

Protocol Engineering Basics

The slides cover important terminology and protocol engineering principles

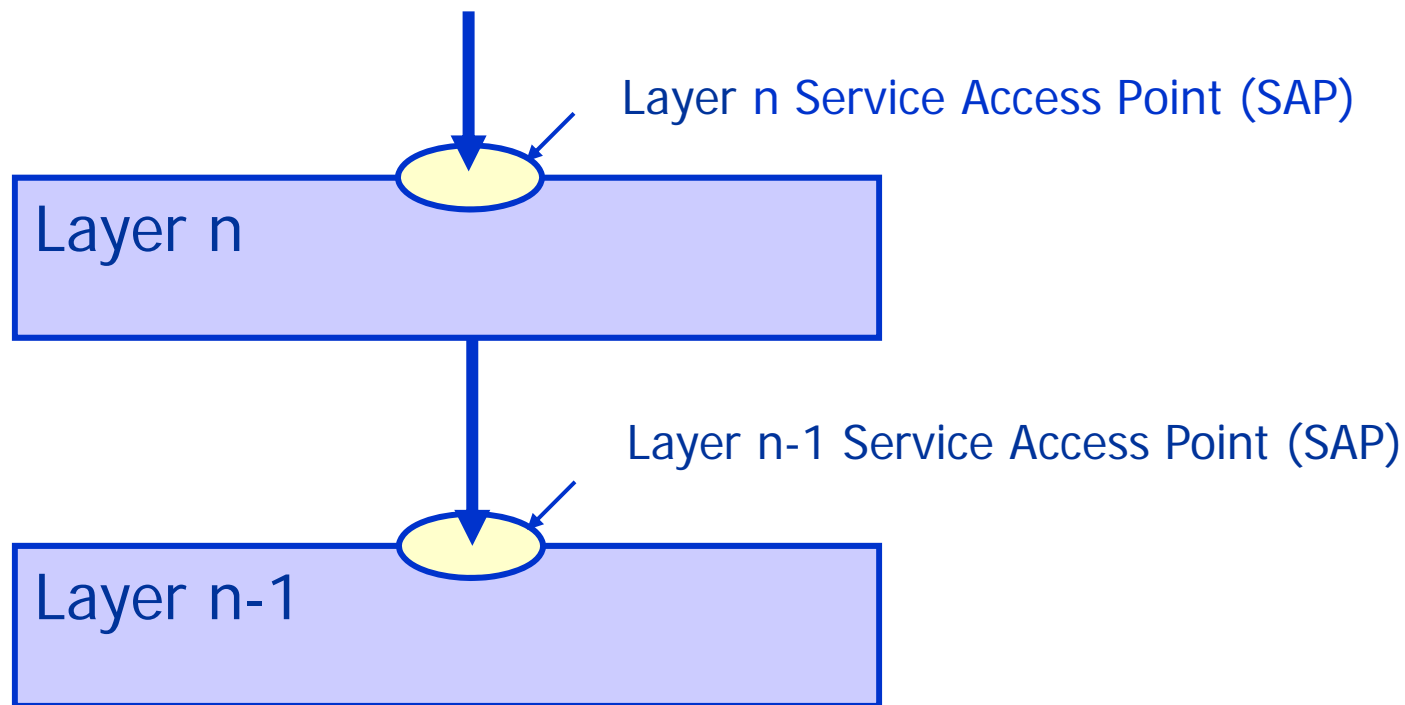
- ◆ Service
- ◆ Function and protocol
- ◆ Service Access Point (SAP)
- ◆ Service Data Unit (SDU)
- ◆ Protocol Data Unit (PDU)
- ◆ Service Primitives
- ◆ Layering Basics, Switching vs. Routing
- ◆ Circuit vs. Packet Switching
- ◆ Connection-oriented vs. Connectionless
- ◆ Control and user plane

Service and Service Access Point

Service(s) are provided at a **Service Access Point (SAP)**

A service is accessed by means of **Service Primitives (SPs)**

Data exchanged at SAPs are called **Service Data Units (SDUs)**

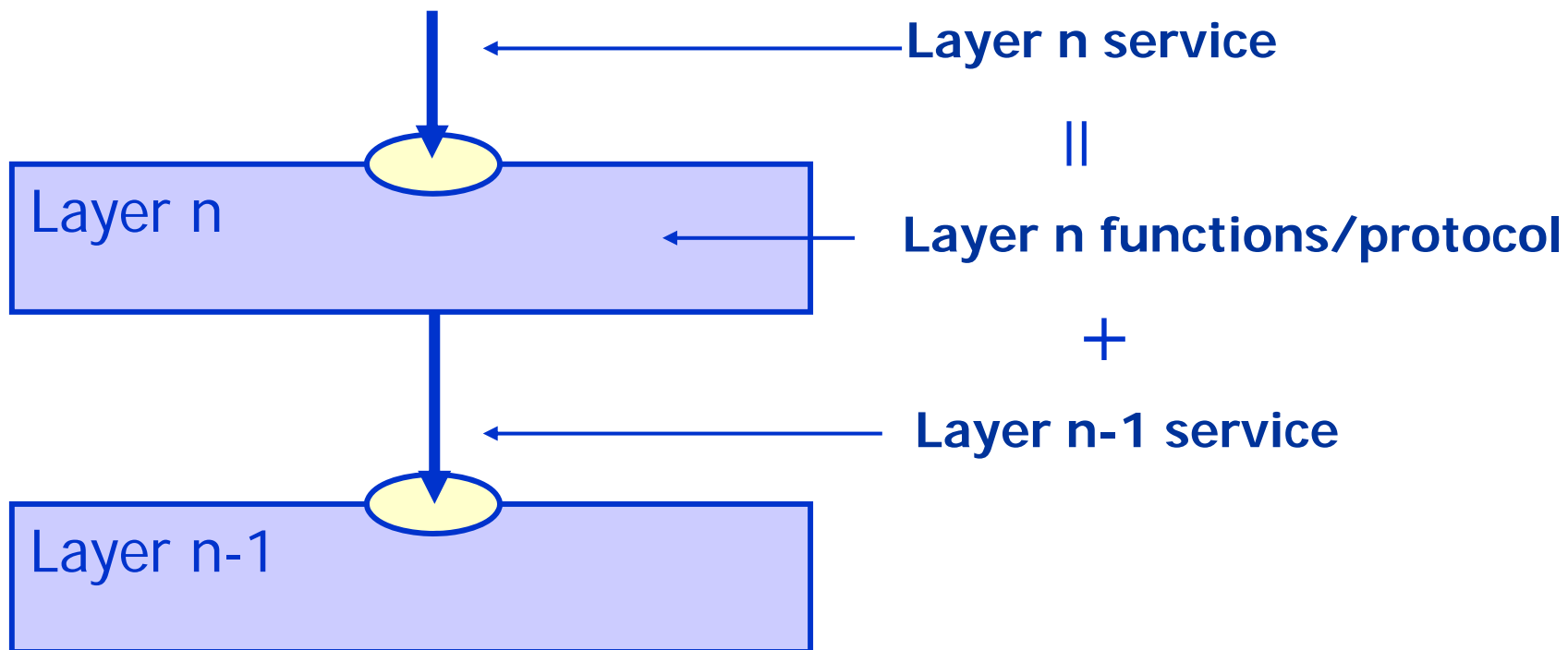


Service and Functions

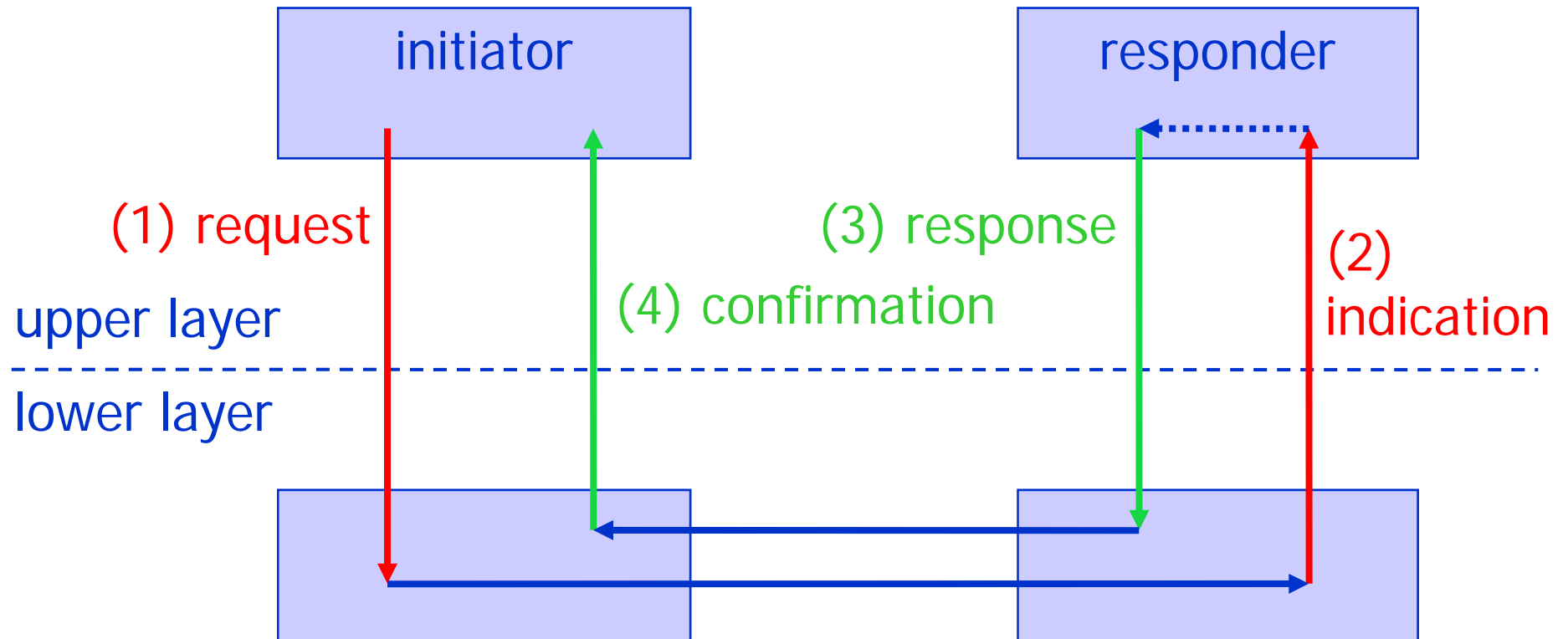
Services are provided to higher layers

A service provided by layer n at its SAP is realised by

- functions provided by the layer n (the n-layer protocol) and
- services provided by the underlying protocol layer (the (n-1)-layer protocol)



Service Primitives

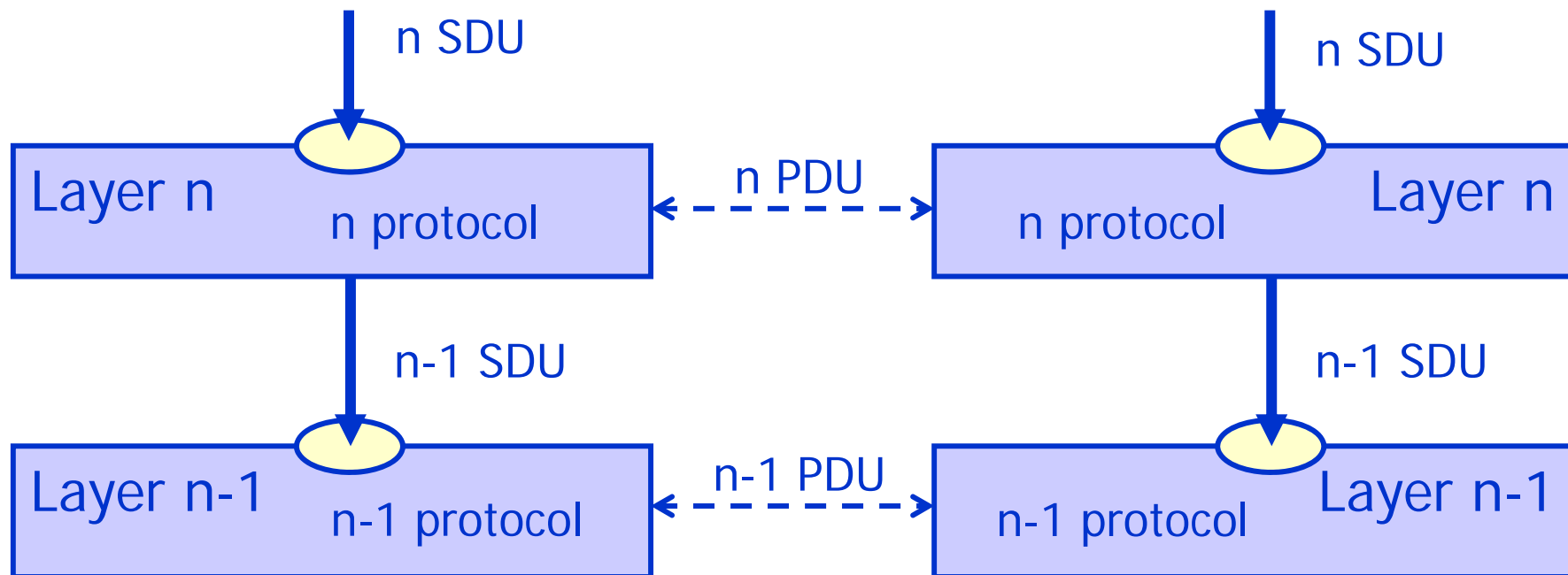


Protocol and Protocol Data Units

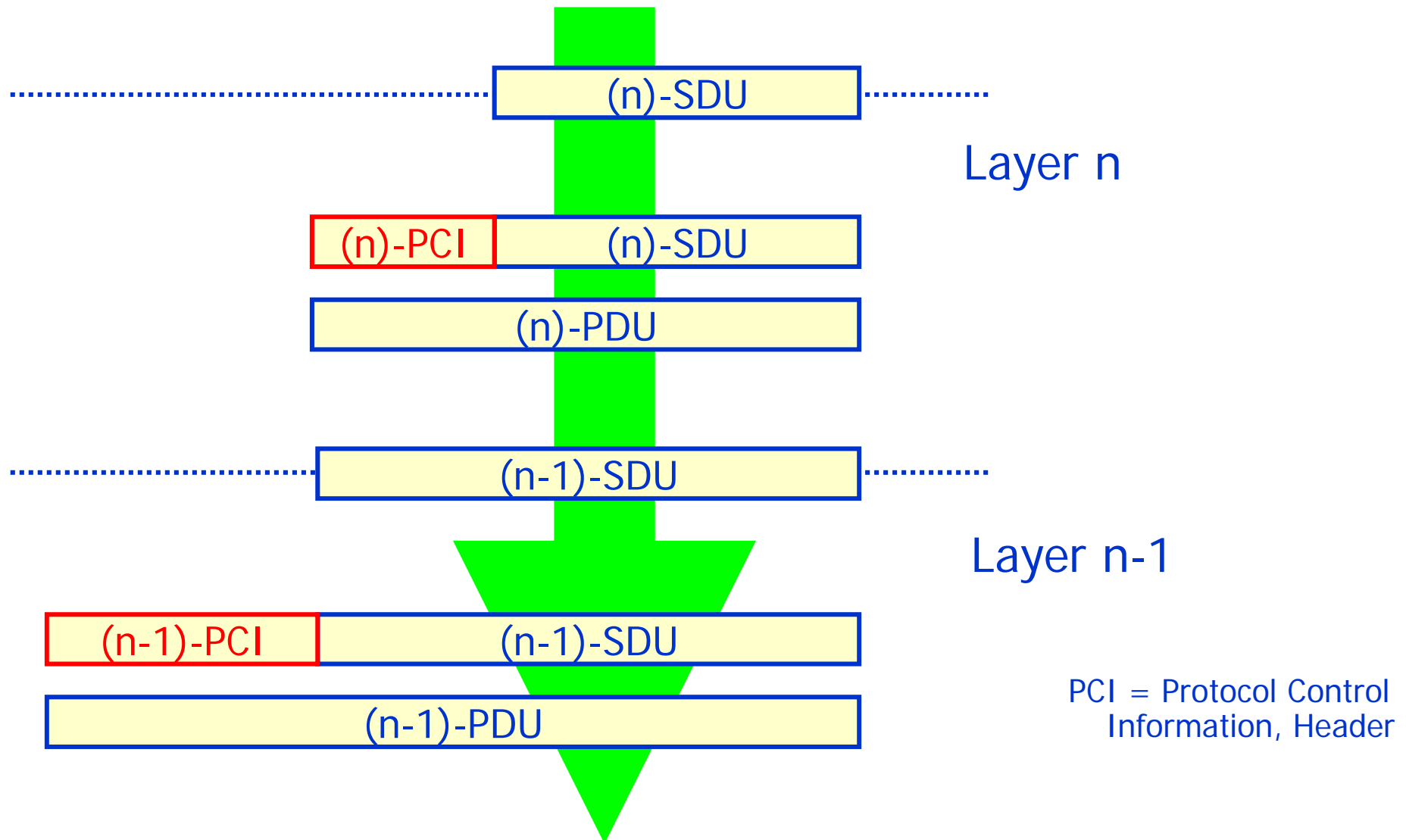
A **protocol** defines a set of procedures between two or more functions within the same layer (defines the rules to exchange messages between the peer entities)

The messages exchanged (virtually) between the protocols are called **Protocol Data Units (PDUs)**

The messages exchanged with the underlying layer are called Service Data Units (SDUs)



Protocol Processing: Enveloping Principle



Layering Basics

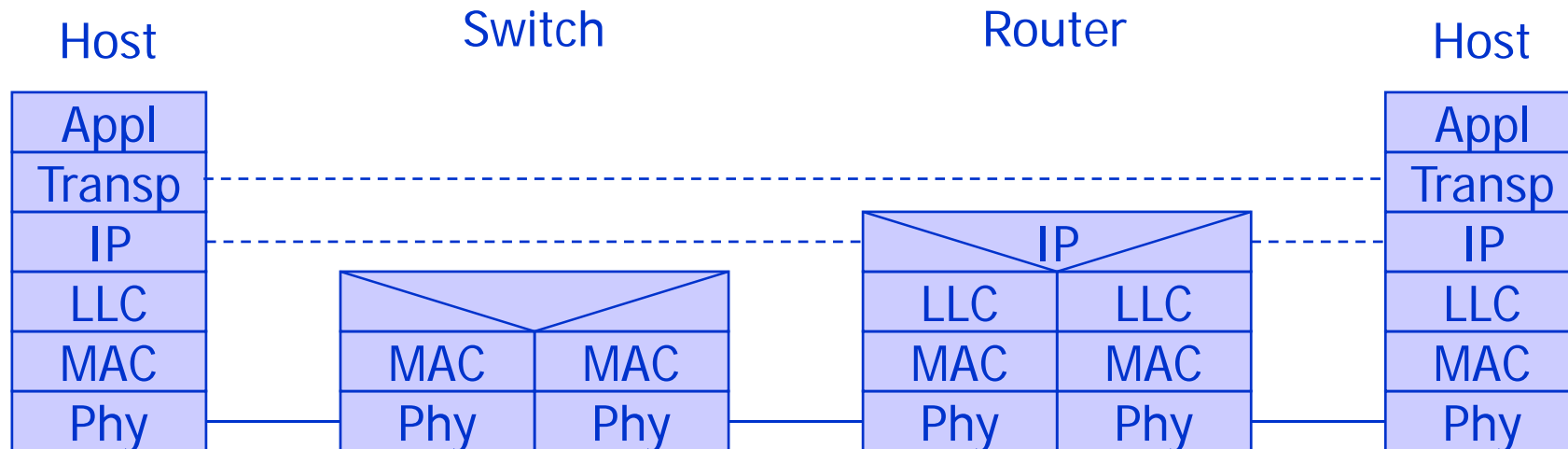
Physical (L1): Management of physical link with its specifics

Data Link (L2): Hop-to-hop transport of data

- ◆ Logical link control: segmentation&reassembly, error detection and correction
- ◆ Medium access control: link address, arbitration of access to medium

Internet (L3): Forwarding beyond a single hop

Transport (L4): End-to-end transport (error detection and correction)

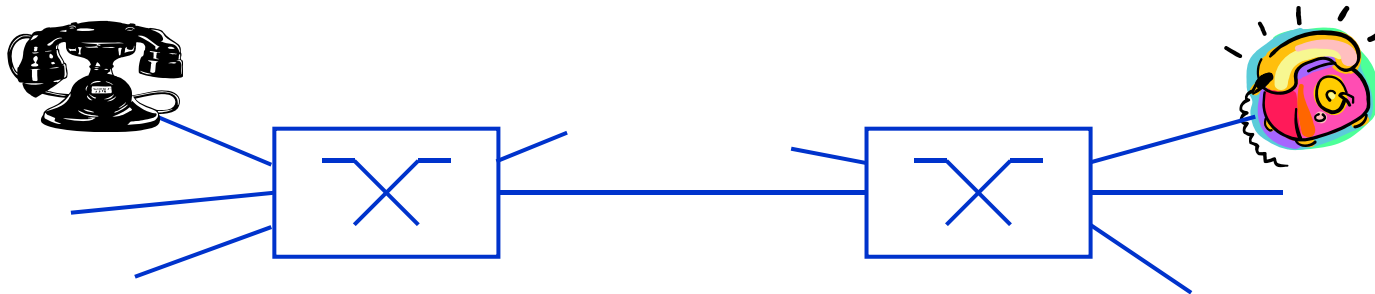


Circuit vs. Packet Switching

Circuit switching:

- > setup a „copper“ path between two phones
- > dedicated resources, no sharing between users
- > small latency (after setup), no queuing
- > constant bandwidth (waste of resources in idle periods)

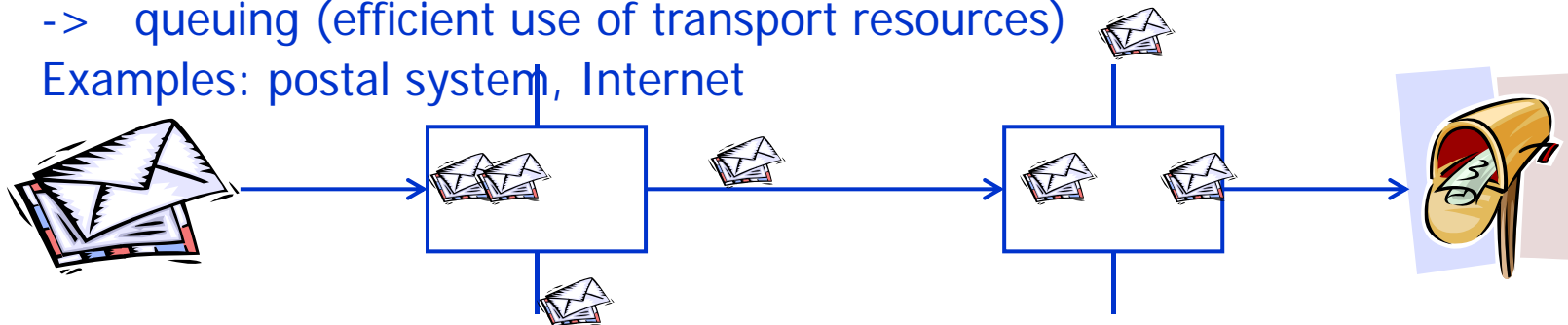
Example: plain old telephone system (POTS)



Packet switching:

- > at each intermediate node (router) the outgoing direction is determined (using the destination address)
- > typically used over „shared“ resources
- > queuing (efficient use of transport resources)

Examples: postal system, Internet



Connection-oriented vs. Connectionless Communication

Connection-oriented: explicit setup before communication

- > fast routing/switching due to use of labels instead of full addresses
- > setup delay before data can be exchanged

Example: plain old telephone system (POTS), TCP



Connectionless: no explicit setup before communication

- > no setup delay
- > no connection-related state information in intermediate nodes
- > overhead for address resolution at each hop

Examples: postal system, Internet IP, UDP



Control and User Planes

In telecommunication systems, protocols are divided into two planes

- ◆ a control plane and
- ◆ a user plane

Control plane protocols:

- ◆ handling and transfer of control information (inband or out-of-band signaling)

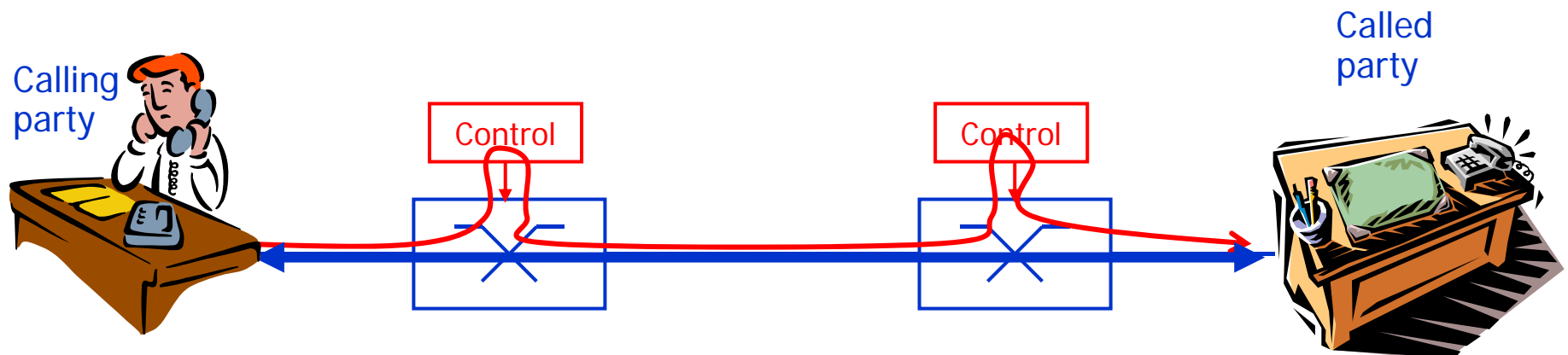
Examples:

- ◆ signaling messages to setup, modify and release connections for user traffic
- ◆ signaling messages to handle mobility, authentication, billing, etc.

User plane protocols:

- ◆ processing and transfer of user data

Examples: speech, video data, file transfer etc.



How to get the 3GPP – Standards: www.3gpp.org

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Warning: Google cannot search compressed Word files such as meeting contributions

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Shaping the future of mobile communication standards

News & info

- 2007-09-04: Mr Edward Hall elected vice chairman of SA4

3GPP – Standards Download Page

Subject of specification series	3G/GSM R99 and later	GSM only (Rel-4 and later)	GSM only (before Rel-4)
General information (<i>long defunct</i>)			00 series
Requirements	21 series	41 series	01 series
Service aspects ("stage 1")	22 series	42 series	02 series
Technical realization ("stage 2")	23 series	43 series	03 series
Signalling protocols ("stage 3") - user equipment to network	24 series	44 series	04 series
Radio aspects	25 series	45 series	05 series
CODECs	26 series	46 series	06 series
Data	27 series	47 series (none exists)	07 series
Signalling protocols ("stage 3") -(RSS-CN)	28 series	48 series	08 series
Signalling protocols ("stage 3") - intra-fixed-network	29 series	49 series	09 series
Programme management	30 series	50 series	10 series
Subscriber Identity Module (SIM / USIM), IC Cards. Test specs.	31 series	51 series	11 series
OAM&P and Charging	32 series	52 series	12 series
Access requirements and test specifications		13 series (1)	13 series (1)
Security aspects	33 series	(2)	(2)
UE and (U)SIM test specifications	34 series	(2)	11 series
Security algorithms (3)	35 series	55 series	(4)
Evolved UTRA aspects	36 series	-	-

Example: GSM 04 series

3GPP Specification series		
Back to numbering scheme page		
Click on spec number for details		
TS 04.01	Mobile Station - Base Station System (MS - BSS) Interface General Aspects and Principles	.
TS 04.02	GSM Public Land Mobile Network (PLMN) Access Reference Configuration	.
TS 04.03	Mobile Station - Base Station System (MS - BSS) Interface Channel Structures and Access Capabilities	.
TS 04.04	Layer 1 - General Requirements	.
TS 04.05	Data Link (DL) Layer General Aspects	.
TS 04.06	Mobile Station - Base Stations System (MS - BSS) Interface Data Link (DL) Layer Specification	.
TS 04.07	Mobile Radio Interface Signalling Layer 3 - General Aspects	.
TS 04.08	Mobile radio interface layer 3 specification	.
TS 04.08dcs	Mobile radio interface layer 3 specification (DCS 1800)	.
TS 04.08ext	Mobile radio interface layer 3 specification, part 1 (Ext)	.
TS 04.10	Mobile Radio Interface Layer 3 - Supplementary Services Specification - General Aspects	.
TS 04.11	Point-to-Point (PP) Short Message Service (SMS) Support on Mobile Radio Interface	.
TS 04.12	Short Message Service Cell Broadcast (SMS-CB) Support on the Mobile Radio Interface	.
TS 04.13	Performance Requirements on Mobile Radio Interface	.
TS 04.14	Individual equipment type requirements and interworking; Special conformance testing functions	.
TS 04.18	Mobile radio interface layer 3 specification; Radio Resource Control (RRC) protocol	.
TS 04.21	Rate Adaption on the Mobile Station - Base Station System (MS-BSS) Interface	.
TS 04.22	Radio Link Protocol (RLP) for data and telematic services on the Mobile Station - Base Station System (MS - BSS) interface and the Base Station System - Mobile-services Switching Centre (BSS - MSC) interface	.
TS 04.30	Location Services (LCS); Supplementary service operations; Stage 3	.
TS 04.31	Location Services (LCS); Mobile Station (MS) - Serving Mobile Location Centre (SMLC) Radio Resource LCS Protocol (RRLP)	.

3GPP Specification detail

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3GPP TS 04.08 (click spec number to see fileserver directory for this spec)

Mobile radio interface layer 3 specification

TSG / WG responsible: [C1](#) (click TSG/WG to see its home page)

Work item which gave rise to this spec: - (click WI code to see Work Item details in the Work Plan)

04.08 will remain as an index. Body txfrd to 24.008. Secondary MCC: Gert Thomsen (even numbered CRs!)CP-27: change of WG as a result of closure of CN and T.

Rapporteur: **SALKINTZIS, Apostolis**

Specification required for: GERAN-based systems

In the table below ...

... click meeting number for meeting details;

... click spec version number to download that version;

... click SDO publication reference to download SDO transposed document.

Release	Freeze meeting	Freeze date	remarks	SDO publications	
Ph1	gsm-25b	1990-01-25	.	ETSI	
	event	version	available	remarks	click ref to download
	ETSI publication	3.13.0	1995-01-01		DGTS/SMG-030408
	ETSI publication	3.14.0	1997-09-15		-
Ph2	smg-11b	1994-09-13	.	ETSI	

Download latest version from bottom of the table

3GPP Specs & Version numbering scheme

- ◆ All 3G and GSM specifications have a 3GPP specification number consisting of 4 or 5 digits. (e.g. TS 09.02 or TS 29.002)
- ◆ The term "3G" means a 3GPP system using a UTRAN radio access network; the term "GSM" means a 3GPP system using a GERAN radio access network. (Thus "GSM" includes GPRS and EDGE features.)
- ◆ TS = Technical Specification (to become a „standard“)
TR = Technical Report (non mandatory study results, explanations, etc.)
- ◆ The first two digits define the series as listed in the table (previous slides)
- ◆ They are followed by 2 further digits for the 01 to 13 series (mainly GSM) or 3 further digits for the 21 to 55 series (mainly 3G)
- ◆ A specification in the 21 to 35 series may apply either to 3G only or to GSM and 3G. A clue lies in the third digit, where a "0" indicates that it applies to both systems. For example, 29.002 applies to 3G and GSM systems whereas 25.101 and 25.201 apply only to 3G.
- ◆ The full title, specification number and latest version number for every specification can be found in the current status list [warning: large file!]
- ◆ Version numbers:
e.g. V7.9.1 = 3GPP-Release-"Package" 7 , TS-related version 9, subversion 1