ASK/Need/INFo

22 February 2018 22:19

C++, Oops, IPC, Thread

Multi threaded programming, synchronization and IPCs
Boost, Advanced C++ Library STL
OO Concepts, Design Patterns & UML

C programming skills with working experience on Common Data structure and algorithms
Expertise in ACLs, TCAM management, 802.1x/MAC Authentication, Access Security features like DHCP snooping, IP source guard, DDos mitigation

Excellent knowledge of Openstack, Dockers, Neutron, Nova.
Experience in NFV, SDN Projects, SDN Applications, SDN Controllers (e.g. OpenDaylight), SDN Data Plane and Openflow or related development.
TCP/IP networking, Routing,Switching
Knowledge on RESTful services and Message Broker system
Ansible, Salt, Puppet, Chef atleast any one
Alteast on of the frameworks like DJango, Flask etc.

Multi-threaded environment development experience

Layer 2, Layer 3, TCP/IP technologies, VLAN, IP, QOS, DHCP, 802.1x, IP forwarding, Routing Protocols.

Hands on experience in networking Switching, DPDK, Network Switches, SDN
Knowledge on Open Network Linux (ONL), ONOS, Open switch Specification is highly desirable

Strong in Data structures, Algorithms

Exposure to Carrier Ethernet
Experience in Ethernet, Layer 2, Layer 3, TCP/IP technologies, VLAN, IP, QOS, DHCP, 802.1x, IP forwarding, Routing Protocols.
Develop and execute feature and/or system integration test cases for networking protocols in L2 and L3 layers like LLDP, ARP, RIP, OSPF etc.,. Knowledge of switch debugging, topology creation, innovative testing to reproduce customer defects.

From <https://mail.yahoo.com/d/folders/1>

Development with Real time OS, Embedded Linux, OSE

Worked in Agile development environment

C/C++; Java/Python

Scripting Skills in Ansible-playbook / Ruby / puppet/ REST/ Platform tools

Networking/SDN

1 year or more development experience in Networking (Switching, SDN)
Hands on experience in networking â€“ Switching, DPDK, Network Switches, SDN
Python programing (basic/advance/REST-API/Jira/Flask is okay)

From <https://mail.yahoo.com/d/folders/1>

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Mav

GNU toolchain over Linux platform.

OOAD and problem solving skills.
Good understanding of multi-threading, IPC, memory management and other OS level concepts.
Knowledge of IPv4/IPv6 networking and transport layer protocols such as TCP/UDP/SCTP.
Knowledge of telecom protocols like S1AP, NAS, Diameter, Radius, GTPC, RANAP, SS7 etc.

should have good IE level understanding of MIB/SIB/RRC attach procedure/HO procedure/re-establishment/cell reselction etc
rocedures like : UL/DL processing chain, CQI/RI/PMI reporting, DCI formats, MIMO, CA etc.
RLC/PDCP is also good to have skillset
Knowledge of L1 testing using test tools from Agilent, R&S (CMW500)

- Familiarity with JTAG, Lauterbach debugging or modem platform debugging environment.

Solid knowledge of LTE Access Stratum protocol layers and procedures required.
Hands on Testing Experience in any of recognized Router/Switching/FW platforms

Knowledge of TCP/IP, SNMP, IPSec, Radius
knowledge of test analysis tools like Wireshark , QXDM, VR5 , Spectrum Analyser etc

Desired Technology Knowledge on:

- Switches and IP Networking Fundamentals.
- Internet Protocols: TCP/UDP/IPv4/IPv6
- Expertise in one of the below technical areas
- **Layer 2:**
  - Data center & Switching technologies
  - STP,RSTP,MSTP
  - Access control, DHCP,Dot1X,POE
  - Virtual chassis, clustering
- **Layer 3:**

Knowledge of Embedded C & Assembly programming
- Working experience in communication protocol CAN, LIN, Flexray, Ethernet
- Working experience diagnostic protocol (UDS)
- Working experience with CANoe, CANalyzer
- Working experience with AUTOSAR architecture, MCAL drivers

From <https://www.naukri.com/mnjuser/inbox>

Worked on L2/L3 protocols like VLAN, OSPF, IPSec, RSVP, Metro Ethernet, LLDP, LAG etc

From <https://www.naukri.com/mnjuser/inbox>

- Routing and routed protocols
- MPLS, LDP, RSVP,L3VPN,L2VPN
- OSPF,ISIS,BGP

- **Platform specific features:**
  - COS ,Firewall,ACL
  - Schedulers ,Rate limiters
  - Virtualization technologies
  - Multi chassis, clustering

From <https://careers.juniper.net/careers/careers/jobdescription.html?jid=938337>

From <https://my.naukri.com/Inbox/viewConversation?id=&conversationId=7810250945>

Hands on experience in WLAN networks,RF,Microwave Technologies,L2 configurations,MPLS-VPN Networking,Transmission Technology,Configuration and troubleshooting of Wireless Modems,WAP,RF Radios,Switches and Routers.

>

Switch switches within the subnet, that is switching. In switching packets are transfered from source to destination using MAC address. Switching is done within the network.

Whereas Router routes between the network. Routing is a process which is done between two networks using IP addresses.

- 1 to 3 years of Test experience in LTE UE Protocols (RRC/PDCP/RLC/MAC/PHY) and various feature and respective call flows - Experience to test UE stability and performance and end-to-end integration with EPC.
- Knowledge of IMS, TCP, UDP, SCTP, IPSEC is highly desirable. - Knowledge on 5G is desirable.
- Experience in one of the scripting language e.g. shell, python, perl, etc., automation tools, test tools used in end-to-end LTE network testing - LTE/5G NR Protocol Testing, Functional Testing, Sanity test, Operator testing, Regression, Error verification etc. - Perform the testing activities in network operators & vendor laboratories if needed. - Preliminary log analysis for failure test cases, Collect, analyze and compile FT results and log files and deliver these to project teams and Error Data Base. - Raise issues with accurate description, issues retest, ad-hoc issues retest in the correct environment and deliver accurate feedback to the project for the same.

Necessary Skills / Attributes

- Hands-on in generating test cases/test plans based out of requirements/3GPP Specifications. (In the above technical domain) - Hands on Planning/building test bed, test execution and debugging skills. - Ability to understand network scenario and come up with test cases beyond standard specification is
- Highly desirable. - Good Attitude towards learning new technologies and Aptitude skills - Mobile testing with telecom network in 2G/3G/4G and network lab equipment testing experience is highly desirable.

Mandatory skills - *P*ython, any RDBMS, Data Structure and Algorithm
Optional skills - AWS, OOPS Concept, Redis, HTML, CSS, JavaScript, and JQuery

From <https://www.naukri.com/mnjuser/inbox>

Working experience in Embedded C and micro controller programming
â€¢ Working experience in projects based on AUTOSAR architecture.
â€¢ Working experience in communication protocol (CAN, LIN, SPI)
â€¢ Working experience with CANoe, CANalyzer and CAPL scripting

Broadcom experience in routing / switching architecture
Broadcom HAL experience in L3 routing and sync of routing tables
Preferable: Experience with HA (High availability). HA synchronisation with switch architecture

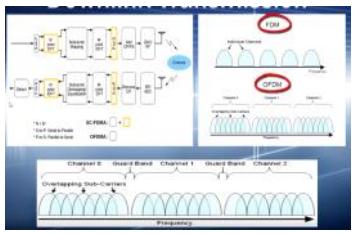
Lte physical layer

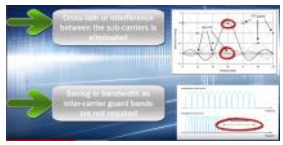
21 February 2018 07:10

Quantization:
is the process of mapping input values from a large set (often a continuous set) to output values in a (countable) smaller set. Rounding and truncation are typical examples of quantization processes.

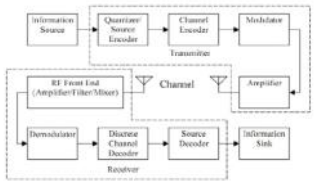
Source encoder(quantization):
Source coding is much about removing the redundant data or the data which is not that important for the data to be conveyed to the receiver, I mean the extra data.
Huffman Coding , Lempel-Ziv coding

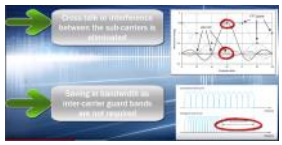
Channel coding
Channel coding is more about adding some extra bits in the form of parity bits so that you can protect the data from being becoming corrupt.
linear block codes, cyclic codes and convolutional codes





Block diagram of a communication system





DI		OFDMA
UL		SDFMA

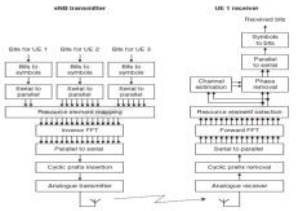
Inter symbol interference(ISI) :
When multiple signal path combine at ue sometime constructive interference and sometimes destructive
Cdma use rate receiver

OFDMA:
Larger no of close spaced orthogonal subcarrier are used to carry data in serval parallel data streams other words OFDMA divide the incoming high speed data stream into serval low rate data stream and each data stream is mapped to one of the closed spaced orthogonal subcarrier and is used to modulate this subcarrier using varying level of QAM modulation (QPSK,QAM,64QAM) depend on signal quality
i.e each carrier is independently modulated.
each carrier in OFDMA is liner combination of the instantaneous symbol on each of sub carrier in the channel.
Subcarriers are chosen in such a way that they are harmonics (integer multiples of the lowest subcarrier => Fc, 2Fc, 3Fc, 4Fc, 5Fc
Subcarrier spacing is constant.
Symbol duration = t = 1/Fc

->crosstalk is eliminated
->saving bandwidth in intercarrier guard band is not required

Each OFDMA symbol have cyclic prefix to prevent ISI caused by multiband delay spread Cyclic prefix represent the guard period at starting of

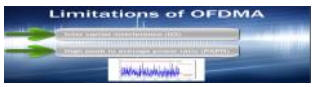
Duration of guard period > multipath delay spread then only ISI is prevented
Short and long both type of cyclic prefix is there

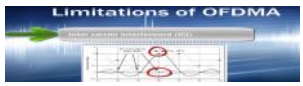


Limitation of OFDMA:
1.(Inter carrier interference ICI)
At receiver during demodulation receive signal + local OXCO of receiver

Should both have identical frequency but not the case as internal OXCO drifts
Therefore base station send periodic synchronization signals to receiver.

2.High peak to average power ratio(PAPR):
The **peak-to-average power ratio** (**PAPR**) is the **peak** amplitude squared (giving the **peak power**) divided by the RMS value squared (giving the **average power**). It is the square of the crest factor: ... As it is a **power ratio**, it is normally expressed in decibels (dB).





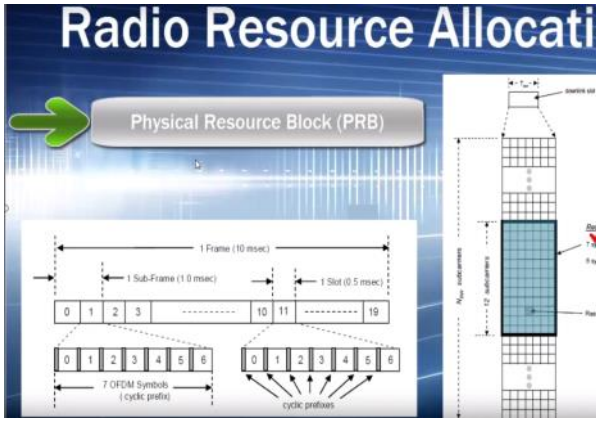
Frame structure:
FDD:
TDD:
d:downlink ,U:uplink
S frame: special

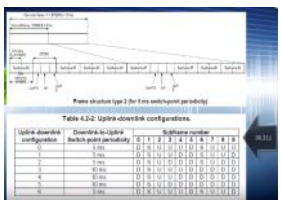
DwPts	downlink pilot time slot: syn +user data+dlchennel for sheduling and control info
GP	Guard period
UpPts	used to transmitting PRACH + sounding ref signal

1ms= dwpts + gp + uppts

Physical resource block:
The smallest element of resource allocation that can be assigned by bTS scheduler to mobile is callecd PRB.

PRB:12 sub carrier duration of 0.5ms +
Normal= 1 subcarrier = 7OFDMA symbols

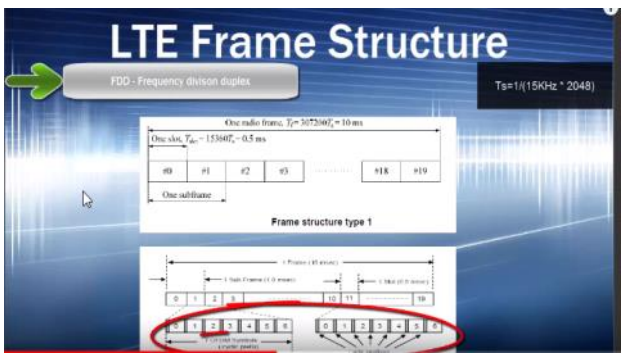




FFT Size:
FFT size is "IDFT(Tx)/DFT(Rx) size

The number of spectral lines is always 1/2 of the selected FFT size.
Therefore :1024 point FFT produces 512 output spectral lines

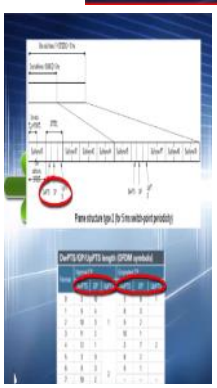
The frequency resolution of each spectral line is equal to the Sampling Rate divided by the FFT size.
For instance, if the FFT size is 1024 and the Sampling Rate is 8192, the resolution of each spectral line will be:
8192 / 1024 = 8 Hz.

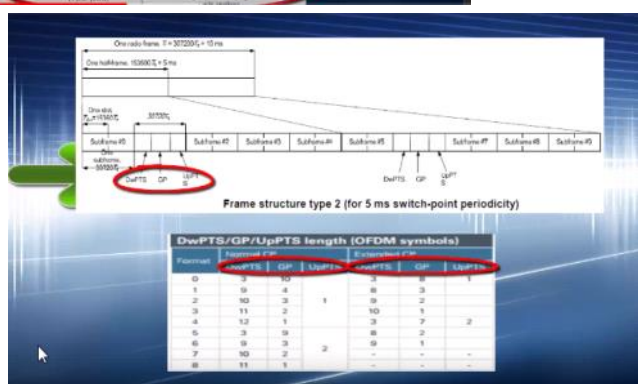


Physical signals:

Downlink physical signal: do not convey information to or from higher layers
1.Reference signals
Use to determine channel impulse response (CIR),carrier off set estimate channel estimation, timing sync for coherent demodulation
CIR is calculated by reference signals(if one sending channel response in MIMO then other is adhoc, when CIR is known data can be transmitted by both simultaneously)
Reference Transmitted by every 6 subcarriers,
They are staggered in time and frequency domain
510 unique ref signals
Specified ref signal is assigned to each cell within a network and acts as cell specific identifier
when UE have to figure out downlink power it take power of this reference signal
2.Synchronization signals:
PSS(primary synchronization signal):Zadoff chu sequence (0,1,2)
Zadoff-Chu sequence
Three sequences possible (0, 1, 2)
Mobile receives incoming signal for a time of at least 5 ms and compares with those three root sequences N(2)-ID

SSS(secondary synchronization signal):
Pseudo-random sequences known as Gold sequences
Different for the first and second transmission of the signal within the frame
Exact sequence indicates the cell identity group N(1)-ID





Physical cell identify

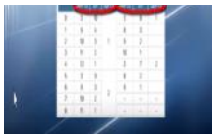
- $N_{ID}^{cell} = 3N_{ID}^{(1)} + N_{ID}^{(2)}$

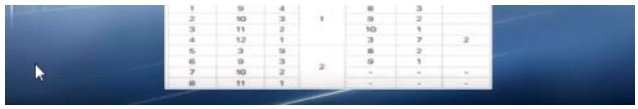
A number between 0 and 503
Transmitted on synchronization signals
N(2)-ID is the cell identity within the group, which runs from 0 to 2 and is signalled using the PSS
N(1)-ID is the cell identity group, which runs from 0 to 167 and is signalled using the SSS

Uplink physical signals:
DRS: demodulation reference signal
channel estimation
SRS: sounding reference signal
scheduling
Uplink transmission:

Lte in UL uses SC FDMA
-->lower PAPR
Misleading term
A multicarrier scheme

A multicarrier scheme





Link Adaption :

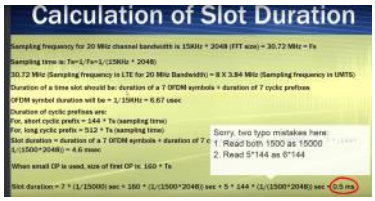
1.Power control without fixed rate(main target: voice/control , Goal: reliable communication)

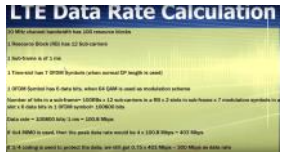
2.Rate control without fixed power(main : data, Goal: Fast data rate)

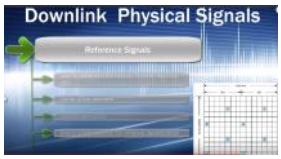
Power and Rate control

Techniques:
Outer loop link adaptation

Channel quality indicator +HRQ+power control







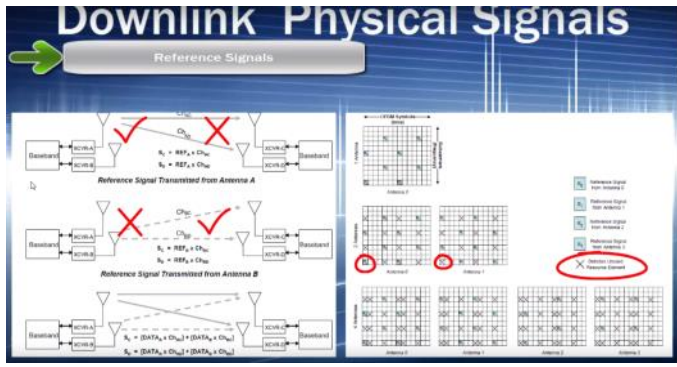
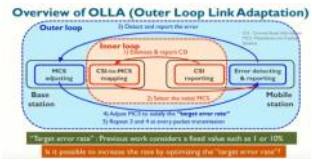


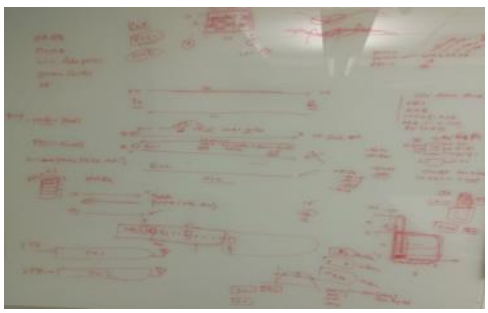
Table 6.6 Physical signals

Signal	Release	Name	Use	Direction
DRS	R8	Demodulation reference signal	Channel estimation	UL
SRS	R8	Sounding reference signal	Scheduling	
PSS	R8	Primary synchronization signal	Acquisition	DL
SSS	R8	Secondary synchronization signal	Acquisition	
RS	R8	Cell specific reference signal	Channel estimation and scheduling	DL
	R8	UE specific reference signal	Channel estimation	
	R8/R9	MBMS reference signal	Channel estimation	
	R9	Positioning reference signal	Location services	
	R10	CSI reference signal	Scheduling	

Table 6.5 Physical control channels

Channel	Release	Name	Information carried	Direction
PUCCH	R8	Physical uplink control channel	UCI	UL
PCFICH	R8	Physical control format indicator channel	CFI	DL
PHICH	R8	Physical hybrid ARQ indicator channel	HI	
PDCCH	R8	Physical downlink control channel	DCI	
R-PDCCH	R10	Relay physical downlink control channel	DCI	
EPDCCH	R11	Enhanced physical downlink control channel	DCI	

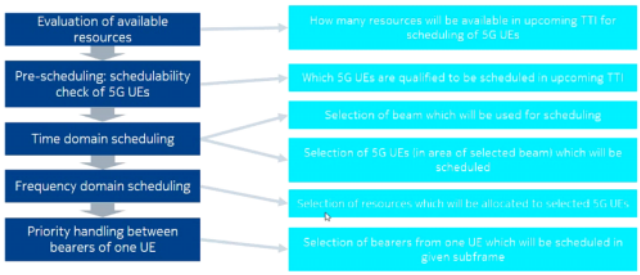




Technical Details

Scheduling process overview

- All of presented steps are done every TTI and separately for downlink and uplink



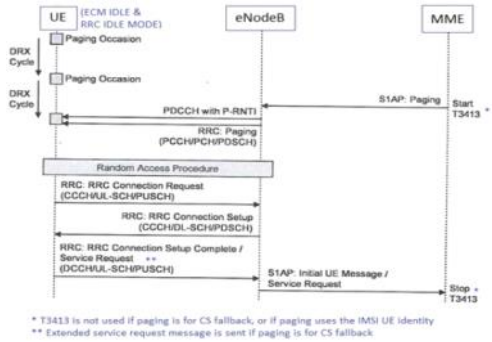
Massive MIMO:

extra anttena-->focusing energy in small regions of space to bring -->huge improvement in troughput and energy efficiency

challenges:
low cost components
synchronization of terminal
reduction in internal power consuption

20 February 2018 11:52

LTE call flow
Handover,(intra rat, x2 ,x1)
Debugging,
Spec:36.331,->lte rrc
36.413->s1ap(enodeb and mme)
38->5g->



Mobile start listening

Send RACH:	Random access procedure	hey I am here

Two part

RAPID=64 values	Random access preamble identity
RA-RNTI: decide time and frequency slot	RA radio network temp identity

RACH response	Rapid and time RA
Message 3	Very small
Message 5	Big message NAS req /PDN connection request

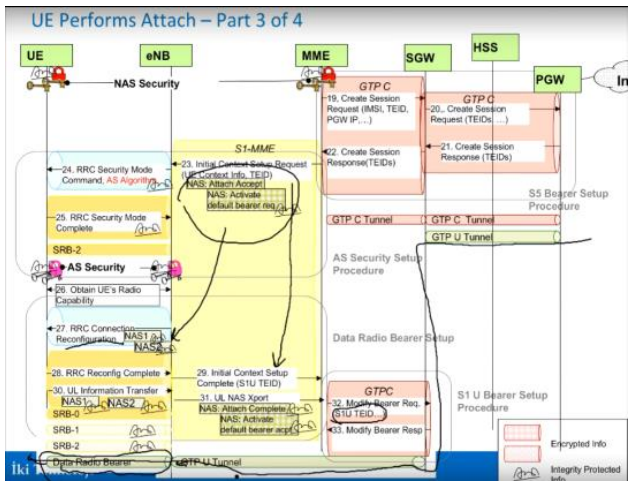
when RACH happens? prach(wcdma),channel request(gsm)

From <http://www.sharetechnote.com/html/RACH_LTE.html#Why_RACH>

intial access from rrc idle	
rrc contention reeastibishment	
handover(contention based and non contention based)	

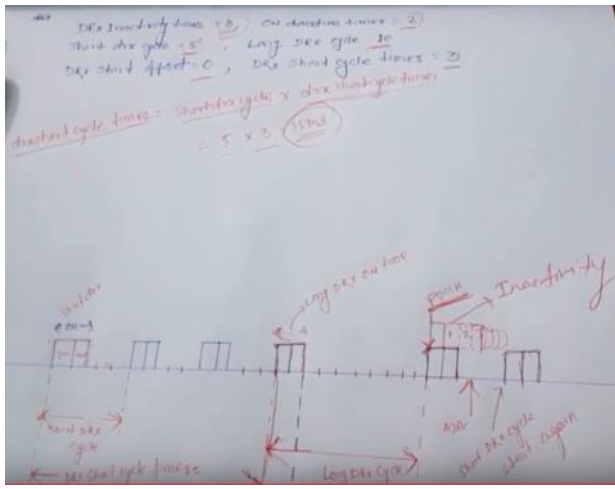
UE attach steps:

Power on UE	UE power on (MM/RR/PLMID) taken from USIM application)
Steps	Initiated by
Random access procedure	1. UE sends Random access preamble: (64 preamble ,RA-RNTI if contention based, zadoff chu seq->FDD) 2. Random access response: Temp CRNTI(RAPID+RANTI) 3. RRC connection req (UE->enb): S-TMSI ,SRB-0 4. RRC connection setup(enb->ue):CRNTI 5. RRC connection setup Complete(UE->ENB):SRB-1,IMSI NAS PDU (EMM attach req: old GUTI or IMSI, ESM PDN connectivity req)
User authentication S6a(MME -> HSS)	1. s1ap initial attach(Enb->mme): 2. Diameter authentication info(MME->HSS):Req IMSI,PLMID 3. Diameter authentication answer(HSS->MME):RAND atu ,Sres,KASME 4. S1AP DL NAS Transport(MME->ENB):EMM athu req {RAND,AUTN} 5. RRC DL info transfer(ENB->UE) :NAS EMM PDU 6. Ue ->UESIM:UISIM authenticate, to get SRES and CK 7. RRC UL info transfer->NAS EMM Authentication uplink response 8. S1AP uplink transport(ENB->MME)->NAS EMM PDU MME compare SRES from UE and HSS
NAS security setup	1. EMM security mode command over RRC/s1ap transport(MME->UE) 2. EMM security mode complete over RRC/s1ap transport(UE->MME) ->algo for encryption and integity protection
Authorization	Update location req (MME-HSS):IMSI, visited PLMID, RAT type Update location answer: subscription data
S5 bearer setup	MME does SGW and PGW selection 1. GTP-C create session req(MME->SGW);(IMSI, APN, PGW S5/S8 address/F-TEID, PDN type, EPS Bearer ID, Default EPS QoS, Aggregate Maximum Bit Rate, PDN address (fixed?), PCO). 2. GTP-
AS security setup	1. S1AP-intial(S1 MME MME->ENB) context setup Request 2. RRC AS security mode command (ENB->UE):cyphering and intregity algo 3. RRC reconfiguration(ENB->UE):(EPS bearer id, DRBid, Radio configs) 4. RRC security mode complete 5. RRC connection reconfiguration complete 6. S1AP-intial context setup response complete(Enb->MME)
Data Radio bearer setup (Between UE and ENB) And S1U bearer setup	1. EMM attach complete over RRC/S1AP(UE->MME): (MME would trigger GTP-C procedure towards SGW to inform eNB related details to SGW.) 2. GTP-C Modify bearer req(MME->SGW): 3. Modify bearer res 4. User uplink data through DRB (UE->ENB): 5. User uplink data through GTP Tunnel (ENB->SGW):S11 6. User uplink data through GTP Tunnel (SGW->PGW):S5/s8
DHCP client ,server	This complete LTE initial attach procedure. UE is attached, default bearer active. RRC-Connected, EMM-Registered, ECM-Connected state.

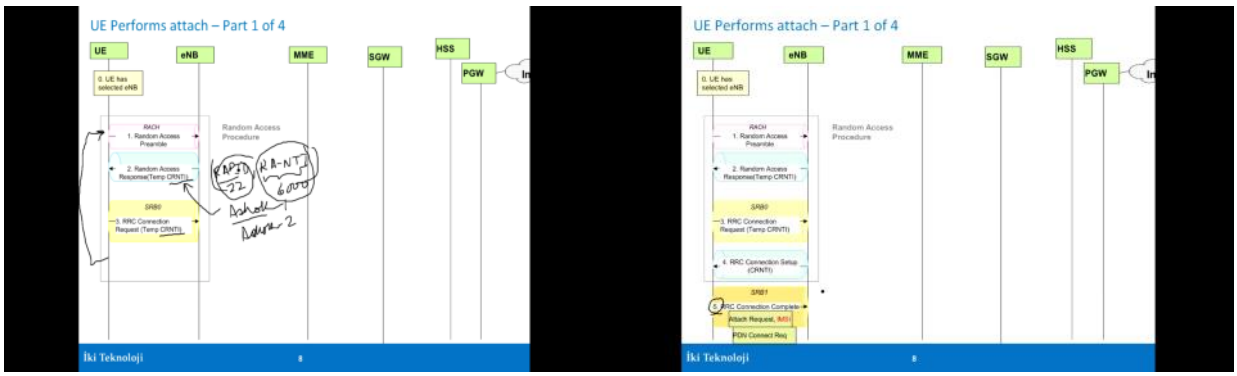


DRX: discontinuous reception
Ue need to wake up and monitor PDCCH for every subframe.->weather N/w is senmding data for UE-->wastage of energy

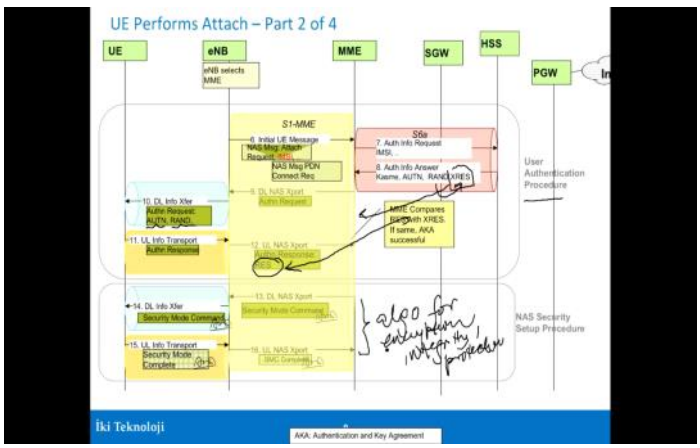
How ue know when N/W send data?
N/w decide when UE wake up or sleep using Transmitted by SIB2 through RRC setup/reconfiguration message

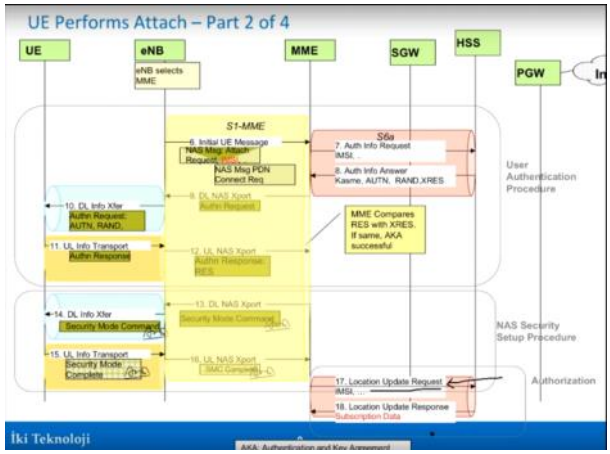


DRX cycle on duration timer	When UE wake up ->why :(downlink data, change of s1,cell reselection, incoming call,receive sms)
DRX cycle off duration timer	
DRX inactivity:	If UE receive PDCCH until in on state then inactivity timer starts. If UE receive DRX mac control reception during inactivity timer: first stop (on state timer and drx inactivity timer) If ACK NAK -> starts DRX retransmission timer
DRX in idle mode: Paging cycle Frame CYCLE Paging Occasion	
DRX Connected and dedicated mode DRX on duration cycle and timer DRX inactivity cycle and timer Short DRX cycle timer Long DRX cycle timer DRX Retransmission timer	
Paging: PCCH->PCH->PDSCH RRC procedure waking up UE when it is in idle mode if any data for it	MME is responsible for LTE paging procedure by forwarding S1AP paging mess to more than one eNodeB Paging is define in term of radio frame(rf): 32rf,64rf,128rf Gen 128rf->1.28ms
idle mode	UE do not have S1AP connectivity with MME UE location of MME in idle mode is known by mme on aper tracking area basis
Which channel contain Paging info	PDCCH->indication of paging comes on PDCCH (it has P-RANTI to wake up look for paging) PDSCH -> actual content of data/info on PDSCH
MIB(24 bit):PBCH Only in DL dir every 40ms	System BW :3bit PHICH configuration:3bit Frame no sync:8bit No of antenna:10bit
SIB:PDCCH->PDSCH 80ms 13 sib	Cell reselection handover Initial attach and mobility related info
SIB-1	Cell selection, PLMN identity, TAC, Cell id
SIB2	RRC information common for all UE,RACH, paging info, initial power, SRS, PUCCH, PUSCH
sIB3	
Cell reselection: SIB 4: cell reselection same frequency SIB5: cell reselection/Handover different frequency SIB 6:from 4g lte to umts3g SIB 7:lte to 2g SIB 8:lte to CDMA200	



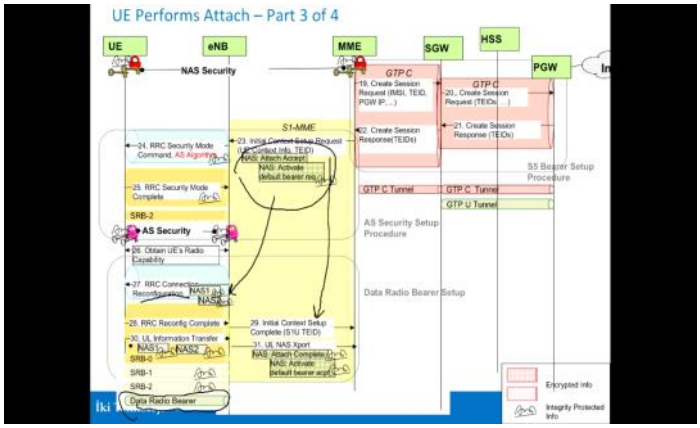
If XRES and Res is same then authentication completes
AFTER that integrity protection begins

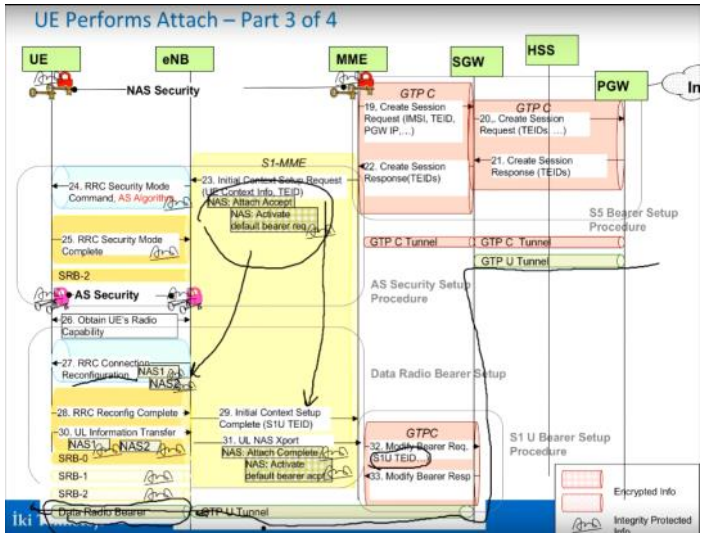




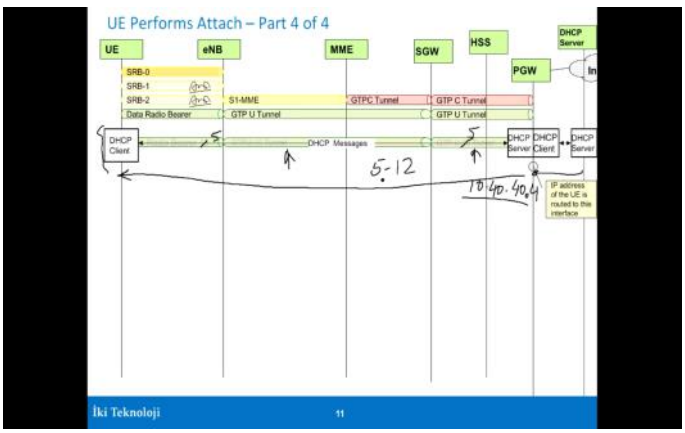
Subscription data	Data connectivity, sms or not, overall Gb
Location update	This mme is serving the mobile ,for ip not needed which mobile
Setting S5 and GTP C tunnels	

Subscription data	Data connectivity, sms or not, overall Gb
Location update	This mme is serving the mobile ,for ip not needed which mobile
Setting S5 and GTP C tunnels	
GTP U	
After that setting data radio bearer	





After all this still we did not get the ip address of mobile,ip



RACH procedure	PRACH: no mac ,no rlc RACH res: no mac ,no rlc
RRC connection Request (UL SCH->ULCCH)	MAC ,RLC TM, no pdcp
RRC connection setup(DL CCCH->DL SCH)	MAC ,RLC TM, no pdcp
RRC connection setup complete(UL SCH->UL DCCH)	MAC ,**RLC AM**, PDCP
Authentication req	mac ,RLC am ,pdcp
Authentication res	mac ,RLC am ,pdcp

Mobility manaement in LTE:
EPS Bearer is a virtual connection between UE and PGW which identifies a data send and recieved between these two end points with specific QoS attributes. The procedure used to establish an **EPS Bearer** is called "**EPS Bearer** Activation

Architecture Concept 2: Mobility Management (MM)

- What is Mobility Management in LTE?
  - It is concerned about the UE's registration state at the NAS layer.
  - There is an MM state-machine that runs in both the MME and UE. They key states are:
    - EMM-DEREGISTERED
    - EMM-REGISTERED
  - Examples of EMM Procedures
    - Attach
    - Authentication
    - Security Mode Command
    - GUTI reallocation
    - Tracking Area Update
    - Paging
    - Service Request
  - For each UE there is a MM context. The MM context consists of UE's security related parameters (keys, counters)

Architecture Concept 2: Session Management (SM)

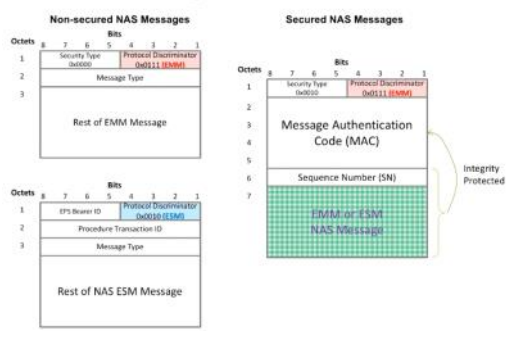
- What is Session Management in LTE?
  - It is related to UE's connectivity (EPS bearers) at the NAS layer.
- There is an ESM state-machine that runs in both the MME and UE for each EPS bearer. They key states are:
  - Bearer Context In-active
  - Bearer Context Active
- Examples of ESM procedures are:
  - PDN Connectivity Request/ Activate Default EPS bearer
  - PDN Disconnect Request/ Deactivate Default EPS bearer
  - Activate dedicated EPS bearer
  - Modify default/dedicated EPS bearer
  - ...
- For each UE there is a ESM context that includes context for all active bearers and includes parameters applicable to the bearers (Bearer ID, QoS parameters,...).

LTE always on ip connectivity untill rel 12

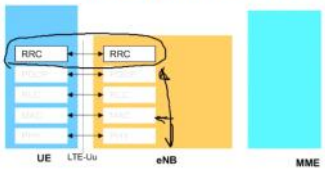
Architecture Concept 2: Mobility Management (MM) and Session Management (SM) Relation

- There are separate NAS messages for EMM and ESM.
- EMM Context and ESM context are stored separately in the MME.
- LTE has the concept of "Always ON" IP connectivity.
  - The moment the UE attaches, a default bearer is setup for the UE to have connectivity. For UE to be in EMM-REGISTERED state, the UE MUST have at least one bearer context.
  - If the last default bearer is removed, UE is moved to detached state. If the last default bearer is removed, the UE automatically enters EMM-DEREGISTERED state.
- ESM procedures can be performed only if an EMM context has been established between the UE and the MME.
- Hence, there is coupling between EMM and ESM state in LTE.

NAS EMM and ESM Message Formats

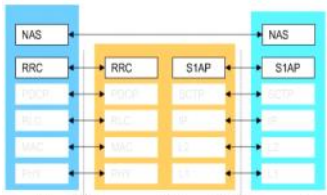


Protocol Stacks: Control Plane between UE, eNB and MME



Radio Resource Control (RRC): The main control interface between eNB and UE

Protocol Stacks: Control Plane between UE, eNB and MME

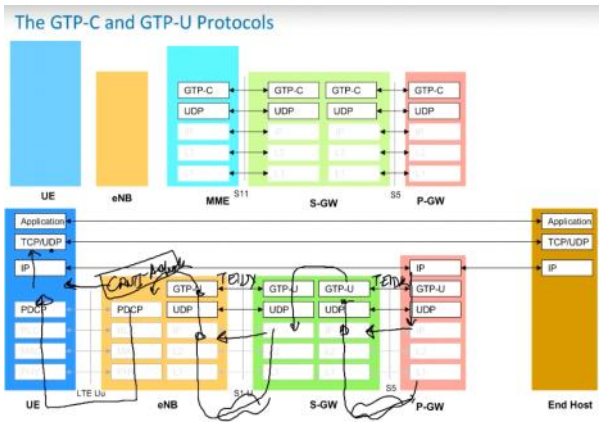


Non-Access Stratum (NAS): The key control interface between MME and UE

Radio Resource Control (RRC): The main control interface between eNB and UE

S1-AP	S1 Application protocol

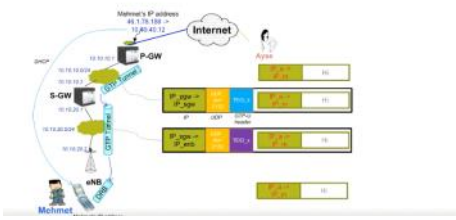
The GTP-C and GTP-U Protocols



GTP:	GPRS tunneling protocol ,
What is tunneling:	Putting one ip packet inside another ip packet
why	route to a path which is not topologically correct
What	

What is the purpose of GTP Tunneling?

- Route an IP packet along a path that is not topologically correct for the packet.

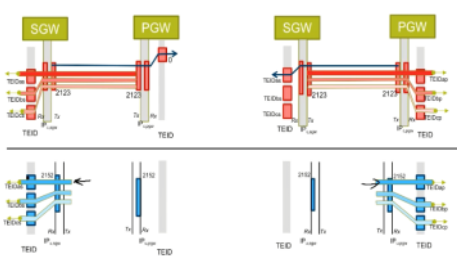


How does the GTP-U Tunnel get setup?

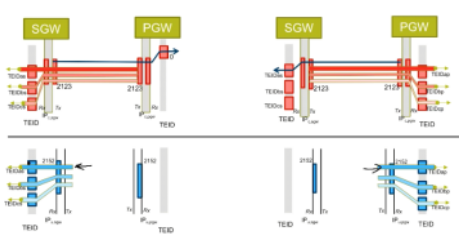
- GTP Protocol has two parts
  - Signaling part called GTP-C (GTP-Control)
  - User data part called GTP-U (GTP-User)
- GTP-C is used to setup GTP-U tunnel
- Both GTP-C and GTP-U run on top of UDP
- IP-in-UDP tunneling is only used for GTP-U
- GTP-C carries control/signaling messages

Full Teid (F-Teid) s11	ip address + TEID
GTPC ->	If ip adress is zero it means that SGW and PGW is same

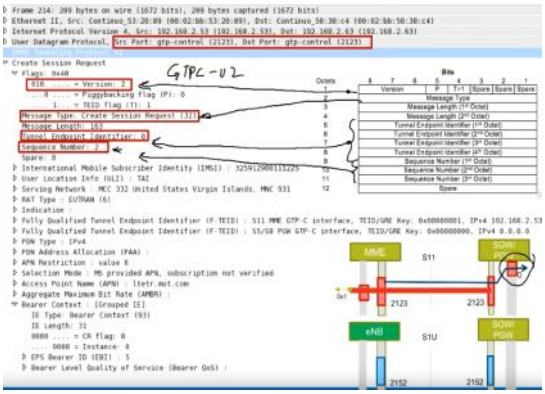
How does GTP-U Tunnel get setup: Example



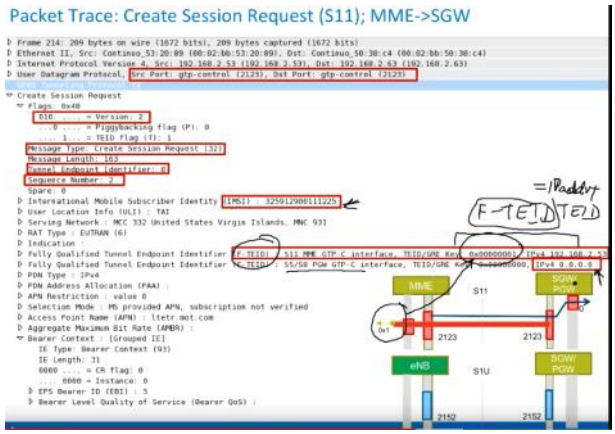
How does GTP-U Tunnel get setup: Example



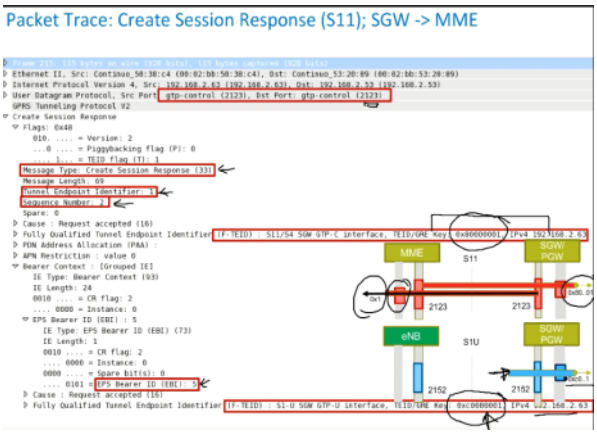
Packet Trace: Create Session Request (S11); MME->SGW



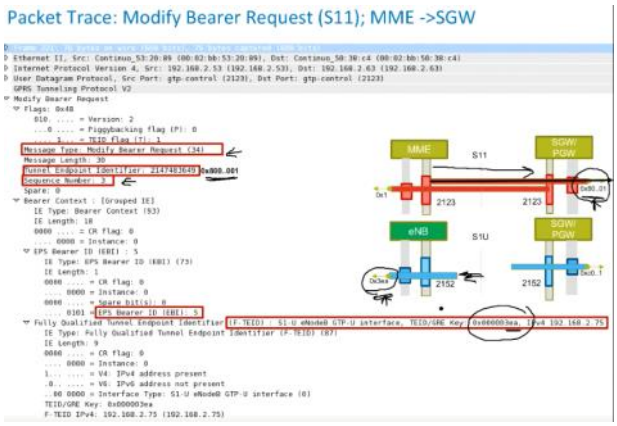
Packet Trace: Create Session Request (S11); MME->SGW



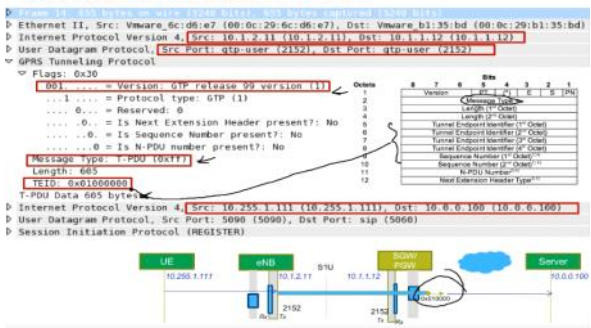
Packet Trace: Create Session Response (S11); SGW -> MME



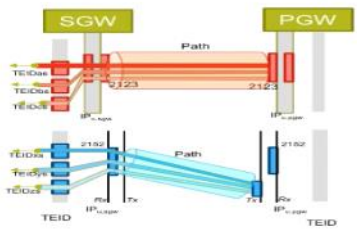
Packet Trace: Modify Bearer Request (S11); MME ->SGW



Packet Trace: GTP-U: S1-U; eNB -> SGW/PGW

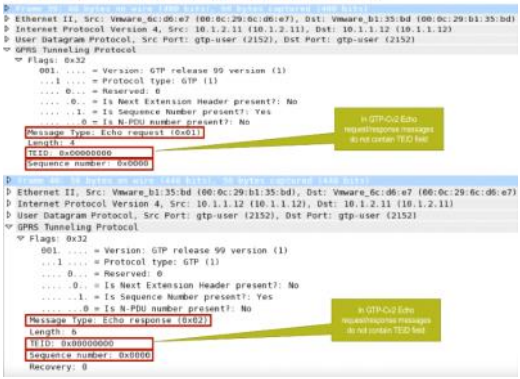


GTP Path and Path Management

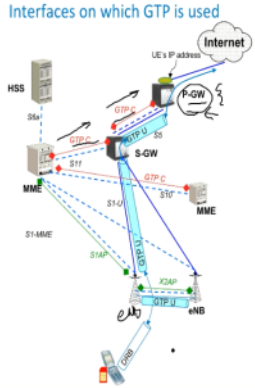


- Path is between two endpoints. Each end point is IP_address+UDP_Port#
- There can be several GTP tunnels on a path (each with different TEIDs).
- There is typically a “software process” that binds to each end-point.
- **Path Management messages**: To ensure that a path is alive (both the physical link and process at the endpoint), periodic echo-request and echo-response are sent.
- Failure-detection and error-recovery mechanisms are defined.

Packet Traces: GTP-U Echo-request & Echo Response



Interfaces on which GTP is used



- GTP-Cv2 is used not only for mobility management, but also for general signaling purposes, eg providing UE's cell information to the PGW and from there to operator's service network.

To access a cell the UE needs to retrieve a Preamble for the system information. Which SIB contains the RA Preamble information?

- SIB8
- SIB4
- SIB2
- SIB1

Correct

That's right! You selected the correct response.

Next Question

The sequence for eNodeB acquisition is?

- Acquire Timing, Acquire Frequency, Physical Layer Cell Id, Read Sys info
- Acquire Frequency, Acquire Timing, Physical Layer Cell Id, Read Sys info
- Acquire Timing, Physical Layer Cell Id, Acquire Frequency, Read Sys info
- Acquire Frequency, Physical Layer Cell Id, Acquire Timing, Read Sys info

Correct

That's right! You selected the correct response.

Next Question

Which network entity allocates the UE the GUTI?

- P-GW
- PCRF
- MME
- S-GW

Correct

That's right! You selected the correct response.

Next Question

What is the main reason for S1 Release?

- Incoming data for UE
- Inactivity
- Failure in connections
- HSS failure

Correct

That's right! You selected the correct response.

Next Question

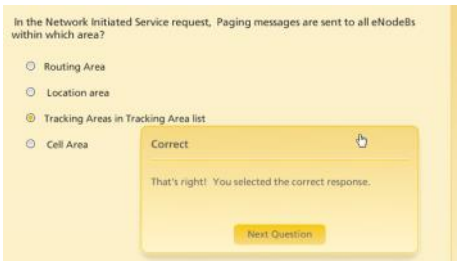
If the UE is in ECM-IDLE state, on Dedicated bearer creation, the MME will trigger?

- Network Triggered Service Request
- Location area update
- De-registration o
- Registration of th

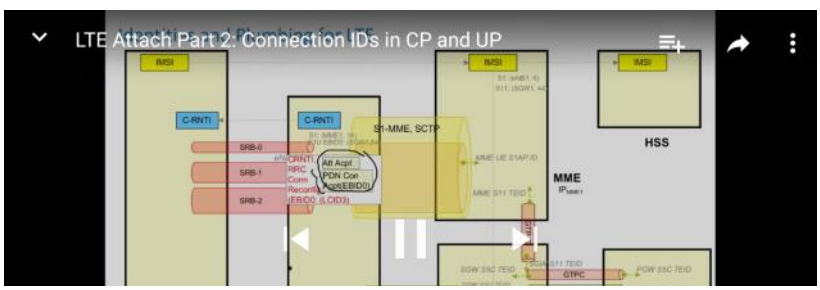
Correct

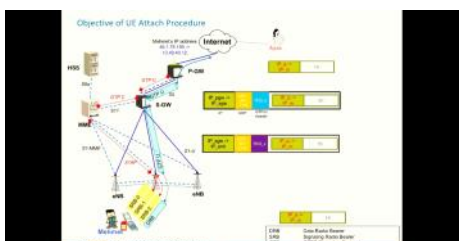
That's right! You selected the correct response.

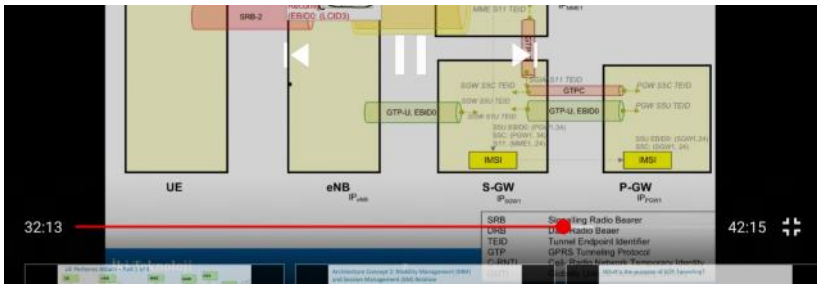
Next Question

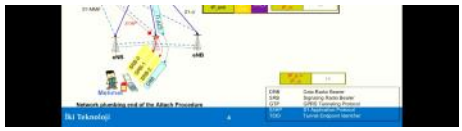

In the Network Initiated Service request, Paging messages are sent to all eNodeBs within which area?
Routing Area
Location area
Tracking Areas in Tracking Area list
Cell Area
Correct
That's right! You selected the correct response.
Next Question

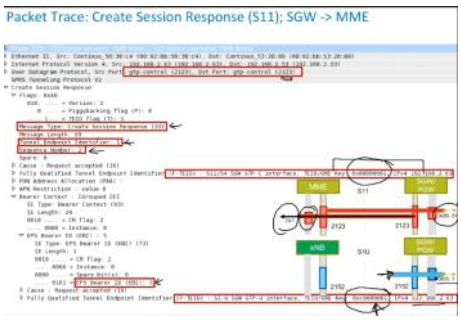

Data for the UE in a Network Initiated Service Request is buffered at which Network Element?
S-GW
P-GW
eNodeB
MME
Correct
That's right! You selected the correct response.
Next Question

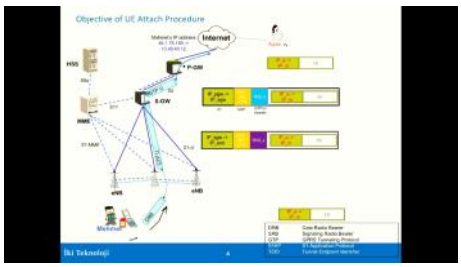

LTE Attach Part 2: Connection IDs in CP and UP
IMSI
C-RNTI
S1-MME, SCTP
HSS
MME

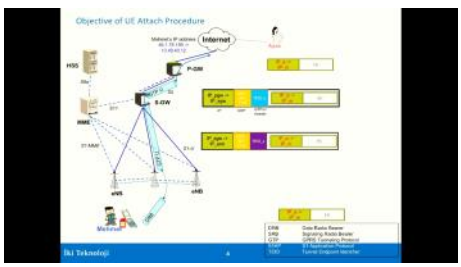

Objective of UE Attach Procedure
Internet
P-GW
S-GW



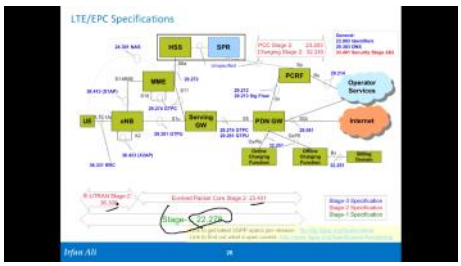


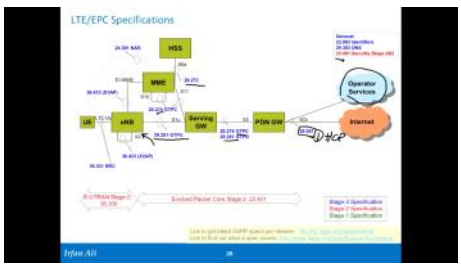


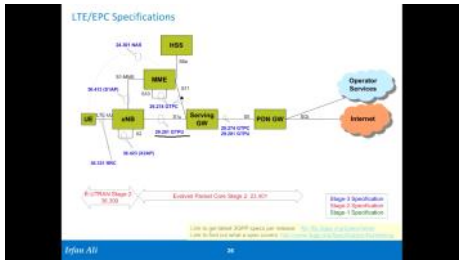




Event	Existing and New Triggering Reasons	HO Usage
A1	Serving cell becomes better than absolute threshold	LTE
A2	Serving cell becomes worse than absolute threshold	LTE
A3	Neighbor cell becomes better than an offset relative to the serving cell	LTE
A4	Neighbor cell becomes better than absolute threshold	LTE
A5	Serving cell becomes worse than one absolute threshold and neighbor cell becomes better than another absolute threshold	LTE
A6	Serving cell becomes worse than one absolute threshold and neighbor cell becomes better than another absolute threshold due to in-device coexistence interference	LTE
A7	Neighbor cell becomes better than an offset relative to the serving cell due to in-device coexistence interference	LTE
A8	Serving cell becomes worse than absolute threshold due to in-device coexistence interference	LTE
B1	Neighbor cell becomes better than absolute threshold	Inter-RAT
B2	Serving cell becomes worse than one absolute threshold and neighbor cell becomes better than another absolute threshold	Inter-RAT
B3	Serving cell becomes worse than absolute threshold and neighbor cell becomes better than another absolute threshold due to in-device coexistence interference	Inter-RAT



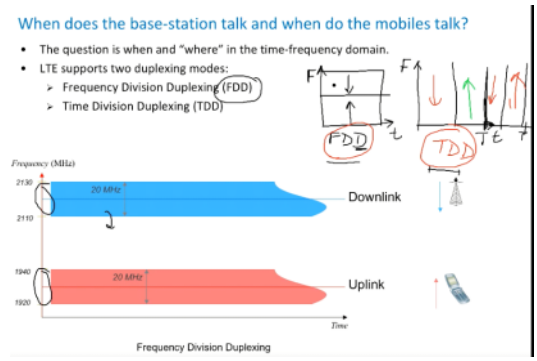



LTE/EPC Specifications
HSS
MME
Operator Services
Internet
eNB
Serving GW
PDN GW
Irfan Ali

Lte frame

14 March 2018 18:32

When and where does the base station talks to mobile?		



What if OFDM

- OFDM = Orthogonal Frequency Division Multiplexing
- What are orthogonal functions?
  - Two functions $h_1(t)$ and $h_2(t)$ are orthogonal over an interval [0,T], if

$$\langle h_1, h_2 \rangle = \int_0^T h_1(t) h_2(t) dt = 0$$

  - Set of functions $\{h_1(t), h_2(t), \ldots, h_n(t)\}$ are mutually orthogonal, if

$$\langle h_i, h_k \rangle = 0, \text{if } i \neq k, \text{ and } \langle h_i, h_i \rangle = m_i$$

m_i = energy = 1 for orthonormal

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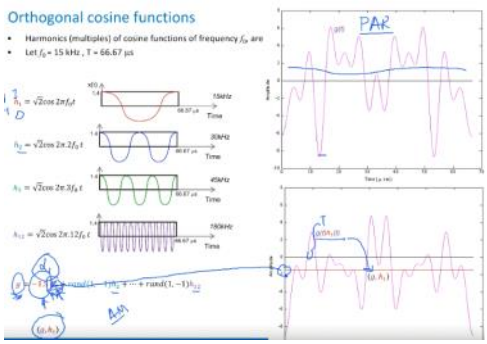
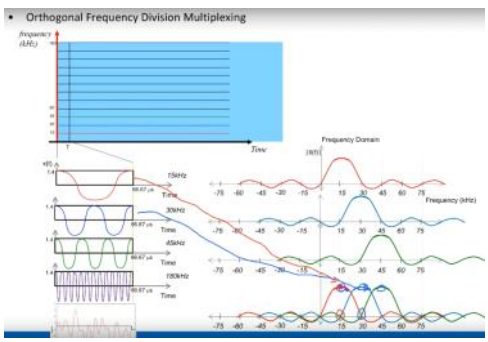
  - If $g(t) = \alpha_1 h_1(t) + \alpha_2 h_2(t) + \ldots + \alpha_n h_n(t)$, for [0,T], then

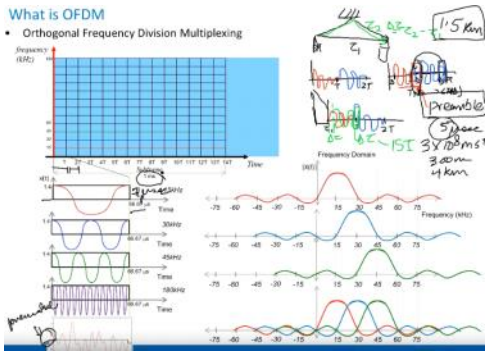
$$\langle g, h_i \rangle = \langle \alpha_i h_i, h_i \rangle = \alpha_i m_i \text{ for } i = 1..n$$



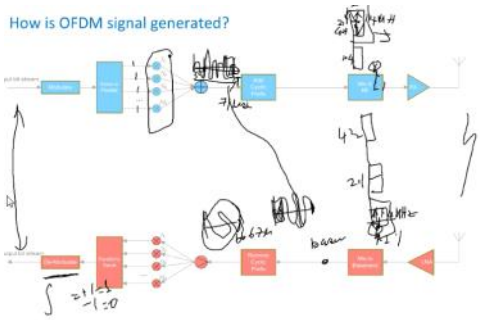


What is OFDM

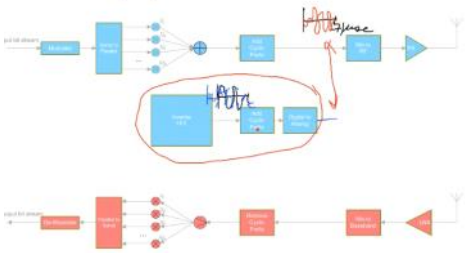
- Orthogonal Frequency Division Multiplexing



How is OFDM signal generated?

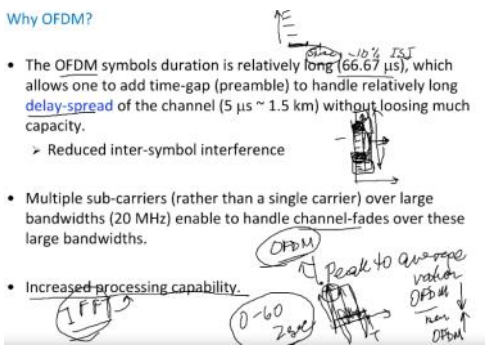


How is OFDM signal generated?

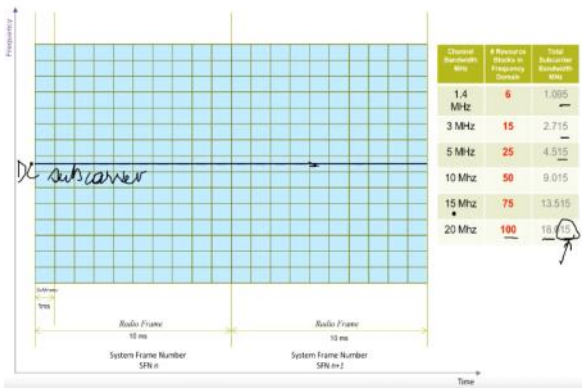


Why OFDM?

- The OFDM symbols duration is relatively long (66.67 µs), which allows one to add time-gap (preamble) to handle relatively long delay-spread of the channel (5 µs ~ 1.5 km) without loosing much capacity.
  - Reduced inter-symbol interference
- Multiple sub-carriers (rather than a single carrier) over large bandwidths (20 MHz) enable to handle channel-fades over these large bandwidths.
- Increased processing capability.



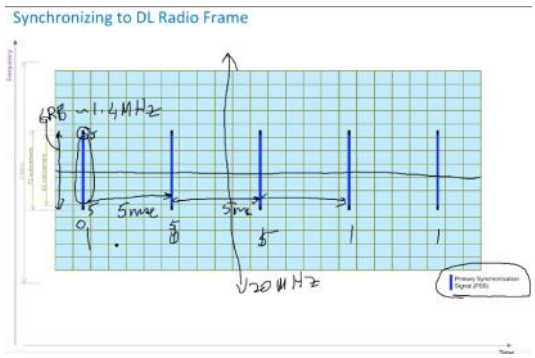
LTE Downlink Frame Structure



Channel Bandwidth MHz	# Resource Blocks in Frequency Domain	Total Subcarrier Bandwidth MHz
1.4 MHz	6	1.095
3 MHz	15	2.715
5 MHz	25	4.515
10 Mhz	50	9.015
15 Mhz	75	13.515
20 Mhz	100	18.015

When mobile looks downlink radio frame it has very little idea of
where exactly center frequency is ?
How many resource grid are there?
He is some where in between the frame?
-->To resolve/facilitate this PSS is provided.
- It is in middle 62 subcarrier
- It is repeated every 5ms,
- Send at middle of dc frequency
- 5 resource at top and 5 at bottom with zero energy
- 72 carrier==6RB i.e min transmitted in 1.4MZ

Synchronizing to DL Radio Frame



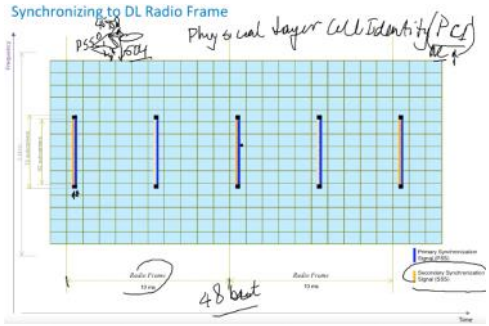
After PSS also UE would not know where is 10ms boundary
So SSS is one signal before PSS which will tell the cell identity.

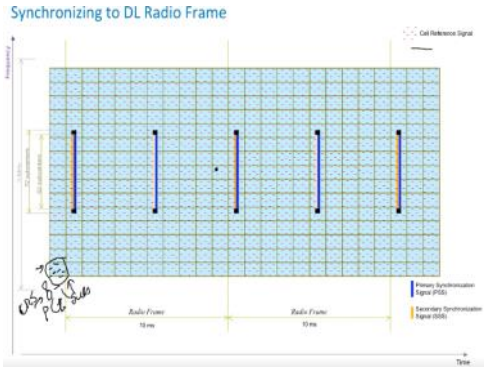
PSS is transmitted on 6th symbol and SSS is transmitted on 5th symbol of slot zero and slot 10 of each radio frame on 72 subcarrier centered around DC.

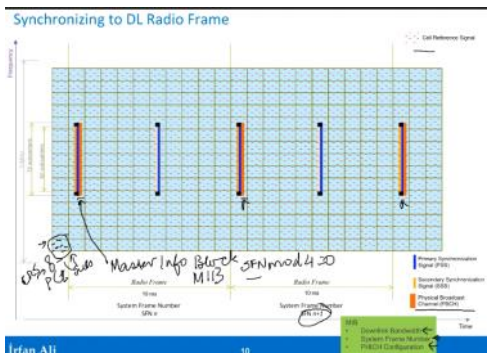
By PSS and SSS the UE will find cell identity 3(PSS)*168(SSS)
Via cell identity UE will find cell reference signal

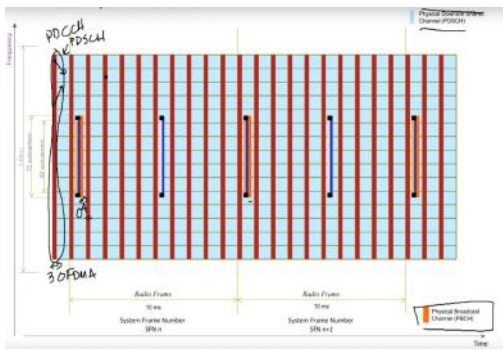
Once UE knows the PCI (physical layer cell identity) it can find out the Reference signal
PCI->cell reference signal ->exact frequency and time structure->there are 8 CRS in each subframe

Next imp thing is to find Physical broadcast channel
It is transmitted every 10ms



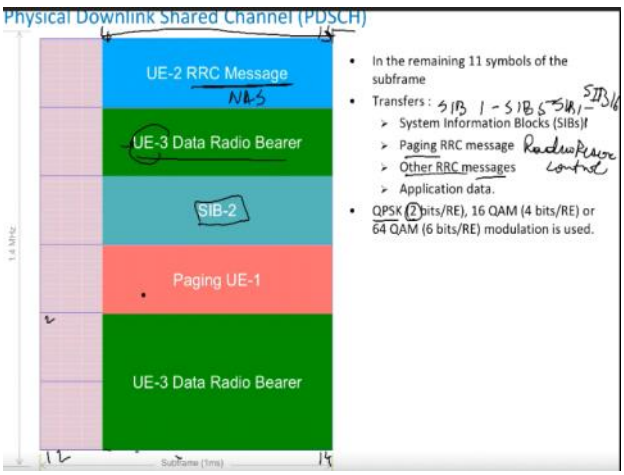


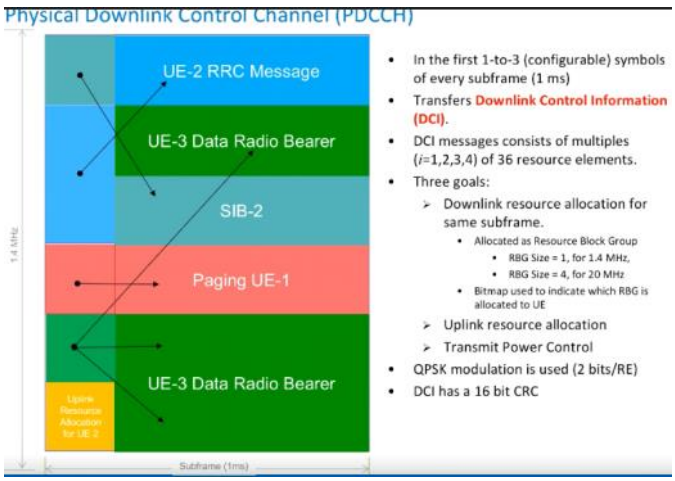


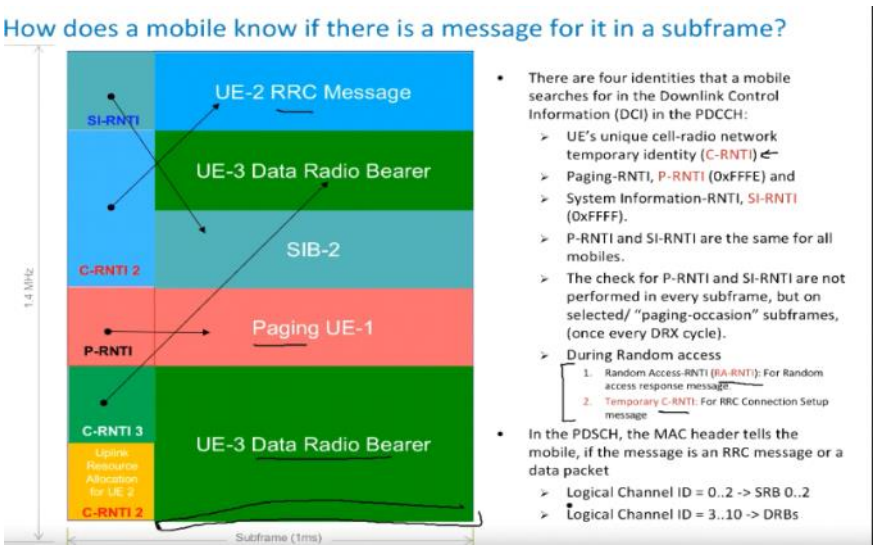


Now see PDSCH

1 frame(10ms) =10 subframe(1ms) = 20 slot(0.5ms)
1slot=7symbol







RACH

23 May 2018 07:12

i) UE --> NW : RACH Preamble (RA-RNTI, indication for L2/L3 message size)
ii) UE <-- NW : Random Access Response (Timing Advance, T_C-RNTI, UL grant for L2/L3 message)
iii) UE --> NW : L2/L3 message
iv) Message for early contention resolution

Typical 'Contention Free' RACH Procedure is as follows :
i) UE <--NW : RACH Preamble (PRACH) Assignment
ii) UE --> NW : RACH Preamble (RA-RNTI, indication for L2/L3 message size)
iii) UE <--NW : Random Access Response (Timing Advance, C-RNTI, UL grant for L2/L3 message)

Exactly when and where Network transmit RACH Response

We all knows that Network should transmit RACH Response after it recieved RACH Preamble from UE, but do we know exactly when, in exactly which subframe, the network should transmit the RACH Response ? The following is what 3GPP 36.321 (section 5.1.4) describes.

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the UE shall monitor the PDCCH for Random Access Response(s) identified by the RA-RNTI defined below, in the RA Response window which starts at the subframe that contains the end of the preamble transmission [7] plus three subframes and has length ra-ResponseWindowSize subframes.

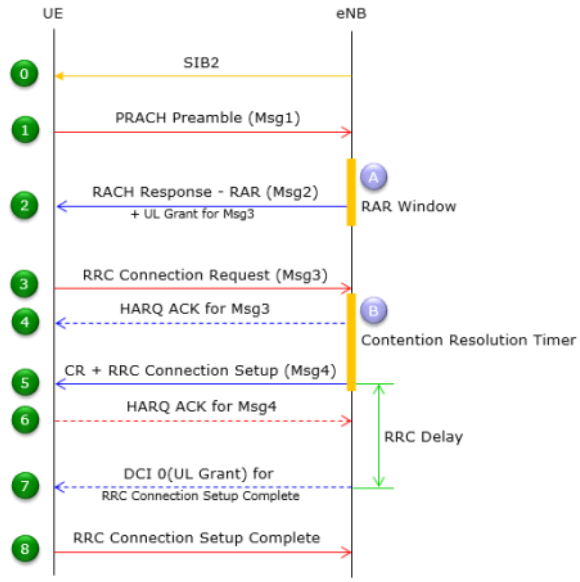
It means the earliest time when the network can transmit the RACH response is 3 subframe later from the end of RACH Preamble. Then what is the latest time when the network can transmit it ? It is determined by ra-ResponseWindowSize. This window size can be the number between 0 and 10 in the unit of subframes. This means that the maximum time difference between the end of RACH preamble and RACH Response is only 12 subframes (12 ms) which is pretty tight timing requirement.

How is the RACH Preamble Power determined ?

Regardless of the cases, the PRACH Power (P_PRACH) is determined by the following equation.
P_PRACH = min{P_CMAX, PREAMBLE_RECEIVED_TARGET_POWER + PL}

PL stands for Path Loss between eNB Tx antenna and UE Rx Antenna. PREAMBLE_RECEIVED_TARGET_POWER is the PRACH power that eNB expect to recieve.

< RACH Procedure during Initial Registration >



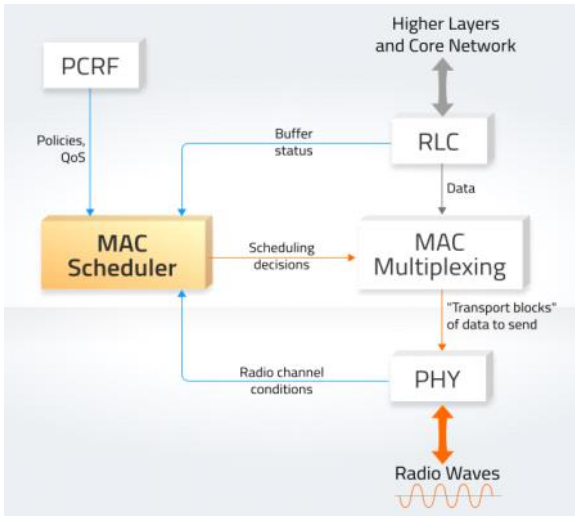
From <http://www.sharetechnote.com/html/RACH_LTE.html#Why_RACH>

the MAC scheduler has control over the OFDM modulation in the sense that it decides, according to information received from other LTE network components, how much bandwidth each UE receives at any given moment.

Typically, a MAC Scheduler can be programmed to support one scheduling algorithm with many parameters.
Here are some examples of scheduling algorithms:

- Round Robin – used for testing purposes and uses equal bandwidth for all UEs without accounting for channel conditions
- Proportional Fairness – tries to balance between the QoS priorities and total throughput, usually preferred in commercial networks
- Scheduling for Delay-Limited Capacity – guarantees that the MAC Scheduler will always prioritize applications with specific latency requirements
- Maximum C/I – guarantees that the Mac Scheduler will always assign resource blocks to the UE with the best channel quality

One of the key features of LTE is the ability to control and prioritize bandwidth across users. It is the MAC scheduler that gives LTE this capability.



RRC

17 March 2018 00:23

RRC/data layer different types of messages

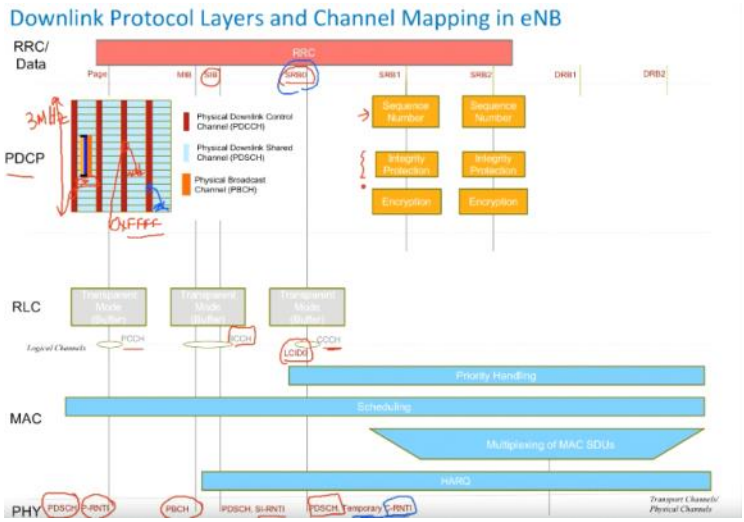
1.radio bearer: SRB0(RRC connection setup), SRB1, SRB2
2.control signaling: paging, MIB(PBCH), SIB(PDSCH)
3.multiple data radio berer:DRB1 (1p), DRB2(voice over ip)

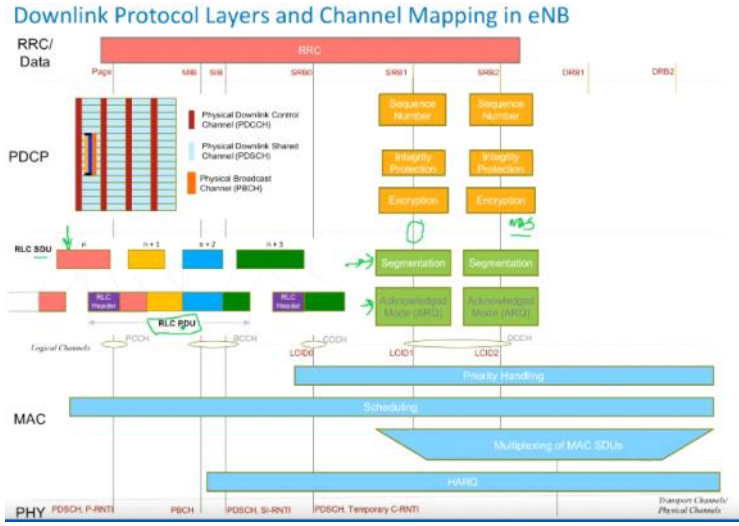
RRC	

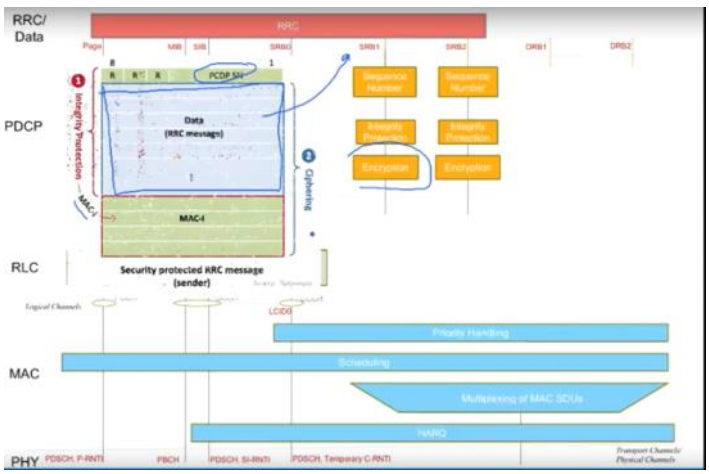
E1 interface	upcu, cpcu
Upf	Simmllar to sgw
Amf	mme

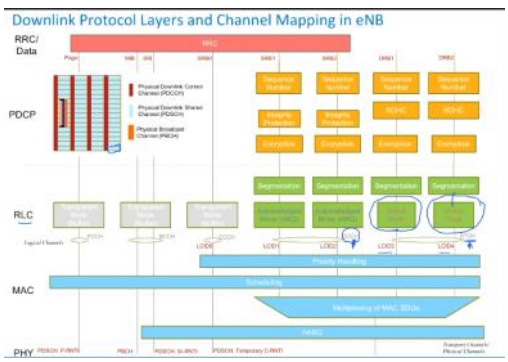
SRB1:Sequence no ,
At PDCP layer integrity protection before encryption

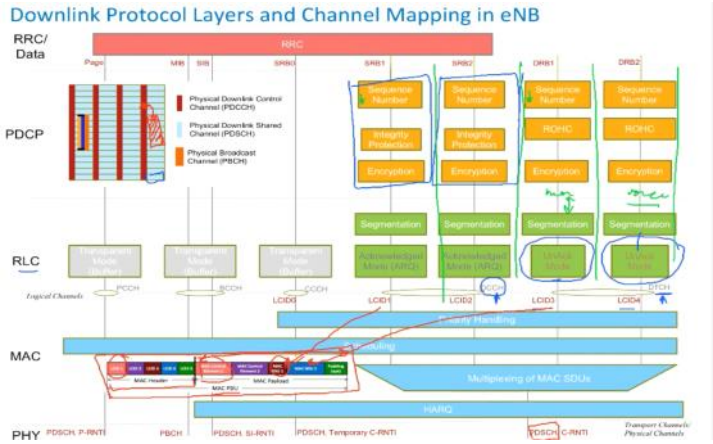
PDCP	->putting SN->take state from SRB1->integrity protection add MAC which is integrity check then take entire thing (DATA+MAC)and do cyphering DRB->SN->ROHC(robust headder compression)->encription Separate PDCP entity for each radio bearer and signaling bearer ->so sequence no are independent,and one per data bearer, so RLC don't concatinate packet from drb1 and drb2 But MAC will able to concatinate across this radio bearer and channels
RLC	Segmentation (gen srb2 NAS mess) , Functionality for acknowledge mode ip packet DL dir->unack mode Do error correction and duplicate detection only in AM mode through ARQ TM UM: real time app ,uni dir ,err insensative AM: bidirectional,delay torlerant ,err sen ,non real time, status pdu

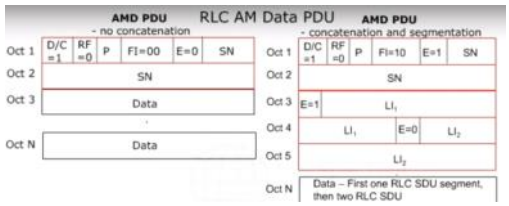






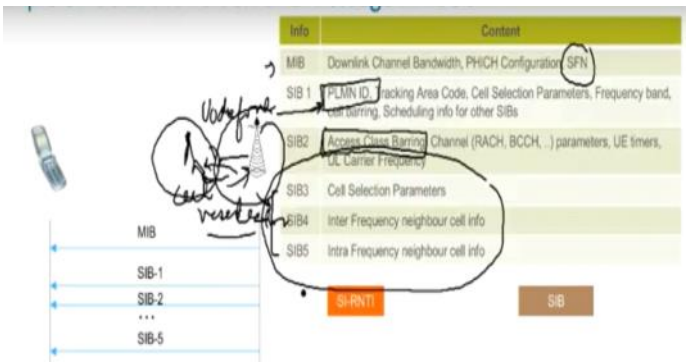


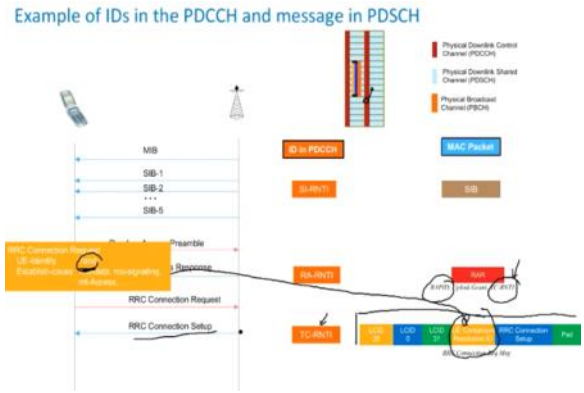


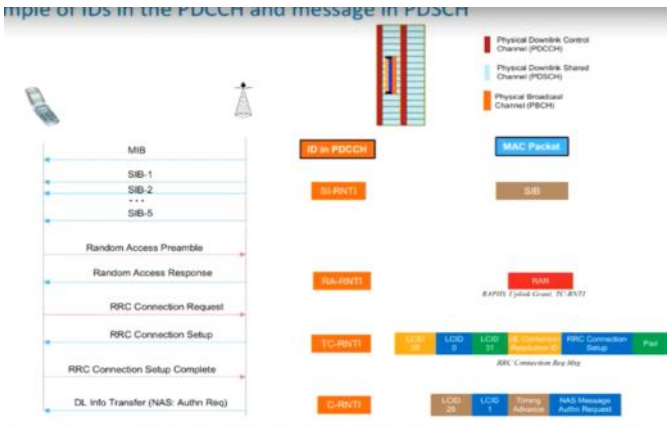


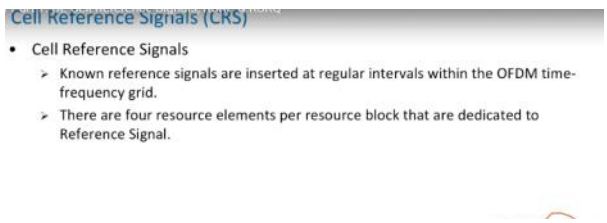
E	Extension bit
SN	Seq no
d/c	Data/ control
Rf	Re-segmentation flag ,0:complete pdu,1:pdu seg
P	Polling bit ,1=status report requested Polling procedure triggers STATUS reporting from receiving side AM RLC entity
Li	Length indicator
ISF	Last segment flag

SIB1	Time:Sent every 20 mili sec but changes every 80 ms Freq: SFN%8 0 ,sib1 changes to new sib1
PRACH	RAPID(0,63) + RARNTI(sub frame id)
RACH response	RAPID value ,Uplink grant(when u send next message,eg 4-5 sub frame down up,transmit in particular RB) , TC-RNTI(radio label identity)
RRC connection req	UE identity:rand, Estb cause: mobile ori signalling







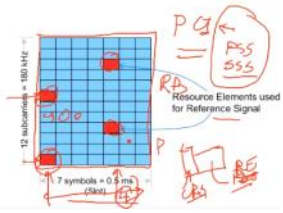


CRS	Cell reference signal, inserted at regular interval in OFDMtime -freq grid There are 4 resource ele per resource block Cell ref sig transmitted much high power then other,and location depends on physical layer cell identity(PSS,SSS) The reference signals are derived from the product of a two-dimensional pseudo-

	There are 4 resource ele per resource block Cell ref sig transmitted much high power then other,and location depends on physical layer cell identity(PSS,SSS) The reference signals are derived from the product of a two-dimensional pseudo-random sequence and a two-dimensional orthogonal sequence. There are 170 different pseudo-random sequences corresponding to 170 cell-identity groups, and three orthogonal sequences each corresponding to a specific cell identity within the cell identity group	
Resource block	12 sub carrier,7 OFDM sym=slot=5ms	

Reference Signal.

- The location of Reference Signals depends on the Physical layer cell identity of the cell.
- The Primary and Secondary Synchronization Signals the Physical Layer Cell Identity

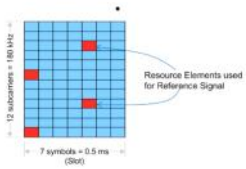


Reference Signal Received Power (RSRP)

- The RSRP is the average power (in watts) received from a single Reference Signal (RS) resource element
- RSRP measures only the RS power and excludes all noise and interference power.
- Knowledge of absolute RSRP enables mobile to calculate downlink path-loss.
- The maximum RSRP is based on maximum input power to UE of -25dBm (0.0032 mWatts). In 1.4 MHz BW with 6 RBs (72 Resource Elements), max RSRP is -44 dBm.
- The minimum value is -140 dBm (has 6 dBm of margin from minimum possible received power at UE).

$$RSRP = \frac{1}{K}\sum_{k=1}^{K} P_{rs,k}$$

where, $P_{rs,k}$ is the estimated received power (in Watts) of the kth Reference Signal Resource element

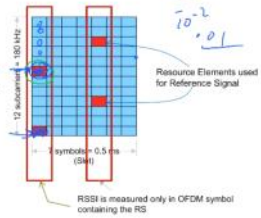


Measurement 2: Reference Signal Received Quality (RSRQ)

- RSRP does not give an indication of signal quality, i.e. the strength of the reference signal compared to overall energy in the channel (aka received signal strength indicator (RSSI))
- The RSSI parameter represents the entire received power including the wanted power from the serving cell as well as all co-channel power and other sources of noise.
- Measuring RSRQ becomes particularly important near the cell edge when decisions need to be made, regardless of absolute RSRP, to perform a handover to the next cell.
- The maximum value of RSRQ is -3 dB. (One reference signal has 50% energy in the RB)
- The minimum value of reported RSRQ is -19.5 dB. (One reference signal RE has only 1% of energy in RB)

$$RSRQ = \frac{RSRP}{(RSSI / N_{RB})}$$

where N_{RB} is the number of Resource blocks (N_{RB}= 6 for 1.4MHz Bandwidth)



References

- Specifications:
  - TS 36.300: RAN Architecture
  - TS 36.331: RRC
  - TS 36.323: PDCP
  - TS 36.322: RLC
  - TS 36.321: MAC
- Other References:
  - LTE in Bullets
  - www.sharetechnote.com
  - www.youtube.com/lte4g

ARQ

If an ACK is damaged/lost, we can have two situations:

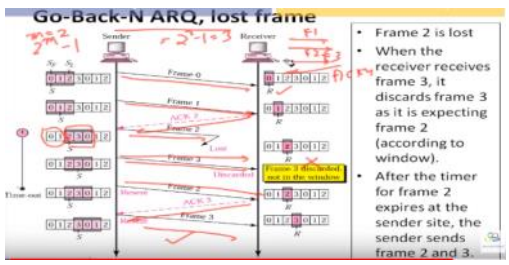
If the next ACK arrives before the expiration of any timer, there is no need for retransmission of frames because ACKs are cumulative in this protocol.

If ACK1, ACK2, and ACk3 are lost, ACK4 covers them if it arrives before the timer expires.

If ACK4 arrives after time-out, the last frame and all the frames after that are resent.

Receiver never resends an ACK.

A delayed ACK also triggers the resending of frames



S1ap

16 March 2018 07:05

The S1 Application Protocol (S1AP) provides the control plane signalling between E-UTRAN and evolved packet core (EPC). The used interface is S1-MME which is located between eNB and MME. The services provided by the S1AP are divided to UE associated and non UE associated. The UE associated services are related to one UE and the non UE associated services are related to the whole S1-MME interface. The S1AP is transfered over SCTP.

From <https://www.synopsys.com/software-integrity/security-testing/fuzz-testing/defensics/protocols/s1ap-server.html>

S1AP messages:
Handover Required
Handover Request Acknowledge
Handover Failure
Handover Cancel
E-RAB Setup Response
E-RAB Modify Response
E-RAB Release Response
Initial Context Setup Response
Initial Context Setup Failure
Reset
S1 Setup Request
UE Context Modification Response
UE Context Modification Failure
eNB Configuration Update
Handover Notification
E-RAB Release Indication
Initial UE Message
Uplink NAS Transport
NAS non delivery indication
Error indication
UE Context Release Request
Uplink S1 CDMA2000 Tunneling
UE Capability Info Indication
eNB Status Transfer
eNB Direct Information Transfer
eNB Configuration Transfer
Uplink UE Associated LPPa Transport
Uplink Non UE Associated LPPa Transport

Tested NAS messages
Attach complete
Attach request
Authentication failure
Authentication response
Detach request
EMM status
Extended service request

Security mode complete
Security mode reject
Security protected NAS message
Service request
Tracking area update complete
Tracking area update request
ctivate dedicated EPS bearer context accept
ctivate dedicated EPS bearer context reject
ctivate default EPS bearer context accept
earer resource allocation request
Bearer resource modification request
Deactivate EPS bearer context accept
ESM information response
Modify EPS bearer context accept
Modify EPS bearer context reject
PDN connectivity request

Handovers

23 February 2018 12:10

X2: between enbs
S1: between enb and Sgnb

cloud

23 February 2018 05:07

Cloud
The term Cloud refers to a Network or Internet. In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over public and private networks, i.e., WAN, LAN or VPN.

Cloud computing is a type of computing that relies on shared computing resources rather than having local servers or personal devices to handle applications.

The term "**cloud** computing" is everywhere. In the simplest terms, **cloud** computing means storing and accessing data and programs over the Internet instead of your computer's hard drive. The **cloud** is just a metaphor for the Internet

Deployment Models:
Public Cloud.
Private Cloud.
Hybrid Cloud.
Service models
Platform as a Service (PaaS)
Infrastructure as a Service (IaaS)
Amazon Web Services (AWS), Microsoft Azure
Software as a Service (SaaS)

Flexibility.
Scalability.

OpenStack:
OpenStack is a software for building and managing cloud-computing platforms for public and private clouds. OpenStack is used to deploy virtual machines and other instances that handle different tasks for managing a cloud environment. OpenStack is considered as – Infrastructure as a Service (IaaS).

Virtualization:
In computing, virtualization refers to the act of creating a virtual (rather than actual) version of something, including virtual computer hardware platforms, storage devices, and computer network resources.

Hardware Virtualization: also known as hardware-assisted virtualization or server virtualization
- Full Virtualization
- Emulation Virtualization
- Paravirtualization

Software Virtualization
- Operating System Virtualization
- Application Virtualization
- Service Virtualization

Memory Virtualization
- Application-level control
- Operating system level control

Storage Virtualization
- Block Virtualization
- File Virtualization

Data Virtualization

Network Virtualization
- Internal network: Enables a single system to function like a network
- External network: Consolidation of multiple networks into a single one, or segregation of a single network into multiple ones

Desktop Virtualization

From <https://redswitches.com/blog/different-types-virtualization-cloud-computing-explained/>

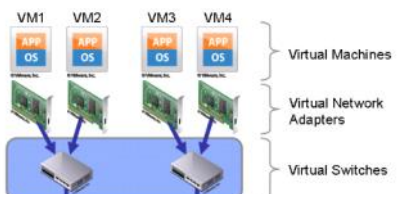
Virtualization
Rapid Elasticity
Resource available on demand
Measure of service
Delivered over web
Reliable

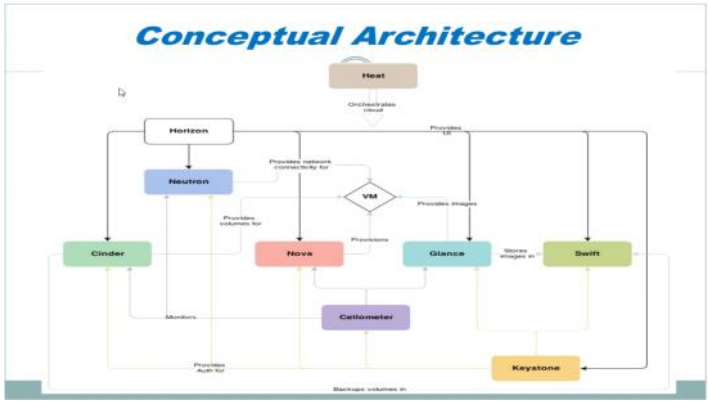
Software as a service	
Infrastructure as a service	
Platform as a service	Google app engine, Amazon web server, Rackspace

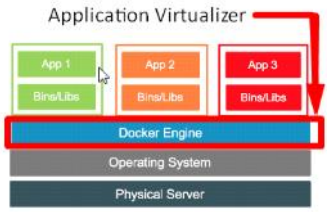
Docker	
Valgrant	

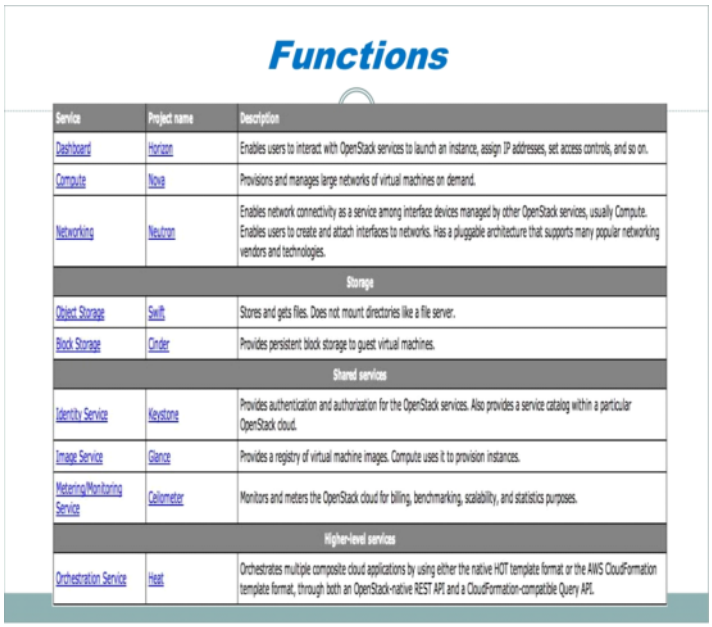
Different services talk to each other using message que or REST API

REST API



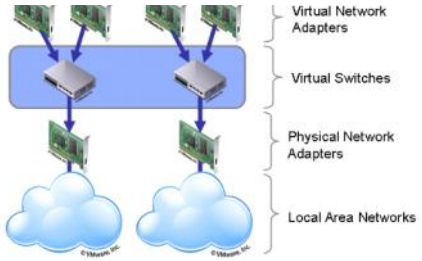






Service	Project name	Description
Dashboard	Horizon	Enables users to interact with OpenStack services to launch an instance, assign IP addresses, set access controls, and so on.
Compute	Nova	Provisions and manages large networks of virtual machines on demand.
Networking	Neutron	Enables network connectivity as a service among interface devices managed by other OpenStack services, usually Compute. Enables users to create and attach interfaces to networks. Has a pluggable architecture that supports many popular networking vendors and technologies.
Storage		
Object Storage	Swift	Stores and gets files. Does not mount directories like a file server.
Block Storage	Cinder	Provides persistent block storage to guest virtual machines.
Shared services		
Identity Service	Keystone	Provides authentication and authorization for the OpenStack services. Also provides a service catalog within a particular OpenStack cloud.
Image Service	Glance	Provides a registry of virtual machine images. Compute uses it to provision instances.
Metering/Monitoring Service	Ceilometer	Monitors and meters the OpenStack cloud for billing, benchmarking, scalability, and statistics purposes.
Higher-level services		
Orchestration Service	Heat	Orchestrates multiple composite cloud applications by using either the native HOT template format or the AWS CloudFormation template format, through both an OpenStack-native REST API and a CloudFormation-compatible Query API.

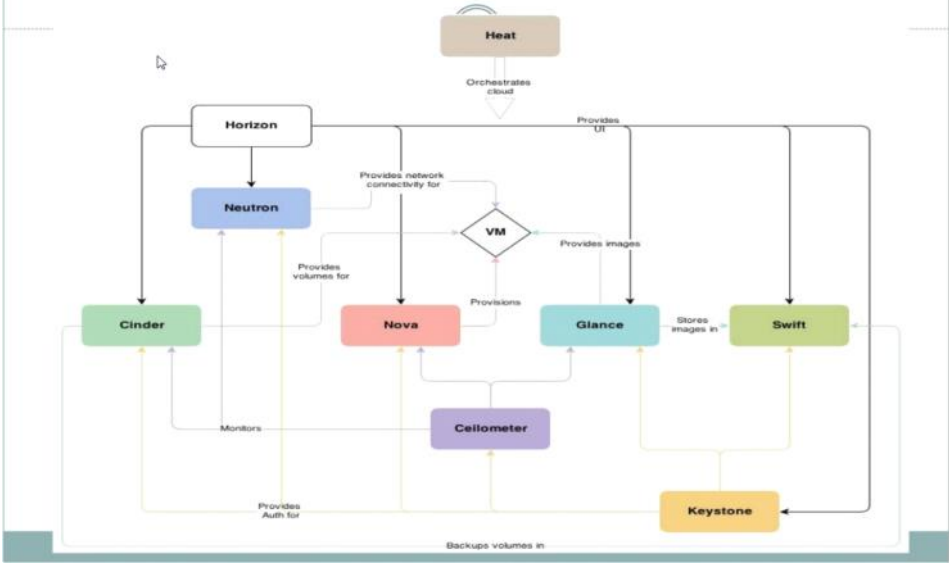
Project	Codenamed
Dashboard	Horizon
Compute	Nova
Identity	Keystone
Network	Neutron
Image Service	Glance
Block Storage	Cinder
Object Storage	Swift
Metering	Telemetry
Orchestration	Heat



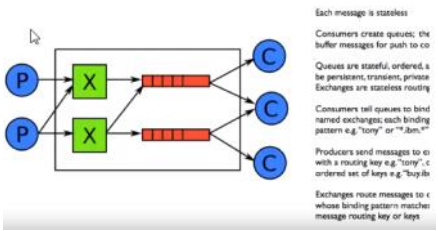
REST Methods

HTTP Method	Action	Examples
GET	Obtain information about a resource	http://example.com/api/orders (retrieve order list)
GET	Obtain information about a resource	http://example.com/api/orders/123 (retrieve order #123)
POST	Create a new resource	http://example.com/api/orders (create a new order, from data provided with the request)
PUT	Update a resource	http://example.com/api/orders/123 (update order #123, from data provided with the request)
DELETE	Delete a resource	http://example.com/api/orders/123 (delete order #123)

Conceptual Architecture



RabbitMQ/QPID - Everything is a message



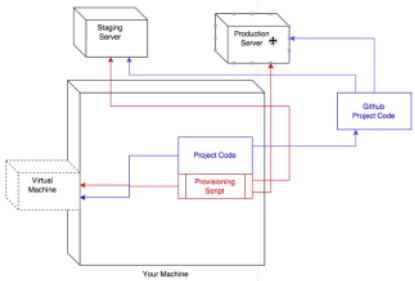
Best Practice – Log Management

- Use log management and indexing
  - Logstash with Kibana
  - ElasticSeach
  - rsyslogd
- Allows to easily follow complete message flows that go across multiple servers and services

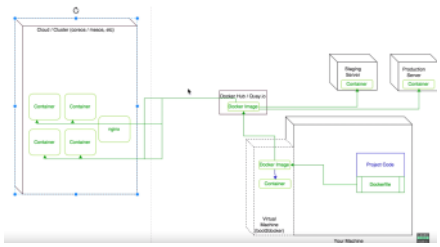
How To Watch The Movement

Node type	Service	Log location
Cloud controller	nova-*	/var/log/nova
Cloud controller	glance-*	/var/log/glance
Cloud controller	cinder-*	/var/log/cinder
Cloud controller	keystone-*	/var/log/keystone
Cloud controller	neutron-*	/var/log/neutron
Cloud controller	horizon	/var/log/apache2/
All nodes	misc (swift, dnsmasq)	/var/log/syslog
Compute nodes	libvirt	/var/log/libvirt/libvirtd.log
Compute nodes	Console (boot up messages) for VM instances:	/var/lib/nova/instances/instance-<instance id>/console.log
Block Storage nodes	cinder-volume	/var/log/cinder/cinder-volume.log

- Logs, logs and more logs
- Each Openstack Service has its own logs
- To follow a flow, or to find problems you often need to look across several logs


Staging Server
Production Server
Github Project Code
Project Code
Provisioning Script
Virtual Machine
Your Machine

------>



RSTP

17 February 2018 01:33

RSTP evolved from the original STP IEEE 802.1D protocol to provide faster spanning-tree reconvergence after a switch port, switch, or LAN failure. Where STP took up to 50 seconds to respond to topology changes, RSTP responds to changes within the timeframe of three hello BPDUs (bridge protocol data units), or 6 seconds

why RSTP:
layer 2 topological loop

1. mac address table corruption
2. broadcast storm unknown unicast and broad cast (switch process)

HELLO time:
Specifies, in seconds, how often the system broadcasts HELLO frames to other members of the spanning tree.

Transmit Hold Count
Specifies the maximum number of spanning tree frames the system can transmit on a port within the Hello Time interval.

Forward Delay
Specifies, in seconds, the length of time for which an interface is blocked from forwarding network traffic
after the spanning tree topology has been modified. This property is more useful for STP than RSTP or MSTP.

Maximum Age
Specifies, in seconds, the length of time for which spanning tree information from other bridges is considered valid.

When you change the value of the Maximum Age option, you change the amount of time, in seconds, that spanning tree information received from other bridges is considered valid. The default value is 20, and the valid range is 6 to 40.
Note that when running RSTP, you must maintain the following relationships between the Maximum Age and the Hello Time and Forward Delay options:
Maximum Age >= 2 * (Hello Time + 1)
Maximum Age <= 2 * (Forward Delay - 1)

Destination mac: 01:80:c2:00:00:00
Protocol version identifier: 0->stp; 2->rstp
Default bridge priority: 32,768
Bridge id: bridge id(16 bit)+mac(48 bit)

Root selection:
lowest bridge ID becomes the root bridge

Port Roles Determine Participation in the Spanning Tree

Root port:
The port closest to the root bridge (has the lowest path cost from a bridge). This is the only port that receives frames from and forwards frames to the root bridge.
Designated port:
The port that forwards traffic away from the root bridge toward a leaf. A designated bridge has one designated port for every link connection it serves. A root bridge forwards frames from all of its ports, which serve as designated ports

Alternate port
A port that provides an alternate path toward the root bridge if the root port fails and is placed in the discarding state. This port is not part of the active spanning tree, but if the root port fails, the alternate port immediately takes over.

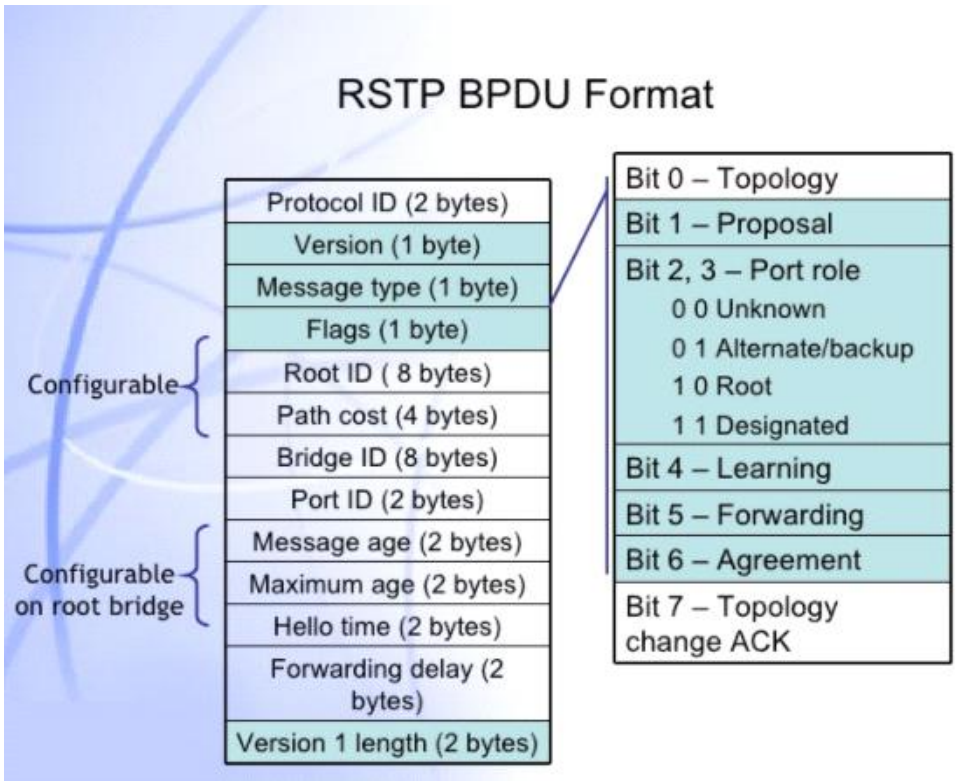
Backup port
A port that provides a backup path toward the leaves of the spanning tree if a designated port fails and is placed in the discarding state. A backup port can exist only where two or more bridge ports connect to the same LAN for which the bridge serves as the designated bridge. A backup port for a designated port immediately takes over if the port fails.

Disabled port

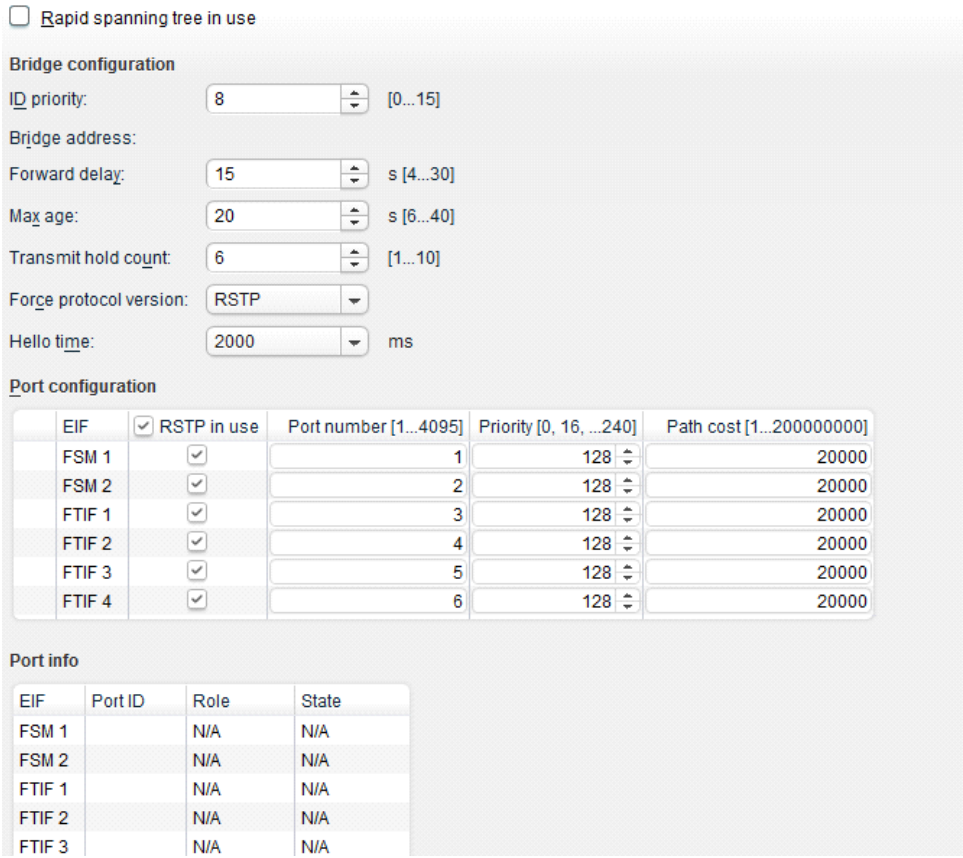
Port States Determine How a Port Processes a Frame

Discarding—The port discards all BPDUs. A port in this state discards all frames it receives and does not learn MAC addresses.
Learning—The port prepares to forward traffic by examining received frames for location information in order to build its MAC address table.
Forwarding—The port filters and forwards frames. A port in the forwarding state is part of the active spanning tree.

In stp :
Blocking - A port that would cause a switching loop if it were active. No user data is sent or received over a blocking port, but it may go into forwarding mode if the other links in use fail and the spanning tree algorithm determines the port may transition to the forwarding state. BPDU data is still received in blocking state. Prevents the use of looped paths.
Listening - The switch processes BPDUs and awaits possible new information that would cause it to return to the blocking state. It does not populate the MAC address table and it does not forward frames.
Learning - While the port does not yet forward frames it does learn source addresses from frames received and adds them to the filtering database (switching database). It populates the MAC address table, but does not forward frames.
Forwarding - A port receiving and sending data in Ethernet frames, normal operation. The Forwarding port monitors incoming BPDUs that would indicate it should return to the blocking state to prevent a loop.
Disabled - A network administrator has manually disabled a switch port




```
Frame 54: 52 bytes on wire (416 bits), 52 bytes captured (416 bits)
IEEE 802.3 Ethernet
  Destination: Spanning-tree-(for-bridges)_00 (01:80:c2:00:00:00)
     Address: Spanning-tree-(for-bridges)_00 (01:80:c2:00:00:00)
     .... ...1 .... .... .... .... = IG bit: Group address (multicast/broadcast)
     .... ..0. .... .... .... .... = LG bit: Globally unique address (factory default)
  Source: NokiaSie_45:62:7c (00:40:43:45:62:7c)
  Length: 38
Logical-Link Control
  DSAP: Spanning Tree BPDU (0x42)
  IG Bit: Individual
  SSAP: Spanning Tree BPDU (0x42)
  CR Bit: Command
  Control field: U, func=UI (0x03)
     000. 00.. = Command: Unnumbered Information (0x00)
     .... ..11 = Frame type: Unnumbered frame (0x03)
Spanning Tree Protocol
  Protocol Identifier: Spanning Tree Protocol (0x0000)
  Protocol Version Identifier: Spanning Tree (0)
  BPDU Type: Configuration (0x00)
  BPDU flags: 0x00
     0... .... = Topology Change Acknowledgment: No
     .... ...0 = Topology Change: No
  Root Identifier: 32768 / 0 / 00:40:43:45:62:7c
     Root Bridge Priority: 32768
     Root Bridge System ID Extension: 0
     Root Bridge System ID: 00:40:43:45:62:7c
  Root Path Cost: 0
  Bridge Identifier: 32768 / 0 / 00:40:43:45:62:7c
     Bridge Priority: 32768
     Bridge System ID Extension: 0
     Bridge System ID: 00:40:43:45:62:7c
  Port identifier: 0x8006
  Message Age: 0
  Max Age: 20
  Hello Time: 2
  Forward Delay: 15
```


Rapid spanning tree in use
Bridge configuration
ID priority: 8 [0...15]
Bridge address:
Forward delay: 15 s [4...30]
Max age: 20 s [6...40]
Transmit hold count: 6 [1...10]
Force protocol version: RSTP
Hello time: 2000 ms
Port configuration
EIF | RSTP in use | Port number [1...4095] | Priority [0, 16, ...240] | Path cost [1...200000000]
FSM 1 | 1 | 128 | 20000
FSM 2 | 2 | 128 | 20000
FTIF 1 | 3 | 128 | 20000
FTIF 2 | 4 | 128 | 20000
FTIF 3 | 5 | 128 | 20000
FTIF 4 | 6 | 128 | 20000
Port info
EIF | Port ID | Role | State
FSM 1 | N/A | N/A
FSM 2 | N/A | N/A
FTIF 1 | N/A | N/A
FTIF 2 | N/A | N/A
FTIF 3 | N/A | N/A

OSPF

17 February 2018 03:01

7 stages of OSPF (**D**arling **I**t **T**est **S**ome **E**xtremely **L**arge **F**arts) layer3

link state protocol
hop count and BW

DR
all flood LSA to DR
and DR send/forward LSA to all other routers
all router from nebi data base with BDR also (flood LSA to BDR)

1. down stage	network cmd hello message A sends router id to 244.0.0.5 (multicast router id add for ospf every other is listening to the add).
2. init	B reply with hello unicast message to A
3. Two way stage	establish neighbor rel and fill neb table (DR,BDR elected)
4. EXSTART State	who will start transmission i will start my router id is ---- no i will start my router id is ---- (master/slave rel setup)
5. Exchange start	start transmission here is summary of LSDB(link state database) by DBD(Database decision packet) (exchange DBD)
6. Loading state	router A checks its own database and neighbor summary database ensuring that both are same by LsACK packet if not same or entry is missing send LSR(link state res) to send complete entry for route B LSU link state update () LSAck
7. FULL State	same sync database calculate OSPF cal BW: 10^8 /BW

====
LSA types(link state advertisment)
type 1->backbone area ->router area
type 2->Standard area -> network lsa (DR generated)
Type 3->Stub area ->Summary LSA (Abr summary route) ->block type 5
Type 4->Totally stub area->Summary loc (ASBR location) ->block type 3,4,5
Type 5->not so stubby area(used type 7 router ripped it to type 5)->external LSA (ASBR summary route)

LSA type 1:Router LSA
when plug in new router tell new router is added.
using LSA type 1 every router advertise connected link info to other router belong to same area
based on router id

LSA 2:originated by DR
tells who is DR
it contains list of attached routers on transmit link and include subnet mask

LSA 1 and LSA 2 will not cross there area boundary within the area between the router

LSA type 3:summary lsa
Summary LSA to area outside originating area
initialized by the ABR of originating area

LSA type4:
summary LSA
location of ASBR
Lsa is used to advertise an ASBR to all other areas in the AS
generated by the ABR of originating area and regenerated by all subsequent ABRs.

LSA type 5:
external LSA
advertise by ASBR used to advertise networks from other autonomous systems.
advertise routerid ASBR unchanged throughout as
Type 4 LSA is need to find ASBR

To control the advertisement of external routes into an area, OSPF uses stub areas. By designating an area border router (ABR) interface to the area as a stub interface, you suppress external route advertisements through the ABR. Instead, the ABR advertises a default route (through itself) in place of the external routes and generates network summary (Type 3) link-state advertisements (LSAs).

A stub area that only allows routes internal to the area and restricts Type 3 LSAs from entering the stub area is often called a *totally stubby area*.

Selection of DR/BDR
router id :name of router is highest ip address of active physical interface of the router
if logical interface(loopback interface never go down) is configured then highest ip add of logical interface
preference
1.manually router id command
2.highest loopback (eg:192.168.1.1) (as loopback will not crash unless you off the router)
3.highest IP

OSPF IPv6 LSA Types :

Routing **N**etworks **I**s **I**ndeed **A** **G**reat **N**ew **L**earning **I**nitiative

Router LSA – Network LSA – InterArea Prefix LSA – InterArea Router LSA – AS External LSA – Group Membership LSA – NSSA LSA (Not so stubby Area) – Link LSA – IntraArea Prefix LSA

From <http://zahid-stanikzai.com/mnemonics-for-networking/>

share LSA directly if point to point
All will send LSA to designated router on 224.0.0.6(all dr address) if it is broadcast (not directly connnected)
and then designated router send info on 224.0.0.5 (all spf address)to all routers
network also select a backup designated router.

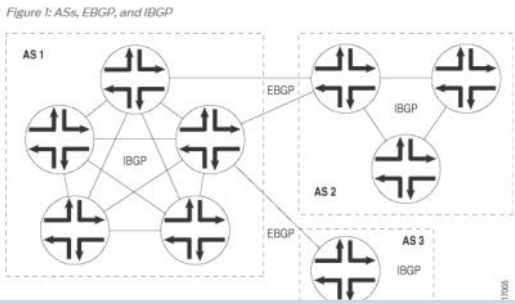
DR and BDR is elected per multicast network not area.

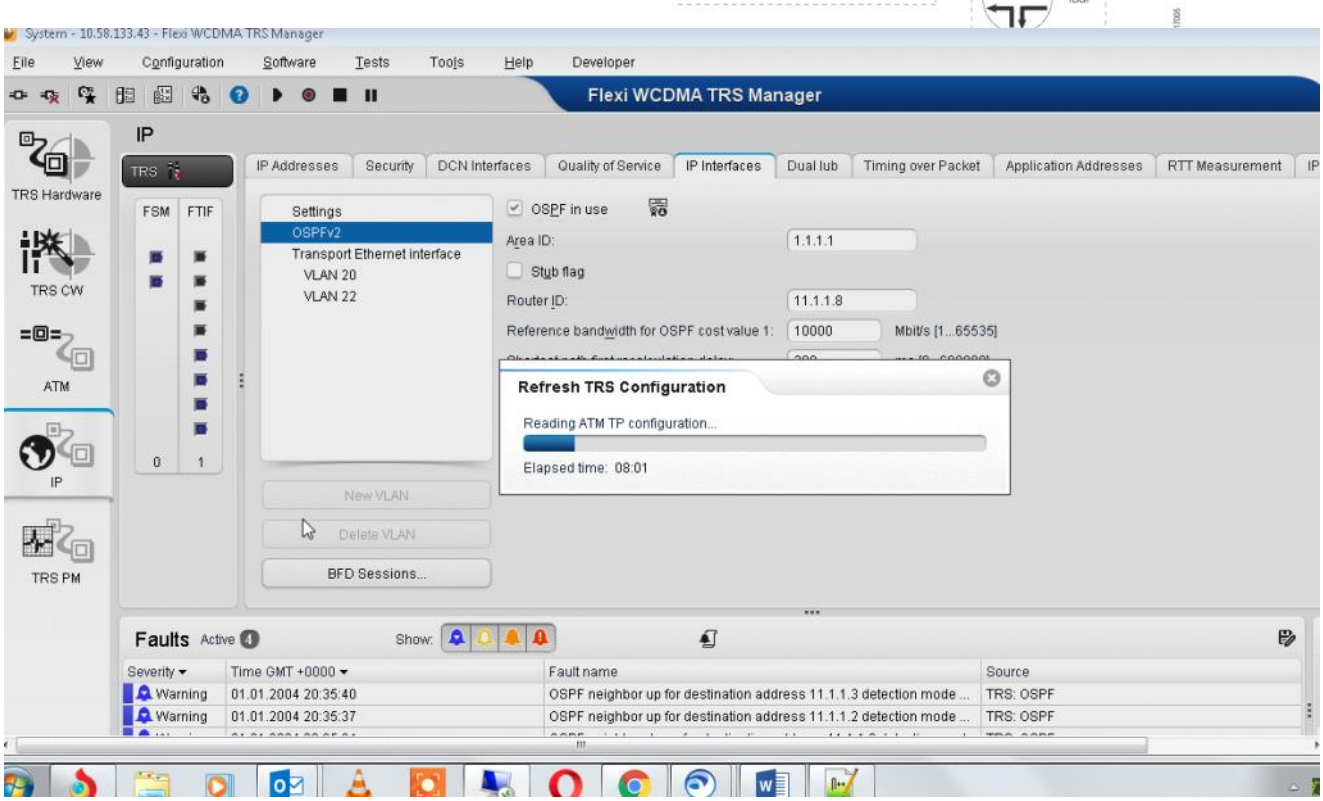
BY default priority of router is one.
if priority is zero it will not take part in DR and BDR election

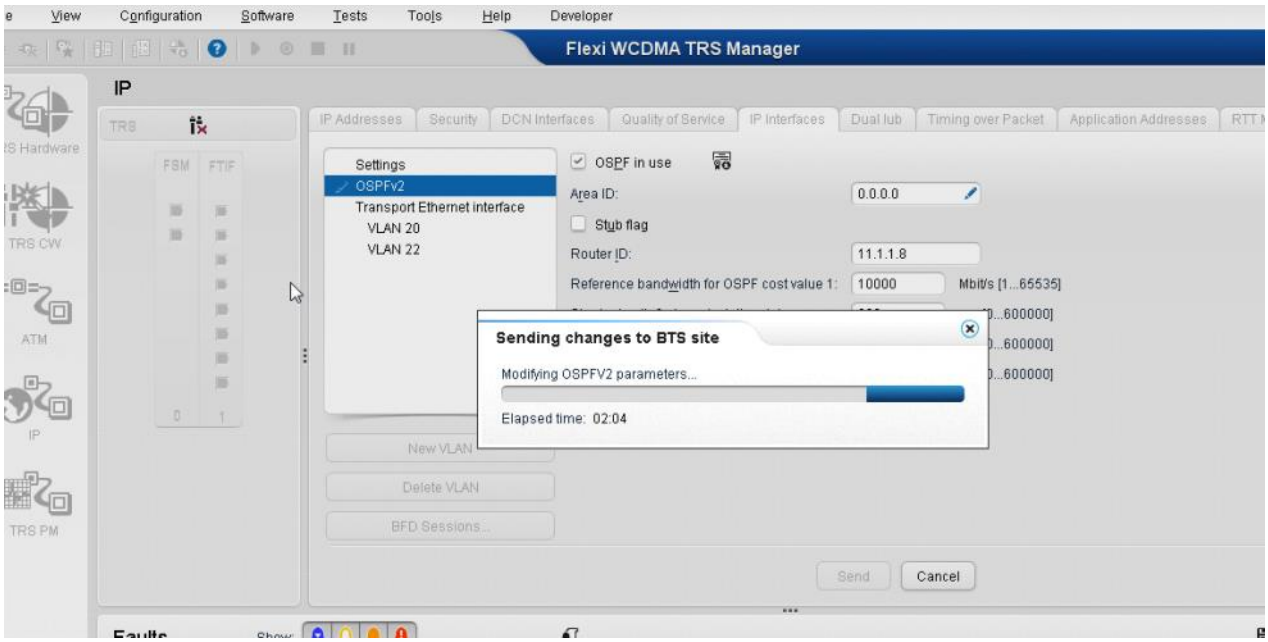
DIJIKSTRA's ALGO:
First select one as source (0) all other path(infinity)--->find path to all nebigour vertexes
-->go to second vertex(with shortest path value) self path+ other path from nei node
if path to other node is short the prev update it

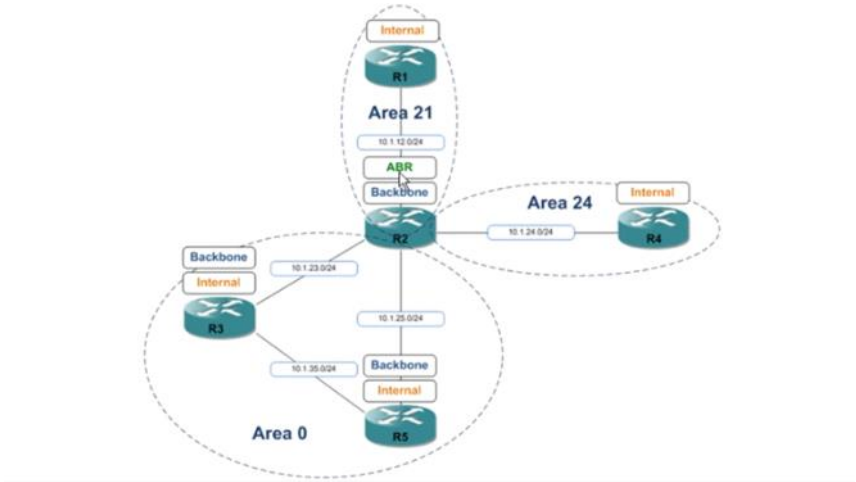
select the shortest city first

[d(0,2)]





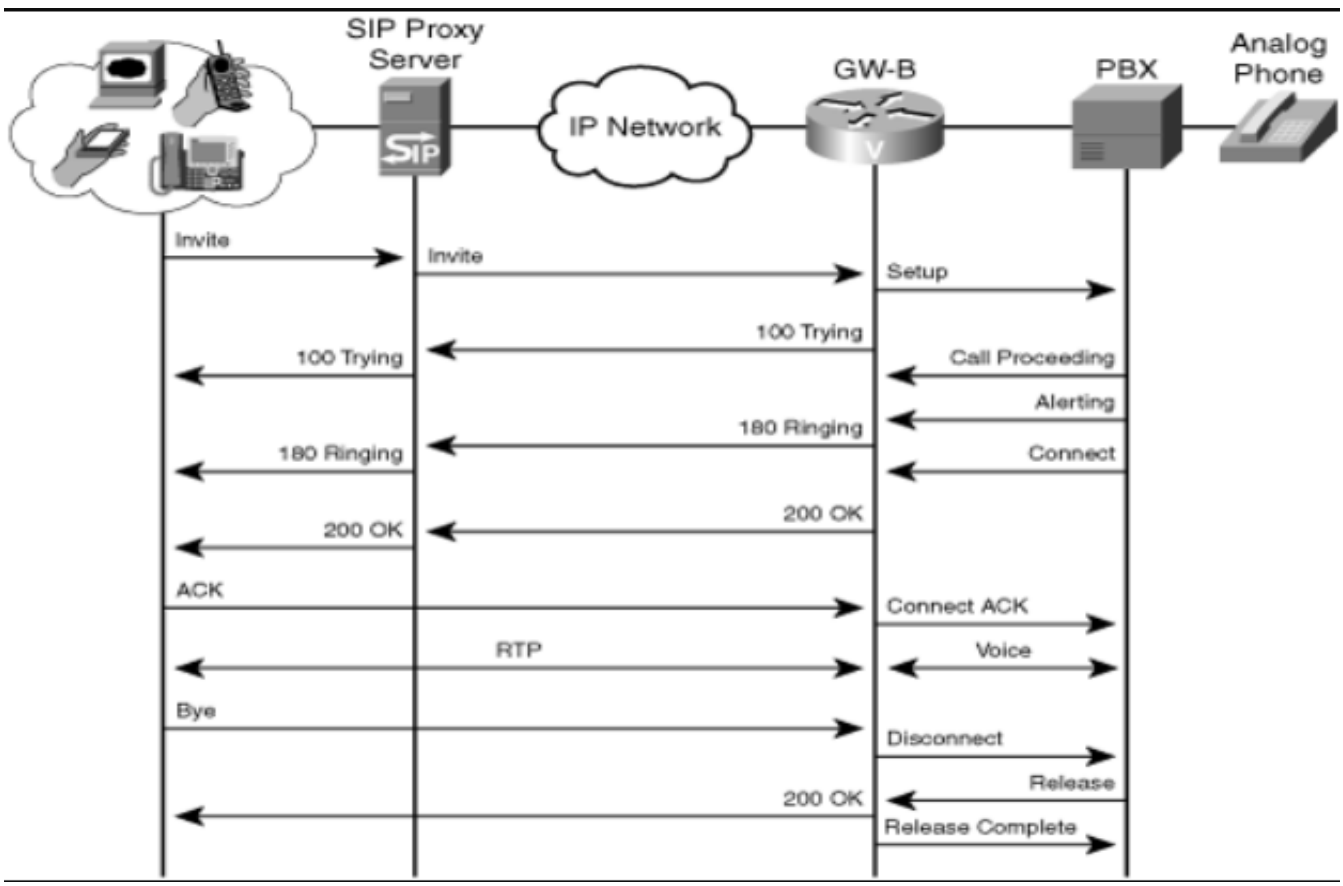

View
Configuration
Software
Tests
Tools
Help
Developer
Flexi WCDMA TRS Manager
IP
IP Addresses
Security
DCN Interfaces
Quality of Service
IP Interfaces
Dual Iub
Timing over Packet
Application Addresses
Settings
OSPFv2
Transport Ethernet interface
VLAN 20
VLAN 22
OSPF in use
Area ID:
0.0.0.0
Stub flag
Router ID:
11.1.1.8
Reference bandwidth for OSPF cost value 1:
10000
Mbit/s [1...65535]
Sending changes to BTS site
Modifying OSPFV2 parameters...
Elapsed time: 02:04
New VLAN
Delete VLAN
BFD Sessions...
Send
Cancel

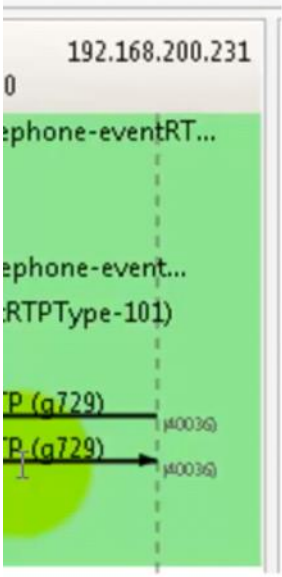

Internal
R1
Area 21
ABR
Backbone
Area 24
Internal
R4
R2
Backbone
Internal
R3
Backbone
Internal
R5
Area 0

SIP

16 February 2018 22:50

Sip is a signalling protocol to setup ip communication





Invite: All calls start with an invite message. The direction of the arrow will show who originated the call. In this case it was originated by the PBX. Also note the letters SDP. This packet included codec options for setting up the voice path. The PBX informs the carrier that it can accept g729, g711A, and g711U.

100 Trying: This is a status message that states that something is happening to begin processing this call. It is not a confirmation message, that the invite has been received by the remote party.

180 Ringing: This is a confirmation that the invite message was received and that the user is being notified of the call.

183 Session Progress: In this packet the carrier has selected the g729 codec and is informing the PBX of the decision. This is codec choice is usually based on a preprogrammed priority table. This message could indicate to the PBX to begin the ring back tone.

200 OK SDP: This message provides acknowledgement of the invite and provides the media properties..

ACK: This message acknowledges that the 200 OK message was received by the PBX.

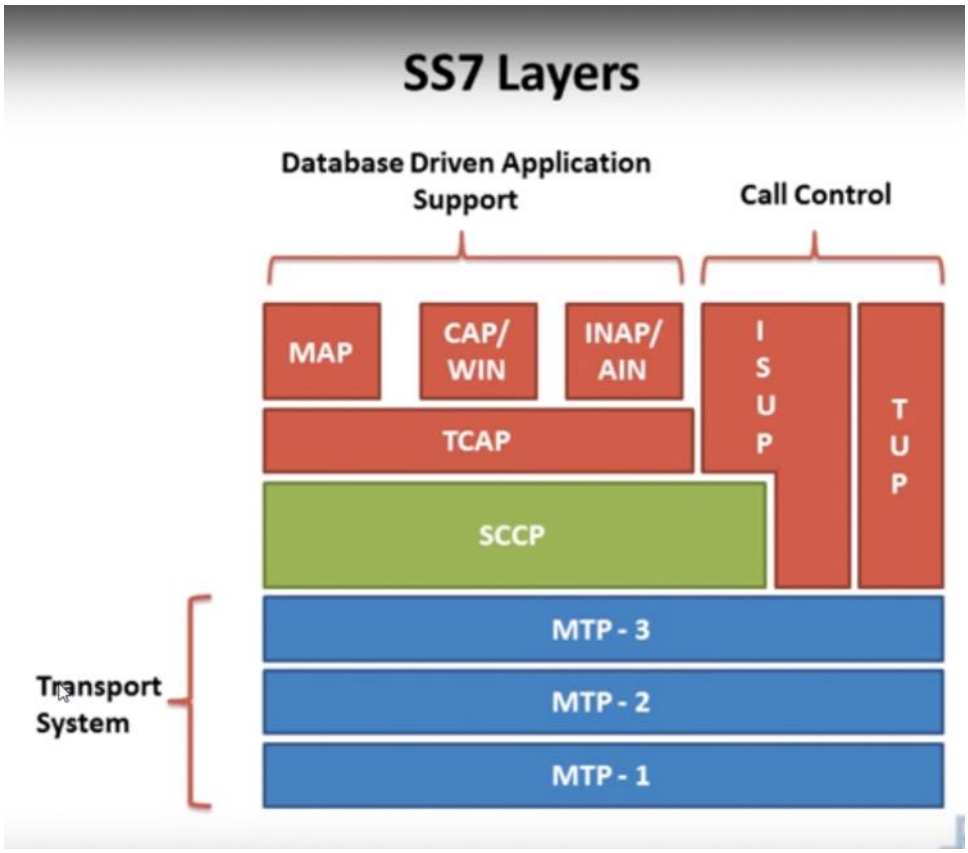
RTP: This is the audio stream between the carrier and your media gateway.

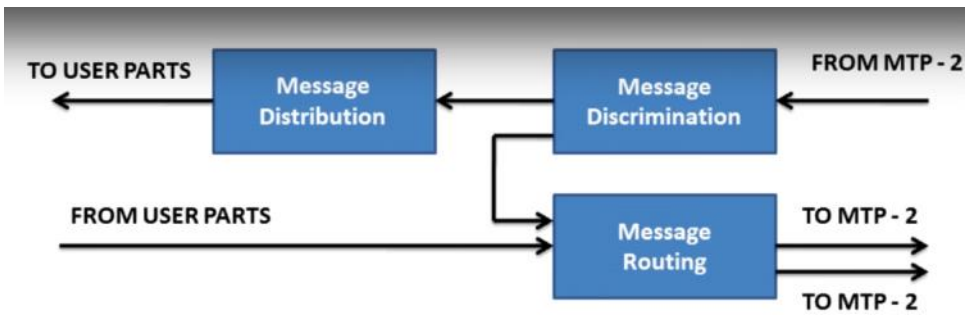
Bye: This is a message to signal the carrier that I have terminated the call from the PBX side. The direction of the arrow can be used to determine who originated the termination of the call.

200 OK: This is the acknowledgement from the carrier, that the Bye message was received.

SS7

17 February 2018 01:20





Message Handling is Based Upon :

- SIO – Service Information Octet – NI, SI.
- Routing Label – OPC, DPC, Signalling link Selection.
- Some Important Service Indicators (SI)

  SCCP – 0011

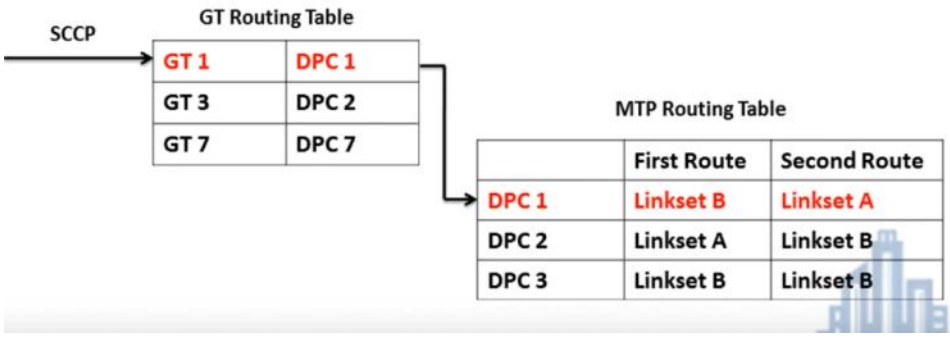
  TUP – 0100

  ISUP – 0101

Additional Features of SCCP

- More Flexible Routing based on GT (Global Title)
- Can be used to run OSI Layers
- Support for TCAP,MAP Layers

Global Title Translation



3. User Parts

- ISUP – ISDN User Part
- TUP – Telephone User Part
- TCAP - Transaction Capabilities Application Part
  - AIN
  - INAP
  - CAP
  - MAP

Ethernet header

01 June 2018 16:03

Destination
source
vlan tag:
type:

Preamble:
SOF

Des mac:48 byte --> manufacture ID(24bits) and serial no() L2 add/hardware address
source mac
type: 2 byte: message to network layer (0x800:IPv4, 0x86DD:IPv6)
data : varies
FCS:32 bits
uses CRC for Hash ,used for error checking

value match -> has integrity

VLAN:
virtual local area network

problem : host in nw(switches) 1 cannot--> connect to network 2
Vlan: connect both in one switch, logical segmentation of networks

possibility to communicate between vlan --<>-- needed router

VTP:
switch->
VTP server :
make a change revision no will be change or inc

VTP client : synchronize with server

VTP transparent: will not sync

Domain name (all switch belong to same switch)
problem
If VTP client deattach (and all vlan is deleted) and attach in network then may advertise revision higher they server and then server sync with it and delete all vlan

IPv4

23 February 2018 04:54

IPv4 is a connectionless protocol for use on packet-switched networks.
It operates on a best effort delivery model
the most significant bits are the network prefix, which identifies a whole network or subnet, and
the least significantset forms the *host identifier*, which specifies a particular interface of a host on that network

Version
IP Header Length : genrally 20bytes to 60 (variation is possible) ipv6:40bytes(fixed)
Differentiated Services Code Point (DSCP)(6 bit field)

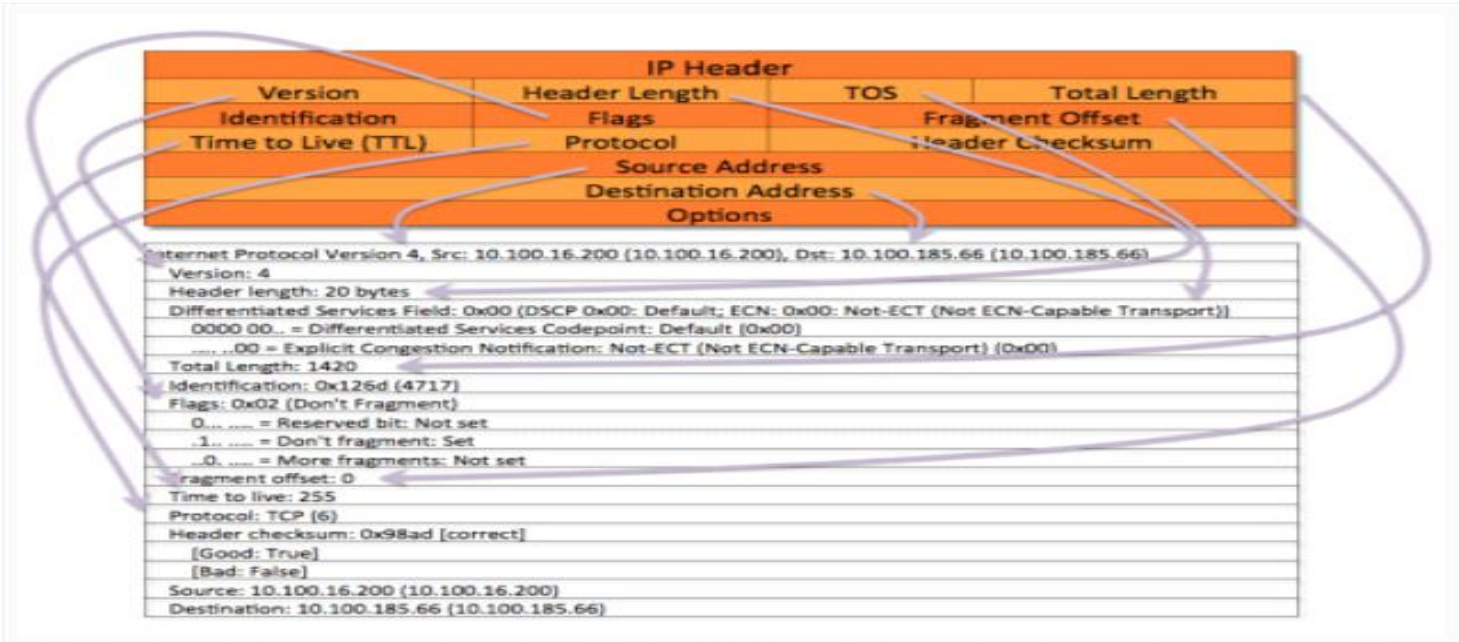
total length: ip and its payload (0 -65535 depends on MTU 1500)
(it is different from total frame size why?
618-604=18 bytes) it will not include ethernet header
DS mac:6bytes, SC mac:6bytes, Type:2bytes(0800 -->IP)

identification: unique no to each packet
flags:
reserved :01
x:0x80 (evil bit)
DF : 0->fragmentation, 1->don't fragment
MF: 0->last segment, 1->more fragment is required
fragment offset

router broke Ip packet and reassemble at far end.
each fragment have same identification no but different offset no(no of bytes)

Time to live: (default windows 128,unix 255)
if time to live value is zero the router will delete the packet and send ICMP message to a origanator
ttl value exceeded
protocol:
UDP(17)
ICMP(1,2)
TCP(6)
IGRP()
OSPF(89)
ESP(15)
AH(11)

header checksum: --->removed from ipv6(flag,offset,identification)



Ipv6

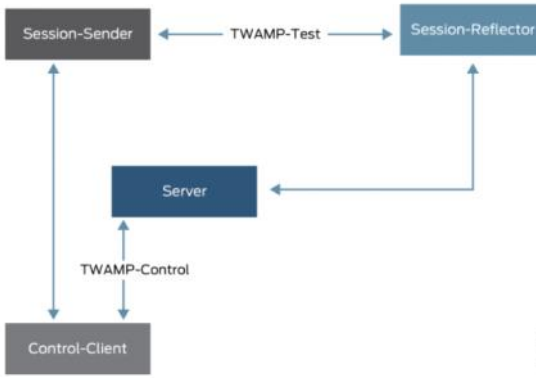
23 February 2018 04:54

TWAMP

23 February 2018 05:00

TWAMP	Two way active measurement protocol

Two-way measurements are helpful because round-trip delays do not require host clock synchronization and remote support might be a simple echo function.



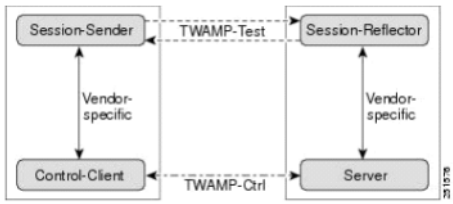
1. Enable
2. configure terminal
3.

ip sla server twamp	Device(config)# ip sla server twamp Configures the device as a TWAMP server and enters TWAMP server configuration mode.

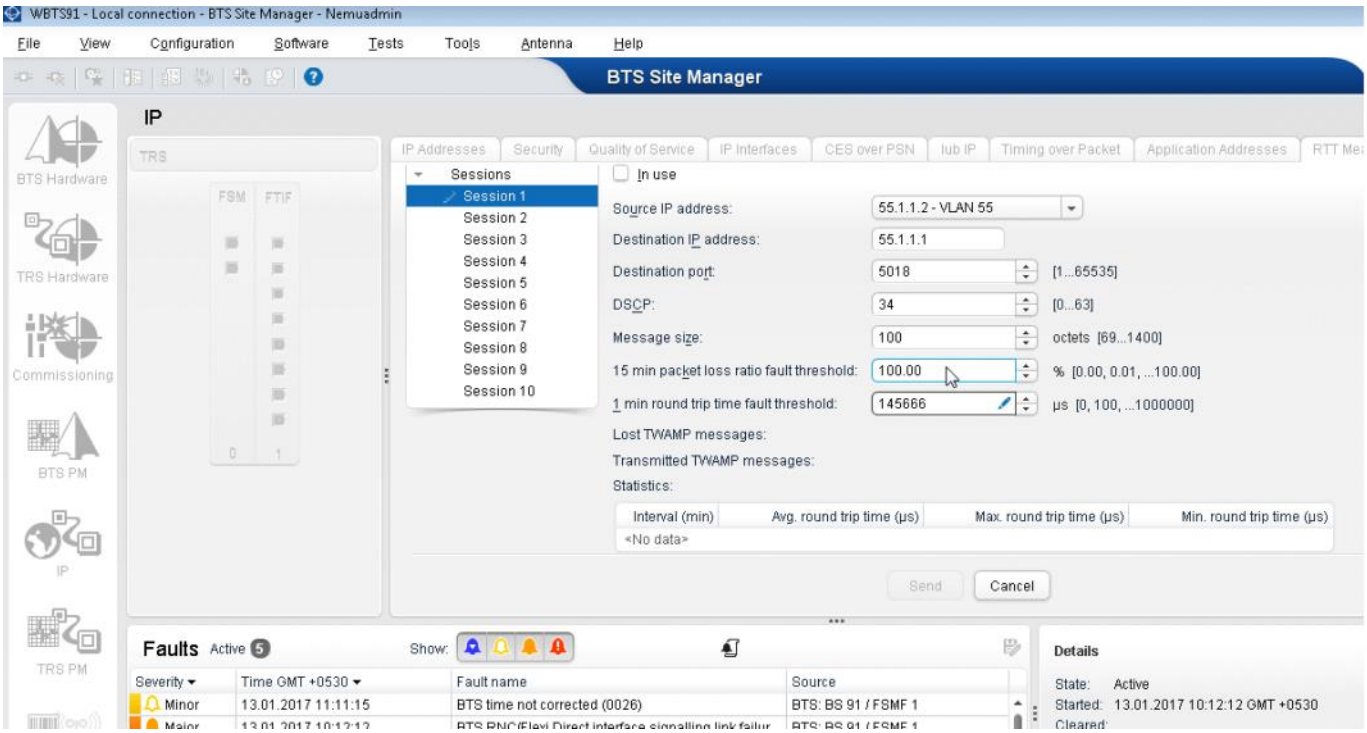
4.

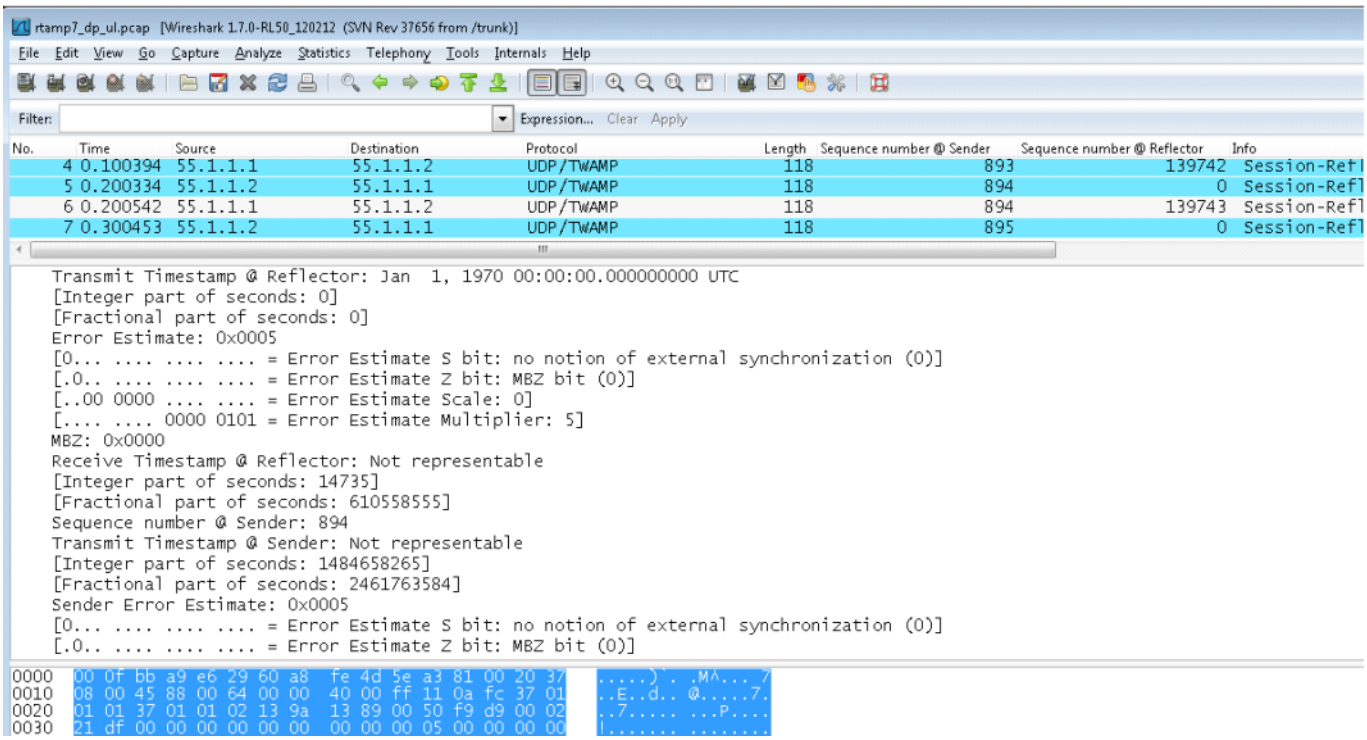
port port-number	Device(config-twamp-srvr)# port 9000 Configures the port to be used by the TWAMP server to listen for connection and control requests.
timer inactivity seconds	Device(config-twamp-srvr)# timer inactivity 300 Configures the inactivity timer for a TWAMP control session

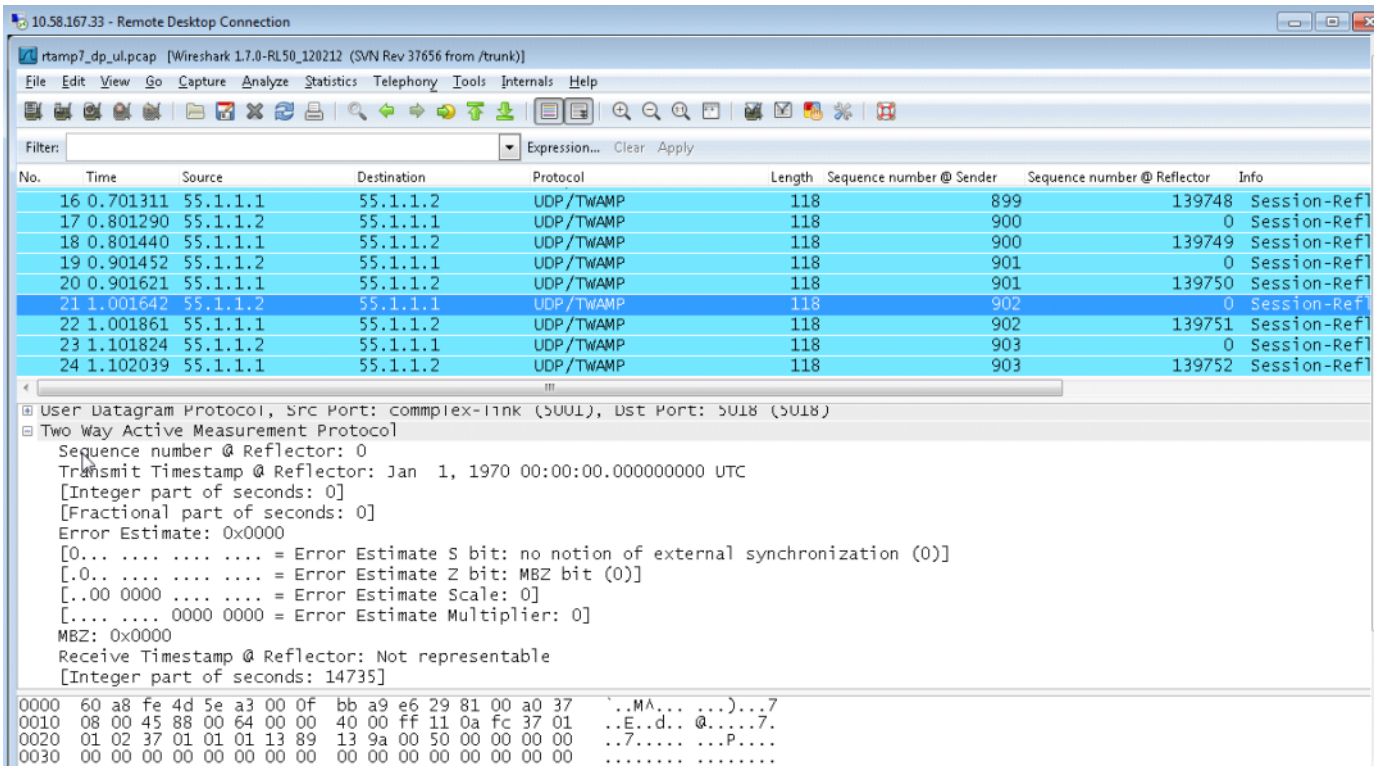
Figure 1: TWAMP Architecture

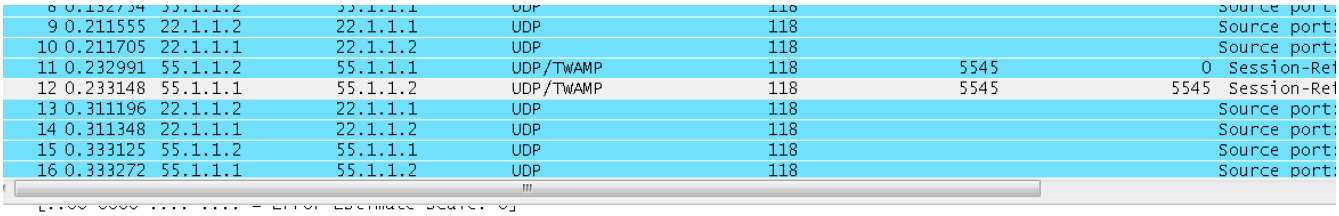


For reflector: no port no is define
1. enable
2. configure terminal
3. ip sla responder twamp
4. timeout seconds
5. end




rtamp7_dp_ul.pcap [Wireshark 1.7.0-RL50_120212 (SVN Rev 37656 from /trunk)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply
No. Time Source Destination Protocol Length Sequence number @ Sender Sequence number @ Reflector Info
4 0.100394 55.1.1.1 55.1.1.2 UDP/TWAMP 118 893 139742 Session-Refl
5 0.200334 55.1.1.2 55.1.1.1 UDP/TWAMP 118 894 0 Session-Refl
6 0.200542 55.1.1.1 55.1.1.2 UDP/TWAMP 118 894 139743 Session-Refl
7 0.300453 55.1.1.2 55.1.1.1 UDP/TWAMP 118 895 0 Session-Refl
Transmit Timestamp @ Reflector: Jan 1, 1970 00:00:00.000000000 UTC
[Integer part of seconds: 0]
[Fractional part of seconds: 0]
Error Estimate: 0x0005
[0... .... = Error Estimate S bit: no notion of external synchronization (0)]
[.0.. .... = Error Estimate Z bit: MBZ bit (0)]
[..00 0000 .... = Error Estimate Scale: 0]
[.... .... 0000 0101 = Error Estimate Multiplier: 5]
MBZ: 0x0000
Receive Timestamp @ Reflector: Not representable
[Integer part of seconds: 14735]
[Fractional part of seconds: 610558555]
Sequence number @ Sender: 894
Transmit Timestamp @ Sender: Not representable
[Integer part of seconds: 1484658265]
[Fractional part of seconds: 2461763584]
Sender Error Estimate: 0x0005
[0... .... = Error Estimate S bit: no notion of external synchronization (0)]
[.0.. .... = Error Estimate Z bit: MBZ bit (0)]
0000 00 0f bb a9 e6 29 60 a8 fe 4d 5e a3 81 00 20 37 .....)`. .M^... 7
0010 08 00 45 88 00 64 00 00 40 00 ff 11 0a fc 37 01 ..E..d.. @.....7.
0020 01 01 37 01 01 02 13 9a 13 89 00 50 f9 d9 00 02 ..7..... ...P....
0030 21 df 00 00 00 00 00 00 00 00 00 05 00 00 00 00 !....... ....


10.58.167.33 - Remote Desktop Connection
rtamp7_dp_ul.pcap [Wireshark 1.7.0-RL50_120212 (SVN Rev 37656 from /trunk)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter: Expression... Clear Apply
No. Time Source Destination Protocol Length Sequence number @ Sender Sequence number @ Reflector Info
16 0.701311 55.1.1.1 55.1.1.2 UDP/TWAMP 118 899 139748 Session-Refl
17 0.801290 55.1.1.2 55.1.1.1 UDP/TWAMP 118 900 0 Session-Refl
18 0.801440 55.1.1.1 55.1.1.2 UDP/TWAMP 118 900 139749 Session-Refl
19 0.901452 55.1.1.2 55.1.1.1 UDP/TWAMP 118 901 0 Session-Refl
20 0.901621 55.1.1.1 55.1.1.2 UDP/TWAMP 118 901 139750 Session-Refl
21 1.001642 55.1.1.2 55.1.1.1 UDP/TWAMP 118 902 0 Session-Refl
22 1.001861 55.1.1.1 55.1.1.2 UDP/TWAMP 118 902 139751 Session-Refl
23 1.101824 55.1.1.2 55.1.1.1 UDP/TWAMP 118 903 0 Session-Refl
24 1.102039 55.1.1.1 55.1.1.2 UDP/TWAMP 118 903 139752 Session-Refl
User Datagram Protocol, Src Port: commplex-link (5001), Dst Port: 5018 (5018)
Two Way Active Measurement Protocol
Sequence number @ Reflector: 0
Transmit Timestamp @ Reflector: Jan 1, 1970 00:00:00.000000000 UTC
[Integer part of seconds: 0]
[Fractional part of seconds: 0]
Error Estimate: 0x0000
[0... .... = Error Estimate S bit: no notion of external synchronization (0)]
[.0.. .... = Error Estimate Z bit: MBZ bit (0)]
[..00 0000 .... = Error Estimate Scale: 0]
[.... .... 0000 0000 = Error Estimate Multiplier: 0]
MBZ: 0x0000
Receive Timestamp @ Reflector: Not representable
[Integer part of seconds: 14735]
0000 60 a8 fe 4d 5e a3 00 0f bb a9 e6 29 81 00 a0 37 `..M^... ...)...7
0010 08 00 45 88 00 64 00 00 40 00 ff 11 0a fc 37 01 ..E..d.. @.....7.
0020 01 02 37 01 01 01 13 89 13 9a 00 50 00 00 00 00 ..7..... ...P....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ....



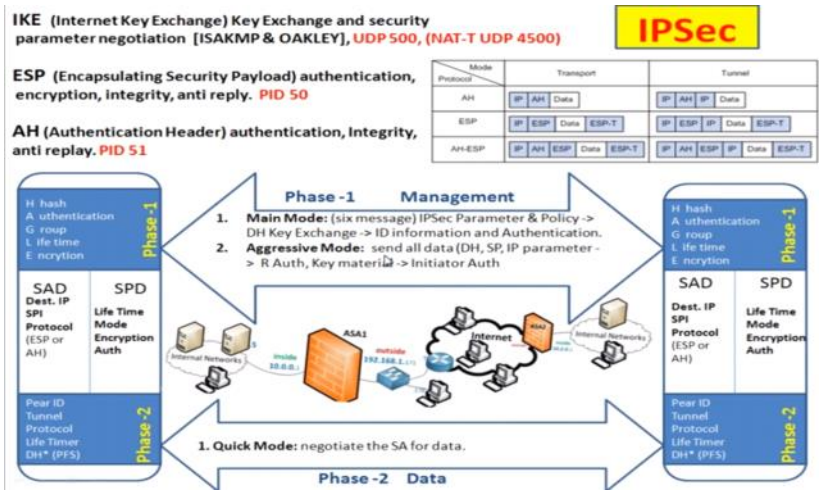
[.... .... 0000 0101 = Error Estimate Multiplier: 5]
MBZ: 0x0000
Receive Timestamp @ Reflector: Not representable
[Integer part of seconds: 2337179]
[Fractional part of seconds: 3741567299]
Sequence number @ Sender: 5545
Transmit Timestamp @ Sender: Not representable
[Integer part of seconds: 1484042192]
[Fractional part of seconds: 2384527188]
Sender Error Estimate: 0x0005
[0... .... = Error Estimate S bit: no notion of external synchronization (0)]

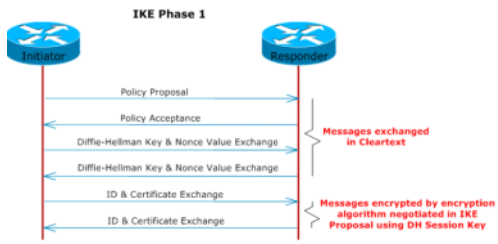
IPSEC

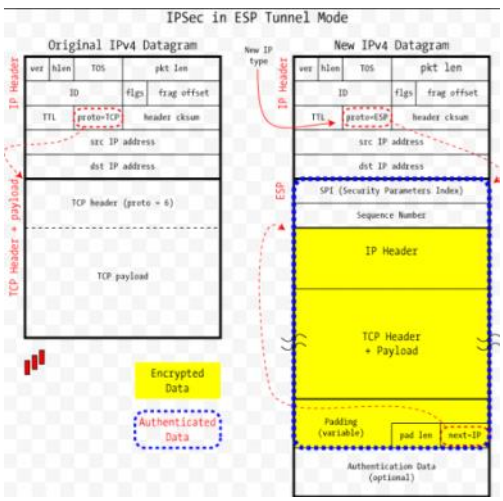
23 February 2018 12:27

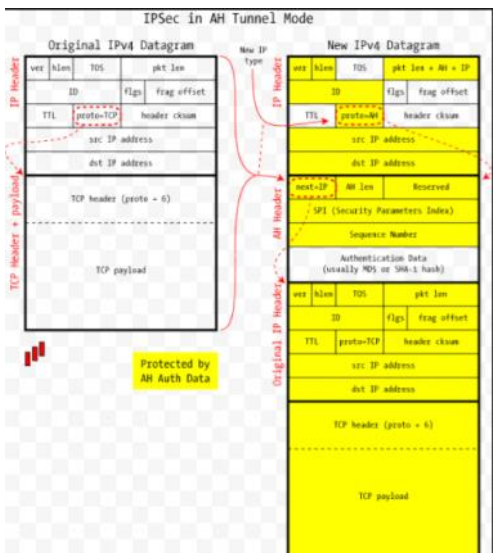
IKE	Internet key exchange,udp500,NAT-T udp 4500,	Key exchange and security parameter negotiation	Phase1:Management Main mode (6 message): ipsec parameter and policy->DH key exchange(defey helman)->id info and authentication Aggressive mode: Send all data in 1st message(DH,SP,IP parameter->R auth,key material->initiator auth Association made here is called IKE association (IZM)	Phase2:DATA Negotiate the SA for data Association made here is called IPSEC association Two unidirectional association are made. One for incoming. Second for outgoing.

ESP	Encapsulating Security payload, PID50	Authentication, encryption, integrity anti reply	Encryption:DES,3DES,RC5
AH	Authentication header,pid51	Authentication, integrity, and anti-reply	Authentication:Preshared ,digital signature,public key
SAD	Security association database		Intregity:HMAC-SHA1
SPD	Security policy database		









GPON

23 February 2018 18:18

GPON	Gigabit passive optical network

Gigabit: data transmission speed
Passive :no optical power is required in GPON network only end point requires power
Optical n/w: optical/light signal used to carry data

Gpon support
Triple -play service(tv,volp and internet service)
High bandwidth
Long reach (up to 20km)

OLT	Optical line terminal
ODN	Optical distribution network
ONU/ONT	Optical network unit/ termination

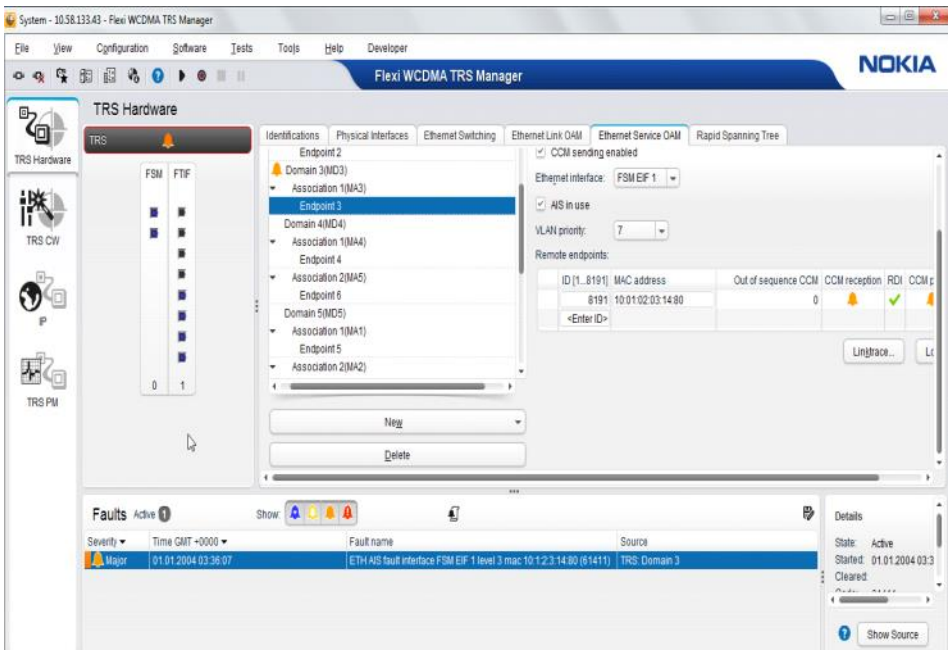
Gpon uses optical wavelength division multiplexing so single fiber can be used as uplink and downlink.
Laser of wavelength (λ) uplink=1490nm
Downlink=1310nm

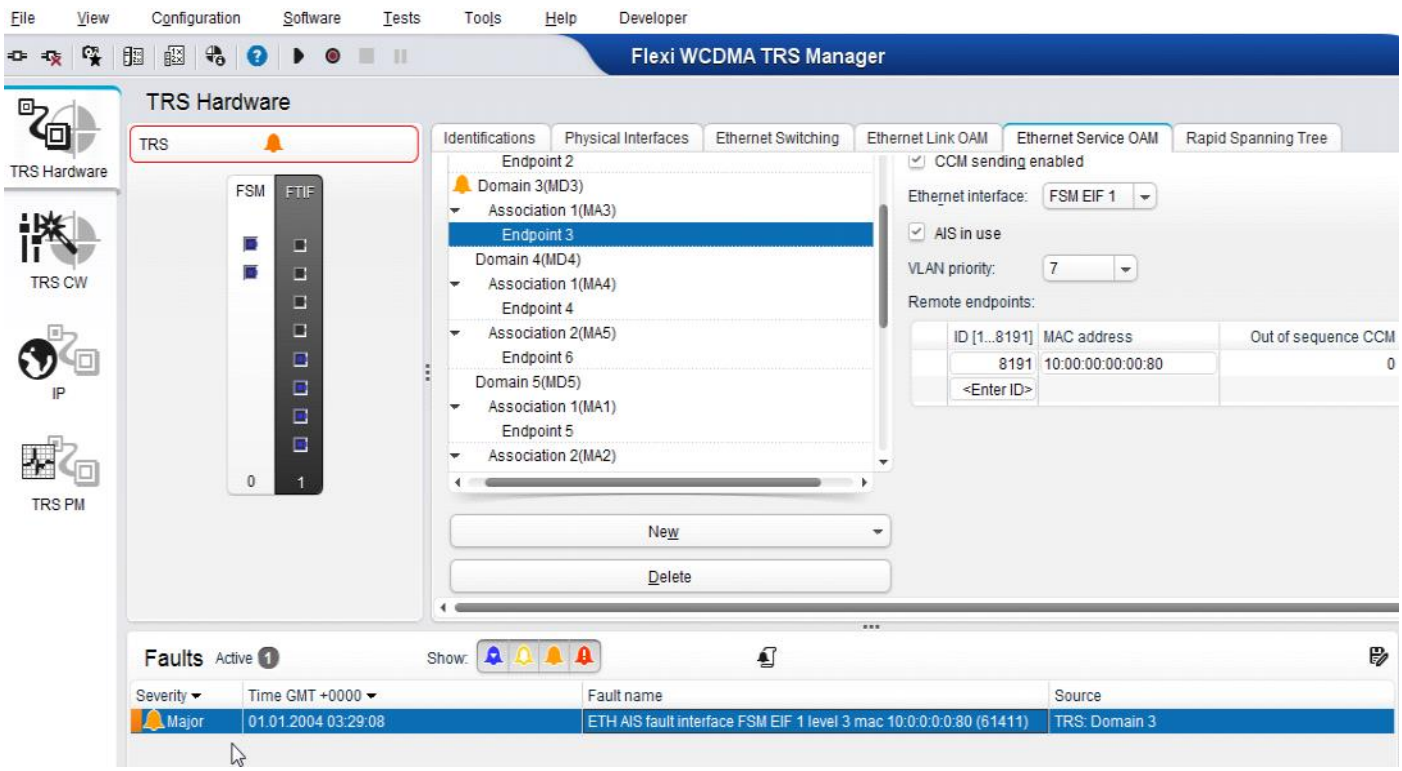
Downstream=transmitted in broadcast manner(AES encription is used)
Upsteam=packet transmitted in TDMA manner

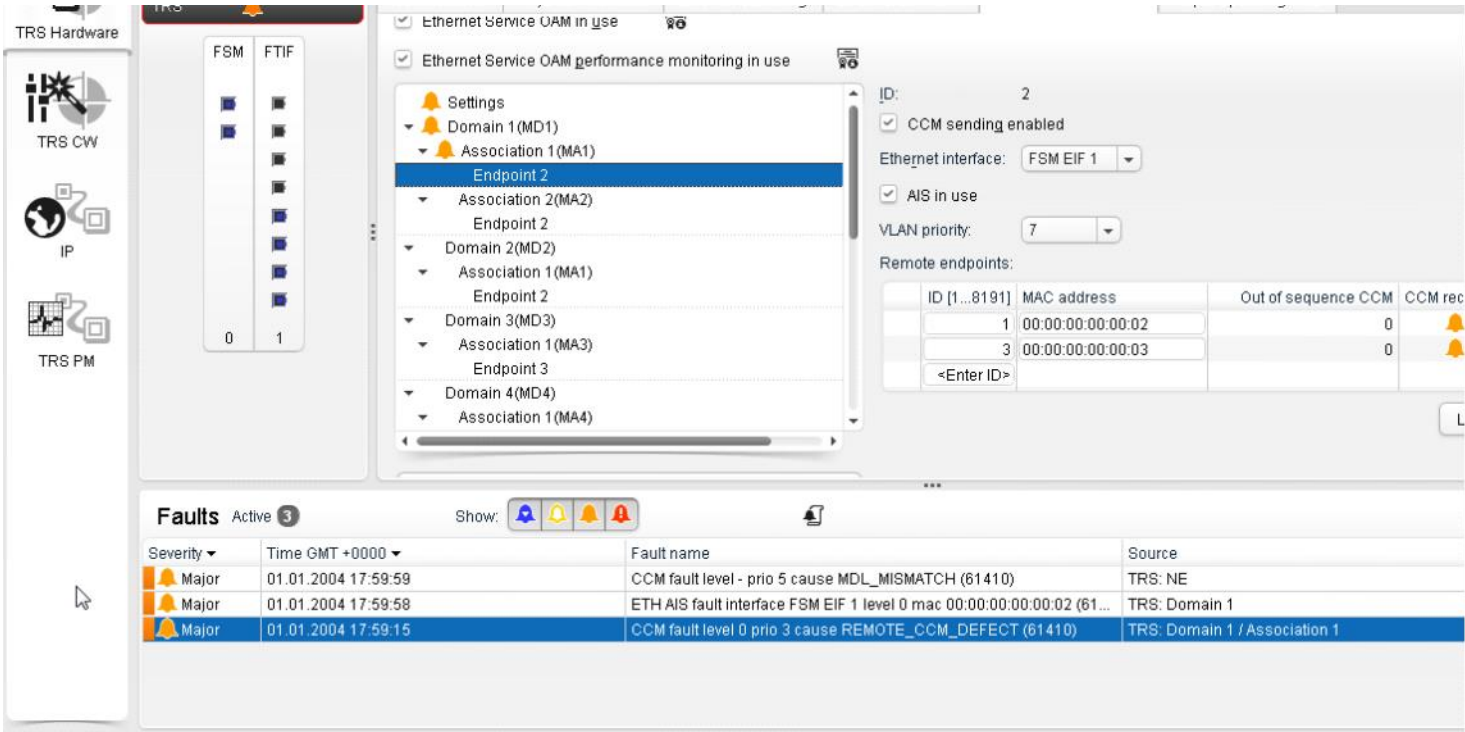
X GPON: dl->10Gbits/sec
ul:->2.4Gbits/s

Soam

25 February 2018 09:14






TRS Hardware
TRS CW
IP
TRS PM
FSM
FTIF
0
1
Ethernet Service OAM in use
Ethernet Service OAM performance monitoring in use
Settings
Domain 1(MD1)
Association 1(MA1)
Endpoint 2
Association 2(MA2)
Endpoint 2
Domain 2(MD2)
Association 1(MA1)
Endpoint 2
Domain 3(MD3)
Association 1(MA3)
Endpoint 3
Domain 4(MD4)
Association 1(MA4)
ID: 2
CCM sending enabled
Ethernet interface: FSM EIF 1
AIS in use
VLAN priority: 7
Remote endpoints:
ID [1...8191]
MAC address
Out of sequence CCM
CCM rec
1
00:00:00:00:00:02
0
3
00:00:00:00:00:03
0
<Enter ID>
Faults
Active 3
Show:
Severity
Time GMT +0000
Fault name
Source
Major
01.01.2004 17:59:59
CCM fault level - prio 5 cause MDL_MISMATCH (61410)
TRS: NE
Major
01.01.2004 17:59:58
ETH AIS fault interface FSM EIF 1 level 0 mac 00:00:00:00:00:02 (61...
TRS: Domain 1
Major
01.01.2004 17:59:15
CCM fault level 0 prio 3 cause REMOTE_CCM_DEFECT (61410)
TRS: Domain 1 / Association 1

ICMP

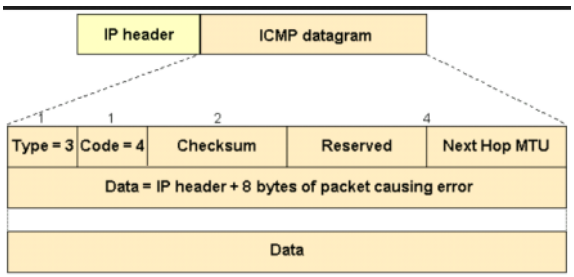
13 March 2018 10:42

ICMP is designed to over come the following two problems in ip

1. no error reporting
2. lacks a mechanism for queries

icmp message are not directly passed to the data link layer.instead the message are first encapsulated inside IP datagrams before going to lower layer.

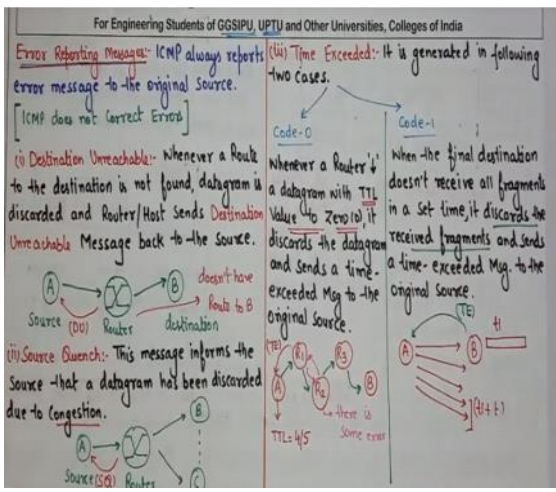
		icmp mes
	ip header	ip data
frame header	frame data	trailer



type	type of mess ,err or query
code	reason for message type
checksum	err checking
data section	err: finds the original packet with error query: carry extra info

icmp always reports error to the original source.

destination unreachable	
Source Quench:	informs source that a datagram has been discarded due to congestion
Time exceeded	code0: TTL value to zero code1: all fragments not reach in time
parameter problem	code0: err/ambiguity in one of header feild code1: required part of option is missing
Redirection	It sent from a router to a host on same local network
ICMP query mess	
echo request and replay	these messages are used to determine weather two system can talk with each other
Timestamp request and replay	sending time= receive -original receiving time=returned -transmit round trip= sending +receiving



Machine learning

22 March 2018 10:32

Machine learning	Using data to solve problem Prediction Iterative correct		
Why	Ability to predict		
where	Search engine, youtube recomm		
Types	Supervised()	Unsupervised	Reinforcement
	Output is know Regression Classification	Output is unknown Clustering	
Data as input	Feature engineering	Algo	Output /model
FEATURE engg			
Dimension reduction			

5g

27 March 2018 11:05

38.300 full 5g spec

Higher fre->sub carrier spacing increase

Within 2.5 full sweep happen

Ss block

Pss max power sss hlaf(3db down)

MIB:->sub carrier spacing data

N fft point

Fr1 range:	450mz->6GHz	microcell
Fr2 range:	24,5GZ-52.6GHZ	120 ,240 Analog beam forming only

Fs=120
->fs 60

10000000
-4.84 guard
--
95160 khz
95160/12=793 sub carrier
793-1 =792 scince one dc sub

792/12
=66 max sub carrier

Cell search :section 4.1

Higher freq->less power ->less region->narrow beam
0-3GZ: max beam 4 (ss block)
3-6 : beam 8 {4,8,16,24}+28*n
6-: beam 64

125/14 *4

Prach:
->how far the ue is
Cp prach seq cp

Max cell radius:
Cp /30.72 =18.75 ->cyclic pre
18.75 -

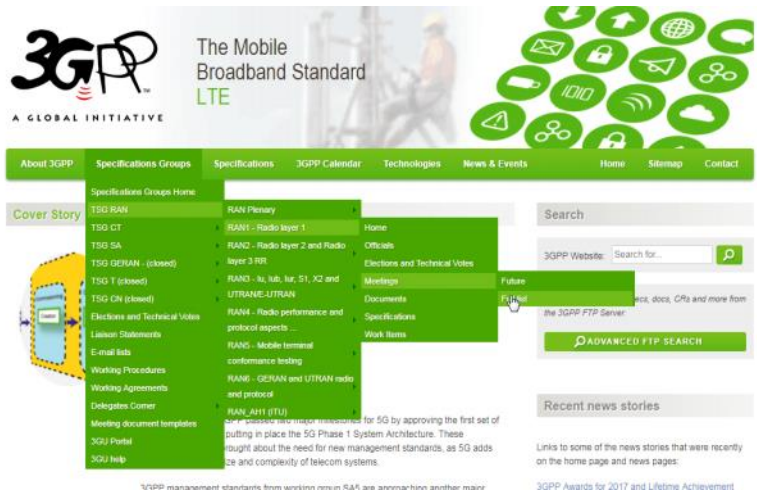
Assume path profile=0
2.34*300/2=350meters

Ss/PBCH block
Tdd:4 ofdm
Fdd:576 sub carreier
576/4->

FFT
Sin wave -> 1 fre
square ware->many fre

Sampling rate= subcarrier spacing* fft size :how many sample available in sec

Eailer ->A to D
IQ sample(time domain digital)->Analog cobham



gNBlogical architecture in5G18A :
•Distributed Unit (gNB-DU) –contains L1, L2-RT, L2-NRT (RLC) baseband processing functions, also Radio Unit (RU) functions are included in scope of gNB-DU
•Central Unit (gNB-CU) –contains L2-NRT (PDCP) baseband processing functions, OAM, C-Plane

Logical unit	Physical unit	Logical functions	HW virtualization	HW implementation	Location
gNB-DU	RU	• RF	• Non-Virtualized HW	AirScale (MAA)	Radio site, typically with integrated antennas
	RAU	• L1 • L2-RT (RLC+MAC)	• Non-Virtualized HW	AirScale (ABIL)	Centralized/remote, has strict real-time requirements (~50us to antenna connector)
		• L2-NRT (RLC) • CP-RT • OAM	• Non-Virtualized HW	AirScale (ASIK)	
gNB-CU-U	RAC	• L2-NRT (PDCP)	• Virtualized HW	AirFrame	Centralized, no strict real time requirements
gNB-CU-C		• C-Plane	• Virtualized HW	AirFrame	
gNB-CU-M		• OAM	• Virtualized HW	AirFrame	

computer networks

12 May 2018 21:25

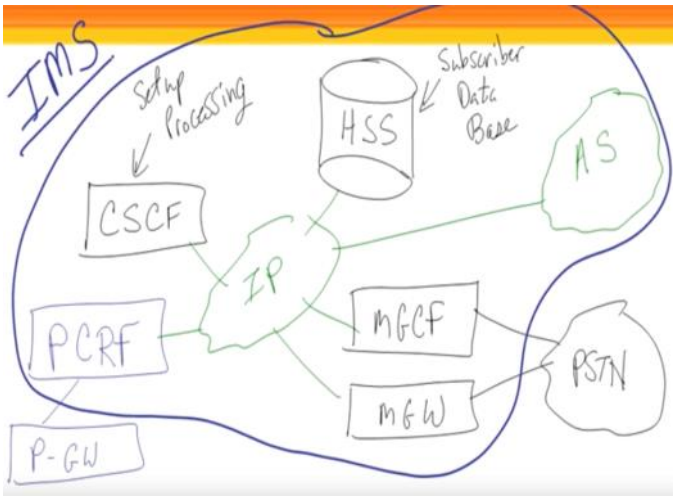
class A	1 ->126
class B	128->192
class C	192->126
class D	127 ->120
limited broadcast	255.255.255.255
directed broadcast	1XX.255.255.255

1. A host 200.100.1.1 want to send packet to all host in the same network. what is Source IP and DIP?
   200.100.1.1 255.255.255.255
2. for loopback?
   DIP: 127.0.0.X
3. How many bits are allocated to NID and HID in 23.192.157.234 address?
   23 ->class A
   class full and classless->depends on /no
   here class full
   NID=8 bits, HID =24 bits
   In subnetting: big n/w to small n/w
   applied for single n/w
   improve security. (can mention access control list for a subnet)
   bits are barrowed from host portion not n/w portion. NID|HID
   In supernetting : small n/w to big n/w
   security decrease.

IMS

18 May 2018 06:27

EUTRAN<-- IP--->EPC-> (packet based)does not have circuit switching
|
|- IMS(ip multimedia subsystem)->service network



IMS is SIP based.

IMS (5 component):

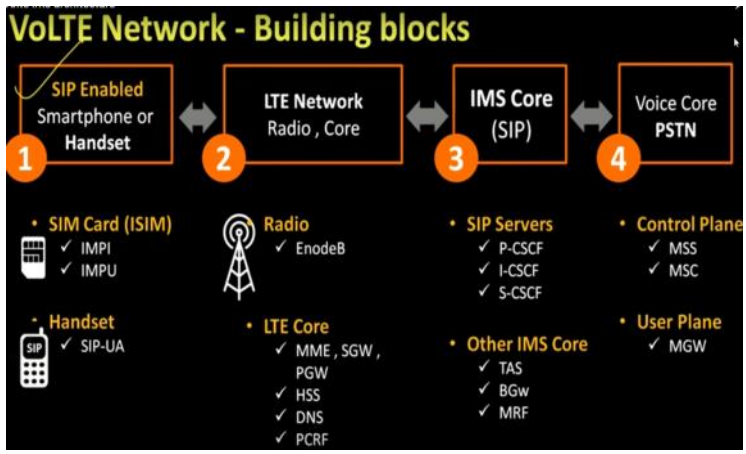
CSCF	setup processing

Volte:(1-2 sec)
HD voice call
vedio calling

Volte handset

SIM(GSM)--USIM(LTE)----ISIM(VoLTE)

IMPI	private entity global identityallocated by home nw
IMPU	public identity like telephone no(SIP URI,)

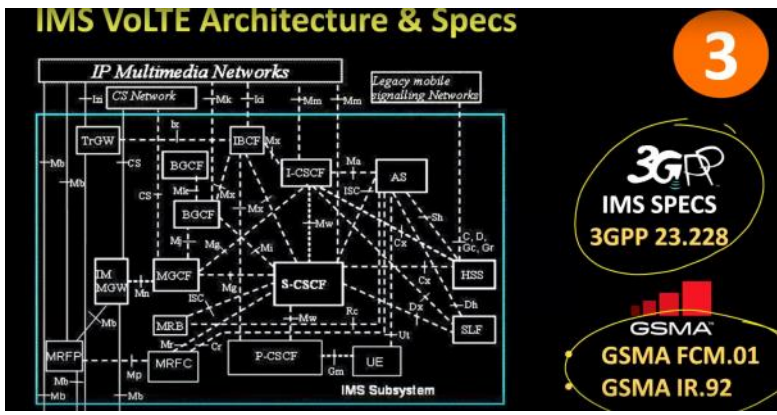


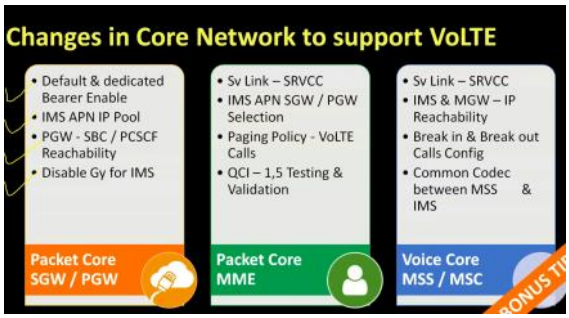
Handset:
SIP User Agent

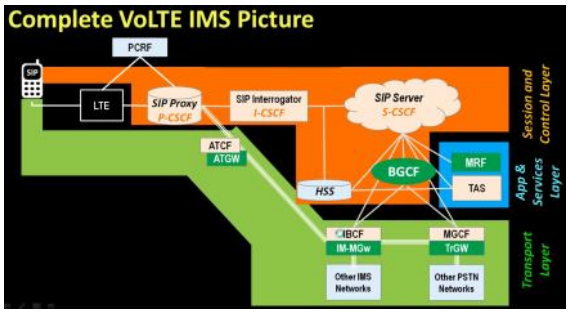
(SIP-UA)	UAC(user agent client): send SIP request UAS(server):receive requests and send response

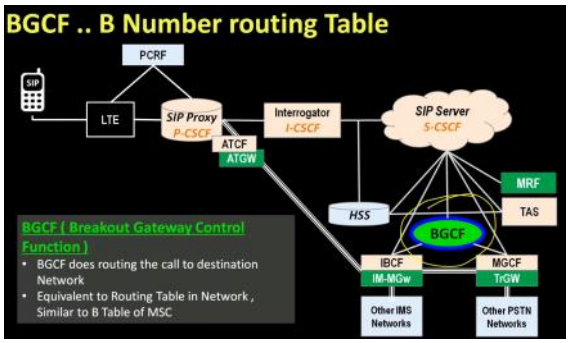
ims core -> directly pgw with Sgi
lte is used as carrier
wifi fixed broadband
DSL

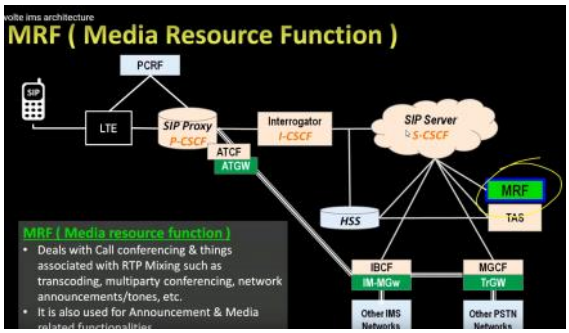
SIP server
media Gateway

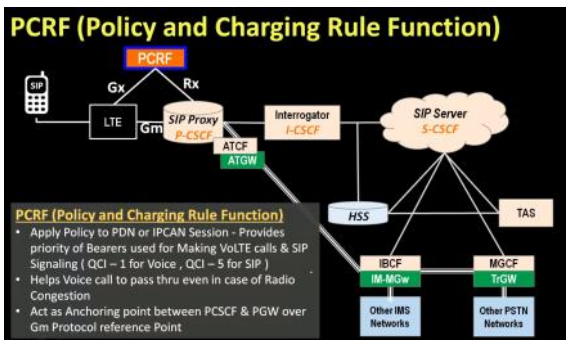


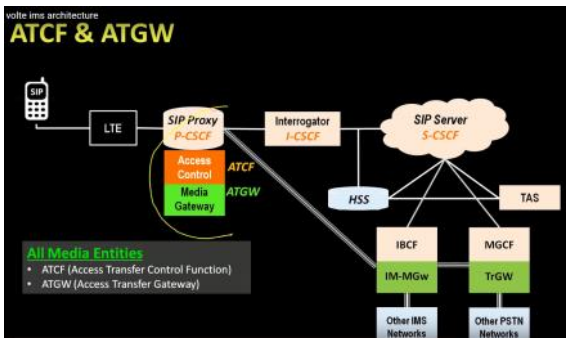


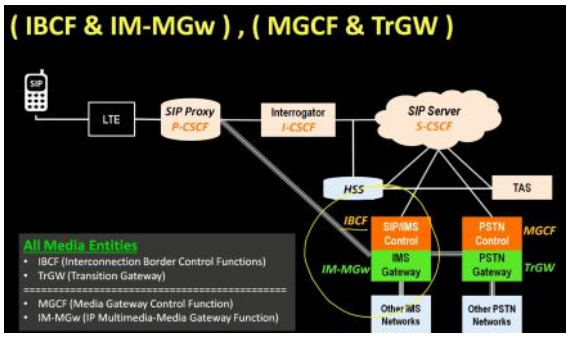

Complete VoLTE IMS Picture
PCRF
SIP
LTE
SIP Proxy
P-CSCF
SIP Interrogator
I-CSCF
SIP Server
S-CSCF
Session and Control Layer
ATCF
ATGW
HSS
BGCF
MRF
TAS
App & Services Layer
IBCF
IM-MGw
MGCF
TrGW
Other IMS Networks
Other PSTN Networks
Transport Layer

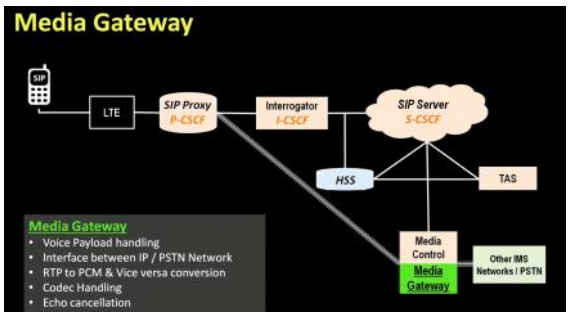

BGCF .. B Number routing Table
PCRF
SIP
LTE
SIP Proxy
P-CSCF
Interrogator
I-CSCF
SIP Server
S-CSCF
ATCF
ATGW
MRF
TAS
HSS
BGCF
IBCF
IM-MGw
MGCF
TrGW
Other IMS Networks
Other PSTN Networks
BGCF (Breakout Gateway Control Function)
• BGCF does routing the call to destination Network
• Equivalent to Routing Table in Network , Similar to B Table of MSC

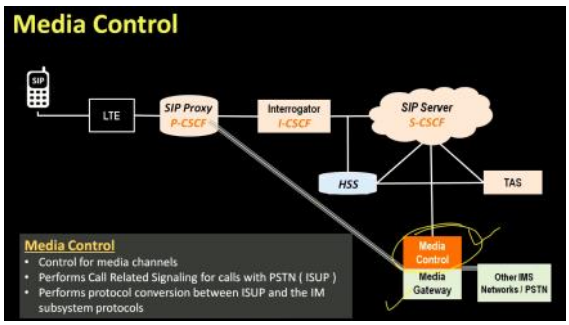

volte ims architecture
MRF (Media Resource Function)
PCRF
SIP
LTE
SIP Proxy
P-CSCF
Interrogator
I-CSCF
SIP Server
S-CSCF
ATCF
ATGW
MRF
TAS
HSS
IBCF
IM-MGw
MGCF
TrGW
Other IMS Networks
Other PSTN Networks
MRF (Media resource function)
• Deals with Call conferencing & things associated with RTP Mixing such as transcoding, multiparty conferencing, network announcements/tones, etc.
• It is also used for Announcement & Media

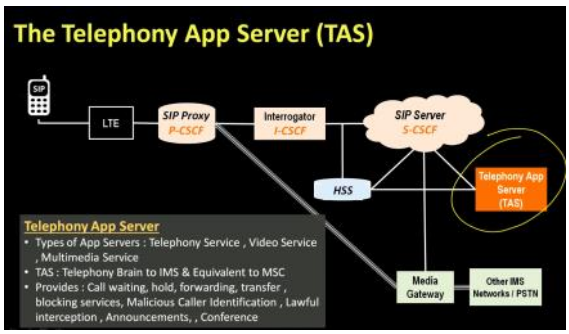

PCRF (Policy and Charging Rule Function)
PCRF
Gx
Rx
SIP
LTE
Gm
SIP Proxy
P-CSCF
Interrogator
I-CSCF
SIP Server
S-CSCF
ATCF
ATGW
HSS
TAS
IBCF
IM-MGw
MGCF
TrGW
Other IMS Networks
Other PSTN Networks
PCRF (Policy and Charging Rule Function)
• Apply Policy to PDN or IPCAN Session - Provides priority of Bearers used for Making VoLTE calls & SIP Signaling (QCI – 1 for Voice , QCI – 5 for SIP)
• Helps Voice call to pass thru even in case of Radio Congestion
• Act as Anchoring point between PCSCF & PGW over Gm Protocol reference Point

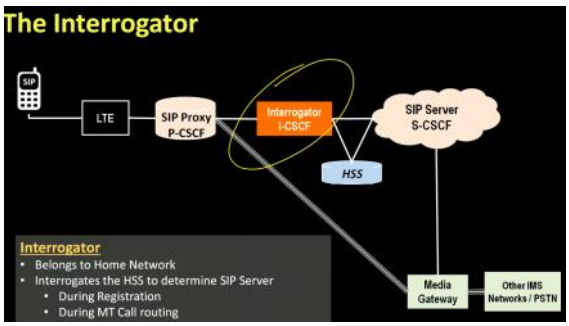

volte ims architecture
ATCF & ATGW
SIP
LTE
SIP Proxy
P-CSCF
Interrogator
I-CSCF
SIP Server
S-CSCF
Access Control
ATCF
Media Gateway
ATGW
HSS
TAS
IBCF
IM-MGw
MGCF
TrGW
Other IMS Networks
Other PSTN Networks
All Media Entities
• ATCF (Access Transfer Control Function)
• ATGW (Access Transfer Gateway)

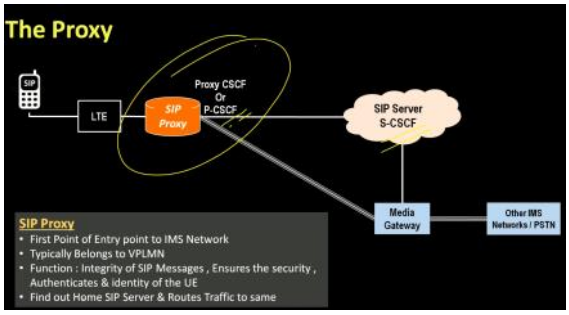

(IBCF & IM-MGw) , (MGCF & TrGW)
SIP
LTE
SIP Proxy
P-CSCF
Interrogator
I-CSCF
SIP Server
S-CSCF
HSS
TAS
IBCF
SIP/IMS Control
IMS Gateway
IM-MGw
PSTN Control
PSTN Gateway
MGCF
TrGW
Other IMS Networks
Other PSTN Networks
All Media Entities
IBCF (Interconnection Border Control Functions)
TrGW (Transition Gateway)
MGCF (Media Gateway Control Function)
IM-MGw (IP Multimedia-Media Gateway Function)

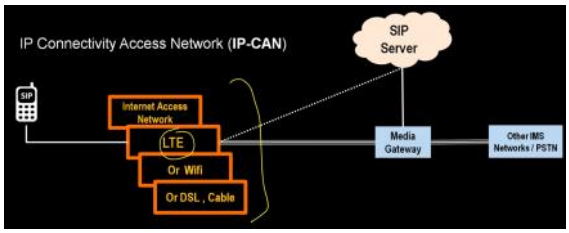

Media Gateway
SIP
LTE
SIP Proxy
P-CSCF
Interrogator
I-CSCF
SIP Server
S-CSCF
HSS
TAS
Media Gateway
Voice Payload handling
Interface between IP / PSTN Network
RTP to PCM & Vice versa conversion
Codec Handling
Echo cancellation
Media Control
Media Gateway
Other IMS Networks / PSTN

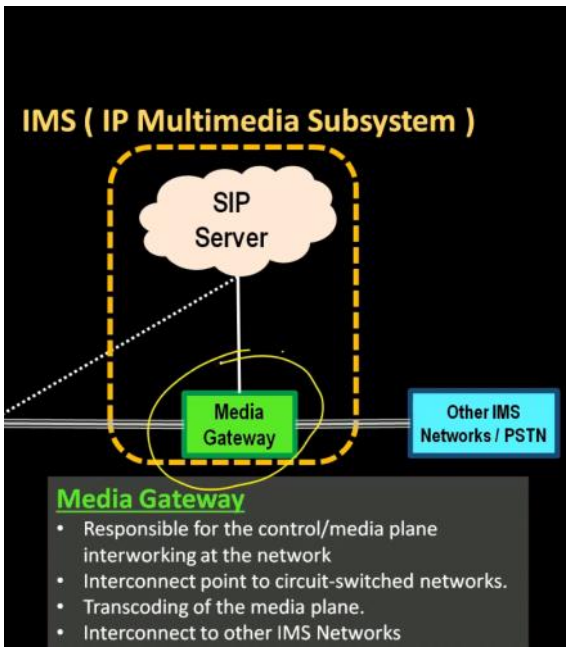

Media Control
SIP
LTE
SIP Proxy
P-CSCF
Interrogator
I-CSCF
SIP Server
S-CSCF
HSS
TAS
Media Control
Control for media channels
Performs Call Related Signaling for calls with PSTN (ISUP)
Performs protocol conversion between ISUP and the IM subsystem protocols
Media Control
Media Gateway
Other IMS Networks / PSTN

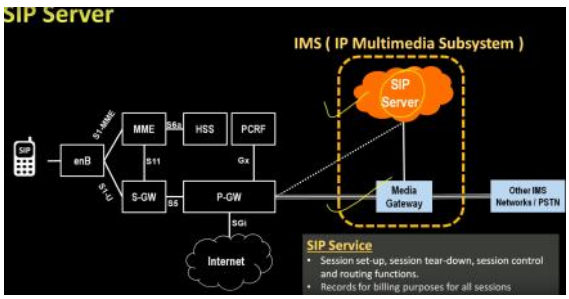

The Telephony App Server (TAS)
SIP
LTE
SIP Proxy
P-CSCF
Interrogator
I-CSCF
SIP Server
S-CSCF
HSS
Telephony App Server (TAS)
Telephony App Server
Types of App Servers : Telephony Service , Video Service , Multimedia Service
TAS : Telephony Brain to IMS & Equivalent to MSC
Provides : Call waiting, hold, forwarding, transfer , blocking services, Malicious Caller Identification , Lawful interception , Announcements, , Conference
Media Gateway
Other IMS Networks / PSTN

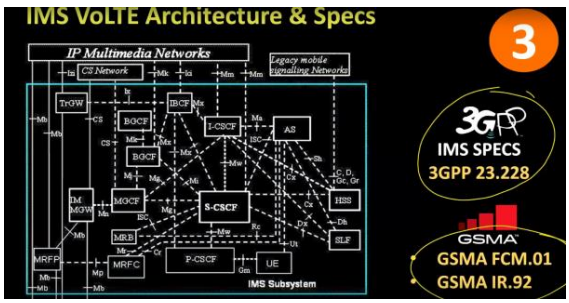

The Interrogator
SIP
LTE
SIP Proxy
P-CSCF
Interrogator
I-CSCF
SIP Server
S-CSCF
HSS
Interrogator
Belongs to Home Network
Interrogates the HSS to determine SIP Server
During Registration
During MT Call routing
Media Gateway
Other IMS Networks / PSTN

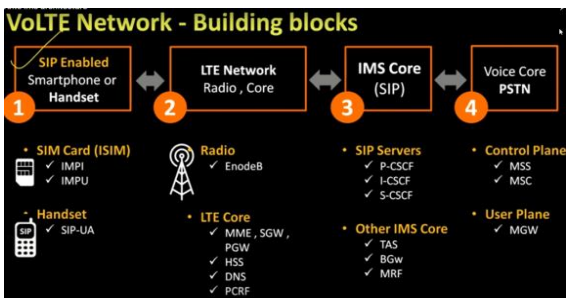

The Proxy
SIP
LTE
Proxy CSCF
Or
P-CSCF
SIP Proxy
SIP Server
S-CSCF
SIP Proxy
First Point of Entry point to IMS Network
Typically Belongs to VPLMN
Function : Integrity of SIP Messages , Ensures the security , Authenticates & identity of the UE
Find out Home SIP Server & Routes Traffic to same
Media Gateway
Other IMS Networks / PSTN

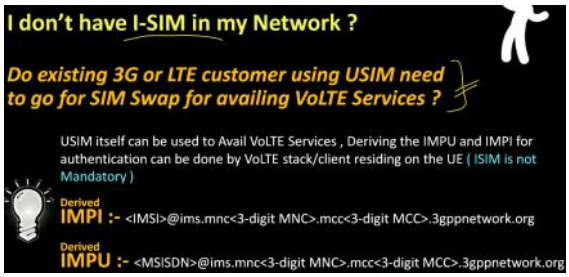

IP Connectivity Access Network (IP-CAN)
SIP Server
SIP
Internet Access Network
LTE
Or Wifi
Or DSL , Cable
Media Gateway
Other IMS Networks / PSTN

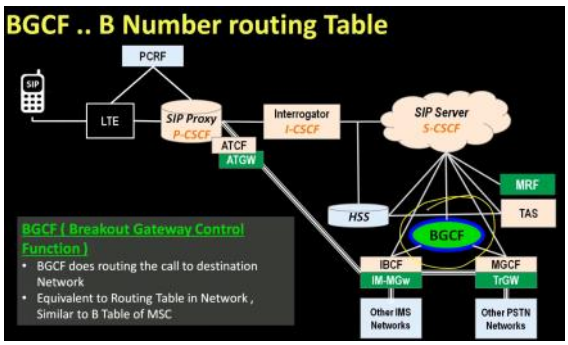

IMS (IP Multimedia Subsystem)
SIP Server
Media Gateway
Other IMS Networks / PSTN
Media Gateway
• Responsible for the control/media plane interworking at the network
• Interconnect point to circuit-switched networks.
• Transcoding of the media plane.
• Interconnect to other IMS Networks

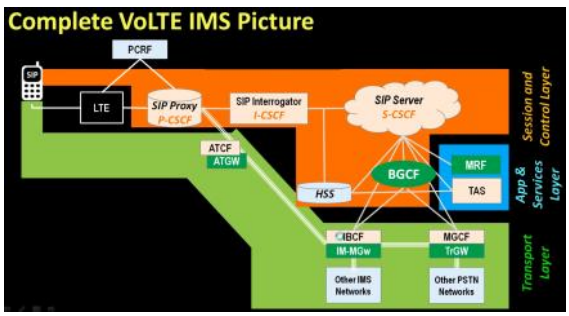

SIP Server
IMS (IP Multimedia Subsystem)
SIP Server
SIP
MME
HSS
PCRF
enB
S-GW
P-GW
Media Gateway
Other IMS Networks / PSTN
Internet
SIP Service
• Session set-up, session tear-down, session control and routing functions.
• Records for billing purposes for all sessions


IMS VoLTE Architecture & Specs
3
IP Multimedia Networks
Legacy mobile signalling Networks
CS Network
TrGW
BGCF
I-CSCF
AS
MGCF
S-CSCF
HSS
SLF
MRFP
MRFC
P-CSCF
UE
IMS Subsystem
IMS SPECS
3GPP 23.228
GSMA
GSMA FCM.01
GSMA IR.92


VoLTE Network - Building blocks
SIP Enabled Smartphone or Handset
LTE Network Radio , Core
IMS Core (SIP)
Voice Core PSTN
1
2
3
4
SIM Card (ISIM)
IMPI
IMPU
Handset
SIP-UA
Radio
EnodeB
LTE Core
MME , SGW , PGW
HSS
DNS
PCRF
SIP Servers
P-CSCF
I-CSCF
S-CSCF
Other IMS Core
TAS
BGw
MRF
Control Plane
MSS
MSC
User Plane
MGW


I don't have I-SIM in my Network ?
Do existing 3G or LTE customer using USIM need to go for SIM Swap for availing VoLTE Services ?
USIM itself can be used to Avail VoLTE Services , Deriving the IMPU and IMPI for authentication can be done by VoLTE stack/client residing on the UE (ISIM is not Mandatory)
Derived
IMPI :- <IMSI>@ims.mnc<3-digit MNC>.mcc<3-digit MCC>.3gppnetwork.org
Derived
IMPU :- <MSISDN>@ims.mnc<3-digit MNC>.mcc<3-digit MCC>.3gppnetwork.org


BGCF .. B Number routing Table
PCRF
SIP
LTE
SIP Proxy
P-CSCF
ATCF
ATGW
Interrogator
I-CSCF
SIP Server
S-CSCF
MRF
TAS
HSS
BGCF
IBCF
IM-MGw
MGCF
TrGW
Other IMS Networks
Other PSTN Networks
BGCF (Breakout Gateway Control Function)
• BGCF does routing the call to destination Network
• Equivalent to Routing Table in Network , Similar to B Table of MSC


Complete VoLTE IMS Picture
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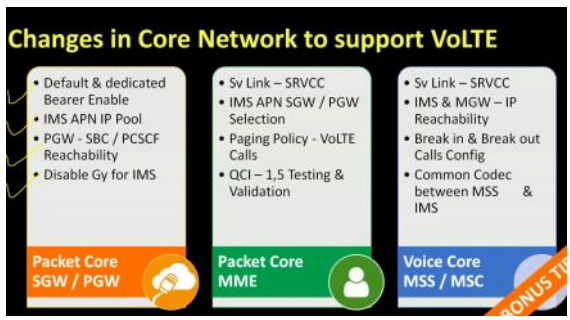
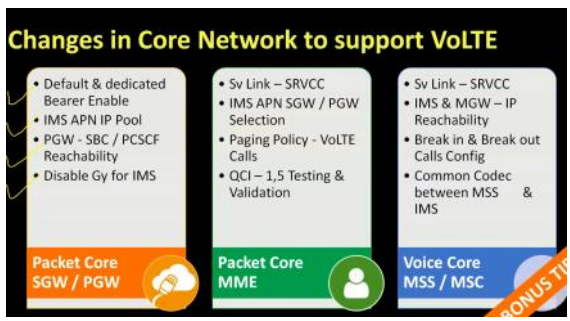
LTE
SIP Proxy
P-CSCF
SIP Interrogator
I-CSCF
SIP Server
S-CSCF
ATCF
ATGW
BGCF
MRF
TAS
HSS
IBCF
IM-MGw
MGCF
TrGW
Other IMS Networks
Other PSTN Networks
Session and Control Layer
App & Services Layer
Transport Layer


Changes in Core Network to support VoLTE
• Default & dedicated Bearer Enable
• IMS APN IP Pool
• PGW - SBC / PCSCF Reachability
• Disable Gy for IMS
Packet Core SGW / PGW
• Sv Link – SRVCC
• IMS APN SGW / PGW Selection
• Paging Policy - VoLTE Calls
• QCI – 1,5 Testing & Validation
Packet Core MME
• Sv Link – SRVCC
• IMS & MGW – IP Reachability
• Break in & Break out Calls Config
• Common Codec between MSS & IMS
Voice Core MSS / MSC
BONUS TIP


Changes in Core Network to support VoLTE
• Default & dedicated Bearer Enable
• IMS APN IP Pool
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• QCI – 1,5 Testing & Validation
Packet Core MME
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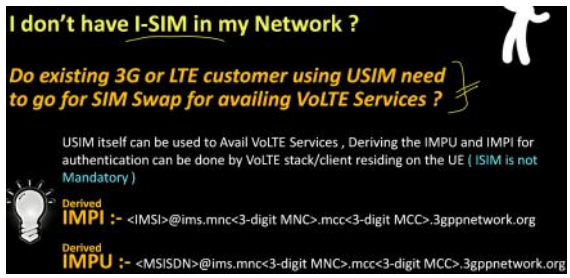
BONUS TIP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Derived
IMPI :- <IMSI>@ims.mnc<3-digit MNC>.mcc<3-digit MCC>.3gppnetwork.org
Derived
IMPU :- <MSISDN>@ims.mnc<3-digit MNC>.mcc<3-digit MCC>.3gppnetwork.org

SCTP

18 May 2018 07:28

SCTP: stream control transmission Protocol
RFC :2960

connection oriented transport protocol
build to overcome specific problems in TCP
Uses sequences no and acknowledgements to provide delivery guarantees.
Uses a "recceiver window" between the peers to indicate the amounnt of data can be receive in buffer

layer4 layer

source port
destination port
verification tag: zero for first packet
initial TSN: random number
forward TSN:

init(chunk type:1)
init_ack
COOKIE_ECO
COOKIE_ACK
Data
sack
data and sack have same tsn
ASCONF(chunk type:193) :change or tear down association n middle

shutdown
shutdown ack
shutdown complete

error:
init --> abort : other side ip address not configured

wire shark filters:
sctp_sack_rtt=
sctp_chunk_type=(9==all error chunks,4==heart beat,5==heartbeat sack,1==init

Session Setup: The Four-Way Handshake

1. INIT - Sent by client. Includes it's "Verification Tag" value.
2. INIT ACK - Response to INIT, includes its own Verification Tag as well as a "State Cookie".
3. COOKIE ECHO - Client sends the State Cookie back to server.
4. COOKIE ACK - Final acknowledgment.

SCTP Protocol Terminology

- Chunk: An individual SCTP message sent within a packet. A “data chunk” is equivalent to a TCP data segment.
- Path: A connection between two IP endpoints.
- Association: Overall connection between two SCTP endpoints. Equivalent to a TCP session.
- TSN: Transmission Sequence Number, roughly equivalent to TCP sequence number. An increment of data chunks, not bytes.
- Heartbeat: Like a TCP keepalive. Sent on a per-path basis.
- Shutdown: Equivalent to FIN flag in TCP
- Abort: Equivalent to RST flag in TCP

Word Offset	Byte 0	Byte 1	Byte 2	Byte 3
0x0000	Hardware Type (0x01)		Protocol Type (0x80)	
0x0010	HLEN (0x06)	PLEN (0x04)	Operation	
0x0020	Sender Hardware Address			
0x0030			Sender Protocol Address	
0x0040				
0x0050	Target Hardware Address			
0x0060			Target Protocol Address	
0x0070				

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0x0030			Sender Protocol Address	
0x0040				
0x0050	Target Hardware Address			
0x0060			Target Protocol Address	
0x0070				

Wireshark Filters for SCTP

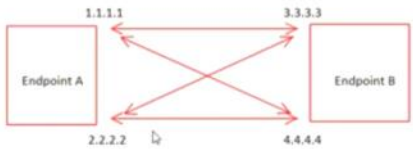
Error Types:

1	Invalid Stream Identifier
2	Missing Mandatory Parameter
3	Stale Cookie Error
4	Out of Resource
5	Unresolvable Address
6	Unrecognized Chunk Type
7	Invalid Mandatory Parameter
8	Unrecognized Parameters
9	No User Data
10	Cookie Received While Shutting Down
11	Restart of an Association with New Addresses
12	User Initiated Abort
13	Protocol Violation

- Multiple data chunks in a single IP packet are very common. This means that TSN numbers and acknowledgements can be harder to follow per-packet than TCP streams. It is even common for multiple applications to be carried over one association, making it harder to trace at a packet level (especially true when SCTP is carrying an SS7 protocol stack).

The Association

- An association is formed between two endpoints.
- Paths are established between IP addresses owned by those endpoints.



Wireshark Filters for SCTP

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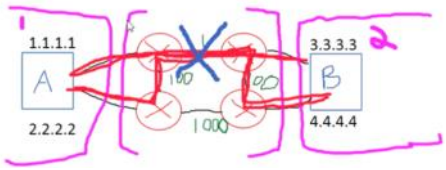
Problems in SCTP:

- Multiple data chunks in a single IP packet are very common. This means that TSN numbers and acknowledgements can be harder to follow per-packet than TCP streams. It is even common for multiple applications to be carried over one association, making it harder to trace at a packet level (especially true when SCTP is carrying an SS7 protocol stack).

- Layer 4 deciding where data is sent and received reduces path predictability for the network administrators working in Layers 1-3. Packets might not be where everyone expects them to be.



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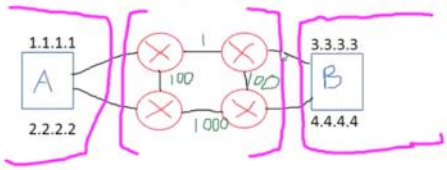


Possible Problems

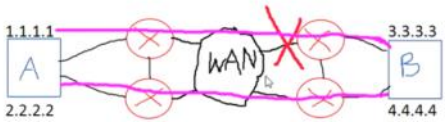
- NAT can create conflict between IP information in L3 and L4.

```
⊞ Internet Protocol Version 4, Src: 192.168.0.101 (192.168.0.101),
⊟ Stream Control Transmission Protocol, Src Port: 6666 (6666), Dst
    Source port: 6666
    Destination port: 9999
    Verification tag: 0x48e63127
    Checksum: 0x500d88fe (not verified)
  ⊟ ASCONF chunk
    ⊞ Chunk type: ASCONF (193)
      Chunk flags: 0x00
      Chunk length: 32
      Sequence number: 0xa1104d8a
    ⊞ IPv4 address parameter (Address: 192.168.0.101)
```

- Not all firewalls that support rules based on Layer 4 port numbers may support this particular Layer 4 protocol.

Advantages over TCP

- Four-way handshake protects from SYN floods
- Supports multiple IP addresses on both sides of a session. The protocol is not bound to one stream or even IP version.
- Supports explicit error codes and message types.
- Selective ACKs are supported in all SCTP connections.
- Window size is 32-bit value with no scaling window.
- Supports "Partially Reliable" delivery options (Forward TSN).
- Multiple IPs from multiple subnets gives potential for L4 convergence to happen before L3.



Retransmissions

- If a receiver notices packet loss, it send a selective ACK indicating the missing TSNs. Sends three times to trigger retransmission, referred to as a "fast retransmission".
- If RTO expires without acknowledgements, retransmission is triggered. **RTO is per destination IP address**.
- The "Forward TSN" chunk can be used to stop retransmission logic for a TSN and essentially give up on it.

OSI

20 May 2018 17:06

Big	bits layer1	mac/physical
Fat	frames layer2	data link
People	packets layer3	network
Snort	segments layer4	transport
Donuts	datagrams layer5 through 7	session, presentation, application

All People Say That Nerds Dress Poorly
All People Seem To Need Data Processors

please do not touch susu arts

bridge selection process in Switches.

The normal order is :

Step 1 : Lowest Root Bridge ID (BID)

Step 2 : Lowest Path cost to Root Bridge

Step 3 : Lowest Sender BID

Step 4 : Lowest Port ID

Ruined Puzzles Sacrifice Programs

From <http://zahid-stanikzai.com/mnemonics-for-networking/>

From <http://zahid-stanikzai.com/mnemonics-for-networking/>

Multicast

20 May 2018 17:32

Protocol Independent Multicast PIM – SM v2 Message types:

High **R**oads **R**eaching **J**ungle **B**locked **A**ll **C**ars

1. Hello
2. Register
3. Register-Stop
4. Join/Prune
5. Bootstrap
6. Assert
7. Candidate RP Advertisement

Remembering the list of Cisco IOS log severity levels.

Every **A**lley **C**at **E**ats **W**atery **N**oodles **I**n **D**oors

- Emergency (0)
- Alert (1)
- Critical (2)
- Error (3)
- Warning (4)
- Notifications (5)
- Information (6)
- Debug (7)

To remember BGP Best Path Algorithm

We **L**ove **O**ranges **A**S **O**ranges **M**ean **P**ure **R**efreshment.

- **W**eight (Highest is Better)
- **L**OCAL_PREF (Highest is Better)
- **O**riginated Locally
- **A**S_PATH (Shortest Wins)
- **O**RIGIN Type (IGP is Lower than EGP and EGP is Lower than Incomplete)
- **M**ED (Lowest is Better)
- **P**aths (External > Internal)
- **R**ID (Router ID – Lowest is Better)

From <http://zahid-stanikzai.com/mnemonics-for-networking/>

DHCP

20 May 2018 17:33

DHCP process. DORA, **D**iscover DHCP server by broadcasting on the LAN segment, the DHCP server with **O**ffer up an IP address, we will Request the IP address, and finally **A**cknowledge the IP address request.

From <http://zahid-stanikzai.com/mnemonics-for-networking/>

dynamic host configuration protocol

assign ip address to hosts
server address , default gateway, DNS
comes as client and server

ip address should be unique in network
each computer run dhcp client,

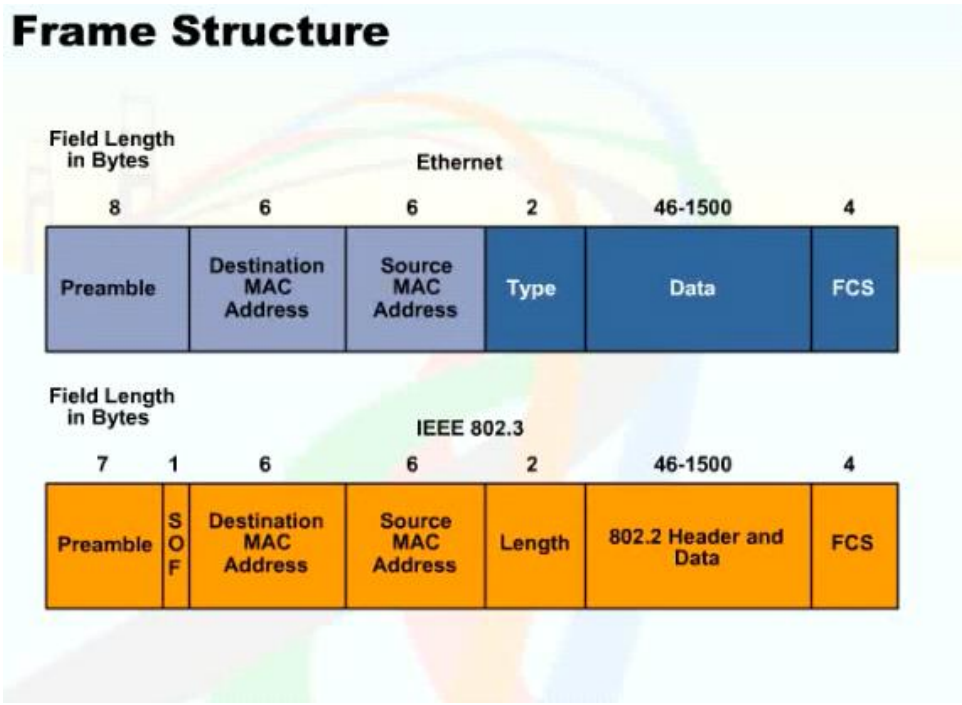
DHCP discover:	if computer attach to a network first it try find DHCP server via broadcast message all other device then DHCP server look at it and drop it.
DHCP offer:	when server gets message it then send offer to host. host take the first offer it receive if more then one is given.
DHCP req:	Host says I take it send re to server
DHCP ACK:	Server sends the ip address to host along with subnet mask ,default gw, dns server server: record the all list of ip address, MAc and there lease time(expiration time) UDP PORT client:68 Server:67

MAC

21 May 2018 00:38

destination is first component
premble is not count in frame size

omkar hills
turahalli



frame	72bytes (data min)
preamble	seq of know bit, used for sync and channel estimation
sof	start of frame
Destination add	group addressing multicast) higher bit order is one for broadcasting all bits are made one
length/type	actual content
data and padiing	
FCS	extra error-detecting code

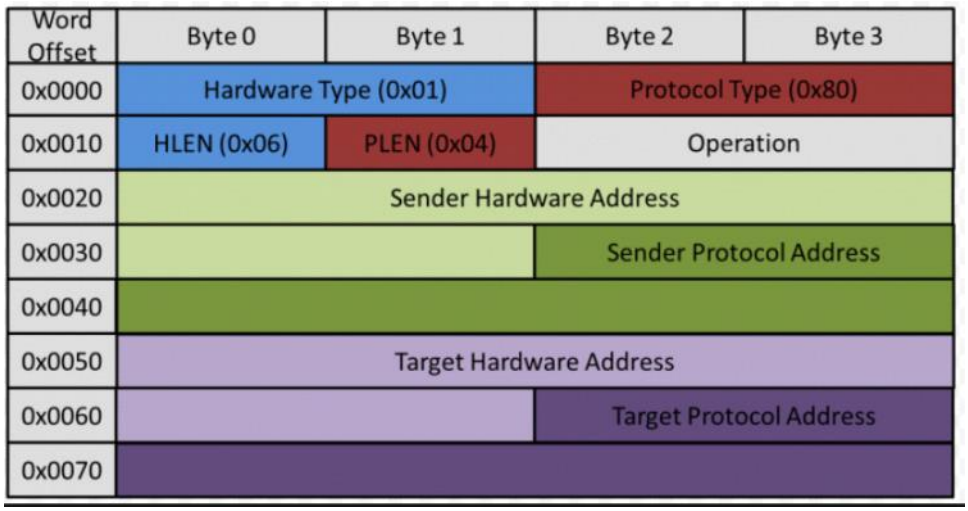
ethernet: connect no of com system to from a local area network
10 base 5

mapping of ip to mac

static mapping	dynamic mapping
table is created with logical and physical add	Each time a machine knows the logical address of the other machine, it can use a protocol to find physical address

ARP:
ARP associates an ip add with the physical address.
Logical address-- ---mapping via ARP---->Physical address

ARP request	broadcast (ip of m1,physical m1 ,intented m2 ip address)
ARP replay	unicast (m2 ip and m2 physical)



hw type	type of h/w
protocol type	ipv4,ipv6
h/w len	length of physical add
protocol len	len of logical add
operation	request(1),replay(2)
target h/w address	in a request not filled, fill via replay

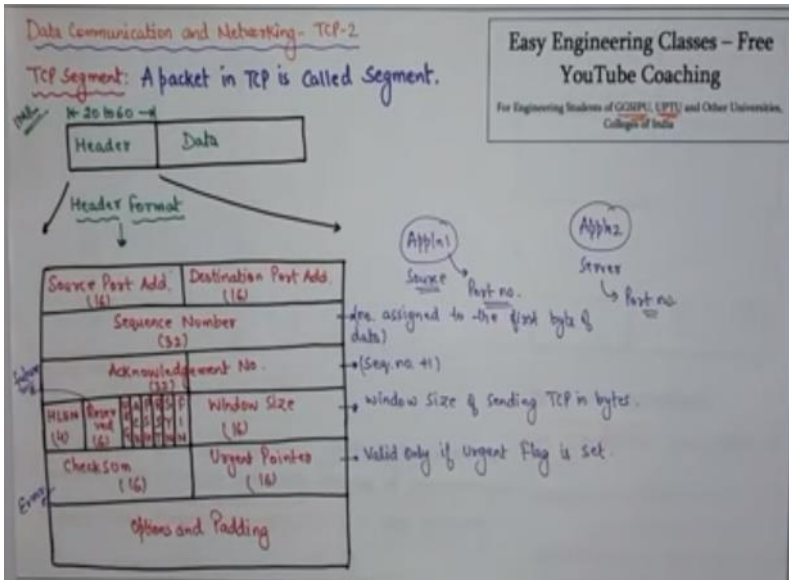
RARP:

RARP maps physical to logical(ip)

TCP

21 May 2018 01:47

Tcp is most widely used for data transmissinon in commmunication network such as internet.
TCP provide process to process communication



Feature:

1. process to process
2. port no
3. numbering system
4. byte no
5. seq no {segment no}
6. ack no
7. flow control
8. error control
9. congestion control

sync	seq no(6000) client
syn+ack	syc(1000)server ,ack(6001),receiving window(5000)server
ack	sync (6000),ack (1001),receving window of client(6000)

diameter

23 May 2018 08:14

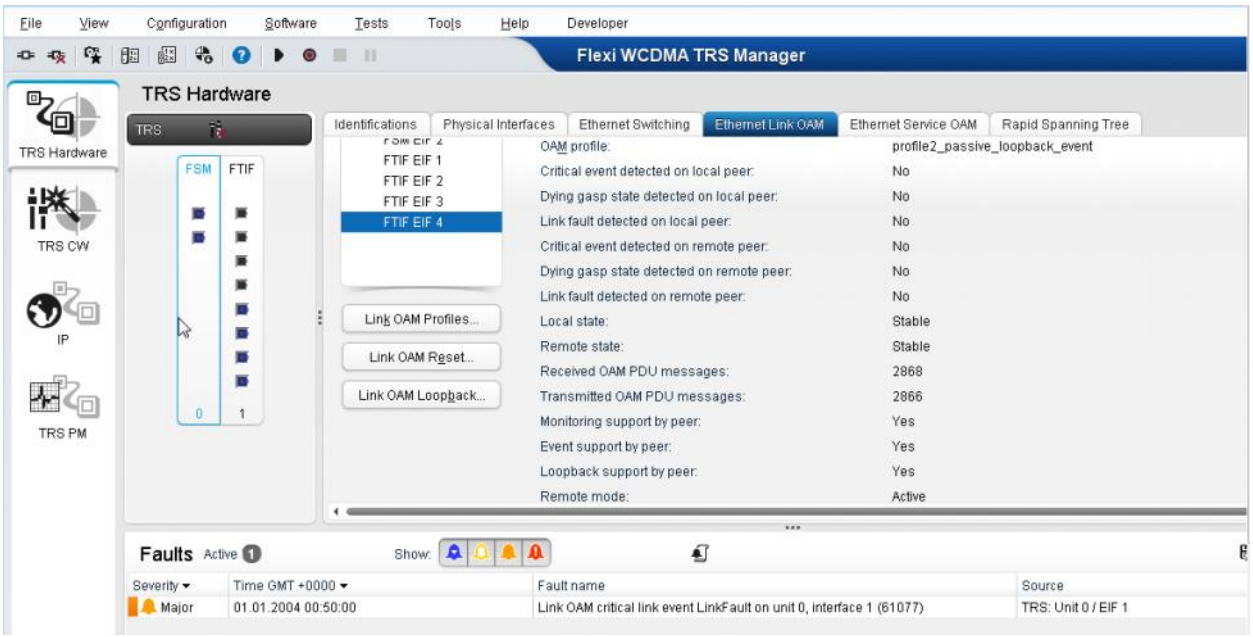
one protocol:
itf dia top of that they adoted

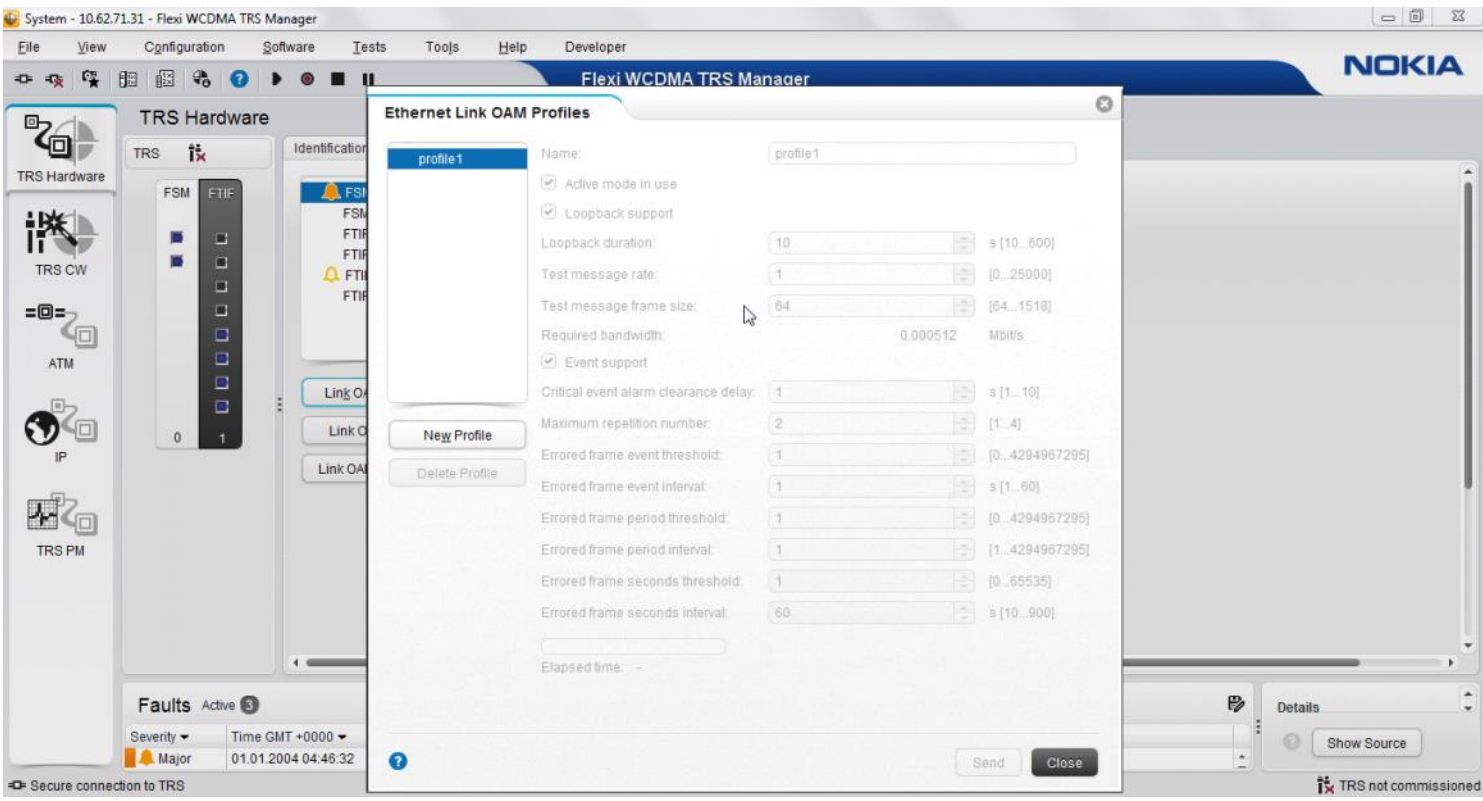
dia enable service provider
qos, smart charging,load balancing

dia (data for ip n/w) is diff for ss7(vioce network pre ip)

LOAM

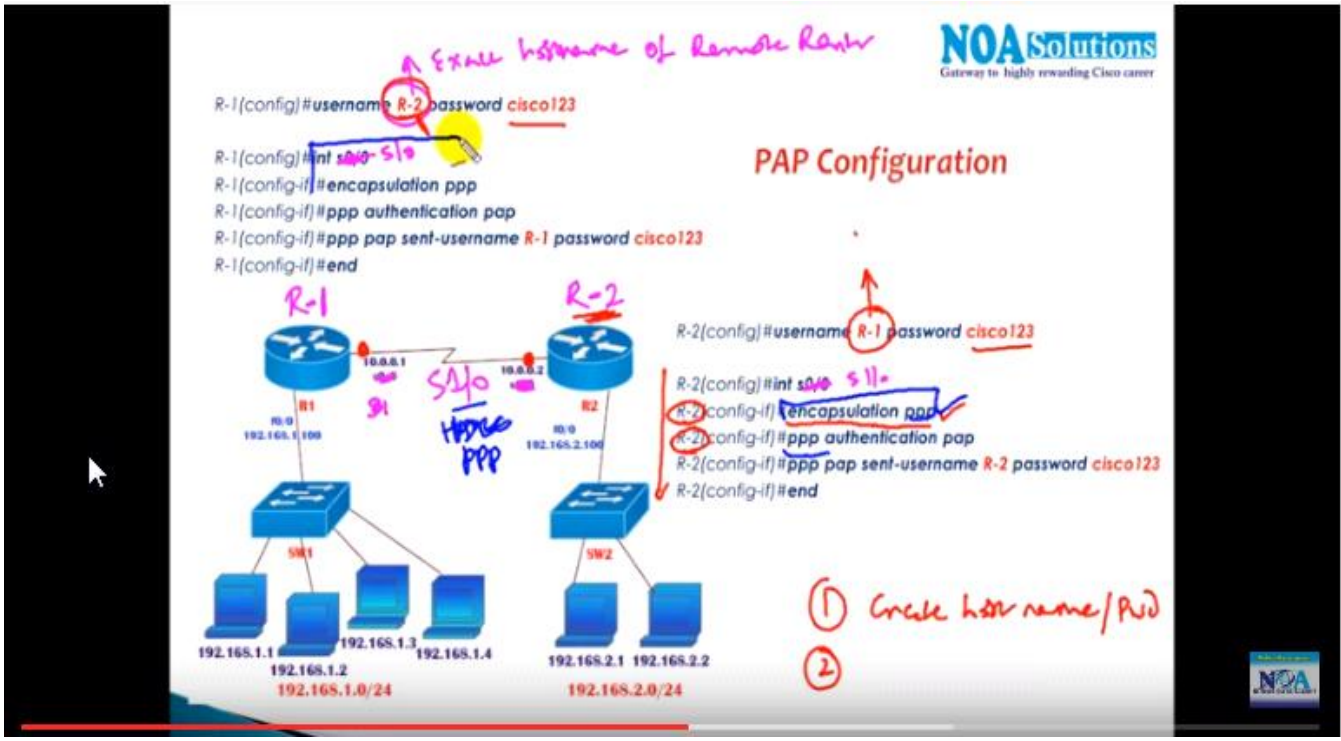
04 June 2018 01:16





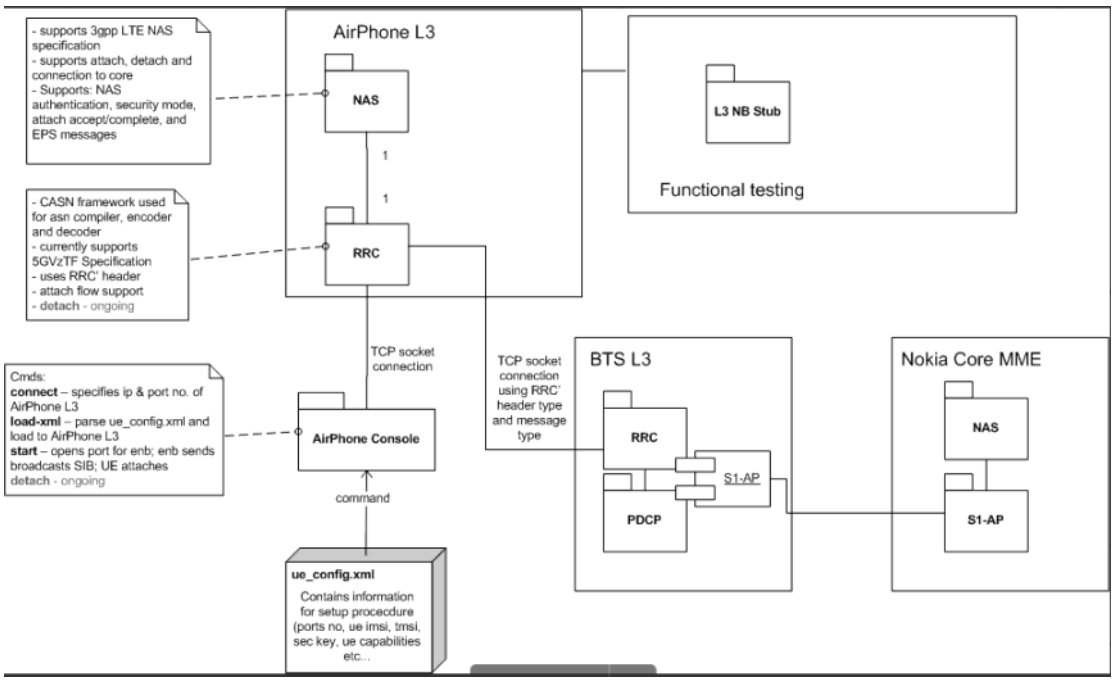
MLPPP

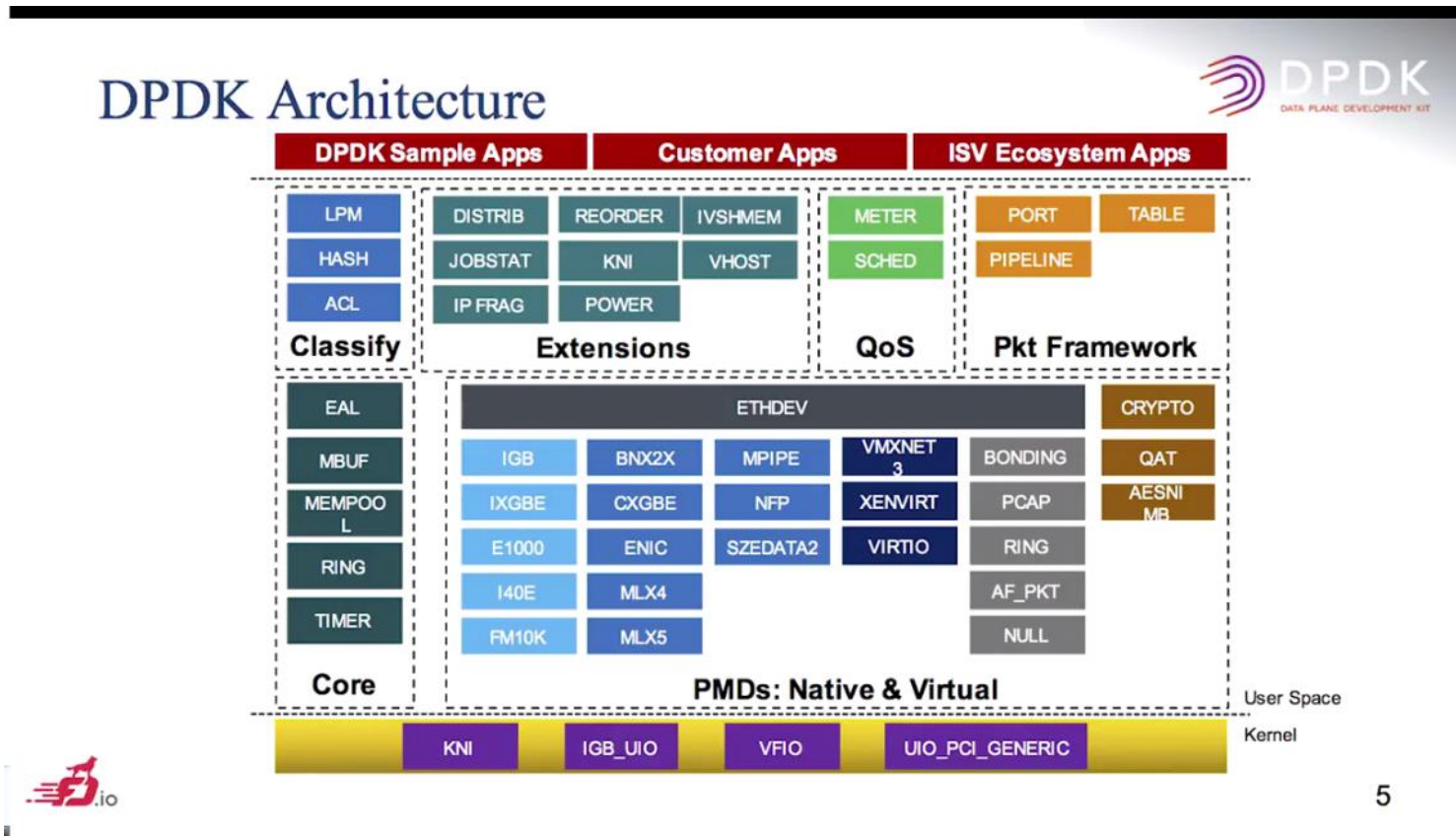
04 June 2018 01:38



5g

04 June 2018 02:42





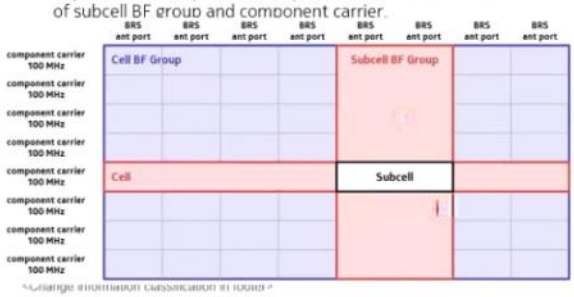
Terminology

Cell

- The cell is defined as the cell as seen by the UE with a single physical-layer cell identity and a single global cell ID.
- According to V5G211: "There are 504 unique physical-layer cell identities". LTE 36.311: "The IE CellIdentity is used to unambiguously identify a cell within a PLMN".
- Cell maps to one component carrier.

Subcell

- Implementation-specific concept defined as the intersection of subcell BF group and component carrier.



Cell BF Group

- The set of cells on different carrier frequencies using the same physical antennas and the same analog beam forming hardware
- In 5G17 there is one Cell BF Group per RAU. In the future, there will be more due to more antennas and/or multiple frequency bands.

Subcell BF Group

- Implementation-specific concept consisting of a subset of BRS antenna ports of a Cell BF Group controlled by the same packet scheduler instance.
- MU-MIMO is possible between subcell BF Groups.
- SU-MIMO cannot cross subcell BF Group boundary.
- In 5G17 there are always 2 BRS antenna ports per subcell BF Group. In the future the number of antenna ports might be different (especially if the number of component carriers is smaller).

BRS Antenna Port

- The BRS antenna port is defined by V5G211: "Beam reference signals are transmitted on one or several of antenna ports 0 to 7".
  - In case of analog beam forming, the BRS antenna ports with the same number on different component carriers are assumed to be mapped to the same analog beam direction and same physical antenna.

NOKIA

Carrier aggregation

08 June 2018 21:00

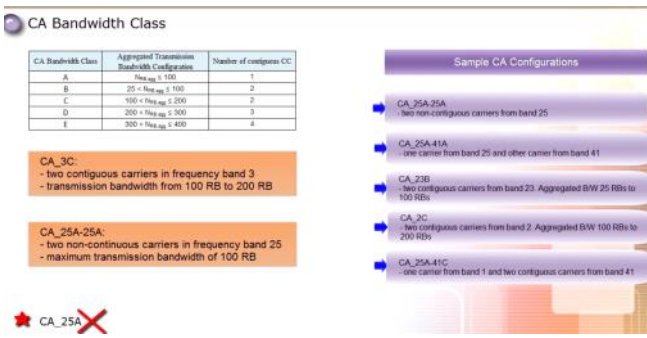
PCC :primary control carrier	1. add and remove secondary component carrier dynamically 2. dynamically activate and deactivate secondary cell 3. handles all RRC and NAS procedures 4. Receive measurment reports and control mobility of UE 5. primary cell can only be changed at time of handover.	
SCC carrier component secondary	A ue can aggregate maximum up to 5 carriers i.i 1pcc and 4 SCC max BW 10mz(20,20,20,20,20) actual no if SCC depends on UE capability Not possible to configure UE with more uplink component carrier then downlink	

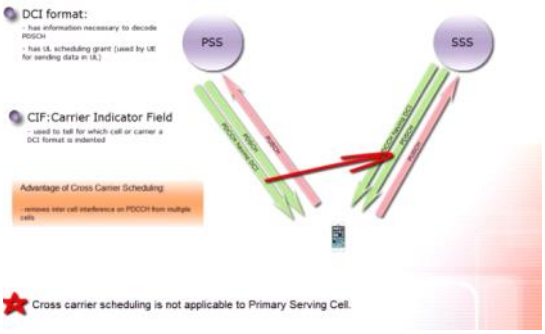
Carrier allocation schemes in CA(36.101)

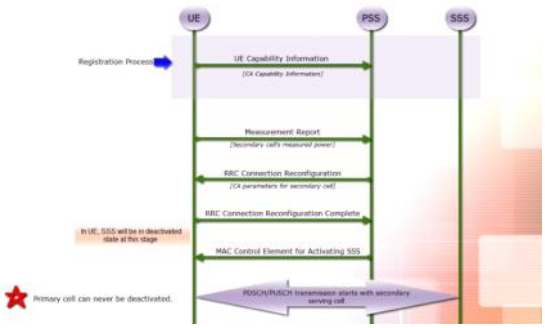
Intra band contiguous(CA_X)	pcc and scc are conti and same band
Intra band noncontiguous (CA_X-X)	pcc and scc are allocated from same band but not contiguous
inter band noncontiguous (CA_X-Y)	pcc and scc are in two different freq band

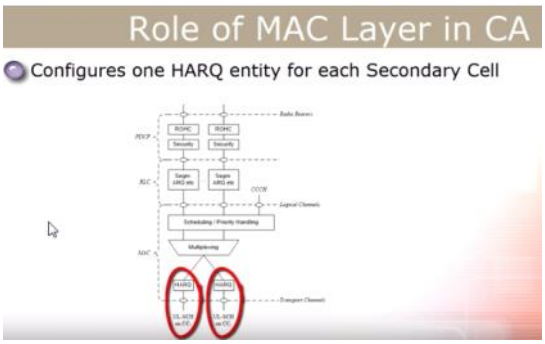
Precondition for CA:ue capability

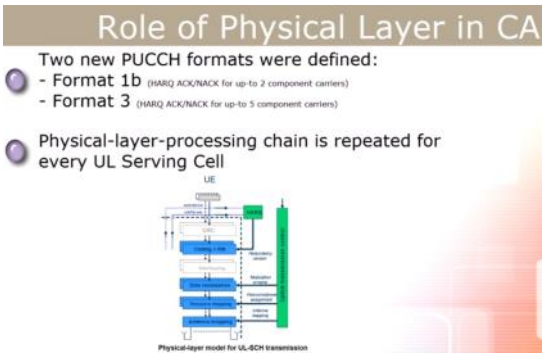
UE category	
supporting band combination	
CA BW class	
BW set	











GPRS

15 June 2018 18:25

TDMA basesd sheduling

reduced mac scheduling ---->Uplink (2 time data)
resource allocater(bsc)
pcu (PACKET CAONTROL UNIT)

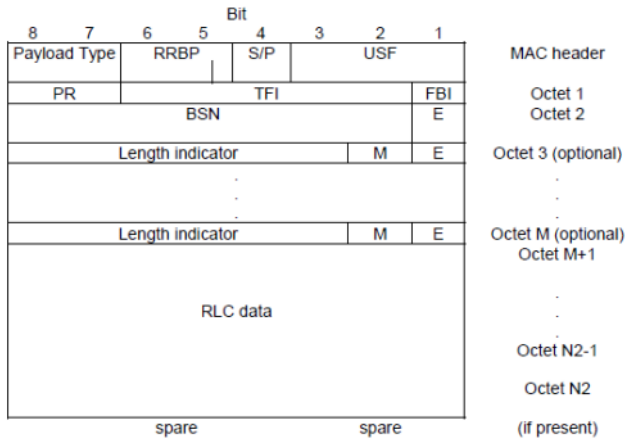
MAC:

rlc:

SIGNALING	dl Ul
control	dl ul

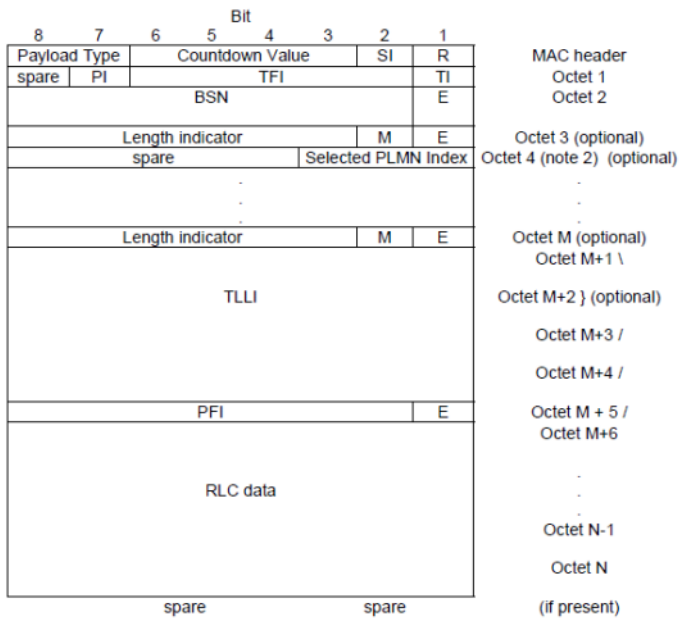
one rlc-->one radio block

DL data block:



RRBP	relative recive block preoid
TFI	l2 link between UE and BTS ,every user have its TBF-->TFI
FBI	final block identity,enables on last data
USF	
s/p	supplumentry polling

UL data block:



D

RLC Block Structure - Uplink RLC/MAC control block

< 44.060 - Figure 10.3.2.1: Uplink RLC/MAC control block together with its MAC header >