SQL	Description
INSERT INTO	inserts new data into a database
SELECT	extracts data from a database
UPDATE	updates data in a database
DELETE	deletes data from a database

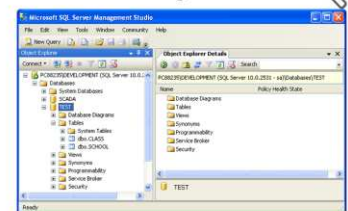
59

Database Engine



A Service running on the computer in the background

Management Studio



A Graphical User Interface to the database used for configuration and management of the database

60

Remote Procedure Call (RPC)

- Birrell and Nelson suggested was allowing programs to call procedures located on other machines.
- When a process on machine A calls a procedure on machine B, the calling process on A is suspended, and execution of the called procedure takes place on B.
- Information can be transported from the caller to the callee in the parameters and can come back in the procedure result.
- No message passing at all is visible to the programmer.

This method is known as Remote Procedure Call, or often just RPC.

61

Remote Procedure Call (RPC) Cont.

- To understand how RPC works, it is important first to fully understand how a conventional (i.e., single machine) procedure call works. Consider a call in C like

```
count = read(fd, buf, nbytes);
```

where

fd is an integer indicating a file,

buf is an array of characters into which data are read,

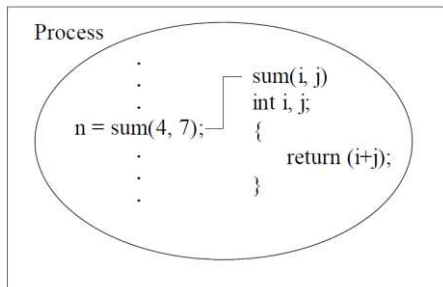
nbytes is another integer telling how many bytes to read.

If the call is made from the main program, the stack will be as shown in following Fig. (a) before the call. To make the call, the caller pushes the parameters onto the stack in order, last one first, as shown in following Fig. (b).

62

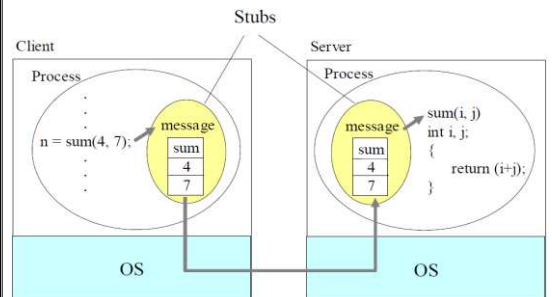
Local Procedure Call

Machine



63

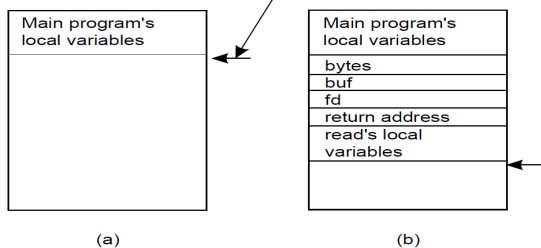
Remote Procedure Call



64

Remote Procedure Call

Stack pointer



(a)

(b)

- (a) Parameter passing in a local procedure call: the stack before the call to read.
(b) The stack while the called procedure is active.

65

Remote Procedure Call (RPC) Cont.

- After read has finished running, it puts the return value in a register, removes the return address, and transfers control back to the caller. The caller then removes the parameters from the stack, returning it to the original state.
- The server cannot normally start up an application containing the destination procedure, and call the procedure in that program (as that program is already running). Thus the destination procedure is usually in a dynamic link library that the RPC server can dynamically link to and call.

66

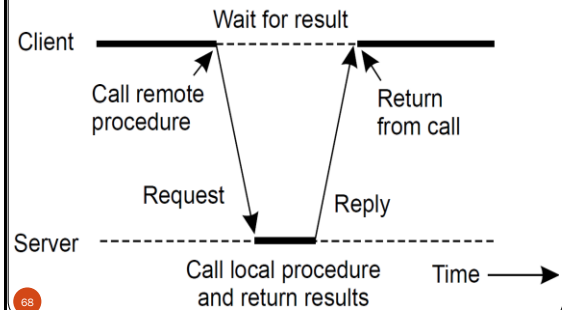
Remote Procedure Call (RPC) Cont.

To summarize, a remote procedure call occurs in the following steps:

1. The client procedure calls the client stub in the normal way.
2. The client stub builds a message and calls the local operating system.
3. The client's OS sends the message to the remote OS.
4. The remote OS gives the message to the server stub.
5. The server stub unpacks the parameters and calls the server.
6. The server does the work and returns the result to the stub.
7. The server stub packs it in a message and calls its local OS.
8. The server's OS sends the message to the client's OS.
9. The client's OS gives the message to the client stub.
10. The stub unpacks the result and returns to the client.

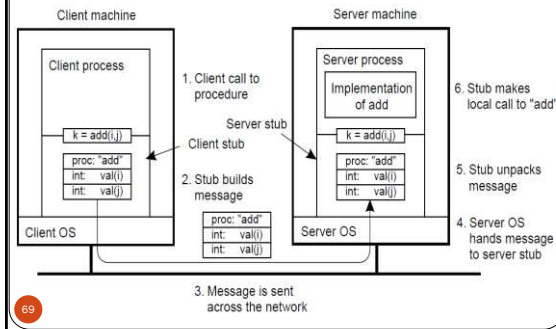
67

Principle of RPC between a client and server program.

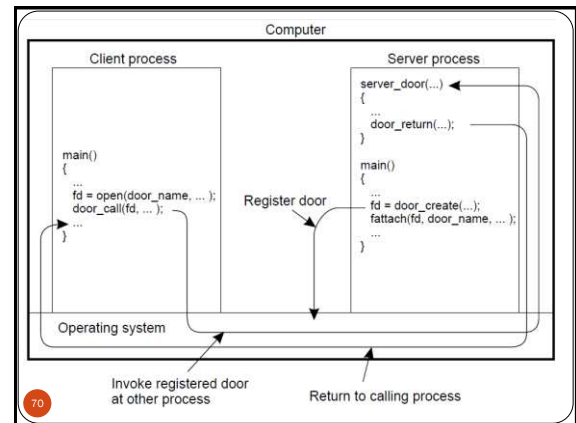


68

The steps involved in doing a remote computation through RPC.

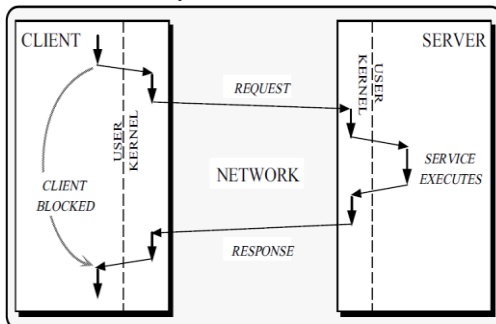


69



70

A Temporal View of RPC



71

Any Questions ?

72

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73

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74