3G All IP Network
Outline

- Mobile Technology Evolution
- GPRS Overview
- 3GPP UMTS System (Release 99)
- Introduction to VoIP Technologies
  - H.323
  - SIP
  - MGCP/MEGACO
  - SIGTRAN
  - Softswitch
- 3GPP All IP Network
Mobile Technology Evolution

- 1G – Analog System
  - AMPS (Advanced Mobile Phone System): 中華電信090系統

- 2G – Digital System
  - GSM (Global System for Mobile Communication)
    - 900MHz and 1.8GHz (DCS1800)
    - TDMA and FDMA Technologies
    - 9.6K bps Data Rate (Shore Message Service; SMS)
      - 歐亞160 Countries, 全球55%市場, 約5億個用戶
  - CDMA (Code Division Multiple Access)
    - IS-95: Data Rate 14.4K bps (cdmaOne) → IS-95B: Data Rate 64 Kbps
    - Qualcomm
      - 亞太北美市場, 約7,500萬用戶
  - D-AMPS
    - 又稱IS-136
2.5G

➢ GSM System
  • High Speed Circuit Switch Data (HSCSD)
    ✓ Up to 115.2 Kbps
  • General Packet Radio Service (GPRS)
    ✓ Up to 171.2 Kbps
  • Enhanced Data rates for GSM Evolution (EDGE)
    ✓ 改變調變技術
    ✓ up to 384 Kbps (Also considered as 3G technology)
    ✓ D-AMPS → EDGE

➢ cdma System
  • cdma 1x
    ✓ Up to 144 Kbps
    ✓ Korea
GPRS System

- Packet Switching Technology
- Based on GSM Cellular Network
- High Data Speed
  - 21.4 Kbps per Time Slot (channel)
  - Up to 8 Time Slots

Physical Channel for Data Transmission
- Assigned on Demand
- Can Be Shared with Other Users

![GPRS System Diagram]
SGSN and GGSN

**Serving GPRS Support Node**
- Mobility Management (Location Update, Paging etc.)
- Access Control & Security (Authentication, Ciphering)
- BSS Queue Management
- GSM Circuit-Switched Interactions
- Operation Data, such as Billing Info.

**Gateway GPRS Support Node**
- Interworking between PDN and GPRS PLMN
- Packet Screening
- Routing Tables about Attached GPRS Subscribers
- Address Mapping
- PDU Tunneling
- Operation Data, such as Billing Info.
GPRS MM/SM

- Mobility Management
  - Attach
  - Detach
  - Security
  - Routing Area Update

- Session Management
  - PDP Context Activation
  - PDP Context Deactivation
  - PDP Context Modification
3G

- **IMT-2000**
  - Year **2000 Ready**
  - Operate at **2000 MHz**
  - Provide **2000K bps Data Rate**

- **3G Data Rate 要求**
  - Vehicular -- 144 Kbps
  - Pedestrian --- 384 Kbps
  - Indoor --- 2Mbps

- Three Important 3G Technologies Standards
  - W-CDMA (Wideband CDMA) (歐日系統)
    - GSM/GPRS/EDGE → W-CDMA
  - cdma2000 (北美系統)
  - TD-SCDMA (Time Division Synchronize CDMA) (大陸系統)
From 2G to 3G

- From Voice Service to Rich, Interactive Multimedia-based Personal Communication Service
- Permanent Network Connection with High Data Rate
  - 384 Kbps to 2 Mbps
  - Mobile Access to High-quality Video, Audio, Graphics and Multimedia as Fixed Internet
- Massive Increase in Network Capacity
  - To Support Billions of Subscribers
- Global Roaming
  - To Use Single Terminal to Access Identical Services All Around the World
3GPP UMTS System

System Architecture of 3GPP Release 99
3GPP All IP Network
All IP Architecture

- Based on packet technologies and IP telephony for real time and non real time services
- An evolution from Release 99 specifications
  - All IP core network should support release 99 CS terminals
- Radio Access Network (RAN)
  - GERAN and UTRAN
- Core Network
  - Based on the evolution of GPRS
3GPP All IP Network

Reference: CCL/ITRI
Circuit-Switched Services

- Circuit
- Signaling (SS7 or IP based)
- Packet (user traffic / signaling)
- Call control function

Reference: CCL/ITRI
Packet-Switched Services

Reference: CCL/ITRI
Real-Time PS Services

Reference: CCL/ITRI
Interworking with PSTN

Reference: CCL/ITRI
HSS

- HSS (Home Subscriber Server) is the master database for a given user.

- **Functionalities**
  - The HLR functionality required by the PS-Domain
  - The circuit switched part of the HLR
  - User control functions required by the IP multimedia (IM) subsystem
CSCF [1/4]

- Call State Control Function
- ICGW (Incoming Call Gateway)
  - Acting as a first entry point to perform routing of incoming calls
- CCF (Call Control Function)
  - Call setup/termination and call state/event management
  - Application level registration handling
- SPD (Serving Profile Database)
  - Interacting with HSS to receive user profile information
- AH (Address Handling)
  - Mapping between alias address (e.g., E.164 number) and transport address
CSCF [2/4]

- Proxy CSCF (P-CSCF) is the first contact point within IM CN subsystem.
  - Its address is discovered by UEs following PDP context activation procedure.
  - Behaving like a **Proxy** server defined in RFC2543

- **P-CSCF Discovery**
  - Use of DHCP (Dynamic Host Configuration Protocol)
  - Transfer the P-CSCF address with the PDP Context Activation signaling to the UE
Serving CSCF (S-CSCF) performs the session control service for the UE.

- Maintaining a session state as needed by the network operator for support of the services

**Registration**

- Behaving as a Registrar as defined in RFC2543
- It accepts registration requests and makes its information available through the location server (e.g., HSS).

**Session Flow**

- Interaction with service platform for support of services
Service Platform Interface
Interrogating CSCF (I-CSCF) is the contact point within an operator’s network for all connections destined to
- a subscriber of that network operator, or
- a roaming subscriber currently located within that network operator’s service area.
- That is, I-CSCF is the first contact point within an operator’s network for incoming call signaling.

**Registration**
- Assigning a Serving CSCF to a user performing SIP registration

**Session Flow**
- Routing a SIP request received from another network towards the S-CSCF (Serving Terminating UE)
- Obtaining the S-CSCF address from HSS
MGCF & MGW

➢ Media Gateway Control Function
  • Being PSTN signaling termination point
  • Performing protocol conversion between the legacy (e.g., ISUP) and the All-IP network call control protocols

➢ Media Gateway
  • Being PSTN transport termination point
  • Interfacing UTRAN over Iu
MSC Server

- Mainly comprising the call control and mobility control parts of a GSM/UMTS MSC
- Performing the connection control for media channels in a MGW
- MSC server + MGW = MSC
MRF

- Multimedia Resource Function
  - Performing multi-party call and multi-media conferencing functions
  - The same function as an MCU in the H.323 network
T-SGW & R-SGW

➢ Transport Signaling Gateway Function
  • Mapping call related signaling from PSTN/PLMN on an IP bearer and sending it to the MGCF
  • Providing PSTN/PLMN↔IP transport level address mapping

➢ Roaming Signaling Gateway Function
  • Providing communication with a 2G/R99 MSC/VLR
IM Subsystem

- IP Multimedia (IM) CN subsystem
  - Comprising all CN elements for provision of multimedia services

- The IM subsystem (IMS) utilizes the PS domain to transport multimedia signaling and bearer traffic.

- The IMS attempts to be conformant to IETF “Internet standards”.
  - SIP (Session Initiation Protocol) has been selected as the interfaces between the IM CN elements.
1. Bearer Level Registration: GPRS

2. PDP Context Activation

3. P-CSCF Discovery

4. Application Level Registration
Application-level Registration

Reference: CCL/ITRI
Application Level Registration

1. Register
2. Register
3. Cx-Query
3. Cx-Query Resp.
4. Cx-Select-Pull
4. Cx-Select-Pull Resp.
5. Register
6. Cx-Put
6. Cx-Put-Resp.
7. Cx-Pull
7. Cx-Pull-Resp.
8. 200 OK
9. 200 OK
10. 200 OK
Call Setup Diagram

Reference: CCL/ITRI
Session Flow Procedure

UE#1 | S-CSCF#1 | S-CSCF#2 | UE#2
---|---|---|---
INVITE
SDP
Final SDP
Reserv Success
Ringing
200 OK
ACK
183 Session Progress + PRACK

Visited Network Home Network#1
UE#1 P-CSCF S-CSCF#1 I-CSCF#2 HSS S-CSCF#2 P-CSCF UE#2

183 (SDP) 183 (SDP) 183 (SDP) 183 (SDP)
PRACK (Final SDP) PRACK (Final SDP) PRACK (Final SDP) PRACK (Final SDP)

Authorize QoS Resource

200 OK 200 OK 200 OK 200 OK
Ring (180 Ringing) + 200 OK (Hang Up) + ACK