# SINGLE RADIO VOICE CALL CONTINUITY (SRVCC)

& CSFB VS SRVCC

SRVCC (Single Radio Voice Call Continuity) Explained in VoLTE IMS Network & Difference between SRVCC Vs CSFB (circuit switched fallback)

- PS to CS handover
- CSFB Vs SRVCC
- Evolution of Voice Call – SRVCC , aSRVCC , eSRVCC , vSRVCC , rSRVCC Phase
- SRVCC handover Call flow
- STNSR (Session transfer number for SRVCC)
- C-MSISDN (Correlation MSISDN)

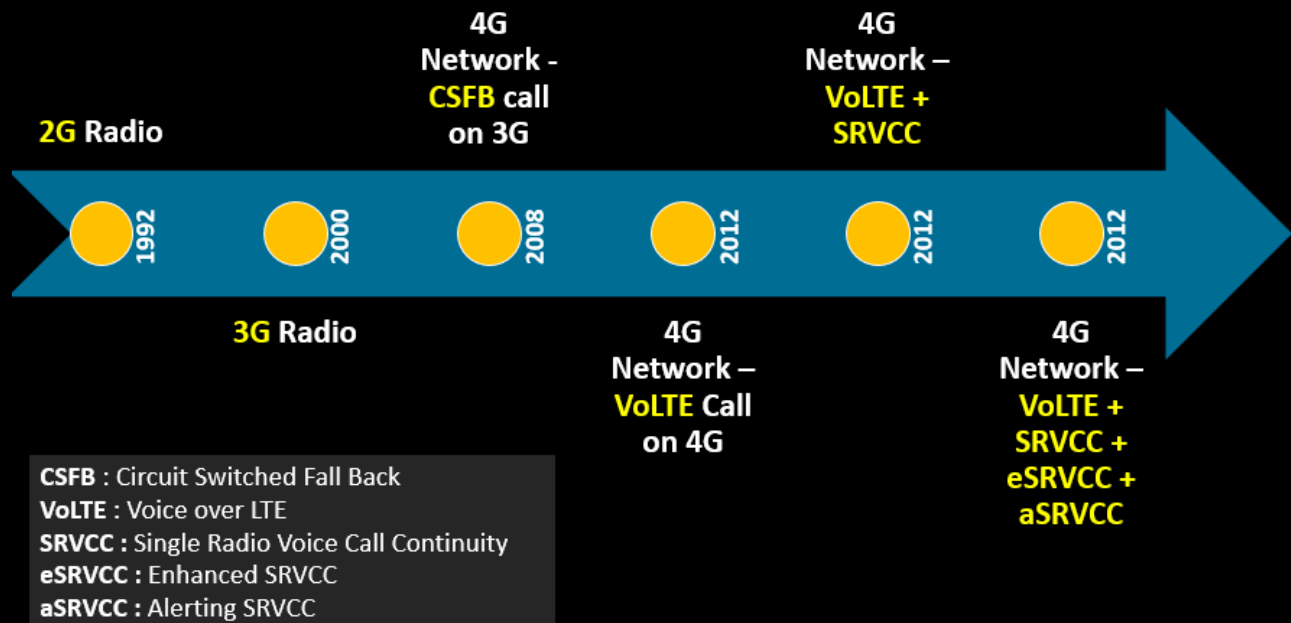## SRVCC – Single Radio Voice Call Continuity Overview
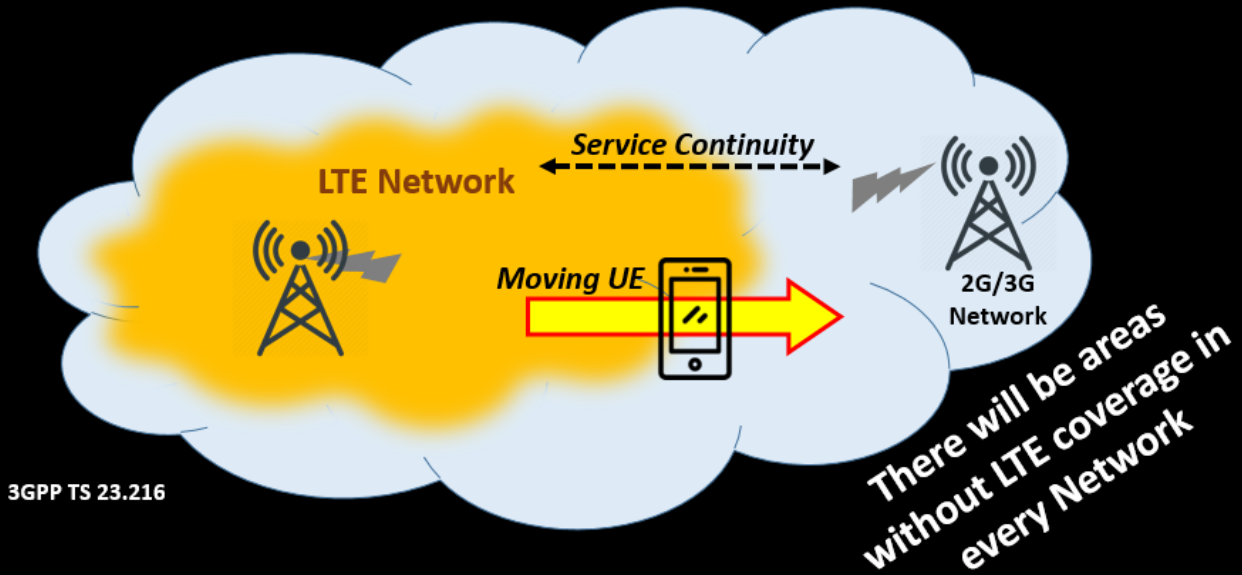
Have you ever wondered , What will happen when User makes 4G Voice Call & moves into Low coverage areas where 3G Network is available but 4G Network is not available ..

Example : You move into Lift of Building or Goes into Basement or Travel by Metro where Radio condition changes rapidly . In these cases , LTE may not be available . Here we use the Technology by Name of SRVCC to ensure Voice call continues and handed over to 3G Network without dropping the call . Name of this technique is single radio voice call continuity and this VoLTE feature is developed on later stage as enhancement

By using SRVCC , Mobile operators are able to make the handovers while maintaining existing quality of service . The SRVCC requires only a single active radio in the handset and requires some upgrades to the supporting network infrastructure to support this feature

What Happened in Life of Voice Call

Evolution of Voice Call

2G Radio — 1992

3G Radio — 2000

4G Network - CSFB call on 3G — 2008

4G Network – VoLTE Call on 4G — 2012

4G Network – VoLTE + SRVCC — 2012

4G Network – VoLTE + SRVCC + eSRVCC + aSRVCC — 2012

CSFB : Circuit Switched Fall Back
VoLTE : Voice over LTE
SRVCC : Single Radio Voice Call Continuity
**eSRVCC** : Enhanced SRVCC
aSRVCC : Alerting SRVCC

Here , We will see options available with User to make outgoing call on Network

- In the 2G legacy networks, voice calls are made practically only on circuits for each call on Circuit Switched domain
- 3G Networks are similar to 2G Networks , No Major Change
- Now Comes , CSFB which is used in Operators where LTE have been launched without support of VoLTE Services
- Next is VoLTE Itself
- Next one is SRVCC Extension where we allow handover of call from LTE to 2G / 3G in case there are coverage Holes in 4G Network such Lifts , Basement etc..
- The Last one is enhanced SRVCC & Alerting SRVCC which reduces call switching time when user moves from 4G to 2G or 3G Radio , This improves user experience

CSFB Vs SRVCC
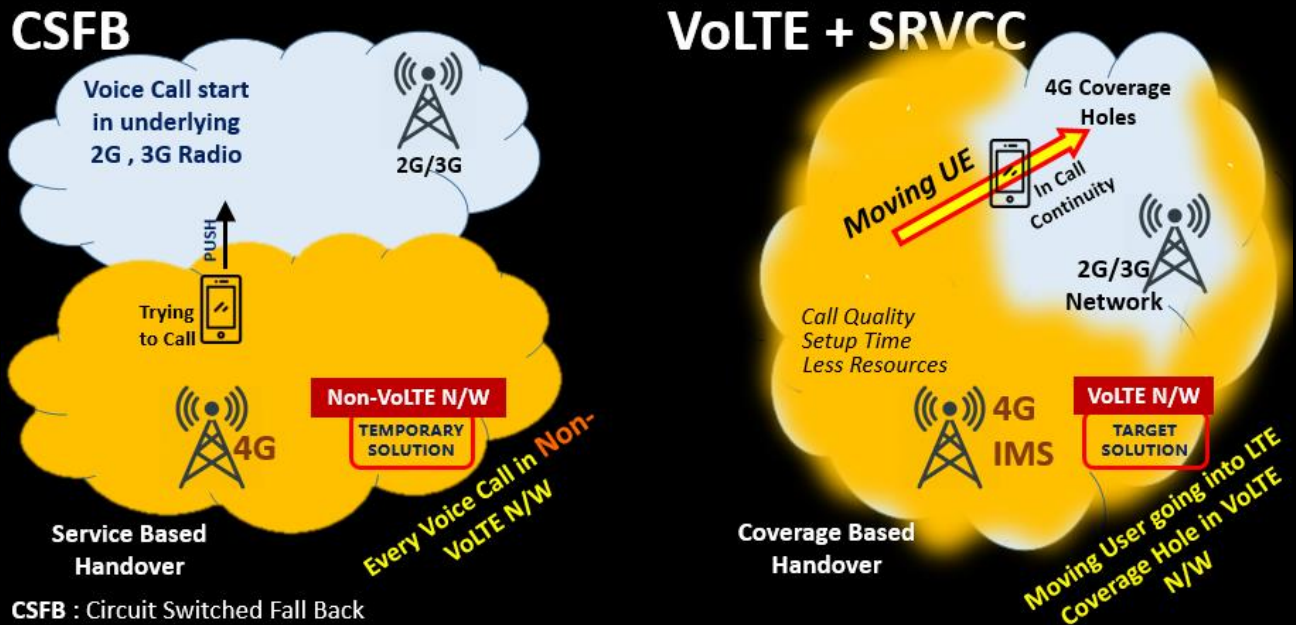
Here , I am show you working & differences between CSFB & SRVCC

CSFB Stands for Circuit Switch Fall Back : This is applicable to Operators where LTE is launched but VoLTE is still not supported . Since LTE itself doesn't support voice & its all IP to IP Network , It uses legacy 3G / 2G network for providing voice services to user . There is SGs link used between MME & MSC for handling Incoming & Outgoing call communication . As you can see in the diagram , Immediately after Initiating Call , User is thrown in 3G Network where it can camp on RNC & Can make or receive Voice Calls . This is temporary solution & will Eliminate once all Operators upgrade to VoLTE Services

SRVCC stands for Single Radio Voice Call Continuity : Basically, SRVCC is a call transfer method or handover which is implemented in a simplified and reliable manner used . When an LTE user has an active voice session in IMS and is moving to areas which have legacy 2G/3G coverage and does not have LTE coverage. For Example , You can see One LTE Coverage hole on top right corner of Screen . The user moving to this Area will loose LTE coverage and uses SRVCC for continuing voice VoLTE Call initiated earlier in LTE Coverage area . The main advantage of this solution is that the call will not drop but will only be transferred to the CS domain of the legacy networks. However, the signaling required is very complicated in such scenarios & There is new Interface used called as Sv for all

communication required . Unlike CSFB , This is a Permanent solution and will stay along with VoLTE for longer duration .

Although CSFB & SRVCC can't be compared because CSFB is a service handover procedure while SRVCC is a coverage handover procedure . I am still trying to convey Benefits which VoLTE+SRVCC Option brings to us as compared to CSFB :-

- **Call setup time**: When operators use CSFB, one of the biggest problems faced (and one of the major disadvantages of CSFB) is the increase in call setup time due to retuning procedures in 2G/3G radios . On Other Hand VoLTE provider faster call setup time
- **Call quality**: call quality in VoLTE is better due to specific QoS allocated to the call IMS, which is not there in 3G serving users with CSFB
- **Resource benefits for VoLTE** : Codec used in VoLTE requires much less resources and data rate than CSFB working on 3G or 2G

Types of SRVCC & 3GPP Release reference

Evolution of SRVCC

Name	3GPP Release	Description
Basic SRVCC	Rel 8	Call Continuity from E-UTRAN to UTRAN/GRAN
aSRVCC	Rel 10	Packet switched to Circuit Switched call transfer during Alerting Phase
eSRVCC	Rel 10	Enhanced SRVCC (Support for MSC Server assisted Mid Call Feature)
vSRVCC	Rel 11	Video SRVCC
rSRVCC	Rel 11	SRVCC from UTRAN/GRAN to E-UTRAN

Improve User experience

GSMA **GSMA IR.64**

3GPP **3GPP TS 23.216**

These are various evolution of SRVCC introduced by 3GPP between Release 8 to Release 11 .

- 1st one is Basic **SRVCC** which came in Release 8 and address basic issue of Call Continuity from LTE to 3G / 2G Networks

- 2nd / 3rd are **aSRVCC** and **eSRVCC** which help in improving user experience by reducing overall Switching time , They will be covered in later part of this Video as I want to keep things simple at this point of time
- 4th One is **vSRVCC** which is Video SRVCC
- Last One is **rSRVCC** which is introduced in Rel 11 , This provides continuity from 3G to LTE (Reverse Direction)

You can also refer to 3GPP Document **TS 23.216** for further study which covers all above Flows in Depth . aSRVCC & eSRVCC are widely in use & these helps to improve overall VoLTE user experience

SRVCC Call flow
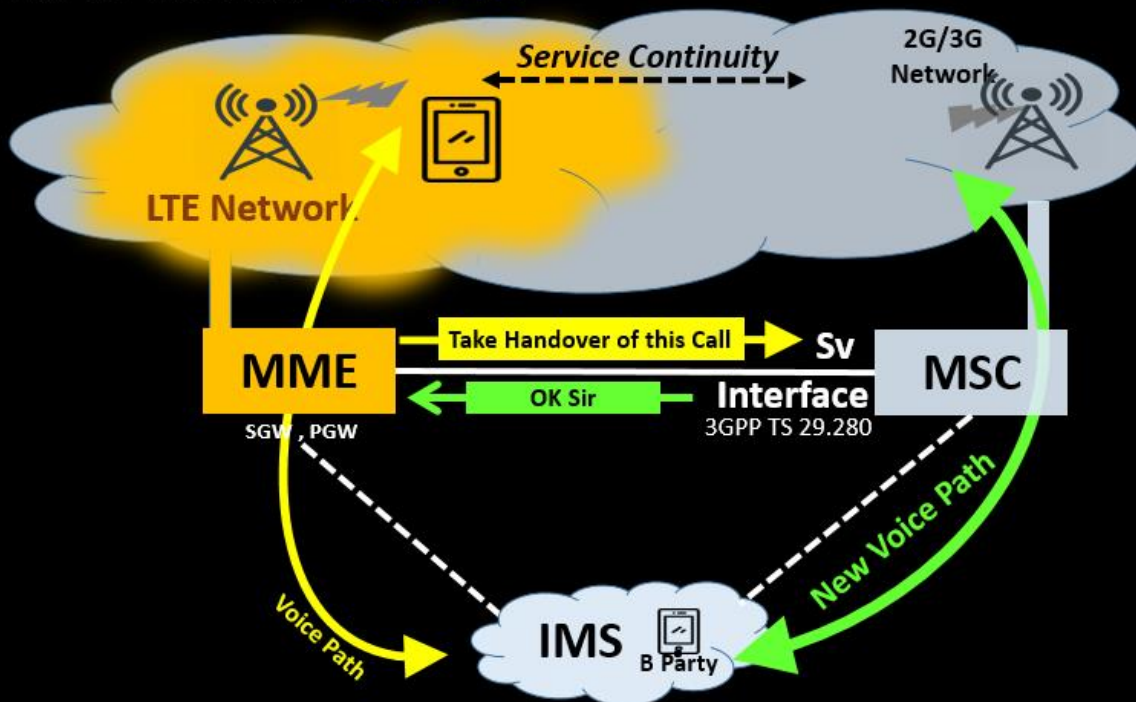
3GPP have introduced a special Link … by the Name of Sv Link between MME & MSC for enabling SRVCC functions . This Sv interface runs on GTPv2 protocol With help of Sv Interface , Both MME & MSC talk to each other & exchange information pertaining to user who is going to perform SRVCC

- Let's See , What happens in Life of User ..
- We can see here that user is latched in LTE network ,
- Now , He makes MO Call to another IMS User , The Voice path used here is shown in Yellow Color

- Since user is moving into Low Coverage of LTE Network , User Informs EnodeB that I am running out of LTE Signal
- MME in-turn uses Sv Link and Ask MSC to take charge of this Call
- As next step , MSC align all the resources & Establishes connectivity with IMS so that it can take full control of Call once user latches on 3G radio. Once everything is aligned , MSC informs MME
- Now , MME Ask user to Release 4G Bearer and Go to 3G Radio . Now User tune to 3G radio & Contact MSC which is already aligned to receive call . Here MSC patches this ongoing call from 3G Radio with IMS Network without dropping the call

## 3GPP Reference Call flow for SRVCC
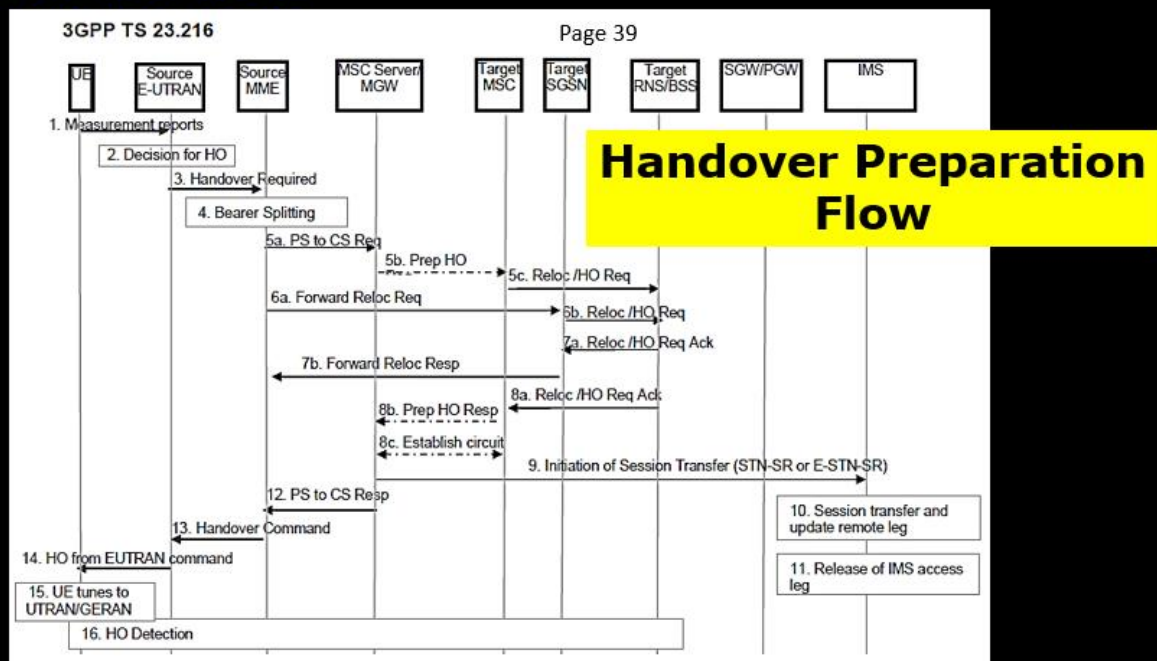
This is extract from 3GPP Specs document # TS 23.216 . Here we can see complete Ladder diagram , How SRVCC works & User move from LTE Radio to underlying 3G Radio without dropping the call

Just like normal data handover , This is also divided into 2 Parts :-

- 1st Part is Handover Preparation flow where all readiness & resource reservation is completed prior to Actual Handover of User
- 2nd One Handover Execution Flow where Actual Handover happens & Call Gets switched to 3G radio

SRVCC Call flow (Contd..)
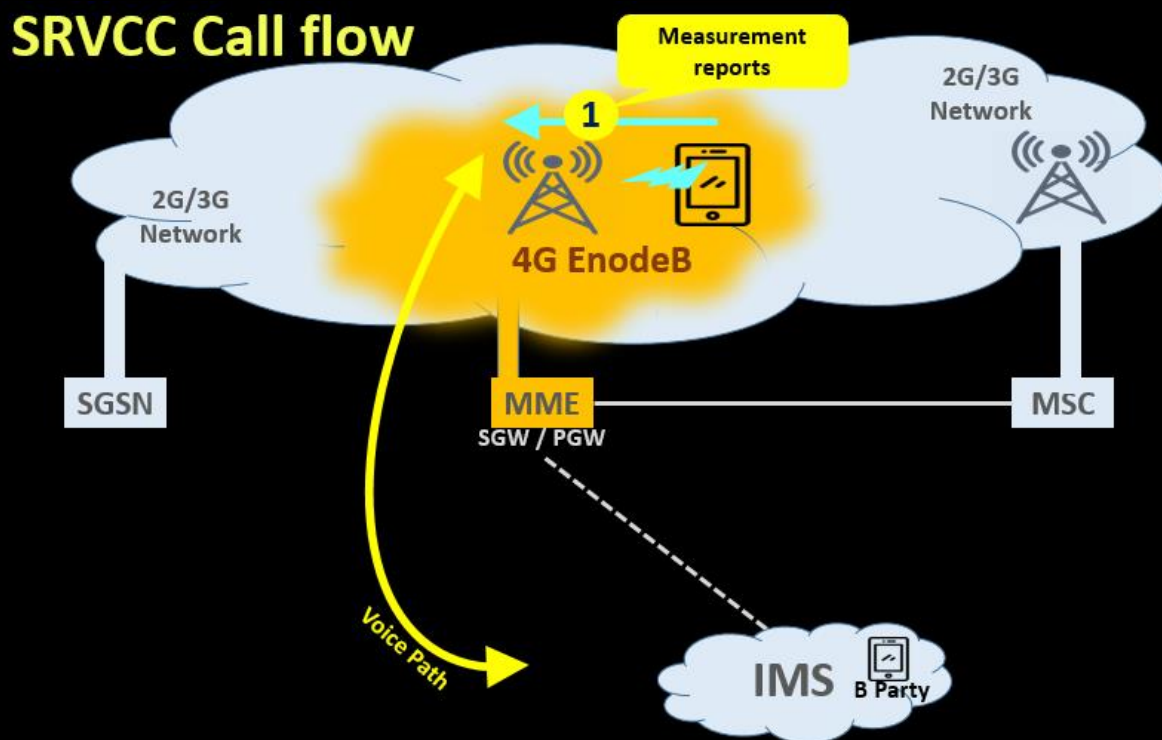
Let's Start our Journey with SRVCC Call flow , We can see Customer Happily latched on 4G network here

- As First Step , UE Makes a VoLTE Call on 4G Network which uses the Path of EnodeB to SAE GW to IMS Core

- Now , UE Starts moving away from 4G coverage & started getting Good signals from 3G network

- As this point of time , Handset Realize that 4G signal level begins to decrease, the UE tells EnodeB about Current Radio Levels with help of Measurement reports

SRVCC Call flow – PS to CS Request
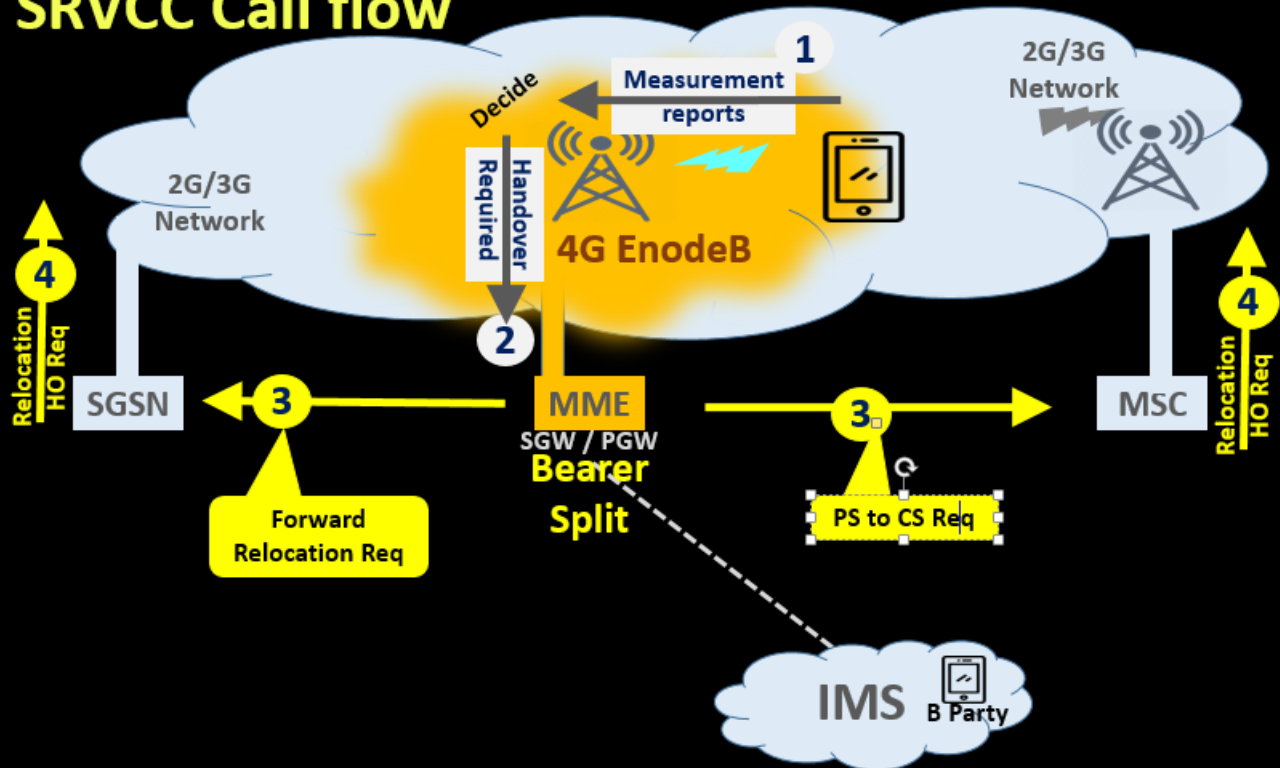
Now , The EnodeB takes decision & identifies the best available network to receive the service .

EnodeB sends the handover request to the MME with SRVCC Handover indication (This will tell MME that its for CS + PS HO)

After receiving the SRVCC HO Indication, the source MME , splits the voice bearer from all other PS bearers and initiates their relocation towards MSC Server and SGSN

This MME does two critical task here after Bearer Splitting :-

- MME Initiates the PS-CS handover procedure for the voice bearer by sending a SRVCC PS to CS Request Message to the MSC Server . This contains critical information such as IMSI, Target ID for Voice Call , STN-SR , C-MSISDN etc.. We will understand significance of these parameter such as STNSR & C-MSISDN in End of this Video
- In parallel , MME initiates relocation of the PS bearers. MME sends a Forward Relocation Request to the target SGSN
- Now , Both MSC & SGSN will approach the RNC of 3G Network by Requesting Resource allocation for the CS & PS

SRVCC Call flow – Session Transfer (STN-SR or E-STN-SR)
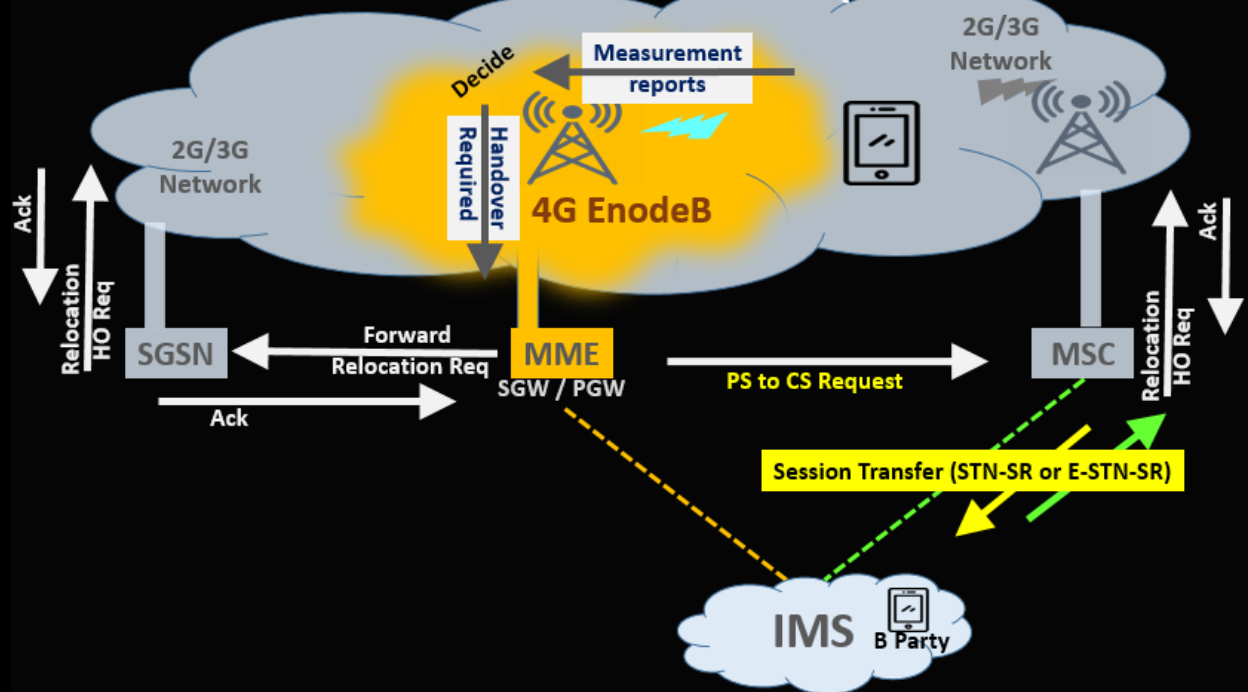
Target RNC acknowledges the PS & CS Relocation Handover by sending the Relocation handover Request Ack too respective SGSN & MSC here SGSN Acknowledge MME by Sending Forward Relocation response back to MME

Once MSC receives Relocation handover Request Ack from RNC , It need to setup CS Leg with IMS Network
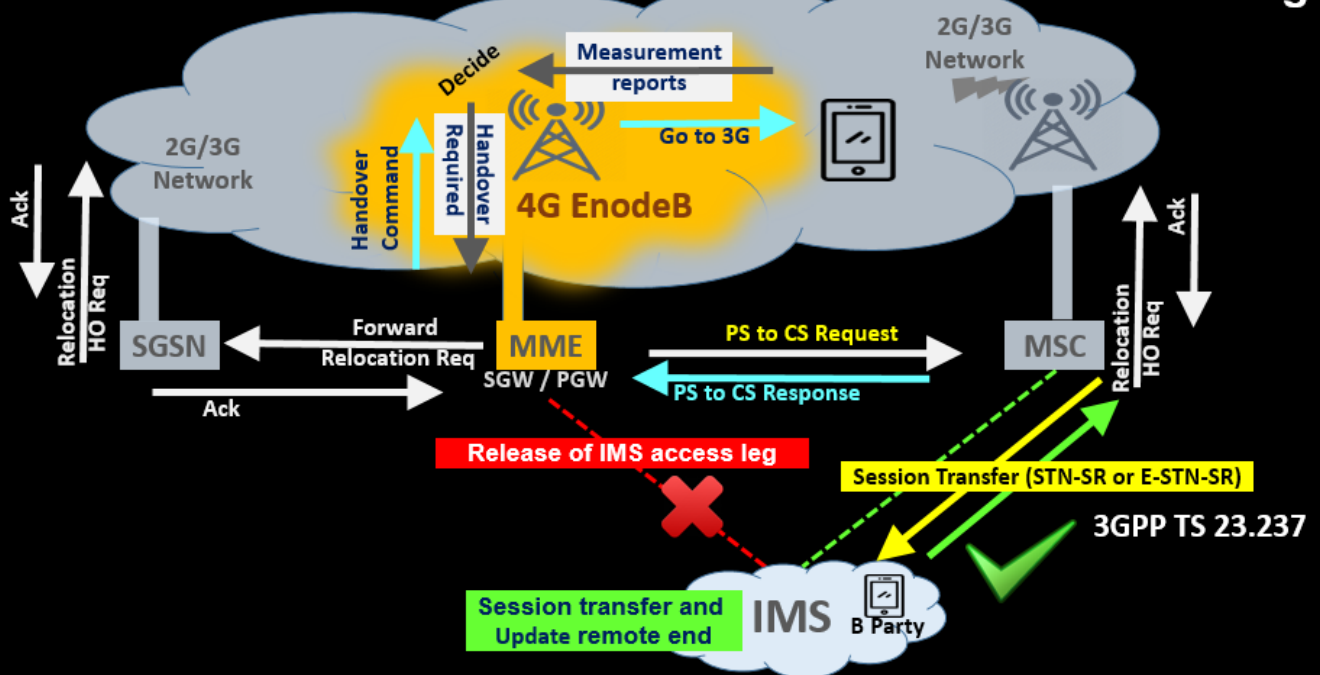
The MSC Server initiates the Session Transfer by using the STN-SR with IMS Network here , In actual , MSC Sends an New Call ISUP IAM message toward the IMS with STNSR as destination

This Newly establish Call between MSC & IMS Network is used to carry voice once handover is completed

## SRVCC Call flow – Session transfer and Release of IMS Leg

Now , It's the time to change flow of Voice Traffic

- Now , Standard IMS Service Continuity procedures are applied for execution of the Session Transfer , Here Two critical task of Session transfer & Update Remote Leg is done to divert the flow of downlink flow of VoIP packets towards CS Leg via MSC
- The IMS Leg to Packet Core is released now as shown in Red Color Cross Icon , Now Traffic is diverted from Packet Switched Network to Circuit Switch Network
- The MSC Server sends a SRVCC PS to CS message to the MME , You can see this in Blue Color Arrow
- The MME sends a Handover Command message to the ENodeB , In turn , The EnodeB sends a Handover Command message to the UE which is direct Order to User to Switch to 3G Radio
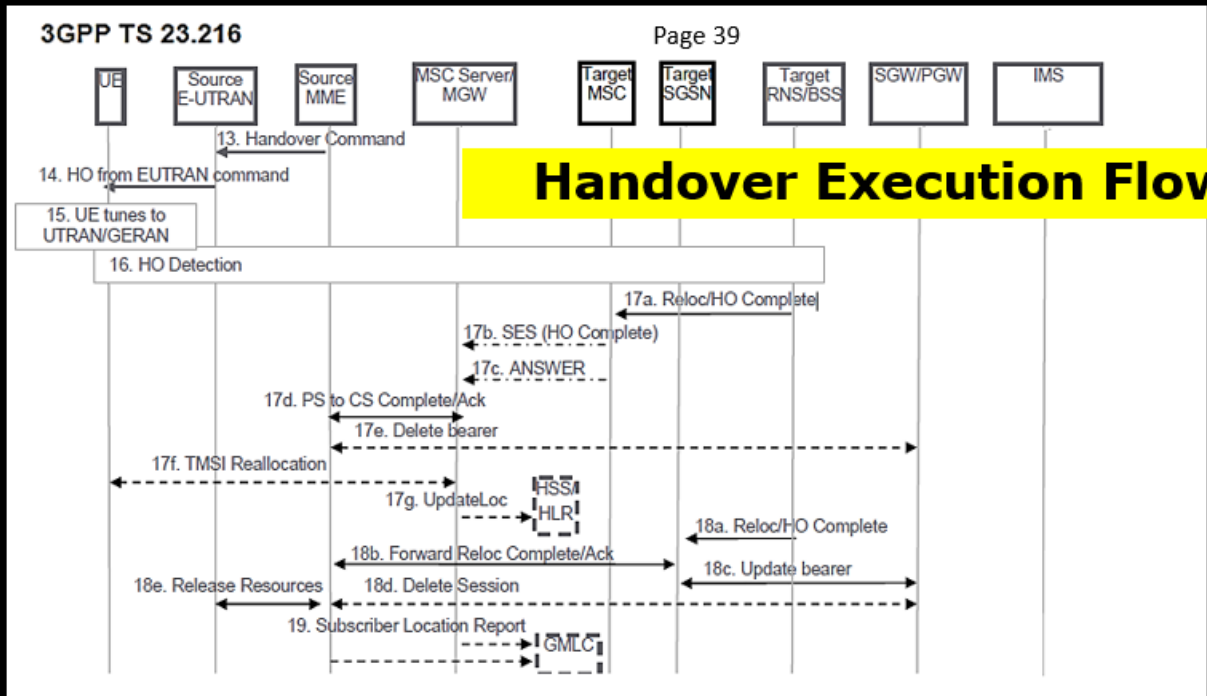
SRVCC Call flow – 3G Latch
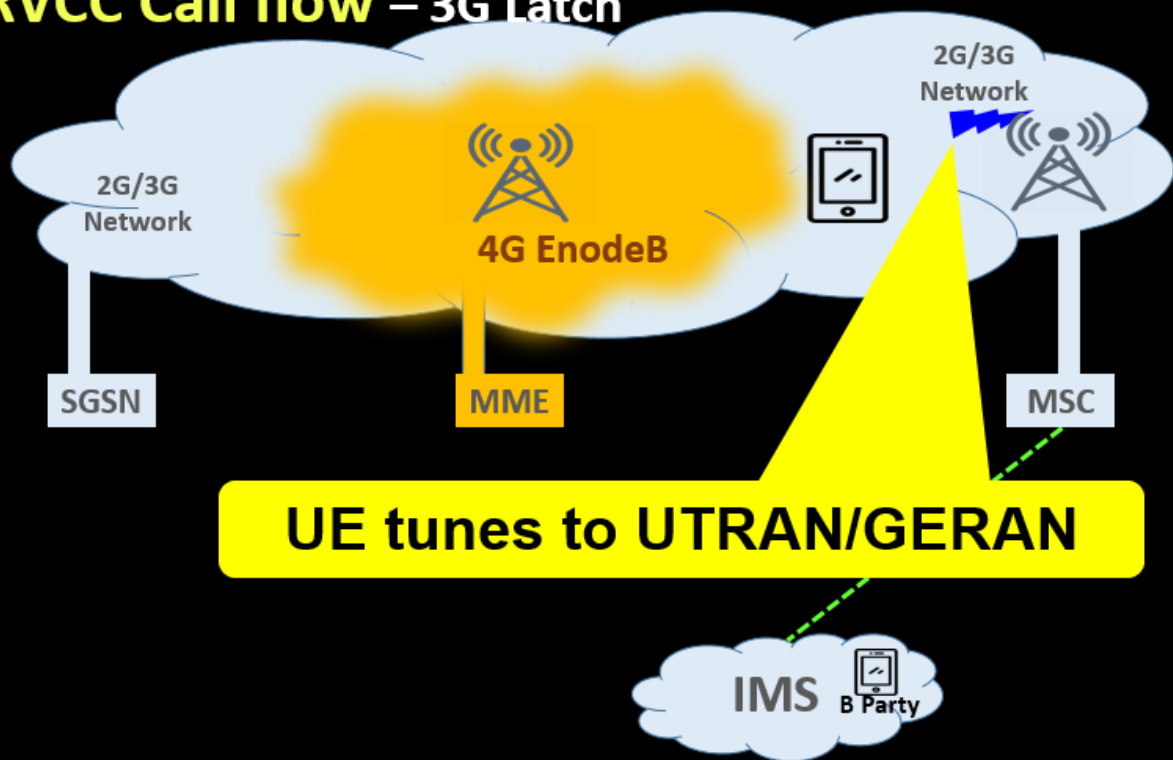
To complete Handover , Now User Camps onto 3G Network

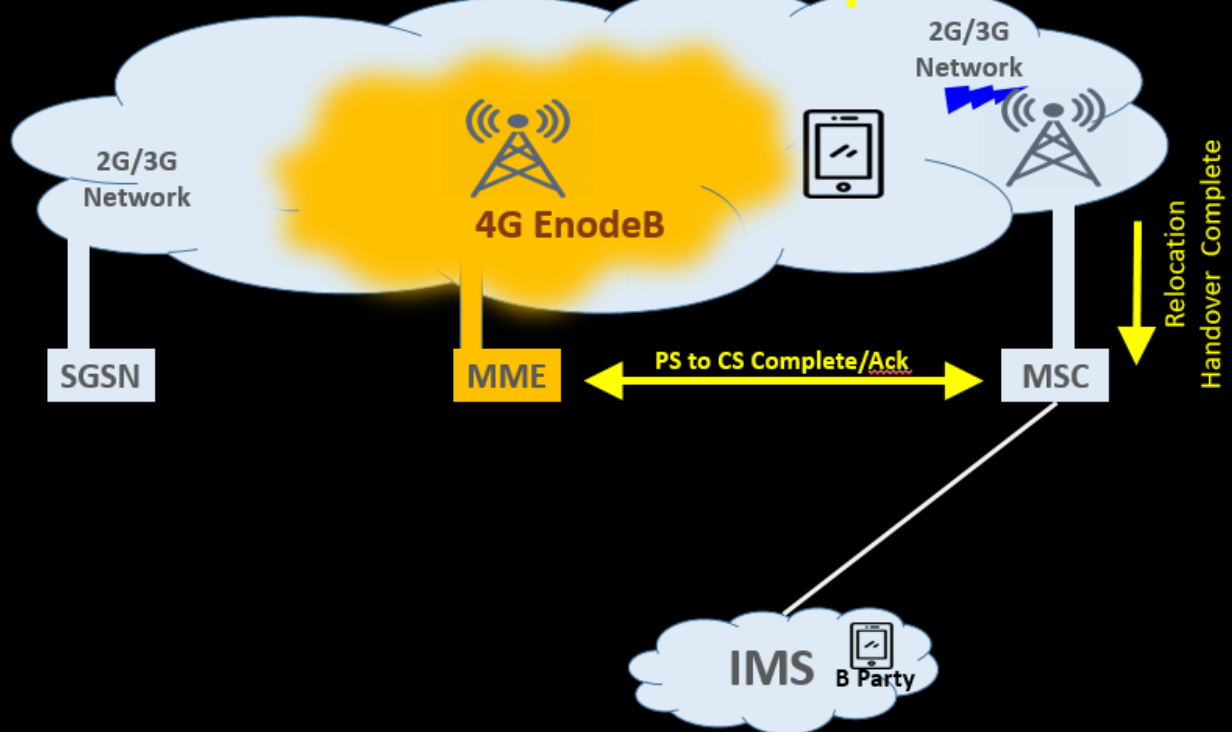## SRVCC Call flow – Handover Execution Flow

This is Reference Ladder as also extracted from 3GPP Document which explains us Handover Execution Flow where Actual Handover happens & Call Gets switched to 3G radio

Now , Let's jump onto understanding Flow for same

SRVCC Call flow – Handover Complete

Now , Let's understand voice first …

- UE tunes to the target UTRAN/GERAN cell
- Handover Detection at the target RNS/BSS occurs. The UE sends a Relocation Handover Complete message via the target RNS/BSS to the target MSC
- At this stage, the UE re-establishes the connection with the network and can send/receive voice data
- MSC Server sends a SRVCC PS to CS Complete Notification message to the MME . The MME acknowledges the information by sending a SRVCC PS to CS Complete Acknowledge message to the MSC Server . Here , The MME deactivates the voice bearer towards S-GW/P-GW

SRVCC

SRVCC Call flow – Call Transfer
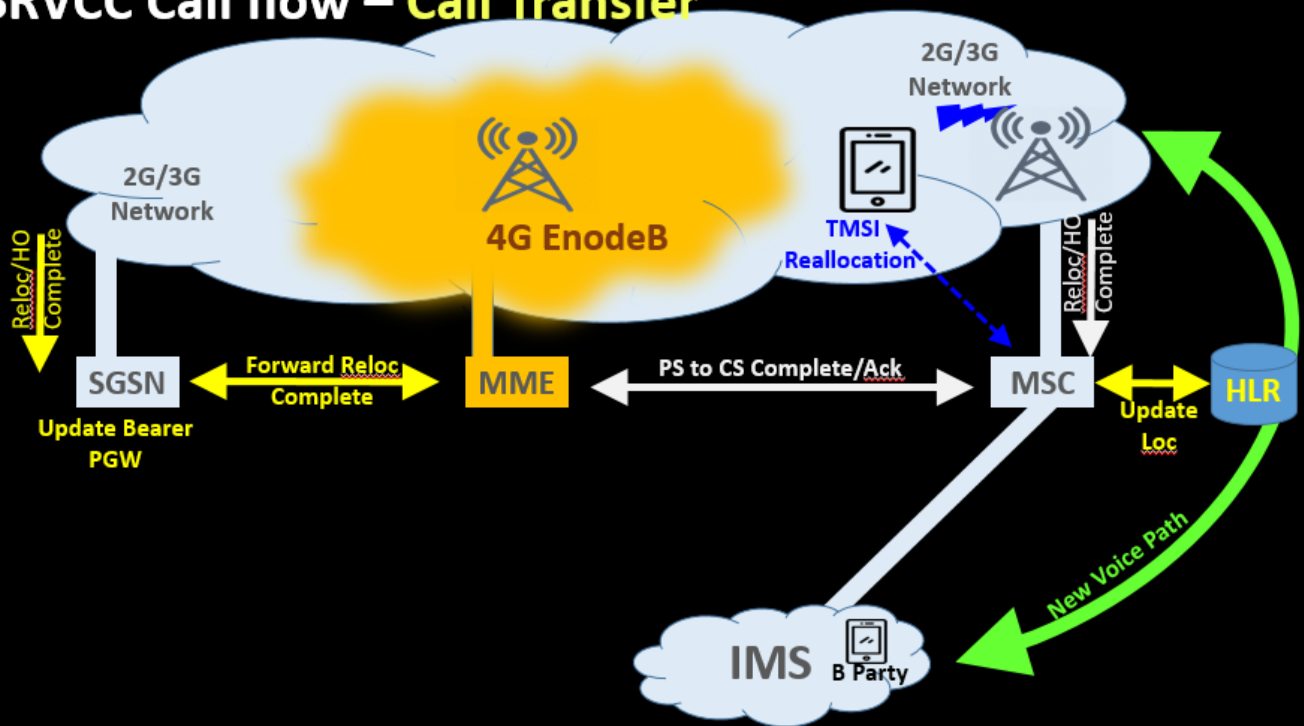
The MSC Server performs other TMSI reallocation towards the UE & It also performs a MAP Update Location to the HSS/HLR

Now all steps are closed & Voice is flowing on new Path

Similarly , For Data Part , Handover completion & Bearer Updation is done between SGSN & PGW so that user can start Internet Session in 3G radio Now

SRVCC Identities

SRVCC Identities

| Session transfer number for SRVCC (STN-SR)	Correlation MSISDN (C-MSISDN)

• Used for Session Transfer of Call to CS Domain
• E.164 Nomenclature (Similar to MSRN)
• Flow
  • HSS -> MME (s6, Attach Flow)
  • MME -> MSC (Sv, PS->CS Req)
  • MSC -> IMS (Voice Call)
	• Used for correlation of sessions at access transfer
	• MSISDN of User in CS Network
	• Helps to Identify Session to be Transferred

Here , We are going to discuss Identities used for SRVCC functionality

1st One is STN SR , STN SR is Session transfer number for SRVCC used by MGCF for routing of call towards IMS Network . This follows the E.164 telecommunications number format, and is used by the MSC server for session transfer of the media path from the PS domain to the CS Domain. HSS provides the STN-SR to the MME that is provisioned for a UE during its attach procedure . The MME sends the STN-SR in the SRVCC PS to CS request to the MSC over the Sv interface . The MSC initiates a request for an access transfer of the active session from the IMS network and includes the STN-SR in the request. The SCC AS eventually receives an INVITE with the STN-SR which indicates the need for an access transfer of an active session. The STN-SR is the number that is used to facilitate that coordination

2nd One is C-MSISDN , This is Correlation MSISDN (C-MSISDN) is an MSISDN that is used for correlation of sessions at access transfer and to route a call from the IMS to the same user in the CS domain.

Network Changes required for Enabling SRVCC

Network Changes required for **Enabling SRVCC**

ATCF	ATGW	MSS
E-UTRAN	**MME**	**HSS**

SR-VCC-IWF · New · **SCC-AS**
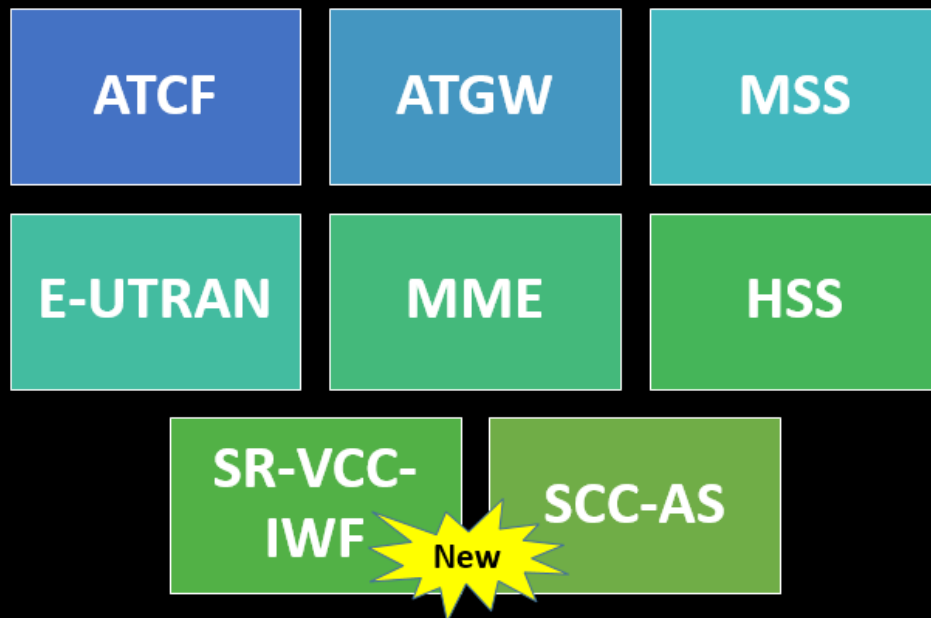
Now , Let's discuss changes required at various Network Elements in order to support SRVCC

SRVCC started evolving from Rel 8 & continued till Rel 10 . The network upgrades required to the cellular network are needed in both the LTE network and that of the legacy Network

- **ATCF :** It is a signaling controller that facilitates handover from LTE to circuit 2G/3G networks and update the VCC (Voice call continuity) application server after the access transfer. These ATCF/ATGW enhancements will be implemented in the SBC
- **ATGW** : Access Transfer Gateway: It acts as an anchor for the IMS media traffic to allow media traffic to be switched quickly from the PS access network to the CS access network via the MSC
- **MSC Server :** MSC Server is Centre of all communication for SRVCC , It handles Relocation Preparation procedure with MME via Sv Interface , It also handles session transfer procedure with IMS Network
- **E-UTRAN** : E-UTRAN selects a target cell for SRVCC handover, and sends an indication to MME that this handover procedure requires SRVCC
- **MME** : MME Needs to support Bearer Splitting , Sv Interface & STN-SR communication with MSC
- **HSS** : HSS Needs to support STN-SR & C-MSISDN Provisioning

- **SR-VCC-IWF** : **Single Radio Voice Call Continuity – Interworking Function** : This is new Node introduced in IMS Network which eliminates the need for MSC upgrades. It connects MME on one side and MSC on the other side
- **SCCAS** : This is also New Node introduced for SRVCC , The SCCAS entity combines the SIP signaling and acts as a back-to-back user agent , providing an anchor point for incoming and outgoing calls

Enhanced SRVCC (eSRVCC)

Enhanced SRVCC (eSRVCC)

Benefits of eSRVCC

- **Interruption Time Reduced**
  - SRVCC : 800-1000 ms
  - eSRVCC : < 300 ms

Changes Done for eSRVCC

- **Anchoring Point Change**
  - **SRVCC** : Home SCC-AS (Call Must Go Back to Home Network for Roamers)
  - **eSRVCC** : Serving Network ATCF/ATGW (Call can be Switched in Visited Network Itself – This Saves Time)

This are few advancements introduced in SRVCC to improve overall user experience , In Plain Old SRVCC, the home network application server .. SCC-AS anchors the call . This anchoring by home network tends to increase the handover delay in case a home subscriber roams to a distant network and latches on to a roaming partner . This effectively means that Call must be routed via Home Network only for any SRVCC handover happening in Network . This problem is Quite significant to Countries where National Roaming prevails

There is major change here with eSRVCC .. In eSRVCC , An ATCF/ATGW is introduced to anchor media sessions. All session messages before and after the handover must exchange through the ATCF/ATGW in Serving Network only . Only Bearers between the calling UE and the ATCF/ATGW need to be updated, which shortens the speech gap

Along with eSRVCC , We got another feature of aSRVCC also known as SRVCC in alerting phase , This adds the ability to perform access transfer of media of an IM session in PS to CS direction in alerting phase for access transfers

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Further Study ..

Further Study ..

Specs Ref	Name of Document
GSMA, IR.92	IMS Profile for Voice and SMS
GSMA, IR.94	IMS Profile for Conversational Video Service
3GPP, TS.23.216	Single Radio Voice Call Continuity (SRVCC)
GSMA, IR.64	IMS Service Centralization and Continuity Guidelines V6.0
3GPP, TS22.278	Service Requirements for the Evolved Packet System (EPS)
3GPP, TS23.237	IP Multimedia Subsystem (IMS) Service Continuity Stage 2

As more and more operators roll out LTE and adopt VoLTE/IMS as platform for providing voice services, SRVCC will be an option for addressing the gaps in LTE coverage while providing continuous coverage for voice service.

Despite the fact that SRVCC is apparently more complex than CSFB , This continues to be the choice of the Mobile Operators due to benefits coming to us from VoLTE Services . SRVCC plays key role in providing uniform services across EPC Domain

You can go thru above Specs for further studies on this domain