All-IP Network Architectures and Wireless Evolution

Assist. Professor Tasos Dagiuklas
Our Location
Presentation Outline

- Technology Evolution
- Towards All-IP Networks
- Characteristics of Next Generation Networking
- Wireless Evolution
- Service Evolution in the Wireless World
Next Generation Networks

**Past:** one network for each service/device

**Future:** common net for all services/devices; services independent of connectivity & control
Technology Evolution

Voice Cycle
- Voice over TDM

Data Cycle
- Voice over Frame Relay
- Voice over ATM

Multiservice Cycle
- Voice over IP

Circuit-Switched Infrastructure
Packet-Switched Infrastructure

1980 2000
The Future is about Value-Added Services (1)

Managed Video Applications

Broadcast Television

Video Communications Services

VIDEO ON DEMAND

TV ON DEMAND / nPVR

Gaming / Interactive TV

VIDEO PHONE / VIDEO CONFERENCING

“Over the Top” Video

VIDEO STREAMING

VIDEO PHONE / VIDEO CONFERENCING

VIDEO TO OTHER DEVICES

Managed Video Applications

Broadcast Television

VIDEO ON DEMAND

TV ON DEMAND / nPVR

Gaming / Interactive TV

“Over the Top” Video

VIDEO STREAMING

University of Patras
Erasmus Program, Wi-CoNet 2009

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The Future is about Value-Added Services (2)

Communication
- Push-to-talk / push-to-show
- Multimedia Messaging
- Multi-Party Chat
- Multimedia Conferencing

Entertainment
- Person-to-Person Gaming
- Interactive Shows and Events
- Multimedia Advertisement
- Audio and Video Streaming

Enterprise and on the road
- Dynamic Info Services
- Interactive guidance
- Remote Facility Control
- Collaborative working
NGN Fundamental Aspects (1)

- Packet-based transfer
- Separation of control functions among bearer capabilities, call/session, and application/service
- Decoupling of service provision from network, and provision of open interfaces
- Both services and access networks are evolving quickly. Support for flexible and generic QoS, traffic handling and bandwidth management is a must to enable user services, conserve network resources where needed, and contain costs.
- Services will need to be adaptable enough to provide a good user experience, regardless of the access method being used.
- A rich user experience does not always demand for high bandwidth. In the future the cached information could be for example the face in a video conversation, stored in addition to the name and the number of a contact.
NGN Fundamental Aspects (2)

• One of the most important aspects of NGN is the separation of the access provider from the "service" provider.
  – It means that the access provider (the service provider that provides the customer with access to the NGN) may be different than the service provider that provides the customer with various services, such as voice and video communication, e-mail, stock quotes, or other services.

  – However the access provider and service provider might be the same company. For example, a subscriber to cable services may elect to purchase voice (telephone) services from the cable company. In that case, the access provider and voice service provider are the same.
NGN Fundamental Aspects (3)

- Support for a wide range of services, applications and mechanisms based on service building blocks (including real time/ streaming/ non-real time services and multi-media)

- Broadband capabilities with end-to-end QoS and transparency

- Interworking with legacy networks via open interfaces

- Ubiquitous mobility

- Unrestricted access by users to different service providers

- A variety of identification schemes which can be resolved to IP addresses for the purposes of routing in IP networks
An NGN is characterized by

- Converged services between Fixed/Mobile
- Independence of service-related functions from underlying transport technologies
- Compliant with all regulatory requirements, for example concerning emergency communications and security/privacy
Advantages of IP Structure

- Heterogeneous wireless networks are complementary to each other
- Single network that represents the convergence of multiple independent networks (voice, data, video) into a single unified network
- Operational efficiencies of a single integrated network
- Facilitate new service development and implementation
- Shorten time-to-market for new services
- Seamless deployment of voice services across packet network
- Distributed networking model for scalability, performance, and reliability
What All-IP means

Main driver: generate revenues

End-to-end IP based application

IP-fication

Main driver: reduce costs

Transport network
Future Trends

• At the network architecture level
  – Higher access network data rates
  – Different access technologies connected to same IP core
  – Flatter architectures

• At the service level
  – The introduction of service enabling framework
  – Engagement of third party providers
  – Rapid introduction of location based services with rich media
Challenges

• Telecom Networks are much than simple networks
  – Multiple tiers (e.g RAN, IP Networks, IMS)
  – QoS must be guaranteed at all tiers
• QoS signaling on end-end basis poses sig
• Multiple design challenges
  – Policy Management Platforms
  – Many Architectural Options (Flat, Hierarchical)
Wireless Evolution
Wireless Vision

Ubiquitous Communication Among People and Devices

- Wireless Internet access
- Nth generation Cellular
- Wireless Ad Hoc Networks
- Sensor Networks
- Wireless Entertainment
- Smart Homes/Spaces
- Automated Highways
- All this and more…
  - Hard Delay Constraints
  - Hard Energy Constraints
GSM (1)

- Groupe Special Mobile », later changed to « Global System for Mobile »
- It is joint European effort beginning in 1982 (The most successful ETSI standard)
- Focus on seamless roaming across Europe
- Services launched 1991
- Time division multiple access (8 users per 200KHz)
- 900 MHz band; later extended to 1800MHz
- Added 1900 MHz (US PCS bands)
- GSM is dominant world standard today
- Bearer services ranging from 300 bps to 9600 bps
- It provides mainly voice services
- Speech Coding
  - (Enhanced) Full-Rate: 13 Kbps
  - GSM Half Rate: 7 Kbps
GSM (2)

- CS-domain services of GSM are adopted from ISDN
- IN, Intelligent Network
  - Centralized call control
- Tailored services to individual users:
  - PrePaid: Enables customers to pay for mobile phone calls without receiving a bill or entering into a contract.
  - VPN, Virtual Private Networks: This service incorporates phone, mobile into a closed 'private network.'
  - Usage Limitation: Helps prevent misuse and fraud by setting call usage limitations based on daily, weekly, or monthly basis.
- Advanced Routing Services: Allows customers to decide how their calls will be routed.
- VAS, Value Added Services
  - Voice Mail System
  - SMS, Short Message Service System
GPRS (1)

- In order to improve GSM’s data transmission capacities (Circuit switching, low data rate 9.6 kbps)
- GPRS provides packet mode transfer for applications with a selection of QoS parameters for service request;
- It allows for broadcast, multicast and unicast service and easily working with the packet-oriented Internet.
- Depending the coding, a transfer rate of up to 150 Kbps is possible, e.g., allocating all time-slots using the coding of 14.4 Kbps traffic channels results in a 115.2 Kbps channel.
• It is independent of channel characteristics and of the type of channel (traditional GSM traffic or control channel), and does not limit the maximum data rate (only the GSM transport system limits the rate).
• All GPRS services can be used parallel to conventional services.
• GPRS offers point-to-point (PTP) packet transfer service (ETSI):
  – one version –"PTP connection oriented network service (PTP-CONS) as like X.25, the typical circuit-switched packet-oriented transfer protocol.
  – PTP connectionless network service (PTP-CLNS) which supports applications on the IP.
• Users of GPRS can specify a QoS-profile to determine the service precedence (high, normal, low), reliability class and delay class of the transmission, and user throughput.
• **SGSN: Serving GPRS Serving Node**
  – At the same hierarchical level as the MSC.
  – Transfers data packets between mobile stations and GGSNs.
  – Keeps track of the individual MSs’ location and performs security functions and access control.
  – Detects and registers new GPRS mobile stations located in its service area
  – Participates into routing, as well as mobility management functions.

• **GGSN: Gateway GPRS Serving Node**
  – Provides inter-working between PLMN and external packet-switched networks.
  – Converts the GPRS packets from SGSN into the appropriate packet data protocol format (e.g., IP or X.25) and sends out on the corresponding packet data network.
  – Participates into the mobility management.
  – Maintains the location information of the mobile stations that are using the data protocols provided by that GGSN.
  – Collects charging information for billing purpose.
GPRS (4)

- Tunnels of data and signaling messages between GPRS support nodes.

- Protocol architecture based on the Internet Protocol (IP).

- GTP (GPRS Tunneling Protocol) used to tunnel user data and signaling between GPRS Support Nodes. All PDP (Packet Data Protocol) PDUs (Protocol Data Units) shall be encapsulated by GTP.
2G/2.5G Architecture
GSM Evolution for Data Access
3G Partnership Project (3GPP)

- 3GPP defining migration from GSM to UMTS (W-CDMA)
- Core network evolves from GSM-only to support GSM, GPRS and new W-CDMA facilities
- 3GPP Release 99 - Adds 3G radios (HSDPA)
- 3GPP Release 4
  - Adds softswitch/voice gateways and packet core
- 3GPP Release 5
  - First IP Multimedia Services (IMS) w/ SIP & QoS
- 3GPP Release 6
  - “All IP” network; contents of r6 still being defined. WLAN integration, Multicast/Broadcast services
- 3GPP Release 7
  - High efficiency VoIP Over HSDPA and EDCH
- 3GPP Release 8
  - WiMax Integration,
EDGE (1)

- Supported by 3GPP
- Add on to GSM/GPRS -> Requires hardware changes in MS and BSS only
- New modulation scheme allows higher speeds
  - Error-tolerant transmission methods
  - Link adaptation
- Data rates up to 384 Kbps
EDGE (2)

- EGPRS
  - Enhanced GPRS
  - Different behavior and protocols on the BTS side
  - Uses the same protocols within the core network
- EGPRS changes only the BSS part of the network
Radio Access Networks

- GERAN (GSM/EDGE Radio Access Network)
  - 3GPP Release 5 defines how to connect to 3G core network
- UTRAN
  - WCDMA based for the UMTS
- HSPDA
- E-DCH
UMTS Multi-Radio Networks

GSM/EDGE
R’99, HSDPA
Other e.g., WLAN

UMTS Core Network (MSC, HLR, SGSN, GGSN)

Packet-Switched Networks
Circuit-Switched Networks
Other Cellular Operators

Radio Access Networks
External Networks
WCDMA

- Wideband CDMA
- Standard for Universal Mobile Telephone Service (UMTS)
- Committed standard for Europe and likely migration path for other GSM operators
- It leverages GSM’s dominant position
- Requires substantial new spectrum
- 5 MHz each way (symmetric)
- Legally mandated in Europe and elsewhere
- Sales of new spectrum completed in Europe
- 3G speeds: 384 Kbps (pedestrian); 144 Kbps (vehicular); 2 Mbps (indoor office).
UTRAN Architecture (1)

- **UTRAN consists of**
  - Base stations (Node B)
  - Controller (RNC)
  - Iur interface between two RNCs
  - Iub interface between RNC and Node B

- **UTRAN is connected to**
  - Circuit switched CN (i.e., 3G MSC) via Iu-CS interface
  - Packet switched CN (3G SGSN) via Iu-PS interface
  - User equipment via Air interface (Uu)
UTRAN Architecture (2)

- 1 RNC and 1+ Node Bs are grouped together to form a Radio Network Sub-system (RNS)
- Handles all Radio-Related Functionality
  - Soft Handover
  - Radio Resources Management Algorithms
- Maximization of the commonalities of the PS and CS data handling
Hard Handover versus Soft Handover

**Hard Handover**

**Soft Handover**

Make before break: *the mobile is connected to two or more base stations*
HSPDA

- High Speed Downlink Packet Access
- High Speed data enhancement for WCDMA/UMTS
- Peak theoretical speeds of 14 Mbps
- Initial devices will support 1.8 Mbps and 3.6 Mbps peak rates
- Methods used by HSDPA
  - High speed channels shared both in the code and time domains
  - Short transmission time interval (TTI) as low as 2 msec, that allows faster responses to changing radio conditions and error conditions
  - Fast scheduling and user diversity (Efficient scheduler favors transmissions to users with best radio conditions)
  - Higher-order modulation (QPSK, 16 QAM)
  - Fast hybrid automatic-repeat-request (HARQ) that improves the efficiency of error processing
WCDMA/HSPDA Spectrum

- = WCDMA/HSDPA band in 3GPP today
- = WCDMA/HSDPA band under work in 3GPP, target end of 2005

<table>
<thead>
<tr>
<th>Up to</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2600</td>
<td>190 MHz</td>
</tr>
<tr>
<td>2100</td>
<td>2x60 MHz</td>
</tr>
<tr>
<td>1900</td>
<td>2x60 MHz</td>
</tr>
<tr>
<td>1700/2100</td>
<td>2x45 MHz</td>
</tr>
<tr>
<td>1800, 1700(^1)</td>
<td>2x75 MHz</td>
</tr>
<tr>
<td></td>
<td>2x30 MHz</td>
</tr>
<tr>
<td>900</td>
<td>2x35 MHz</td>
</tr>
<tr>
<td>800, 850</td>
<td>2x25 MHz</td>
</tr>
</tbody>
</table>

\(^1\)1800 completed, 1700 under work in 3GPP
E-DCH/HSUPA

- Uplink Enhanced Dedicated Channel (E-DCH)
- Sometimes called High Speed Uplink Packet Access (HSUPA)
- 85% increase in overall cell throughput on the uplink
- 50% gain in user throughput
- Reduces packet delays by up to 50%
- Methods:
  - Dedicated channel that is shared in time between different users
  - Short transmission time interval (TTI), as low as 2 msec, that allows faster responses to changing radio conditions and error conditions
  - Fast Node B based scheduling, that allows the base station to efficiently allocate radio resources
  - Fast Hybrid Automatic Repeat Request, that improves the efficiency of error processing
GERAN Interfaces

• 2G interfaces
  – A GSM circuit switched interface (voice)
  – Gb GPRS packet switched interface

• 3G interfaces
  – Iu-cs UMTS interface to the circuit switched part of core network
  – Iu-ps UMTS interface to the packet switched part of core network

• A mobile terminal may operate either in A/Gb mode or in Iu mode
## Comparison of Capabilities

<table>
<thead>
<tr>
<th></th>
<th>Peak Network Downlink Speed</th>
<th>Average User Throughput for File Downloads</th>
<th>Capacity/Spectral Efficiency</th>
<th>Other Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GPRS</strong>[^1]</td>
<td>115 kbps</td>
<td>30 – 40 kbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EDGE</strong></td>
<td>473 kbps</td>
<td>100 – 130 kbps</td>
<td>Double that of GPRS</td>
<td>Backward compatible with GPRS</td>
</tr>
<tr>
<td><strong>UMTS - WCDMA</strong></td>
<td>2 Mbps[^2]</td>
<td>220 - 320 kbps</td>
<td>Increased over EDGE for high-bandwidth applications</td>
<td>Simultaneous voice and data operation, enhanced security, QoS, multimedia support, and reduced latency</td>
</tr>
<tr>
<td><strong>UMTS - HSDPA</strong></td>
<td>14 Mbps[^3]</td>
<td>550-1100 kbps</td>
<td>Two and a half to three and a half times that of WCDMA</td>
<td>Backward compatible with WCDMA</td>
</tr>
<tr>
<td><strong>3GPP Long Term Evolution</strong></td>
<td>100 Mbps (Target goal)</td>
<td>10 Mbps (Target goal)</td>
<td>Two to four times higher than HSDPA (Target goal)</td>
<td>Goal of radio interface latency of less than 10 msec. (Target goal)</td>
</tr>
</tbody>
</table>

[^1]: Reference for GPRS
[^2]: Reference for UMTS - WCDMA
[^3]: Reference for UMTS - HSDPA
3GPP Architecture (Rel 4)
All-IP 3G Network

CS Domain
- Wireless Access (Cellular, Wireless LAN)
- Mobile Switch Server
- Mobile Packet Server (SGSN)
- MGW
- GW Switch Server

PS Domain
- IP backbone
- GW Packet Server (GGSN)

IMS (IP Multimedia Subsystem)
- HSS (HLR+AAA)
- SIP Server
- MGW Controller
- Signaling GW
- Application Server

Circuit-switched Communication
- ISDN/PSDN

Data Communication
- Internet

CS: Circuit Switched
PS: Packet switched

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Towards 3G LTE

- **A step in performance and capabilities**
  - Data rates up to 100 Mbps in local area
  - Latency less than 10 ms
  - Improved spectrum efficiency
  - IP optimized
  - Broadcasting
  - Spectrum flexibility

- **Wider carrier bandwidth based on AML-OFDM** (up to 20 MHz, scalable downwards)

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3GPP Long Term Evolution

- Planned for 2008+ deployment
- Detailed stage 2 description by 2006
- OFDM a candidate technology
- Goals
  - Increase spectral efficiency over Release 6 by a factor of two to four
  - Support flexible bandwidth, ranging from 1.25 MHz to 20 MHz
  - Support peak rates of 100 Mbps on the downlink and 50 Mbps on the uplink
  - Reduce latency to 10 msec round trip time between user equipment and the base station, and
  - Less than 100 msec transition time from inactive to active
UMTS Features (1)

- **UMTS R99**
  - GSM RAN replaced by UTRAN
    - W-CDMA
    - Higher bandwidth (Up to 2Mb/s)
    - Macrodiversity, soft(er) handover
    - Functionality differently distributed compared to GSM RAN
  - Support for QoS classes

- **UMTS Rel4**
  - Separation of Transport and Control in CS domain
  - CS Domain may also be IP-based
UMTS Features (2)

- Release 5
  - IMS
  - Layer 2 between RNC and GGSN not necessarily ATM-based
  - Flexible RANs
  - May attach GSM RAN and GERAN to PS domain
  - The proper term to refer to a system including GERAN and GSM RAN is „3GPP network“ rather than „UMTS network“
  - HSDPA (High Speed Downlink Packet Access)
    - 3.5G“
    - UTRA enhancement to increase downlink packet rate
    - Up to 14 Mb/s
UMTS Features (3)

- **Release 6**
  - Allow cost efficient sharing of network resources
    - Scenario 1: Multiple core networks sharing common radio access network
    - Scenario 2: Geographically split networks sharing
    - Scenario 3: Common Network Sharing
    - Scenario 4: Common spectrum network sharing
    - Scenario 5: Multiple radio access networks sharing common core network
  - IMS Services
  - These are services (mostly) supporting actual user applications
  - Partly standardized by OMA (Open Mobile Alliance)
    - E.g. Push-to-Talk
  - MBMS (Multimedia Broadcast and Multicast Service)
  - WLAN interworking
    - use WLAN as access network for IMS instead of PS Domain
UMTS Features (4)

- Use WLAN as access network
- WLAN operated either by 3GPP operator or by 3rd party
- 6 scenarios are defined:
  - Scenario 1: Common billing and customer care
    - Receive only one bill
  - Scenario 2: Common access control (authentication and authorisation) using a (U)SIM based solution and charging
  - Scenario 3: Access to all 3GPP packet-switched services (e.g., IMS, Push etc.) and services like SMS or MMS
  - Scenario 4: Service continuity between different accesses like WLAN and UTRAN (i.e. service must not be set-up again, if access technology is changed)
  - Scenario 5: Seamless mobility between WLAN and 3GPP access networks
  - Scenario 6: Seamless handover even for CS services
- In Rel6, only scenarios 1-3 are supported
3GPP Architecture (Rel 5/6)

- **IP Multimedia Subsystem – Basic communications platform**
  - SIP signaling, registration, session initiation
  - Usage of IETF protocols, e.g., IPv6, SIP, Diameter
  - SIP-based service environment
  - GERAN alignment with UMTS
  - WCDMA enhancements (e.g., HSDPA, IP transport)
  - MMS enhancements, LCS enhancements

- **IMS Phase II**
  - R5 left-over items (regulatory requirements, circuit-switched interworking, service based local policy enhancements, etc.)
  - Optimised voice communications
  - Presence, Instant Messaging, Group Management and Conferencing
  - * New Work items: 3GPP/3GPP2 IMS harmonisation, UMTS-WLAN interworking, etc.
3GPP Architecture (Rel 7/8)

- LTE results in eUTRAN (evolved UTRAN) for *packet-optimized* radio-access technology
- Goals
  - Decrease user-plane latency
  - Decrease control-plane latency
  - Increase User throughput
- Increased Peak Data Rate (100Mb/s downlink, 50Mb/s uplink)
- Handover to and from UTRAN and GERAN
- WiMax Integration
- PAN Integration
MBMS Technology

- SGSN
- GGSN
- Core Network
The Path towards 4G

2G
- GSM Operator
- Service provider
- Network operator
- Access provider
- Subscriber
- User

3G
- 3G Operator
- Network operator
- Access provider
- Subscriber
- User

4G
- Application provider
- Content provider
- Network Operator
- Access provider
- Mediator
- Subscriber
- User

Static

Dynamic
Beyond 3G

- Multi-access, multi-radio
  - Seamless integration of several radio access networks
- Vertical handovers between systems
- Joint radio resource management
- ABC – Always Best Connected
- Spectrum sharing (Cognitive radio)
  - Coexistence of several systems on same band
  - Spectral efficient communications
  - Free frequency slot can be utilized if the license holder does not occupy it
  - Carrier sensing, withdraw from spectrum if licensed user becomes active
- Multi dimensional communications
  - MIMO antennas, spatial processing
  - Multi-carrier (OFDM)
  - OFCDM = CDMA + OFDM
  - Multi-hop communications, some radio terminals act as relays or routers
### 4G Architecture

- **Internet**: IP backbone
- **Billing**: VHE, SIP Proxy Server, Signalling Gateway, WAP Accounting
- **VHE**
- **Signalling**
- **WAP**
- **Accounting**
- **The Internet**: Context-aware information Centre
- **GSM / GPRS**
- **Broadcast Networks**: (DAB, DVB-T)
- **Satellite FE**
- **Broadcast Networks**: (DAB, DVB-T)
- **UMTS**
- **IP-based micro-mobility**
- **Wireless LANs**
- **SIP Proxy Server**
- **IS**
Service Evolution in the Mobile World

- **Initial Services** will be based on client-server paradigms:
  - Presence
  - Buddy Lists
  - Messaging
  - Push-to-Talk
  - Chat

- **Over time**, real-time requirements and high data volumes will create the need to support direct user-to-user traffic:
  - P2P Gaming
  - Instant file transfer
  - Conferencing/Netmeeting
  - Voice & Video
What is IMS

• It is the acronym for the IP Multimedia Subsystem
• Access framework allowing interworking among heterogeneous networks
• It offers a framework where services can be designed horizontally rather than vertically
• Interworking with other technologies (e.g. CAMEL, Service Oriented Applications) using application servers
• IMS is based on set of standardized protocols (SIP, MEGACO/H.248) thus facilitating interoperability
• IMS is part of wireline (xDSL) and wireless (3GPP, 3GPP2, WiMax)
IMS provides common enablers for services

- Example of Common Enablers
- Authentication and Authorisation
- Naming and Addressing
- Control of QoS and Charging
- Presence and Location
- Session Management
- Group Management
**IMS-supported Session Continuity**

- **Definition of Session Continuity:**
  - The ability of a user or terminal to change the access system while maintaining the ongoing sessions.
  - This may include a session break and resume, or a certain degree of service interruption or loss of data while changing.

- **Support of Session Continuity within the IMS:**
  - Changing the access system usually results in changing the IP address and in changing the fixed point in the network.
  - Authentication of user and authorisation of QoS bearers (including charging information) has to be repeated.

- **IMS can be enabled to support session continuity**
  - (RE-REGISTER to new P-CSCF & RE-INVITE to peers)
Some IMS Components

- IMS Core
  - P-CSCF (Proxy Call Session Control Function) Entry point into IMS world
  - I-CSCF (Interrogating Call Session Control Function) providing topology hiding
  - S-CSCF (Serving Call Session Control Function) the IS anchor point in the home network
- MS (Media Server) – Media Server hosting special resources
- MGF (Media Gateway) for Interworking with legacy networks
- PDF (Policy Decision Function) for QoS Control using Policies (COPS)
  - IMS Application Layer
- HSS (Home Subscriber System) for maintaining subscriber and AS profiles
- AS (Application Server Function) for hosting applications
- IMS enablers (e.g. Presence, Group Mgt.) are specific ASs with generic functions
  - And the IMS end system (IMS Client) plays an important role real multimedia / IMS services
IMS 3GPP Evolution

- IMS brainstorming started in Release 4, without real specs.
- IMS Release 5 is the first complete specification of IMS finished in 2003
- Key features of IMS Release 5:
  - IMS Architecture: IMS Architecture, network entities, reference points (interfaces) between the network entities.
    - User Identities: Public/Private User Identity, usage of the SIP-URI and TELURI,
    - IMS Session Control: IMS Registration, IMS Session Routing, Session-Modification and Teardown, SIP Signaling Compression.
    - IMS Service Control: invocation/control of IMS Application Servers based on Filter Criteria in the CSCF. IM-SSF and there-use of CAMEL Services.
  - Interconnect with the OSA-GW and the use of OSA services.
    - QoS Mechanisms: QoS Preconditions, QoS/Media Authorization based on the PDF.
    - Security Mechanisms: IMS User Authentication, Message Integrity Protection,
    - IMS Network Domain Security.
IMS 3GPP Release 6

- Release 6 adapted IMS to the real world (i.e. lack of IMS SIM cards, IPv6 deployment, competing PoC standards), etc.) and was finished end of 2005
- Key Features defined in Rel-6 IMS:
  - IMS Interworking: IMS Interworking to the CS-Domain (more details for CS and PSTN), Interworking with SIP Clients in the Internet (IPv4/v6 Interworking),
  - WLAN access to the IMS (not completed)
  - IMS Session Control: multiple registrations, routing of group identities.
  - Security Mechanisms: confidentiality protection of SIP messages, use of public key infrastructure, Ut-interface security, early IMS security
  - IMS Services: Presence, Instant Messaging, Conferencing, group management.
IMS Architecture

The HSS holds the IMS service profile of the subscribers.

CSCFs are the IMS entities responsible of the call control; there are 3 types of CSCFs depending on their role:
- P-CSCF (Proxy CSCF)
- S-CSCF (Serving CSCF)
- I-CSCF (Interrogating CSCF)

S-CSCF interconnects to external IP networks and other IMS networks.
If THG is used by the operator to hide its internal configuration, the connection to external networks goes through an I-CSCF.

The PS domain provides the IP bearer to access to the IMS, i.e. a PDP context.
Claire is Registered

P-CSCF

I-CSCF

S-CSCF

HSS

Media: AS

User Client (Alice)

User Client (Bob)

1: INVITE

To: media@open-ims.test
SDP
o=claire xxx yyyy IN IP4 (IP Address)
i=uploading file
i="name of saved file"
C=IN IP4 (IP Address)

2: INVITE

3: INVITE

4: 100 Trying

5: 100 Trying

6: 100 Trying

7: Diameter

8: Diameter

9: INVITE

10: 200 OK

11: ACK

12: ACK

13: ACK

14: Triggers For File Retrieval

15: UPLOADING

16: MESSAGE

17: MESSAGE

18: MESSAGE

19: 200 OK

20: BYE

21: MESSAGE

22: Digest

23: Digest

24: MESSAGE

25: 200 OK

26: MESSAGE

27: Digest

28: Digest

29: MESSAGE

30: 200 OK

Waits for AS to accept this file

Sends a message: File…successfully uploaded

Retrieve Contact List of user Claire
Sends MESSAGE to Contacts with context: “File…is available from user Claire@open-ims.test at AS”

To : alice@open-ims.test
Body: File…is available from user Claire@open-ims.test at media server

To : bob@open-ims.test
Body: File…is available from user Claire@open-ims.test at media server
To: media@open-ims.test
SDP
o=claire xxx yyyy IN IP4 (IP Address)
i= service

1: INVITE
2: INVITE
3: INVITE
4: 100 Trying
5: INVITE
6: 100 Trying
7: 100 Trying
8: 200 OK
9: ACK
10: ACK
11: ACK
12: MESSAGE
13: 200 OK
14: BYE
15: INVITE
16: INVITE
17: INVITE
18: 100 Trying
19: INVITE
20: 100 Trying
21: 100 Trying
22: 200 OK
23: ACK
24: ACK

Service: Send a list of files for streaming

Check if file exists and user has permission
Send INVITE to MRF (Service Initiation)
Open port to send file to MRF

To: Media@open-ims.test
o=claire xxx yyyy IN IP4 (IP Address)
i= "Start Service"
i- "name of file"
C= IN IP4 (IP address)
M= video 3400 RTP/AVP 98 99
A=rtpmap:99 H.261
M= video 3456 RTP/AVP 98 99
A=sendonly
A=rtpmap:98 H.261
A=rtpmap:99 MPV
Questions