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移动网络演化史

- 最新版本：`v1.0`
- 更新时间：`20200916`

简介

总结移动网络的演化历史，包括相关的1G、2G和GSM、3G和UMTS及CDMA2000、4G和LTE、5G和NR等网络的名称和背后所用的核心技术要点，以及实现多媒体服务的方案IMS，包括IMS的概述、架构、核心元素、相关内容如ETSI、TISPAN、SIP、用户认证、SIM卡、用户标识、IMS认证、SIP授权认证、SBC等，以及基于IMS之上的VoLTE、RCS、ViLTE、VoWiFi等常见协议。

源码+浏览+下载

本书的各种源码、在线浏览地址、多种格式文件下载如下：

Gitbook源码

- crifan/mobile_network_evolution_history: 移动网络演化史

如何使用此Gitbook源码去生成发布为电子书

详见：crifan/gitbook_template: demo how to use crifan gitbook template and demo

在线浏览

- 移动网络演化史 book.crifan.com
- 移动网络演化史 crifan.github.io

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鸣谢

感谢我的老婆**陈雪**的包容理解和悉心照料，才使得我 `crifan` 有更多精力去专注技术专研和整理归纳出这些电子书和技术教程，特此鸣谢。

移动网络概述

总结移动网络相关知识。

概述

从1G到5G

- 相关名词和术语
  - 5GC Core
    - gNB, AMF, SMF, NSSF, UDM, AUSF, UPF
  - 4G LTE
    - eNB, MME, SGW, PGW, HSS, EIR, PCRF, OCS & OFCS
  - IMS
    - CSCFs, HSS, MGCF, MGW, AS, OCS & OFCS
  - 3G
    - NB, HNB, HNBGW, RNC, MSC, SGSN, GGSN
  - 2G
    - BTS, BSC, MSC, HLR, EIR, VLR, SMSC, GMSC
  - TDM | PSTN
    - ISDN, ISUP, CAS
      - requires additional PSTN Network setup
  - Supports IPSec, TLS, SRTP, and MSRP

不同实现

- GL
  - Simulation of CSFB for Voice and SMS over SGs Interface
    - gl_simu_csfb_for_voice_sms_sgs
  - Simulation of IP-SM-GW for SMS over IMS Network
    - gl_simu_ip_sw_gw_for_sms_ims
- 其他
  - other_network_arch_ims

网络接口

- 背景
  - 不同网络，不同运营商，很复杂
  - 希望不同用户可以互相沟通
- 涉及到
  - 不同网络之间的沟通：
    - NNI=Network-to-Network Interface
  - 终端网络和用户之间的沟通
    - UNI=User-to-Network Interface

VoLTE和RCS

- 共同特点
  - 都是基于IMS架构演化出的新功能
- 共存
  - 运营商部署 `VoLTE` 时，往往也会部署 `RCS`
    - 用于一步到位，支持全 `IP` 的网络
      - `RCS` 可看成是旧的 `SMS` 和 `MMS` 的演化
  - 在某些特定场景下，（比如信号不够好？） `VoLTE` 也会用 `CS` 的服务作为补充
  - 以 `RCS` 为基础的 `VoWiFi` 的电话，有时候可以作为 `VoLTE` 和 `CS` 的补充

网络阶段

移动网络发展总体上经过了5代，分别是：

- 1G
- 2G
  - GSM
- 3G
  - UMTS
  - CDMA2000
- 4G
  - LTE
- 5G
  - NR

1G

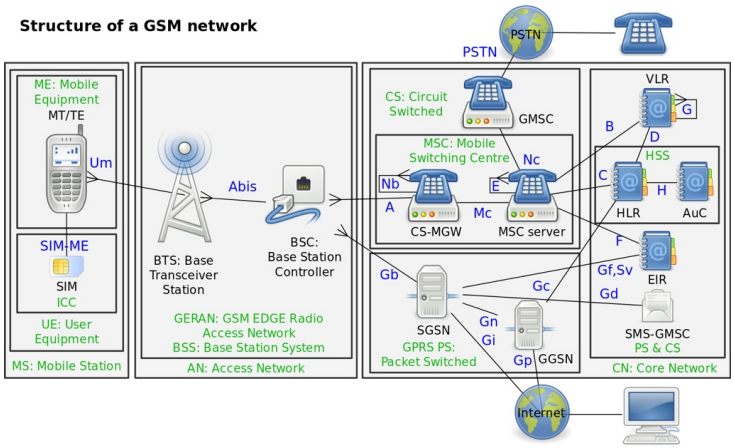
- `1G = AMPS / TACS / NMT / C-Netz`
  - 信号编码方式：`FDMA`
    - `FDMA = Frequency Division Multiple Access`
  - 协议标准
    - `AMPS`
      - 美国
    - `TACS`
      - 英国
    - `NMT`
      - 北欧
    - `C-Netz`
      - 德国
        - ABC网络=A、B、C Network
          - A=A-line
          - B=B-grid
          - C=C-grid
        - 出现时间：1992年

2G

- 2G=GSM / D-AMPS / IS-95
  - 概述
    - 2G包含：GSM、CDMA （其他不常用的 D-AMPS、IS-95）
      - 单个手机同时支持GSM和CDMA，被称为双模dual-mode？
    - GSM比CDMA用的更广泛
  - 编码方式=数据接入方式=数据接入技术=access technology
    - TDMA
      - TDMA=Time Division Multiple Access
        - D-AMPS有时候也被叫做：TDMA
  - 协议标准standard
    - GSM=Global System for Mobile Communications
      - 别称：`2G`
      - 编码方式：FDMA 和 TDMA的组合
      - 频谱
        - 范围
          - uplink上行：890 MHz ~ 915 MHz
          - downlink下行：935 MHz ~ 960 MHz
        - 别称：P-GSM
          - P-GSM=Primary GSM
        - 后续
          - 上下行都新增10MHz
      - 传输速度：
        - 最大14.4 kb/s
          - 基于：传统ABC网络
        - 最大 171.2 kb/s
          - 基于：GPRS
            - GPRS=General Packet Radio Service
              - 是什么：一种服务
                - 介于UMTS和GSM之间
                  - 和设备建立永久连接
                  - 但只在必要时传输数据
              - 相关
                - always-on mode
              - 别称：2.5G
        - 最大 384kb/s
          - 基于：EDGE
            - EDGE
              - EDGE=Enhanced Data for Global Evolution
                - =Enhanced Data Rates for GSM Evolution
              - 是什么：一种传输技术
                - 是GSM网络中的传输技术
              - 基于GSM衍化出的
                - 传输速度：最大384kb/s

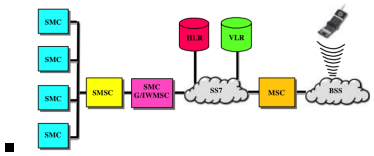
        - 基于ECSD扩展出
            - E-GPRS=Enhanced GPRS
            - HSCSD
        - 别称：2.75G
- 主要用途：
    - 打电话☎️
        - 老式电话telephony
    - 也用于
        - 数据传输
        - 短消息=SMS=短信
    - 基于
        - CS=Circuit-Switched
        - PS=Packet-Switched

GSM

- GSM
  - 架构
    

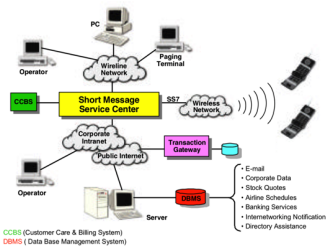
    -
  - 包含
    - `NSS` = `Network Switching Subsystem` = `网络交换子系统`
      - 别称：`GSM核心网络` = `GSM core network`
      - 包含
        - `MSC` = `Mobile Switching Center`
          - `MSCS` = `Mobile Switching Center Server`
          - 有2种
            - `SMSC` = `Short Message Service Center`
              - 全称：`SMS-SC` = `Short Message Service - Service Center`
              - 是什么：一个网络节点
                - 移动电话网络中的一个节点
              - 作用：存储、转发、转换、传送SMS短信
              - 具体实现
                - 举例
                  - Network Elements and Architecture

                    Figure 1: Network Elements and Architecture

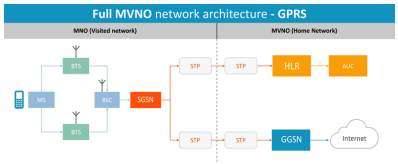
                    

                    -
                  - Network Infrastructure

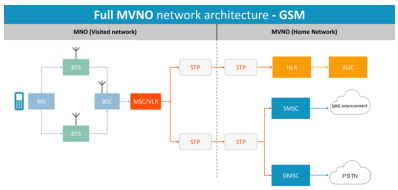
Figure 2: Network Infrastructure



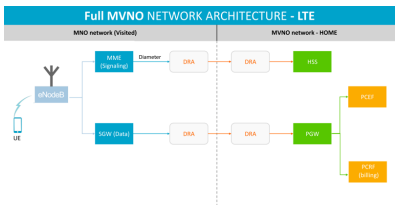
- `GMSC = Gateway Mobile Switching Center`
  - 相关架构
    - Full MVNO network architecture - GPRS



    - Full MVNO network architecture - GSM



    - Full MVNO network architecture - LTE



  - 连接到 `MSC` 的元素
    - `HLR = Home Locator Register`
      - 获取SIM和MSISDN（如手机号）等数据
    - `BSS = Base Station Subsystems`
      - 负责2G和2.5G手机的无线电通讯
    - `UTRAN = UMTS Terrestrial Radio Access Network`
      - 负责3G手机的无线电通讯
    - `VLR = Visitor Location Register`
      - 提供用户的信息
        - 当用户不在家庭网络中
- `HLR = Home Locator Register`
  - 是什么：一个数据库
    - 数据：已注册到移动核心网络的移动用户数据
      - 即所有的SIM卡信息
        - 每个SIM卡有个唯一的IMSI
        - 每个SIM卡有个MSISDN
          - MSISDN：手机号码
- `AuC = Authentication Center`
  - 是什么：是一个功能function=模块
  - 功能：认证（想要连接到GSM网络的）SIM卡

- 比如：当手机开机（上电）后
- 目的：确保有权限使用相关服务

3G

- 3G=UMTS/CDMA2000
  - 概述
    - 编码方式
      - 都是
        - CDMA
          - CDMA=Code Division Multiple Access
    - 2条技术路线 track
      - UMTS
        - 从GSM发展而来
      - CDMA2000
        - 从IS-95 和 D-AMPS 演化而来
          - IS-95
            - 别称：cdmaOne
        - 别称：
          - CDMA2000 1xRTT
          - IS-2000
  - 协议标准standard
    - `UMTS`
    - `CDMA2000`

UMTS

- `UMTS`
  - `UMTS` = `Universal Mobile Telecommunication System`
    - = `UMTS broadband`
    - = `3G`
      - = `the third generation`
  - 属于
    - PS=Packet-Switched网络
      - 之前的GSM和EDGE也是PS网络
        - 可利用现有资源=网络节点
          - SGSN
          - GGSN
  - 编码和传输
    - 最大速度
      - downlink下行：2 Mb/s + uplink上行：128 kb/s
        - 基于：WCDMA
          - WCDMA=Wideband Code Division Multiple Access
      - 21 Mb/s
        - 基于：HSPA
          - =HSPA+
            - HSDPA=High Speed Packet Access
          - downlink下行：HSDPA
            - HSDPA=High Speed Downlink Packet Access
              - 别称
                - =3.5G
                - =3G+
                - UMTS broadband
              - 是什么：UMTS网络中的一种传输技术
              - 最大速度： 3.6Mb/s ~ 7.2Mb/s
              - 发布时间：2007年
              - 特点
                - 支持（在移动网络中）实现DSL-like = xDSL 数据传输
              - 相关网络运营商
                - Vodafone
                - E-Plus
                - O2
                - Swisscom
                - Sunrise
                - Orange
                - A1
                - T-Mobile
          - uplink上行：HSUPA
            - HSUPA=High Speed Uplink Packet Access
              - 是什么：UMTS网络中的一种传输技术

        - 最大速度：5.8 Mb/s
            - 具体
                - HSUPA Category 6：5.76 Mb/s
                - HSUPA Category 9：23 Mb/s
        - 逻辑关系
            - 是UMTS Release 9的一部分
    - 出现时间：2004年
    - 相关历史
        - 最早是ETSI制定的UMTS
        - 后来被ITU采纳了
        - 以及出现了3GPP
            - 3GPP=3rd Generation Partnership Project
                - 其中的3rd Generation，就是3G
                    - 就是为了3G弄了个组织，用于协调统一各方标准，实现3G网络推广
    - 最新情况：3GPP制定的UMTS标准

CDMA2000

- `CDMA2000`
  - 最大速度
    - `EV-DO` = `EVDO`
      - `EVDO` = `Evolved Data Optimized`
      - 下行downlink：14.7 Mb/s
      - 上行uplink：5.4 Mb/s

4G

- 4G= `LTE` / `WiMax`
  - `LTE` = `Long Term Evolution` (of mobile networks)
    - = `4G` = `the fourth generation` = `4G standard`
  - 最大速度：300 Mb/s
  - 2条技术路线
    - `LTE`
      - 演化自UMTS和CDMA2000
      - 目前主流是LTE
    - `WiMax`
      - WiMax=Worldwide Interoperability for Microwave Access
  - 协议标准
    - `LTE`

LTE

- `LTE`
  - 编码方式：
    - downlink下行：OFDMA
      - OFDMA=Orthogonal FDMA
        - 适合多用户
    - uplink上行：SC-FDMA
      - SC-FDMA=Single-Carrier FDMA
        - 能效比高，适合用电池的移动手机
  - 最大传输速度
    - `LTE`
      - 下行：300 Mb/s
      - 上行：75 Mb/s
    - `LTE-A` = `LTE Advanced`
      - 下行：1Gb/s
    - `LTE Advanced Pro`
      - 下行：3Gb/s
  - `LTE Advanced Pro`
    - 支持
      - `MIMO` = `Multiple-Input Multiple-Output`
      - `CA` = `Carrier Aggregation`
- 相关名词
  - `TTI` = `Transmission Time Interval`
  - `HARQ` = `Hybrid Automatic Repeat Request`
  -

5G

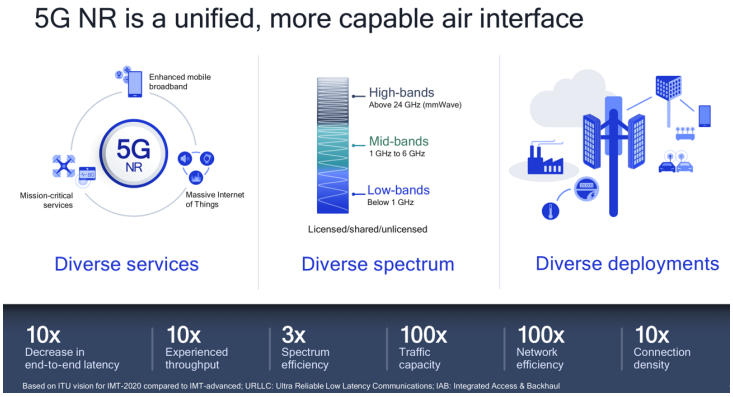
TODO:

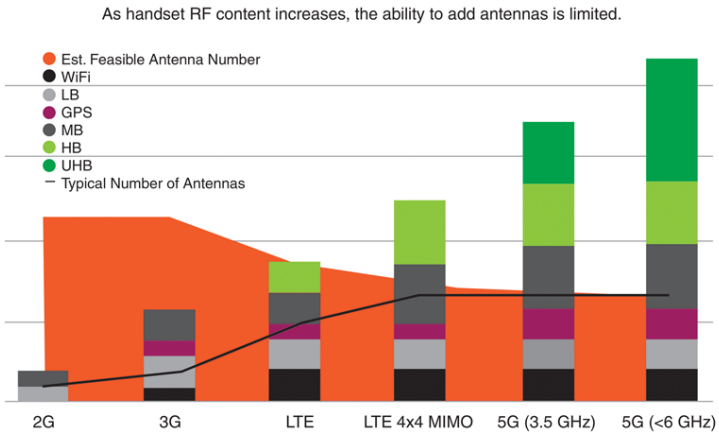
把

- Qualcomm Future of 5G Building a unified, more capable 5G air interface for the next decade and beyond
- The-5G-Guide_GSMA_2019_04_29_compressed.pdf

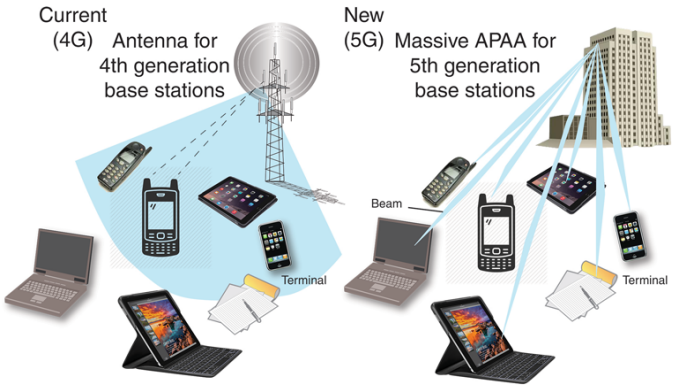
中关于5G技术内容整理过来

> 关于5G更多细节，详见：5G技术概述

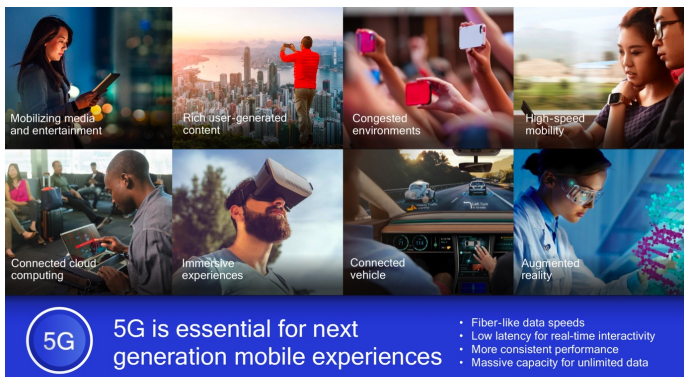
- 5G
  - = `fifth generation`
  - `3GPP` 组织制定的标准
  - 概述
    - 

  - 频段范围
    - `FR1` = `Frequency Range 1`
      - 包括 sub-6 GHz
    - `FR2` = `Frequency Range 2`
      - 包括了 `mmWave` = `mm-wave` 的24–100GHz
  - 2G到5G频谱对比
    - 

  - 相关技术

- Massive MIMO
  - 

- 应用
  - 概览
    - 

    - 

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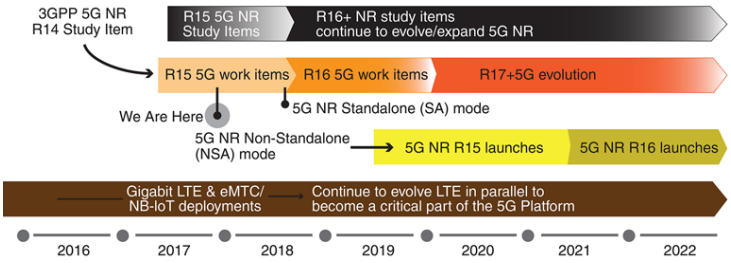
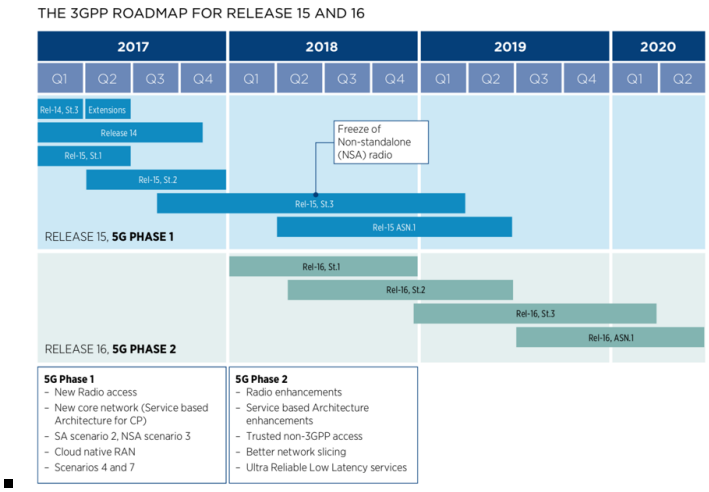
5G标准版本历史

- 5G标准版本历史
  - 图
    - 

    - 

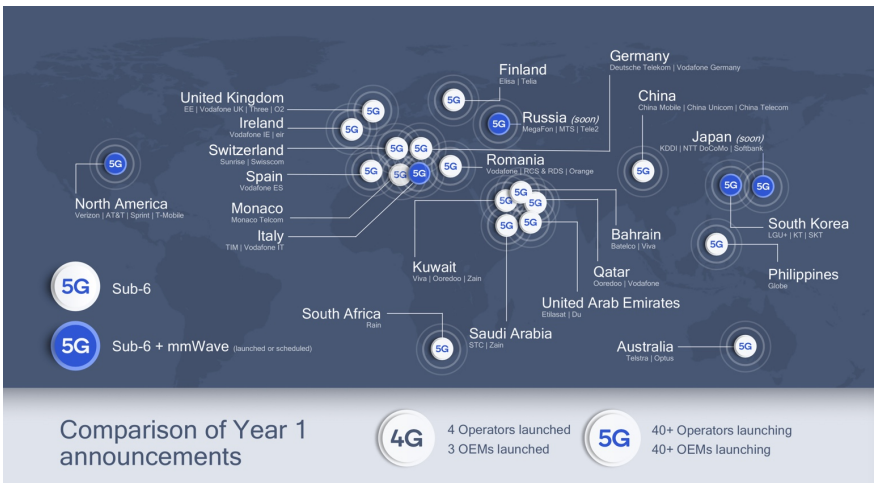
    - THE 3GPP ROADMAP FOR RELEASE 15 AND 16
    - 

  - 文字
    - 2015年：开始研究
    - 2017年：第一次发布 5G NSA
    - 2018年：3GPP `Release 15` =5G `phase 1`
      - `eMBB` = `Enhanced Mobile Broadband`
      - `URLLC` = `Ultra-Reliable and Low Latency Communication`
    - 2020年6月：3GPP `Release 16` =5G `phase 2`
      - `mMTC` = `massive Machine Type Communication`
      - `V2V` = `Vehicle to Vehicle`
    - 预计2021年：`Release 17`

4G vs 5G

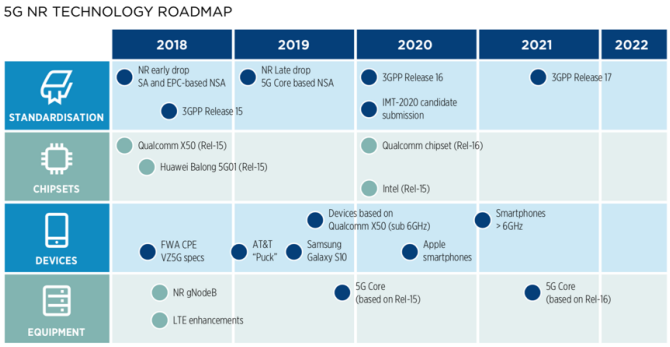
Technology	Data Rates	Latency	Mobility Support	Spectrum Efficiency	Use Dens
5G (NR)	Avg 100 Mb/s Peak 20 Gb/s	~ 1 ms	>500 Km/h	x3 Better DL- 30 bits/Hz UL- 15bits/Hz	1000K/
4G (LTE)	Avg 25 Mb/s Peak 300 Mb/s	~10- 50 ms	<=350 Km/h	DL – 6 bits/Hz UL- 4 Bits/Hz	~ 2K/K

运营商支持5G情况

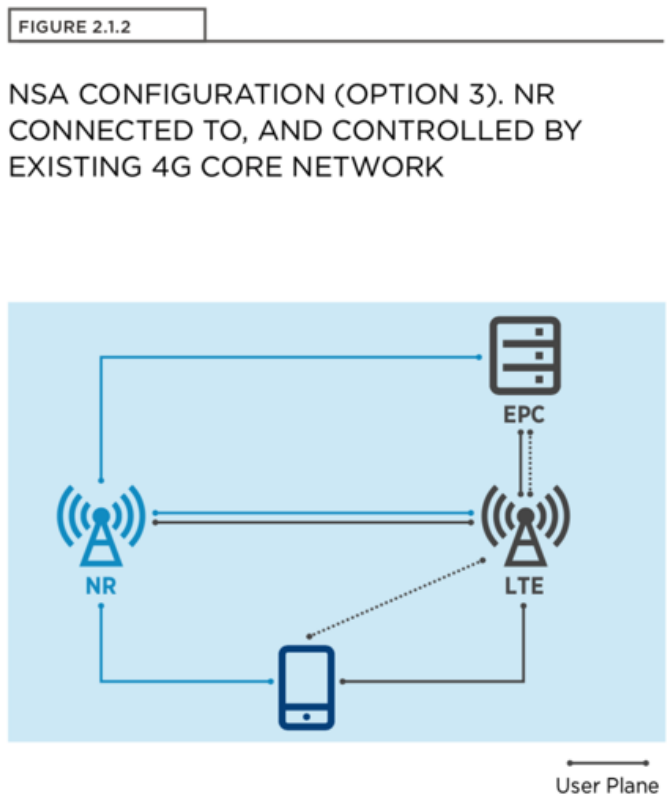


NR

- NR
  - = New Radio
  - 编码方式：OFDM
  - 路线图
    - 5G NR TECHNOLOGY ROADMAP



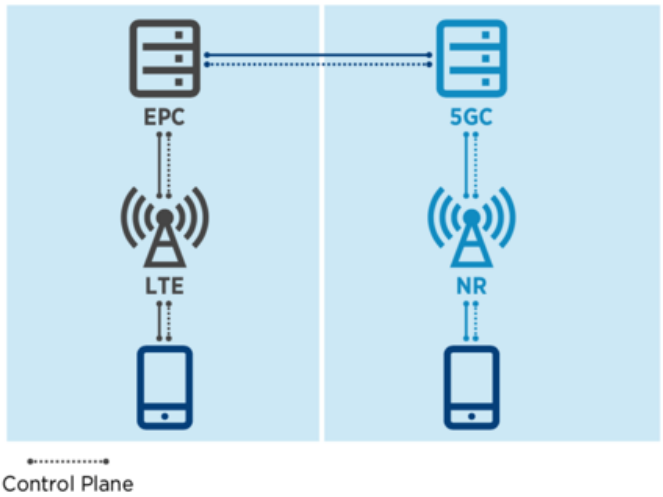
  - 部署
    - 基于已有4G LTE的：NSA = Non-StandAlone



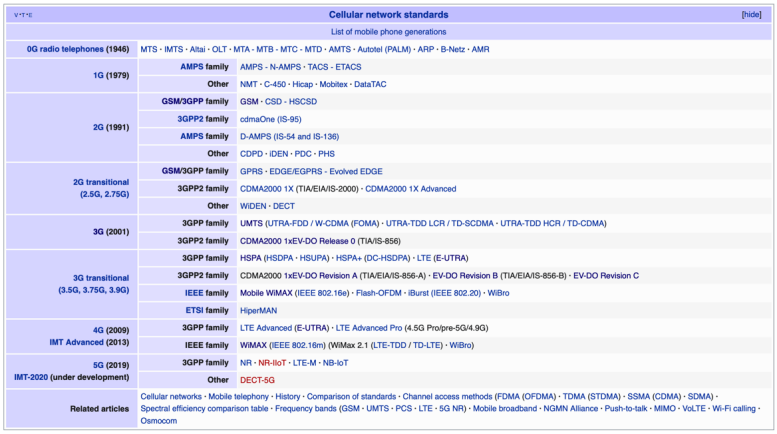
    - 纯5G的：SA = StandAlone

FIGURE 2.1.3

SA CONFIGURATION (OPTION 2). NR CONNECTS TO THE 5G CORE ONLY. THE STANDALONE 5G SYSTEM INTERWORKS AT CORE NETWORK LEVEL WITH LEGACY 4G SYSTEM



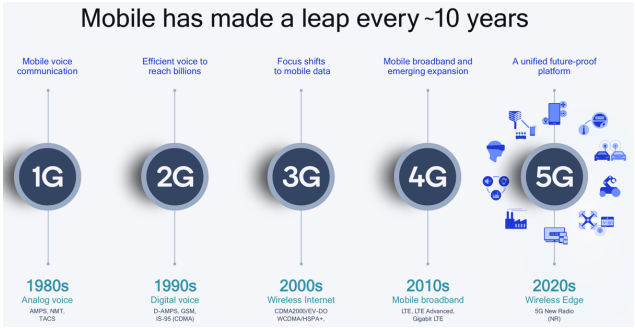
总结

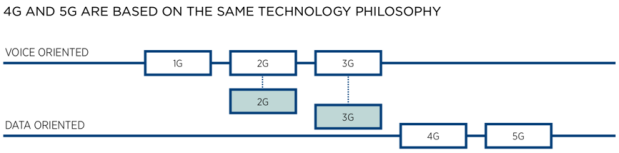
- 概览
  - 

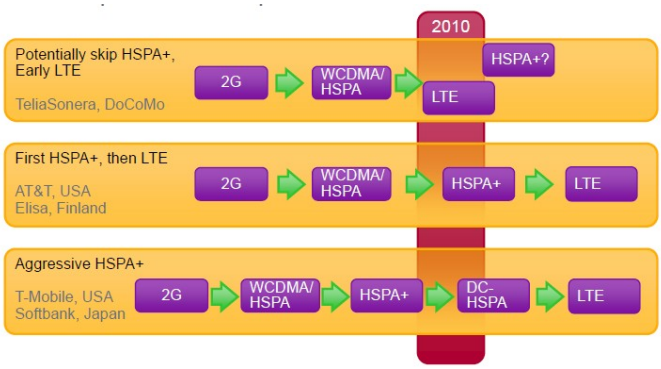
v · t · e	Cellular network standards	[hide]
List of mobile phone generations		
0G radio telephones (1946)	MTS · IMTS · Altai · OLT · MTA · MTB · MTC · MTD · AMTS · Autotel (PALM) · ARP · B-Netz · AMR	
1G (1979)	AMPS family	AMPS · N-AMPS · TACS · ETACS
	Other	NMT · C-450 · Hicap · Mobitex · DataTAC
2G (1991)	GSM/3GPP family	GSM · CSD · HSCSD
	3GPP2 family	cdmaOne (IS-95)
	AMPS family	D-AMPS (IS-54 and IS-136)
	Other	CDPD · iDEN · PDC · PHS
2G transitional (2.5G, 2.75G)	GSM/3GPP family	GPRS · EDGE/EGPRS · Evolved EDGE
	3GPP2 family	CDMA2000 1X (TIA/EIA/IS-2000) · CDMA2000 1X Advanced
	Other	WiDEN · DECT
3G (2001)	3GPP family	UMTS (UTRA-FDD / W-CDMA (FOMA) · UTRA-TDD LCR / TD-SCDMA · UTRA-TDD HCR / TD-CDMA)
	3GPP2 family	CDMA2000 1xEV-DO Release 0 (TIA/IS-856)
3G transitional (3.5G, 3.75G, 3.9G)	3GPP family	HSPA (HSDPA · HSUPA) · HSPA+ (DC-HSDPA) · LTE (E-UTRA)
	3GPP2 family	CDMA2000 1xEV-DO Revision A (TIA/EIA/IS-856-A) · EV-DO Revision B (TIA/EIA/IS-856-B) · EV-DO Revision C
	IEEE family	Mobile WiMAX (IEEE 802.16e) · Flash-OFDM · iBurst (IEEE 802.20) · WiBro
	ETSI family	HiperMAN
4G (2009) IMT Advanced (2013)	3GPP family	LTE Advanced (E-UTRA) · LTE Advanced Pro (4.5G Pro/pre-5G/4.9G)
	IEEE family	WiMAX (IEEE 802.16m) (WiMax 2.1 (LTE-TDD / TD-LTE) · WiBro)
5G (2019) IMT-2020 (under development)	3GPP family	NR · NR-IIoT · LTE-M · NB-IoT
	Other	DECT-5G
Related articles	Cellular networks · Mobile telephony · History · Comparison of standards · Channel access methods (FDMA (OFDMA) · TDMA (STDMA) · SSMA (CDMA) · SDMA) · Spectral efficiency comparison table · Frequency bands (GSM · UMTS · PCS · LTE · 5G NR) · Mobile broadband · NGMN Alliance · Push-to-talk · MIMO · VoLTE · Wi-Fi calling · Osmocom	

- 网络演化历史
  - 文字
    - 精简
      - `2G = GSM`
        - 编码方式：`TDMA` 和 `FDMA`
        - 包含
          - `2.5G = GPRS`
          - `2.75G = EDGE`
      - `3G = UMTS`
        - 编码方式：`WCDMA`
        - 包含
          - `3.5G = HSDPA`
      - `4G = LTE`
        - 编码方式：`OFDMA` 和 `SC-FDMA`
      - `5G = NR`
    - 详细
      - `1G`
        - `AMPS` 、`NMT` 、`C-Netz` 、`TACS`
          - 编码方式：`FDMA`
      - `2G`
        - `GSM`
          - 编码方式：`FDMA` 和 `TDMA`
          - 传输方式
            - `GPRS`
              - `= 2.5G`
            - `EDGE`
              - `2.75G`
        - `D-AMPS`
        - `IS-95 = cdmaOne`
      - `3G`
        - `UMTS` ：来自 `GSM`
          - `WCDMA`

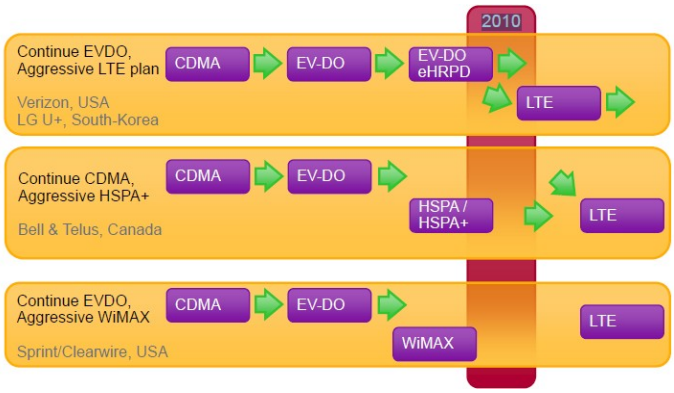
        - `HSPA+`
            - `3.5G = HSDPA`
        - `DC-HSPA+`
    - `CDMA2000`：来自`IS-95 = cdmaOne`
        - `EVDO`
- `4G`
    - `LTE`
        - `TD-LTE`
        - `FDD`
- `5G`
    - `NR`

- 不同代的网络
    - 演化图
        - 1G到5G
            - 移动网络每10年进化一代
            - 

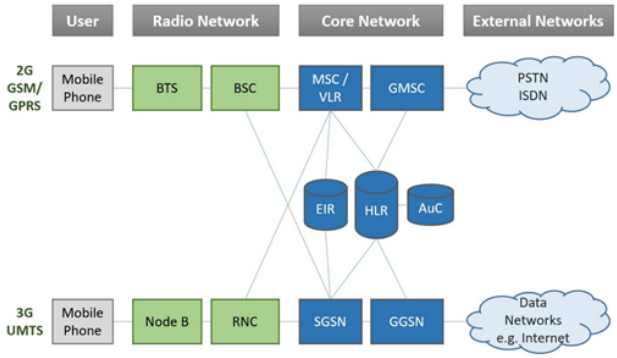
            - 4G和5G在语音和数据方面的发展路线
            - 

        - 2G到LTE
            - 

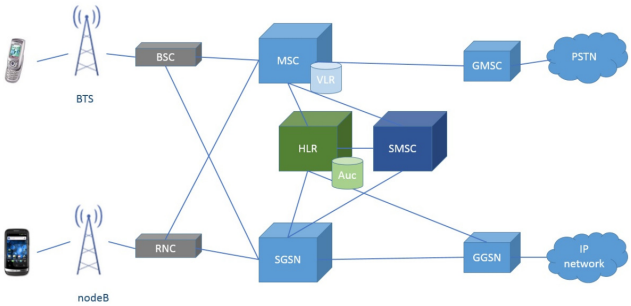
        - CDMA到LTE



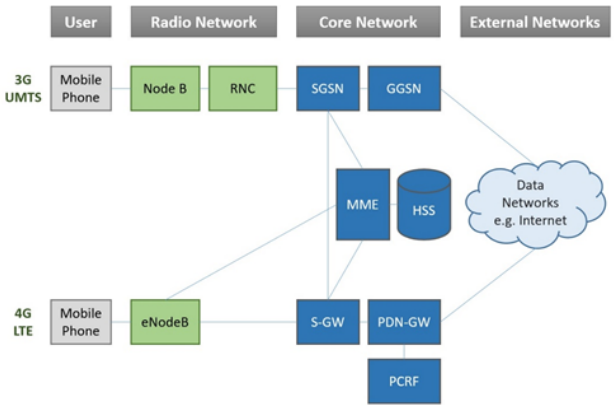
- 架构图
  - 2G和3G
    - High-level network diagram for GSM (2G) and UMTS (3G)



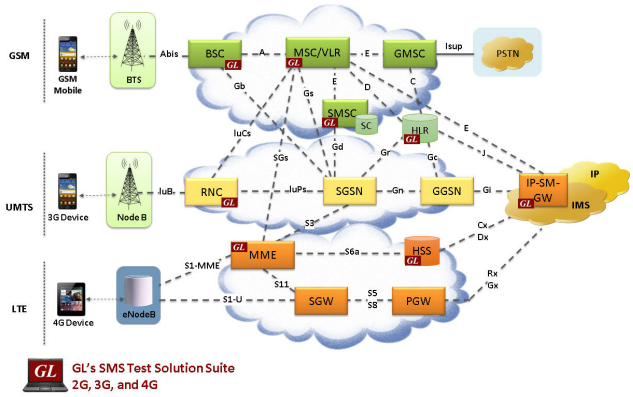
    - SMS in 2G/3G network architecture



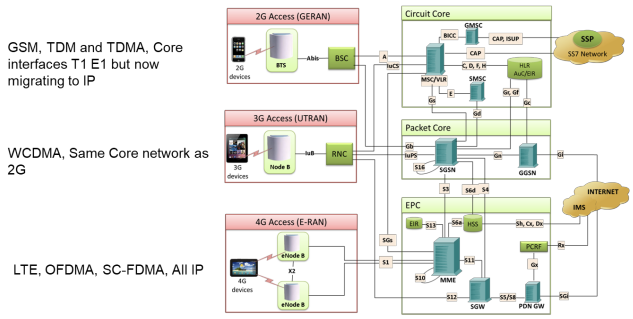
  - 3G和4G
    - High-level network diagram for UMTS (3G) and LTE (4G)



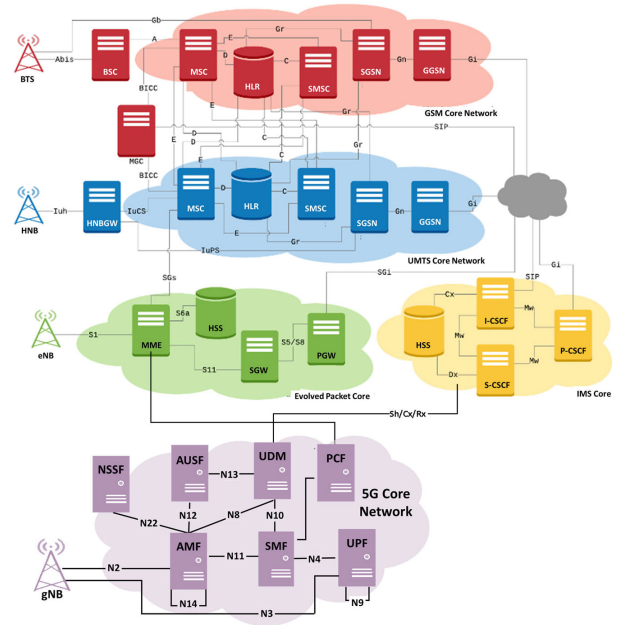
  - 2G、3G、4G
    - GL's SMS Test Suite for LTE, UMTS, and GSM Networks



- 2G 3G 4G COMMUNICATIONS NETWORKS



- 2G、3G、4G、5G
  - Wireless Network Simulation (5G, 4G, 3G, 2G, IP, TDM)



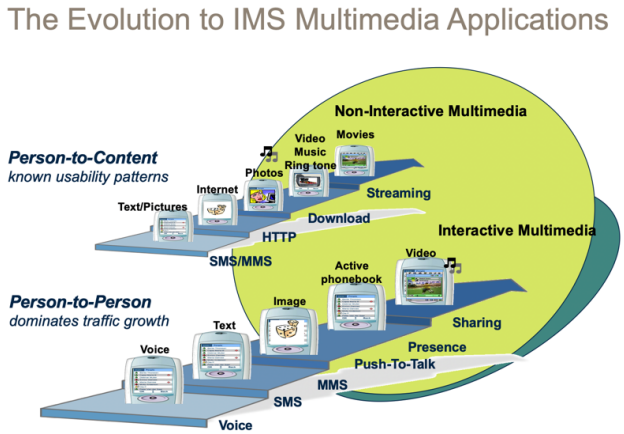
IMS

此处介绍IMS技术。

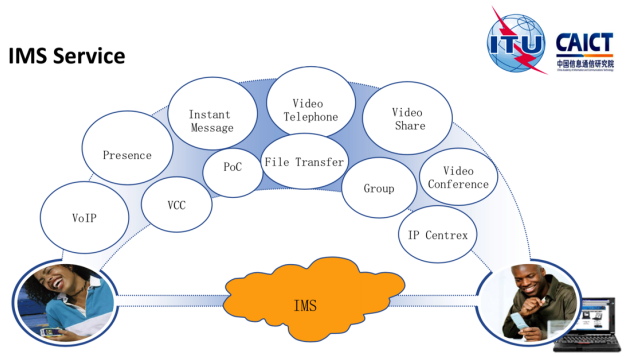
IMS概述

- `IMS`
  - `IMS` = `IP Multimedia Subsystem` = `Internet Protocol Multimedia Subsystem` = `IP多媒体子系统`
    - = `IMCNS` = `IM CN Subsystem` = `IP Multimedia Core Network Subsystem` = `IP多媒体核心网络子系统`
  - 是什么：一个基于互联网协议提供多媒体业务的体系架构
    - 属于3GPP组织旗下的
    - `3GPP` = `3rd Generation Partnership Project`
  - 作用：提供一种通用的架构，用来实现/提供VoIP和多媒体服务
  - 历史
    - IMS发展历史
      - 3GPP R5
        - 第一次提出IMS概念：
        - 2G发展到3G阶段，出现W-CDMA网络（UMTS）
        - 基于SIP多媒体领域（domain） 加到了 NGN网络
          - 也支持GSM和GPRS网络
      - 3GPP R6
        - 新增支持WLAN的互联（interworking）
      - 3GPP R7
        - 支持固定网络，和TISPAN一起支持更多类型网络
          - 其内部是：SOA=Subsystem-Oriented Architecture=面向子系统的架构
      - 出现 Early IMS=早期IMS
        - 支持IPv4网络
        - 为IPv6提供扩展路径
      - 最新叫法：IMS = core IMS
    - 蜂窝网络发展历史
      - 1G
        - 使用模拟信号传输
        - 只支持CS传输电话语音
      - 2G
        - 全数字
        - 支持CS的语音和数据（传输）服务
      - 2.5G
        - 新增PS交换数据服务
          - 在2G基础上
      - 3G
        - （尝试）提供基于PS的全部类型的服务
          - 包括传统的电话语音
  - 特点
    - 模块化modular
    - 可扩展extendable
  - 背景
    - 文字

        - 传统移动电话使用类电路交换网络提供语音通话服务
            - 而非使用计算机分组交换通信方式的网络。
        - 虽然已有很多方式在智能手机上提供网络电话与其他互联网多媒体服务
            - 但并未形成行业标准
        - IMS则为此提供了一个标准化体系架构
    - 图
        - 应用演化直到IMS

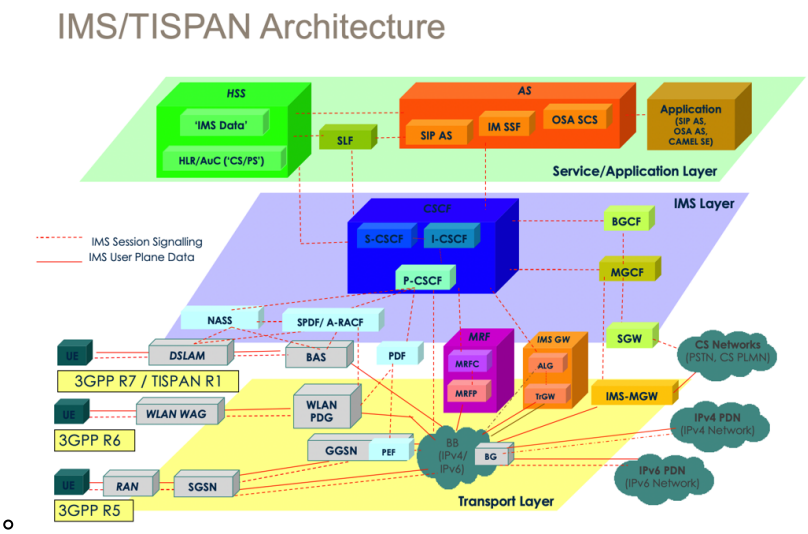


        - 希望用IMS实现各种功能和服务

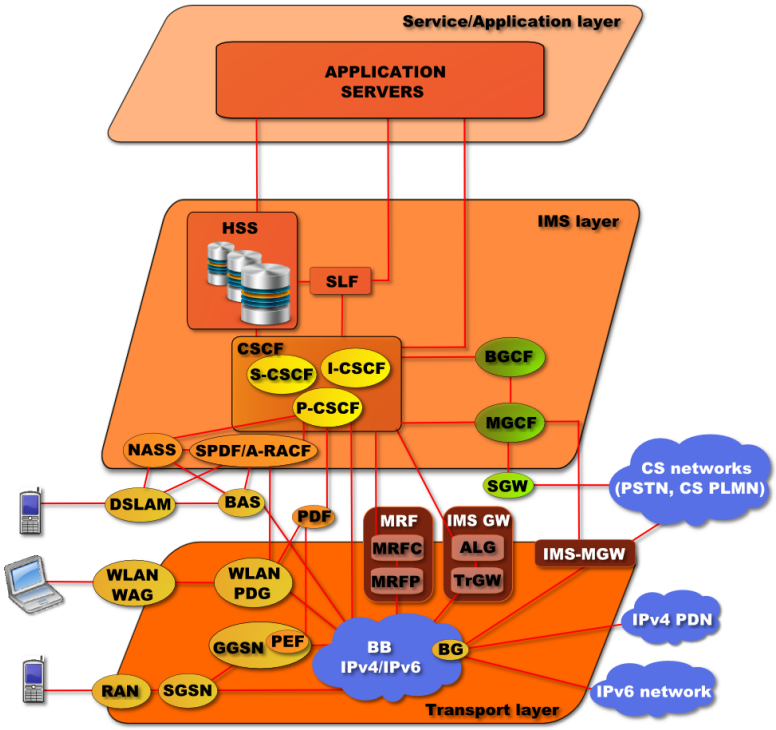


- 接入方式=接入网络
    - 早期：
        - GPRS
    - 后续：支持其他
        - WLAN
        - CDMA2000
        - 固定电话线
        - 等
- 新应用
    - presence information
    - video conferencing
    - POC=Push to talk over Cellular
    - multiparty gaming
    - community services
    - content sharing

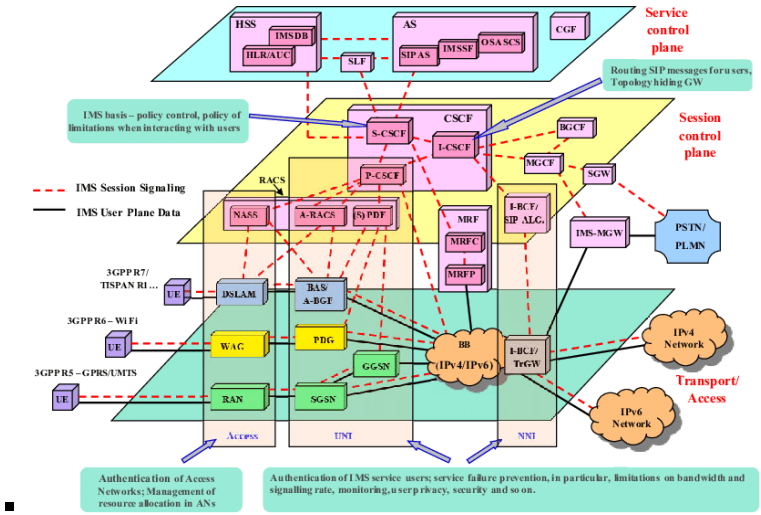
IMS架构

- 3GPP / TISPAN IMS 架构网络
  - 

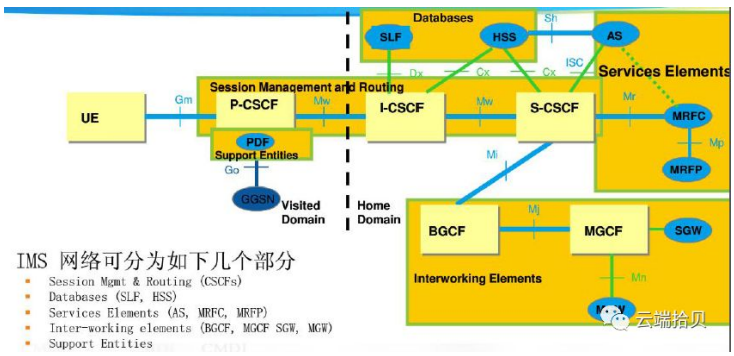
  - 说明
    - `NGN = Next Generation Networking`
    - `TISPAN`：提供了DSL访问的规范
      - `TISPAN = tispan = Telecoms & Internet converged Services & Protocols for Advanced Networks = 电信和互联网融合业务及高级网络协议`
    - `SGW = Signaling Gateway`
      - 作用：在传输层（`SCCP`，`SCTP`）中处理信号转换
    - `A-RACF = Access - Resource and Admission Control Function`
    - `NASS = Network Attachment Subsystem = 网络附着子系统`
    - `DSLAM = Digital Subscriber Line Access Multiplexer`



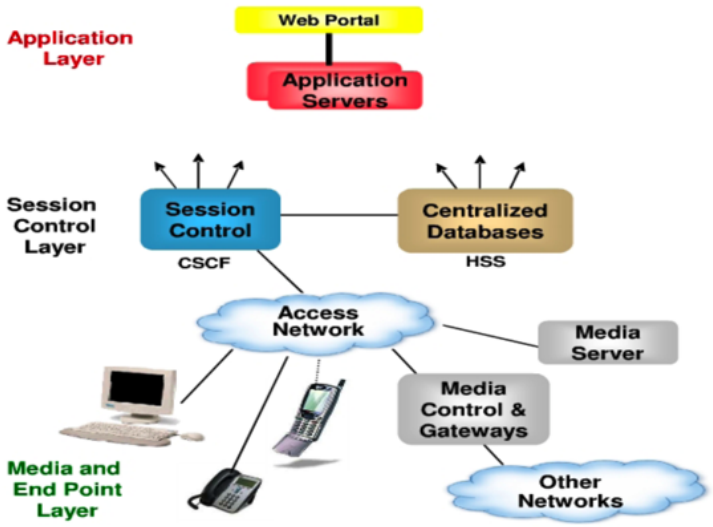
- 更侧重interface接口的IMS架构



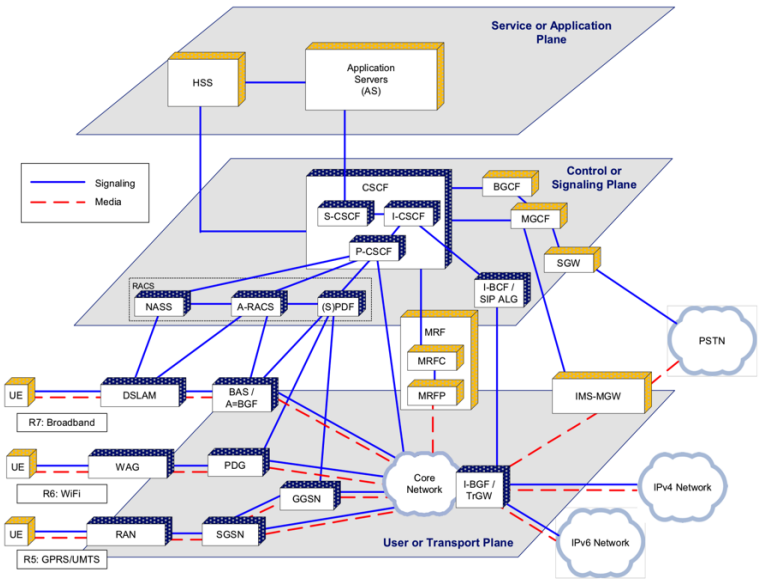
- 其他版本的架构

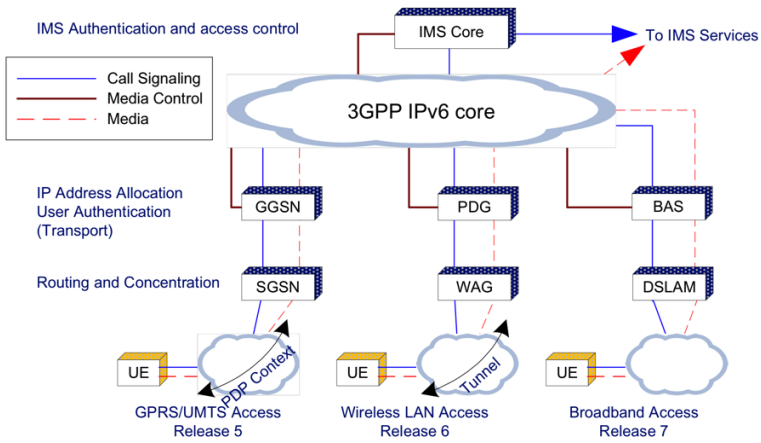


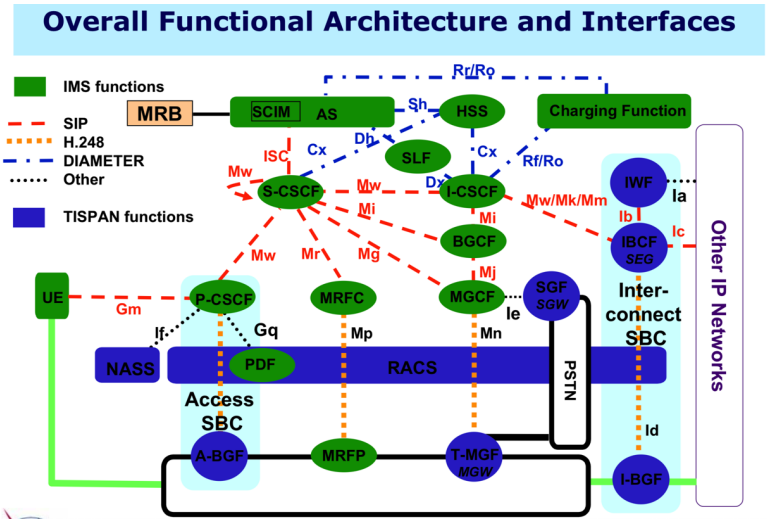
- 简化版IMS架构


Application Layer
Web Portal
Application Servers
Session Control Layer
Session Control
CSCF
Centralized Databases
HSS
Access Network
Media Server
Media Control & Gateways
Other Networks
Media and End Point Layer

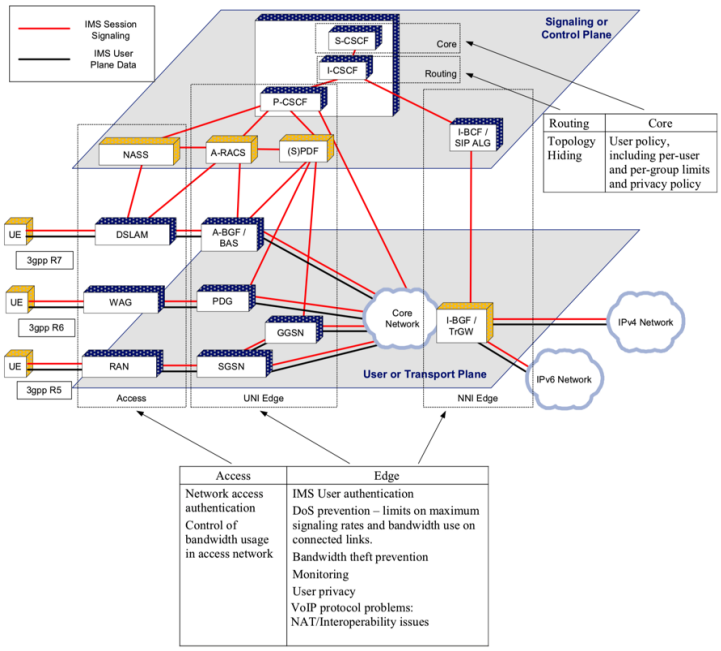
- IMS总体架构


Service or Application Plane
HSS
Application Servers (AS)
Signaling
Media
Control or Signaling Plane
CSCF
S-CSCF
I-CSCF
P-CSCF
BGCF
MGCF
SGW
I-BCF / SIP ALG
RACS
NASS
A-RACS
(S)PDF
MRF
MRFC
MRFP
PSTN
IMS-MGW
UE
DSLAM
BAS / A=BGF
R7: Broadband
WAG
PDG
R6: WiFi
GGSN
Core Network
I-BGF / TrGW
IPv4 Network
RAN
SGSN
R5: GPRS/UMTS
User or Transport Plane
IPv6 Network

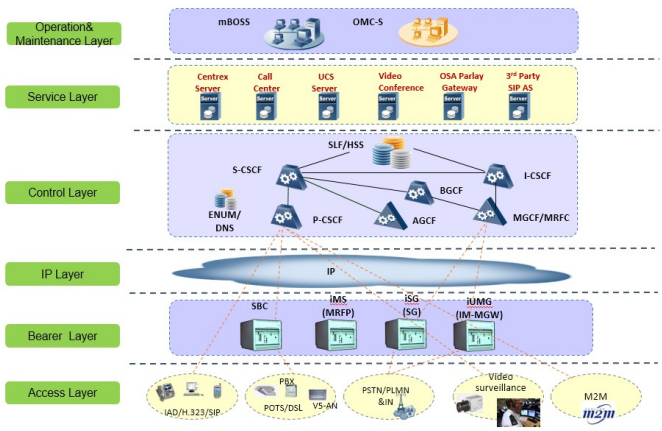

IMS Authentication and access control
IMS Core
To IMS Services
Call Signaling
Media Control
Media
3GPP IPv6 core
IP Address Allocation
User Authentication
(Transport)
GGSN
PDG
BAS
Routing and Concentration
SGSN
WAG
DSLAM
UE
PDP Context
Tunnel
GPRS/UMTS Access Release 5
Wireless LAN Access Release 6
Broadband Access Release 7



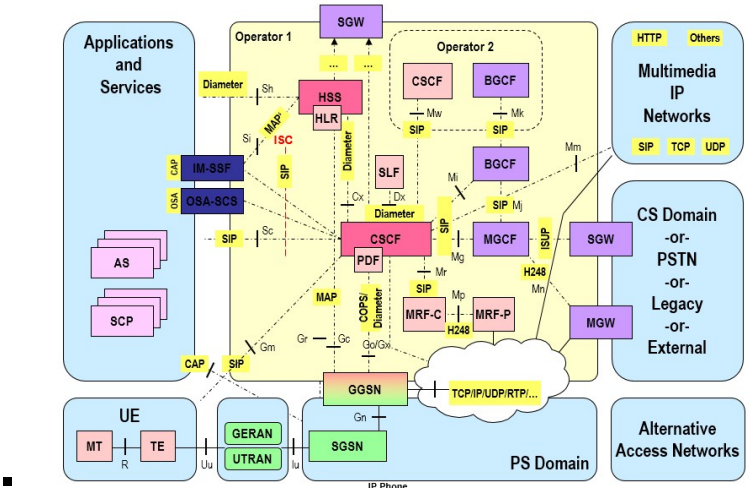
- IMS architecture for SBC

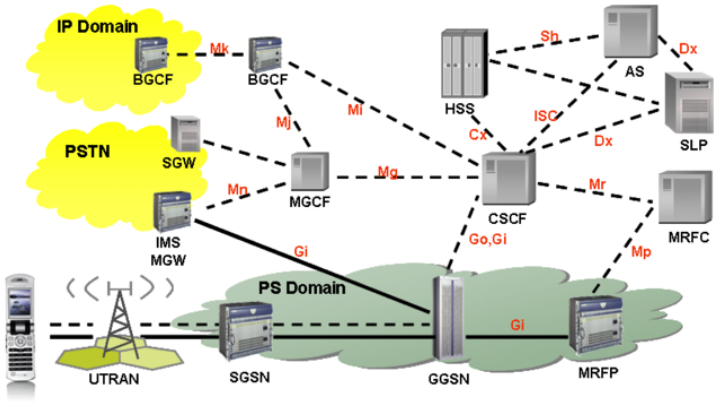


- 相关架构
  - IMS方案
    - FiberHome IMS Solution

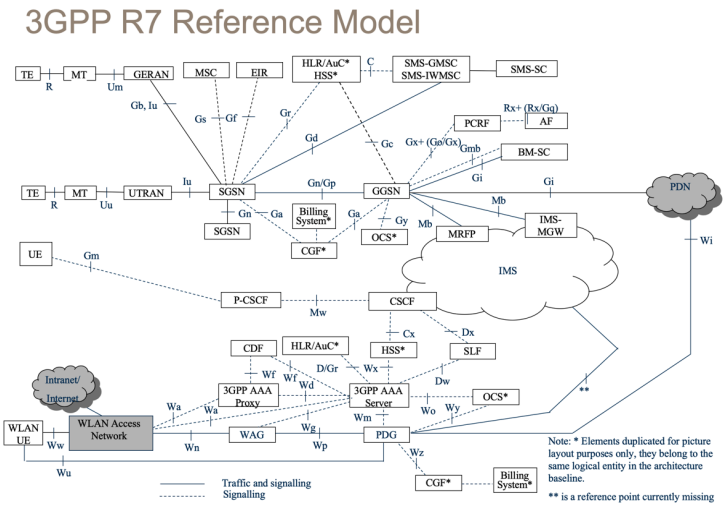


  - IMS架构和接口





- 3GPP R7参考模型



- IMS网络架构

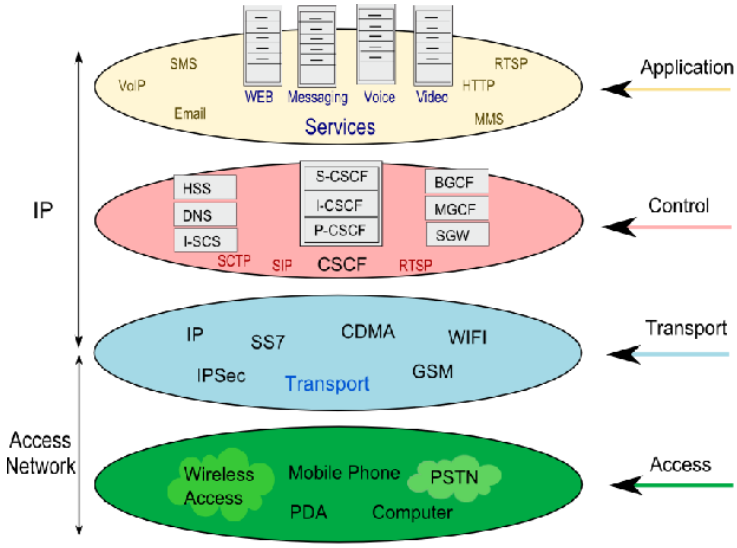
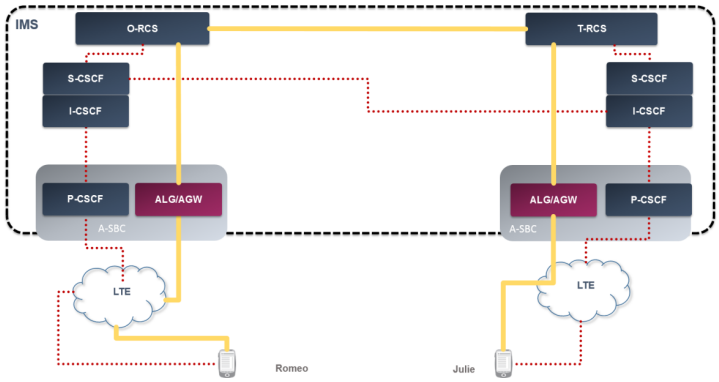
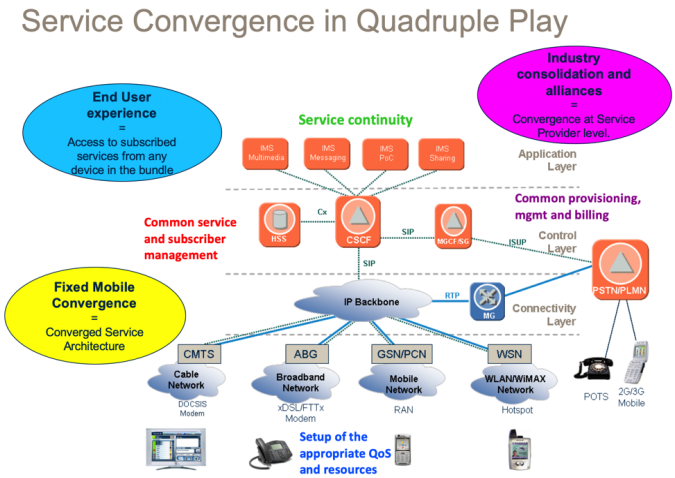


Fig. 2: IMS Network Architecture

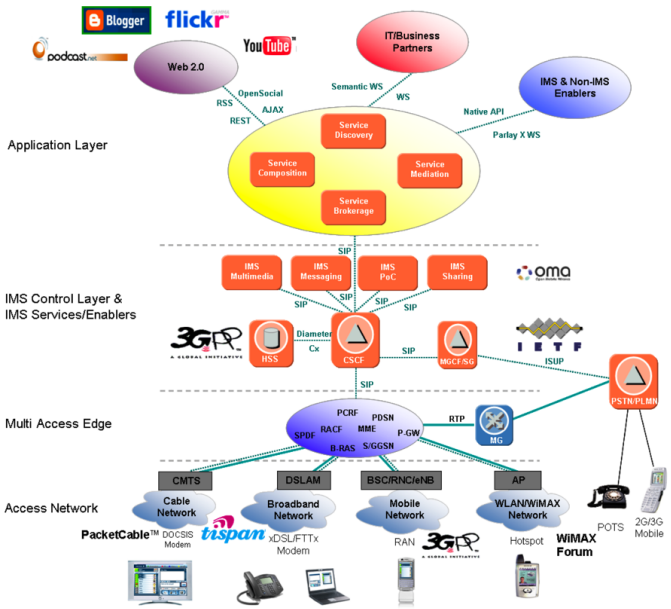
- IMS and MSRP



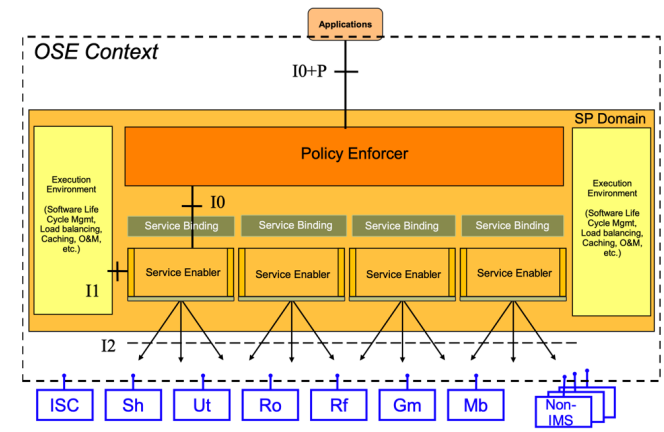
- 基于IMS的下一代服务平台
  - Service Convergence in Quadruple Play



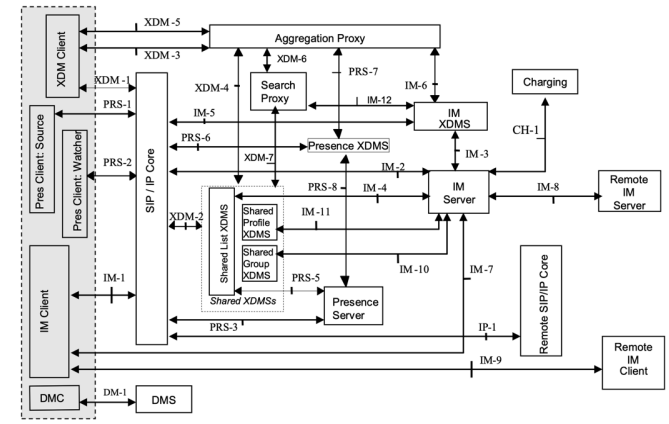
  - NG Service Platform The IMS-based Design



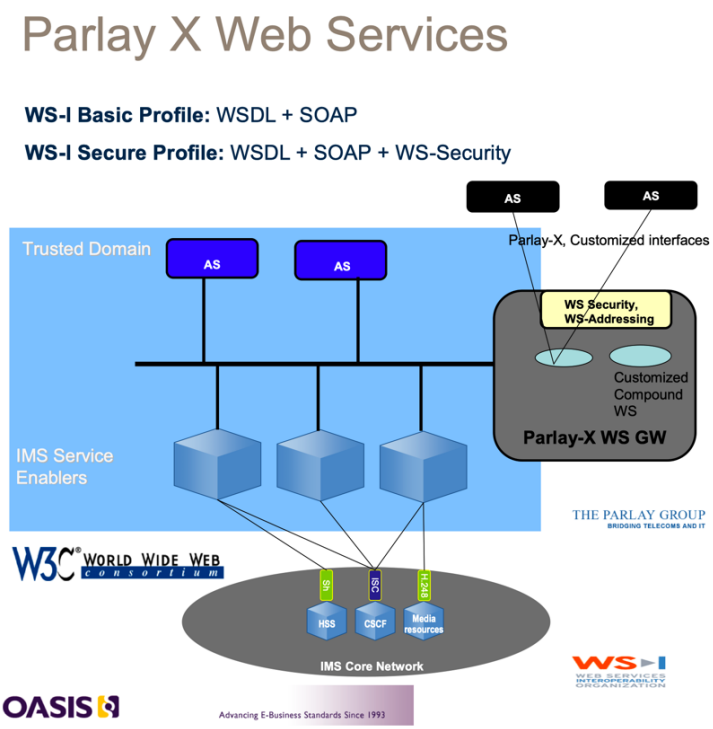
- OMA
  - IMS in OMA服务环境上下文



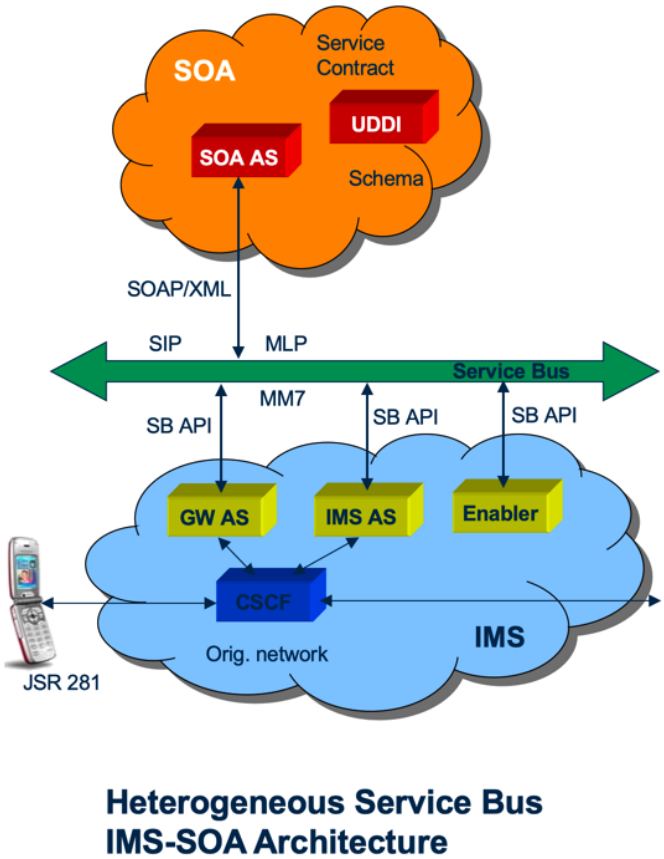
  - OMA SIMPLE 即时通讯参考模型



- Parlay X网络服务

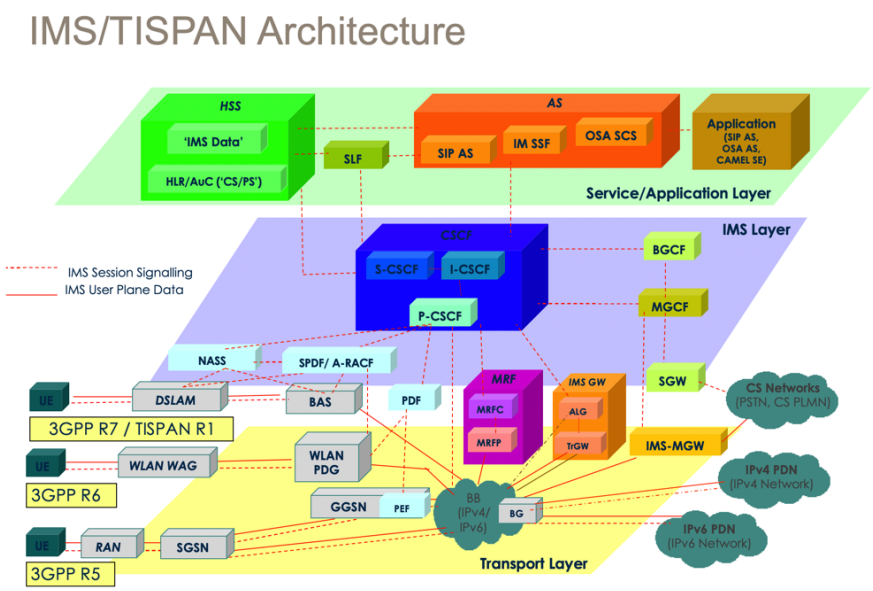


- SOA
  - Heterogeneous Services Bus IMS-SOA Architecture



IMS元素

对于IMS架构



其中的：

- 核心元素和简介
  - `AS` = `Application Server` = `应用服务器`
    - Executes service logic associated with value-added services
    - Provides enhanced and intelligent services to subscribers
  - `CSCF` = `Call Session Control Function` = `调用会话控制功能`
    - `P-CSCF` = `Proxy CSCF`
      - is the first point of contact and the control point for the User Equipment (UE) within the Service Provider network. It forwards session requests from the UE to the S-CSCF
    - `S-CSCF` = `Serving CSCF`
      - has access to the user subscription data and actually handles the session request
    - `I-CSCF` = `Interrogating CSCF`
      - is the first contact point within a Service Provider network for all incoming session requests from another Service Provider
  - `BGCF` = `Breakout Gateway Control Function`
    - Identifies the network that will be used for connecting IP sessions to the PSTN
  - `HSS` = `Home Subscriber Server` = `归属用户服务器` = `HSS用户数据库`
    - Stores all the static and dynamic information for a subscriber
    - Maintains a list of features and services associated with a user, and also the location and means of access to the user
    - Provides user profile information
  - `SLF` = `Subscription Locator Function`

        - Queried during Registration and Session Setup to get the name of the HSS containing the required subscriber specific data
    - `MGCF` = `Media Gateway Control Function`
        - Controls the parts of the call state that pertain to connection control for media channels in a T-MGF MGW
        - Selects the CSCF depending on the routing number for incoming calls from legacy networks
        - Performs protocol conversion between ISUP and call control protocols (e.g., SIP) and maintains call states
    - `MRF`
        - `MRFC` = `Multimedia Resource Function Controller`
            - Controls the media stream resources in the MRFP under direction from an S-CSCF or Application Server
            - Interprets information coming from an AS or S-CSCF (e.g., session identifier) and controls MRFP accordingly
        - `MRFP` = `Multimedia Resource Function Processor`
            - Provides media resources under the direction of MRFC
            - May generate media streams (e.g., multimedia announcements), mix incoming media streams for multiple parties, or process media streams (e.g., audio trans-coding, media analysis)
    - `PDF` = `Policy Decision Function`
        - Provides management of network QoS resources, authorization of resource allocations, and makes policy decisions with regard to use of network QoS resources
        - `SPDF` = `Service Policy Decision Function`
    - `T-MGF` = `Trunk Media Gateway Function`
        - Terminates bearer channels from a switched circuit network and media streams from a packet network (e.g., RTP streams in an IP network)
        - Establishes and releases connections between these channels under control of the MGCF in support of calls between PSTN and IP network
    - `SGF` = `Signaling Gateway Function`
        - Acts as a gateway between the IP call/session control signaling and the SS7-based PSTN signaling
        - May provide signaling translation, for example between SIP and SS7 or simply signaling transport conversion e.g., SS7 over IP to SS7 over TDM
    - `A-BGF` = `Access Border Gateway Function`
        - Packet gateway between an access network and a core network used to mask a service provider’s network from access networks, through which UE accessing packet-based services (e.g., IMS, Internet)
        - Functions may include Opening and closing gate, Traffic classification and marking, Traffic policing and shaping, Network address and port translation, and Usage information
        - Under control of the PDF

    - `I-BGF` = `Interconnection Border Gateway Function`
        - Packet gateway used to interconnect a service provider's core network with another service provider's core network supporting the packet-based services
        - Functions may be the same as that of the A-BGF
    - `I-BCF` = `Interconnection Border Control Function`
        - Controls I-BGF to interwork with other packet-based networks
        - May support the following functions (not limited to)
            - Inter-domain protocol normalization and/or repair
            - Inter-domain protocol interworking
            - Interaction with PDF for resource reservation, resource allocation, and/or other resource related information
    - `MRB` = `Media Resource Broker`
        - Assigns specific media server resources to incoming calls at the request of service applications (i.e., an AS)
        - Acquires knowledge of media server resources utilization and reservation requests that it can use to help decide which media server resources to assign to resource requests from applications
        - Employs methods/algorithms to determine media server resource assignment

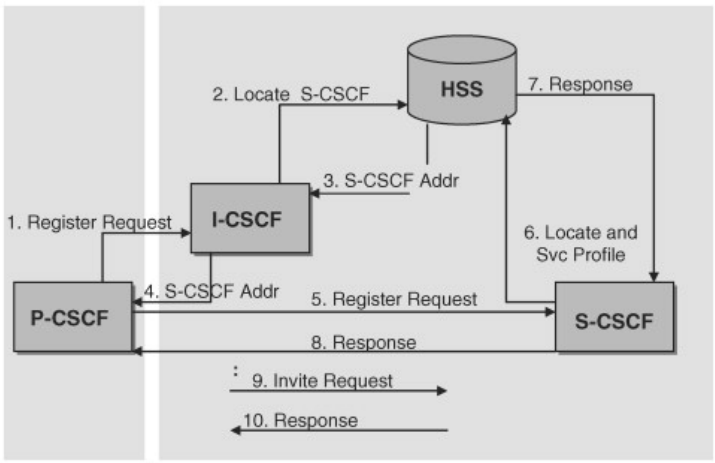
子元素详解

AS

- `AS` = `Application Server` = `应用服务器`
    - 作用：SIP应用服务器负责和提供服务
    - 其他说明
        - 它与S-CSCF之间使用SIP
    - 模式
        - 基于具体的服务不同，AS可以选择不同的SIP模式
            - SIP代理模式
            - SIP用户代理（UA - User agent）模式
            - SIP B2BUA模式
    - 部署位置
        - 可以设置在：IMS本网内
            - 如果位于本网，它还可以使用Sh或Si接口查询HSS。
        - 也可以设置在：外部的第三方网络
    - 典型案例
        - VCC Server
            - 由3GPP开发的语音持续调用功能
        - SIP AS
            - 负责和提供IMS具体服务
        - IM-SSF
            - =IP Multimedia Service Switching Function=IP多媒体切换功能
            - SIP和CAP之间的接口，用于与CAMEL应用服务器通信
        - OSA SCS
            - =OSA Service Capability Server=OSA服务性能服务器

            - OSA=Open Service Architecture=开放服务架构
        - SIP和OSA框架之间的接口
        - 多个OSA服务之间的交互
    - 功能模型
        - AD-ILCM和AS-OLCM用来保存事务状态并且可以根据特定服务的需要保存会话状态
        - 对于S-CSCF来说
            - AS-ILCM接口是输入端
            - AS-OLCM接口是输出端
        - 应用逻辑提供服务和AS-ILCM、AS-OLCM之间的交互
    - PSI
        - =Public Service Identity=公共服务标识
        - 用来标识应用服务提供的服务
        - PSI可以提供两种标识格式
            - SIP URI
            - Tel URI
        - 通常被HSS以完整PSI或通配PSI保存
        - 说明
            - 完整PSI包含完整的PSI标识，可以直接用来路游
            - 通配PSI表达一组PSI标识

CSCF

- `CSCF` = `Call Session Control Function` = `调用会话控制功能`
    - 是什么
        - SIP服务器和代理共同实现通话控制功能，统称为：`CSCF`
    - 会话控制流程
        - 

    - 功能：它们在IMS系统中处理SIP信号数据包
    - 包含
        - `P-CSCF` = `Proxy CSCF`
            - 概述
                - is the first point of contact and the control point for the User Equipment (UE) within the Service Provider network. It forwards session requests from the UE to the S-CSCF
                - 是一个SIP代理，作为与IMS终端直联通信点
                - 它可以设置在公网中也可以设置在IMS本网中

        - 某些网络在这个功能组中可能使用了SBC
            - SBC= Session Border Controller=会谈边界控制器
        - P-CSCF其核心是一个特殊的SBC
            - 该SBC使用的用户网络接口不仅保护网络，也保护了IMS终端
            - 在IMS终端和P-CSCF之间传递加密信号时，使用附加的SBC是毫无意义同时也是不可用的。
        - 终端可以使用DHCP协议来找到它的P-CSCF，也可以使用配置（如出厂设置、3GPP IMS管理对象）、或是记录在ISIM中、或是在PDP环境（GPRS PDP Context）中赋值。
    - 其他说明
        - 它在IMS终端注册之前就被分派给IMS终端，并且在注册期间不会改变
        - 它位于所有信号的通路，可以检查所有的信号。IMS终端必须忽略任何其它未加密的信号。
        - 它提供用户的认证，并且为IMS终端创建一个IPsec或TLS连接。这样可以阻止欺骗攻击和重放攻击，并且保护用户的隐私。
        - 它检查信号，确保IMS终端没有企图作弊（比如改变通常信号路游，不遵守IMS网络路游策略）
        - 它也可以使用SigComp压缩和解压缩SIP信息，以降低较慢的无线电链路的负载。
        - 它也可以加入PDF。它可以允许媒体水平的资源（如QoS）可以达到媒体水平。它也可以用作策略控制、带宽管理等等。
            - `PDF` = `Policy Decision Function` = `策略决择功能`
            - `SPDF` = `Serving Policy Decision Function`
            - `QoS` = `Quality of Service`
        - PDF也可以作为独立的功能组
        - 它也产生费用记录
- `S-CSCF` = `Serving CSCF`
    - 概述
        - has access to the user subscription data and actually handles the session request
        - 从信号层面的来看，S-CSCF是IMS子系统的核心节点
        - 它虽然是SIP服务器，但也负责会话的控制
        - 它永远设置在IMS本网络中，径直地使用Cx和Dx接口访问HSS
        - 它从HSS下载用户配置并且上传用户与S-CSCF关系信息
            - 出于对处理用户配置效率的考虑，S-CSCF会在其本地缓存用户配置。但它不会在本地对用户配置进行更改
        - 所有必要的用户配置信息都会从HSS那里加载
    - 其他说明
        - 它负责处理SIP注册。它会将用户位置（如终端的IP地址）和SIP地址进行绑定。
        - 它位于所有在它那里注册的用户所发出的信号信息的通路上，可以检查所有的信息。

            - 它负责决定SIP信息将抵达哪一个应用服务处理，以完成应用服务。
            - 它提供路游服务，通常是使用电子号码（ENUM - Electronic Numbering）查找
            - 它运行网络运营商的策略
            - 出于分布式负载和高可靠性的原因，IMS网络中允许设置多个S-CSCF。这种情况下，由HSS在用户配置记录哪一个S-CSCF被关系到该用户，而后由I-CSCF来查询这些记录。
        - `I-CSCF` = `Interrogating CSCF`
            - 概述
                - is the first contact point within a Service Provider network for all incoming session requests from another Service Provider
                - 是另一个位于管理域边缘的功能组
                - 它的IP地址通过DNS发布，所以远程服务器可以查找到它，并把它作为向它所在的域传递SIP包的跳点
            - 功能
                - 它查询HSS，获取S-CSCF的地址并且分派给用户以完成SIP注册。
                - 它也为S-CSCF传递SIP请求和回应
                - 直到IMS第6版，它是可以用来把内网隐藏起来，使外部网络无法获取内部网络的信息（加密部分SIP信息）。这里称之为THIG
                    - `THIG` = `Topology Hiding Inter-network Gateway` = `隐藏内部网络拓扑网关`
                - 从第7版开始，这个功能从I-CSCF移走，作为IBCF的一部分。IBCF被用作外部网络的网关，提供NAT和防火墙功能。IBCF实际上是NNI的会谈边界控制器的裁剪版本。
                    - `IBCF` = `Interconnection Border Control Function` = `互联边界控制功能组`

HSS

- `HSS` = `Home Subscriber Server` = `归属用户服务器` = `HSS用户数据库`
    - 功能
        - Stores all the static and dynamic information for a subscriber
        - Maintains a list of features and services associated with a user, and also the location and means of access to the user
        - Provides user profile information
    - 主用户数据库
        - 它为IMS网络中实际管理通话的实体提供支持
        - 如访问用户相关的信息（称之为用户配置），对用户认证和授权以及提供用户位置IP地址等相关信息
        - 在同时使用多个HSS时，需要SLF映射用户保存的位置
            - SLF=Subscriber Location Function=用户位置功能组
            - 即当查询某个用户配置时，由SLF指出哪个HSS保存了这个用户配置
    - 保存用户信息
        - IMPU

        - IMPI
        - IMSI=国际移动用户标识符
        - MSISDN
        - 用户服务配置
        - 服务开关
        - 其它信息
    - 其他说明
        - 类似的
            - GSM的
                - `HLR` = `Home Location Regiser` = `归属位置寄存器`
                - `AuC` = `Authentication Centre` = `认证中心`

MRF

- MRF
    - =Media Resource Function=媒体资源功能组
    - 提供与媒体相关的功能，包括媒体处理（如混音）、播放拨号音和语音提示
    - 进一步划分为
        - MRFC=Media Resource Function Controller=媒体资源功能控制器
            - MRFC是信号层面的节点，它根据来自AS和S-CSCF的信息来操控MRFP
            - 作用类似于：SIP B2BUA
        - MRFP=Media Resource Function Processor=媒体资源功能处理器
            - MRFP是媒体层面的节点，用来混合、产生或者处理媒体流。
            - 它也可以管理共享资源的访问权限
    - MRB
        - =Media Resource Broker=媒体资源协商器
        - 一个功能实体。
        - 负责收集已经发布的MRF信息，并且向AS这样的信息消费实体提供适当的MRF信息。
        - MRB通常有两个模式：
            - 查询模式：AS主动查询MRB相应的媒体并且创建使用MRB回应的调用。
            - 线性模式：AS向MRB发送SIP INVITE，由MRB创建调用。

BGCF

- BGCF
    - =Breakout Gateway Control Function=出口网关控制功能
    - 是一个SIP代理，它处理来自S-CSCF的路由请求。
    - BGCF有基于电话号码的路由功能，用来选择与PSTN网络的接口点。
    - 当BGCF发现被叫网络位于一个PSTN网络时，BGCF就选择一个媒体网关控制功能(MGCF)，将会话路由到MGCF，MGCF负责与PSTN网络交互。

BGF

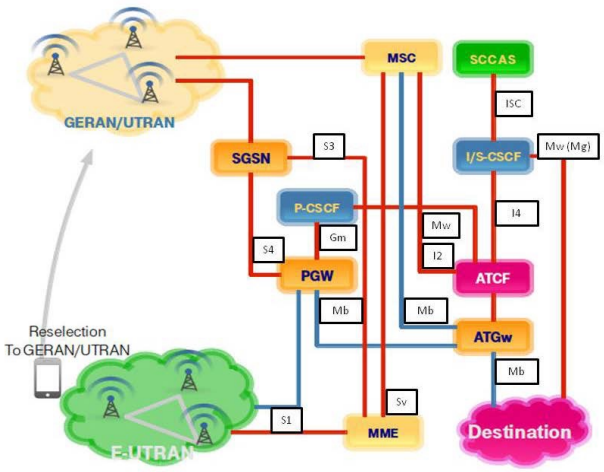
- `BGF` = `Border Gateway Function`
    - `C-BGF` = `CBGF` = `Core - Border Gateway Function`

        - 是什么：一种访问网关access gateway
        - 位置：介于某种访问网络access network和IMS核心网络（core network）之间
    - `I-BGF = IBGF = Interconnection – Border Gateway Function`
        - 是什么：`NNI` 的其中一种
        - 位置：介于core(可信的）和 外部网络

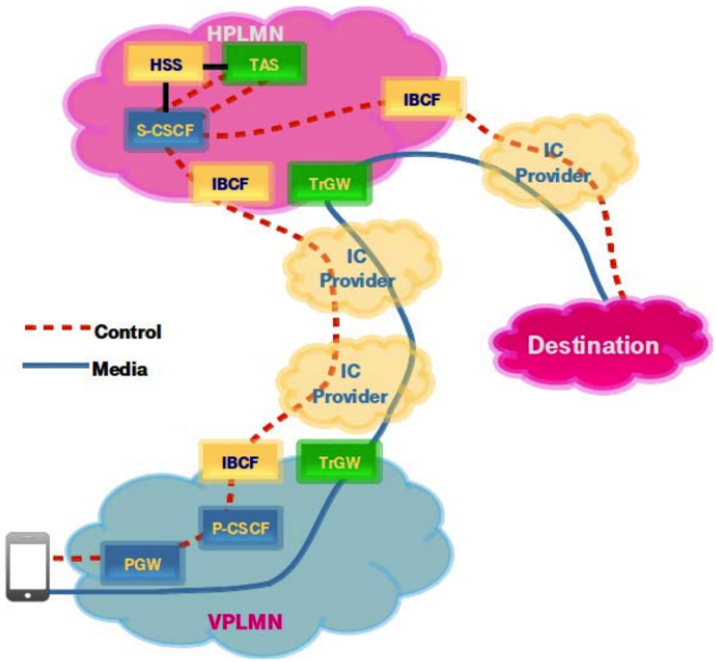
MGCF

- MGCF
    - =Media Gateway Control Function=媒体网关控制功能
    - 完成IMS网络与PSTN网络之间的调用控制协议转换
    - 主要是将SIP消息转换成ISUP消息。
    - 并控制IM-MGW中媒体信道，管理PSTN网络的承载和与IMS网络的IP流间的连接。
        - IMS MGW=IMS Media Gateway

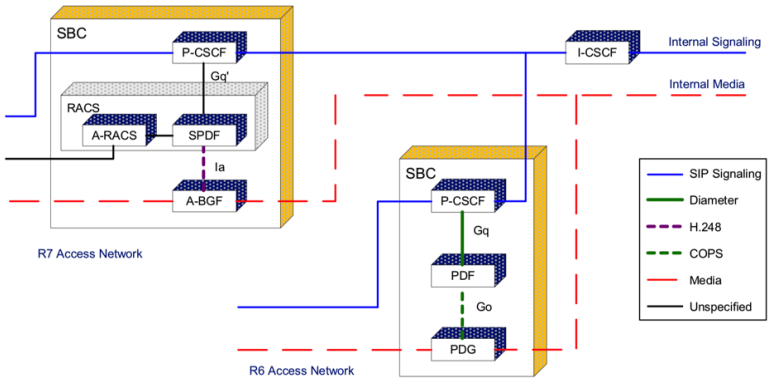
其他IMS细节

- 通话连续性 SR-VCC
    - Enhanced Single Radio Voice Call Continuity Architecture, 3GPP Rel-10
        - 

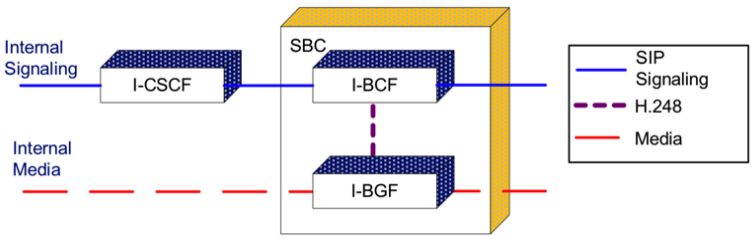
- Roaming漫游
    - IMS Roaming Architecture with LBO and VoLTE MO Call Media Home Routed



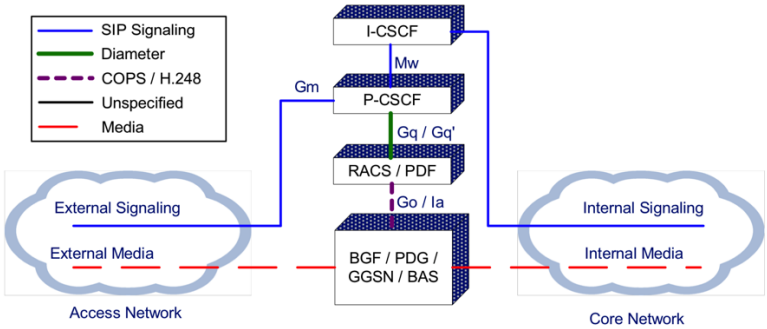
- UNI



- NNI



- Reference Points



- IMS Protocol Stack协议栈
  - 概述

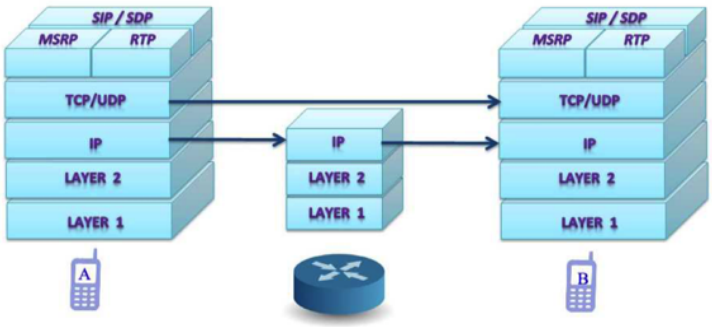


Figure 19.IMS Protocol stack

  - Transport level interworking - Protocol Stack

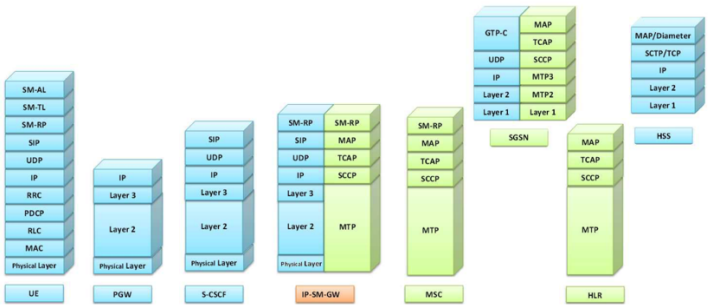


Figure 24.Transport level interworking - Protocol Stack

  - Service level interworking - Protocol Stack

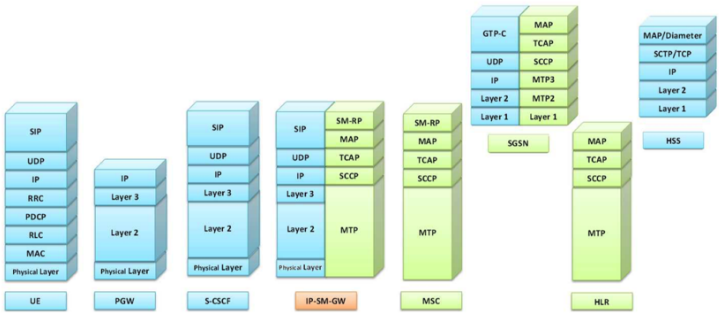


Figure 31.Service level interworking - Protocol Stack

IMS相关

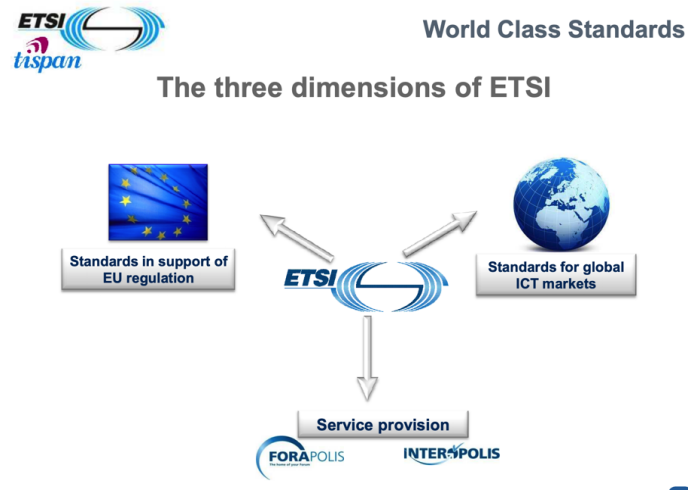
和IMS相关的有很多协议：

- IMS相关协议
  - RFC 1889 Real-time Transport Protocol (RTP)
  - RFC 2327 Session Description Protocol (SDP)
  - RFC 2748 Common Open Policy Server protocol (COPS)
  - RFC 2782 a DNS RR for specifying the location of services (SRV)
  - RFC 2806 URLs for telephone calls (TEL)
  - RFC 2915 the naming authority pointer DNS resource record (NAPTR)
  - RFC 2916 E.164 number and DNS
  - RFC 3261 Session Initiation Protocol (SIP)
  - RFC 3262 reliability of provisional responses (PRACK)
  - RFC 3263 locating SIP servers
  - RFC 3264 an offer/answer model with the Session Description Protocol
  - RFC 3310 HTTP Digest Authentication using Authentication and Key Agreement (AKA)
  - RFC 3311 update method
  - RFC 3312 integration of resource management and SIP
  - RFC 3319 DHCPv6 options for SIP servers
  - RFC 3320 signalling compression (SIGCOMP)
  - RFC 3323 a privacy mechanism for SIP
  - RFC 3324 short term requirements for network asserted identity
  - RFC 3325 private extensions to SIP for asserted identity within trusted networks
  - RFC 3326 the reason header field
  - RFC 3327 extension header field for registering non-adjacent contacts (path header)
  - RFC 3329 security mechanism agreement
  - RFC 3455 private header extensions for SIP
  - RFC 3485 SIP and SDP static dictionary for signaling compression
  - RFC 3574 Transition Scenarios for 3GPP Networks
  - RFC 3588 DIAMETER base protocol
  - RFC 3589 DIAMETER command codes for 3GPP release 5 (informational)
  - RFC 3608 extension header field for service route discovery during registration
  - RFC 3680 SIP event package for registrations
  - RFC 3824 using E164 numbers with SIP

以及其他相关内容。

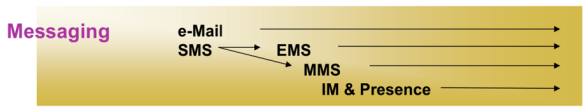
ETSI

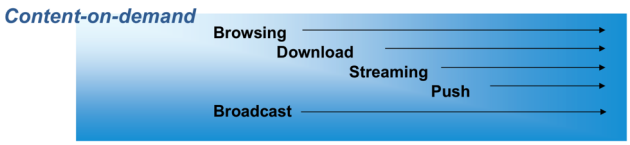
- 相关名词
  - ETSI=European Telecommunications Standards Institute=欧洲电信标准协会
  - ICT=Information and Communication Technologies=信息通讯技术
  - EU=European Union=欧盟
  - TISPAN=Telecommunication and Internet Converged Services and Protocols for Advanced Networking=电信和互联网融合业务及高级网络(协议)
  - EURO-ISDN=欧洲综合业务数字网
  - NGN=Next Generation Networking=下一代网络
  - Home Networking
    - 在特定范围内（例如家庭内部）通过有线 或无线方式将多个通信、家电等设备连接起来形成的内部网
- ETSI
  - 是什么：一个欧洲的技术组织/机构
  - 全称：ETSI Technical Committee=ETSI技术委员会
  - 总部：法国
  - 目标：致力于欧盟范围内的ICT方面标准化
    - 主要负责标准制定
      - 主要涉及3方面=领域
        - 电信 Telecommunications
        - 信息技术 Information Technology
        - 广播 Broadcasting
  - 成员
    - 来自 59国家
      - 的653个成员
  - 维度
    - 3个维度



NGN

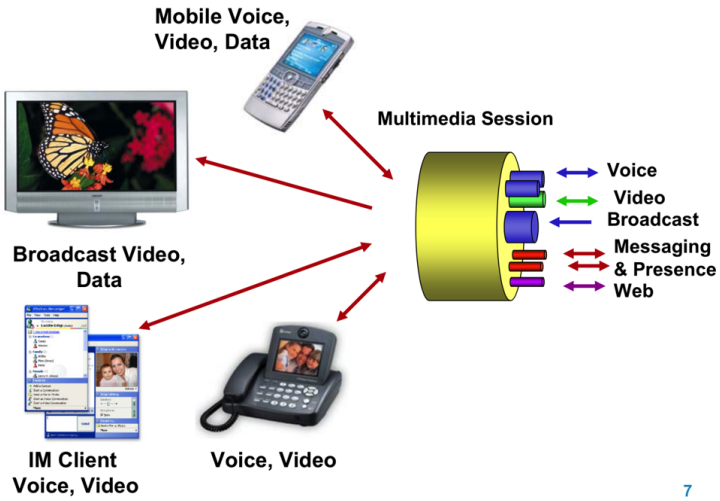
- NGN
  - 范畴：ETSI的NGN
  - 愿景=目标
    - 基于IP的网络的内部和网络之间均可互操作
      - Inter-operable, Inter-domain All IP-based network
    - 宽带接入
      - Broadband access
    - 多媒体能力
      - Multi-media capabilities
    - 支持多种服务的移动和漫游
      - Support mobility & nomadicity Multiple services
    - 业务模型无关
      - Business Model Agnostic
  - 服务范围
    - 个人间通讯 Person-to-Person
      - 会话 Conversational
        - 概述
          - 

        - 包含
          - 语音电话Voice call
            - 视频电话Video call
              - 聊天 Chat
            - 多媒体会话Multimedia Sessions
      - 消息 Messaging
        - 概述
          - 

        - 包含
          - 邮件eMail
          - 短信SMS
            - 增强短信EMS
              - 多媒体消息MMS
                - 即时通讯和状态呈现 IM & Presence
    - 内容点播 Content-on-demand
      - 概述
        - 

      - 包含
        - 浏览Browsing
          - 下载Download
            - 流媒体传输 Streaming

        - 推送Push
      - 广播Broadcast
  - 实现多媒体=富媒体功能



7

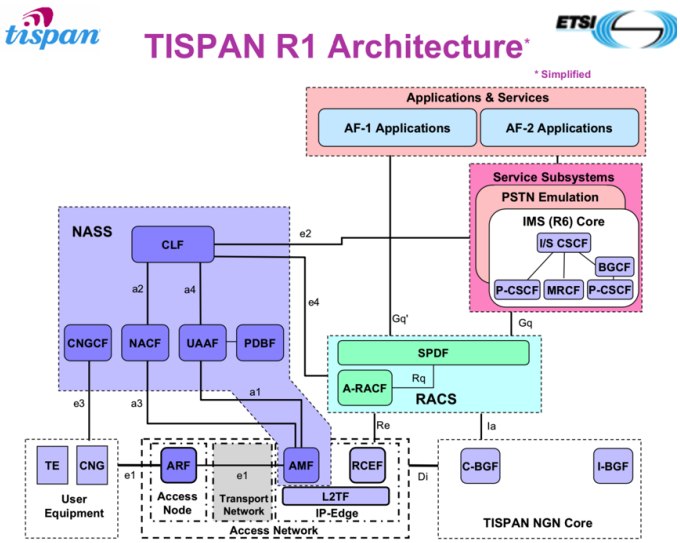
  - 主要特点
    - "plugging in" new Subsystem
    - Separate Transport and Service Layers
    - Open access to services from multiple operators
    - Interoperability and flexible innovative services
  - 核心组件=主要内容：包含各个子系统Subsystem
    - IP connectivity subsystems
      - NASS=Network Attachment Subsystem
        - 主要功能
          - Access authentication
          - NW configuration e.g. DHCP
          - Location function
      - RACS=Resource and Admission Control Subsystem
        - 主要功能
        - Resource admission control in Access Network
    - Service-oriented subsystems
      - IMS = Core IMS
        - 概述
          - Based on 3GPP IMS core
        - 主要功能
          - 3GPP IMS (R6) supporting multimedia services and adapted to accommodate xDSL-based access, and PSTN/ISDN Simulation & Emulation
      - PES = PSTN/ISDN Emulation Subsystem=PSTN Emulation
        - 概述
          - CS phones: emulate legacy CS core network
        - 主要功能
          - A PSTN/ISDN Emulation Subsystem specifically tailored to allow TDM equipment replacement, while keeping legacy terminals unchanged
  - 接入技术Access Technologies
    - 主流网络

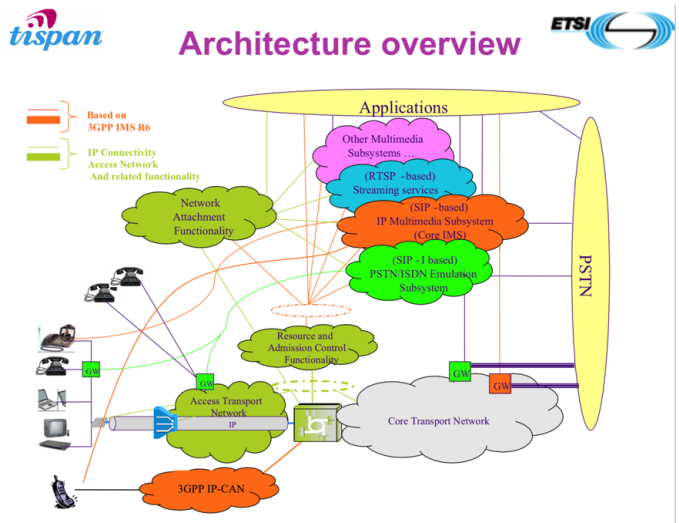
        - Mobile
            - 3GPP standardization
        - DSL=Digital Subscriber Line
        - Wired & Wireless LAN
        - Cable
    - 旧网络=遗留网络 Legacy Networks
        - PSTN/ISDN emulation
            - Provides PSTN/ISDN service capabilities and interfaces using **adaptation** to an IP infrastructure
        - PSTN/ISDN simulation
            - Provides PSTN/ISDN-**like** service capabilities using session control over IP interfaces and infrastructure
- 版本和内容
    - TISPAN R1= Release 1
        - 发布时间：2005年12月
        - 内容
            - 概述
                - Adopts the 3GPP IMS standard for SIP-based applications, and adds further functional blocks and subsystems to enable fixed access to IMS and to handle non-SIP applications
            - 具体包含
                - Service capabilities
                    - Real time conversational services (Voice, Video calls/sessions)
                    - Messaging (Instant Messaging, MMS) and Presence
                    - PSTN/ISDN emulation and simulation
                - Network Architecture
                    - 3GPP IMS (R6) core sub-system reused as basis for SIP-based services control
                    - xDSL access a primary focus
                    - Initial network-edge QoS controls
    - TISPAN R2
        - 时间：2008年4月
        - 内容：
            - TISPAN and 3GPP agreed on Common IMS platform
                - 3GPP IMS (R7)
            - Introduces new IMS enabled services and adds key elements
                - Supplementary services (see 3GPP)
                - IPTV (both IMS and non-IMS based)
                - Home Networking
                - Corporate networks and the NGN
                    - Additional support for Mobility & Nomadicity
    - TISPAN R3
        - 内容

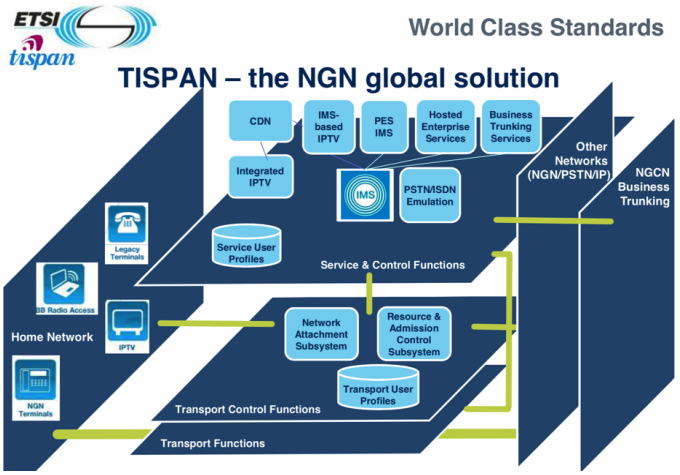
- Improvement of several aspects introduced in the previous Releases
  - IPTV service evolution
  - IP Network to Network interconnection
  - Corporate Network interconnection
  - Home Network interconnection
  - QoS and Security
  - CDN
  - P2P Study

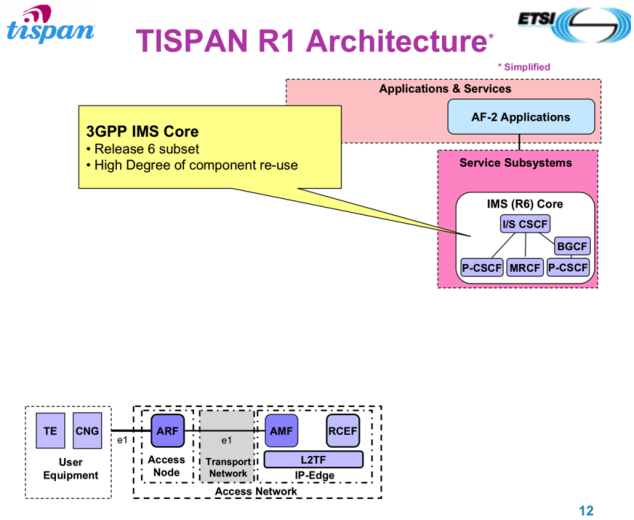
TISPAN

此处整理 `TISPAN` 相关内容。

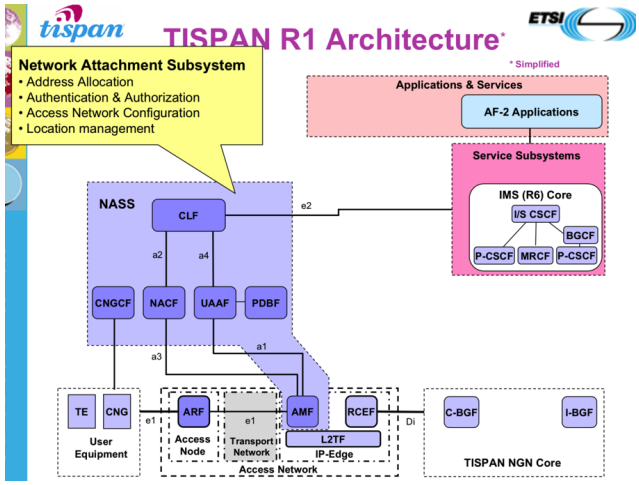
- TISPAN=tispan
  - 一句话简介：ETSI下的一个工作组
    - 是NGN的具体实现方案
      - the NGN global solution
    - 往往也叫：TISPAN NGN
  - 起源
    - 2003年9月成立
    - 合并自
      - SPAN=Services and Protocols for Advanced Networks
        - 一个合并后的工作小组
          - 合并自
            - SPS=Services, Protocols & Switching
            - NA=Network Aspects
        - 主要负责EURO-ISDN
      - TIPHON=Telecommunications and Internet Protocol Harmonization Over Networks
        - 1997年成立的
        - 一个ETSI的项目
        - 最开始研究VoIP
        - 后来扩展到基于IP传输任何电信（包括MM=Multimedia=多媒体）数据
  - （TISPAN NGN ）架构=architecture
    - 总体架构
      - 

- 

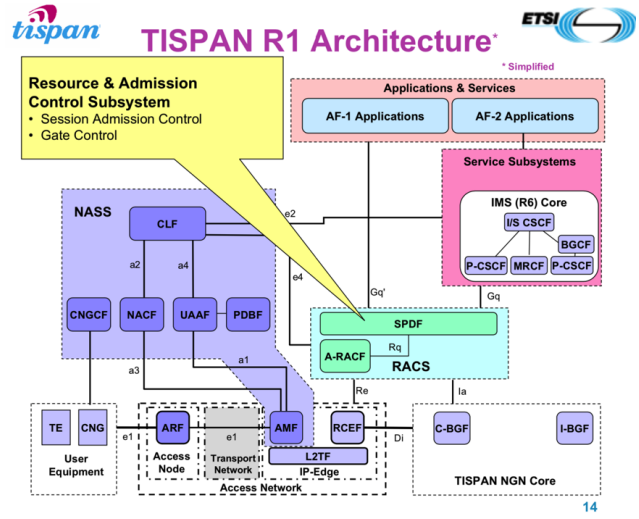
- 

- 架构含义解释
  - 最初
    - 

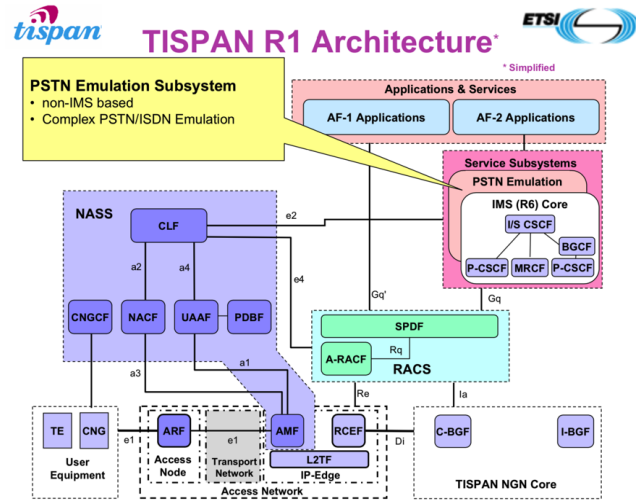
    - NASS子系统 负责接入：地址管理、授权和认证等



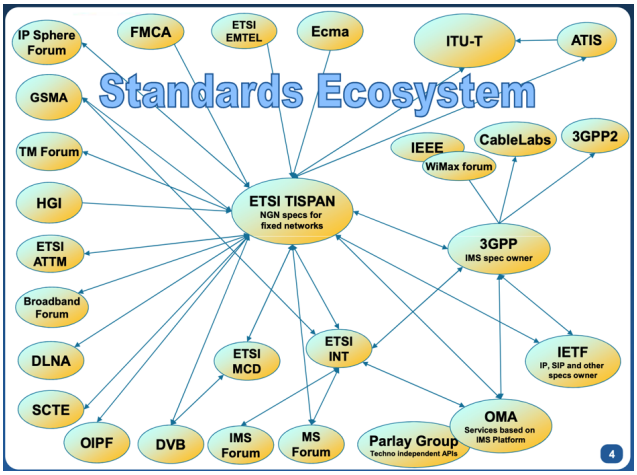
- RACS子系统：负责会话管理和控制

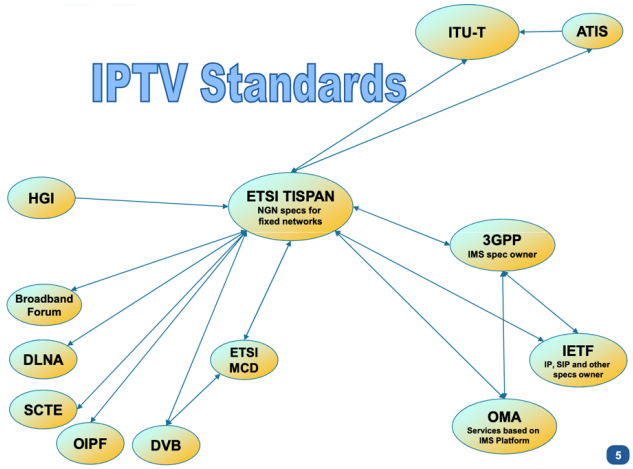


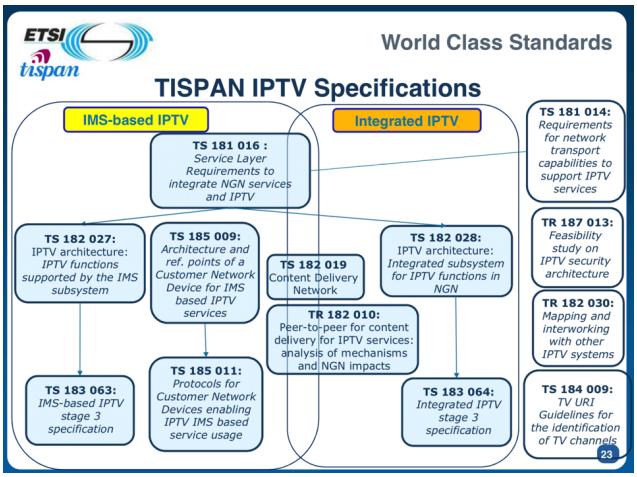
- PSTN Emulation=PSTN仿真：支持非IMS的旧有系统



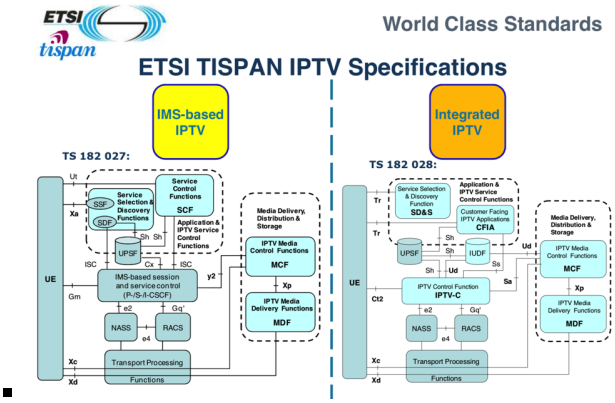
- 相关内容
  - 生态和协议
    - 概述

- 

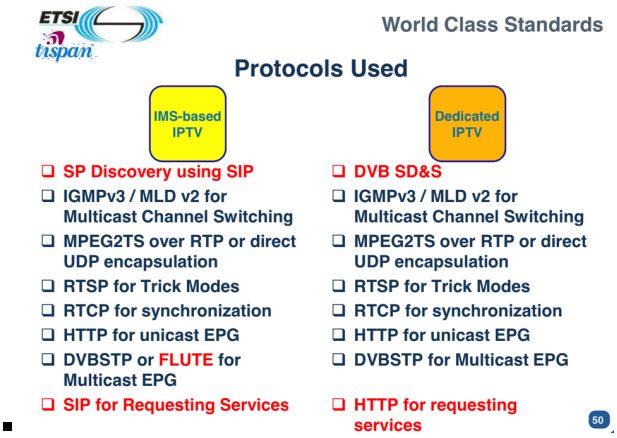
- IPTV方面
  - IPTV协议生态
    - 

  - IPTV相关协议
    - 

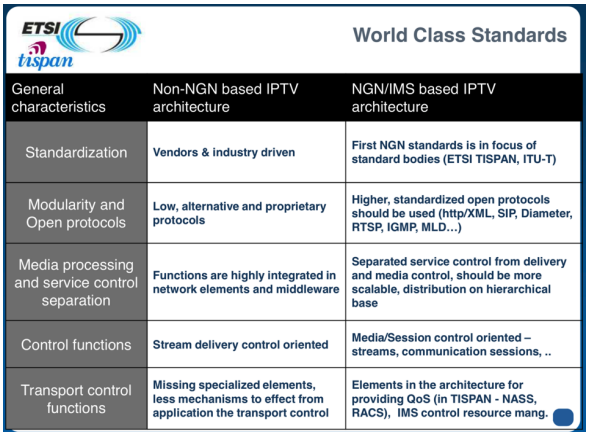
  - IMS-based IPTV vs Integrated IPTV
    - Specification协议规范

- 

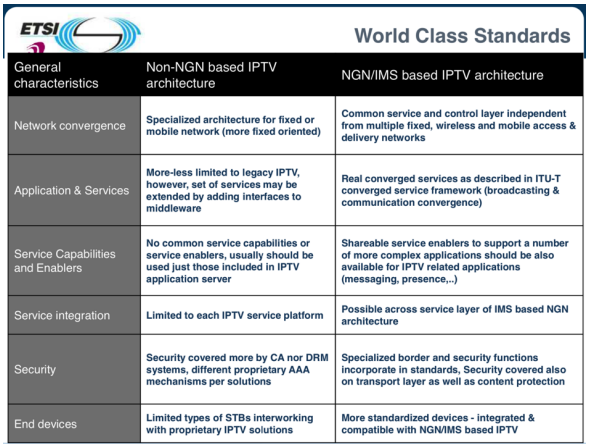
- Protocols Used



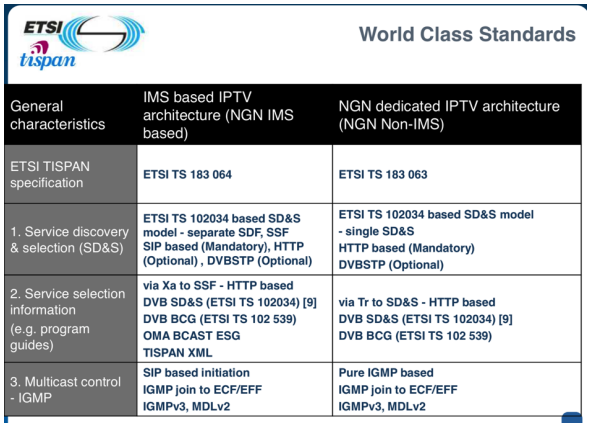
- 特点Characteristic



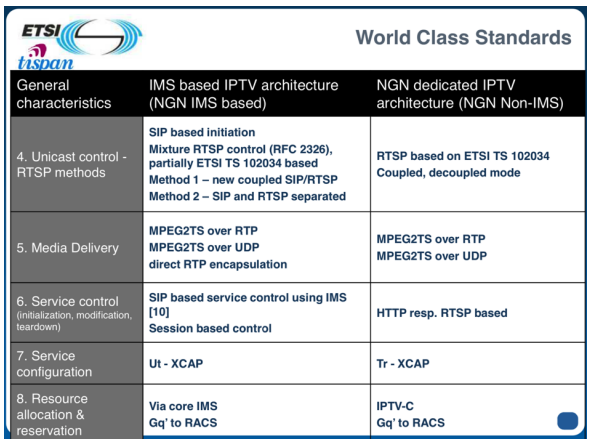
General characteristics	Non-NGN based IPTV architecture	NGN/IMS based IPTV architecture
Standardization	Vendors & industry driven	First NGN standards is in focus of standard bodies (ETSI TISPAN, ITU-T)
Modularity and Open protocols	Low, alternative and proprietary protocols	Higher, standardized open protocols should be used (http/XML, SIP, Diameter, RTSP, IGMP, MLD…)
Media processing and service control separation	Functions are highly integrated in network elements and middleware	Separated service control from delivery and media control, should be more scalable, distribution on hierarchical base
Control functions	Stream delivery control oriented	Media/Session control oriented – streams, communication sessions, ..
Transport control functions	Missing specialized elements, less mechanisms to effect from application the transport control	Elements in the architecture for providing QoS (in TISPAN - NASS, RACS), IMS control resource mang.

- 

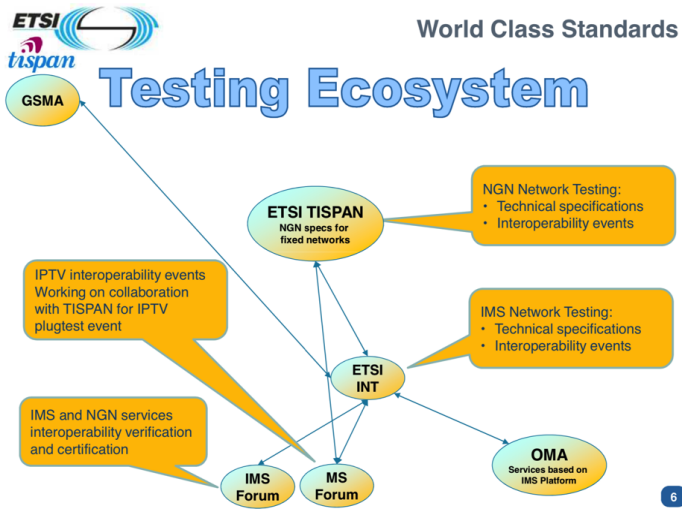
General characteristics	Non-NGN based IPTV architecture	NGN/IMS based IPTV architecture
Network convergence	Specialized architecture for fixed or mobile network (more fixed oriented)	Common service and control layer independent from multiple fixed, wireless and mobile access & delivery networks
Application & Services	More-less limited to legacy IPTV, however, set of services may be extended by adding interfaces to middleware	Real converged services as described in ITU-T converged service framework (broadcasting & communication convergence)
Service Capabilities and Enablers	No common service capabilities or service enablers, usually should be used just those included in IPTV application server	Shareable service enablers to support a number of more complex applications should be also available for IPTV related applications (messaging, presence,..)
Service integration	Limited to each IPTV service platform	Possible across service layer of IMS based NGN architecture
Security	Security covered more by CA nor DRM systems, different proprietary AAA mechanisms per solutions	Specialized border and security functions incorporate in standards, Security covered also on transport layer as well as content protection
End devices	Limited types of STBs interworking with proprietary IPTV solutions	More standardized devices - integrated & compatible with NGN/IMS based IPTV

- 

General characteristics	IMS based IPTV architecture (NGN IMS based)	NGN dedicated IPTV architecture (NGN Non-IMS)
ETSI TISPAN specification	ETSI TS 183 064	ETSI TS 183 063
1. Service discovery & selection (SD&S)	ETSI TS 102034 based SD&S model - separate SDF, SSF SIP based (Mandatory), HTTP (Optional) , DVBSTP (Optional)	ETSI TS 102034 based SD&S model - single SD&S HTTP based (Mandatory) DVBSTP (Optional)
2. Service selection information (e.g. program guides)	via Xa to SSF - HTTP based DVB SD&S (ETSI TS 102034) [9] DVB BCG (ETSI TS 102 539) OMA BCAST ESG TISPAN XML	via Tr to SD&S - HTTP based DVB SD&S (ETSI TS 102034) [9] DVB BCG (ETSI TS 102 539)
3. Multicast control - IGMP	SIP based initiation IGMP join to ECF/EFF IGMPv3, MDLv2	Pure IGMP based IGMP join to ECF/EFF IGMPv3, MDLv2

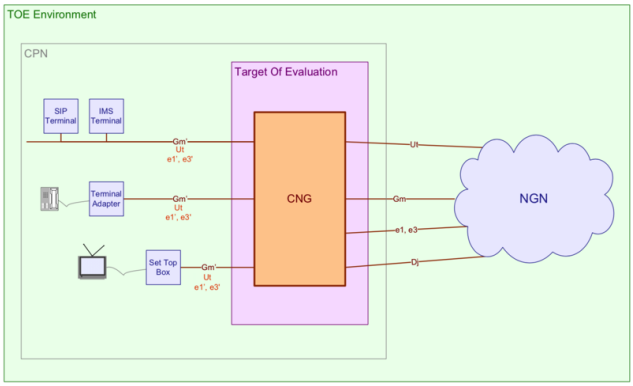
- 

General characteristics	IMS based IPTV architecture (NGN IMS based)	NGN dedicated IPTV architecture (NGN Non-IMS)
4. Unicast control - RTSP methods	SIP based initiation Mixture RTSP control (RFC 2326), partially ETSI TS 102034 based Method 1 – new coupled SIP/RTSP Method 2 – SIP and RTSP separated	RTSP based on ETSI TS 102034 Coupled, decoupled mode
5. Media Delivery	MPEG2TS over RTP MPEG2TS over UDP direct RTP encapsulation	MPEG2TS over RTP MPEG2TS over UDP
6. Service control (initialization, modification, teardown)	SIP based service control using IMS [10] Session based control	HTTP resp. RTSP based
7. Service configuration	Ut - XCAP	Tr - XCAP
8. Resource allocation & reservation	Via core IMS Gq' to RACS	IPTV-C Gq' to RACS

- 测试方面
  - 

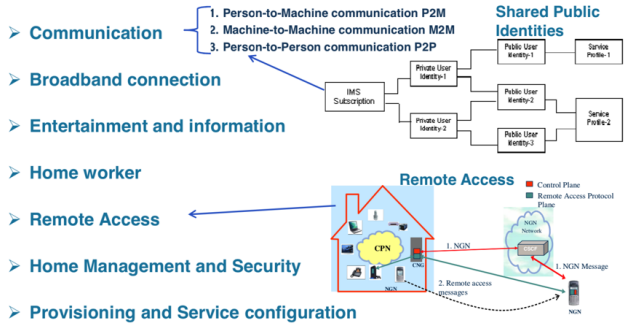
- Home Network相关
  - Home Networking Security

Home Networking Security

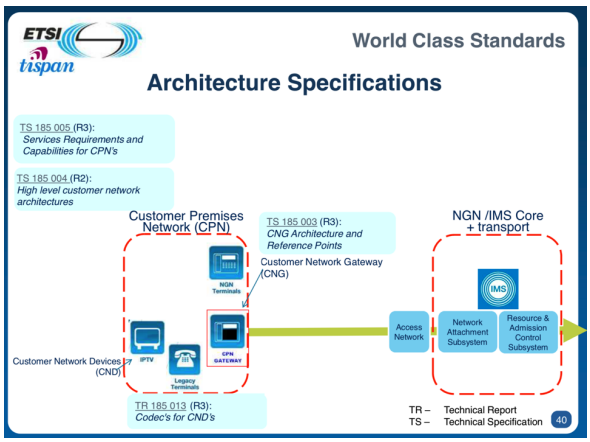


- Service Requirements

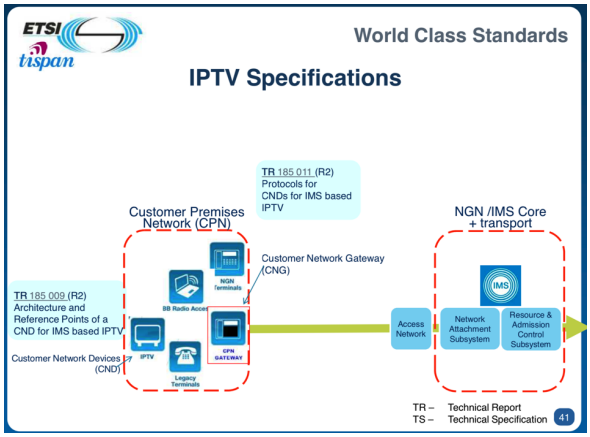
Service Requirements

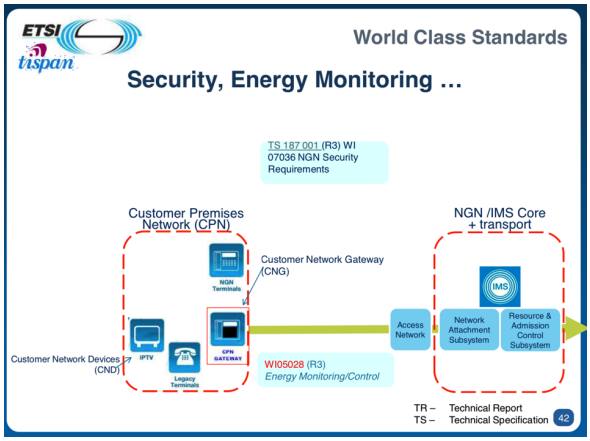


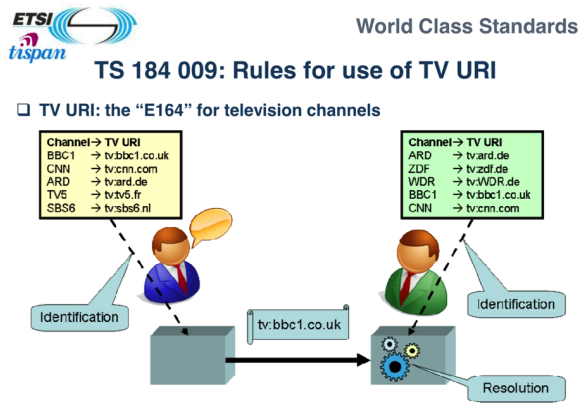
- 架构和协议
  - 说明
    - TISPAN sees Home Networks as an IMS NGN end-point
  - Architecture Specifications



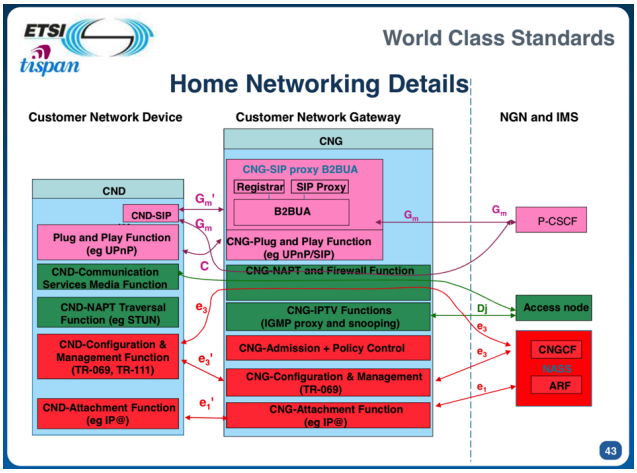
  - IPTV Specifications

- 

- Security, Energy Monitoring
  - 

- TV URI
  - 

- Home Networking Details详情

- 

- 总体内容和架构
  - 文字版
    - Service Layer Model
      - Subsystems
        - Core
          - IMS= IP Multimedia Subsystem
        - Other
          - PES=PSTN/ISDN Emulation subsystem
            - IPTV Subsystem
      - Common components
        - UPSF=User Profile Server Function
        - SLF=Subscription Locator Function
        - ASF=Application Server Function
        - IWF=Interworking Function
    - Transport layer
      - Transport control sublayer
        - NASS=Network Attachment Subsystem
        - RACS=Resource and Admission Control Subsystem
      - Transport processing function
        - BGF=Border Gateway Function
        - RCEF=Resource Control Enforcement Function
        - ARF=Access Relay Function
        - MGF=Media Gateway Function
        - MRFP=Media Resource Function Processor
        - SGF=Signalling Gateway Function
        - AMF=Access Management Function
        - BTF=Basic Transport Function
          - EFF=Elementary Forwarding Function
          - ECF=Elementary Control Function
    - UE=User Equipment
  - 图
    - TISPAN NGN overall architecture

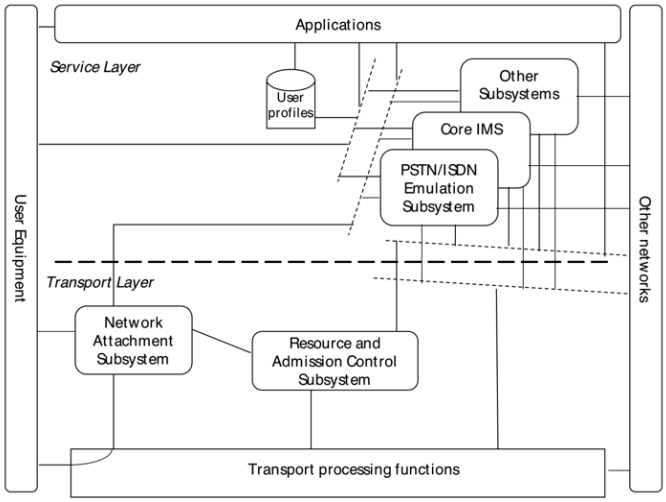


Figure 1: TISPAN NGN overall architecture

- Example architecture with xDSL access

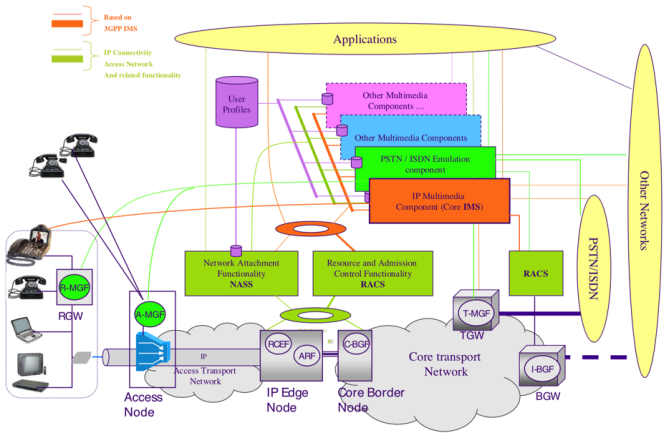


Figure A.1: Example architecture with xDSL access

- Transport processing functions overview

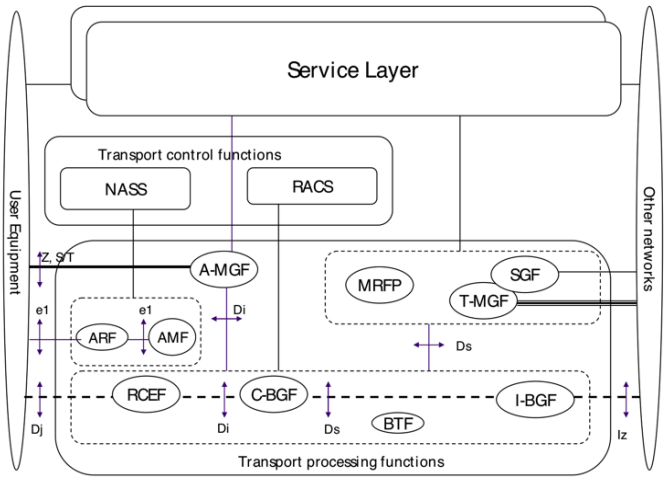
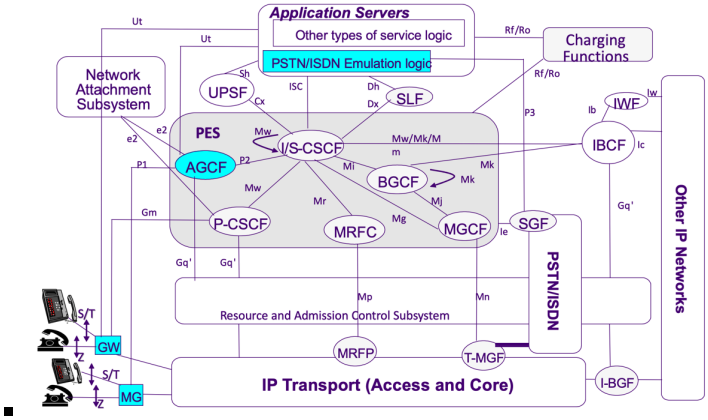
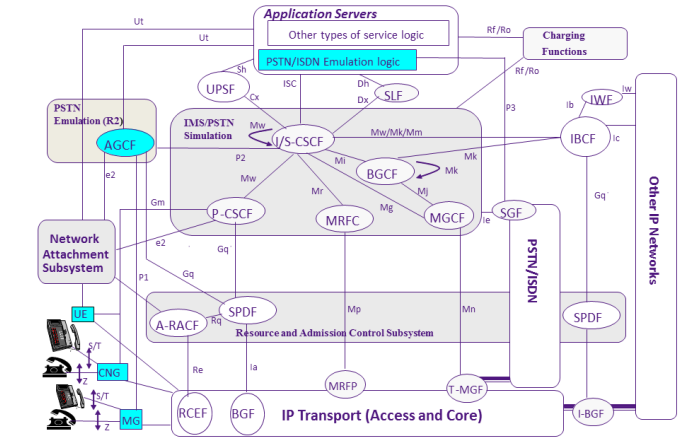


Figure 3: Transport processing functions overview

- TISPAN R1参考模型

TISPAN R1 Reference Model





- TISPAN 不同模块内容
  - Distributed subsystems

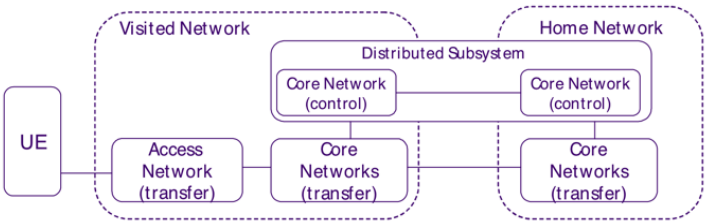


Figure 2: Distributed subsystems

  - Access and aggregation segments

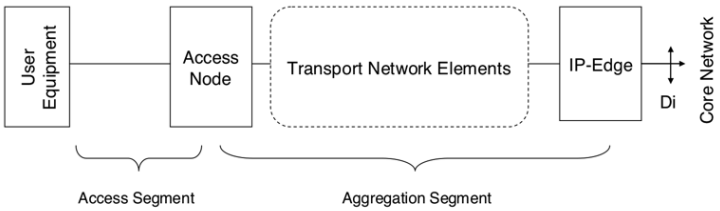


Figure 2a: Access and aggregation segments

  - Common components overview

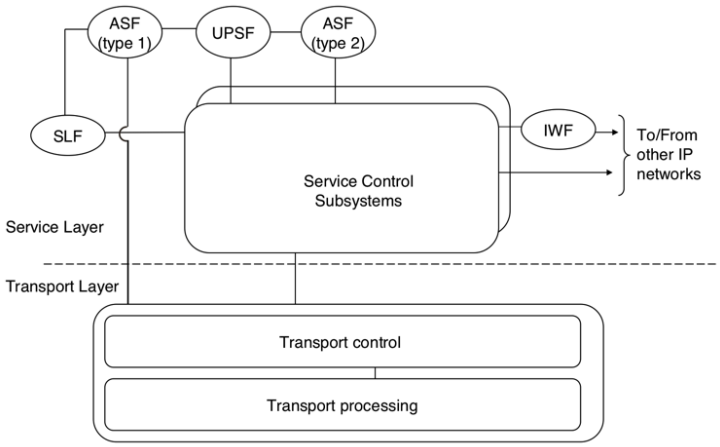


Figure 4: Common components overview

- Charging and Data Collection Functions

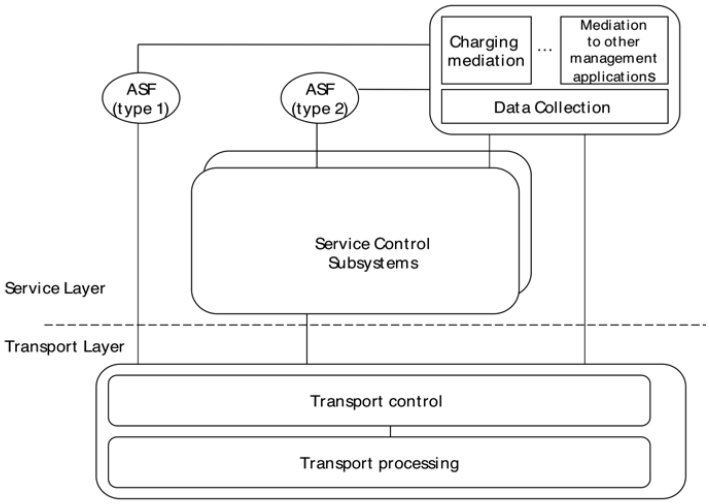


Figure 4a: Charging and Data Collection Functions

- Network interconnection at transfer level

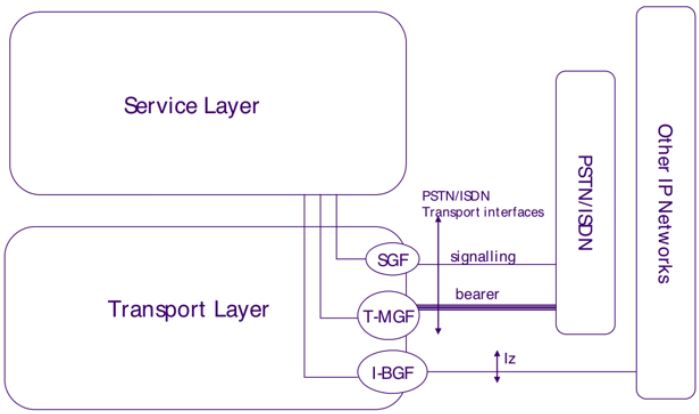


Figure 5: Network interconnection at transfer level

- User Equipment (UE)

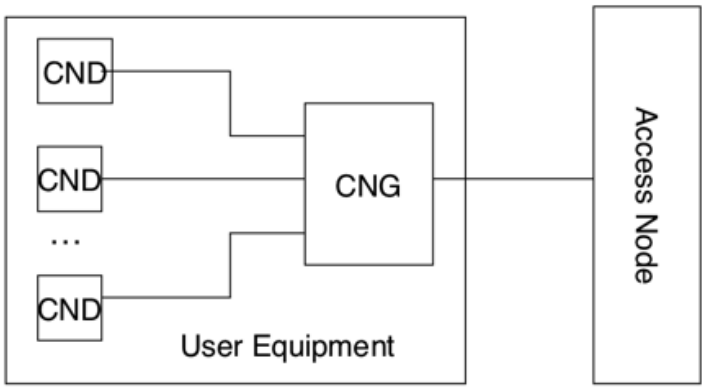


Figure 7k: User Equipment with a CNG

- 说明
  - UE=User Equipment
  - TE=Terminal Equipment
  - CPN=Customer Premises Network
  - CND=Customer Network Devices
  - CNG=Customer Network Gateway
  - R-MGF=Residential MGF

- Authentication
  - NGN Authentication Levels

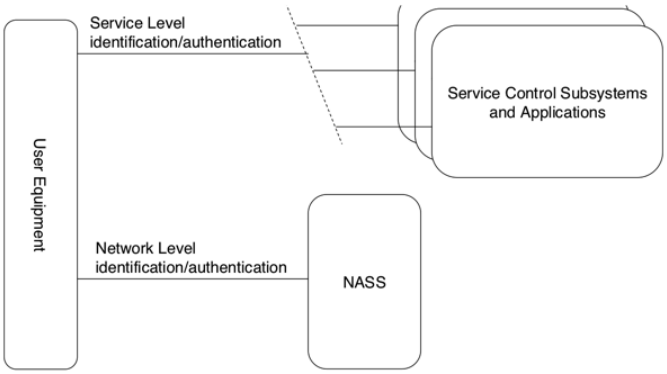
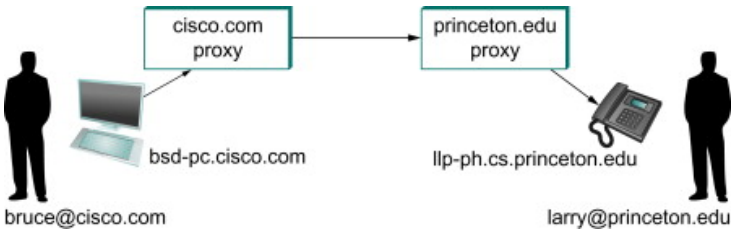


Figure 8: NGN Authentication Levels

SIP

- `SIP = Session Initiation Protocol = 会话发起协议`
  - SIP代理

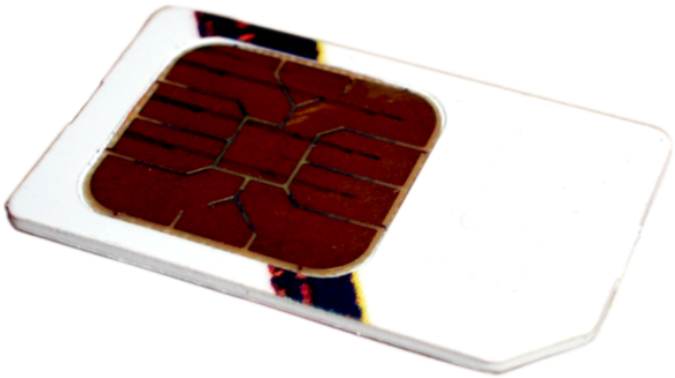


  - 消息类型
    - Requests
      - INVITE
      - ACK
      - REFER
      - OPTIONS
      - BYE
      - CANCEL
      - REGISTER
      - SUBSCRIBE
      - NOTIFY
      - MESSAGE
    - Responses
      - Success
      - Redirection
      - Forwarding
      - Request failure
      - Server failure
      - Global failure

用户和认证

此处整理IMS中相关的用户标识，以及如何认证的过程。

SIM卡

- SIM
  - 相关名词
    - `UICC` = `Universal integrated circuit card`
      - 别称：`SIM卡`
        - 含义：在GSM或UTMS网络中移动终端中的智能卡=`SIM卡`
        - 图
        - 
        - 
        - 
        - 细节
      - 包含应用（程序）
        - 不同网络
          - GSM网络中，UICC中包含一个SIM应用
          - UTMS网络中，UICC中包含一个USIM应用
          - cdmaOne/CDMA2000网络中，UICC除了包含USIM和SIM外，还包含一个CSIM应用
        - 一张卡可能包含多个程序
          - 一张卡可能同时支持GSM和UTMS
    - `ISIM` = `IMS SIM`
      - 是什么：一种应用程序application

- UICC vs SIM vs ISIM vs USIM vs CSIM 关系

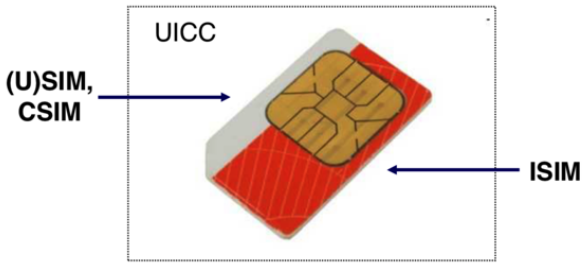


Figure 1 IP Multimedia Services Identity Module (ISIM)

- USIM = Universal SIM = SIM

用户标识=User identities

- `用户标识 = User Identities = User Identitiy`
  - IMS可以使用多种用户标识
    - IMPI=IP Multimedia Private Identity=IP多媒体私有标识
      - 一种由主网络操作者永久性分派的全局性标识
      - 可以用于注册、认证、管理和计费等用途
      - 每个IMS用户可以有多个IMPI
    - IMPU=IP Multimedia PUblic Identity=IP多媒体公共标识
      - 当IMS用户想要和其他用户通信时，需要使用IP多媒体公有标识
        - 它可以写在那个人的名片上
      - IMS允许一个IMPI上绑定多个IMPU。
      - IMPU也可以和其它电话共享
        - 就像一个家庭使用一个电话号码
    - WPUI=Wildcarded Public User Identity=通配公共享户标识
      - 表示一组相似的IMPU
    - GRUU=Globally Routable User Agent URI=全局可路游用户代理统一资源标识符
      - 一个由IMPU和UE实例组成的标识符
      - IMS中有两类GRUU
        - 公共GRUU(P-GRUU)
          - 明示了用户的IMPU并且长期有效
        - 临时GRUU(T-GRUU)
          - 隐藏了用户的IMPU
          - 当用户显式注销T-GRUU或者过了有效期时，T-GRUU就会失效
  - 说明
    - IMPI和IMPU是一种URI
      - URI=统一资源标识符
    - 它可以是
      - 数字：Tel URI
        - 举例
          - `tel: +1-555-123-4567`
      - 字符标识符SIP URI
        - 举例：
          - `sip:john.doe@example.com`
    - 去掉前缀后
      - 举例
        - `+31 72 5621771`
        - `sales@vc4.com`

IMS中用户身份和编号基础知识

- IMS中用户身份和编号 基础知识
  - ISIM文件结构

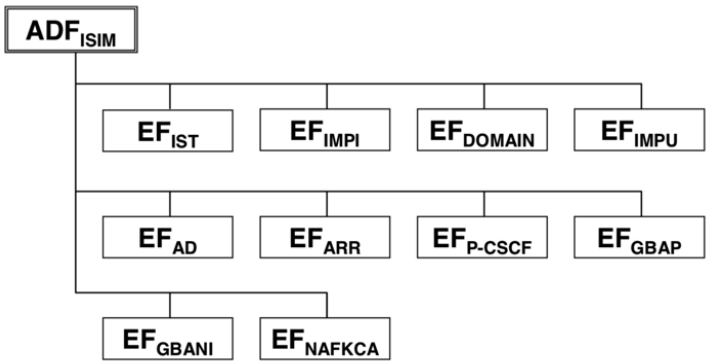


Figure 2 ISIM file structure

- ADFI SIM包含内容
  - EF**IMPI** – IMS private user identity,
  - EF**DOMAIN** - Home Network Domain Name,
  - EF**IMPU** - IMS Public User Identity (one or more),
  - EF**AD** - Administrative Data (UE operation mode, e.g. normal or type approval),
  - EF**ARR** - Access Rule Reference (access rules for files located under the ISIM ADF),
  - EF**IST** - ISIM Service Table (lists available optional services:P-CSCF address, Generic Bootstrapping Architecture (GBA), HTTP Digest, GBA-based Local Key Establishment Mechanism, support of P-CSCF discovery for IMS local break out),
  - EF**P-CSCF** - P-CSCF Address (one or more),
  - EF**GBABP** - GBA Bootstrapping parameters (contains the AKA Random challenge (RAND) and Bootstrapping Transaction Identifier (B-TID) associate with a GBA bootstrapping procedure),
  - EF**GBANL** - GBA NAF List (contains the list of NAF_ID and B-TID associated to a GBA NAF derivation procedure)
  - EF**NAFKCA** - NAF Key Centre Address (one or more).
- home domain
  - Home network domain name

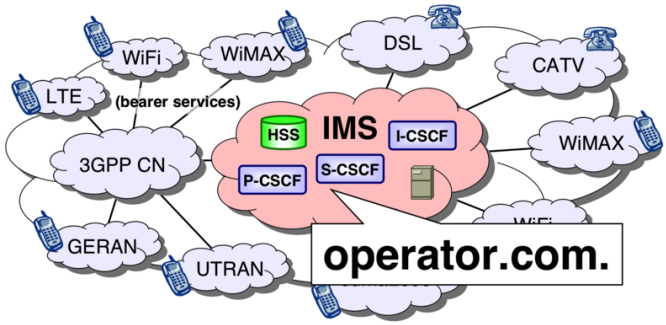


Figure 3 Home network domain name

  - 对应标准： `IETF RFC 1035`
  - Home network domain name derivation from IMSI

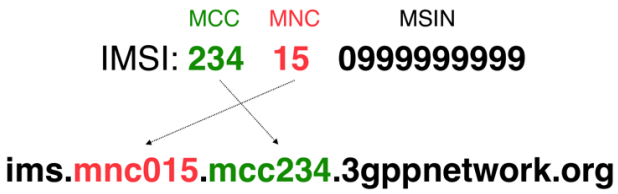


Figure 4 Home network domain name derivation from IMSI

- IMPI
  - Private user identity=Private Identity=IP Multimedia Private Identity=IMPI
  - 每个IMS用户都有一个Private User Identities
    - 是Home Network Operator网络运营商？分配的
  - 用途
    - Registration注册
    - Authorisation授权
    - Administration管理
    - Accounting计费
  - 形式
    - NAI=Network Access Identifier
    - 语法：username@realm
  - 举例

Figure 5 Private user identity

  - Private User Identity derivation from IMSI
    - 3GPP中没有IMSI，所以需要从IMSI中推算出来
      - IMSI=International Mobile Subscriber Identity=国际移动用户识别码
    - Private user identity derivation from IMSI

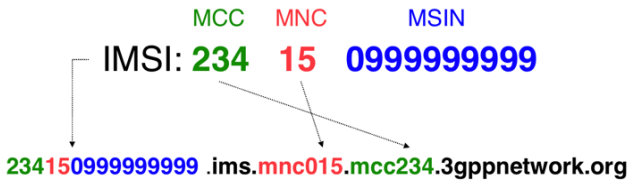


Figure 6 Private user identity derivation from IMSI

- IMPU
  - =Public User Identity=Public identity=IP Multimedia PUblic identity=IMPU
  - 概述
    - 每个IMS用户都有1或多个IMPU
    - 任何用户都可以用IMPU去和其他用户通信
      - 例如，可以被包含到一个商务名片中
  - 格式
    - 种类
      - SIP URI
        - 协议标准：IETF RFC 3261
        - 格式：sip:username@domain

        - Tel URI
            - 协议标准：`IETF RFC 3966`
                - `E.164 number`
            - 格式：`tel:<Global Number>`
                - 说明
                    - 不带分隔符
                        - contains a global number without visual separators
    - 举例
        - 文字
            - SIP URI
                - `sip:jakub.bluszcz@ekiga.net`
            - Tel URI
                - `tel:48399571981`
            - SIP URI
                - `sip:+1-212-555-1212 @gateway.com;user=phone`
        - 图

Figure 7 Public user identity

- WPUI=Wildcarded Public User Identity=通配公共享户标识
    - IMPU可能会被以WPUI的方式存储在HSS中
    - WPUI目的是为了针对注册了大量的账号，且其处理方式都类似的场景实现优化
        - 保存成一组类似的账号
            - 也就是：WPUI=Wildcarded Public User Identity
    - 语法
        - 会用到ERE=Extended Regular Expression=扩展正则表达式
            - 分隔符delimiter是：感叹号！
    - 举例
        - `sip:user!.*!@example.com`
        - `tel:4832376630!.*!`
        - 图

sip:user!.*!@example.com	tel:4832376630!.*!
sip:chatlist1@example.com	tel: 48323766300
sip:chatlist2@example.com	tel: 48323766301
sip:chatlist42@example.com	tel: 48323766302
sip:chatlistAbC@example.com	tel: 4832376630356
sip:chatlist!1@example.com	tel: 483237663098888

Figure 8 Wildcarded Public User Identities

- IMPI 和 IMPU 关系
    - Relationship of Private and Public User Identities

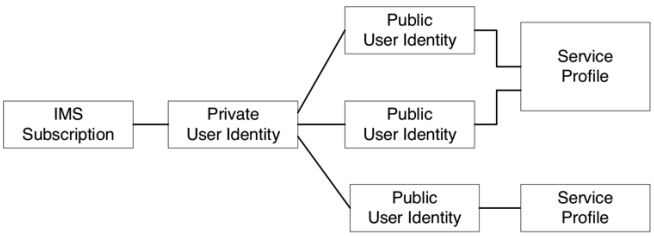


Figure 9 Relationship of the Private User and Public User Identities

IMS用户认证

- IMS认证总体流程
  - 3GPP网络环境中，即使IMS（订阅）用户通过了PS域的认证，也还要经过IMS的IMPI的认证，才能继续访问IMS的服务
  - -》即2步认证
    - 第一步：PS的认证
      - 具体实现：3GPP AKA
    - 第二步：IMS的IMPI
      - 具体实现：IMS AKA
  - 图

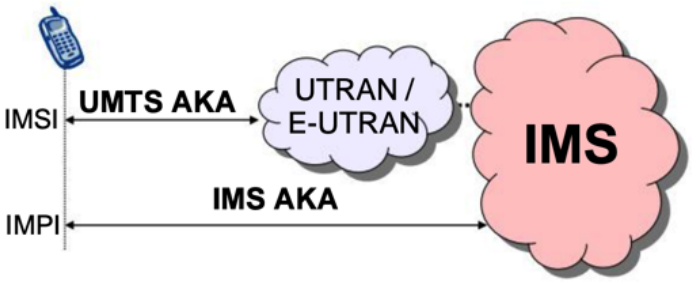


Figure 5-1 3GPP AKA & IMS AKA

- 相关名词
  - IMPI=IP Multimedia Private Identity=IP多媒体私有识别码
  - AKA=Authentication and Key Agreement=认证和密钥协商
    - 常称为：3GPP AKA
- UTMS AKA
  - UTMS中的双向认证机制叫做：UTMS AKA
- IMS AKA
  - 认证流程
    - 认证成功

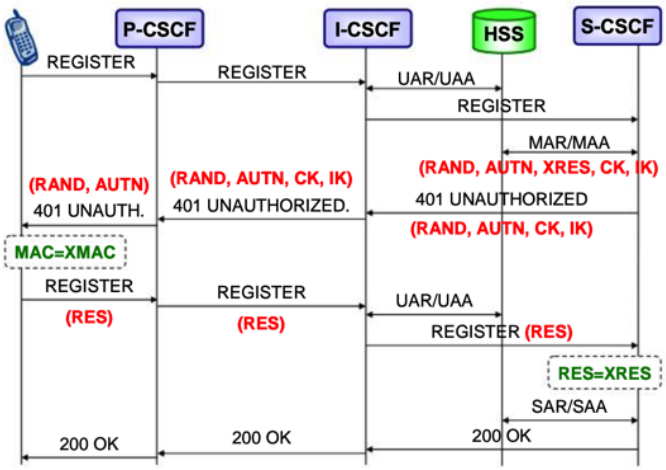


Figure 5-2 IMS AKA (successful)

    - 用户认证失败

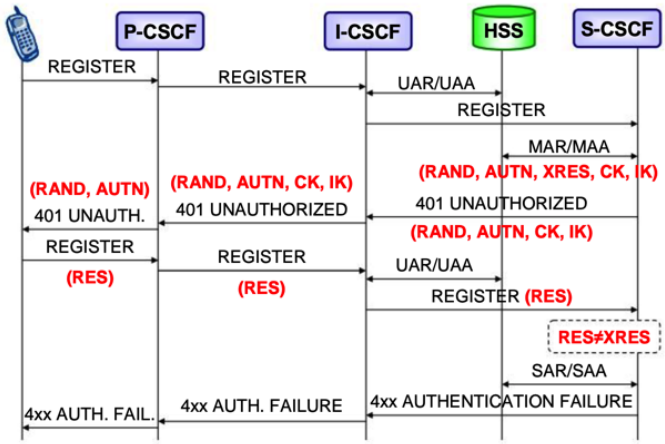


Figure 5-3 IMS AKA (user authentication failure)

- 网络认证失败

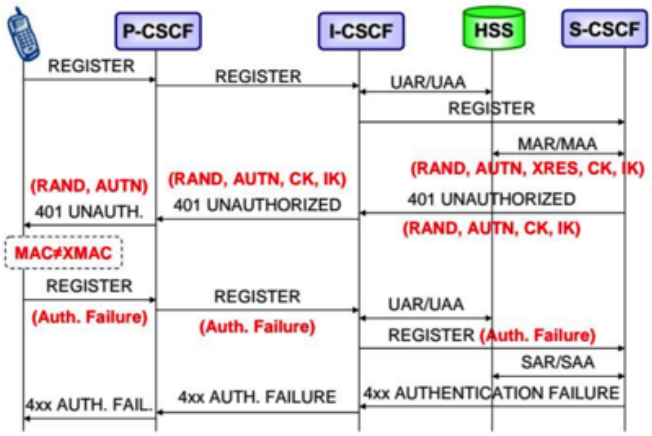


Figure 5-4 IMS AKA (network authentication failure)

- 同步失败

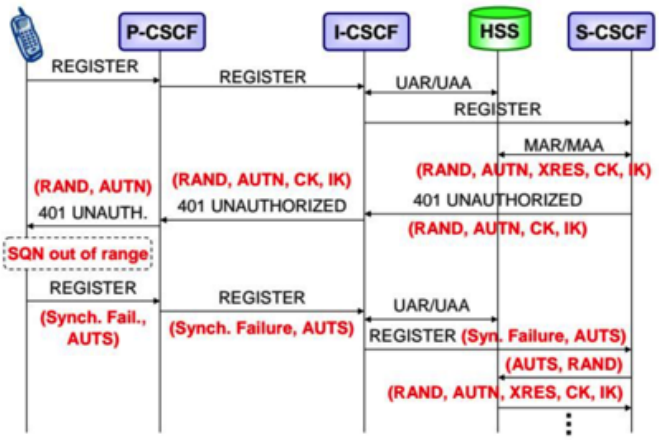
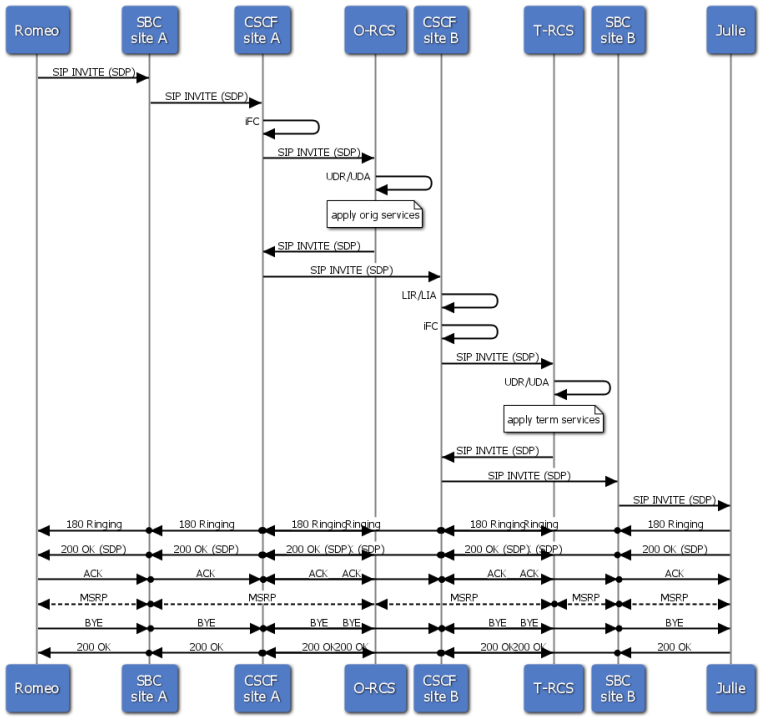
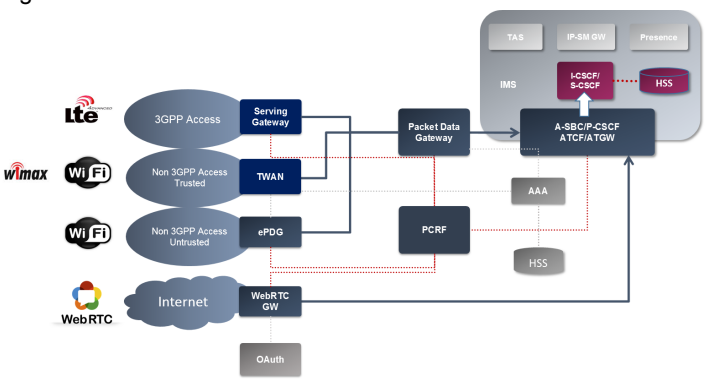


Figure 5-5 IMS AKA (synchronisation failure)

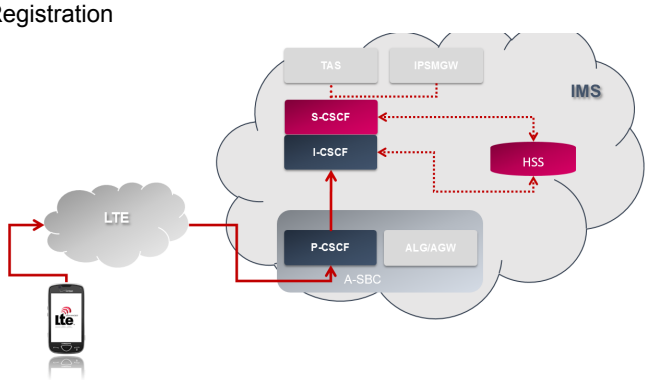
- Session Mode Messaging CallFlow



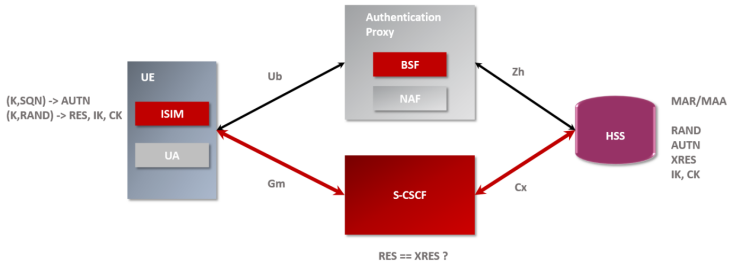
- IMS注册和认证 架构
  - IMS Registration – access networks



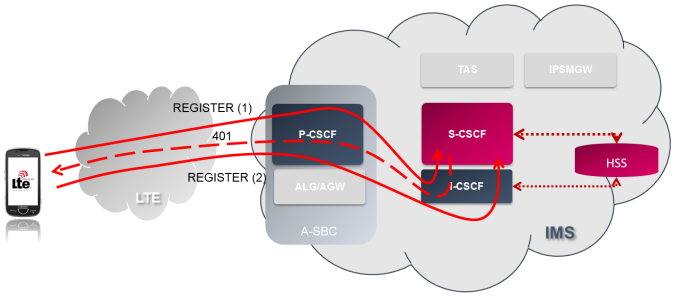
  - VoLTE Registration



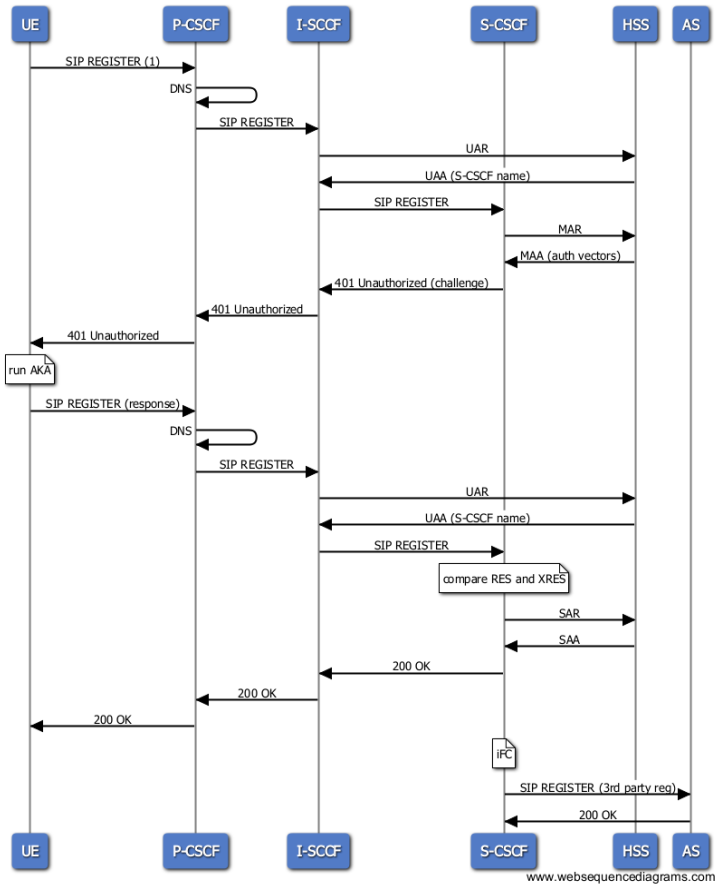
  - 3GPP AKA



- IMS AKA



- IMS Registration



SIP授权认证

- SIP confidentiality and integrity
  - 相关
    - ESP=（IPsec 的）Encapsulating Security Payload
    - SA=Security Association=安全关联
  - 建立安全关联

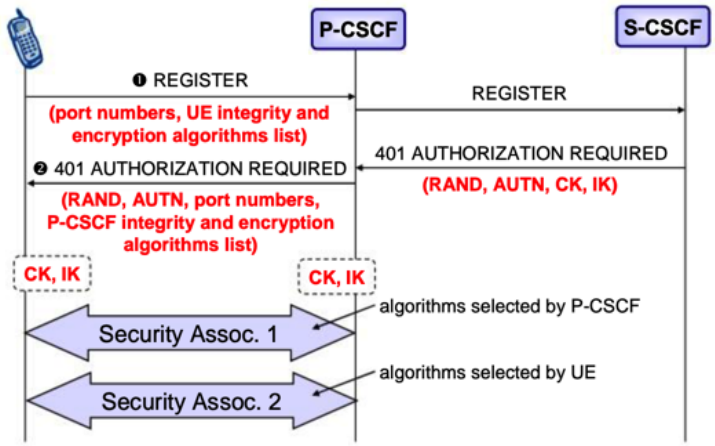


Figure 5-6 Security association set-up

  - SA1和SA2的使用

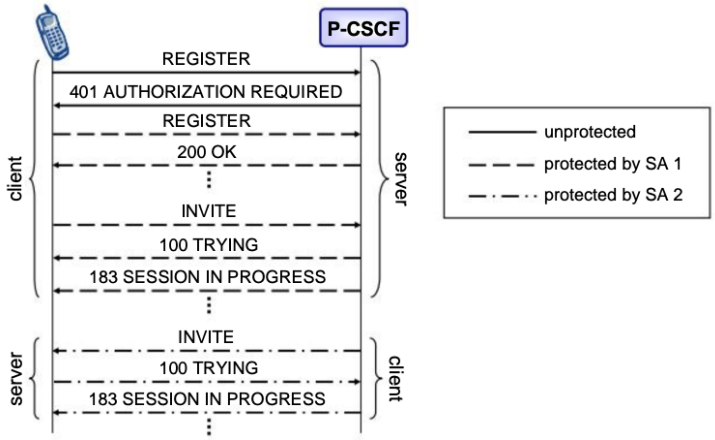


Figure 5-7 SA 1 and SA 2 usage

- SIP Digest
  - 是一种认证方法，只适用于非3GPP的访问网络
  - 基于HTTP DIGEST，实现UE和HE之间的双向认证
  - SIP Digest

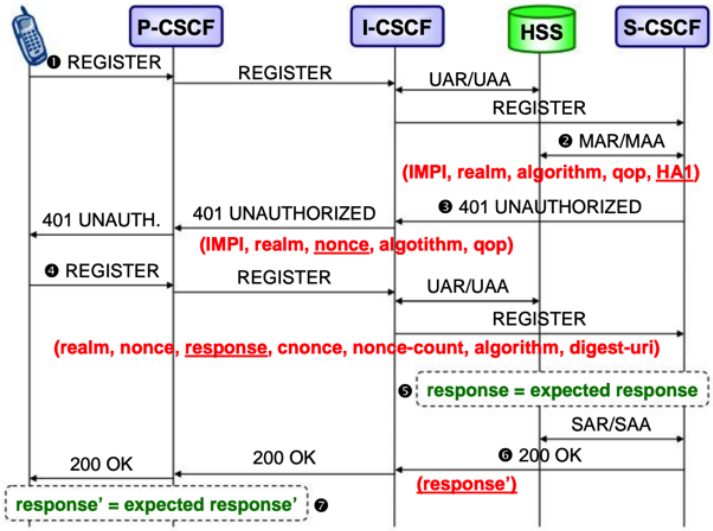


Figure 5-8 SIP Digest

HA1=MD5(A1)=MD5(username:realm:password)

HA2=MD5(A2)=MD5(method:digestURI)

response=MD5(HA1:nonce:moce-count:cnonce:qop:HA2)

username = IMPI
realm = HN domain name
digestURI = SIP URI of the domain name of the HN
qop = auth
method = REGISTER
algorithm = MD5

Figure 5-9 SIP Digest (variables)

- SIP Digest with TLS
  - SIP Digest with TLS

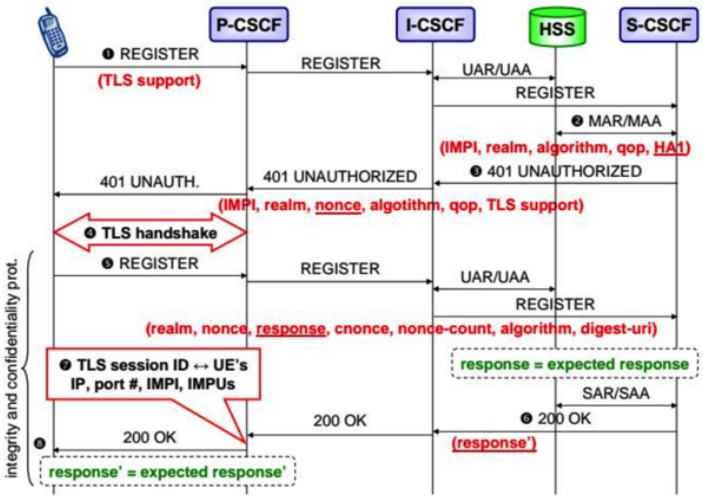


Figure 5-10 SIP Digest with TLS

- GIBA=GPRS-IMS-Bundled Authentication
  - 背景：
    - 3GPP的IMS安全功能，很好
    - 但是早期的时候，早期设备，并不能很好的支持这方面的功能
    - 比如早期的2G手机，不支持USIM、ISIM

        - 因为本身不支持IPsec
      - 需要一个简单但够用的安全机制
      - -》出现了：GIBA
    - 别名：early IMS security=-早期IMS安全（机制）
    - 原理
      - 在HSS中创建一个安全绑定
        - 在两者之间
          - SIP级的标识： 公开/私有的用户身份
          - GRPS级别的 承载/网络层的标识：IP地址
    - GIBA认证流程

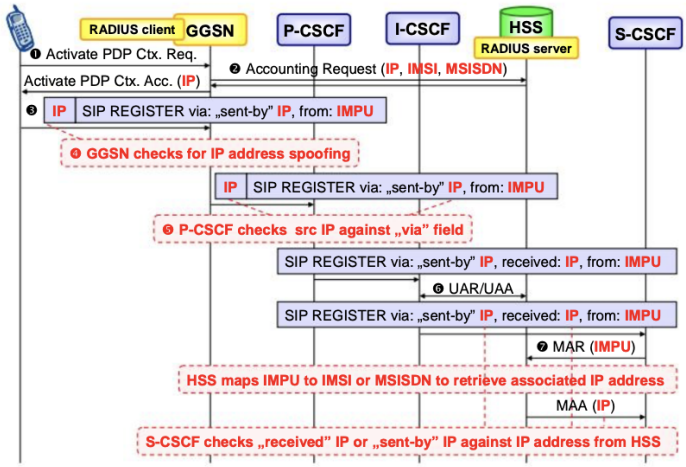


Figure 5-11 GPRS-IMS-Bundled Authentication (GIBA)

- GAA=Generic Authentication Architecture
  - 背景：
    - 许多应用（程序）都有个需求是，在通讯之前，实现互相认证，以实现在一个客户端（比如UE）和一个AS（应用程序服务器）的通讯
    - 所以需要一个通用认证的架构
    - -》GAA
  - GAA应用举例

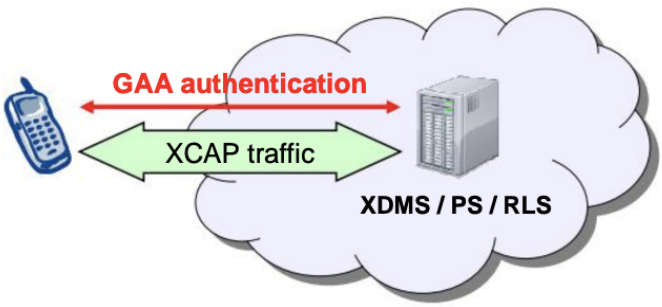


Figure 5-12 Generic Authentication Architecture (usage example)

  - GAA机制签发资格证书

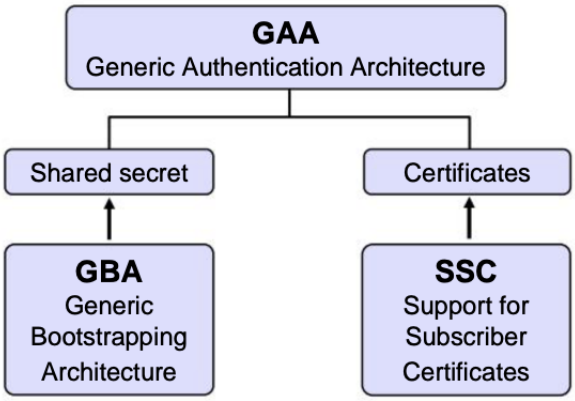


Figure 5-13 GAA mechanisms to issue authentication credentials

- GBA
  - =Generic Bootstrapping Architecture=通用引导架构
  - GBA架构

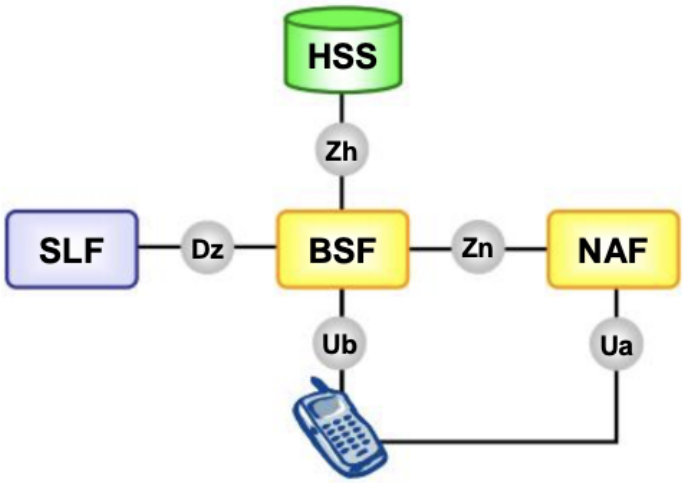


Figure 5-14 GBA architecture

  - 服务发现过程
    - BSF地址

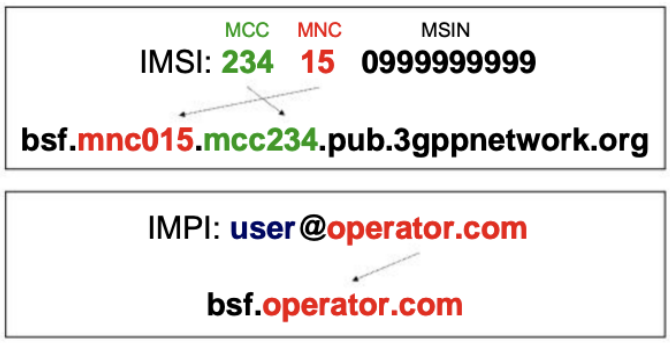


Figure 5-15 BSF address (GBA)

  - 引导初始化
    - GBA的引导过程的初始阶段

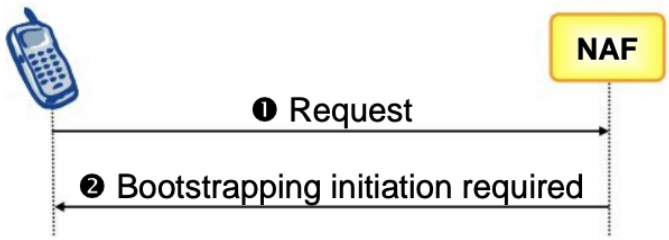


Figure 5-16 Initiation of bootstrapping (GBA)

- GBA引导过程

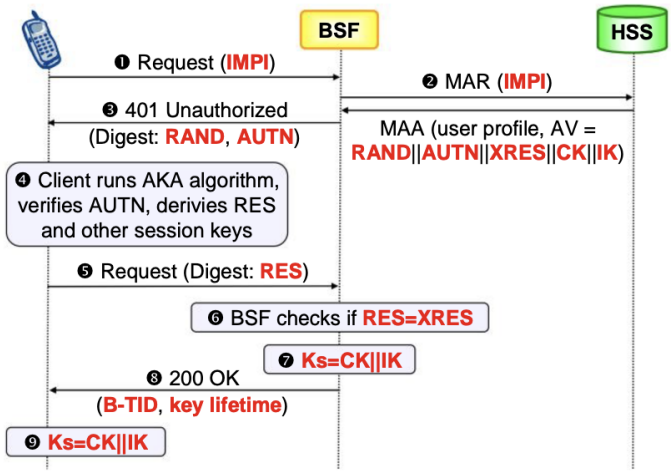


Figure 5-17 Bootstrapping procedure (GBA)

- GBA引导使用过程

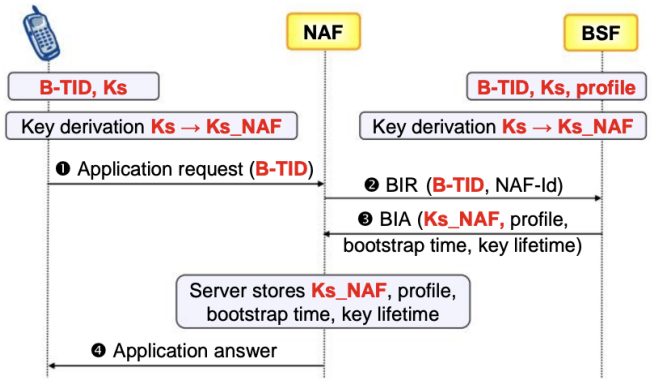


Figure 5-18 Bootstrapping usage procedure (GBA)

- SSC架构
  - 签发证书

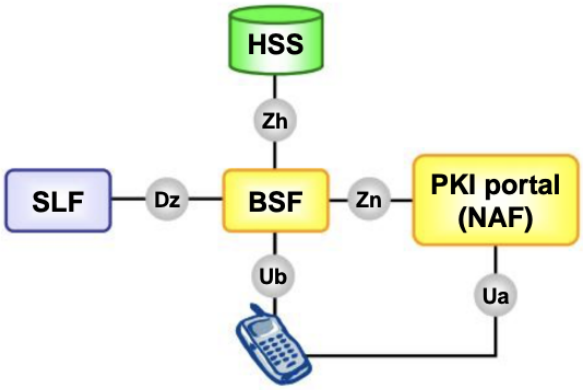
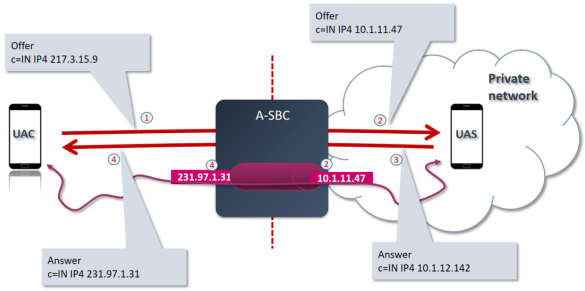


Figure 5-19 SSC architecture (certificate issuing) [33.221]

- 相关
  - BSF= Bootstrapping Server Function
  - NAF=Network Application Function

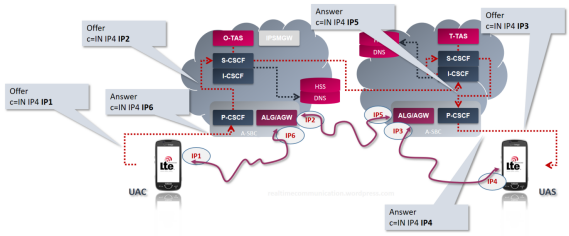
SBC

- `SBC = Session Border Controller = 会话边界控制器`
  - 是什么：一个 控制器=网络节点=网络元素
    - 位置：
      - 位于 `IMS` 系统中
      - 介于2个网络之间的
    - 作用：控制所有的数据传输
      - 包括
        - 信号signalling
        - （媒体）数据media
  - 协议
    - rfc5853
      - https://tools.ietf.org/html/rfc5853
  - 用于解决各种问题
    - 多种（访问 接入）网络multiple access networks
      - IPv4/IPv6
      - SIP normalization
      - VPNs
    - 安全问题security issues
      - DOS attacks
      - topology hiding
      - 加密
        - 信号：TLS和IPSec
        - 媒体数据：SRTP
    - legislative issues=Regulatory=管制
      - emergency calls
      - legal intercept
      - interworking
    - 媒体相关问题media related problems
      - QoS
      - transcoding
      - media security
  - 实际作用
    - 最早：作为NAT
      - SBC as a NAT

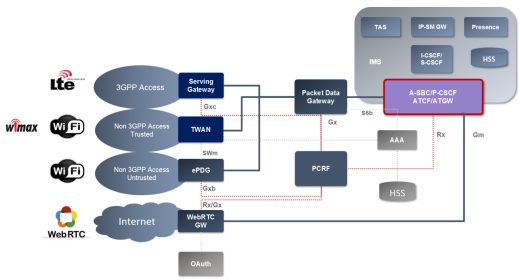


      - 具体例子

- VoLTE Call – Data Path

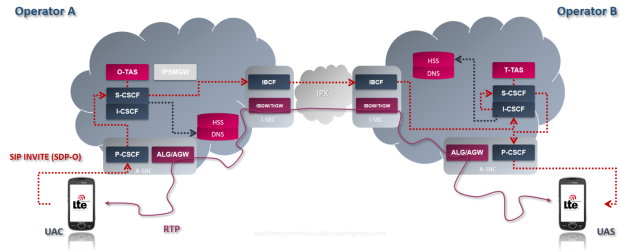


- 现状
  - 各种类型SBC
    - `A-SBC`
    - `I-SBC`
    - `ICS-SBC`
    - `Enterprise SBC`
    - `Trunking SBC`
    - `WebRTC GW`
  - 功能重叠或独立
    - 某些功能可以独立出其他模块
      - 比如
        - `P-CSCF`
        - `E-CSCF`
  - 最新：把SBC理解为负责**安全**和**连接**方面的功能
  - 其他一些也可以被视为SBC的
    - `CBGF`
    - `E-CSCF`
    - `ATCF`
    - `ATGW`
    - `EATF`
    - `WebRTC GW`
    - `ICE`
- 从IMS角度
  - 2种类型SBC
    - 包含
      - A-SBC=Access-SBC
        - 架构

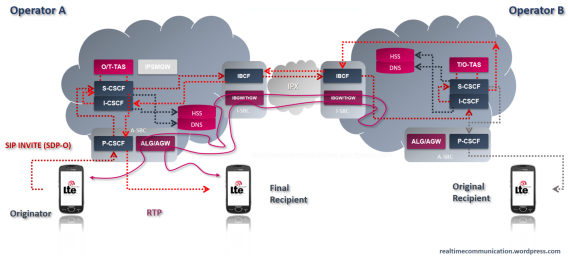


        - 相关内容=对应功能
          - P-CSCF=Proxy Call Session Control Function
          - IMS-ALG=IMS Application Level Gateway
          - IMS-AGW=IMS Access Gateway
      - I-SBC=Interconnecting-SBC

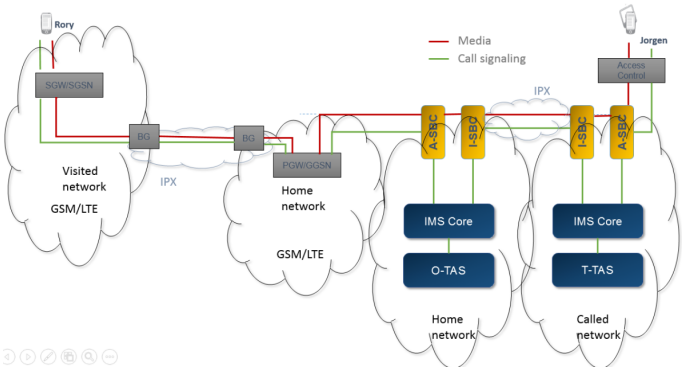
        - 相关内容=对应功能
            - IBCF=Interconnection Border Control Function
            - TrGW=Translation Gateway
            - THIG=Topology Hiding Interwork Gateway
            - IWF
    - 对比
        - A-SBC and I-SBC



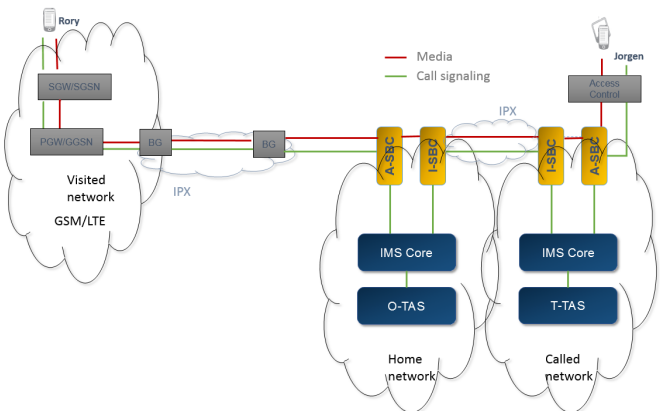
        - 稍微复杂点的情况
            - Call Forwarding and LI and Interconnect



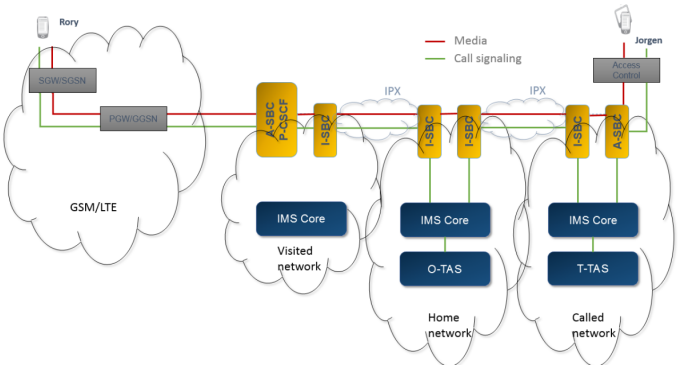
- 漫游往往涉及到SBC
    - 可能方案1



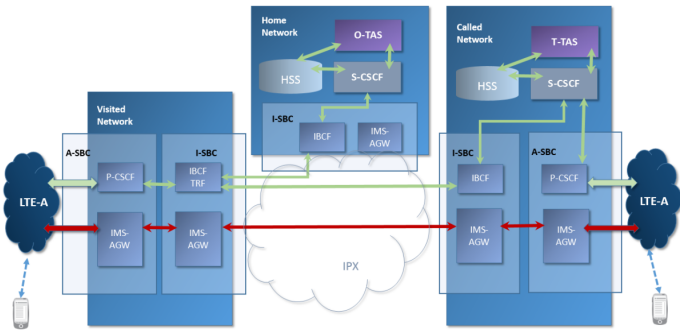
    - 可能方案2



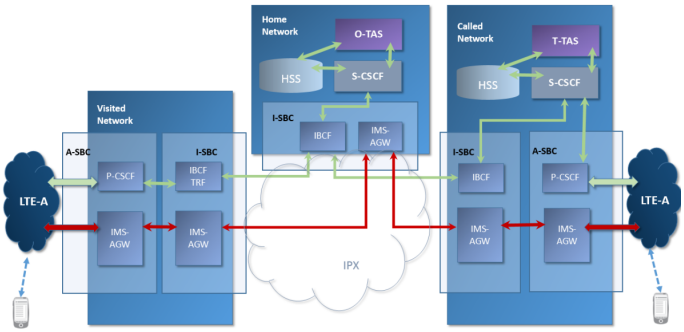
- 可能方案3



- LBO-VR with OMR



- LBO-HR



- 其他相关架构
  - Logical Position of D-SBC and SmartEdge BGF in IMS or Other Multimedia Networks

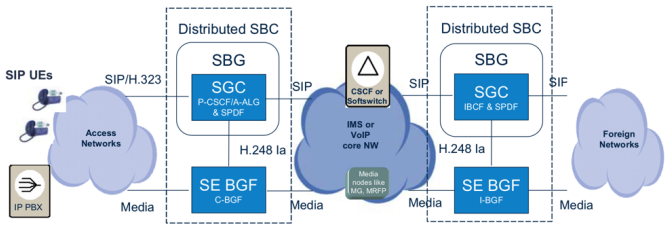


Figure 1 Logical Position of D-SBC and SmartEdge BGF in IMS or Other Multimedia Networks

基于IMS的技术

基于IMS实现的其他技术有：

- VoLTE
- RCS
- ViLTE
- VoWiFi

VoLTE

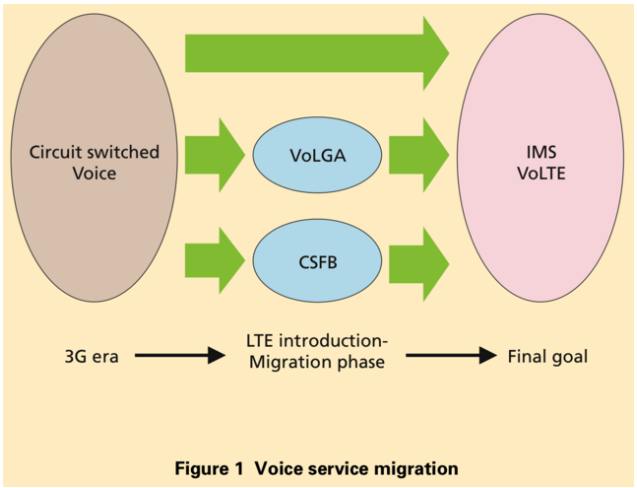
- VoLTE
  - = Voice over LTE
- 出现背景
  - 3GPP Release 8发布了 LTE
  - 现存几种系统
    - 传统的：（基于 CS 的）语音voice服务
    - 新的：（基于 LTE 的）多媒体短信SMS服务
      - 范围：通过 3G 网络实现的
        - 不带 CS
      - 几种方案
        - 3GPP 的 CSFB
        - IMS
        - 非国际标准的 VoLGA
  - GSMA 建议统一成一种：基于 IMS 的 VoLTE
    - 其他方式都转换成 IMS 的
      - Voice service migration
      - 

        Figure 1 Voice service migration
- 为何需要 VoLTE
  - 如果想要在 4G 网络中实现语音通话=打电话
    - 之前：
      - 需要额外部署实现一套 3G 网络，底层是用基于 CS 的方式，去实现语音数据传输，实现打电话
        - 接入方式效率很低，还需要占用收取授权费的频谱
    - 有了 VoLTE
      - 在已有的 4G 的 LTE / EPC 网络之上，基于 PS 的方式，传输控制信号和语音媒体数据，实现打电话
        - 无需额外的3G网络
        - 大大提高了通信效率
- 现状
  - VoLTE 广泛流行，主流网络运营商都已支持
- 相关
  - ViLTE

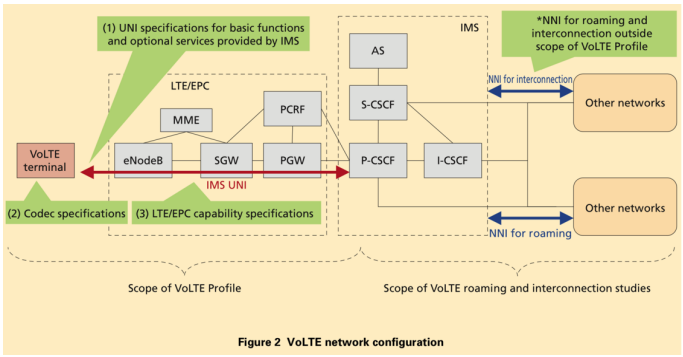
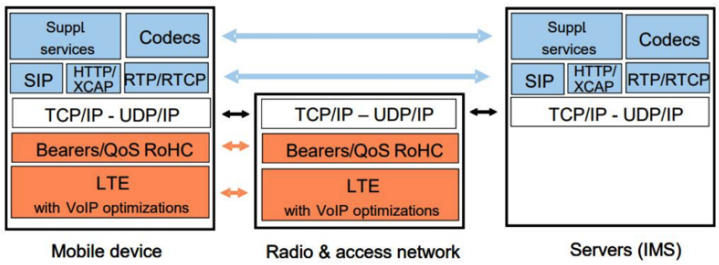
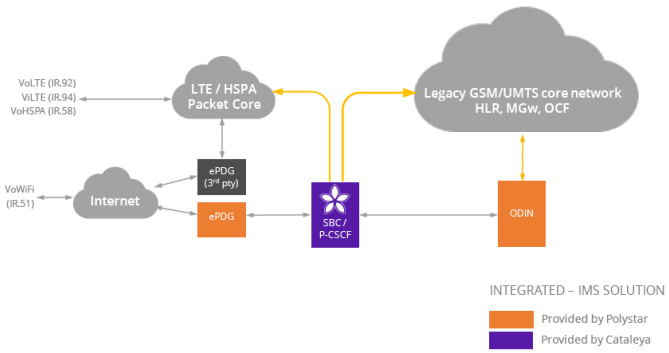
        - 作为 `VoLTE` 的补充
        - 也是 `GMSA` 制定的规范
        - 也正在被慢慢接受
- 前景
    - `VoLTE` 和 `ViLTE` 逐渐成为基于 `IP` 的网络的核心服务
        - 就像
            - 语音是 `2G` 和 `3G` 网络的核心服务
- 功能
    - 实现高清电话
        - 用于帮助网络运营商对抗 `OTT` 互联网的 `VoIP` 服务
- 优势和特点
    - 延迟更低，容量更高
        - 对比
            - `OTT` 的 `VoIP`
                - 其最大化利用了底层网络能力
                    - 会在一定程度上影响音视频服务的质量
    - 支持 `QoS`
- 架构
    - `VoLTE` 的架构=Profile=configuration
        - VoLTE network configuration
        - 

        Figure 2 VoLTE network configuration
        - -> VoLTE Profile中：
            - 定义了：`UNI`
            - 但是没定义：`NNI`
                - 涉及到不同网络之间的交互和漫游
                    - 其他规范中定义了
    - GSMA PRD IR.92 Depiction of UE and Network Protocol Stacks in IMS Profile for Voice
        - 

        GSMA PRD IR.92 Depiction of UE and Network Protocol Stacks in IMS Profile for Voice
        - 作用
            - VoLTE中的
                - `SIP` 用于 （传输）控制（信号）

            - registration
            - authentication
            - addressing
            - call establishment
            - call termination
        - `SDP` 用于 （传输音视频）数据
            - `RTP` media and bandwidth negotiation
- 服务标准：`SR-VCC`
    - `SR-VCC` = `Single Radio Voice Call Continuity`
    - 背景
        - 当LTE网络还没完全覆盖时，但却又希望提供VoLTE和ViLTE的服务
    - 方案
        - 为了解决当单射频UE在LTE/Pre-LTE 网络和2G/3G CS网络之间移动时，如何保证语音呼叫连续性的问题
        - 3GPP提出的一种VoLTE语音业务连续性方案
        - 实现2G/23到VoLTE的语音电话的无缝衔接
            - 实现voice call continuity=持续性语言呼叫=保持语音的持续性（不断掉）
    - 等级
        - `eSRVCC` = `enhanced SR-VCC`
        - `vSRVCC` = `video SR-VCC`
        - `rSRVCC` = `reverse SR-VCC`
- 具体实现路径（策略）
    - 有多种
        - 根据运营商的不同情况
            - 可用的频谱多少
            - 语音策略
            - 技术架构
            - 商业目标
            - 市场情况
    - 举例
        - 逐渐演化的方式
            - 以 `CSFB` 开始
            - 先部署好IMS
            - 在 `LTE` 网络没有完全覆盖之前
                - 再引入 `SR-VCC`
        - 一步到位方式
            - 当 `LTE` 网络完全覆盖后
            - 再直接实现 `VoLTE`
- 编解码codec
    - `EVS` = `Enhanced Voice Services`
        - 不同模式
            - `WB` = `WideBand`
            - `SWB` = `Super-WideBand`
            - `FB` = `Full-Band`
        - 不同比特率
- 符合监管Regulatory
    - 美国和加拿大

        - E-911 location requirements
        - text-to-911
        - 紧急和警报服务 emergency and alerting services
        - 合法监听 lawful interception
        - 政府优先服务 government priority services
- 漫游
    - 架构=模型
        - 旧：`LBO` = `Local Breakout`
        - 新：`S8HR` = `S8 Home Routed`
    - 涉及到多个方面
        - 收费 billing and charging
        - 紧急情况 emergency
        - 合法监听 lawful interception
- 实现方案
    - 举例
        - 某公司：CATALEYA



RCS

详见独立教程：

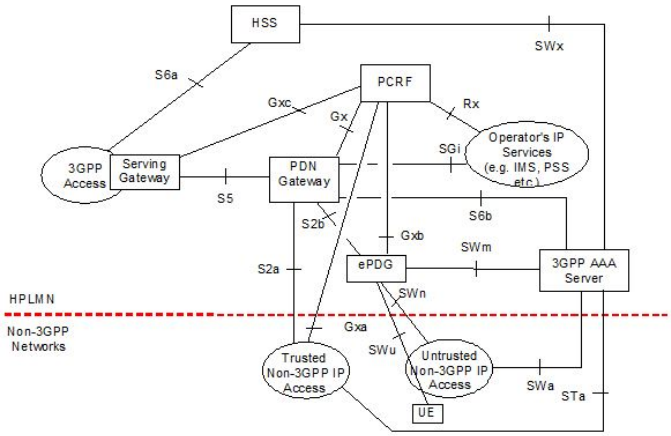
- 5G消息RCS技术总结
- RCS技术开发总结

ViLTE

- `ViLTE`
  - = `Video over LTE`

VoWiFi

- VoWiFi
  - = `Voice over Wi-Fi`
  - 架构
    - TS-23-402 architecture enhancements for non-3GPP (non-roaming) access



附录

下面列出相关参考资料。

名词术语

- CPM=Converged IP Messaging
- ISF=Interworking Selection Function
- IWF=Interworking Function
  - SMS-IWF
  - MMS-IWF
  - EMAIL-IWF
- OMA
  - NI=Network Interface
    - UNI=User-Network Interface
    - NNI=Network-Network Interface
  - MO=Management Objects
  - DM=Data Management
  - CP=Contents Provisioning
  - XDM=XML Document Management
    - XDMS=XML Document Management Server
  - PF=Participating Function
  - CF=Controlling Function
- MMSC=MultiMedia Service Center
- SMSC=SM-SC=Short Message Service Center
- AMPS=Advanced Mobile Phone System
- TACS=Total Access Communications System
- NMT=Nordisk MobilTelefoni
  - 英语名：Nordic Mobile Telephone
- C-Netz
  - 德语：Funktelefonnetz-C
  - 英语：Radio Telephone Network C
- D-AMPS=Digital Advanced Mobile Phone System
- IS-95=Interim Standard 1995
- IRAT=Inter Radio Access Technology
- IMT2000=International Mobile Telecommunication specifications for the year 2000
- TD-SCDMA=Time division-synchronous code-division multiple access
- TDD=Time Division Duplex
- BTS=Base Transceiver Station
- NR=New Radio
- BSC=Base Station Controller
- RNC=Radio Network Controller
- eNB=eNodeB=evolved Node B
- `CSFB` = `Circuit Switched Fallback`
- `VoLGA` = `Voice over LTE via Generic Access`
- `CS` = `Circuit Switched`
- `PS` = `Packet Switched`
- `ViLTE` = `Video over LTE`
- `VoLTE` = `Voice over LTE`

- `QoS` = `Quality of Service`
- `SR-VCC` = `Single Radio Voice Call Continuity`
- `eSRVCC` = `enhanced SR-VCC`
- `vSRVCC` = `video SR-VCC`
- `rSRVCC` = `reverse SR-VCC`
- `IMS` = `IP Multimedia Subsystem`
- `EVS` = `Enhanced Voice Services`
- `WB` = `WideBand`
- `SWB` = `Super-WideBand`
- `FB` = `Full-Band`
- `LBO` = `Local Breakout`
- `S8HR` = `S8 Home Routed`

参考资料

DOING:

-

TODO:

- 【整理】RCS相关名词和含义解析和逻辑关系
- 【整理】什么是ABG
- 【整理】什么是DSLAM

DONE:

- 【整理】什么是IBCF CBGF SBC
- 【整理】什么是MSC SMSC GMSC
- 【整理】什么是HLR AuC
- 【整理】IMS架构兼容不同阶段和类型无线网络
- 【整理】IMS即IP多媒体子系统详解
- 【整理】IMS系统中的User Identity用户标识用户身份相关基础知识
- 【整理】什么是GPRS GSM LTE
- 【已解决】rcsjta项目RCS中IMS认证方式GIBA和DIGEST区别
- 【整理】IMS相关知识学习：es_282001v020000m.pdf TISPAN NGN Functional Architecture
- 【整理】搞清楚RCS和IMS的架构逻辑关系
- 【整理】NGN和TISPAN和IMS架构和相关组织关系整理
- 【整理】ETSI和TISPAN和NGN协议标准及相关内容
-
- 5G技术概述
- 5G消息RCS技术总结
- RCS技术开发总结
-
- Full MVNO Architecture - HSS/HLR, GMSC, GGSN, PGW and SMSC
- What is GSM, EDGE, GPRS, UMTS 3G, HSDPA, HSUPA, LTE – 4G LTE Mall
- CDMA vs GSM vs LTE: The Differences & What You Need to Know | US Mobile
- What is the difference between GSM, UMTS and LTE? - Commsbrief
- Past and present reports - Mobility Report - Ericsson
- june2020-ericsson-mobility-report.pdf
- Difference between digital and analogue mobile networks - Commsbrief
- What is a GSM network and how does it work? - Commsbrief - Mobile Networks & Devices
- What is the average speed of 4G LTE? Commsbrief Mobile Networks & Devices

- 3G - 维基百科，自由的百科全书
- 3G - Wikipedia
- High Speed Packet Access - Wikipedia
- 5G NR - Wikipedia
- What is the Difference Between 5G NR and 4G LTE? – Router Switch Blog
- What is the difference between 5G NR and 4G LTE?
- Differentiate Between 4G LTE and Non-Standalone 5G NR Antennas | Microwaves & RF
- Qualcomm Future of 5G Building a unified, more capable 5G air interface for the next decade and beyond
- The-5G-Guide_GSMA_2019_04_29_compressed.pdf
- 基于IMS的固定和移动网络融合 - 技术现状IMS全面推动业务能力开放 ICT融合应用开启政企市场蓝海专题 — C114(通信网)
- IMS网络在全业务运营背景下的地位 - C114通信网
- VoLTE移动语音演进之路
- S.5 Network Domain Security for IMS – iTecTec
- IMS Identification and numbering | Rauf's Knowledge Portal
- ims_identification_and_numbering.pdf
- 实现 IMS | Android 开源项目 | Android Open Source Project
- IMS/SIP - RCS : Presence Notify ShareTechnote
- Much Ado about Registration | Real Time Communication
- Toward a Service Broker for telecom service integration in IMS network | Semantic Scholar
- Telecoms & Internet converged Services & Protocols for Advanced Networks - Wikipedia
- Telecommunication and Internet Converged Services and Protocols for Advanced Networks - Wikipedia, la enciclopedia libre
- Svyazcom — IM-SSF
- IP Multimedia Service Switching Function (IM-SSF)
- IM-SSF - IP Multimedia - Service Switching Function
- RFC 3398 - Integrated Services Digital Network (ISDN) User Part (ISUP) to Session Initiation Protocol (SIP) Mapping
- draft-ietf-sip-isup-03 - ISUP to SIP Mapping
- SIP-AS - SIP Application Server
- Plain old telephone service - Wikipedia
- How Telephones Work | HowStuffWorks
- DOCSIS - Wikipedia
- CableLabs - Wikipedia
- SCTE- ISBE Live Learning Webinar Series: Getting Ready for DOCSIS 4.0 | Light Reading
- Cable_Architecture_Declaration_01.14.10.pdf
- 02_TISPAN_Muench.pdf
- PTT : Push-To-Talk
- WAG - WLAN Access Gateway
- What is the difference between a Hotspot and an Access Point and a Wireless Access Point?
- Difference between WiFi and HotSpot - GeeksforGeeks
- 热点 (Wi-Fi) - 维基百科，自由的百科全书

- What does WAP or WAG or WDM written over train engine signifies? - Quora
- Wi-Fi Access Gateways - TechLibrary - Juniper Networks
- GPRS core network - Wikipedia
- es_282001v020000m.pdf
- Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture
- TISPAN
- Overview of ETSI TISPAN IPTV ETSI TISPAN
- ETSI NGN Work: TISPAN Status
- CENELEC - About CENELEC - Who we are - Technical Bodies
-