HIPERLAN

- HIGHPERLAN- HIGH PERFORMANCE LOCAL AREA NETWORK.

- It is a European alternative – IEEE 802.11.

- Defined by European telecommunications standards Institute (ETSI)

EUROPEAN COUNTRIES

HIPERLAN REQUIREMENTS

- Short range-50m.

- Low mobility-1.4m/s.

- Networks with and without infrastructure.

- Data 10Mbps immediate access.

HIPERLAN TYPES:

- HIPERLAN 1

- HIPERLAN 2

- HIPERLAN 3

- HIPERLAN 4

HIPERLAN 1

- HIPERLAN 1 is a wireless LAN.
- It Supports:-
- ➤ Priorities of Packet.
- ➤ Forwarding mechanism.
- ➤ Topology discovery.
- ➤ Encryption.
- ➤ Network Identification.
- ➤ Power conservation mechanism.

HIPERLAN 1- PHASE

- EY-NPMA USED FOR CHANNEL ACCESS DURING THE CONTENTION PERIOD.

- Elimination-yield non-preemptive priority multiple access(EY-NPMA) is the heart of the **channel access** providing priorities and different access schemes.

➢ Prioritization

➢ Contention.

➢ Transmission.

PRIORITIZATION PHASE

➢ Determine the highest priority of a data packet ready to be sent by competing nodes.

➢ The main objective of this phase is to make sure that no node with a lower priority gains access to the medium while packets with higher priority are waiting at other nodes.

CONTENTION PHASE

- Elimination phase.

- Yield phase.

- Elimination burst.

- Elimination survival verification.

- Yield listening.

TRANSMISSION PHASE

- The winner of prioritization and contention phase can now send its data.

- If the channel was idle for a longer time , then a bit terminal can send at once without using EY-NPMA.

QUALITY OF SERVICES SUPPORT.

- PACKET FORWARDING.

- ENCRYPTION MECHANISM.

- POWER CONSERVATION MECHANISM.

WATM- WIRELESS ASYNCHRONOUS TRANSFER MODE

- WATM- also known as WMATM.

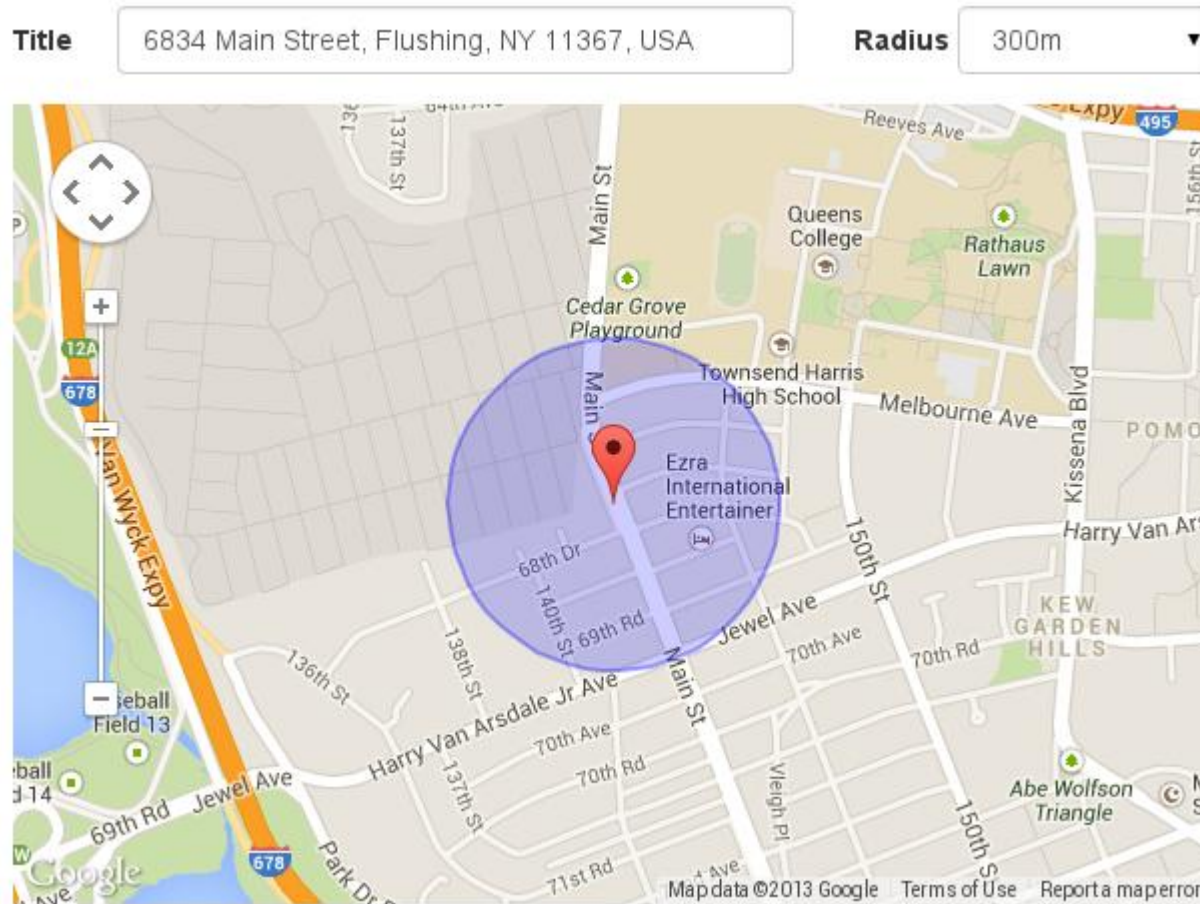- High performance network supporting different types traffic streams.

WATM-SUB GROUPS

➢ Mobile ATM protocol Extensions.

➢ Radio Access Layer(RAL) PROTOCOLS.

MOBILE ATM PROTOCOL EXTENSIONS-FUNCTION

- LOCATION MANAGEMENT.

- MOBILE ROUTING.

- HANDOVER SIGNALING.

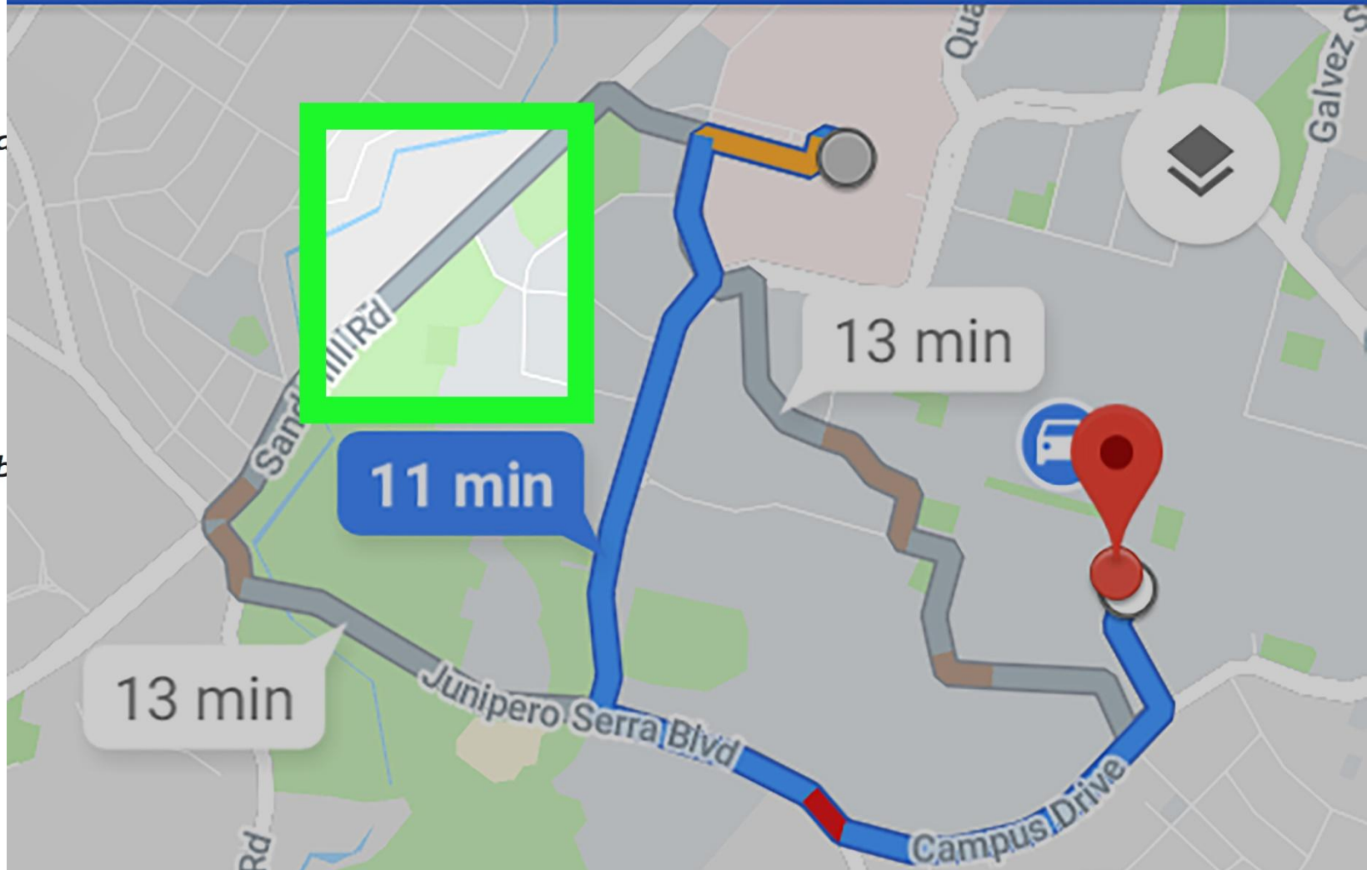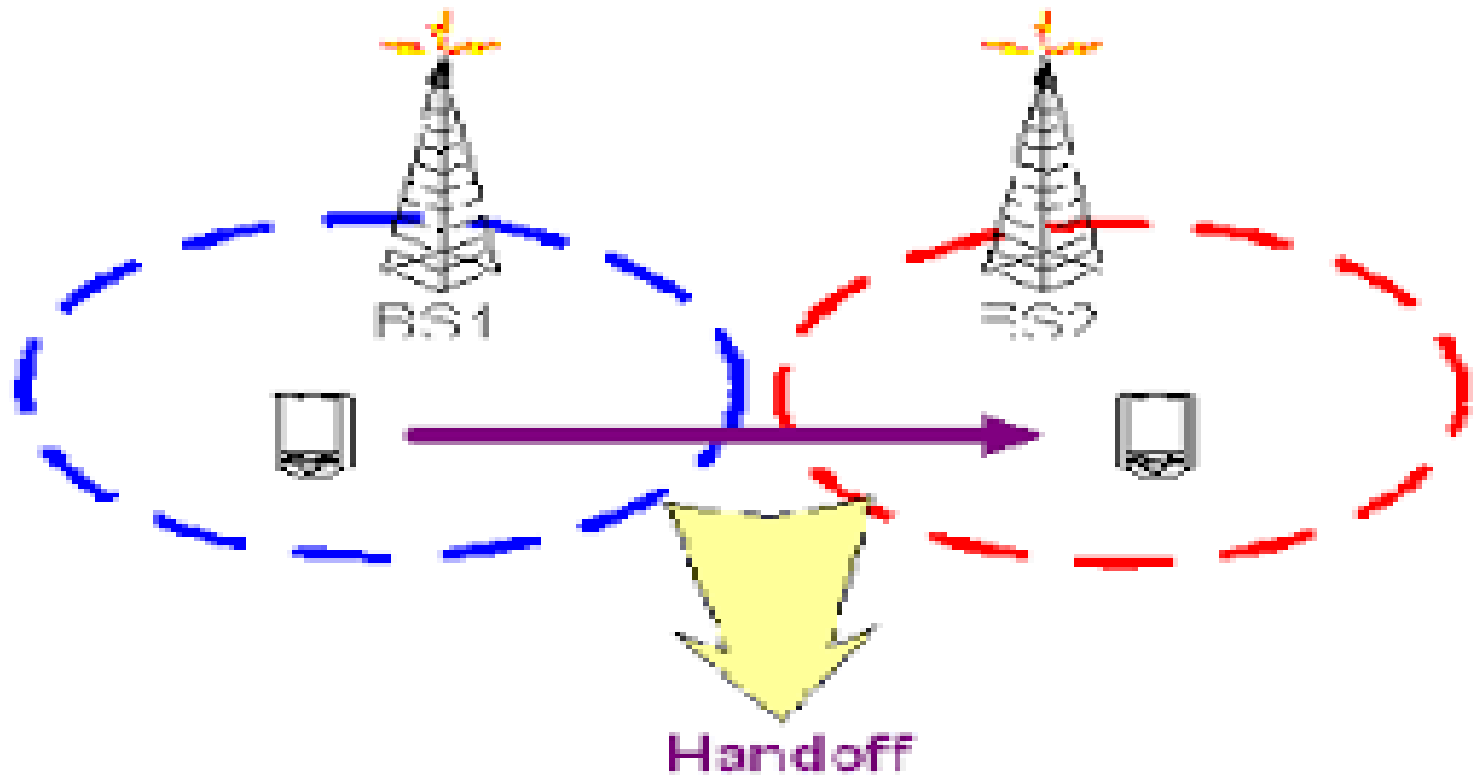- QoS and Traffic control.

- Network Management.

LOCATION MANAGEMENT

HANDOVER SIGNALING

Radio Access Layer(RAL)

- RADIO RESOURCE CONTROL

- WIRELESS MEDIA ACCESS.

- WIRELESS DATA LINK CONTROL.

- HANDOVER ISSUES

WATM-SERVICES

- OFFICE ENVIRONMENT.
- UNIVERSITIES, SCHOOLS, TRAINING CENTERS.
- INDUSTRY
- HOSPITALS.
- HOME.
- NETWORKED VEHICLES.

# HANDOVER

HANDOVER

REQUIRMENTS FOR HANDOVER

- HANDOVER OF MULTIPLE CONNECTION
- HANDOVER OF POINT-TO-MULTIPOINT CONNECTION
- QoS SUPPORT.
- DATA INTEGRITY & SECURITY.
- SIGNALLING & ROUTING SUPPORT.
- PERFORMANCE & COMPLEXITY.

LOCATION MANGEMENT: REQUIRMENTS:

- TRANSPARANCY OF MOBILITY.

- SECURITY

- EFFECIENCY AND SCALABILITY.

- IDENTIFICATION.

- INTERWORKING AND STANDARDS.

GENERIC REFERENCE MODEL.
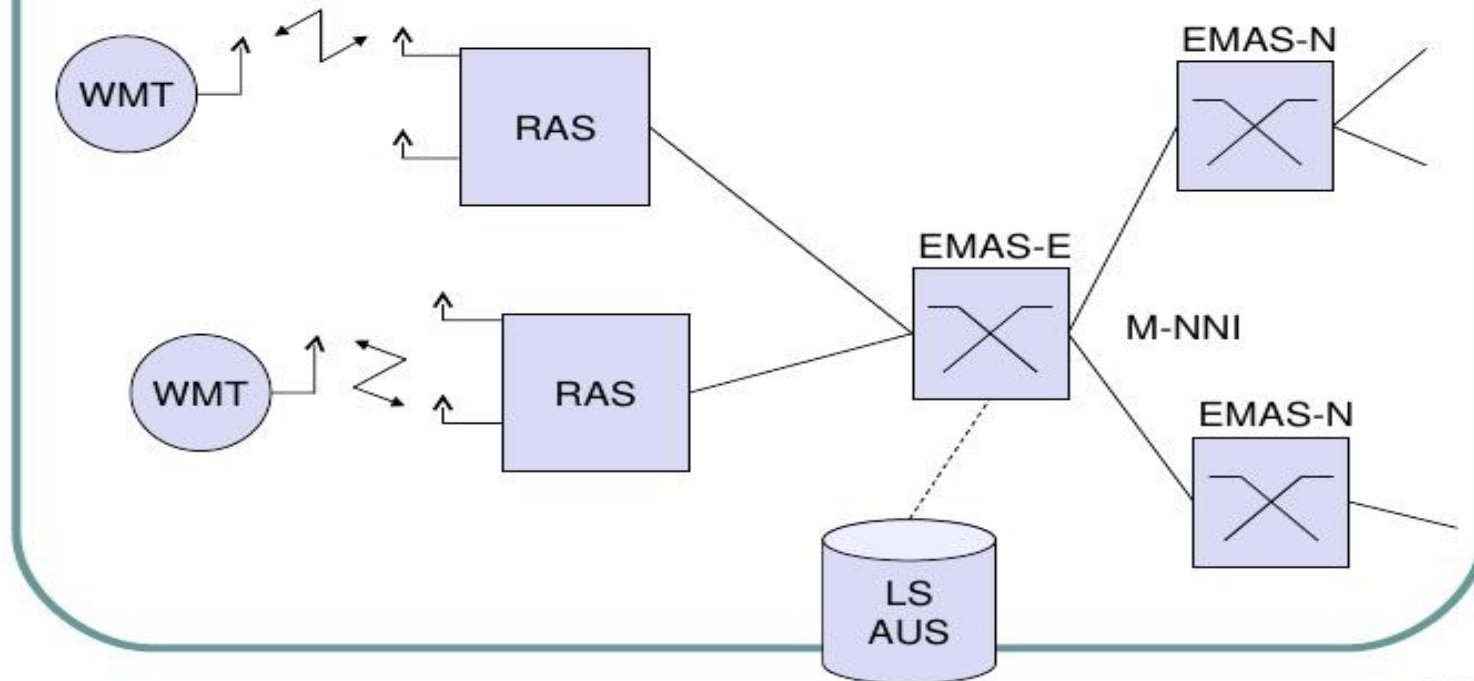
COMPONENTS.

- MOBILE TERMINAL.—MOVABLE

- WIRELESS TERMINAL– GIVES THE WIRELESS LINK.

- RAS- RADIO ACCESS SYSTEM.

- SWITCHES:

-    EMAC- END USER MOBILITY SUPPORTING ATM SWITCH.

    NMAC- NETWOK MOBILITY SUPPORTING ATM SWITCH.

BRAN-BROADBAND RADIO ACCESS NETWORK

- Standardized by European telecommunications standards Institute (ETSI)
- Main motivation – Privatization of the telecommunication sector in Europe.
- Radio is used to provide network access for customers.

BENEFITS

- Radio is used to provide network access for customers.

- Radio access advantage-High flexibility Quick installation.

- Application:

    Private customers,

    Small companies with internet application.

    Multimedia conferencing &

    Virtual private Network.

APPLICATION

TYPES

- HiperLAN 1

- HiperLAN 2

- HIPERACCESS.

- HIPERLINK.

BRAN LAYERED MODEL
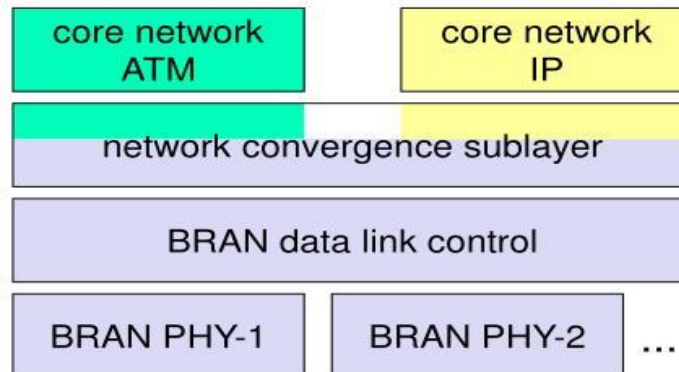
BRAN and legacy networks

Independence
- ❑ BRAN as access network independent from the fixed network
- ❑ interworking of TCP/IP and ATM under study

Layered model
- ❑ Network Convergence Sub-layer as superset of all requirements for IP and ATM

core network ATM	core network IP
network convergence sublayer	
BRAN data link control	

| BRAN PHY-1 | BRAN PHY-2 | ... |

Coordination
- ❑ IETF (TCP/IP)
- ❑ ATM forum (ATM)
- ❑ ETSI (UMTS)
- ❑ CEPT, ITU-R, ... (radio frequencies)

HIPERLAN 2

- It can work at 5GHz.

- Data rates of up to 54Mbit/s.

- Qos.

- Security features.

HIPERLAN 2 FEATURES

- High Throughput Transmission.
- Connection-Oriented.
- Quality of service support.
- Dynamic Frequency selection.
- Security support.
- Mobility Support.
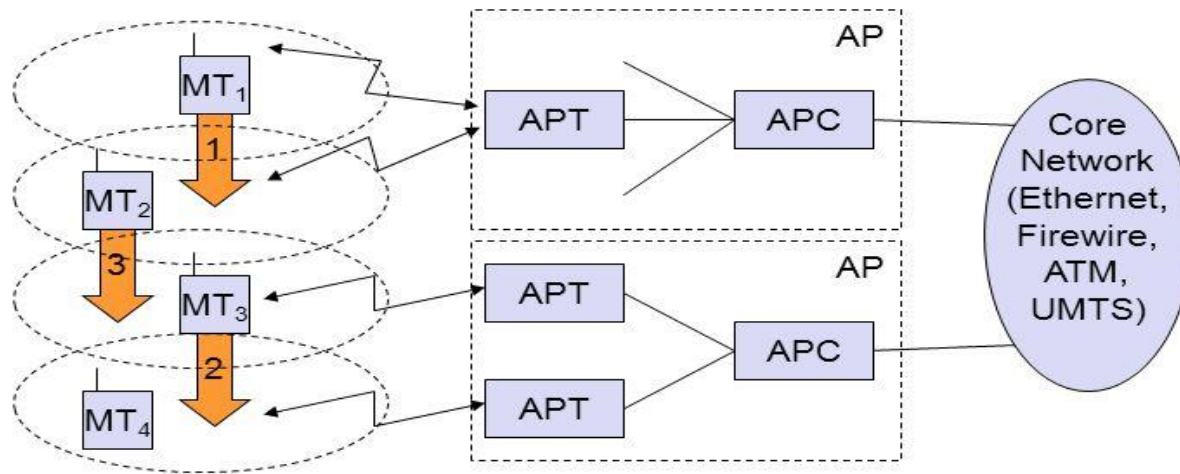- Application and Network Independence.
- Power Save.

HIPERLAN 2 ARCHITECTUE

- AP-ACCESS POINT.

- APC- ACCESS POINT CONTROLLER.

- APT- ACCESS POINT TRANSCEIVERS.

ARCHITECTURE

HiperLAN2 architecture and handover scenarios

HIPERLAN-2 -HANDOVER

- Sector Handover.(Inter Sector)

- Radio Handover(Inter-APT)

- Network Handover

SECTOR ANTENNA
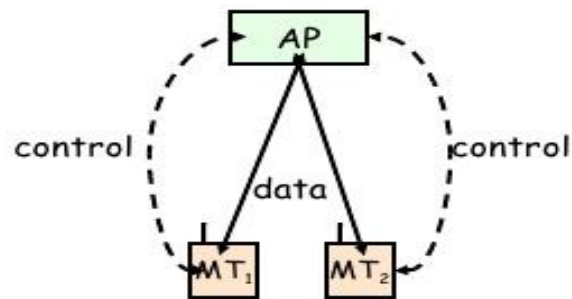
HANDOVER- OPERATING MODES.

- 1.Centralized Mode(CM)

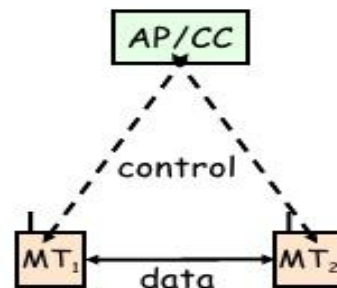- 2. DIRECT MODE.
    Data's is directly exchanged between MT's.

HANDOVER- OPERATING MODES

[ET2405 - WLAN]   Doru Constantinescu
ET2437 - Network Security
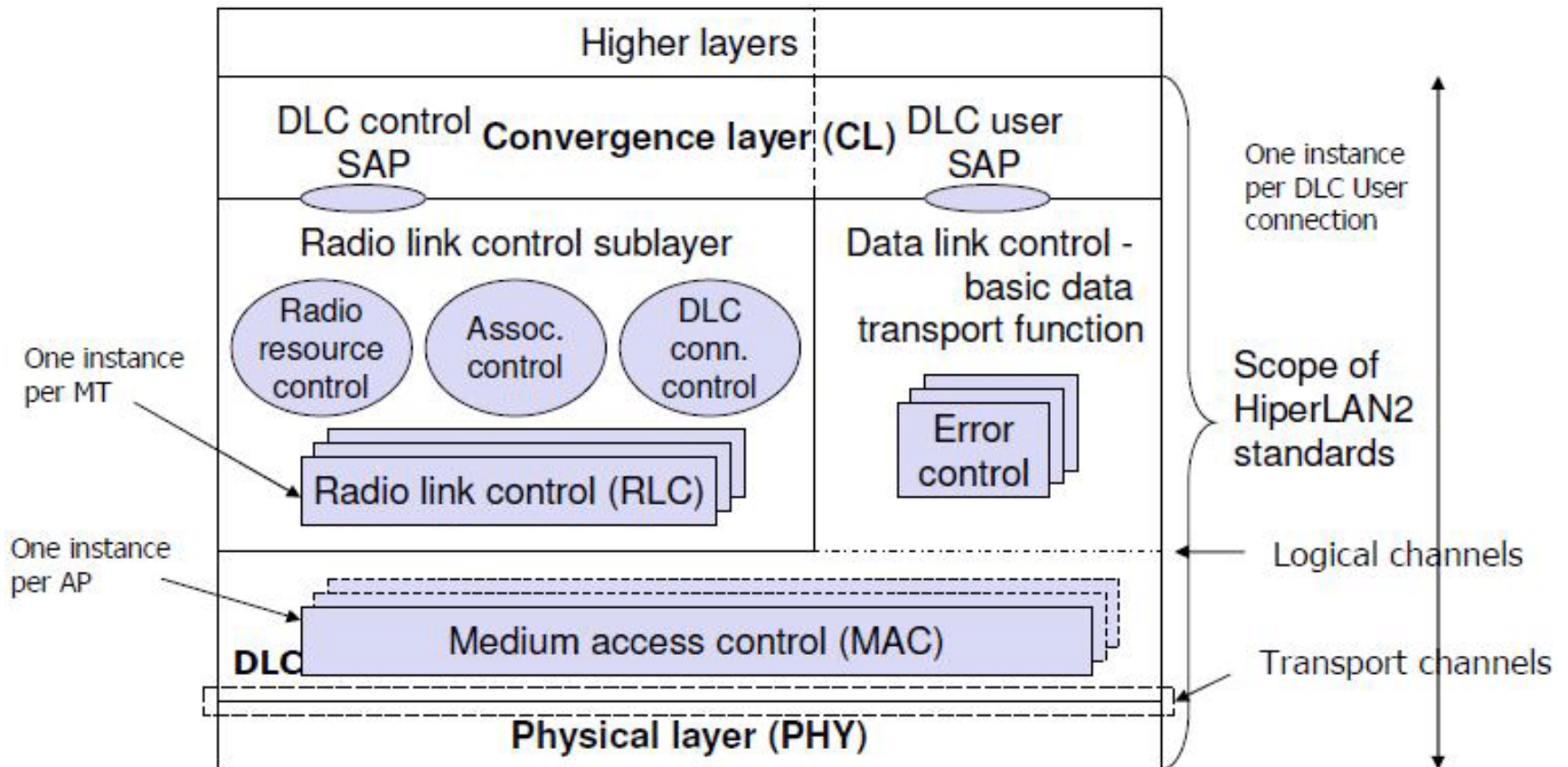
46

HIPERLAN 2 PROTOCOL STACK

HIPERLAN 2 –PROTOCOL STACK

- Physical layer

- Data link control(DLC) layer.

- Convergence layer.

PHYSICAL LAYER

- MODULATION
- FORWARD ERROR CORRECTION
- SIGNAL DETECTION
- SYNCHRONIZATION.
- OFDM IS USED.
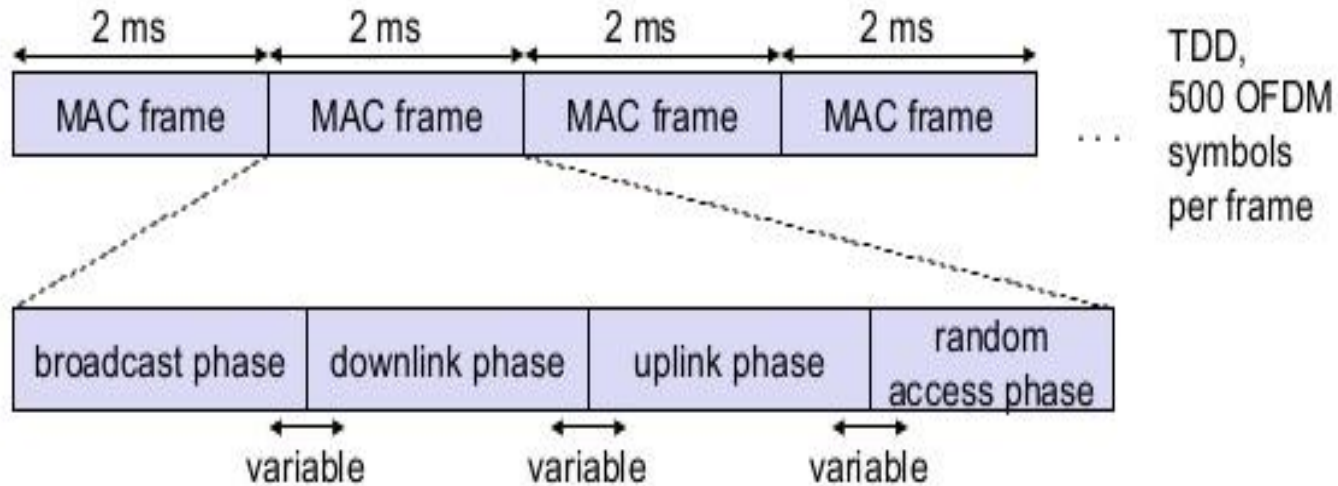- OFDM- Orthogonal Frequency Division Multiplexing.

DATA LINK CONTROL LAYER

- MEDIUM ACCESS CONTROL LAYER.(MAC) (6)
- LOGICAL LINK CONTROL(LLC) LAYER.(10)
- RADIO LINK CONTROL(RLC) LAYER.(3)

MAC FRAME

Basic structure of HiperLAN2 MAC frames

TRANSPORT CHANNELS(6)

- Broadcast channels.(BCH)
- FRAME CHANNEL.(FCH)
- ACCESS FEEDBACK CHANNEL(ACH)
- LONG TRANSPORT CHANNEL(LCH)
- SHORT TRANSPORT CHANNEL.(SCH)
- RANDOM CHANNEL(RCH).

LOGICAL CHANNELS IN LLC LAYER(10)

- BROADCAST CONTROL CHANNEL. (BCCH)
- FRAME CONTROL CHANNEL.(FCCH)
- RANDOM ACCESS FEEDBACK CHANNEL.(RFCH)
- RLC BROADCAST CHANNEL(RBCH)
- DEDICATED CONTROL CHANNEL(DCCH)
- USER BROADCAST CHANNEL.(UBCH)
- USER MULTI-CAST CHANNEL(UMCH)
- USER DATA CHANNEL(UDCH)
- LINK CONTROL CHANNEL(LCCH)
- ASSOCIATION CONTROL CHANNEL(ASCH)

RADIO LINK CONTROL LAYER

- ASSOCIATIONCONTROL FUNCTION(ACF)

- RADIO RESOURCE CONTROL(RRC)
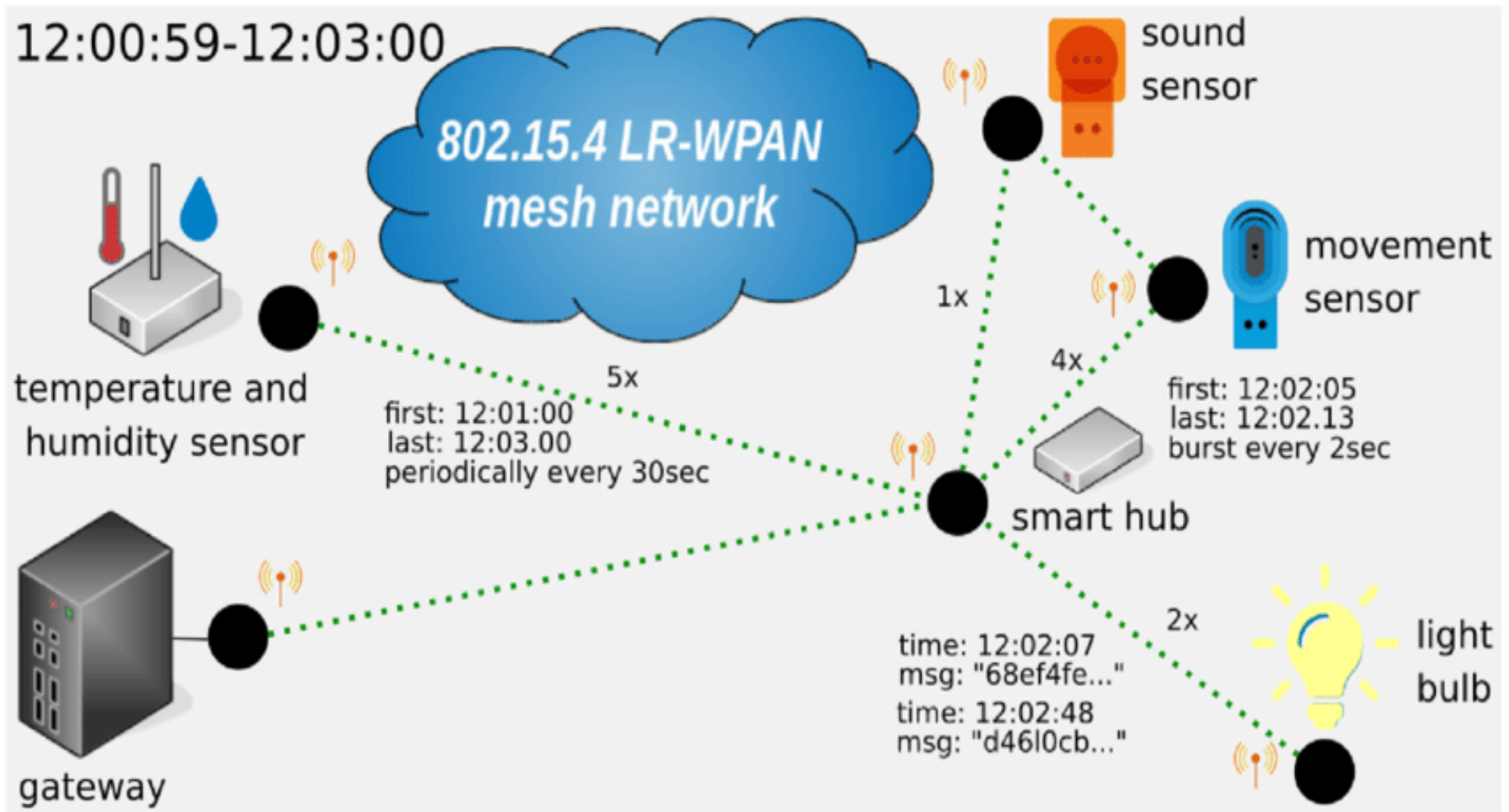
- DLC USER CONNECTION CONTROL

CONVERGENCE LAYER

- SEGMENTATION & REASSEMBLY.
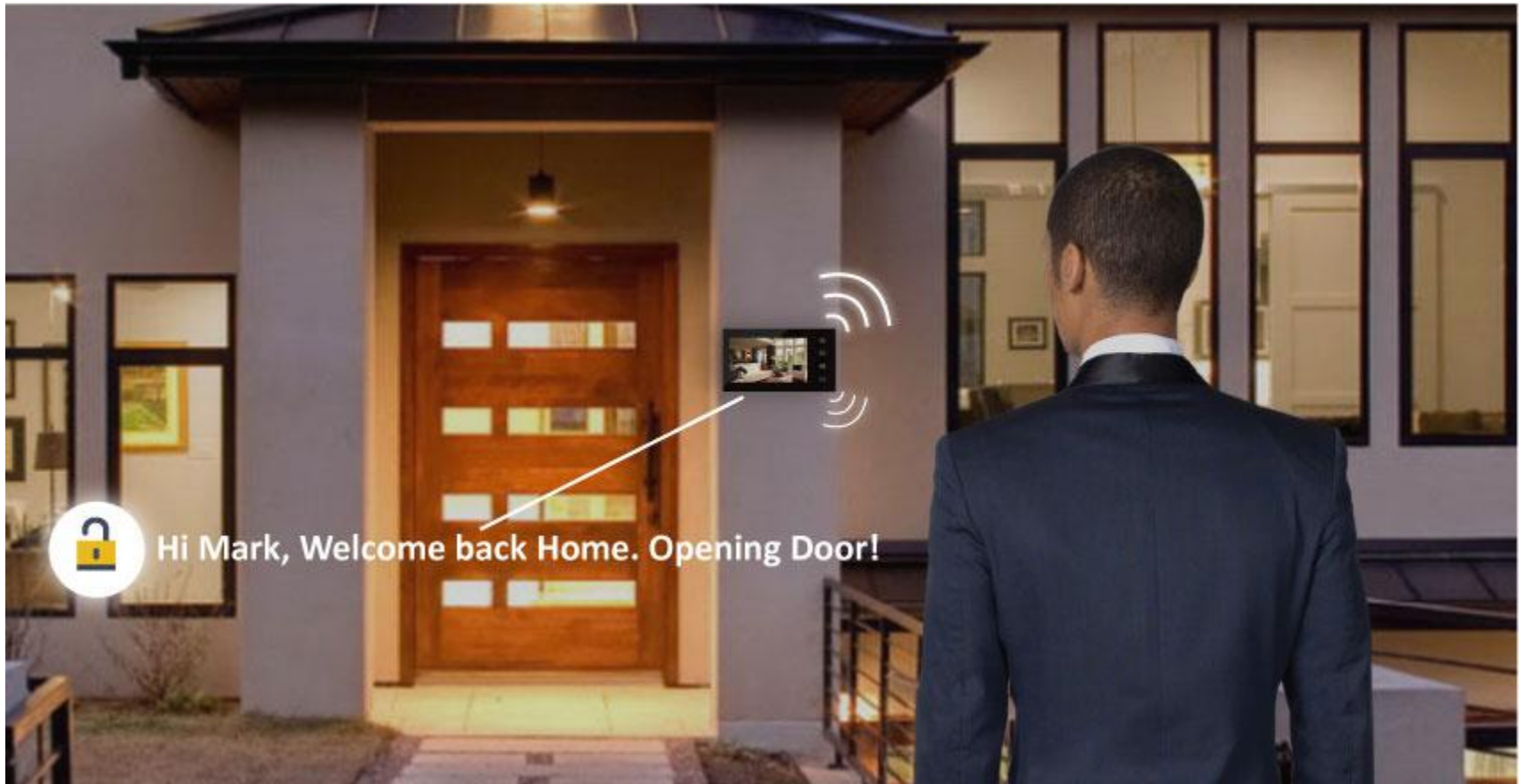
WPAN-WIRELESS PERSONAL AREA NETWORK

WPAN-HOME ACCESS & HOME DISTRIBUTION

HOME APPLIANCE CONNECTS THEM INTERNET THROUGH A HOME GATEWAY.
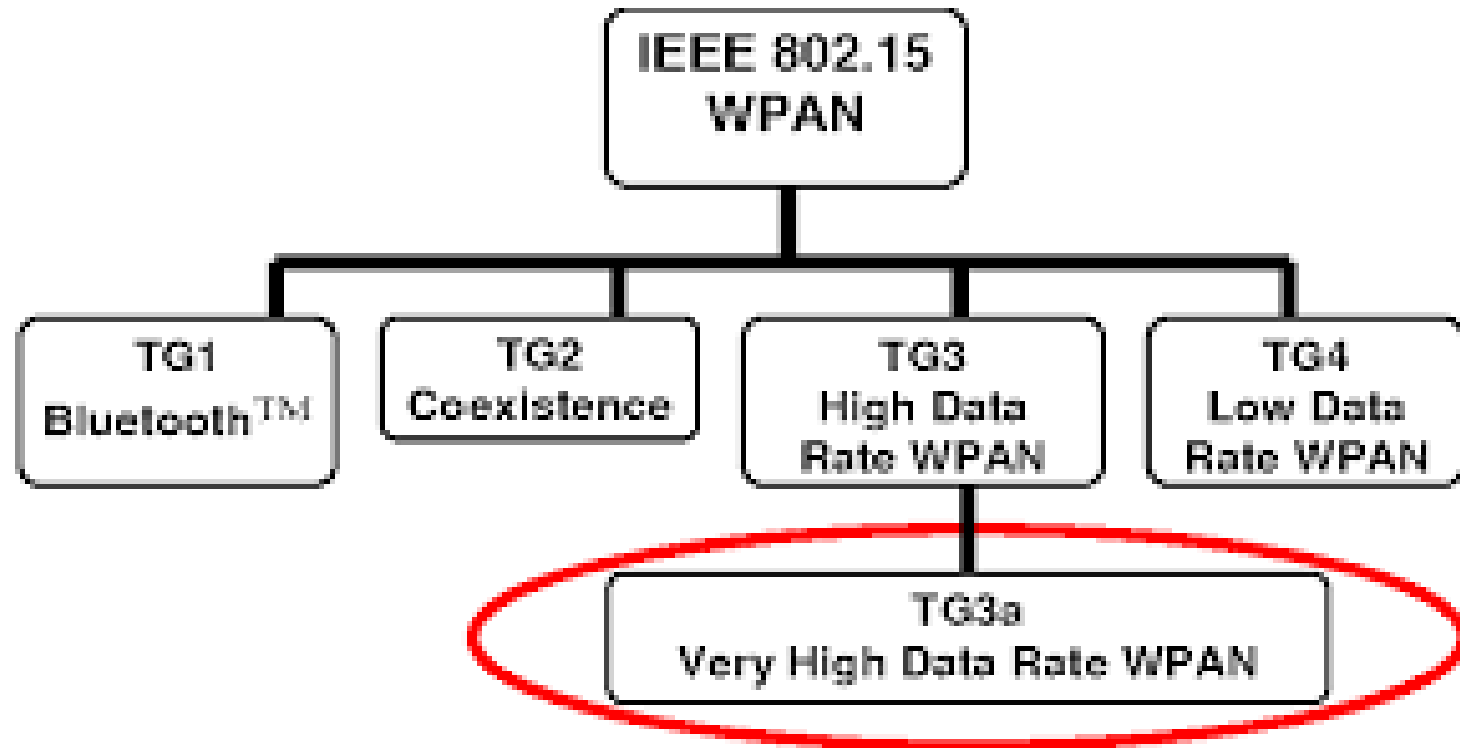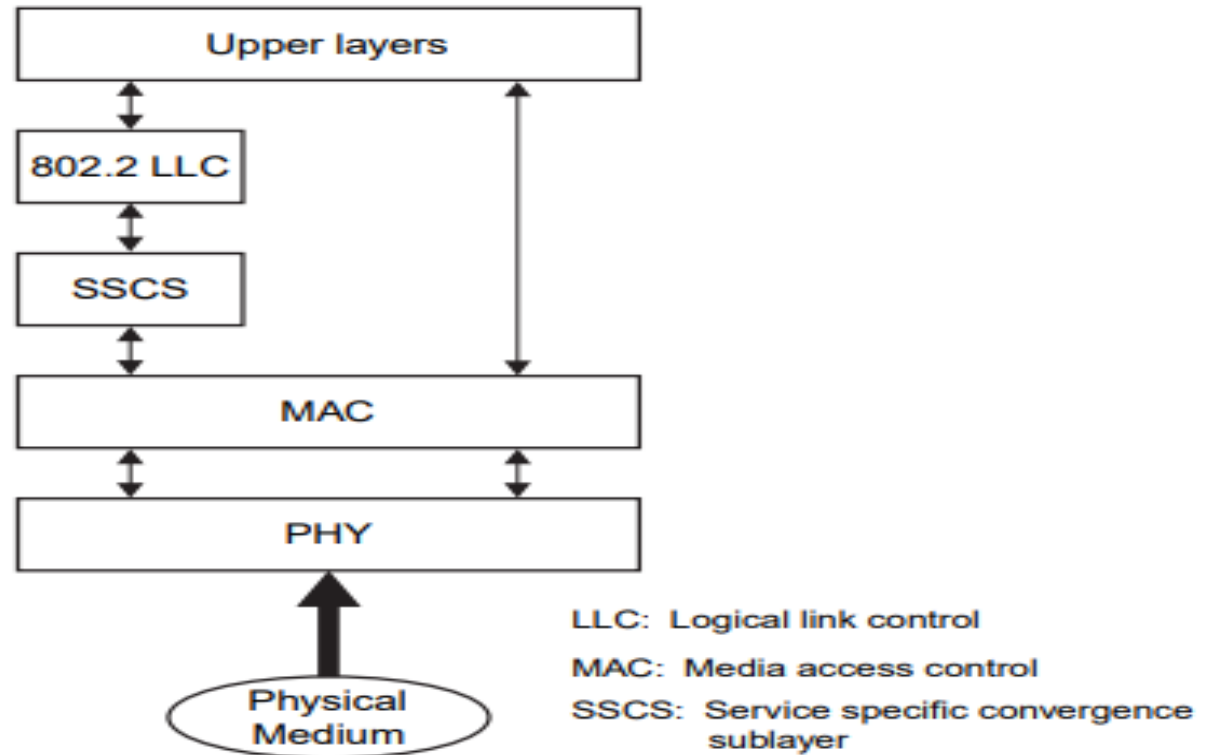
IEEE 802.15.4 TASK GROUPS

Figure 2: IEEE 802.15, standards group responsible for WPAN stand

IEEE 802.15.4 LR-WPAN

- Low Rate Wireless Personal Area Network

LR-WPAN DEVICE ARCHITECTURE

LR-WPAN device architecture.

PHYSICAL LAYER:

PHY DATA SERVICE;PHY MANAGEMENT SERVICE.
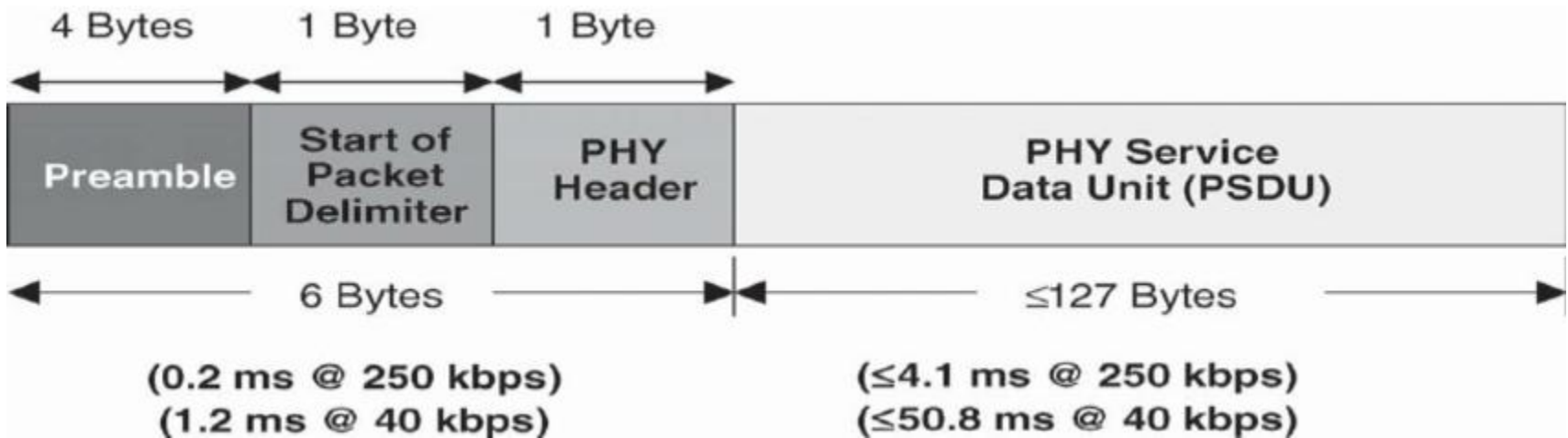
DATA LINK LAYER
MAC; LLC SUB LAYERS

- FEATURES OF IEEE 802.15.4 MAC ARE:-

➢ ASSOCIATION AND DISASSOCITAION.

➢ ACKNWLEDGED FRAME DELIVERY.

➢ CHANNEL ACCESS MECHANISM.

➢ FRAME VALIDATION.

➢ GUARANTED TIME SLOT MANAGEMENT.

➢ BECON MANAGEMENT.

GENERAL MAC FRAME FORMAT.
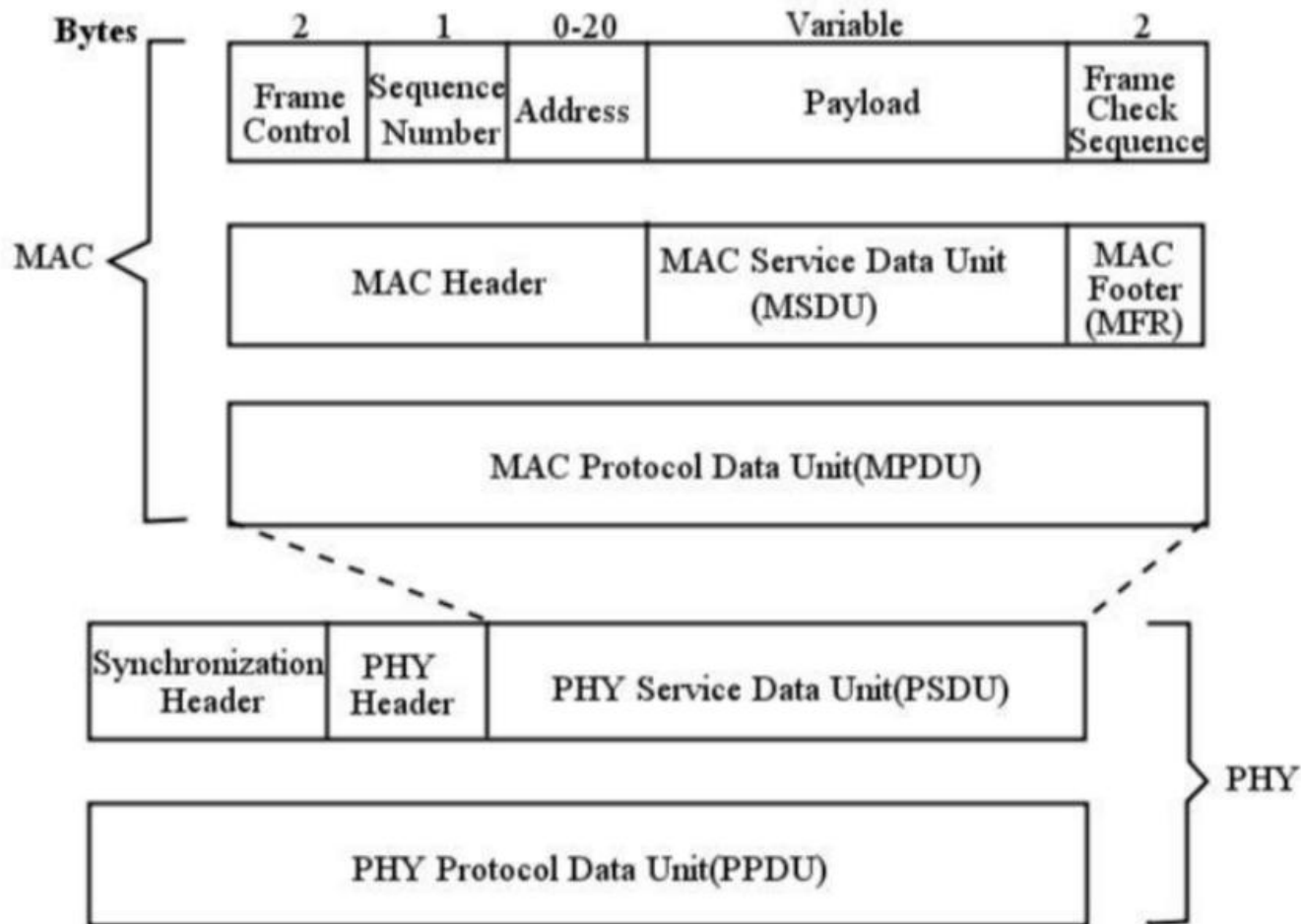
MAC FRAMES

- BECON FRAME.

- DATA FRAME.

- ACKNOWLEDGMENT FRAME.

- MAC COMMAND FRAME.

SUPER FRAME STRUCTURE
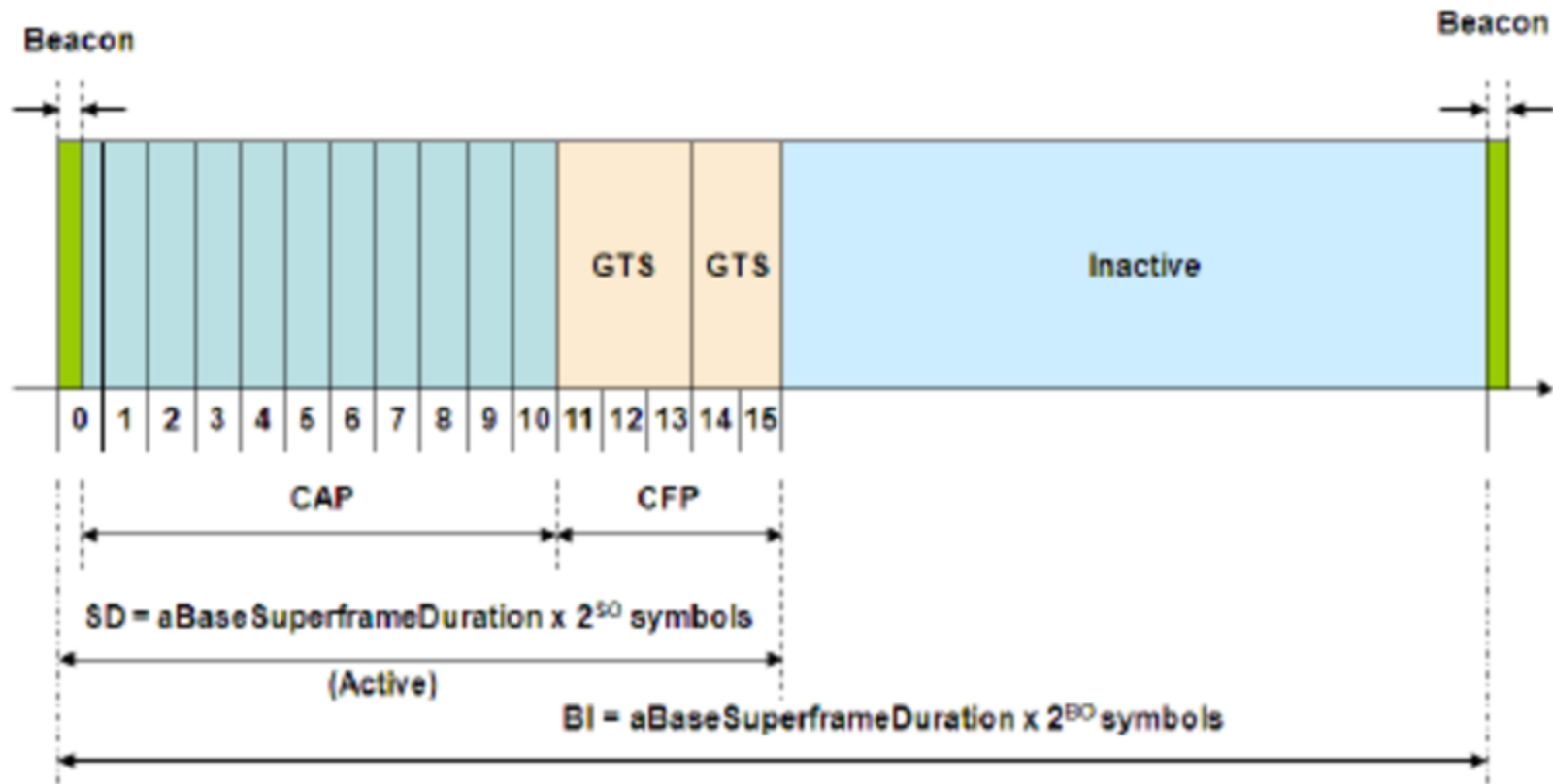
NETWORK LAYER

- ROUTING PROTOCOL

- TABLE DRIVEN (PROACTIVE).

- SOURCE-INITIATED ON-DEMAND – DRIVEN.(REACTIVE)

PROACTIVE

- DESTINATION SEQUENCED DISTANCE VECTOR(DSDV)

- WIRELESS ROUTING PROTOCOL(WRP)

- CLUSTER SWITCH GATEWAY ROUTING(CSGR)

REACTIVE ROUTING

- Adhoc On-demand Distance Vector(AODV).

- Dynamic Source Routing.(DSR)

- Temporally Ordered Routing Algorithm(TORA)

Adhoc On-demand Distance Vector(AODV).
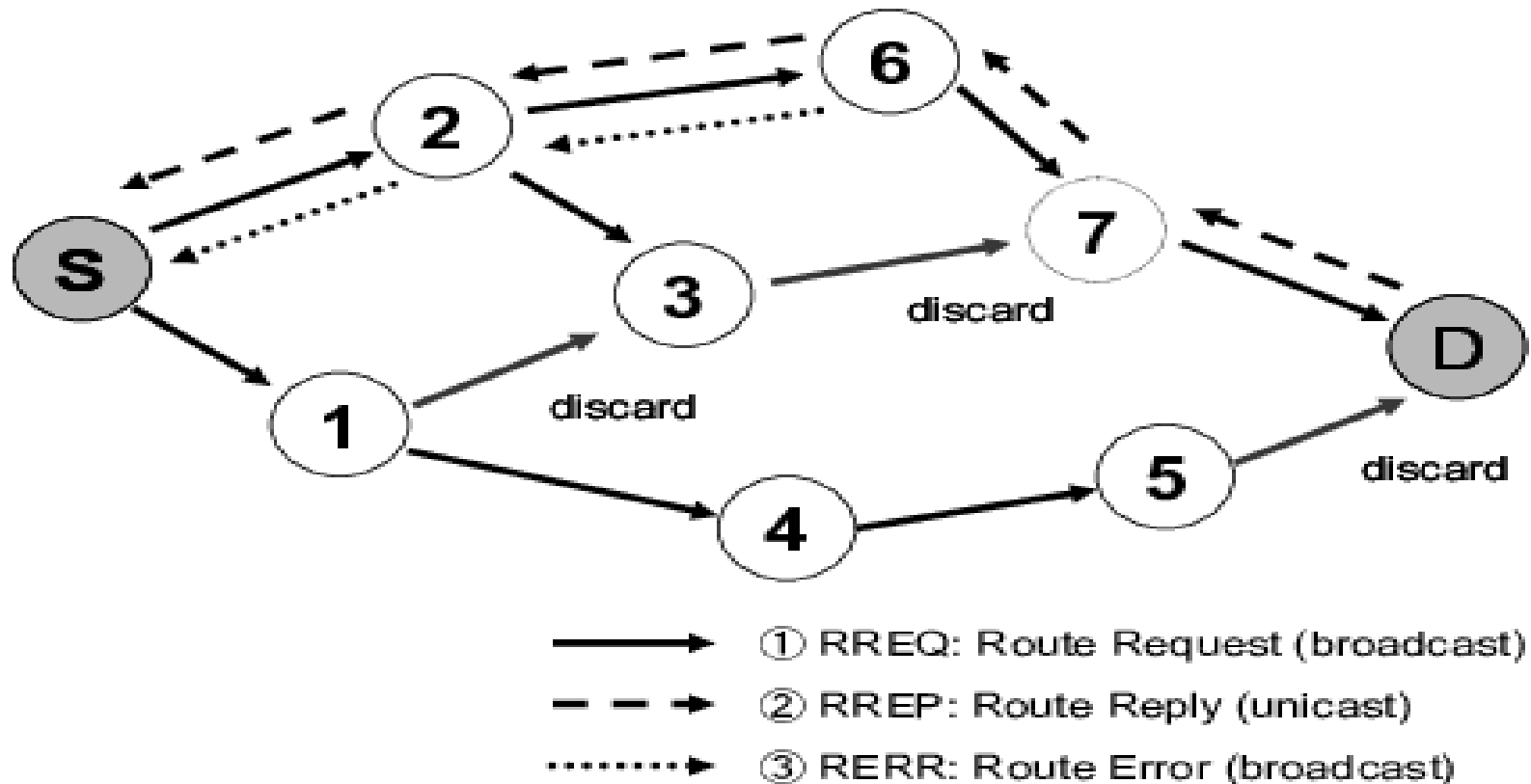
Cluster tree protocol DD-DESIGNATED DEVICE; CH-CHANNEL HEAD
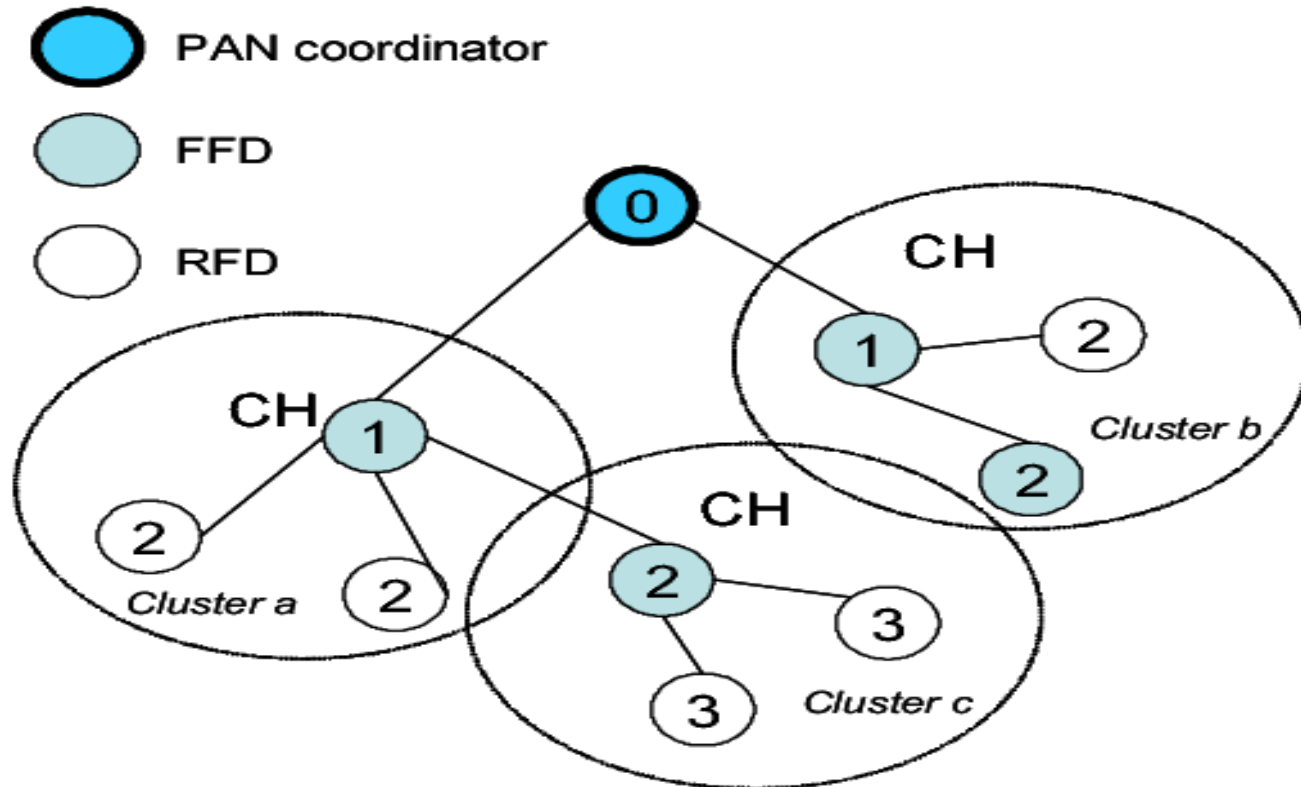
Figure 1 - A generic structure of WPAN organized in a cluster tree topology; the level of each node is indicated by the number in the circle.

APPLICATIONS

- HOME AUTOMATION.
- HEATING, VENTILATION,
- AIR CONDITIONING
- SECURITY.
- LIGHTINING.
- CONTROL OF OBJECTS SUCH AS CUTAINS, WINDOWS ,DOORS, & LOCKS.
- HEALTH MONITORING.
- SENSORS & MONITORS.

Application
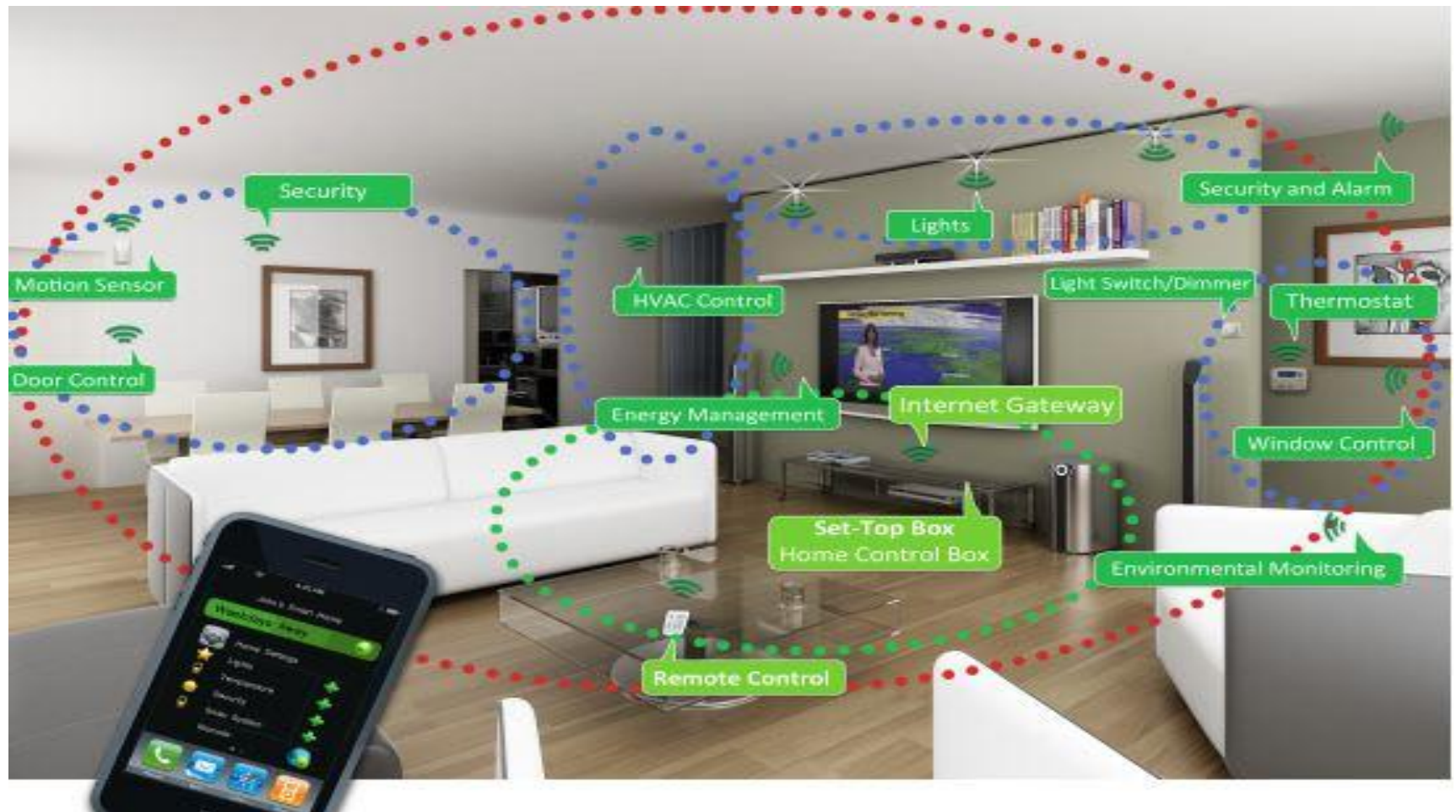
MOBILE NETWORK LAYER
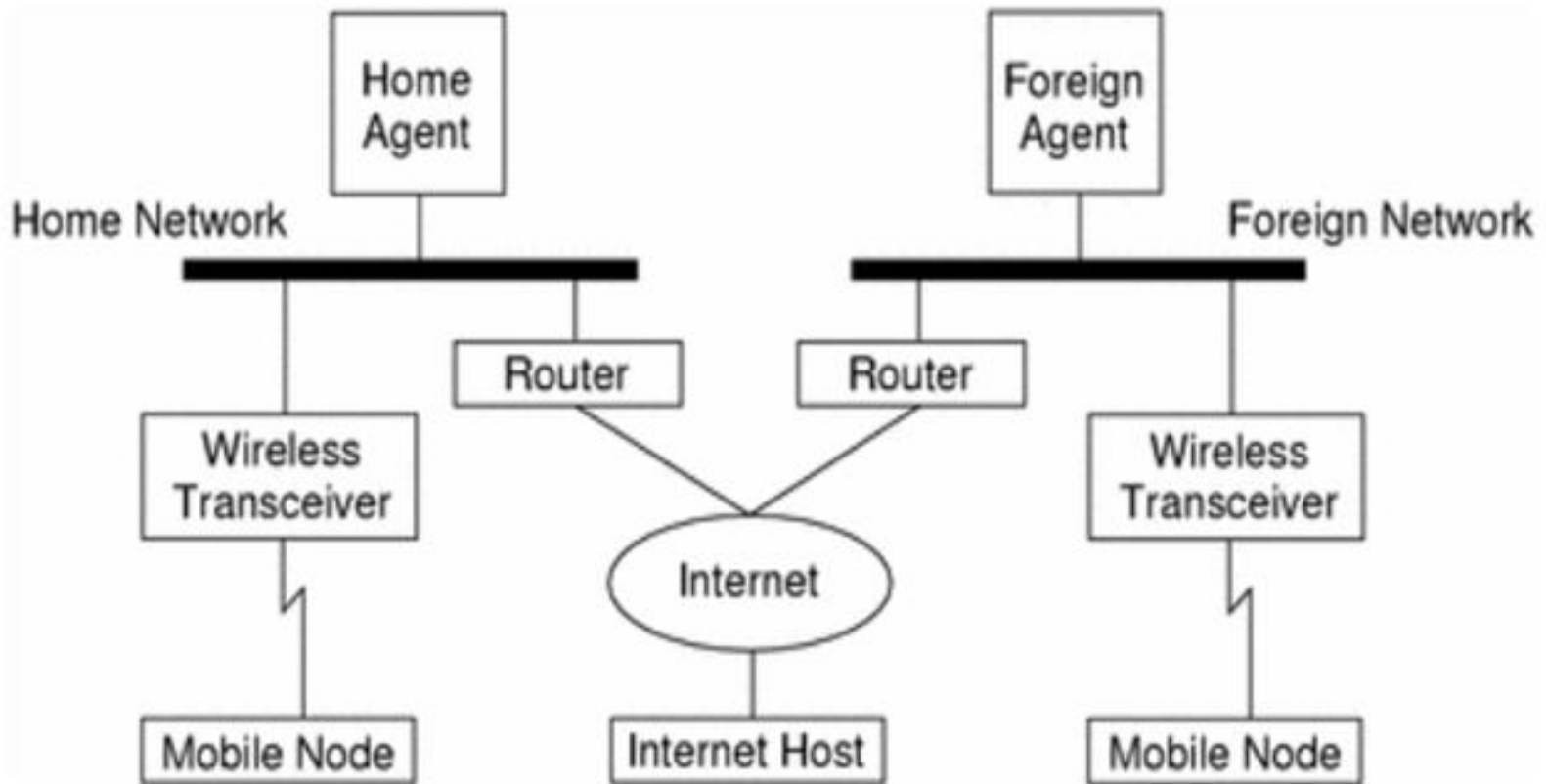
Fig: Mobile IP topology

MOBILE NETWORK LAYER

REGISTRATION
TUNNELING & ENCAPSULATION

REGISTRATION

REGISTRATION

- HLR-HOME LOCATION REGISTER.
  VLR-VISITOR LOCATION REGISTER.

REGISTRATION-HLR,VLR

REGISTRATION

- The main purpose of the registration is to inform the HA of the current location for correct forwarding packets.

- REGISTRATION CAN BE DONE IN TWO DIFFERENT WAYS.

REGISTRATION PROCESS
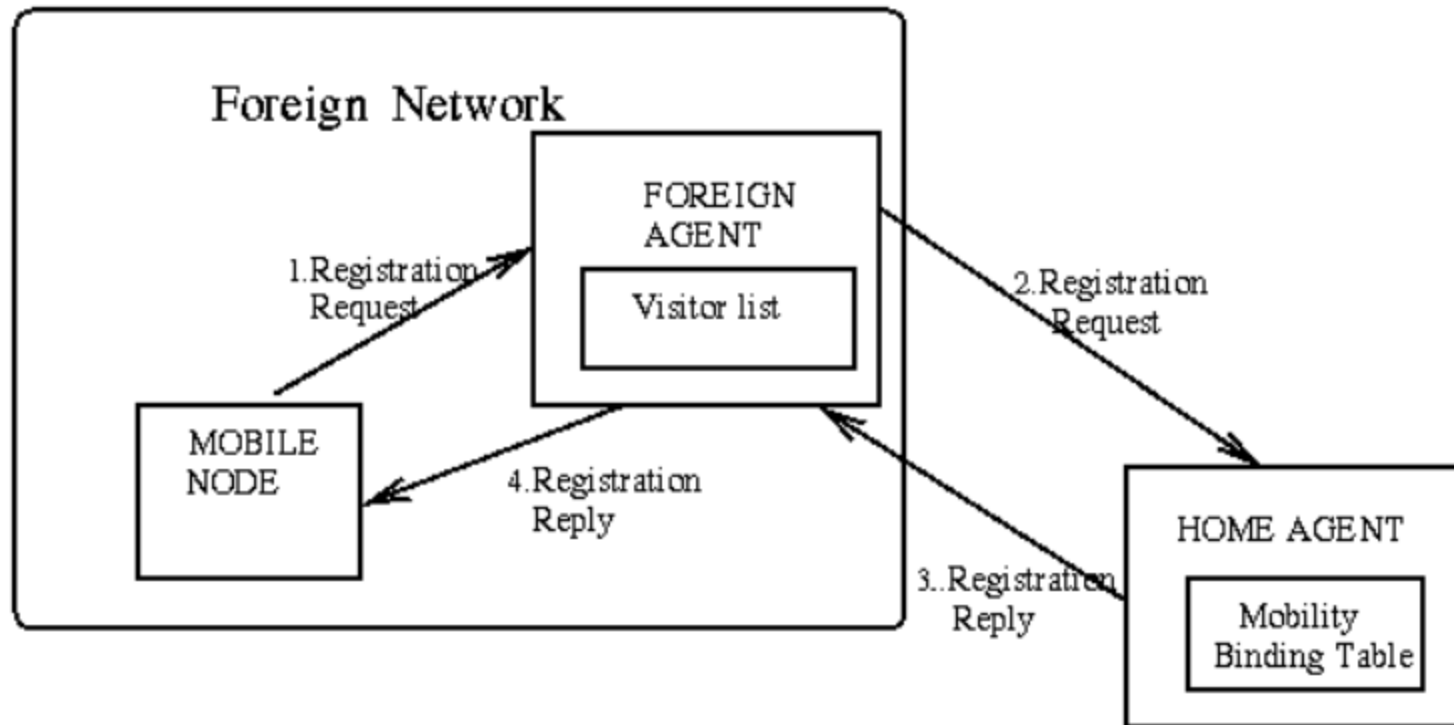
REGISTRATION:
REGISTRATION CAN BE DONE IN TWO DIFFERENT WAYS

Registration

8.11
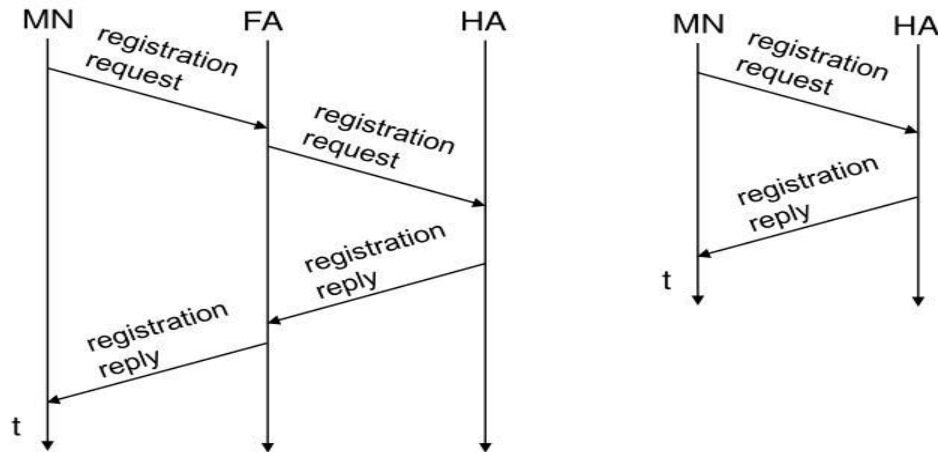
REGISTRATION PROCESS

- The MN sends its registration request containing the COA to the FA which forwards the request to the HA.

- The HA now sets up mobility binding.

- MOBILITY BINDING: CONTAINING THE MOBILE NODE'S HOME IP ADDRESS AND THE CURRENT COA.

- REGISTRATION REQUEST, REGISTRATION REPLY.

SUMMARY

Mobile Node — FA — HA — Correspondent Node

Agent Solicitation

Agent Advertisement

Registration Request

Registration Request

Registration Reply

Registration Reply

User Packet

User Packet

TUNNELING

ENCAPSULATION

TUNNELING:

- Tunnel establishes a virtual pipe for data packets between a tunnel entry and a tunnel endpoint.

- Packets entering a tunnel are forwarded inside the tunnel and leave the tunnel unchanged.

- Tunneling: sending a packet through a tunnel is achieved by using encapsulation.

Mobile IP Tunneling
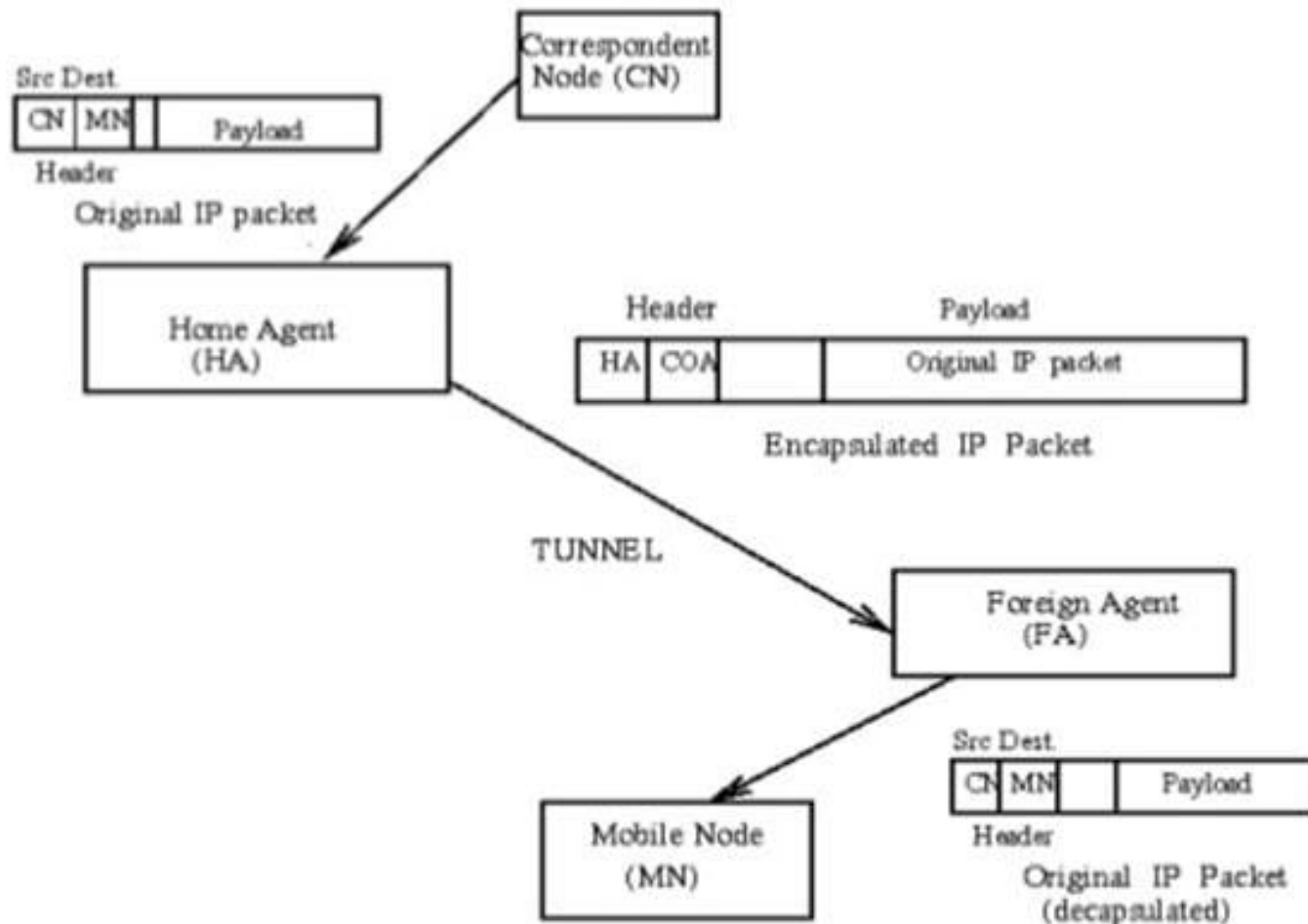
ENCAPSULATION, DECAPSULATION

- ENCAPSULATION:- is the mechanism of taking a packet consisting of packet header and data and putting it into the data part of a new packet.

- DECAPSULATION:- The reverse operation taking a packet out of the data part of another packet is called decapsulation.

IP-ENCAPSULATION

IP-IN-IP ENCAPSULATION

IP in IP Encapuslation

(a) IP-within-IP encapsulation

New IP header:

Version = 4	IHL	Type of service	Total length
Identification		Flags	Fragment offset
Time To Live	Protocol = 4	Header checksum	
Source address (home agent address)			
Destination address (care-of address)			

Old IP header:

Version = 4	IHL	Type of service	Total length
Identification		Flags	Fragment offset
Time To Live	Protocol	Header checksum	
Source address (original sender)			
Destination address (home address)			

IP payload (e.g., TCP segment)

Unshaded fields are copied from the inner IP header to the outer IP header.

MINIMAL ENCAPSULATION

ver.	IHL	DS (TOS)	length	
IP identification			flags	fragment offset
TTL		min. encap	IP checksum	
IP address of HA				
care-of address of COA				
lay. 4 protoc.	S	reserved	IP checksum	
IP address of MN				
original sender IP address (if S=1)				
TCP/UDP/ … payload				

Fig : Minimal encapsulation

GENERIC ROUTING ENCAPSULATION
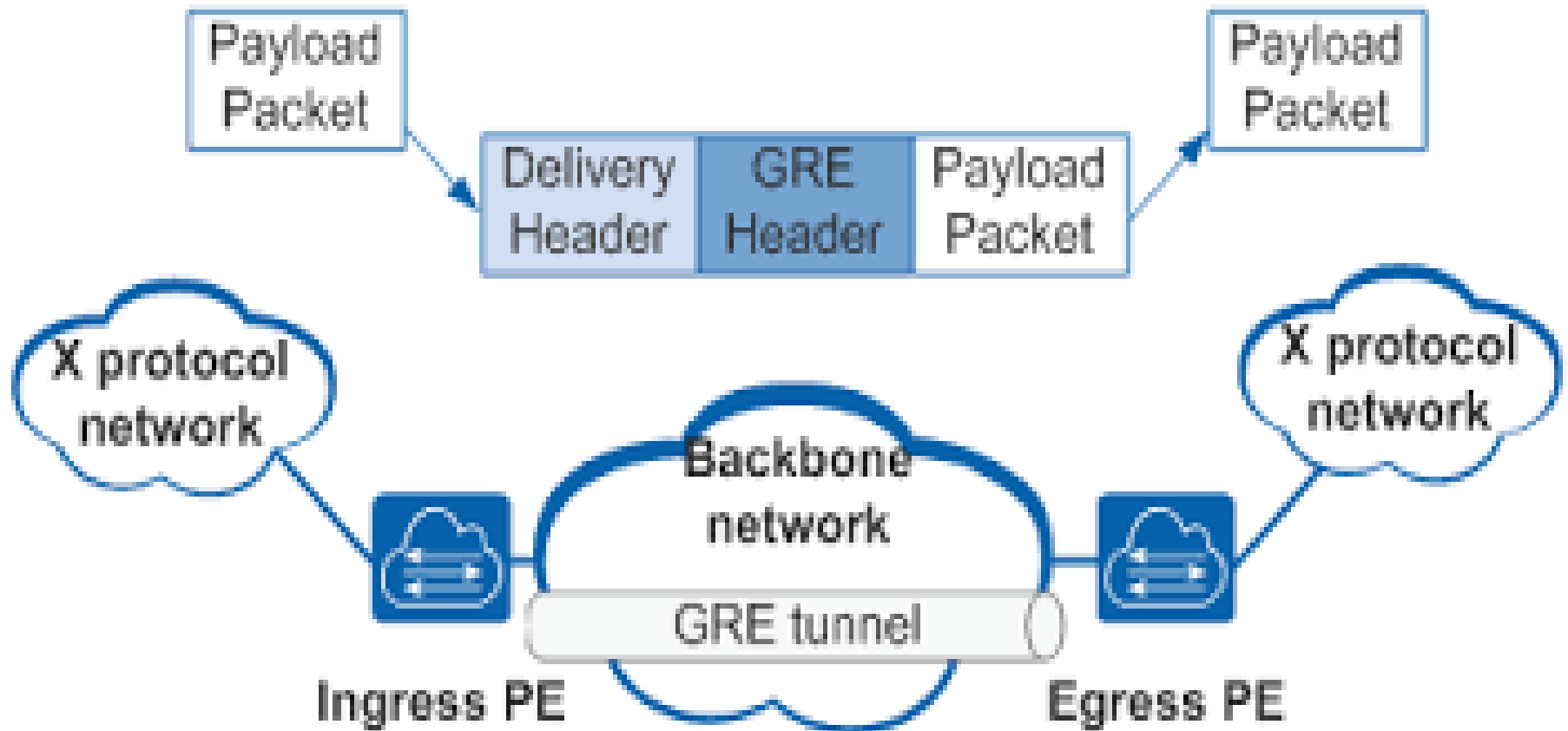
GENERIC ROUTING ENCAPSULATION

ver.	IHL	DS (TOS)		length	
IP identification			flags	fragment offset	
TTL		GRE		IP checksum	
IP address of HA					
care-of address of COA					
C R K S s rec.		rsv.	ver.	protocol	
checksum (optional)				offset (optional)	
key (optional)					
sequence number (optional)					
routing (optional)					
ver.	IHL	DS (TOS)		length	
IP identification			flags	fragment offset	
TTL		lay. 4 prot.		IP checksum	
IP address of CN					
IP address of MN					
TCP/UDP/... payload					

Fig 2 : Protocol fields for GRE according to RFC 1701

OPTIMIZATION

- TRIANGULAR ROUTING.
- ITS NEED ADDITIONAL FOUR MESSAGES:
- ➢ BINDING REQUEST.
- ➢ BINDING UPDATE.
- ➢ BINDING ACKNOWLEDGEMENT.
- ➢ BINDING WARNING.

OPTIMIZATION

Change of foreign agent
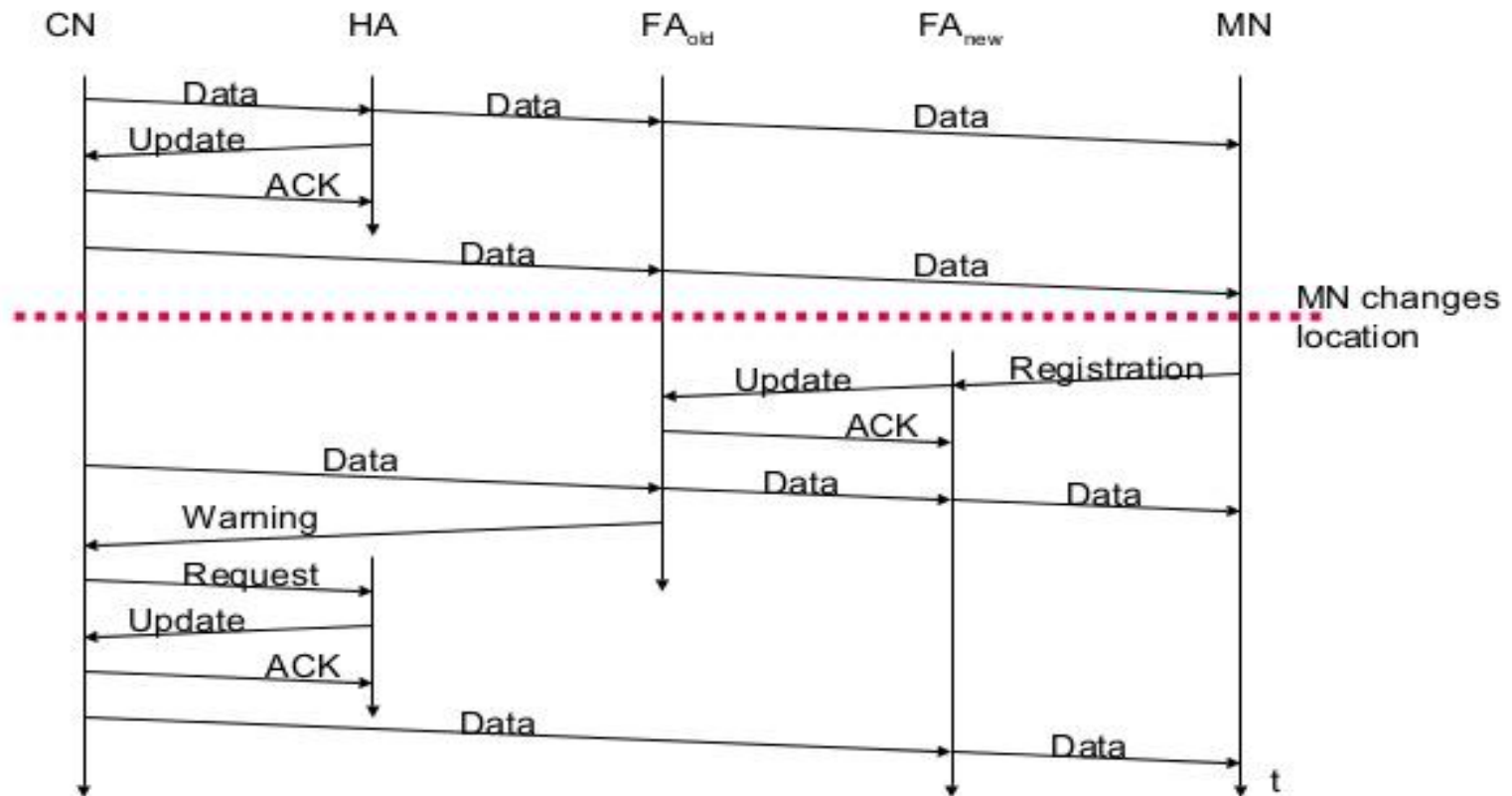
REVERSE TUNNELING

Reverse tunneling (RFC 2344)

HA
home network
2

Internet

MN
sender
1
FA
foreign network

CN
receiver
3

1. MN sends to FA
2. FA tunnels packets to HA by encapsulation
3. HA forwards the packet to the receiver (standard case)
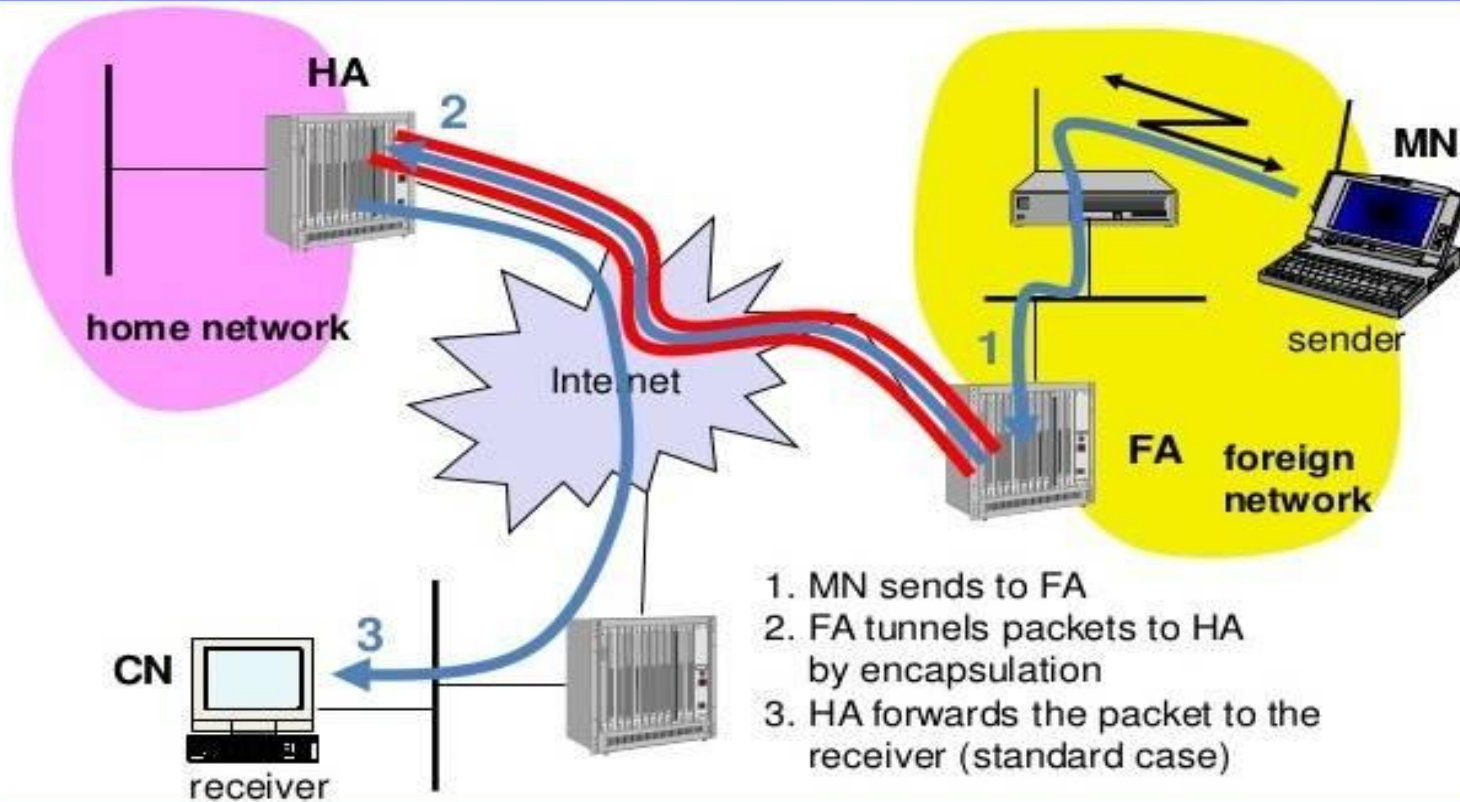
REVERSE TUNNELING

- The reverse path from MS to the CN.
- MN can directly send its packets to the CN.
- Problem Identification.
- Firewalls.
- Multicast problems.
- TTL has to be adjusted
- Tunnel hijacking
- Optimization of data paths.(Drouble triangular routing)

CDMA 2000

- CDMA 2000- CODE DIVISION MULTIPLE ACCESS 2000(3G) DEVELOPED BY INTERNATIONAL TELECOMMUNICATION UNION. (ITU).

- THIS PROTOCOL USES TO SEND VOICE & DATA SIGNALS BETWEEN MOBILE & CELL SITES.

- SPPED 114Kbps-2Mbps.

SYSTEM ARCHITECTURE
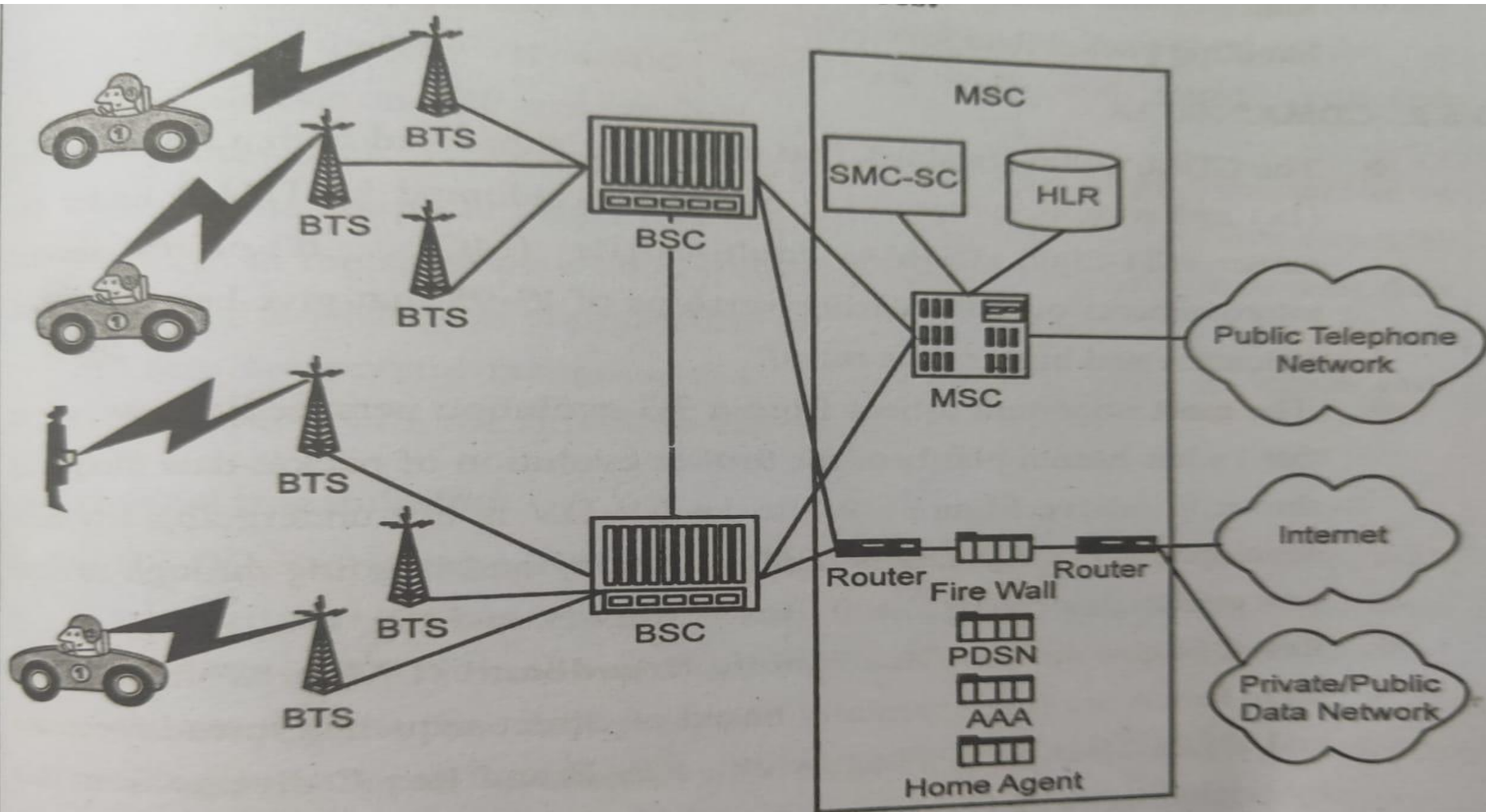
Fig. 3.15. Generic CDMA2000 system architecture

SYSTEM ARCHITECTURE

• SUPPORT PACKET DATA SERVICES.

• PACKET DATA SERVICE CAN EITHER CENTRALIZED OR DISTRIBUTED.

CDMA 2000 1X

- SUPPORTS BOTH SINGLE CARRIER & MULTI CARRIER MODE.

- SUPPORTS BETTER SPECTRAL EFFICIENCY AND HIGHER DATA RATES.

1X EV-DO REV 0

- DEFINES A NEW UPLINK AND DOWNLINK STRUCTURE FOR CDMA 2000 1X.

- DO-DATA ONLY.

- EV-DO: CARRIER HAS A STRUCTURE OPTIMIZED FOR DATA.

- EV-DO: DOES NOT SUPPORT VOICE & CIRCUIT SWITCHED SERVICES.

- PEAK DATA RATE OF 2.4 Mbps.

- DOWNLINK CARRIER IS 1.25MHz.

1X EV-DO REV 0-COMPONENTS

- SHARED CHANNEL TRANSMISSION.(TDM)
- CHANNEL- DEPENDENT SCHEDULING.
- SHORT TRANSMISSION TIME INTERVAL(TTI)
    TTI=1.6ms.
- RATE CONTROL.
- HIGHER ORDER MODULATION.(16 QAM).
- RECEIVE DIVERSITY IN THE MOBILE.
- DOES NOT USE SOFT HANDOVER.
- HYBRID ARQ SCHEME.

1X EV-DO REV A

- FOCUS ON UPLINK IMPROVEMENT.(AND ALSO INCLUDES UPDATED DOWNLINK.
- MULTICAST MODE. ADVANCE QoS.
- COMPONENTS:-
- ➤ HIGHER PEAK RATES.(DOWNLINK=3.1Mbps.)
- ➤ SHORTER PACKETS.(128,256,512 bit packet)
- ➤ HIGHER ORDER MODULATION (QPSK, 8PSK)
- ➤ HYBRID-ARQ.
- ➤ REDUCED LATENCY.

1X EV-DO REV B

- ENABLES HIGH DATA RATESBY AGGREGATION OF MULTIPLE CARRIERS.

- PERMITS UP TO SIXTEEN 1.25MHZ CARRIER TO BE AGGREGATED.

- PEAK DOWNLINK DATARATE UPTO 9.3Mbps.

- MULTILINK RADIO LINK PROTOCOL(ML-RLP) ENABLES MULTIPLE CARRIERS.

MULTI CARRIER OPERATION
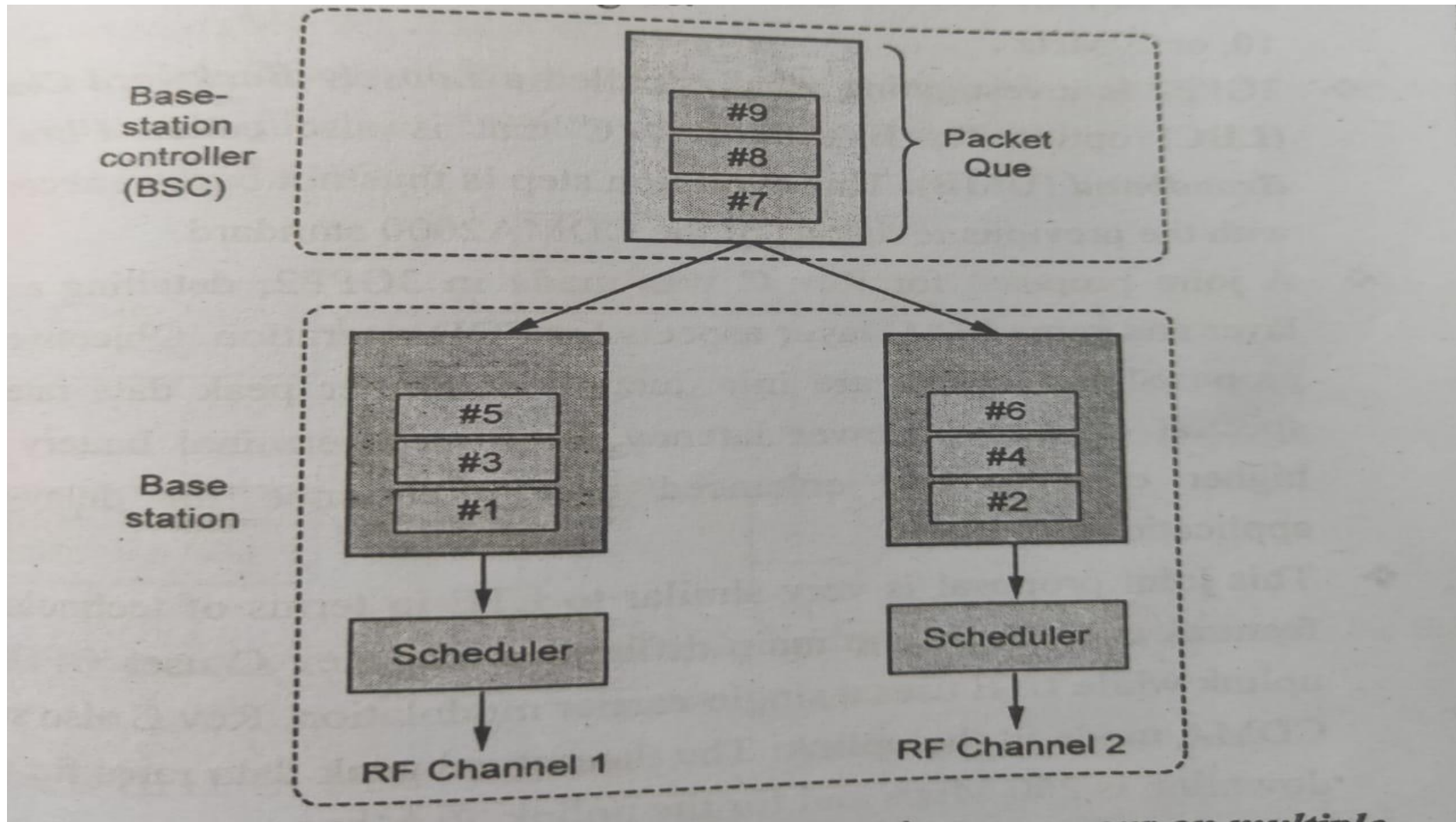
1X EV-DO REV C(UMB)

- UMB-ULTRA MOBILE BROADBAND.
- OBJECTIVES:
➢ HIGHER PEAK DATA RATE.
➢ BETTER SPECTRAL EFFICIENCY.
➢ LOWER LATTENCY.
➢ IMPROVED TERMINAL BATTERY LIFE.
➢ HIGHER CAPACITY.
➢ DELAY-SENSITIVE APPLICATION.

1X EV-DO REV C(UMB)

- UPLINK-OFDM,CDMA IS USED.
- PEAK DATA RATES FOR 20MHz is:
  downlink =260 Mbps. Uplink= 70Mbps.
- SUPPORTS MULTI ANTENNA TECHNIQIES.
- DOWNLINK DEDICATED CHANNEL SUPPORTS QPSK, 8PSK,16QAM,64QAM.
- MULTIPLEXING DIVERSITY.
- SUPPORTS FRAGMENTAED SPECTRUM.

MULTIPLEXING OF OFDM & CDMA TRAFFIC ON THE UPLINK

g. 3.17. 1x EV-DO Rev C enables multiplexing of OFDMA and CDMA traffic on the uplink
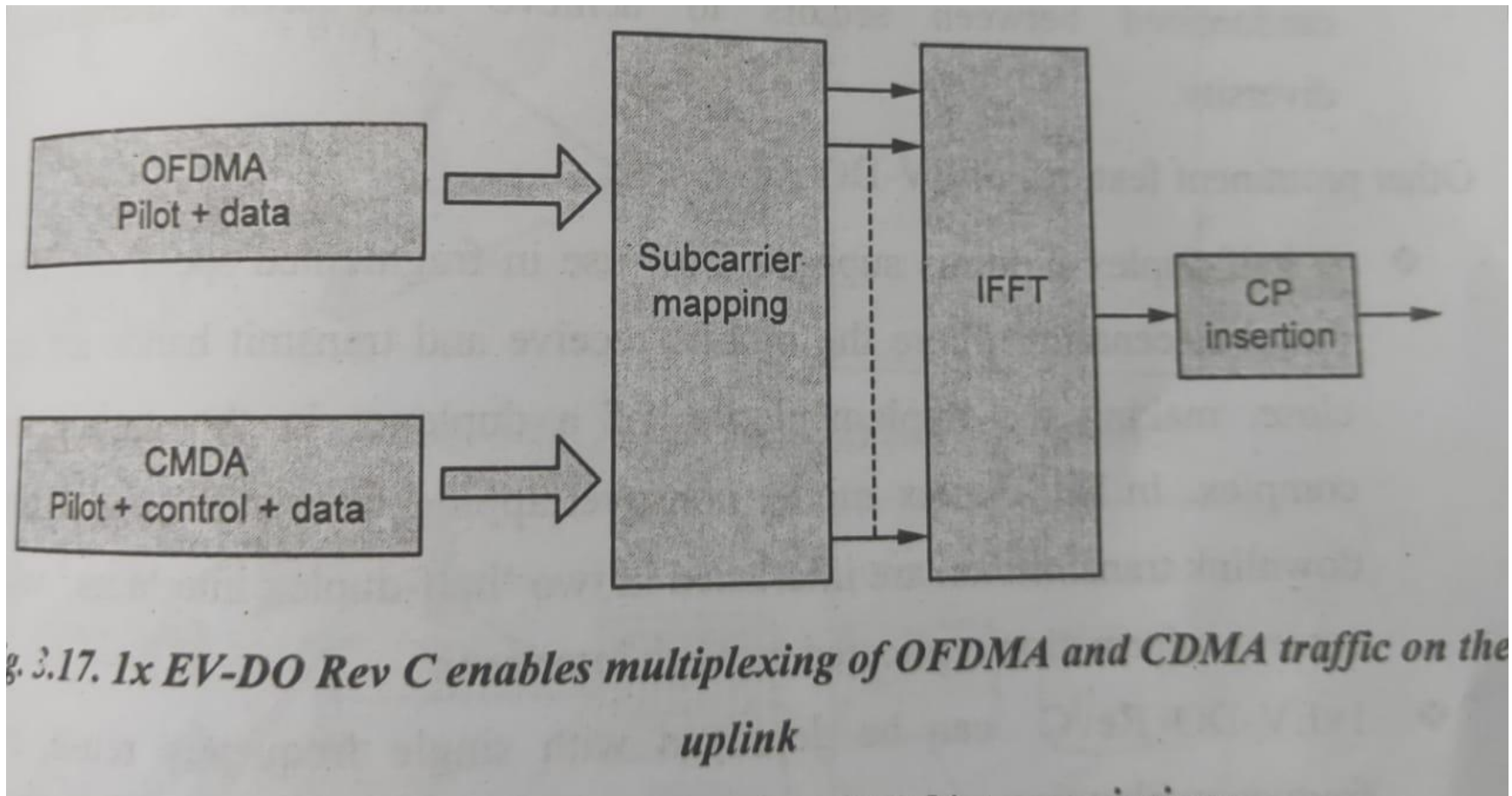
UMTS CORE NETWORK ARCHITECTURE

- UMTS- 3G MOBILE COMMUNICATION SYSTEM PROVIDES BROADBAND SERVICES TO THE WORLD OF WIRELESS & MOBILE COMMUNICATION.

- DATA RATE 2 Mbps.

- UMTS is designed deliver:

pictures, graphics, video communication, multimedia information,

 as well as voice & data to mobile wireless subscribers.

UMTS CORE NETWORK ARCHITECTURE

- UMTS network is divided into:-

➢ CORE NETWORK.

➢ RAN.

- CORE NETWORK:-

➢ CIRCUIT SWITCHED (CS) DOMAIN.

➢ PACKET SWITCHED (PS) DOMAIN.

UMTS CORE NETWORK ARCHITECTURE

Fig. 3.10. UMTS core network architecture
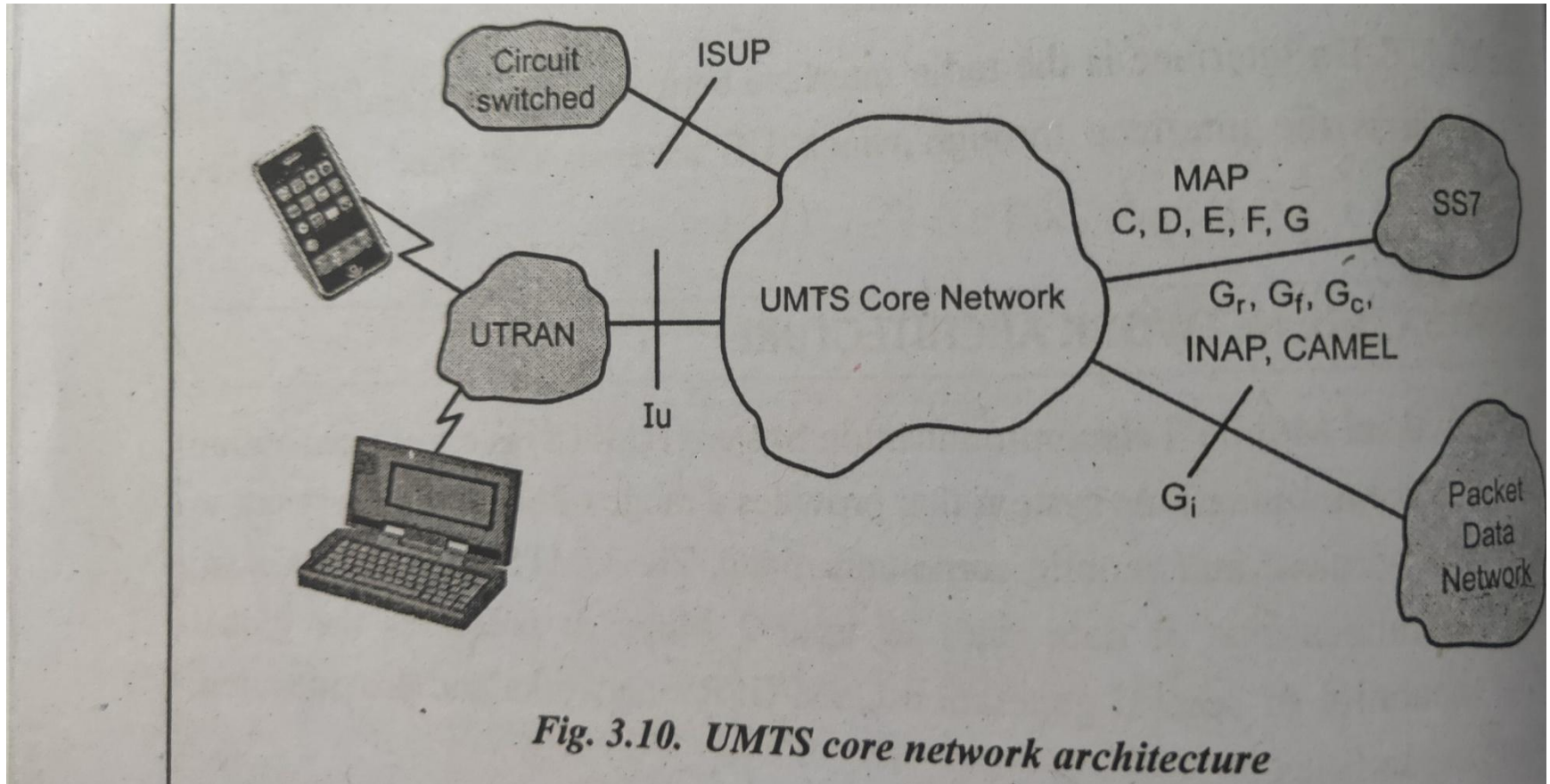
UMTS CORE NETWORK ARCHITECTURE

- CIRCUIT SWITCHED DOMAIN- PROVIDING VOICE, CS DATA SERVICE.

- CIRCUIT SWITCHED DOMAIN ENTITIES:
- 1. MOBILE SWITCHING CENTRE.(MSC)
- 2. GATEWAY MSC.

PACKET SWITCHED DOMAIN

- PS DOMAIN ENTITIES:-
- SGSN-SERVING GPRS SUPPORT NODE.
- GGSN- GATEWAY GPRS SUPPORT NODE.
- DNS- DOMAIN NAME SERVER.
- DHCP- DYNAMIC HOST CONFIGURATION PROTOCOL.

LOGICAL ARCHITECTURE OF THE UMTS CORE NETWORKS

Fig. 3.11. Logical architecture of the UMTS core network
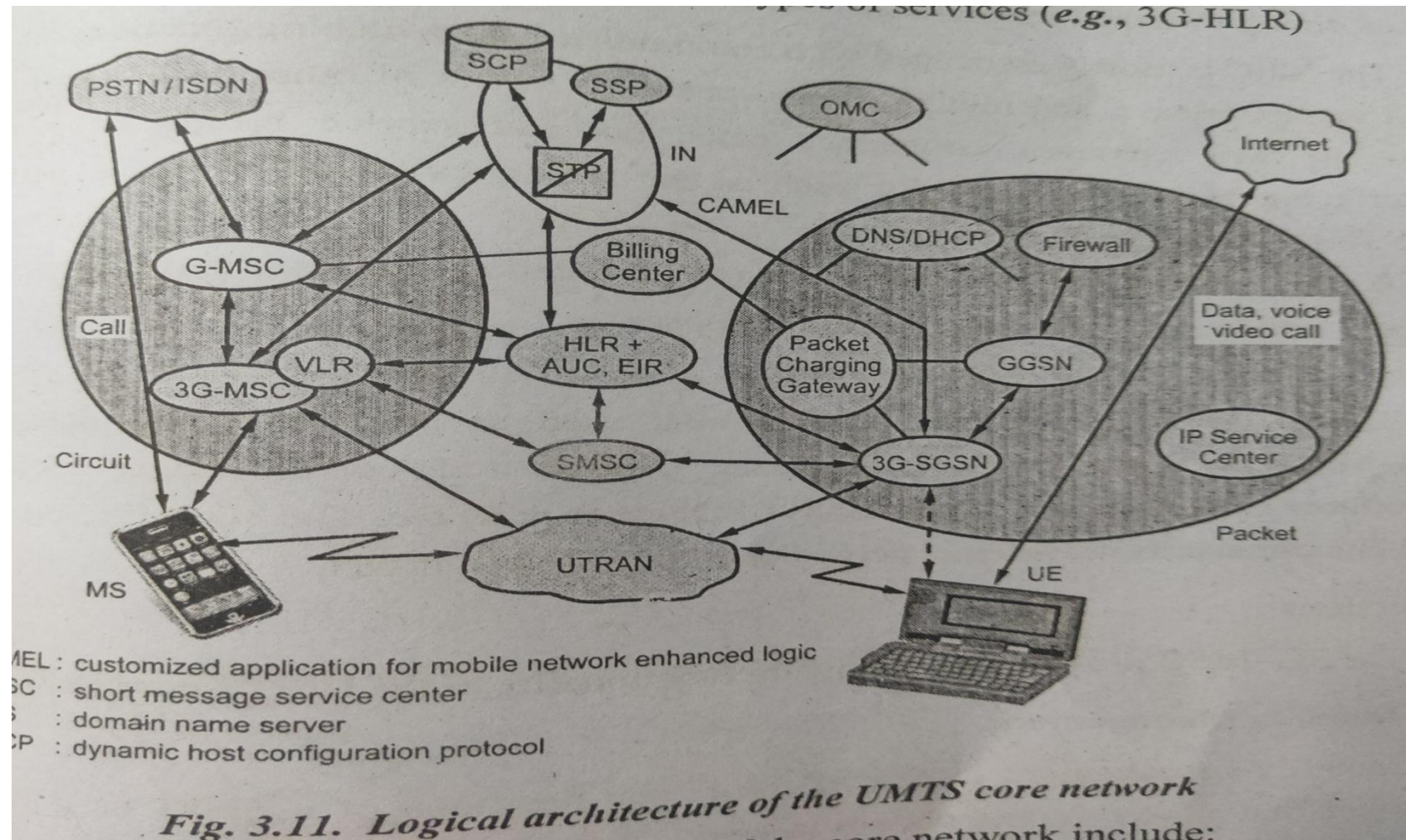
UMTS

- 3G-MSC
- 3G-SGSN
- 3G-GGSN
- SMS-GMSC/SMS-IWMSC
- FIREWALL
- DNS/DHCP.

3G-MSC

- INTERFACE BETWEEN CELLULAR NETWORK AND EXTERNAL FIXED CIRCUIT SWITCHED TELEPHONE NETWORKS (PSTN).

- MSC ASSOCIATED WITH COMMUNICATION SWITCHING FUNCTION SUCH AS:-

  CALL SET-UP, RELEASE, & ROUTING.

3G-MSC

- INCLUDING,

➢ ROUTING SMS MESSAGE.

➢ CONFERENCE CALLS.

➢ FAX.

➢ SERVICE BILLINGS.

➢ INTERFACING WITH PSTN.

3G-MSC FUNCTIONS:-

- MOBILITY MANAGEMENT.(CALL,SMS)
- CALL MANGEMENT.(CALL SET-UP etc)
- SUPPLEMENTARY SERVICES.(CALL WAITING)
- CS DATA SERVICE.(FAX)
- SHORT MESSAGE SERVICE(SMS)
- VLR FUNCTIONALITY.
- ATM/AAL2 CONNECTION TO UTRAN.(Transportation of user plane)

3G-SGSN

SGSN-SERVING GPRS SUPPORT NODE.

- HANDLES MOBILITY MANAGEMENT, AUTHENTICATION OF USERS.

- SGSN CONTROLS ACCESS NETWORK RESOURCES - PREVENTING UNAUTHORIZED ACCESS TO NETWORK,SPECIFIC SERVICES, APPLICATIONS.

3G-SGSN FUNCTIONS

- SESSION MANAGEMENT.(Qos MECHANSIM)
- Iu INTERFACE.
- SMS.
- MOBILITY MANAGEMENT.
- SUBSCRIBER DATA BASE FUNCTIONALITY.
- CHARGING.
- ATM/AAL5- TRANSPORTION OF USER DATA PLANE TRAFFIC ACROSS THE Iu.

3G-GGSN
GGSN-GATEWAY GPRS SUPPORT NODE.

- CONNECTS GSM-BASED 3G NETWORKS TO THE INTERNET.
- FUNCTION:-
➢ MAINTAIN INFORMATION LOCATION.
➢ GATEWAY BETWEEN UMTS & EXTERNAL DATA NETWORK.
➢ USER LEVEL ADDRESS LOCATION.
➢ CHARGING.(CHARGING INFORMATION RELATED TO OTHER NETWORKS)

4.SMS-GMSC/SMS-IWMSC

- SMS-GMSC;- SMS GATEWAY MSC.

➢ SHORT MESSAGE SERVICES.

- FUNCTION:-

➢ RECEPTION OF SHORT MESSASGE PACKET DATA UNIT.

➢ HLR ROUTING INFORMATION.

SMS-IWMSC
SMS INTER WORKING MSC

- RECEIVING A SHORT MESSAGE FROM THE MOBILE NETWORK AND SUBMITTING IT TO MSC.

FIREWALL
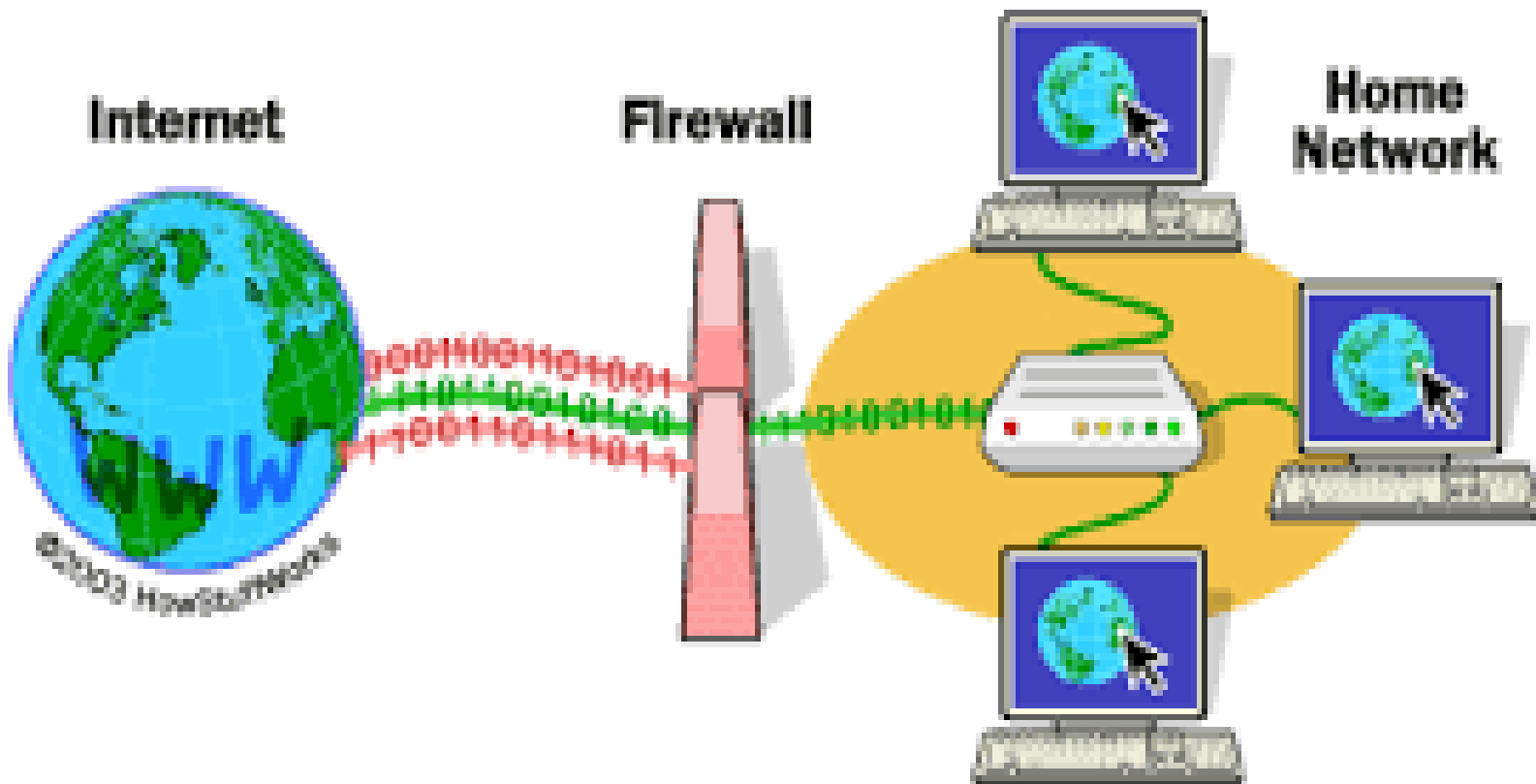
FIREWALL

- FIREWALL IS A NETWORK SECURITY DESIGNED TO PREVENT UNAUTHORIZED ACCESS TO OR FROM PRIVATE NETWORK.

- FIREWALL IS MAY NE A HARDWARE OR SOFTWARE OR COMINATION OF BOTH.

- UNAUTHORIZED INTERNET USERS.

DNS/DHCP

- DOMAIN NAME SYSTEM IS AN INTERNET SERVICE TRANSLATES DOMAIN NAMES INTO IP ADDRESS.

- WWW.GOOGLE.COM

- 198.105.232.4

- 000110011000.000100000101.001100110010.0100

DHCP

- IT MANAGE THE ALLOCATION OF IP CONFIGURATION INFORMATION BY AUTOMATICALLY ASSIGNING IP ADDRESS TO SYSTEM

3GPP(3rd GENERATION PARTNERSHIP PROJECT)

- 3GPP- STANDARD ORGANIZATION WHICH DEVELOPS PROTOCOLS FOR MOBILE TELEPHONY.

.

3GPP-DEVELOP & MAINTANENCE

- GSM AND RELATED 2G AND 2.5G STANDARDS, INCLUDING GPRS AND EDGE.

- UMTS & RELATED 3G.

- LTE AND RELATED 4G.

- 5G AND RELATED STANDARDS.

- IP MULTIMEDIA SUBSYSTEM.

3GPP ORGANIZES ITS WORK INTO THREE DIFFERENT STREAMS:

- RADIO ACCESS NETWORKS.

- SERVICES AND SYSTEMS ASPECTS.

- CORE NETWORK & TERMINALS.

HSDPA- HIGH SPEED DOWNLINK PACKET ACCESS

- HIGH DATA RATE PACKET SWITCHED SERVICE.

- OBJECTIVE:-

  HSPDA PROVIDE COST-EFFECTIVE,HIGH BANDWIDTH, LOW DELAY, PACKET ORIENTED SERVICES WITHIN UMTS

- HSDPA TARGETING 8to 10 Mbps to support multimedia services.

HSPDA THREE TECHNIQUES:

- 1. ADAPTIVE MODULATION AND CODING.

- 2. FAST HYBRID AUTOMATIC REPEAT REQUEST(HARQ)

- 3. FAST SCHEDULING.(MULTI USER DIVERSITY)

HSDPA CHANNELS

- 1. HIGH SPEED DOWNLINK SHARED CHANNEL (HS-DSCH) (SHARED BY SEVERAL UE)

- 2. HIGH SPEED SHARED CONTROL CHANNEL (HS-SCCH)(BETWEEN NODE B & UE)

- 3. HIGH SPEED DEDICATED PHYSICAL CONTROL CHANNEL(HS-DPCCH) (ACK,NACK)

-

RADIO & NETWORK COMPONENTS

- PSDN
- AAA
- HOME AGENT.
- ROUTER
- HOME LOCATION REGISTER.
- BASE TRANSCEIVER STATION.(BTS)
- BASE-STATION CONTROLLER(BSC)

Fig. 3.15. Generic CDMA2000 system architecture

PSDN-PACKET DATA SERVING NODE

- SUPPORT PACKET DATA SERVICE.

- ESTABLISH, MAINTAINS, TERMINATES .

- SUPPORT BOTH SIMPLE AND MOBILE IP PACKET SERVICES.

AAA-AUTHENTICATION,AUTHORIZATION, & ACCOUNTING

- AUTHENTICATION.(MOBILE IP,PPP)
- AUTHORIZATION.(SERVICE PROFILE, SECURITY KEY DISTRIBUTION)
- ACCOUNTING.

OTHERS…..

- HA.
- ROUTER.
- HLR.
- VLR.
- BTS.
- BSC.

RADIO NETWORK
CDMA 2000

- FORWARD CHANNEL.

- REVERSE CHANNEL

- SPREADING RATE, POWER CONTROL.

- POWER CONTROL.

DHCP

- DHCP- DYNAMIC HOST CONFIGURATION PROTOCOL

- DHCP- AUTOMATIC CONFIGURATION PROTOCOL USED ON IP networks.

- DHCP allows a computer to join an IP-based network without having a pre-configured IP address.
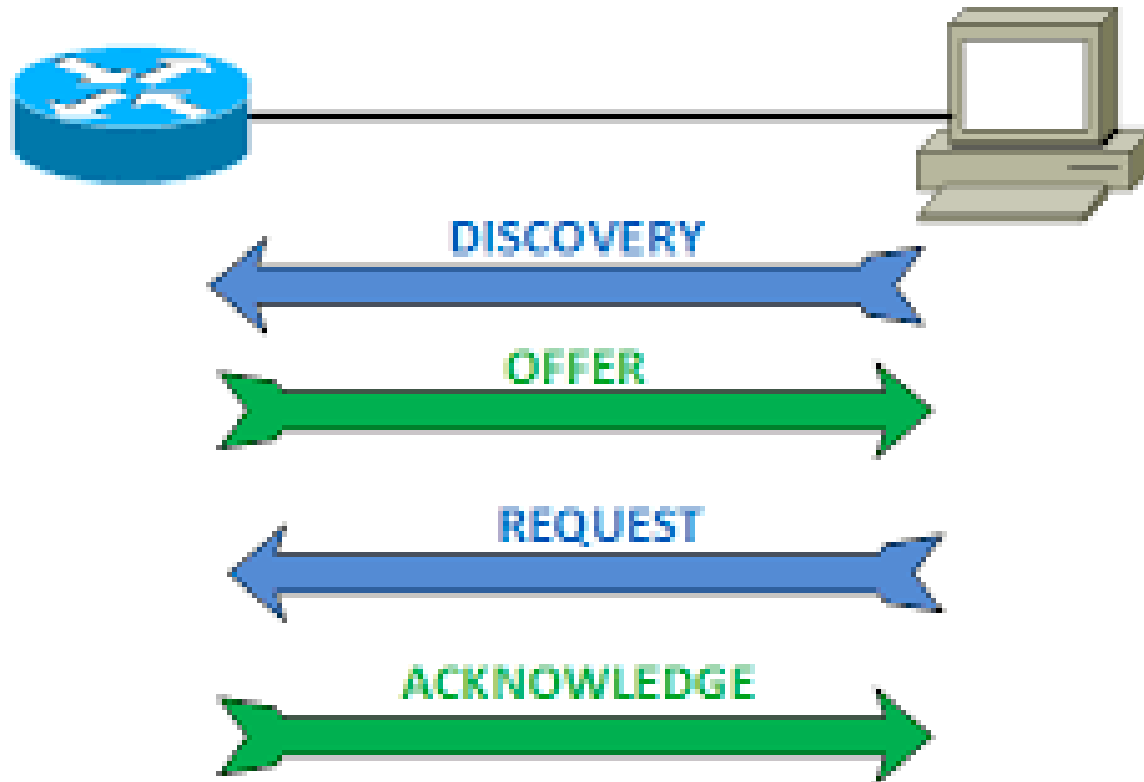
DHCP

- DHCP is a protocol that assigns unique IP addresses to devices, then releases and renews these addresses as devices leave and re-join the network.

- DHCP provides address of a DNS server, default router, subnet mask, and the domain name, and an IP address.

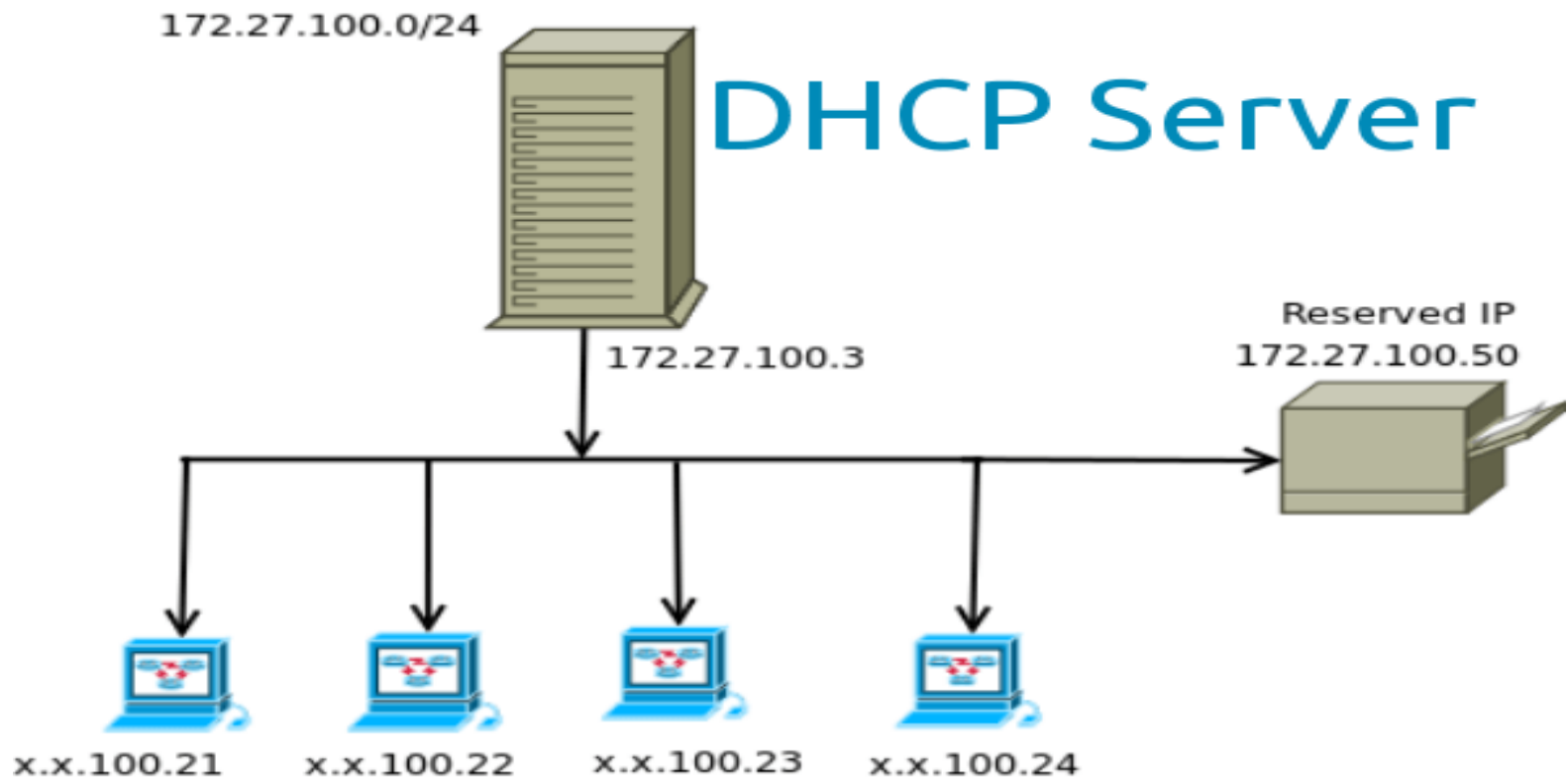- Providing an IP address makes DHCP very attractive for mobile IP as a source of Care-of-addresses.
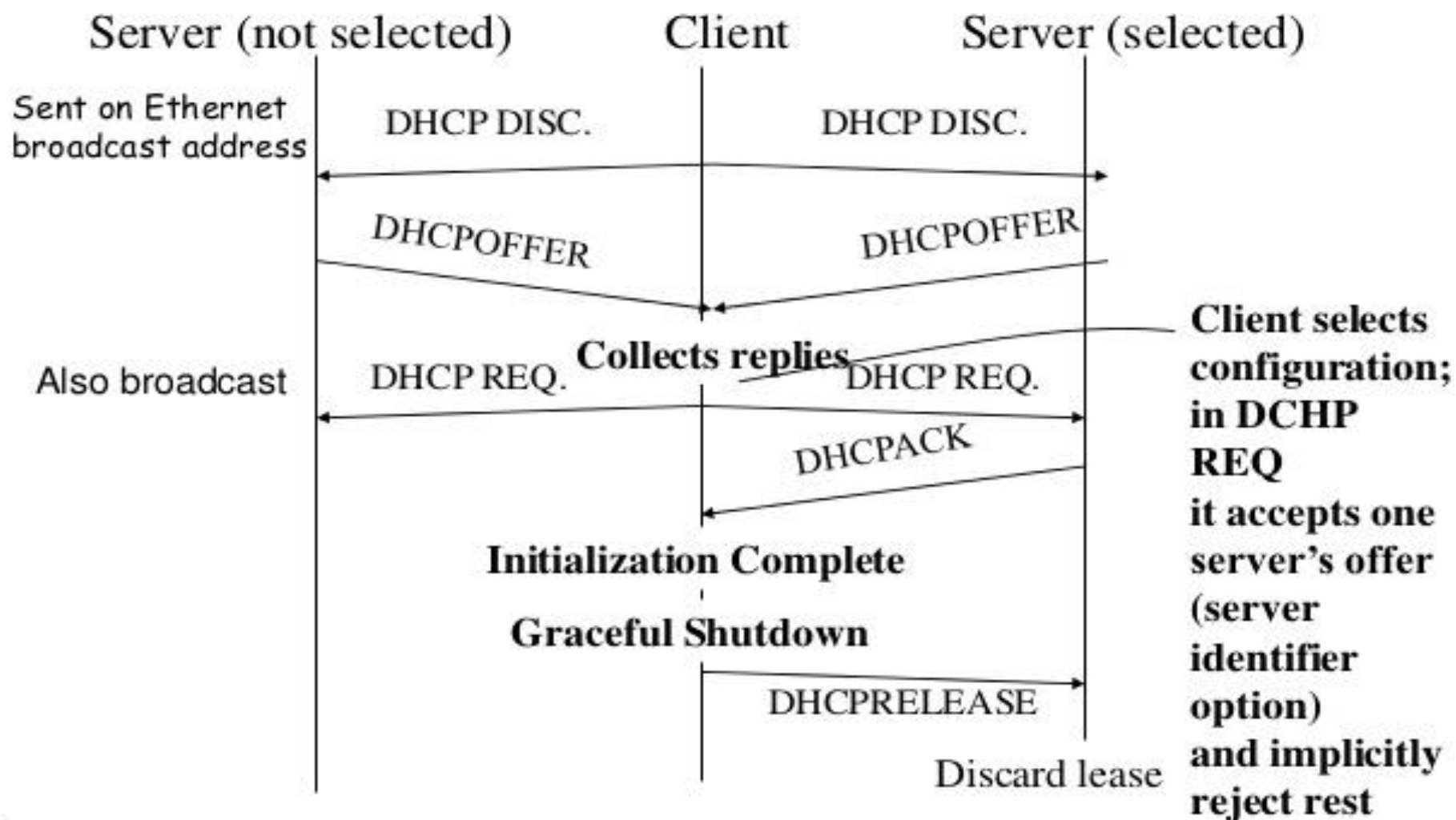
DHCP

DHCP

Client Initialization via DHCP

Server (not selected)	Client	Server (selected)

Sent on Ethernet broadcast address — DHCP DISC.   DHCP DISC.

DHCPOFFER   DHCPOFFER

Collects replies

Client selects configuration; in DCHP REQ

Also broadcast — DHCP REQ.   DHCP REQ.

DHCPACK

it accepts one server's offer (server identifier option) and implicitly reject rest

Initialization Complete

Graceful Shutdown

DHCPRELEASE

Discard lease

NETWORK LAYER IN THE INTERNET
IP DATAGRAM

0	4	8	16	19	31
Version	IHL	Type of Service		Total Length	
Identification			Flags	Fragment Offset	
Time To Live		Protocol		Header Checksum	
Source IP Address					
Destination IP Address					
Options				Padding	

INTERNET ADDRESS

- CLASS A

- CLASS B

- CLASS C

- CLASS D

- CLASS E

IP ADJUNCTION PROTOCOLS

- AP: APPLICATION PROTOCOL/PROCESS.
- ARP:ADDRESS RESOLUTION PROTOCOL.
- RARP:REVERSE ARP.
- ICMP:INTERNETCONTROL MESSAGE PROTOCOL.
- IGMP:INTERNET GROUP MESSAGE PROTOCOL
- OSPF: OPEN SHORTEST PATH FIRST.
- UDP: USER DATAGRAM PROTOCOLO
- TCP: TRANSMISSION CONTROL PROTOCOL.

IP ADJUNCTION PROTOCOLS

- ARP/RARP- TO FIND THE LINK LAYER ADDRESS.
- OSPF-
- IGMP-
- ICMP-
- ➢ Error reporting.
- ➢ Reach ability testing.
- ➢ Congestion control.
- ➢ Route change notification.
- ➢ Performance measuring.
- ➢ Subnet addressing.

Qos Support in the INTERNET.

- Qos requirments:-
- ➢ Packet throughput rate.
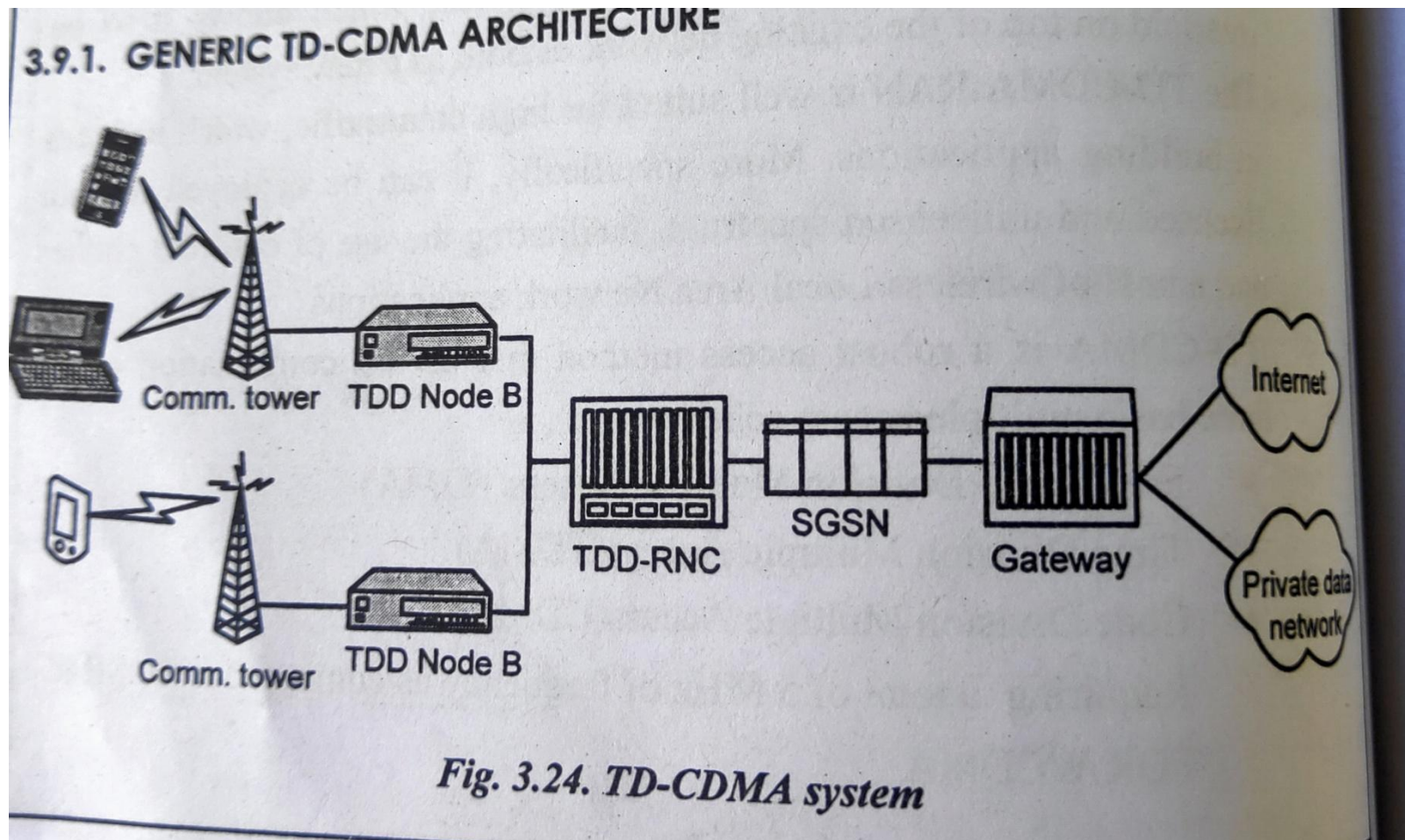- ➢ Maximum end-to-end packet transfer delay.

- ■ Integrated services.
- ■ Differentiated services.

TD-CDMA

- TIME DIVISON CODE DIVISION MULTIPLE ACCESS.- 3G RAN.

- SUITED FOR HIGH DATA TRAFFIC.

- LICENCED SPECTRUM & UNLICENSED SPECTRUM.

- TD-CDMA USES A COMBINATION OF:-

➢ FDMA

➢ TDMA

➢ CDMA.

GENERIC TD-CDMA ARCHITECTURE

Fig. 3.24. TD-CDMA system

CORE NETWORK

- VOICE AND DATA ARE HANDLED IN THE SAME MANNER.

- NO SEPARATE Iu-PS, Iu-CS interface.

- NO SEPARATE MEDIA GATEWAY FOR VOICE AND DATA.

CORE NETWORK:-ELEMENTS

- CALL STATE CONTROL FUNCTION.(CSCF)
- MEDIA GATEWAY CONTROL FUNCTION.(MGCF)
- ➢ INTERWORKING WITH EXTERNAL NETWORKS AT THE CONTROL PATH LEVEL.
- MULTIMEDIA RESOURCE FUNCTION.(MRF)
- INTERWORKING WITH EXTERNAL NETWORKS AT THE MEDIA PATH LEVEL.
- TRANSPORT SIGNALING GATEWAY.(T-SGW)

  PROVIDES INTERWORKING WITH EXTERNAL NETWORKS Eg:- PSTN
- ROAMING SIGNALING GATEWAY.(R-SGW)

  PROVIDES SIGNALLING INTERWORKING WITH LEGACY MOBILE NETWORKS.

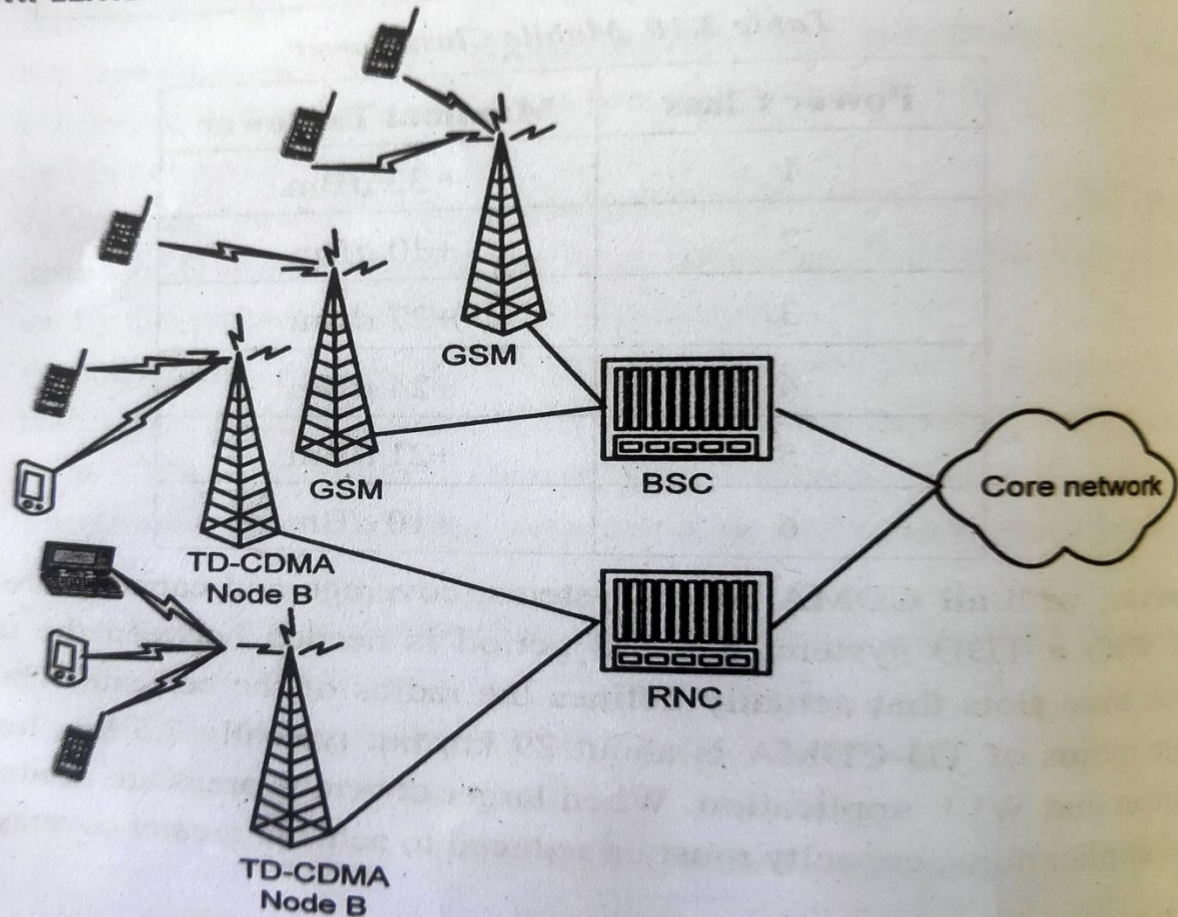# RADIO NETWORK- CHANNEL STRUCTURE

- In TD-CDMA AIR INTERFACE CONSISTS OF 15 TIME SLOTS, &

- EACH TIME SLOTS IS CONSISTS OF 12 SPREADING CODES.

- EACH TIME SLOTS 16 SEPARATE CODE ORTHOGONAL TO EACH OTHER.

RADIO NETWORK- CHANNEL STRUCTURE

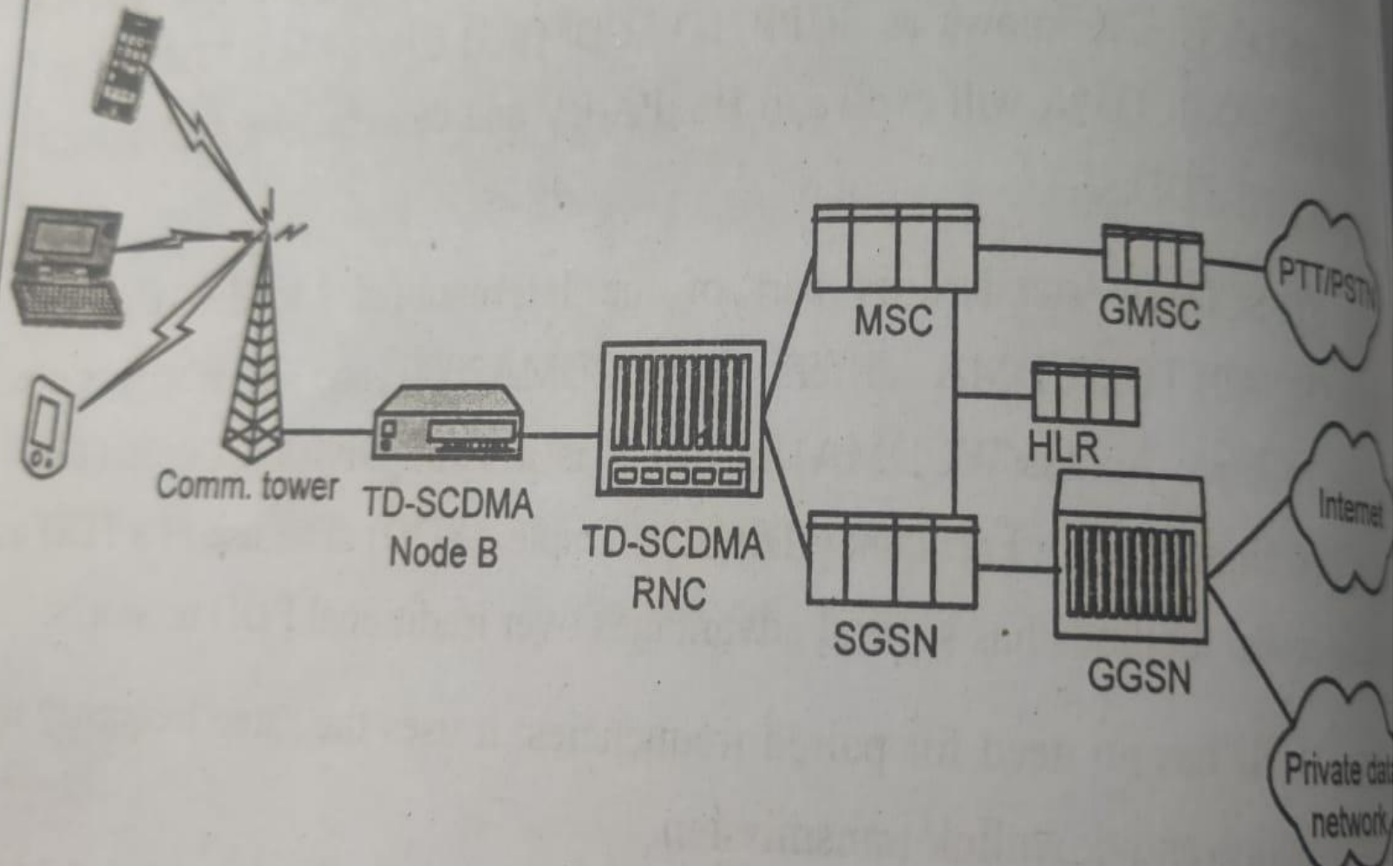Fig. 3.26. TD-CDMA radio channel structure
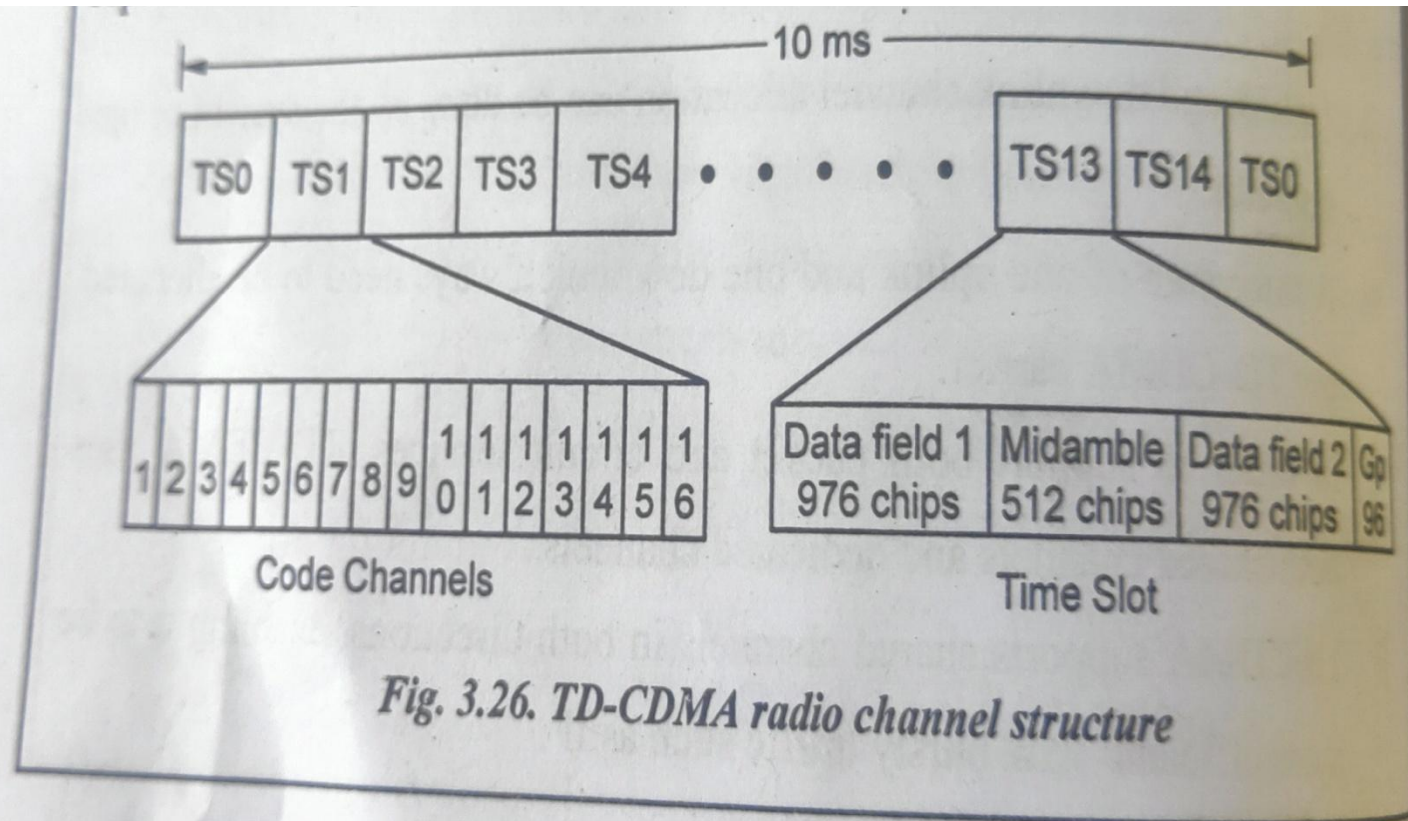
HANDOVER

3.9.7. IMPLEMENTATION

TD-SCDMA

- TIME DIVISION –SYNCHRONOUS CODE DIVISION MULTIPLE ACCESS-3G-CHINA.

GENERIC –TD-SCDMA

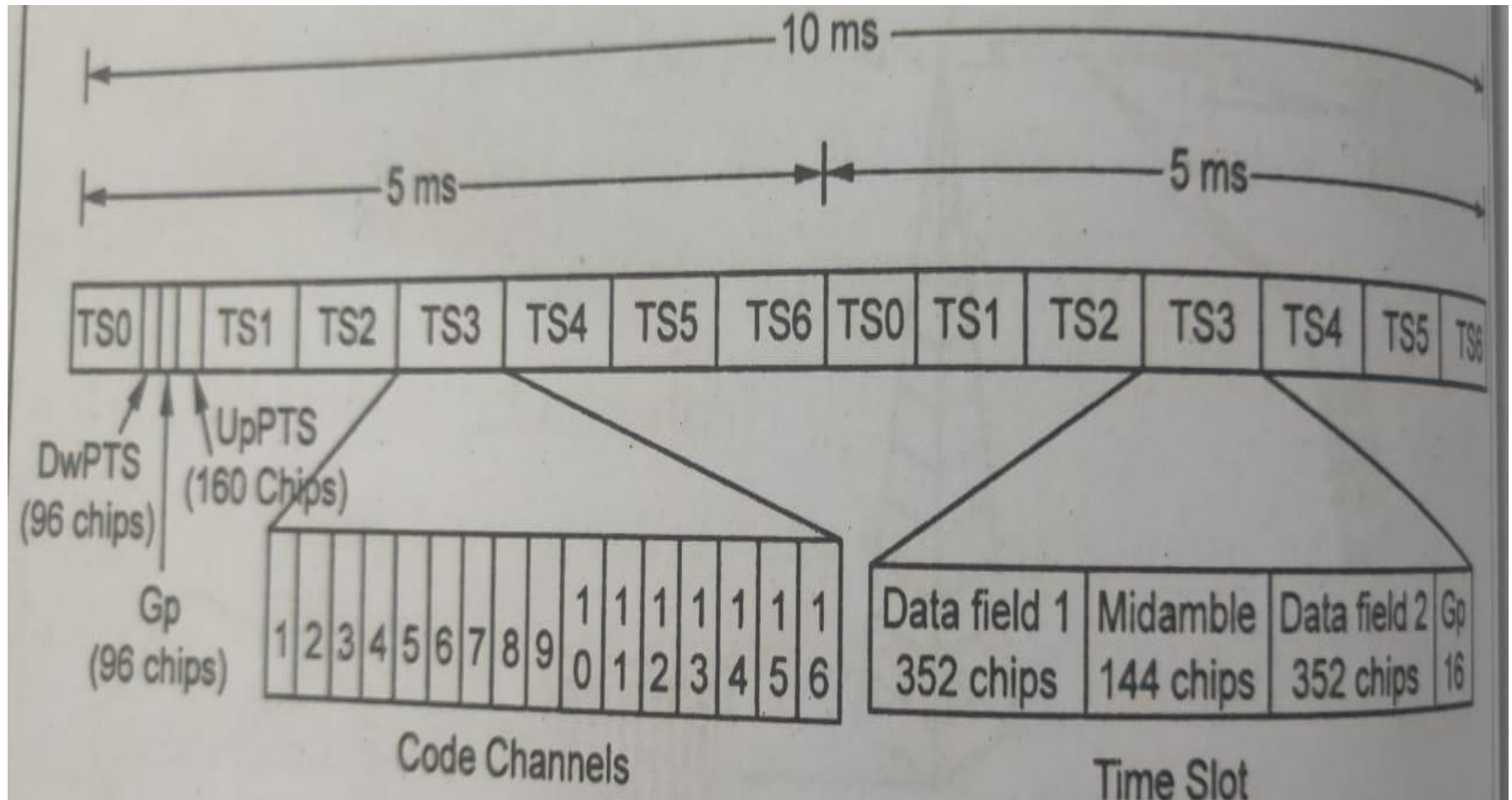# RADIO NETWORK

- SUPPORTS BOTH CIRCUIT SWITCHING, PACKET SWITCHING.

- TOTAL OF SEVEN TIME SLOTS FOR EACH TD-SCDMA CARRIER.

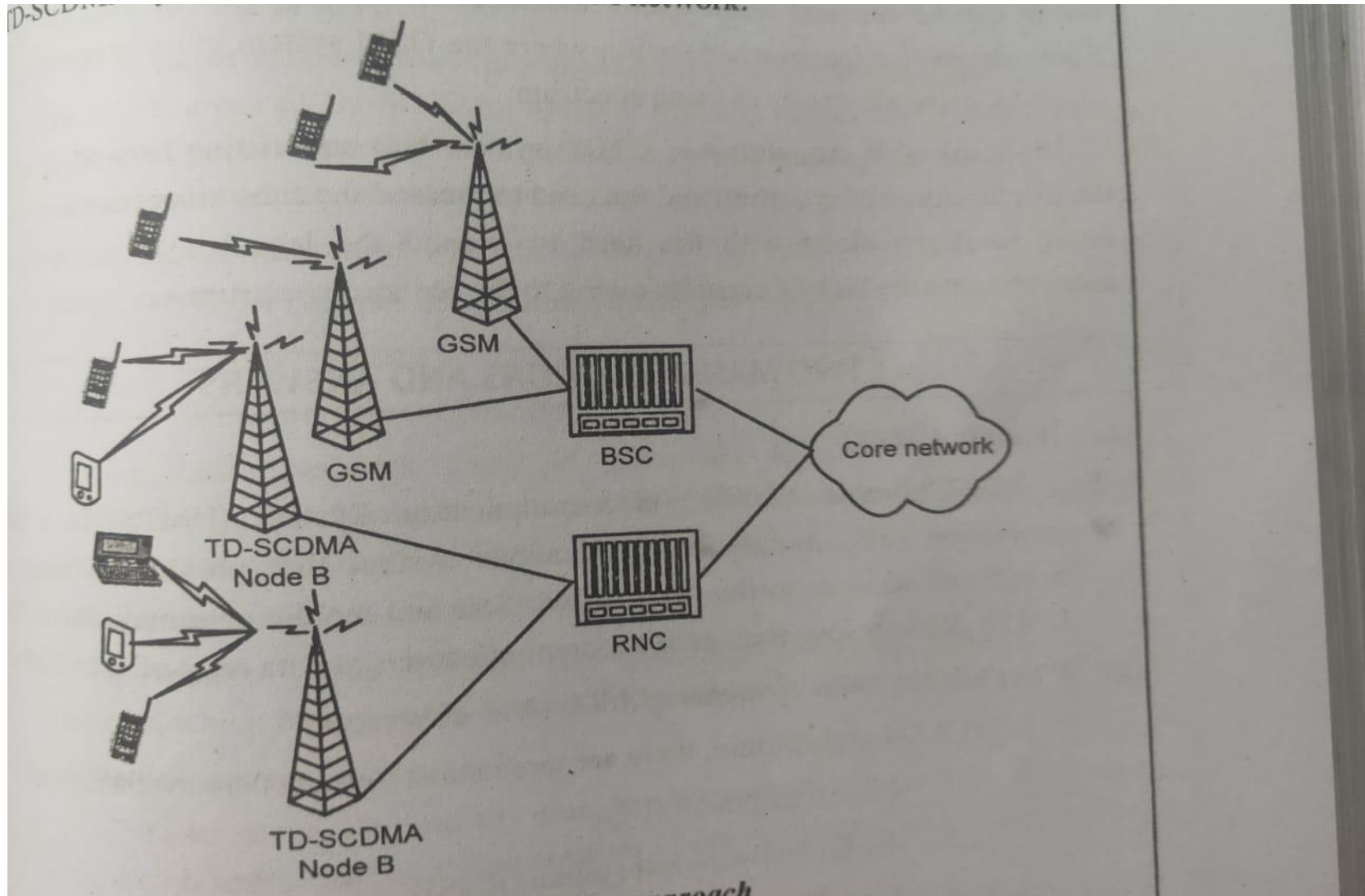- 16 SPREADING CODES.

RADIO NETWORK

HANDOVER

LONG TERM EVOLUTION

- LTE – PACKED SWITCHED SERVICES.

- IT AIMS TO PROVIDE SEAMLESS INTERNET PROTOCOL CONNECTIVITY BETWEEN USER EQUIPMENT AND PACKET DATA NETWORK.

- TOGOTHER LTE AND (SYSTEM ARCHITECTURE EVOLUTION) SAE COMPRISE THE EVOLVED PACKET SYSTEM(EPS).

Elements of the LTE System

LTE encompasses the evolution of

- Radio access through **E-UTRAN (eNodeB)**
- Non-radio aspects under the term System Architecture Evolution (**SAE**)

Entire system composed of LTE & SAE is called Evolved Packet System (**EPS**)

At a high level a LTE network is composed of

- Access network comprised of **E-UTRAN**
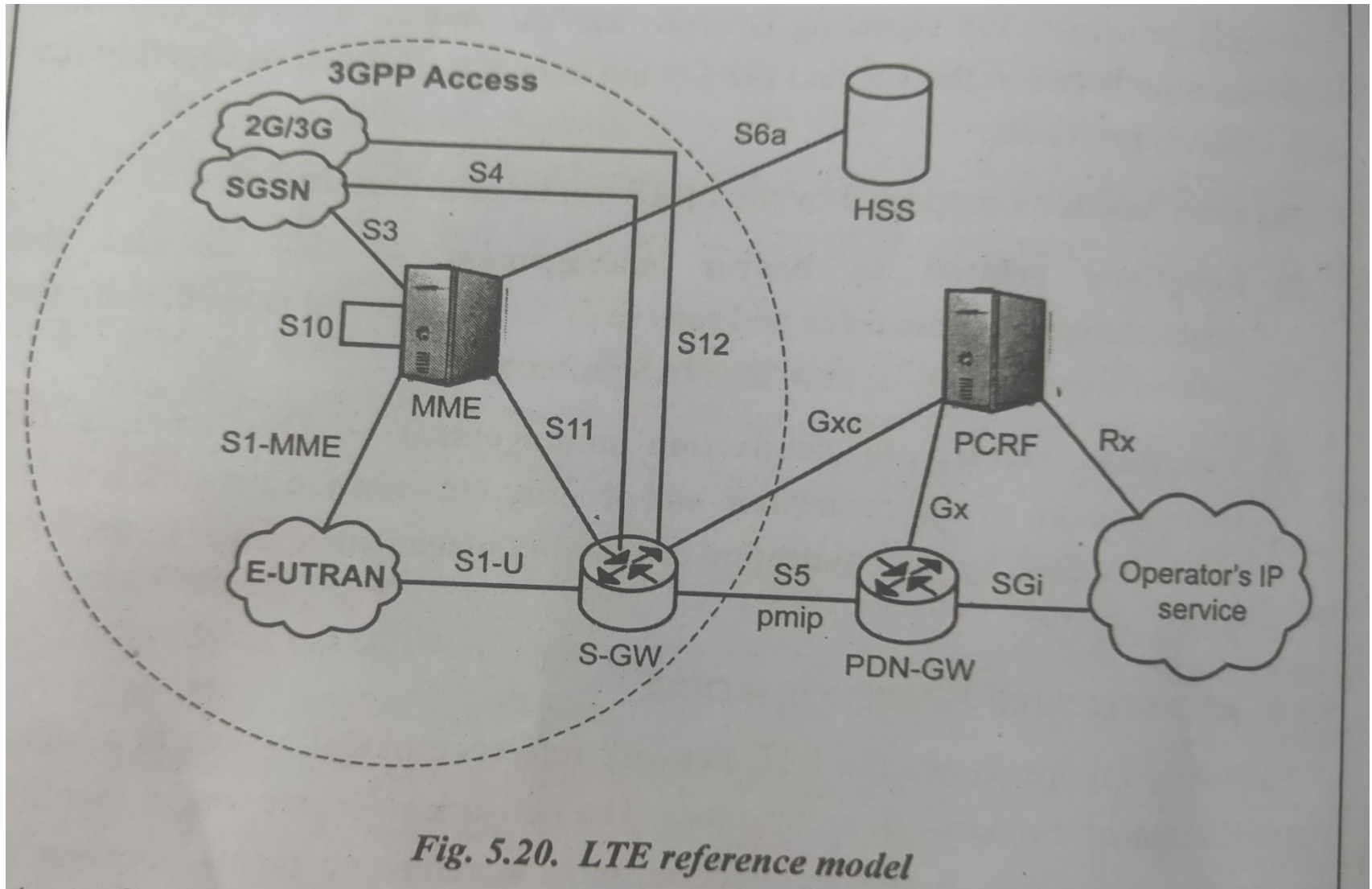- Core Network called Evolved Packet Core (**EPC**)

OVERALL ARCHIYECTURAL OVERVIEW

- EPS PROVIDES THE USER WITH IP CONNECTIVITY TO A PDN FOR ACCESSING THE INTERNET & SUPPORTS VoIP.

- IN ORDER TO PROVIDE DIFFERENT QoS STREAMS OR CONNECTIVITY TO DIFFERENT PDNs.

- Eg:- SIMULTANEOUSLY SUPPORT BOTH VoIP CALL AT THE SAME TIME PERFORMING WEB BROWSING OR FTP DOWNLOAD.

ARCHITECTURAL REFERENCE MODEL

- OVERALL ARCHITECTURE HAS TWO COMPONENTS:-

➢ THE ACCESS NETWORK.

➢THE CORE NETWORK.

ARCHITECTURAL REFERENCE MODEL

Fig. 5.20. LTE reference model

ARCHITECTURAL REFERENCE MODEL

- The access network is the EVOLVED UNIVERSAL TERRESTRIAL RADIO ACCESS NETWORK(E-UTRAN)

- THE CORE NETWORK IS ALL-IP CORE NETWORK AND IS FULLY PACKET SWITCHED SERVICE.

- THE CORE NETWORK- EVOLVED PACKET CORE(EPC)

- EPC- DESIGNED TO SUPPORT NON 3GPP ACCESS SUPPORTS FOR MOBILE IP..

ARCHITECTURAL REFERENCE MODEL

- EPC CONTAINS HOME SUBSCRIBER SERVER(HSS) – IN ORDER TO TRACK USER ACTIVITIES. (i.e AAA & POLICY AND CHARGING AND RULING FUNCTIONS- PCRF)
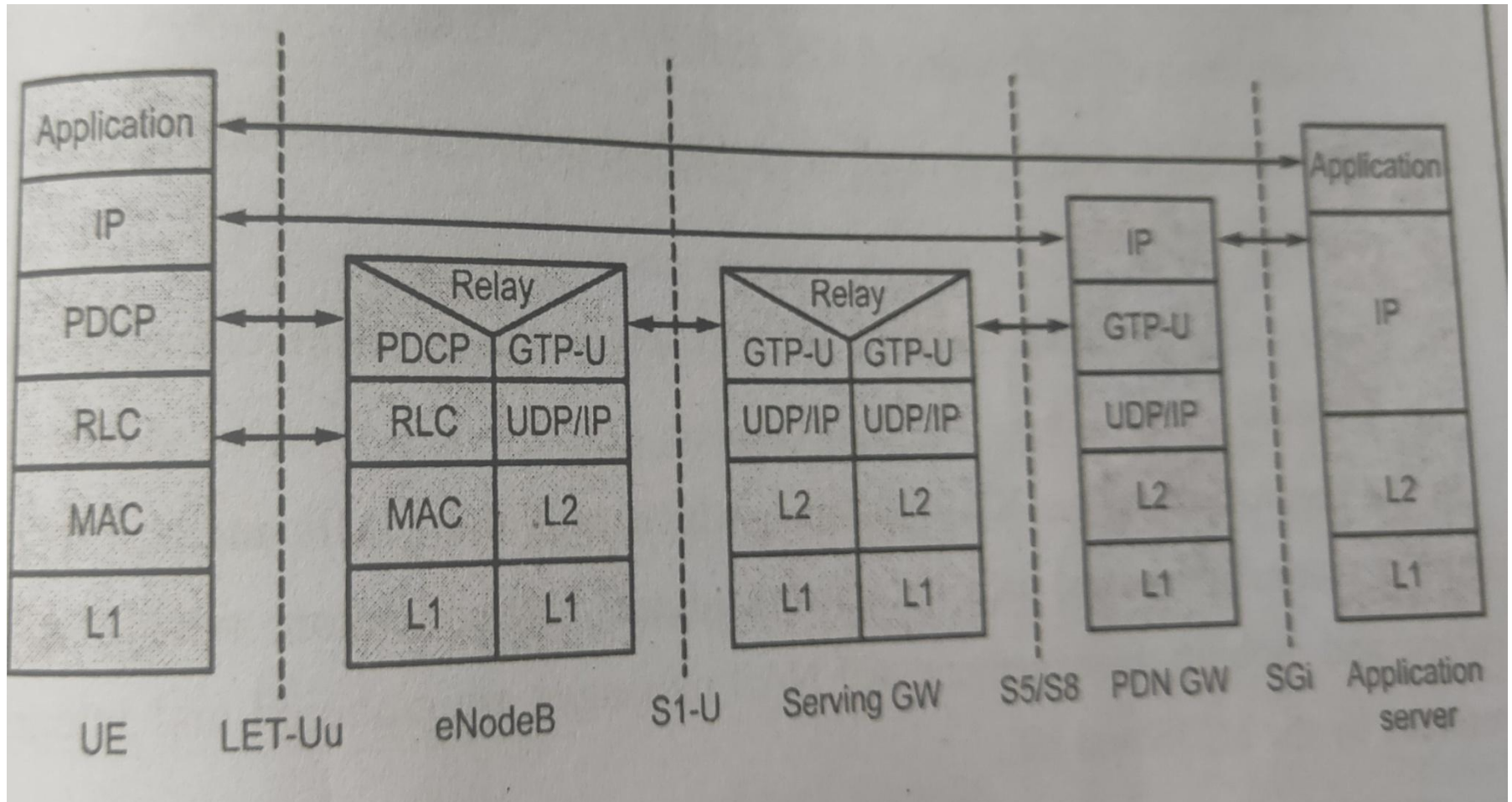
RADIO ACCESS NETWORK AND CORE NETWORK – COMBINED FUNCTIONS:-

- NETWORK ACCESS CONTROL FUNCTIONS.
- PACKET ROUTING AND TRANSFER FUNCTIONS.
- MOBILITY MANAGEMENT FUNCTIONS.
- SECURITY FUNCTIONS.
- RADIO RESOURCES MANAGEMENT FUNCTIONS.
- NETWORK MANAGEMENT FUNCTIONS.

PROTOCOL ARCHITECTURE

- EACH INTERFACE PROTOCOL STACK HAS TWO PLANES.

➢ USER PLANE- HANDLE DATA GENERATED BY USER.

➢ CONTROL PLANE TO HANDLE SIGNALING MESSAGE IN THE NETWORK & CONTROLLING THE CONNECTIONS BETWEEN THE UE AND THE NETWORK.

USER PLANE

CONTROL PLANE

Fig. 5.23. *Control plane end-to-end protocol stack*