

Komunikačné funkcie

- výkon určitej vopred vymedzenej činnosti realizujúcej časť riadenia komunikácie
- cieľ / metóda
- tri skupiny:
 - základné KF
 - otvorenie/ukončenie prenosu
 - vytvorenie/zrušenie spoja
 - synchronizácia
 - KF súvisiace s požiadavkami na výkonnosť siete
 - zabezpečenie prenosu voči chybám
 - riadenie toku
 - smerovanie
 - rozkladanie/skladanie
 - riadiace KF
 - predchádzanie zahlteniu siete
 - diagnostika v sieti

Sieťová architektúra

- štruktúra riadenia komunikujúcich alebo aj sústava protokolov použitých v sieti
- VRSTVENIE
 - základný princíp štruktúrovania riadenia
 - dekompozícia KF na vhodné podmnožiny – vrstvy
 - ako určiť počet vrstiev?

→ Open Systems Interconnection (ISO 7498)

Komunikačný protokol

- súbor pravidiel zahŕňajúci formáty a význam správ vymieňaných medzi protíahľými entitami na tej istej vrstve
- formálna definícia: $KP \{V, F(V), L(V)\}$

V – množina protokolových slov (správ)

$F(V)$ – množina formátov slov

$L(V)$ – množina významov slov

OSI model			
	Dátová jednotka	Vrstva	Funkcia
Stanica	Dáta	Aplikačná	Sprístupnenie siete pre aplikácie
		Prezentačná	Reprezentácia dát a šifrovanie
		Relačná	Komunikácia v rámci stanice
	Segmenty	Transportná	End-to-end spoľahlivé spojenie (TCP)
Médium	Pakety	Sieťová	Stanovenie cesty a logické adresovanie (IP)
	Rámce	Linková	Fyzické adresovanie (MAC & LLC)
	Bity	Fyzická	Binárny prenos dát/signálov cez médium

Koncept vrstvomého modelu

- *vrstvomá dekompozícia*

Základné princípy tvorby vrstiev:

- Každá vrstva má plniť jednoznačné a špecifické funkcie
- Podobné funkcie majú byť sústredené v jednej vrstve
- Vnútoraná výstavba vrstvy má byť nezávislá od jej funkcií
- Hranice medzi vrstvami majú byť definované tak, aby sa minimalizovali nároky na riadiace a kontrolné informácie medzi nimi
- Výmena informácií sa uskutočňuje len medzi susednými vrstvami
- Vrstva používajú služby nižšej vrstvy a poskytuje služby vyššej vrstve
- Počet vrstiev je dostatočne veľký na to, aby sa absolútne odlišné funkcie nenachádzali v jednej vrstve
- Počet vrstiev je dostatočne malý na to, aby bol model ako celok ešte prehľadný

Entita

je aktívnym elementom v rámci vrstvy.

Layered communication principles

Communication function

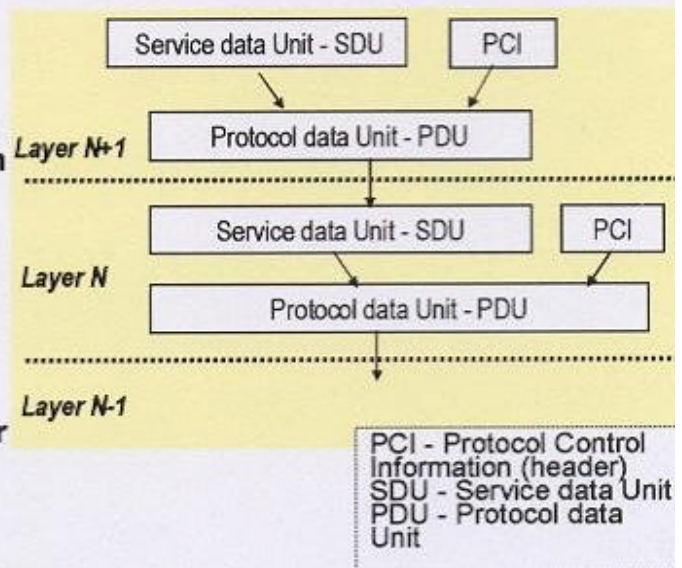
- actions to be taken to control a certain aspect of communication
- decomposition of communication functions -- layering

Layer

- responsible for handling certain problems of communication control performing some communication function(s)
- vertical hierarchy
- upper layer -- request, lower layer -- service

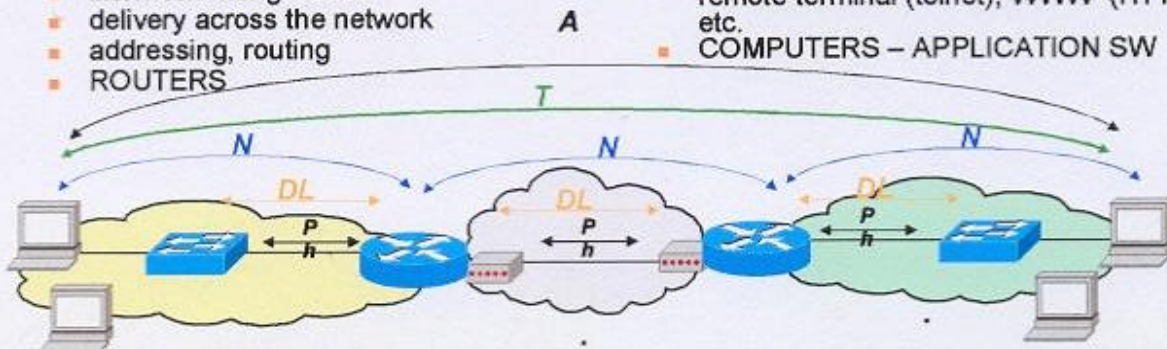
Layers

- Network architecture
 - layering model used for communication in the network
- TCP/IP suite
- Reference Model Open System Interconnection
- IBM System Network Architecture, DEC Digital Network Architecture, Novell IPX/SPX



Layered communication TCP/IP

- hardware (physical) layer
 - physical transmission of bits, signal definitions (bandwidth, voltages, etc.), bit synchronization, connectors, etc.
 - MODEMS
- network interface (data link) layer – LAN, PPP
 - point-to-(multi)point communication
 - handling of the transmission errors
 - multiple access scheme
 - BRIDGES / SWITCHES
- internet (network) layer - IP
 - internetworking issues
 - delivery across the network
 - addressing, routing
 - ROUTERS
- transport layer – TCP, UDP
 - end-to-end communication
 - reliable data transfer
 - flow control, session multiplexing
 - COMPUTERS – OPERATING SYSTEM, SOCKETS
- application layer
 - user interface
 - compatible data representation
 - application-specific tasks, e.g.
 - authentication, privacy
 - synchronization of session
 - e-mail (SMTP), file transfer (FTP), remote terminal (telnet), WWW (HTTP), etc.
 - COMPUTERS – APPLICATION SW



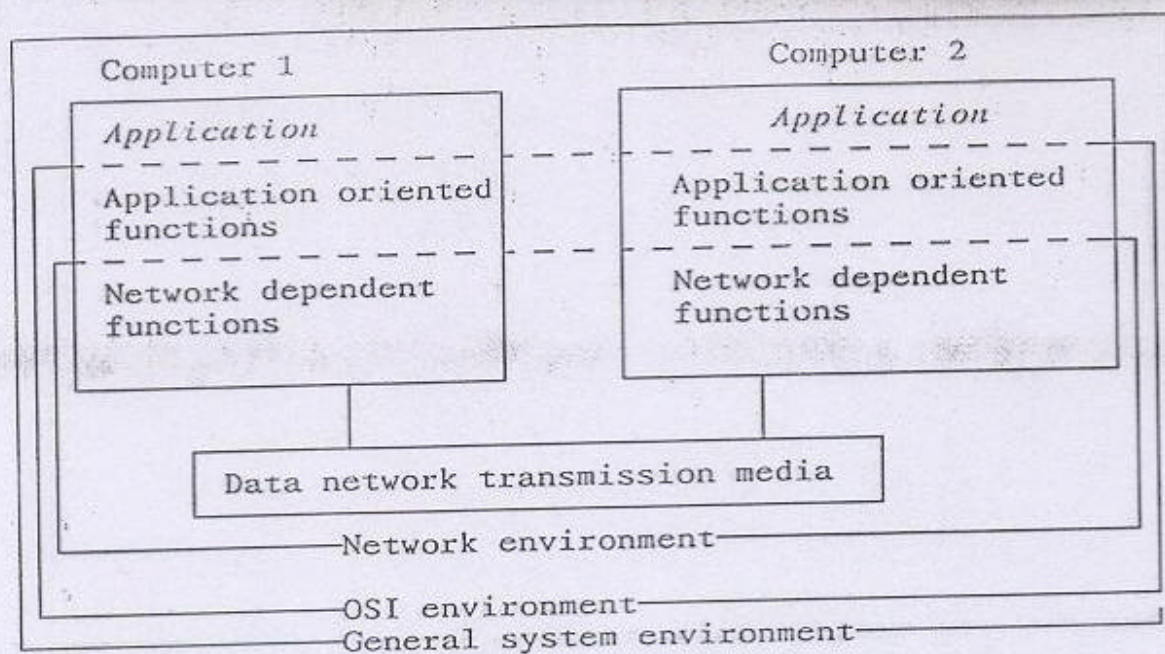


Fig. 1.3 System operational environments

*Peer - to - peer
protocols*

Endpoint - to endpoint

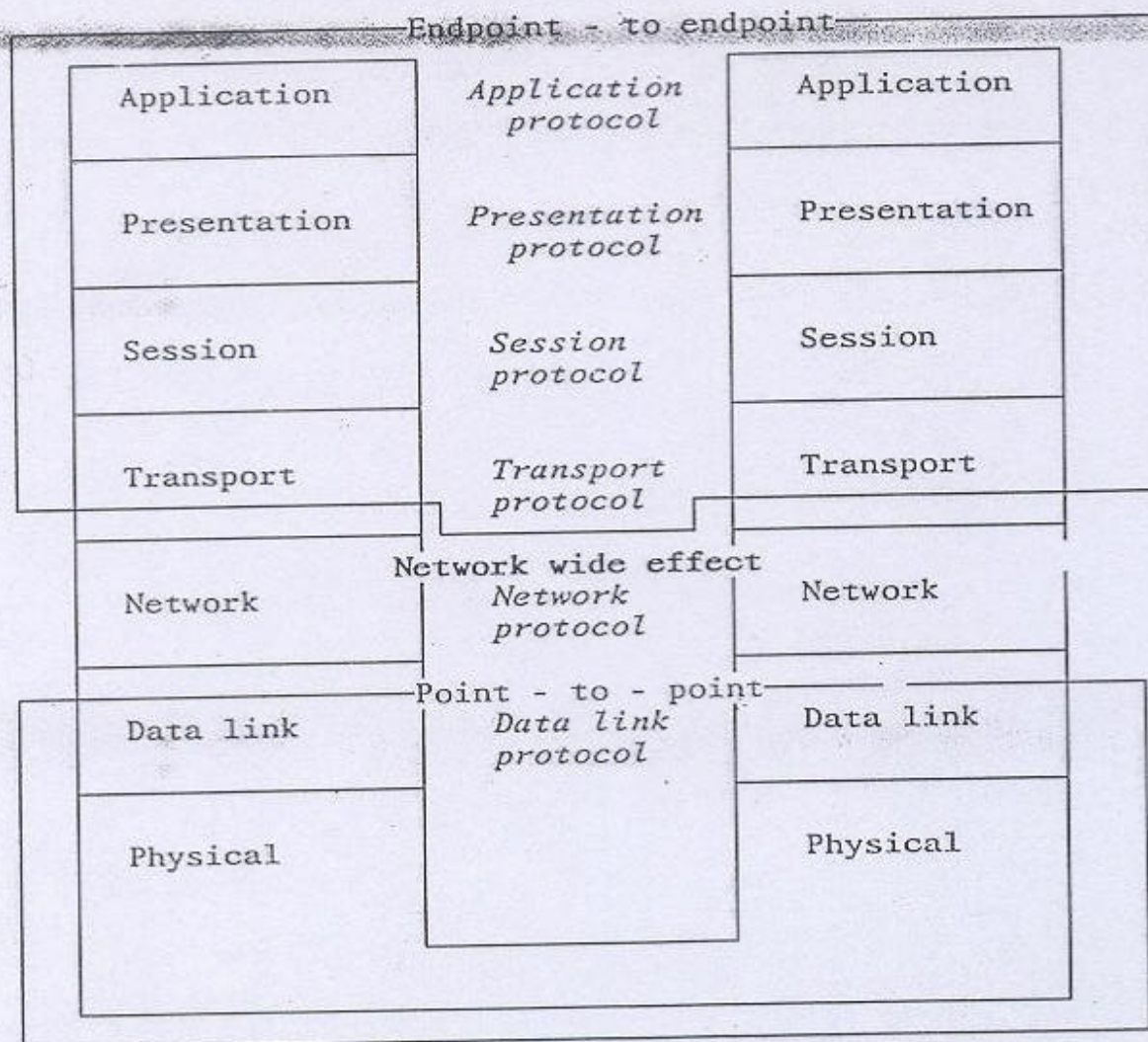


Fig. 1.4 ISO layered architecture. Reference model OSI.

Global structure of RM OSI with function contents is shown in this diagram.

	End-user application process
	<i>Distributed information services</i>
Application layer	File transfer, access and managment, document and message interchange, job transfer and manipulation
	<i>Syntax independent message interchange service</i>
Presentation layer	Transfer syntax negotiation data representation transformations
Session layer	Dialogue and synchronization control for application entities
	<i>Network-independent message interchange service</i>
Transport layer	End-to-end message transfer connection managment, error control fragmentation, flow control
Network layer	Network routing, addressing call set-up and clearing,
Link layer	Data link control framing, data transparency, point to point error control, character and frame synchronization
Physical layer	Mechanical and electrical network interface definition bit transmission, bit synchronization
	<i>Physical connection to network termination equipment</i>
	Data communication network (transmission media)

Functions and services of the physical layer (services with connection)

Functions

Transparent transmission of bits
Activation, maintenance and deactivation of the physical connection
Physical layer managment

Services

Physical connection
Data units Physical (bits)
Physical connection end points
Data circuit identification
Synchronization (bit)
Fault condition notification
Quality of service parameters

Functions and services of the data link layer

Functions

Establishment, maintenance and release of connection
Data link service data unit mapping
Data link connection splitting
Delimiting and synchronization
Sequencing
Error detection
Error recovery
Flow control
Identification and parameter exchange
Control of data circuit interconnection
Data link layer management

Services

Data link connection
Data units DL
Data link connection endpoint identifiers
Sequencing
Error notification
Flow control
Quality of service parameters

Functions and services of the network layer

Functions

Establishment, maintenance and release of connections
Routing and relaying
Network connection multiplexing
Segmentation and blocking
Error detection
Error recovery
Sequencing
Expedited data transfer
Flow control
Reset
Service selection
Network layer management

Services

Network Addresses
Network connections
Network connection endpoints identifiers
Data units N
Error notification
Sequencing
Flow control
Expedited data transfer
Reset
Release
Receipt of confirmation
Quality of service parameters

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Functions within the transport layer (service with connection)

- Establishment, maintenance and release of connections
- End-to-end multiplexing of transport connections on to a network connection
- Mapping transport addresses to the network addresses
- Sequencing on each connection
- End-to-end error detection
- End-to-end error recovery
- End-to-end segmenting blocking and concatenation
- Expedited data transfer
- Selection of transport service class
- Transport layer management
- End-to-end flow control on individual connections

Functions within the session layer (service with connection)

- Establishment, maintenance and release of connections
- Expedited data transfer
- Translation of transport and session addresses
- Exception reporting
- Session connection synchronization
- Interaction management (two-way simultaneous, two-way alternate, one-way)
- Flow control
- Recovery
- Isolation
- Access control and Session layer management

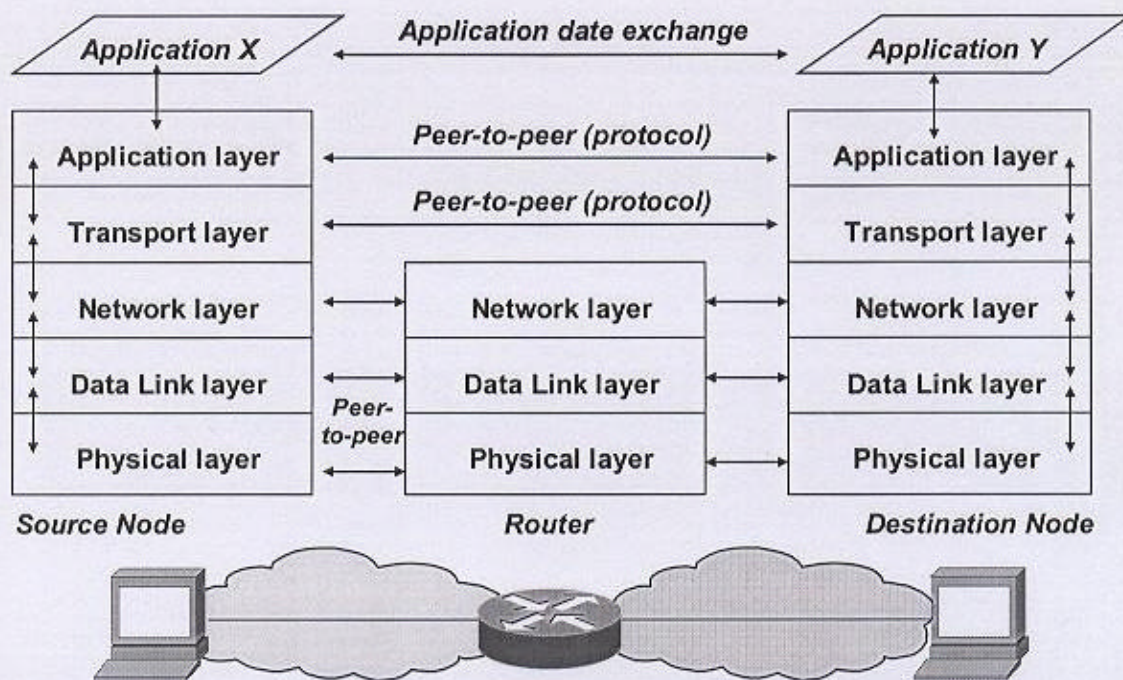
Functions within the presentation layer (service with connection)

- Session establishment and termination request
- Transformation of syntax (compression, coding)
- Syntax selection
- Syntax negotiation
- Formating
- Presentation layer management

Services provided by the application layer (service with connection)

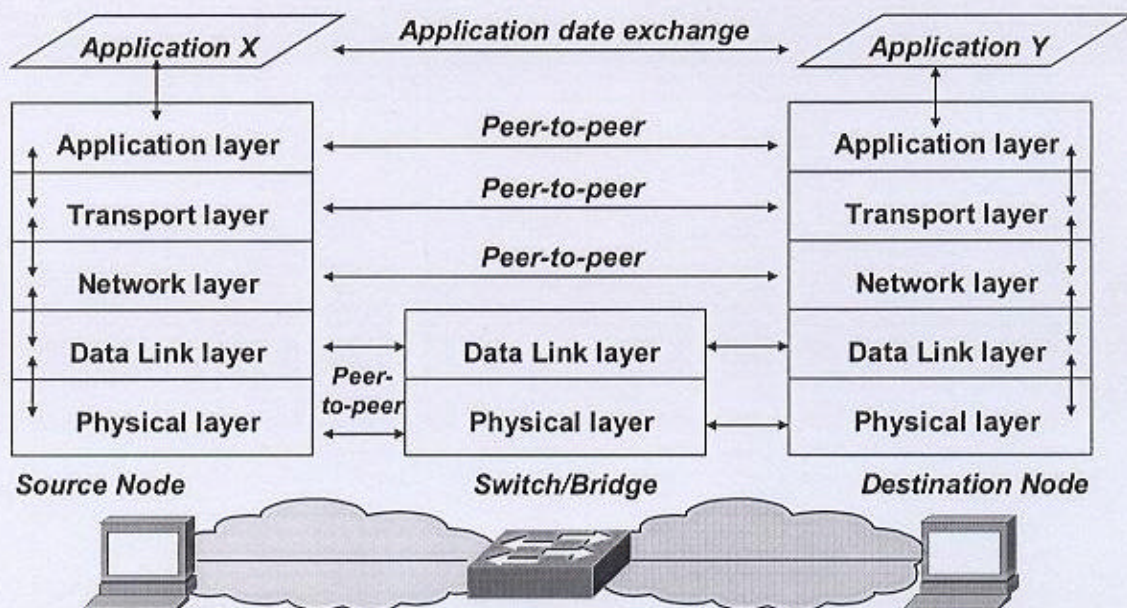
- Authentication and identification of the communication partners
- Determination of the availability of the partners
- Establishment of the authority to communicate
- Agreement on privacy mechanisms
- Determination of cost allocation methodology
- Determination of the necessary resources and quality of service
- Selection of rules for the dialogue
- Synchronization of the partners
- Agreement on the responsibility for recovery
- Agreement on the procedure to monitor data integrity
- Identification of syntax constraints (alphabet, data, structure)
- Data transfer

Data exchange with intermediate router

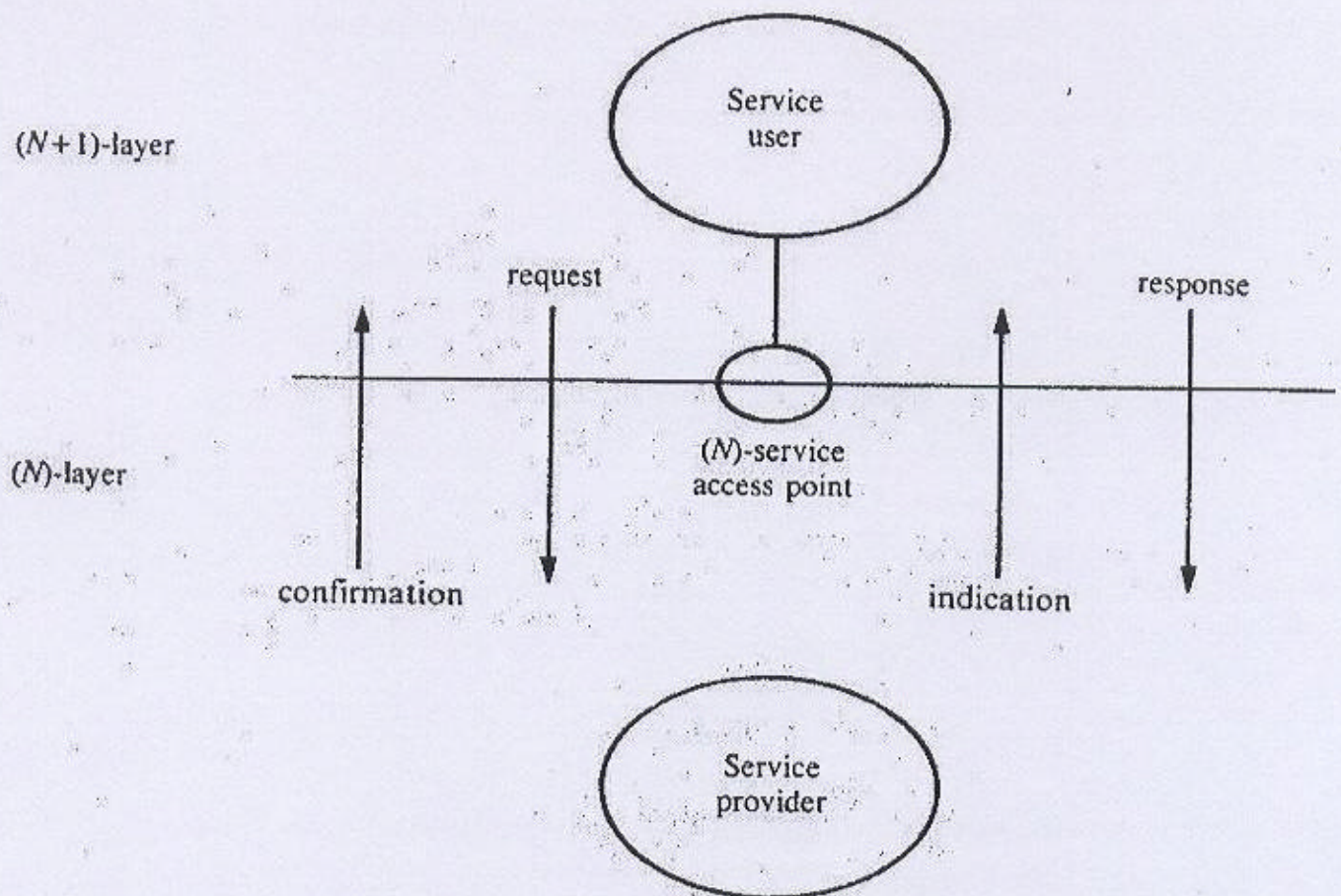


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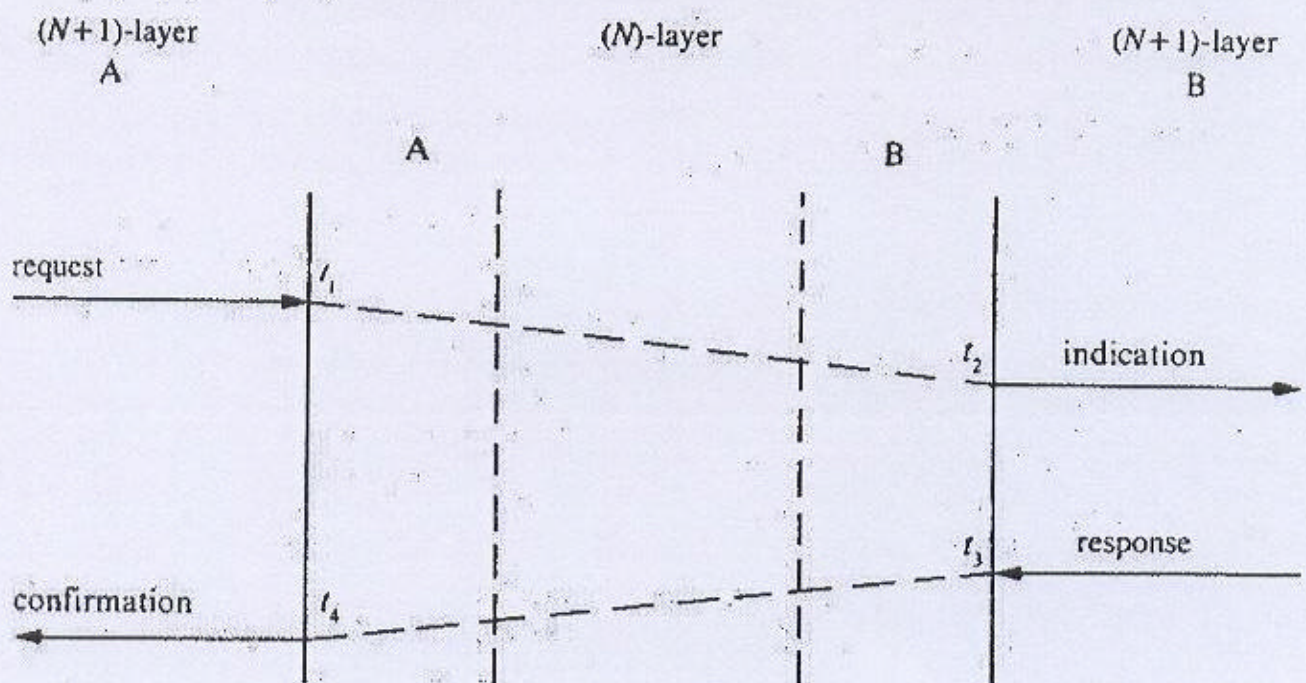
Data exchange with intermediate switch



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Service primitives exchanged at the interface between two layers



Sequence of exchanges of service primitives

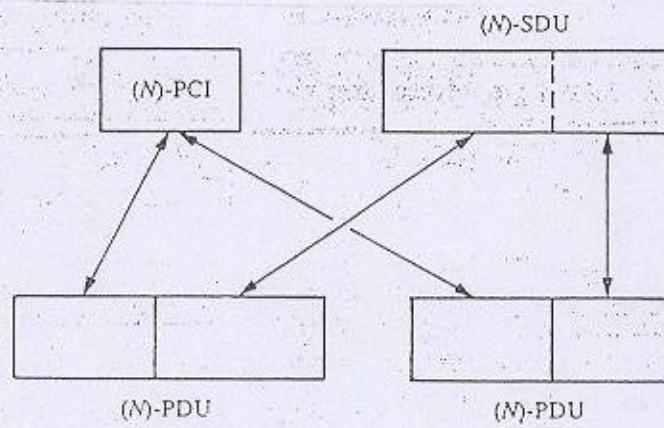
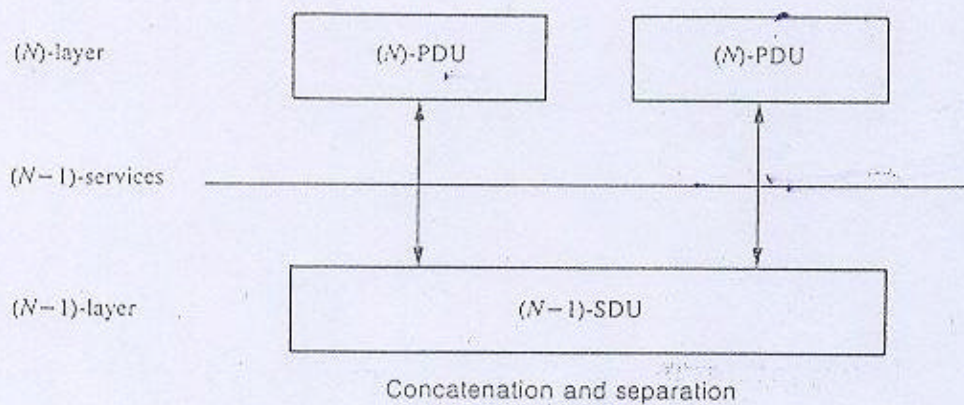
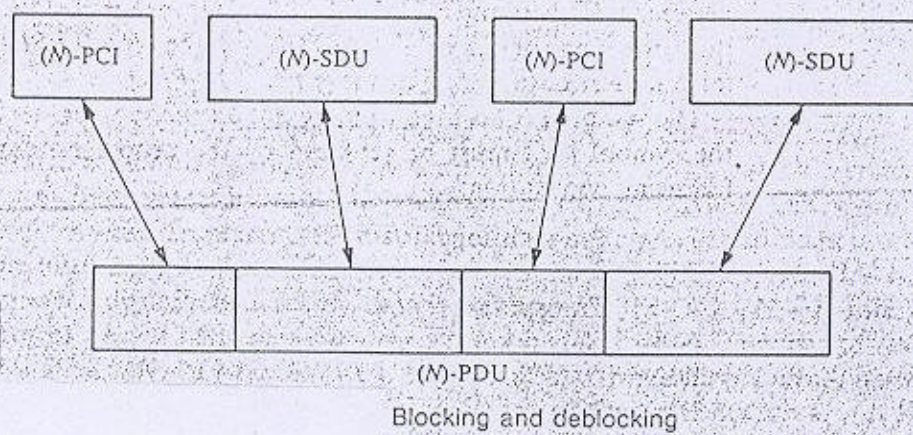


Figure 1.29 Segmentation and reassembly



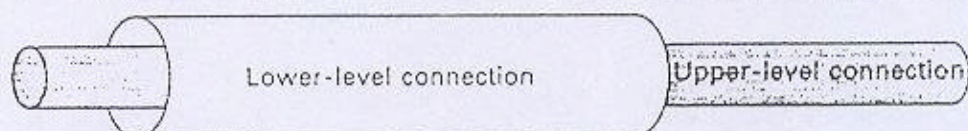
Use of OSI Quality of Service Parameters

	OSI Layer						
	1	2	3	4	5	6	7
Service availability							
Residual error rate	C	C	C	N	N	P	P
Throughput	C	N	N	N	N	P	P
Transit delay	C	C	N	N	N	P	P
Protection	C	N	N	N	N	P	P
Priority		N	N	N	N	P	P
Resilience		C	C	N	C	P	P
Connection-establishment delay			C	N	C	P	P
Connection-release delay			C	N	C	P	P
Connection-establishment-failure probability			C	N	C	P	P
Transfer-failure probability			C	N	C	P	P
Connection-release-failure probability			C	N	C	P	P
Maximum acceptable cost			C				
Extended control					N	P	P
Optimized dialogue transfer					N	P	P

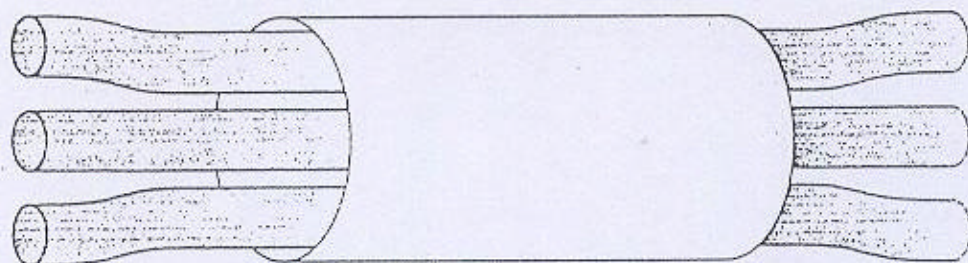
C = configured or selected prior to connection establishment.

N = negotiated on a per-connection basis.

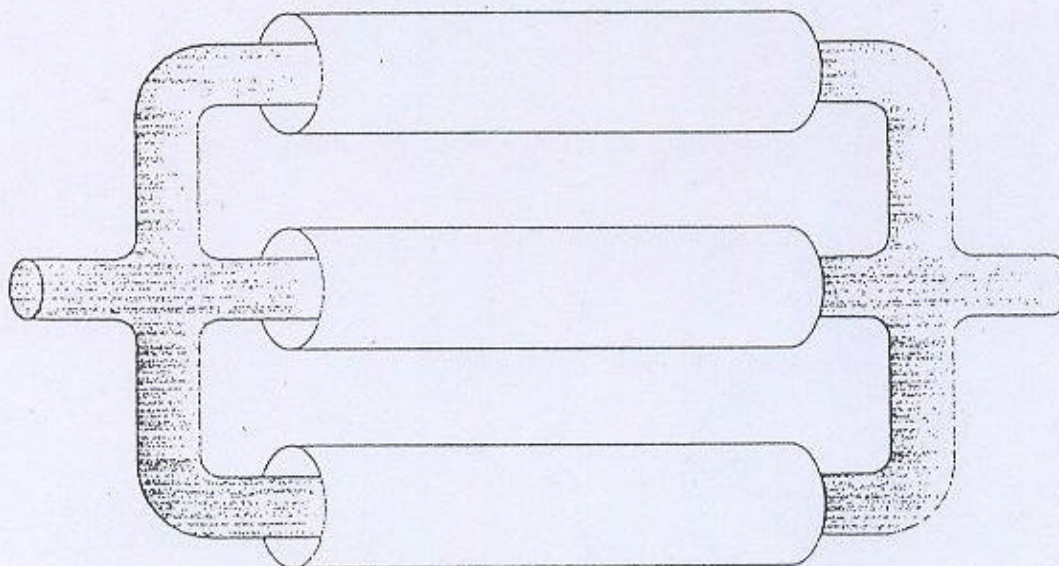
P = parameter passed down to next lower layer.



(a) One to one



(b) Multiplexing (many to one)



(c) Splitting (one to many)