Messaging in GPRS / 3G networks: Introduction to Multimedia messaging Service (MMS), Wireless Application Protocol (WAP) and IP Multimedia Subsystem (IMS)

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Development of messaging (1)

Short Message Service (SMS):
- Started year 1992
- Published commercially 1996
- Messages transmitted using SS7 signaling channels
- Limited size on properties of the message
- Cheap and easy way to communicate -> very popular
Development of messaging (2)

Enhanced Messaging Service (EMS):

- Follower of SMS
- Works is the same infrastructure as SMS -> cheap investment to operators
- Mode developed messaging properties
  - Simple pixel pictures
  - Simple melodies
  - Possible to modify message properties
  - Animations
Development of messaging (3)

Multimedia Messaging Service (MMS):

- Latest step in mobile messaging evolution
- Messaging possibilities: Text, audio, pictures, video and any combination of these
- Expected to become the most popular way of messaging
- Messages use same traffic channels as speech
- Nearly unlimited messaging properties
- Brings new network elements to mobile networks
Service capabilities in versions of UMTS standards

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<th>Before 3GPP Release '99</th>
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SMS = Short message service
WAP = Wireless application protocol
MMS = Multimedia message service
UMTS Quality service classes and differentiation

- Background, no QoS priorities
- Interactive, QoS Priorities, e.g. web browsing
- Streaming QoS, e.g. video streaming
- Conversational QoS, e.g. VoIP
UMTS QoS classes

Mapping QoS classes to UMTS channels

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<th>Video streaming</th>
<th>Web browsing</th>
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<td>Conversational</td>
<td>Streaming</td>
<td>Interactive</td>
<td>Background</td>
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<td>Guaranteed min bit rate</td>
<td>Yes, guaranteed min bit rate</td>
<td>No, but prioritisation possible</td>
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<td>Scheduling</td>
<td>Non-scheduled</td>
<td>Scheduled by packet scheduler</td>
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<td>Transport channels</td>
<td>DCH</td>
<td>DCH, DSCH, HS-DSCH, RACH/FACH/CPCH</td>
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Protocols for services

- Real time services → UDP, RTP
- Non-real time services → TCP
Some UMTS services
Video sharing

Real time video sharing
Push to talk over Cellular (PoC) service

Features:
- Ad hoc and predefined communication groups;
- Access control so that a user may define who is allowed to make calls to him/her;
- ‘Do-not-disturb’ in case immediate reception of audio is not desirable.
VoIP & streaming

VoIP + real time video, video sharing, content sharing, gaming etc.
Scope of Rec. H.264 for video telephony
Multimedia Messaging Service (MMS)
Multimedia Messaging Service architecture

MMS User Agent = MMS enabled mobile terminal
Foreign MMS Relay/Server = e.g. another operator’s MMS Center
MM1 – MM7 = standardized interfaces between the MMS network elements
The "Heart" of the Multimedia Messaging Service is Multimedia Messaging Service Center (MMS-C)

- MMS system is composed of many nodes that perform specific tasks:
  - MMS-C offers:
    - Support to various interfaces of the network
    - Message storage services
    - Charging information
    - Subscriber information
    - Generally: MMS-C enables transmission, transport and reception of messages in mobile networks
Service Architecture

MMS clients in mobile terminals: originator, recipient

MMS Environment (MMSE):
- All necessary service elements for MM delivery, storage and notification
- MMSE can be based 2G and 3G networks

Multimedia Messaging Service Centre (MMSC) is composed of MMS relay and MMS server

MMSE interfaces:
- MM1 interface between MMS Relay and MMS client
- MM2 interface between MMS server and MMS Relay (MMSC internal)
- MM3 interface between MMSC and external servers
- MM4 interface between MMSCs
- MM5 interface between MMSC and external network elements (HLR, DNS)
- MM6 not standardized
- MM7 interface between MMSC and external Value Added Service (VAS) applications
- MM8 interface enables interactions between MMSC and billing system

MMS uses WAP as the bearer technology. MMS network is built on top of WAP architecture.

WAP GW provides HTTP, push services, over-the-air (OTA) security and terminal capability negotiations
MMS architecture details

Message stores. The temporary message store is used for storing temporarily messages that are awaiting retrieval. The persistent message store is used for storing messages persistently; the user personal storage space is known as an MMBox.

MMS center (MMSC) (a.k.a. MMS relay/server). The MMSC is in charge of storing and handling incoming and outgoing multimedia messages. It also ensures interoperability with other messaging systems.

User databases. These databases maintain user-specific information such as user profiles and subscription parameters.

2G or 3G network

Internet

Remote 2G or 3G network
Wireless Application Protocol (WAP)

MMS can use WAP protocols to provide multimedia services. WAP is intended to work as a platform to run applications over various wireless environments. Main ideas are:

- Interoperability
- Scalability
- Efficiency
- Reliability
- Security

WAP technology provides an application model close to World Wide WEB model (known as web model). In web model contents is presented using standardized description formats. Also the web browsers used to retrieve content use standardized transport protocols. Following are key elements of web model:

Standard naming model. Objects available on the web are identified by Uniform Resource Identifiers (URI)

Content type: Objects in the web are typed. Thus web browsers can correctly identify the type to which the content belongs

Standard content format. Browsers support standard content formats, e.g. HyperText Markup Language (HTML)

Standard protocols: Browsers support standard content retrieval protocols, e.g. HyperText Transfer Protocol (HTTP).
WAP features

WAP ideology is based on WEB model of accessing services, but to cope with requirements of mobile environment it add following features:

- The *push technology* allows content to be pushed directly from the server to the mobile device without any prior explicit request from the user.
- The adaptation of content to the capabilities of WAP devices relies on a mechanism known as the *User Agent Profile (UAProf)*.
- The support of advanced *telephony features* by applications, such as the handling of calls (establishment and release of calls, placing a call on hold or redirecting the call to another user, etc.).
- The *External Functionality Interface (EFI)* allows ‘plug-in’ modules to be added to browsers and applications hosted in WAP devices in order to increase their overall capabilities.
- The *persistent storage* allows users to organize, access, store and retrieve content from/to remote locations.
- The *Multimedia Messaging Service (MMS)* is a significant added value of the WAP model over the web model. It relies on generic WAP mechanisms such as the push technology and the UAProf to offer a sophisticated multimedia messaging service to mobile users.
Generic WAP architecture

Wireless Network
- Push proxy
- Direct connection
- Pull Proxy/Gateway
- Supporting servers

Internet
- Secure full proxy
- Secure Network
- Application servers
  - e.g. web server, MMSC, etc.

WAP device
WAP 1.x Legacy configuration

- WAE (Wireless Application Environment)
- WSP (Wireless Session Protocol)
- WTP (Wireless Transaction Protocol)
- WTLS (Wireless Transport Layers Security)
- WDP (Wireless Data Protocol)

Diagram:

- WAP device
  - WAE
  - WSP
  - WTP
  - WTLS (optional)
  - WDP
  - Bearer

- WAP gateway
  - WSP
  - WTP
  - WTLS (optional)
  - SSL (optional)
  - WDP
  - TCP
  - Bearer
  - IP

- Web server or MMSC
  - HTTP
  - SSL (optional)
  - TCP
  - IP

Layer defined in the scope of the WAP Forum technical specifications.
Layer defined outside the scope of the WAP Forum technical specifications.
WAP protocol stack

- WAE (Wireless Application Environment): General purpose application environment to build wireless applications.
- WSP (Wireless Session Protocol): provides features as in HTTP, e.g. requests and corresponding responses. Also supports long lived session and suspend / resume sessions.
- WTP (Wireless Transaction Protocol) lightweight transaction oriented protocol. Provides reliability to underlying datagram services by providing acknowledgement and retransmission (corresponds to TCP in the Internet protocol stack). WTP has no explicit connection set-up or release. WTP is message oriented and suitable to e.g. browsing. Segmentation and reassembly (SAR) can be supported.
- WTLS (Wireless Transport Layers Security). WTLS is optional and provides secure transport service.
- WDP (Wireless Data Protocol). A general datagram service using underlying wireless bearer services. WDP offers service equivalent to UDP (Internet User Datagram Protocol)
WAP 1.x configuration for MMS

Push Proxy Gateway
The MMSC instructs the PPG to deliver message notifications and reports to MMS clients.

MM1 interface
Wireless Session Protocol

MMS Client
The MMS Client provides its capability profile to the MMSC as part of the delivery request.

Push Proxy Gateway

MMSC

Push Access Protocol

WAP 1.x Gateway
Message_queue() and transport mechanism for messages. The MMSC exposes HTTP interface to WAP gateway and the MMS.
Wireless Access Protocol (WAP) Architecture for MMS
WAP 2.0 Implementation of MMS

WP-HTTP = Wireless profiled HTTP
WAP Implementation of MMS

WAP transport protocols are used for MMS:

- Multimedia message (MM) sending over WAP Wireless Session Protocol, WSP (WAP 1.x) or WP-HTTP (WAP 2.0)
- WAP browser is not involved in MMS

MMS Client traffic to MMS Relay: Client is sending message over WSP or WP-HTTP to WAP Gateway and then over HTTP from the WAP Gateway to the MMS Relay.

HTTP POST method is used for message sending, WAP Push protocols and for data originating at the MMS Relay.

WAP Gateway provides standard WAP services needed to implement MMS, these include:

- Translation of requests from the WAP protocol stack (WSP) to the WWW protocol stack (HTTP) for communication with the MMS Relay.
- PUSH services used by the MMS Relay to provide MMS notification and MMS delivery reports to the MMS User Agent.
- OTA security with WTLS (Wireless Transport Layer Security) with WAP 1.x
- OTA security with TLS (Transport Layer Security) with WAP 2.0
- Capability Negotiations (UAProf). WAP GW inform the MMSC of the capabilities and preferences of the MMS User Agent.
MMS Message sending, notification and retrieval

1. Message submission
2. Message notification
3. Message retrieval
4. Delivery report
5. Read report
6. Read report

Originator
MMS client

1. Message submission

2. Message notification

3. Message retrieval

4. Delivery report

5. Read report

6. Read report

MMSC

Originator
MM1

Recipient
MMS client

Recipient
MM1
MMS Message Sending

The user composes the multimedia message with MMS capable device
The user defines the MM recipients
Originator MMS client transfers the MM to the MMSC of the user’s MMSE
MMS Client traffic to MMS Relay: Client is sending message over WSP or WP-HTTP to WAP Gateway and then over HTTP from the WAP Gateway to the MMS Relay.
(WSP/)HTTP POST method is used for data originating from the MMS Client
Originating MMSC performs the checking of message format, sufficient prepaid credit, possible barring conditions
If message submission is accepted, the originator MMSC transfers the MM to the recipient MMSC(s).
Every message has a validity period defined by user or originating MMSC
Message sending can also include:
- Request to store the message on the network (“album service”)
- Hidden originator address
- Charging indication
- Delivery time
- Report request (delivery and read)
MMS Message notification and retrieval

MMSC PUSH is implemented by using the notification-pull method. The delivery of MM from MMSC to MMS Client is two-phased:

**MM notification is delivered to the user agent**
- MMS server uses PUSH technology to provide MMS notification and MMS delivery reports to the MMS Client with WAP Push (non-confirmed connectionless push technique)
- Push data does not contain the message itself, but reference (URI) to it.
- Notification sending shall apply sufficient authentication and security.
- SMS/WAP push is used as the bearer for the notification.

**When the terminal receives the notification, it automatically retrieves the multimedia message, based on its capabilities (deferred retrieval)**
- Notification is used to alert a MMS client that a new message has arrived at the MMSC.
- MMS client will open a session to the relevant MMSC and retrieve (PULL) the MM from the MMSC over WSP.
- In this retrieval, the HTTP GET method is invoked in the MMS server over a connection-oriented WAP session.
Multimedia Message Box

- Multimedia Message Box (MMBox) is the area in which MMS users can store messages to free up the memory on their MMS terminals, and keep their messages long-term.
- MMBox (“Multimedia Album”) can be accessed either via a Web interface or a WAP interface.
- Users can compose and send MM using Album service, browse existing stored messages, retrieve a previously stored messages from the Album onto the MMS terminal and forward a retrieved message to either an email address or another phone (MSISDN address).
- User can delete MMS from Multimedia Album using either WAP or Web interface.
- Multimedia Albums for legacy users is a part of legacy terminal support.
Multimedia Message

MM Header includes:

- Address of the originator
- Address of the recipient(s)
- Priority
- Class
- Date and time
- Validity period
- Reply charging parameters
- Request for reports
- Message subject
- Sender visibility
- Earliest delivery time
- Message distribution indicator
- MMBox status

MMS content: text, image, audio and video clip

MMS content is encapsulated in a body part container:

- the only mandatory parameter Content type
Multimedia Message

- MMS terminal can support several media types, each requiring a specific format and respective codec:
  - standard image formats such as GIF and JPEG,
  - video formats such as MPEG 4
  - audio formats such as MP3 and MIDI.
  - MMS speech codecs: AMR (Adaptive Multirate Codec) in use, 13-K (OMA)
- Full interoperability guaranteed for Core MM Content Domain: text, image basic, image rich, video basic and video rich content classes
- Standard MM Content Domain includes MMs content compliant with MMS standards but content classes are left for vendors’ implementations: e.g. animation basic, animation rich and music basic content classes
- Unclassified MM content domain gives full freedom to create multimedia messages
MMS Implementation in GPRS network

- Multimedia messaging requires high transmission speeds, which can be provided by GPRS and 3G.
- MMS is the key business case driver for GPRS (General Packet Radio Service) and is also the central driver of the 3G business case.
- Specific GPRS Access Point shall be used for MMSC connection and for other WAP services (support for phones with one PDP context).
- GPRS roaming is required for MMS interoperability between operators (IREG IR.34 Specification by International Roaming Expert Group).
IP Multimedia Subsystem (IMS)
IP Multimedia Subsystem (IMS) Overview

IMS architecture is a standardized access independent IP based architecture.
IMS architecture makes it possible to establish peer-to-peer IP communications between all types of clients in 2G / 3G networks as defined in the 3GPP release 5 specifications.

IMS architecture (3GPP rel5) includes:
- Network entities and reference points
- Signaling: routing principles, registration, session management, signaling compression
- Security: IMS AKA (authentication and key agreement), integrity protection of signaling messages, network domain security
- Quality of service: policy control between IMS and GPRS network
- Service provisioning

IMS architecture (3GPP rel6) additions:
- Interworking with CS, WLAN and other IP networks
- Group management and conferencing
- Presence, messaging
- Local services
IP Multimedia Subsystem, Network Configuration

IMR = IP Multimedia Register
CPS = Connection Processing Server

SIP-Enabled Terminals

SIP

GSM/EDGE WCDMA

WLAN Cable DSL

IP Transport

GGSN

MGW

FW

PSTN

Internet

Application Servers e.g: PoC Presence Messaging GW Push Server Group Server
IP Multimedia Subsystem (IMS) Principles

- Supporting user and terminal mobility.
- Enables establishing IP connections between terminals using the SIP (Session Initiation Protocol).
- Targeted for handling of voice calls and multimedia sessions in packet based mobile networks.
- Access independent: the access network can be 2G GPRS (GSM), 3G GPRS (WCDMA, EDGE), WLAN or wireline IP network.
- Flexible service creation platform, application servers can be connected to the IMS through ISC interface.
- User and control plane are separated in IMS: SIP signaling is routed via IMS, the multimedia user data during session in a different route over IP network.
IMS Network Elements: CPS

- Connection processing server (CPS) for multimedia session control is using SIP (session initiation protocol)
- CPS includes the connection processing engine (CPE) that implements call state control functions (CSCFs):
- Policy decision function (PDF) interacts with GPRS network (QoS, charging correlation, PDP context reservation)
IMS Network Elements: IMR

- IP Multimedia Register (IMR) consists of UMS and SLF functionalities
- Home subscriber server (HSS) functionality as defined in 3GPP Rel.5 includes the existing home location register (HLR) and User Mobility Server (UMS)
- UMS is the main subscriber and service data storage of IMS: identification data, registration status and services provided
- User Mobility Server (UMS) of IMR stores the user identities:
  - Private user identity used for registration and authentication
  - Public user identity used for communication requests
- UMS handles also location management parameters, roaming authorization and S-CSCF selection
- Subscription Locator Function (SLF) is gives the HSS address of the subscriber to the I-CSCF
- Cx interface between CPS and UMS supports the transfer of service parameters of the subscriber from UMS to CSCF
IMS Functional Elements

- Call State Control Function (CSCF)
- Home Subscriber Server (HSS): HLR+UMS+SLF
- Media Gateway Control Function (MGCF)
- Media Gateway Function (MGW)
- Multimedia Resource Function (MRF)
- MSC Server
- Gateway MSC Server
Session Initiation Protocol (SIP)

- SIP as a protocol is standardized by the IETF (Internet Engineering Task Force), while 3GPP is standardizing the way SIP is used in mobile networks.
- SIP is the signaling protocol for IP Multimedia sessions.
- SIP supports multiparty multimedia sessions.
- SIP supports IMS based multimedia messaging.
- SIP user agents in terminals.
- SIP session is established between SIP user agents.
- User and control plane are separated in IMS: SIP signaling is routed via IMS, the multimedia user data during session in a different route over IP network.
SIP Session Establishment, CSCF Functionalities

Originating Network

Terminating Network

Home of A subscriber

Home of B subscriber

I-CSCF

S-CSCF

P-CSCF

HSS

Number analysis and Service Control

Service Control

HSS Query

INVITE

INVITE

INVITE

INVITE

INVITE

INVITE

HSS
SIP session establishment and ending, 3GPP
SIP session establishment and ending, RFC 3261 (IETF)
IMS Service Categories

Person-to-person Interactive applications
- Tools and means for new kind of interactivity between users, such as Interactive Games, Content Sharing, Real Time Video Sharing
- Mobile clients and PC clients will interconnect!

Application server supported applications
- Added value and control in the network (e.g. PoC, Presence, Conferencing, Messaging)

Session control services
- supplementary services to IMS users regardless of terminal and application in use
Content Sharing

Browse content in your friends’ phone
Direct file sharing between terminals
Can be used to transfer files between users or later between group of users
Sharing also between PC & mobile
Real Time Video Sharing

Share the moment instantly in real-time, ‘See What I See’

Enables spontaneous behavior
Share the camera view or video clip whilst in an ongoing session
Unidirectional mobile video streaming between peer users
Enables convergence with SIP PC clients
Ideal service for WCDMA and EDGE (DTM) networks
Voice Instant Messaging

Instant messaging with audio content
Voice messages created in terminal and sent via IMS to recipients as SIP MESSAGE

Instant Messaging Gateway (IMGW) to provide Store & Forward functionality
- Store messages if the recipient is unavailable at the moment
- Forward messages via MMSC to non-IMS subscribers

Can be easily implemented with IMS in any packet network (e.g. GPRS)
Enables convergence with PC clients
Example of IM Store&Forward delivery

1. User sends a voice message

2. MESSAGE

2. CPS determines user is not registered and sends the message to the S&F with the S&F indication

4. MESSAGE

5. MESSAGE (repeated periodically)

6. 202 Accepted

7. IMS Registration

8. MESSAGE

9. 200 OK

Event PA = Event Publication Agent

collection-set

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presence info can be used as trigger for resending
SIP Game Examples

**MAD MAC SIP**

MM is a 3D two-player online action/strategy game. Each player will control a team of animated robots battling each other using cannons, missiles, rockets, etc. After full release, new battle fields, weapons, characters, etc. can be downloaded from the carriers’ platforms. Players with new updates can pass them to friends via SIP.

**TREASURES SIP**

Treasures SIP is a 2D two-player turn based board game. The rules are similar to Minefield: two players face a grid map with hidden treasures. At the beginning, the entire grid is covered. Two players choose to dig at a grid turn by turn. When digging, a grid will show either a treasure or treasure grid number near this grid. When the map is entirely uncovered, the player who finds the most treasures win.

**Genre:** Action/Strategy  
**Memory space:** <800Kb  
**Runtime memory:** <3.5M

**Genre:** Board Game  
**Memory space:** <400Kb  
**Runtime memory:** <2.5M
Content Push
News Service Use Case

Person A downloads the Content Push application
- Downloading via Web or WAP
Person A opens the Content Push application
Person A selects from the menu “Update content catalog” or updated automatically
Person A selects the wanted content and defines the parameters for content delivery -> delivery activated
Person A gets a notification when new content available
Person A checks the new content
Person A sees a news item that interests her and clicks it to read more
3G mobile terminal (an example of SIP client)

- 3G speed with series 60 built on the Symbian OS
- WCDMA: maximum download 384kbps, upload 128kbps
- EGPRS (class B, Multislot class 10) - maximum download 236.8kbps, upload 118.4kbps
- 1.3 megapixel camera sensor, effective resolution 1.23 megapixels for image capture (1280 x 960 pixel resolution)
- 6x smooth digital zoom and sequence mode
- 10 MB internal dynamic memory with hot swap and 64 MB reduced size MultiMediaCard (MMC)
- Multimedia messaging: combine image, video, text and voice clip and send as MMS to a compatible phone or PC
- Video recording time up to 1 hour per clip
- WAP 2.0 XHTML/HTML multimode browser
- Via Bluetooth: images, video clips, graphics and business cards
- Downloadable java™ MIDP 2.0, CLDC 1.1 applications
- 3d API (JSR-184)
- Dual stack ipv4/ipv6
- SIP stack
- SIP application SW