Module 4- UMTS

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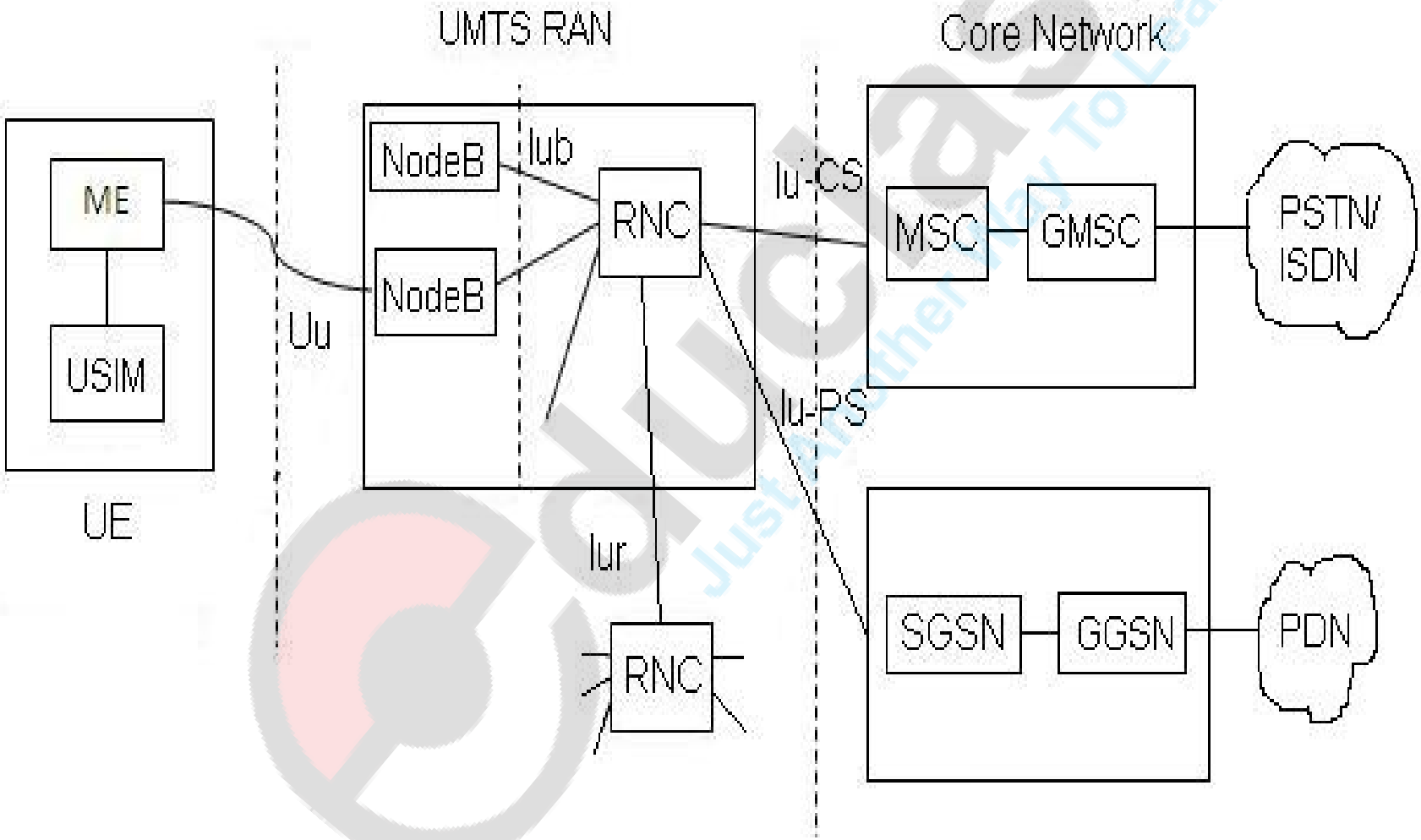
UMTS

- Universal Mobile Telecommunication Systems
- 3G standard
- Delivers high bandwidth data and voice services to mobile users
- Based on wideband CDMA technology
- To support voice,video and data together.
- Evolutions:
  - Release 99: based on WCDMA, part of GSM/GPRS can be used
  - Release 4: merge CS and PS into a single entity
  - Release 5: special control layer for multimedia- using IP multimedia subsystem(IMS)- extension to PS network

1. UMTS Network Architecture-R99



UMTS Network Architecture Components-I

- 3 main functional entities:
  - User Equipment (UE)
  - UMTS Radio access network (UTRAN)
  - Core network (CN)
- RAN is based on WCDMA and ATM(Asynchronous mode of transmission)
- **User Equipment (UE)**
  - Replaces MS in GSM/GPRS
  - New handset and new SIM, USIM(Universal SIM)
  - Every UE can contain one or more USIM simultaneously.
  - USIM is downloadable and can be accessed via the air interface and be modified by the network.

UMTS Network Architecture Components-II

- **Node B**
  - Base station in UMTS
  - Support higher data rates
  - Termination point between air interface and transmission network of the RAN.
  - Functions:
    - Power control
    - Reports the RNC
    - Combines the received signals coming from multiple sectors of the antenna that a UE is connected to.

UMTS Network Architecture Components-III

- **Radio Network Controller (RNC)**
  - Main element of RNS (radio network system)
  - Controls the usage and reliability of radio resources
  - Similar to BSC in GSM
  - Interfaced with MSC as well as SGSN
  - Interconnection to other RNCs
  - Main functionalities:
    - Call admission control
    - Radio bearer management
    - Power control
    - General Management control in connection to OMC

UMTS Network Architecture Components-IV

- 3 types of RNC
  - Serving RNC (SRNC)
    - Controlls user's mobility within UTRAN
  - Drift RNC (DRNC)
    - Receives connected Users that are drifted or handed over from SRNC cell connected to a different RNS.
  - Controlling RNC (CRNC)
    - Controls, configures and manages an RNS
    - Handles access request from UE

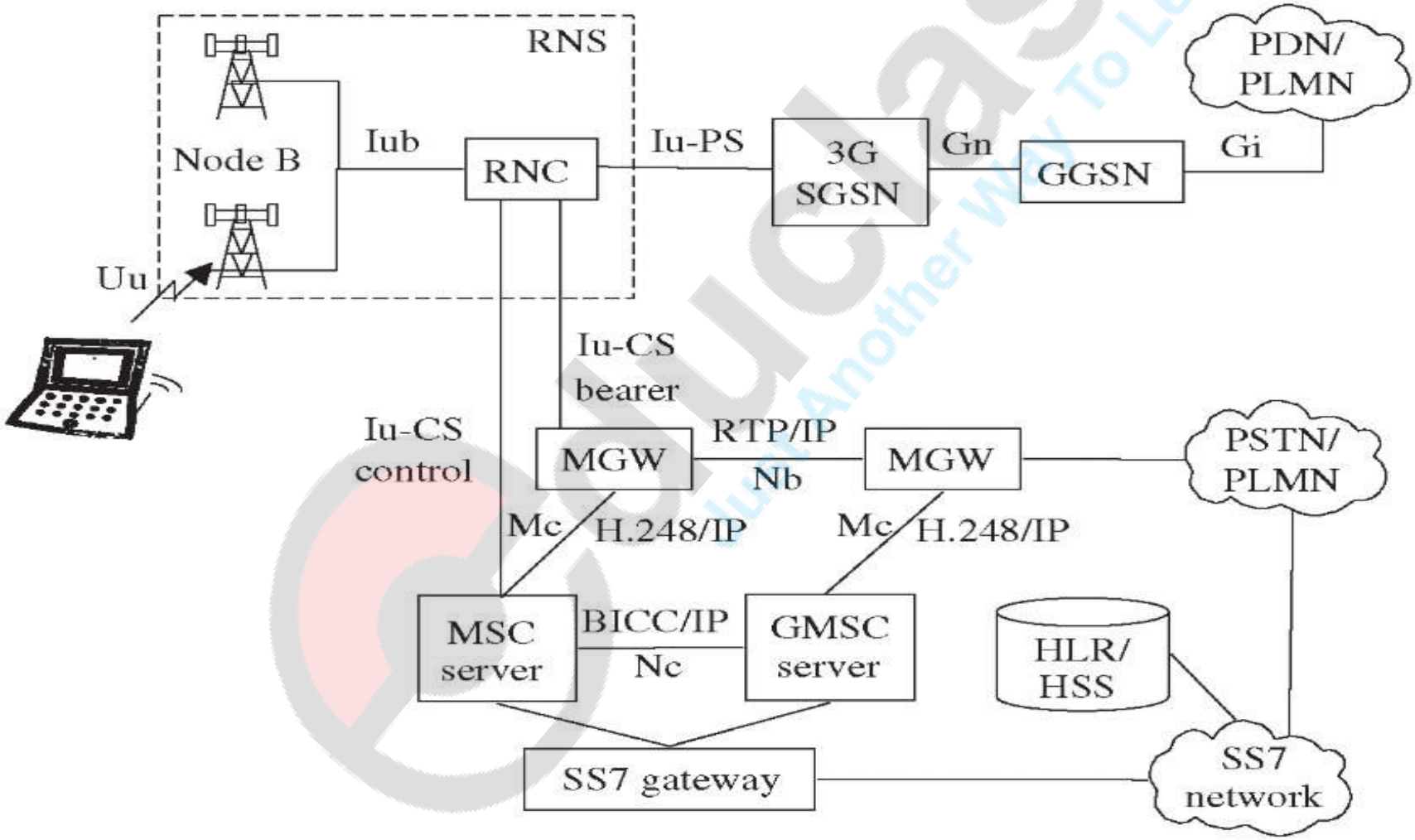
2. UMTS Interfaces

- New Interfaces:
  - Uu- radio interface between UE and Node B
  - Iub-interface between Node B and RNC
  - Iur- interface between RNC and RNC
  - Iu(CS)-interface between RNC and MSC for circuit switching
  - Iu(PS)-interface between RNC and SGSN for packet switching

3. Network Evolution-Release 4

- Merges separate circuit switched(MSC/VLR, GMSC) and packet switched(SGSN/SLR,GGSN) data into one based on IP network infrastructure
- Supports VoIP (Voice over internet protocol) technology
- New nodes are added to support VoIP:
  - MSC server
  - Media gateway (MGW)
  - Gateway MSC (GMSC)
- MGW
  - User traffic handling inside core network
  - Adaptation of circuit switched voice traffic to VoIP
  - Converts protocol for radio subsystem for fixed network like PSTN or pre-release 4 PLMN

Network Evolution-Release 4-Cont..



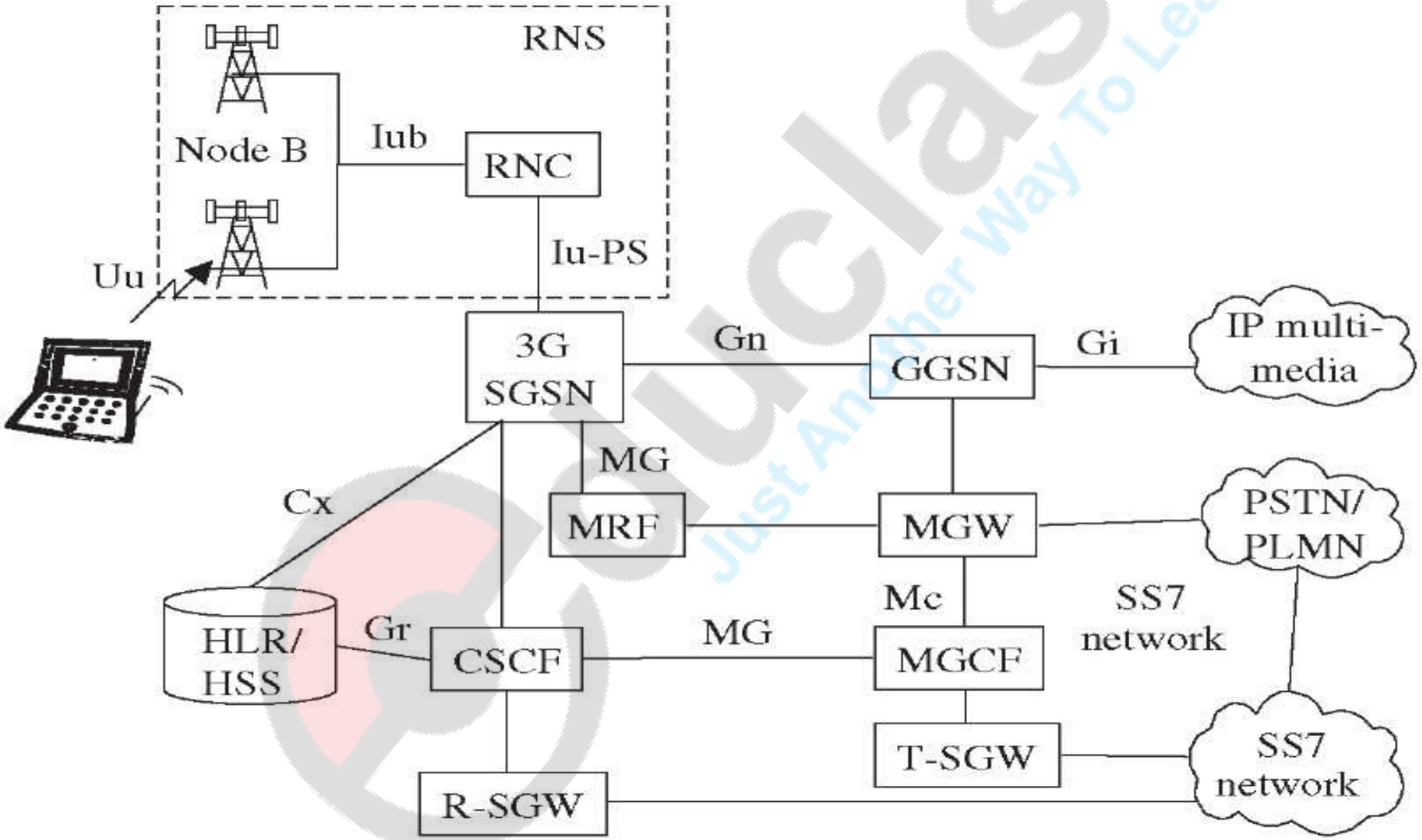
Network Evolution-Release 4- Cont..

- GMSC and MSC:
  - Call control and mobility management
- Uses ATM or IP in between MGW
- For IP, SGSN and MGW can be merged
- Core network consists of 2 parts:
  - IP based traffic network
  - SS7 signalling network
- GMSC and MSC are connected through H.248 protocol
- MGWs are connected through RTP(real time protocol)/UDP/IP protocols
- 2 additional gateways within IP based core network:
  - Transporting signalling gateway(T-SGW): call related signalling
  - Routing signalling gateway(R-SGW)-roaming, mobility management

Network Evolution-Release 4-cont..

- New interfaces:
  - Mc- between MGW and MSC servers
  - Nc- classical SS7 interface/ IP based
  - BICC(Bearer Independent Call Control)/ SIP(Session Initiation Protocol)- between MSC and GMSC servers
  - SCTP(Stream control transmission protocol) – for transporting SS7 message on an IP interface
  - On Mh interface- SS7 implemented over SCTP/IP

4. UMTS Release 5



UMTS Release 5- Cont..

- To provide IP oriented services by the operators
- Conventional Circuit switched domain replaced by enhanced IP based access completed by packet switching
- IP Multimedia subsystems(IMS) based network
- 2 components of IMS:
  - **CSCF-** Call state control function- entry point for signalling of incoming signals
  - **MGCF-** media gateway control function- internetworking with PSTN of CS network
- Contains integrated database **HSS**- Home Subscriber Server- provides subscriber profile information
- Session initiation protocol(**SIP**)- call and session control protocol

5. FDD and TDD

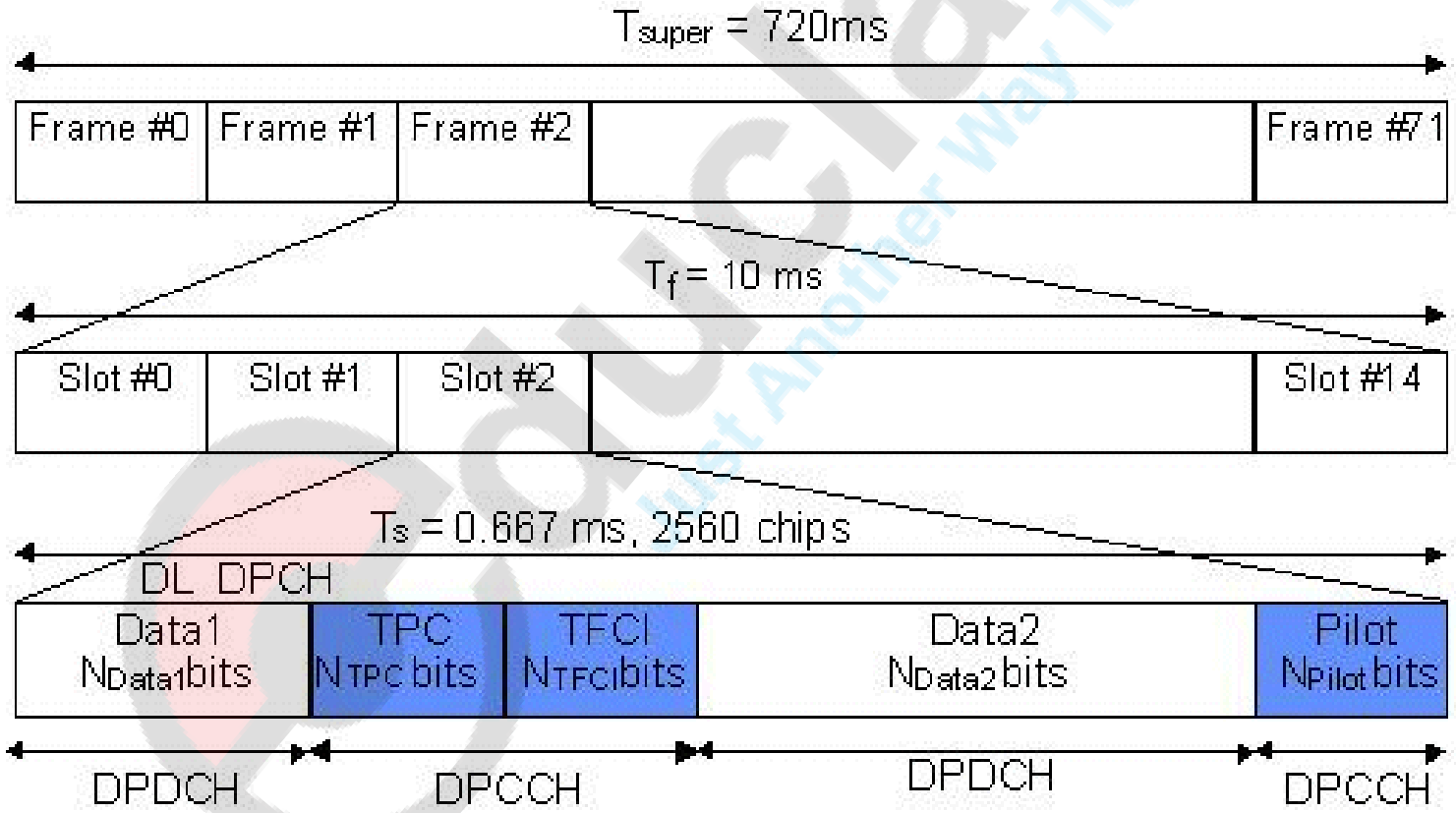
- Physical layer access is based on Wideband Direct Sequence CDMA with 2 duplex modes: FDD and TDD
- FDD- defined by code and frequency
- TDD- defined by code and time
- FDD
  - 1920-1980 MHz for uplink
  - 2110-2170 MHz for downlink
  - Min paired frequency allocation- 5 MHz
  - Frequency separation between uplink and downlink- 190 MHz
- TDD
  - 5 MHz unpaired band
  - Satellite uplink and downlink is 1980-2010 MHz and 2170-2200 MHz

6. Time Slots

- DPDCH- dedicated physical channel at the physical layer
- DPCCH- dedicated physical Control channel
- DPDCH and DPCCH are separated using different channelization codes for uplink transmission
- DPDCH and DPCCH are combined using TDM for downlink transmission
- **TPC**- Transmit Power Control
  - Used to control power in the downlink
  - 1 bit information
    - 0- power needs to be decreased
    - 1- power is up
- **FBI**- Feedback information- used to apply diversity techniques in the BTS, getting feedback from MS.
- **TFCI**- Transport Format Combination Indicator- used in order to inform the receiving side of the currently valid Transport Format Combination

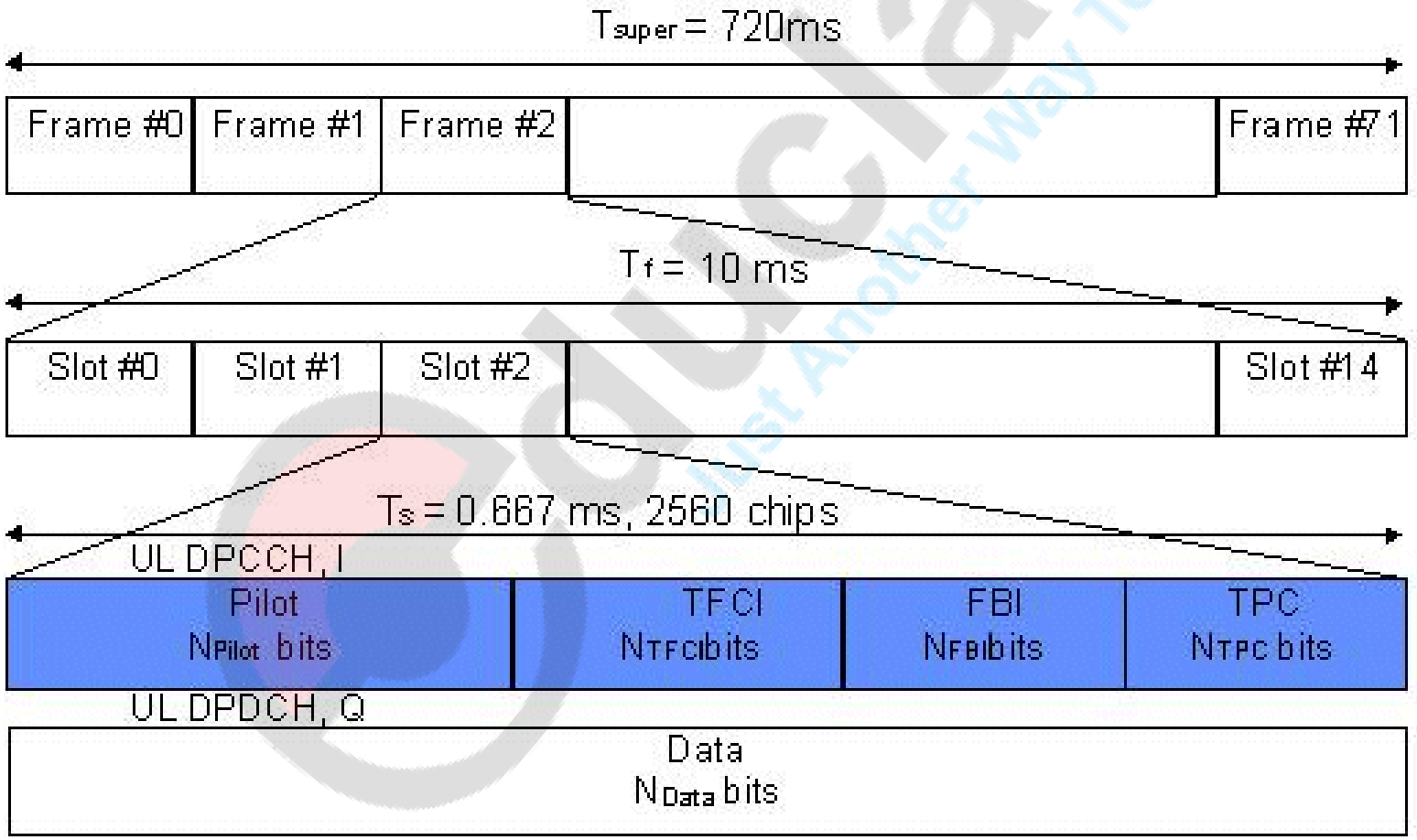
Time Slots- Cont..

- Downlink DPCH(Dedicated Physical channel) slot allocation



Time Slots- Cont..

- Uplink DPCH slot allocation

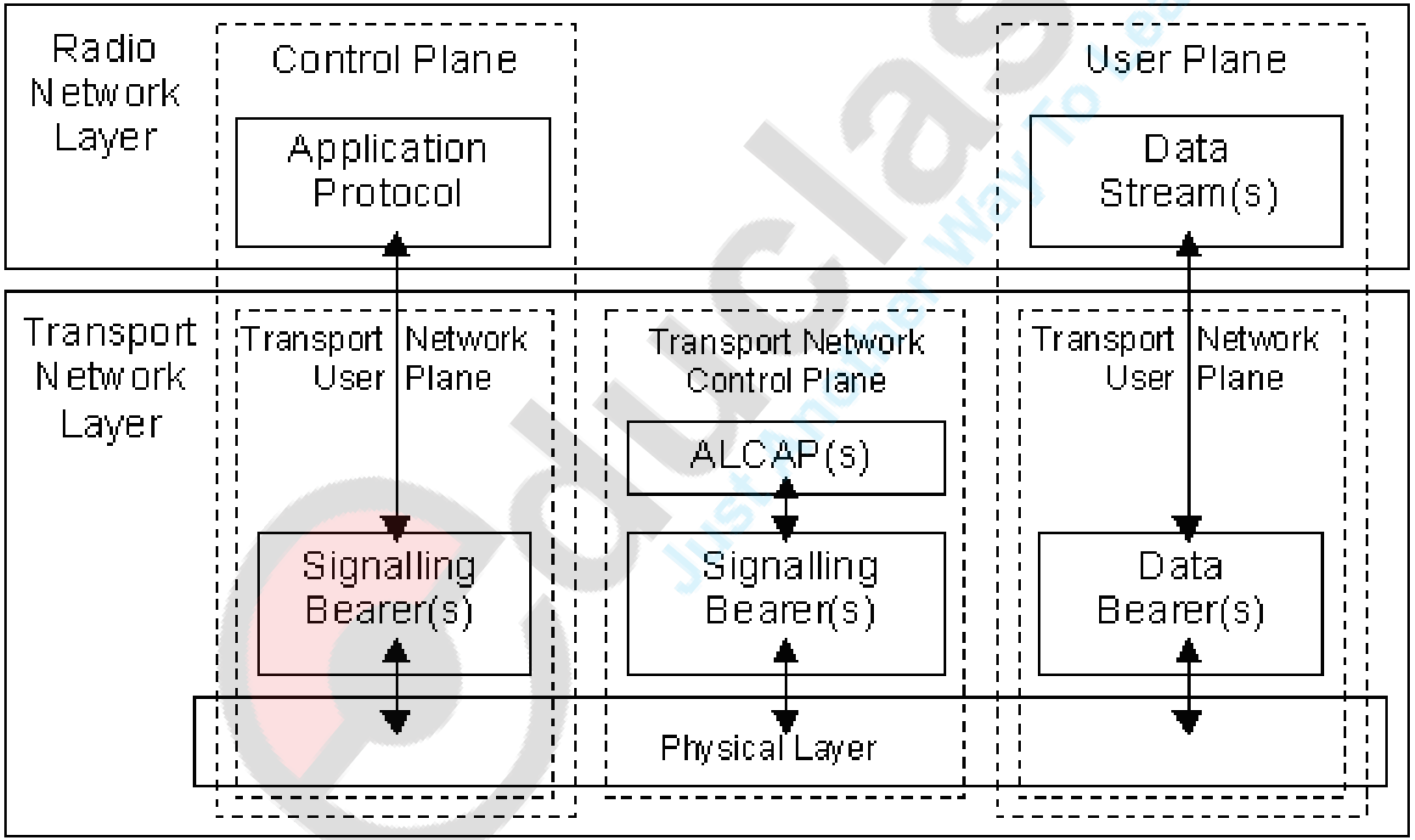


7. Network Protocol Architecture

- Divided into 3 layers:
  - Transport network layer
  - Radio network layer
  - System network layer
- Each layer is divided into user plane and control plane.

- **Transport network layer**
  - Allows communication between UTRAN and Core network
- **Radio network layer**
  - Provide management of radio interface and communication between UTRAN components and between UTRAN and UE.
- **System Network layer:**
  - Allows communication between CN and UE.

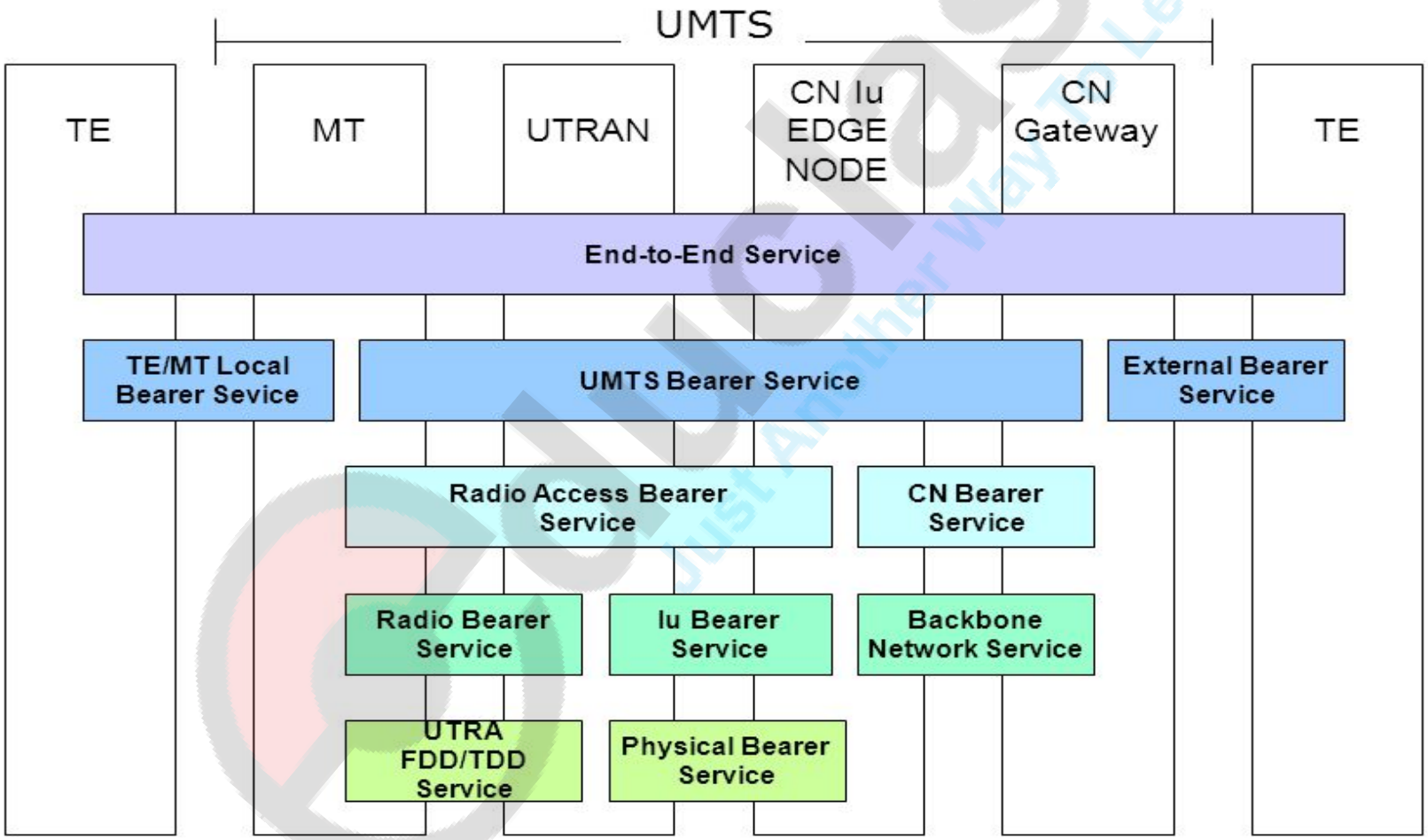
General Protocol Model



General Protocol Model-Cont..

- **Control plane:**
  - Application protocols
    - RANAP- RAN application part
    - RNSAP- Radio network subsystem application part
    - NBAP- Node B application part
    - Signalling Bearer- to transport application protocol messages
- **User plane:**
  - Data streams and data bearers
- **Transport network control plane:**
  - ALCAP- Access link control application protocol

8. Bearer Model



Bearer Model- Cont..

- A bearer service is a link between two points, which is defined by a certain set of characteristics.
- Whenever a UE is being provided with any service (CS/PS service), the service has to be associated with a Radio Bearer specifying the configuration for Layer-2 and Physical Layer in order to have its QOS clearly defined.
- Radio bearers are channels offered by Layer 2 to higher layers for the transfer of either user or control data.
- In other words, Layer 2 offers to the upper layers the service of information transmission between the UE and the UTRAN by means of the Radio Bearers (RBs) and Signaling Radio Bearers (SRBs).

Reference book

- Wireless Communications and Networks, 3G and Beyond, Second Edition, ITI Saha Misra, McGraw Hill Education-Chapter 11