Chapter XII
An example of NGN: 3GPP UMTS

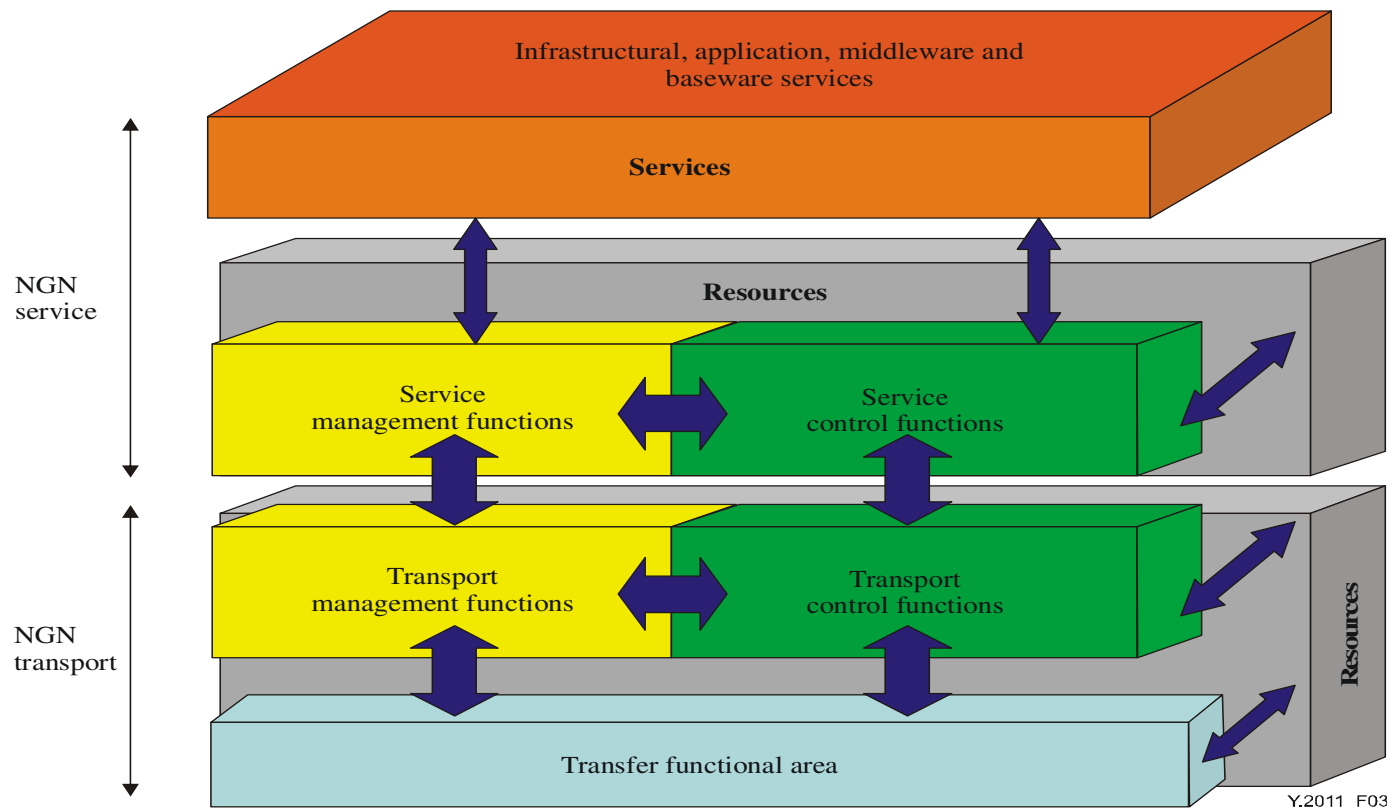**Roch H. Glitho**

Layering in next generation networks

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Services (value-added services) also called application / services
Services (Basic service) also called call/session
Transport (Below IP + IP + transport layer) also called bearer

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Layering in next generation networks

Infrastructural, application, middleware and baseware services

Services

NGN service

Resources

Service management functions

Service control functions

NGN transport

Transport management functions

Transport control functions

Resources

Transfer functional area

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Layering in UMTS

UMTS (Universal Mobile Telecommunication Systems)

- An example of 3G system:
    - Evolution of GSM
        - Use of WCDMA
        - Largest footprint

- Another example of 3G system
    - Evolution of CDMA-One
        - Use of WCDMA, but a version incompatible with UMTS
        - Dwindling footprint

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Layering in UMTS

UMTS (Universal Mobile Telecommunication Systems)

- UMTS transport:
  - TCP
  - IP
  - Below IP
    - WCDMA
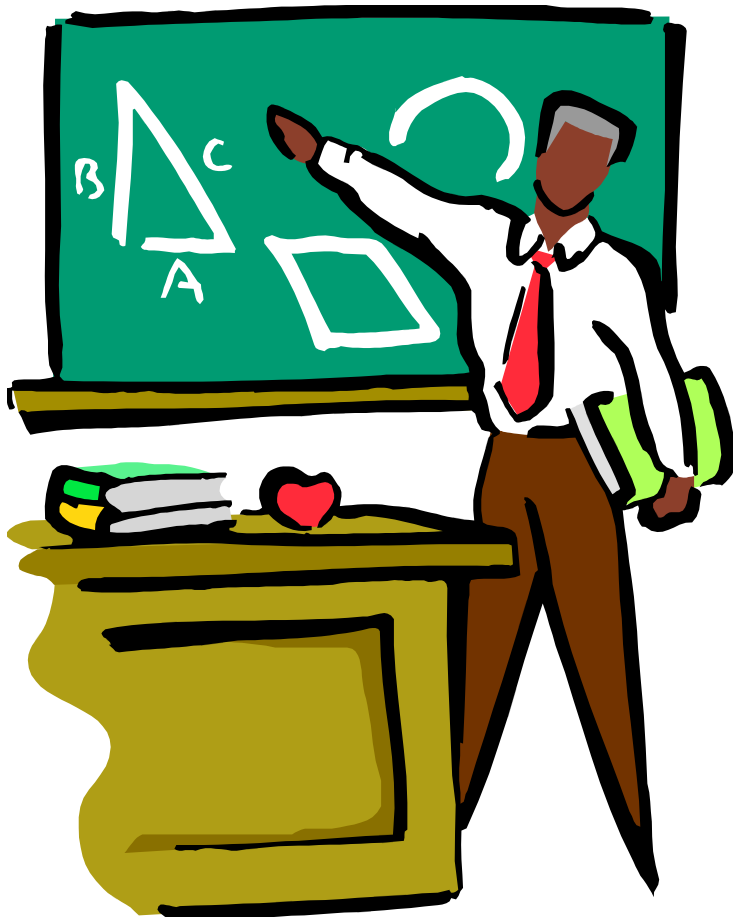   - Bandwidth (Peak rate: single digit Mbits/s – usually lower than 2)

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Layering in UMTS

UMTS (Universal Mobile Telecommunication Systems)

- UMTS Service:
    - IP Multimedia Subsystem (IMS)
        - Basic service (call / session or control layer)
        - Value added services (value added service or service layer)
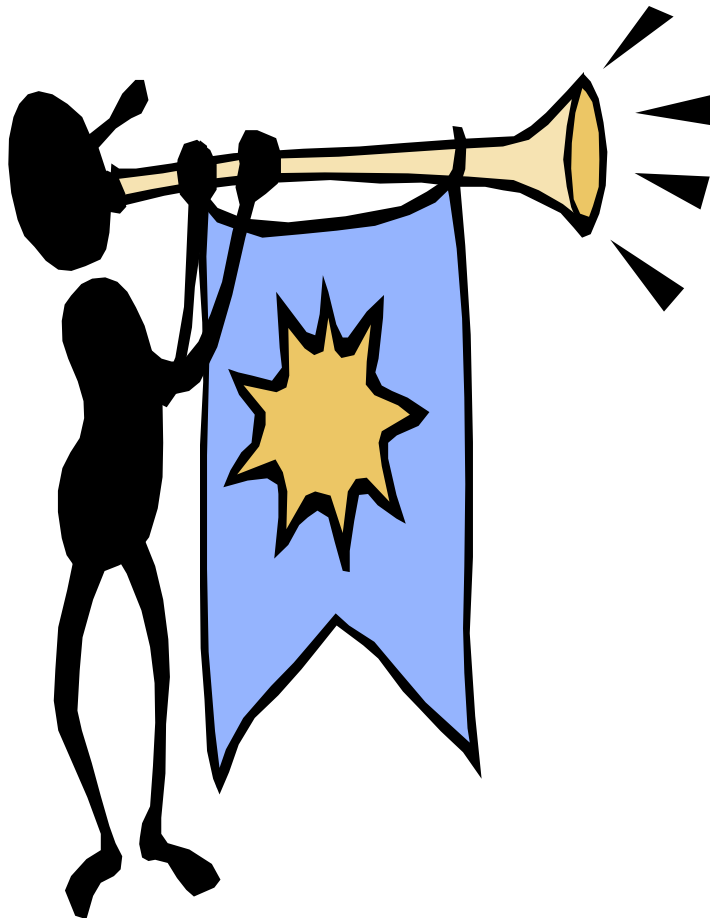   - Focus of this lecture: IMS

IMS

1. **Overall view**

2. **Control layer**

3. **Service layer**
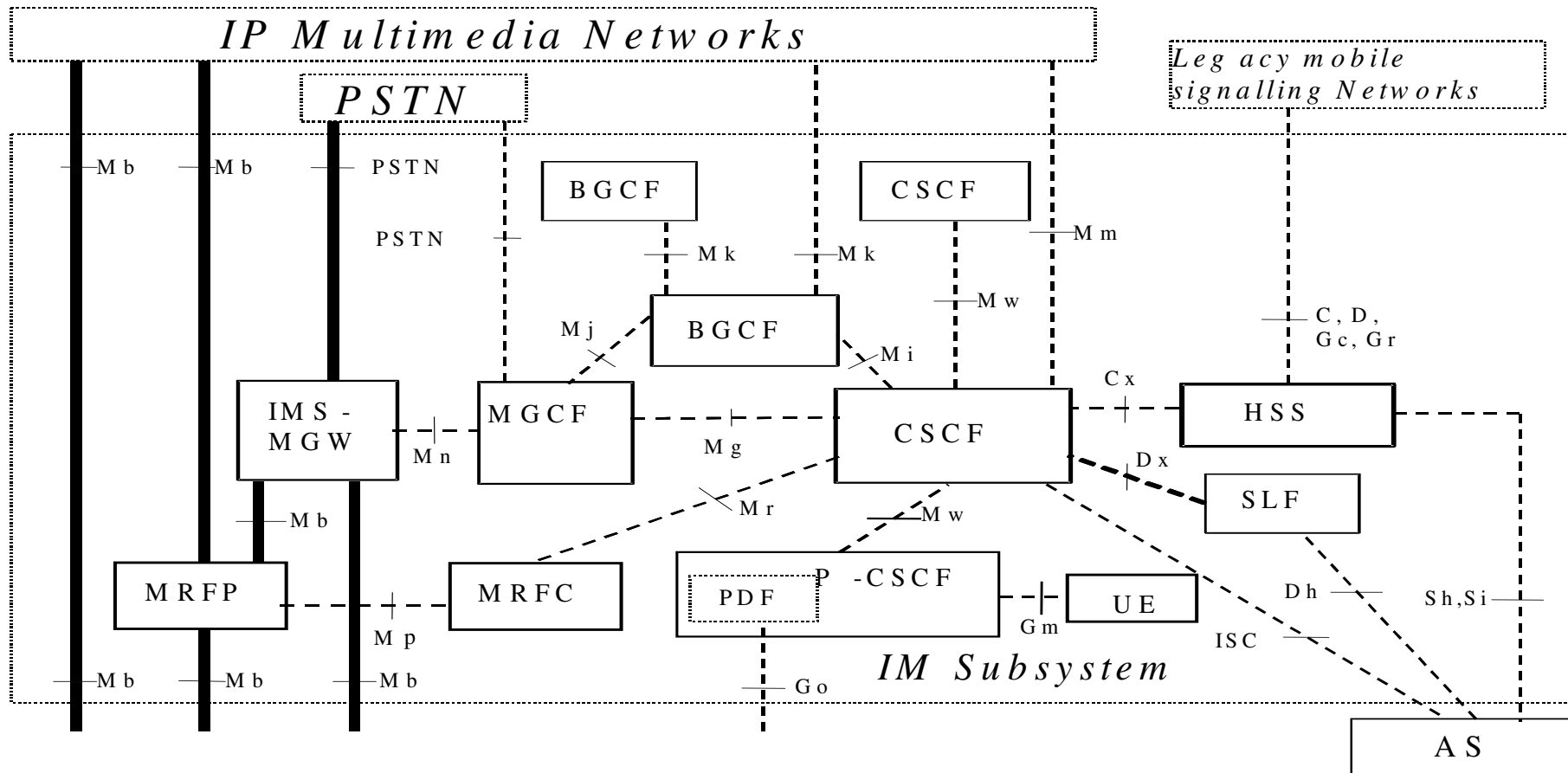
Overall view

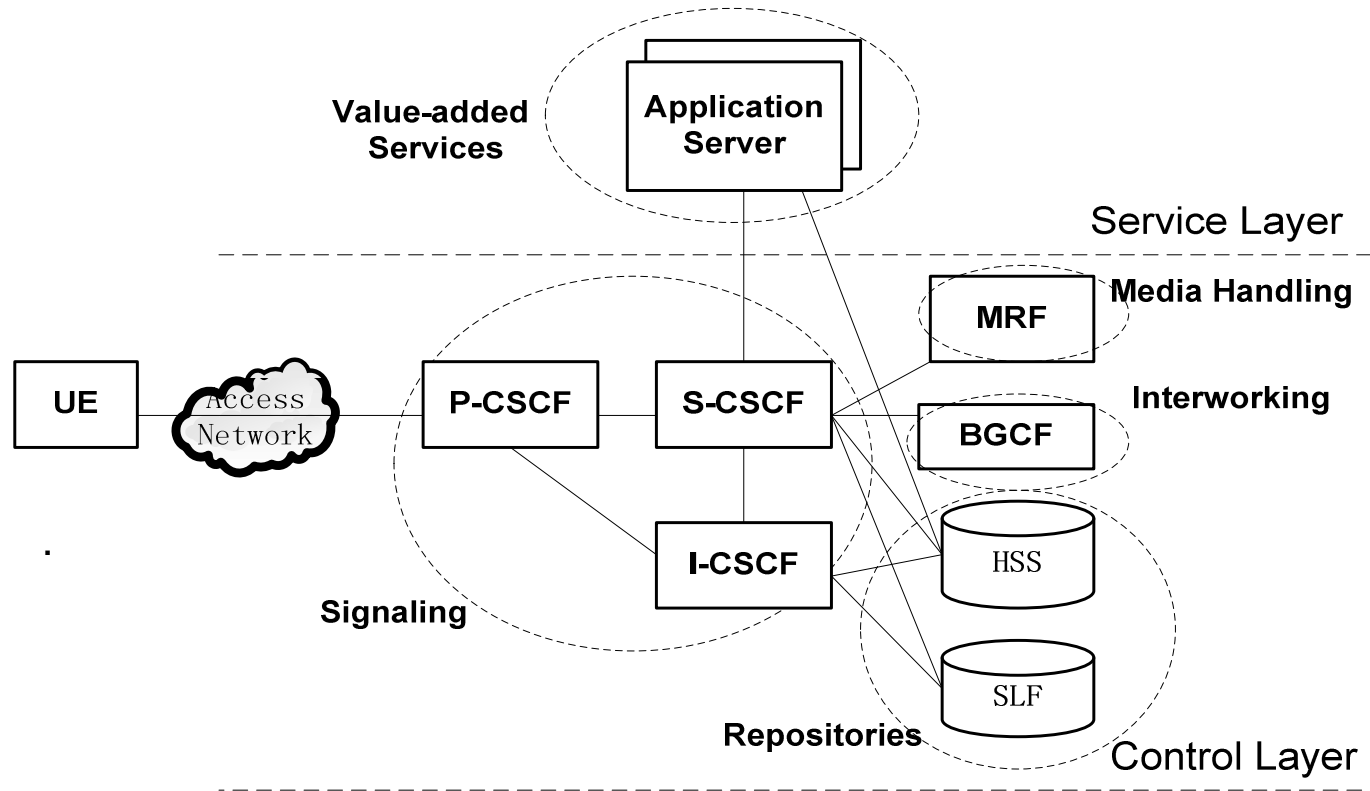1. **General picture**
2. **Simplified picture**
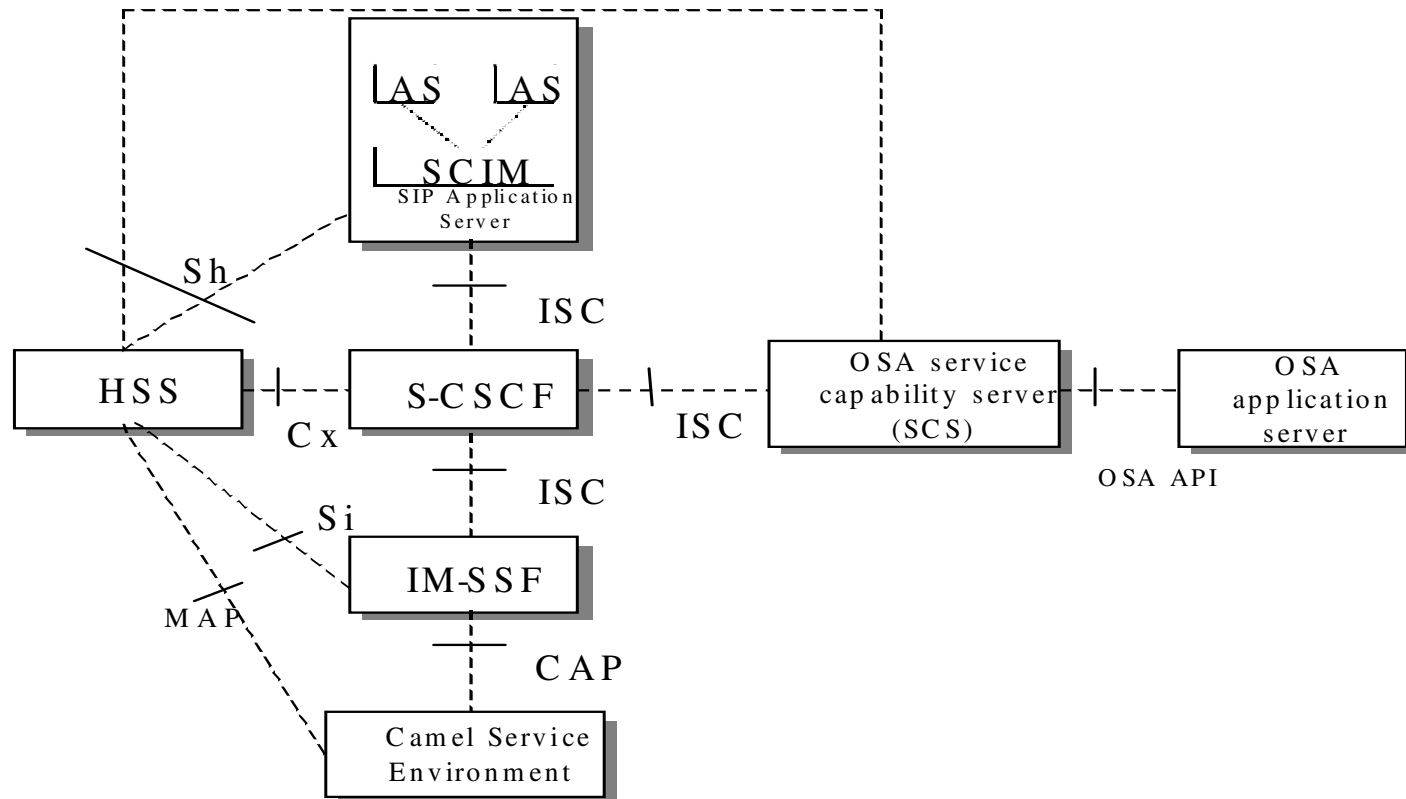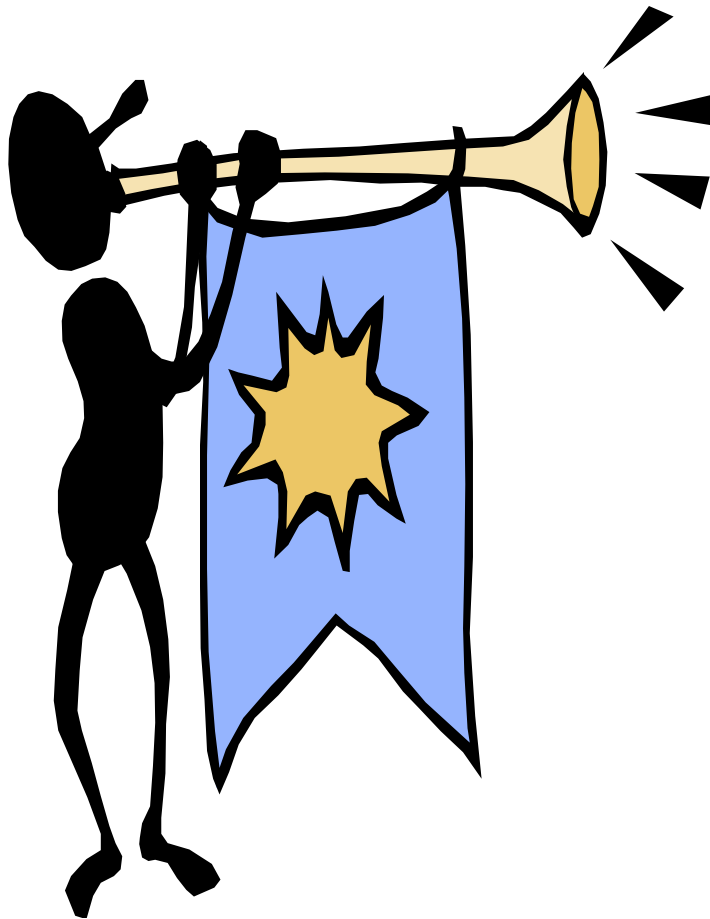
General picture

Simplified picture

Another simplified picture

Control layer

1. **Functional entities**
2. **Protocols**
3. **Call cases**

Functional entities

Data bases (just one)

Home Subscriber Server (HSS)

    - Evolution of the HLR

    - All user related subscription data (e.g. profile)

    - A network may contain one or several

      - Subscriber Location Function (SLF) maps users to specific HSS

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Functional entities

Control entities

Call Session Control Function (CSCF) "The switch"

Three types (May be collocated)

- Proxy CSCF
- Serving CSCF
- Interrogating CSCF

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Functional entities

Control entities

Proxy-CSCF:

- Location

    Either visited network or home network

- First contact point in the IM network

- Outbound / In-bound SIP proxy (All requests from/to IMS terminals go through it)

- Forward SIP requests in the appropriate direction (Terminals or IMS network)

- Several functions

    - Security

    - Generation of charging information

    - Compression and un-compression of messages

Functional entities

Control entities

Interrogating CSCF (I-CSCF):

SIP proxy located at the edge of an admnistrative domain

- **Listed in the domain name server (DNS)**
- **There may be several in the same network for scalability reasons**

Functional entities

Control entities

Serving CSCF (S-CSCF):

Always located in home domain

SIP proxy + SIP registrar with possibility of performing session control

- **Binding between IP address (terminal location) and user SIP address**
- **Interacts with application servers for value added service purpose**
- **Translation services (Telephone number / Sip URIs)**
- **Routing**

Functional entities

Control entities

Media Resource Function (MRF)

- Source of media (media mixing, announcement playing)

- Two parts

Control part: MRFC

Media Part: MRFP

Functional entities

Control entities

Media Gateway Function (MGF):
  Signaling conversion between PSTN/2G and IMS

Media Gateway (MG)
  Media conversion between PSTN/2G and IMS

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Protocols

Signalling

SIP with extensions

Interactions with HSS

AAA

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Protocols

Example of SIP extension for IMS

Reliability of Provisional Responses for SIP

PRACK Method

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Example of SIP extension for IMS

PRACK

- Bring more reliability by enabling the acknowledgement of provisional responses:
    - Only final responses are acknowledged in standard SIP
        - ACK for OK
    - PRACK plays the same role as OK, but for provisional responses (e.g. 180 - ringing) except (100 – trying)

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Example of SIP extension for IMS

PRACK

- Essential features

  - Normal SIP request with its own response (i.e. OK)

  - Each provisional response is given a sequence number Rseq

  - PRACK contains a header Rack to indicate the sequence of the provisional response being acknowledged

  - Caller indicates if it supports or not PRACK

  - Both parties can indicates if it is required or not
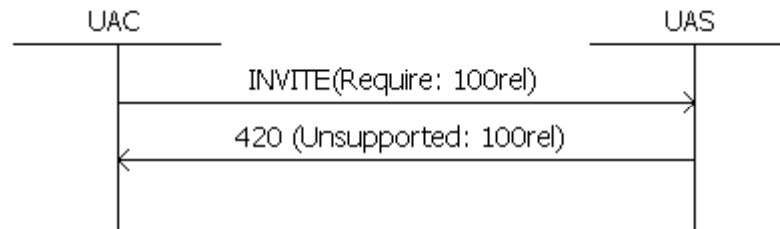
Example of SIP extension for IMS
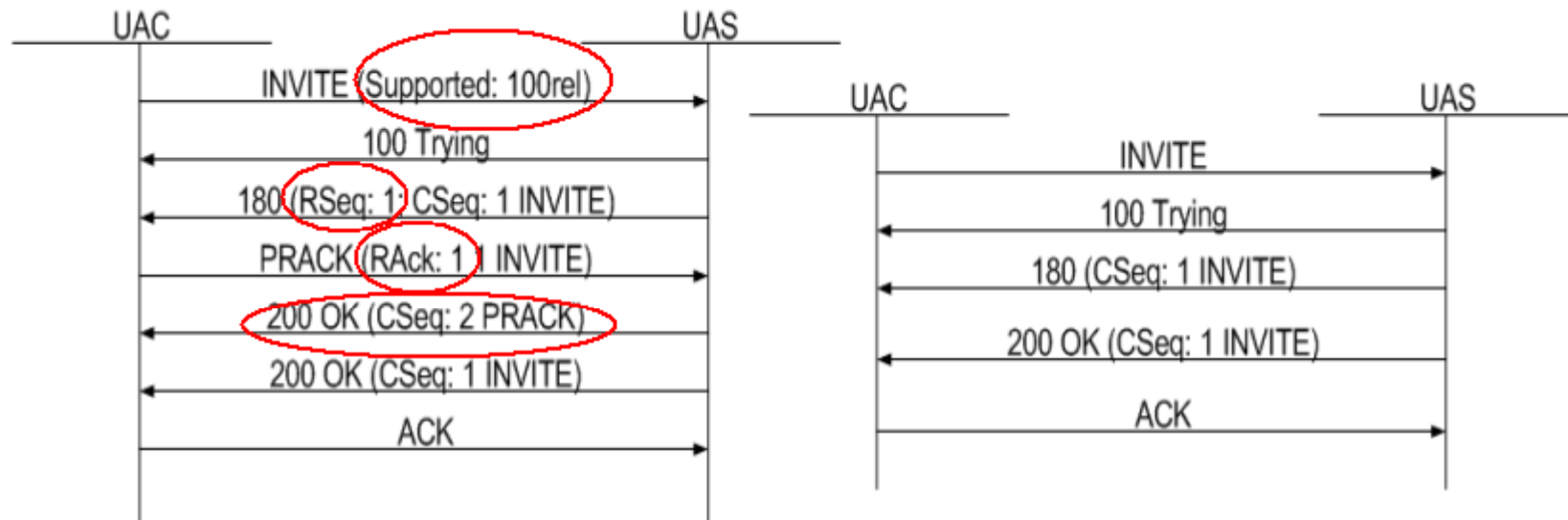
PRACK

- http://www.dialogic.com/webhelp/IMG1010/10.5.1/WebHelp/Description/SIP/SIP_PRACK_Call_Flows.htm

Example of SIP extension for IMS

PRACK

- http://www.dialogic.com/webhelp/IMG1010/10.5.1/WebHelp/Description/SIP/SIP_PRACK_Call_Flows.htm

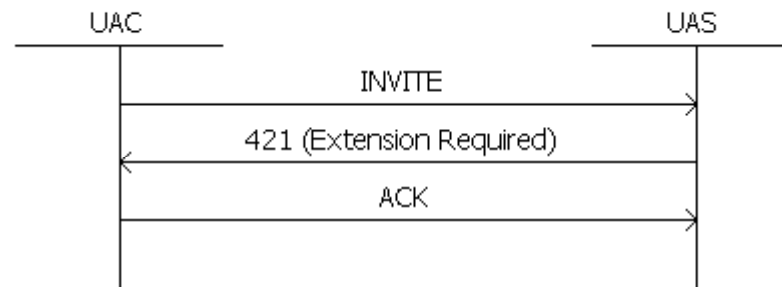**Roch H. Glitho**

Example of SIP extension for IMS

PRACK

- http://www.dialogic.com/webhelp/IMG1010/10.5.1/WebHelp/Description/SIP/SIP_PRACK_Call_Flows.htm

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Authentication, Authorization and Accounting

1. **Informal definitions**

2. **AAA in Internet**

3. **AAA in IMS**

4. **Call cses**

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Informal definitions

- ## Authentication
  - – **Means of verifying that an entity is really what it claims to be**

- ## Authorization
  - – **Means of ensuring that en entity does only what it is allowed to do**

- ## Accounting
  - – Means of keeping track of what an entity does for auditing, billing and other purposes

AAA in Internet

Remote Authentication Dial In User Service (RADIUS) protocol

– **RFC 2058, then 2138, 1997**

– **RFC 2865, 2000**

- Possibility for a Network Access Server (NAS) to get authentication, authorization and accounting (AAA) services from a RADIUS server
- Client/server
- Runs on top of UDP
- Example: Computer with a modem, connected to a NAS and NAS connected to a RADIUS server
  - » Very useful when there are several NAS

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AAA in Internet

Remote Authentication Dial In User Service (RADIUS) protocol

- Issues
  - Lack of scalability
  - Lack of functionality (e.g. no possibility for unsolicited messages from RADIUS server to NAS)

AAA in Internet

Diameter

– **Addresses RADIUS shortcomings**
  - **Scales**
  - **More functionality**
– **Much more complex**
  - Base protocol, RFC 33588, 2003
    – Basic commands (e.g. Re-Auth-Request, Re-Auth-Answer, Accounting-Request)
  - Application protocols
    – Extend the basic commands

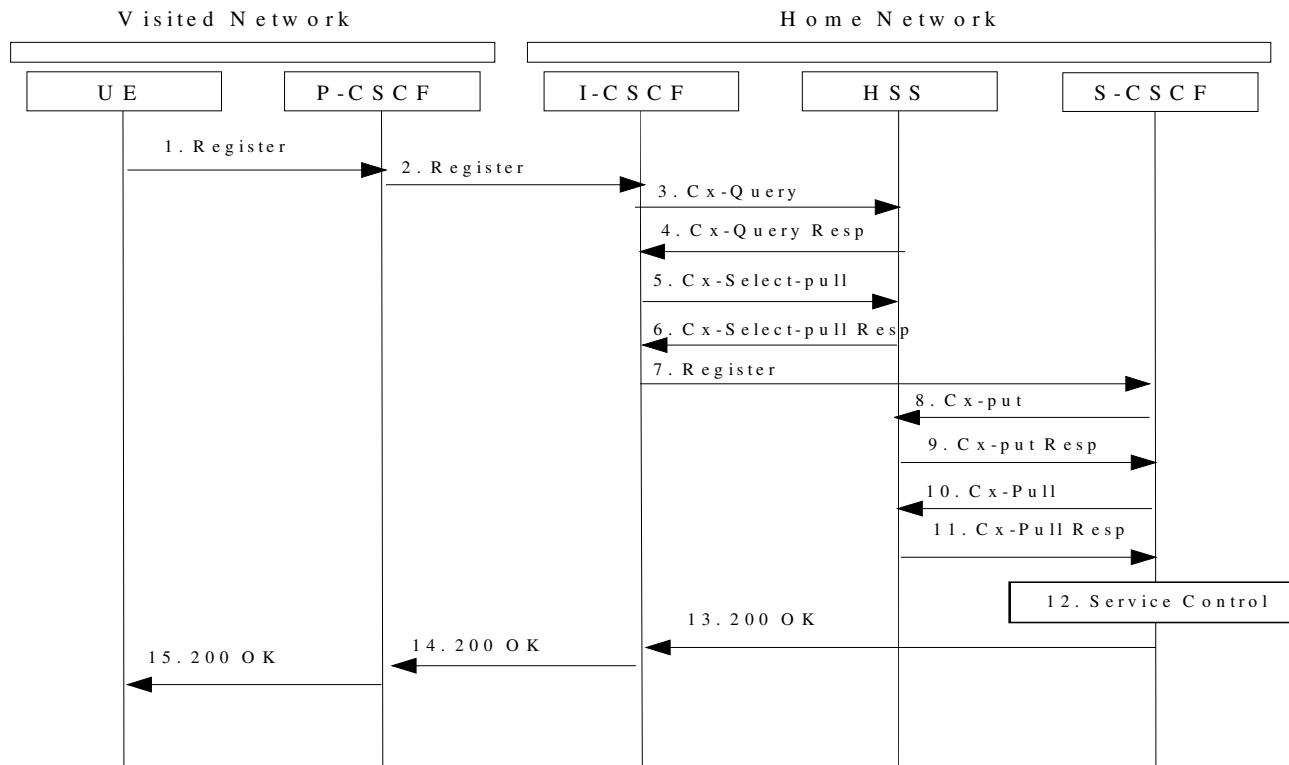# AAA in IMS

- **Interfaces**
  - **Cx: I-CSCF / HSS and S-CSCF/HSS**
  - **Dx: I-CSCF / SLF and S-CSCF / SLF**
  - **Sh: HSS/SIP AS and HSS/OSA SCS**

- **Protocol**
  - Diameter with IMS specific applications

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IP Multimedia portion – Registration

Visited Network — Home Network

UE | P-CSCF | I-CSCF | HSS | S-CSCF

1. Register
2. Register
3. Cx-Query
4. Cx-Query Resp
5. Cx-Select-pull
6. Cx-Select-pull Resp
7. Register
8. Cx-put
9. Cx-put Resp
10. Cx-Pull
11. Cx-Pull Resp
12. Service Control
13. 200 OK
14. 200 OK
15. 200 OK

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IP Multimedia portion – Un-Registration

Visited Network   Home Network

| UE | P-CSCF | I-CSCF | HSS | S-CSCF |

1. REGISTER

2. REGISTER

3. Cx-Query

4. Cx-Query-Resp

5. REGISTER

6. Service Control

7. Cx-Put

8. Cx-Put Resp

9. 200 OK

10. 200 OK

11. 200 OK

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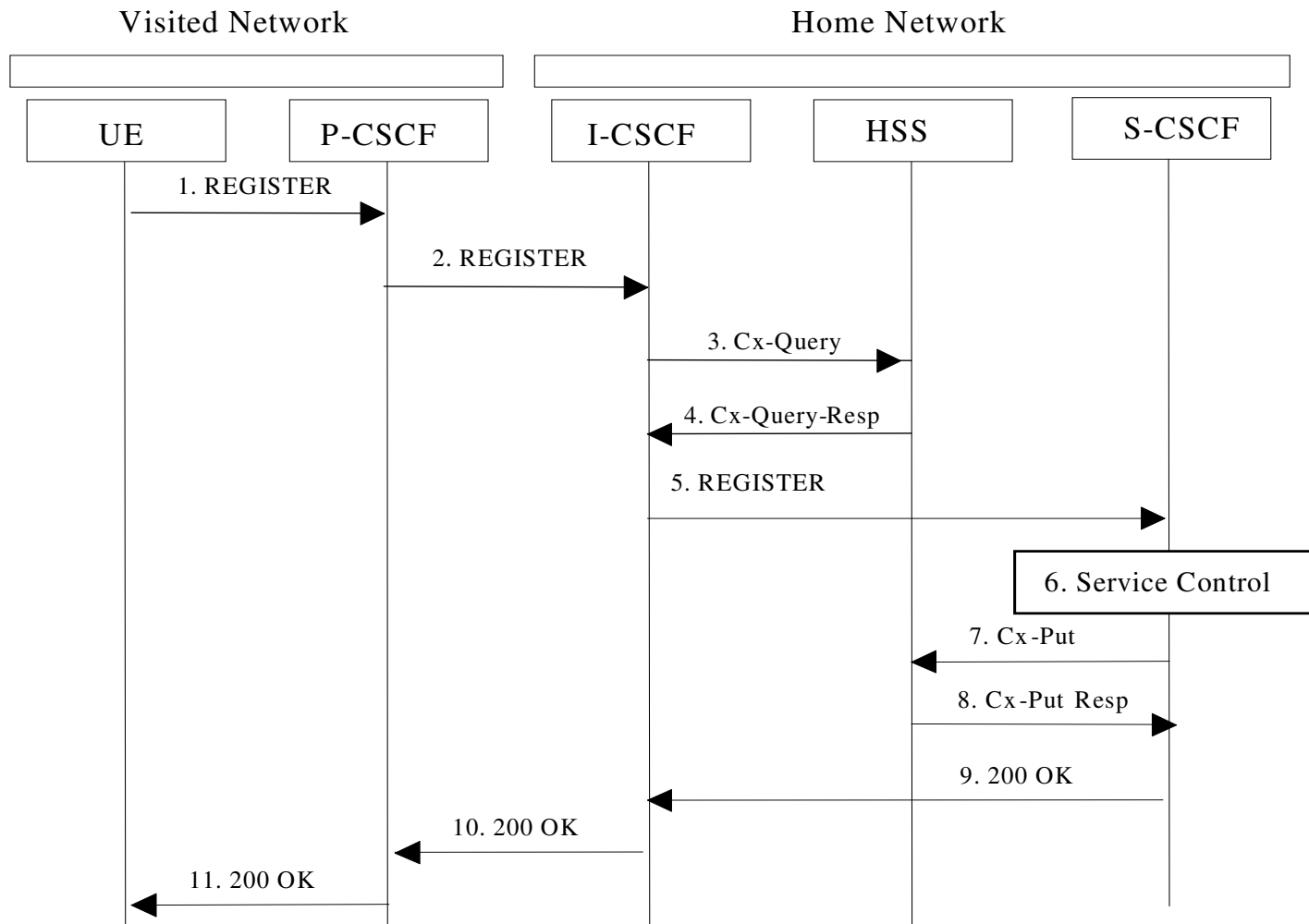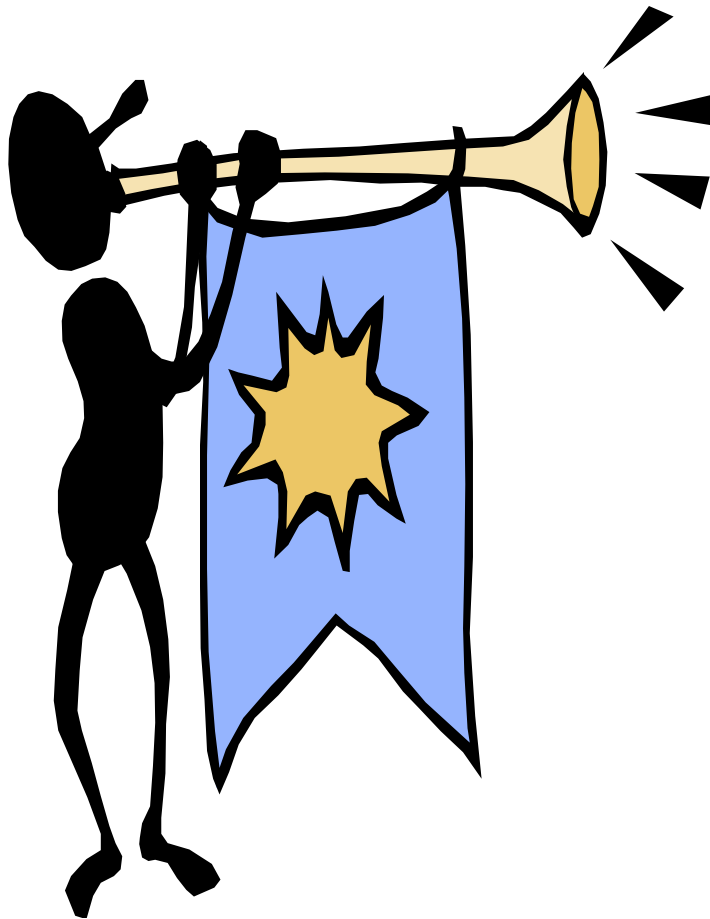
Use of Megaco / H.248

- **Interworking 3G/2G**
  - **MGF**
  - **MG**
- **Conferencing**
  - MRFC
  - MRFP

Service layer

1. **Functional entities**
2. **Protocols**

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Functional entities

Application server (AS)

Host services and execute services

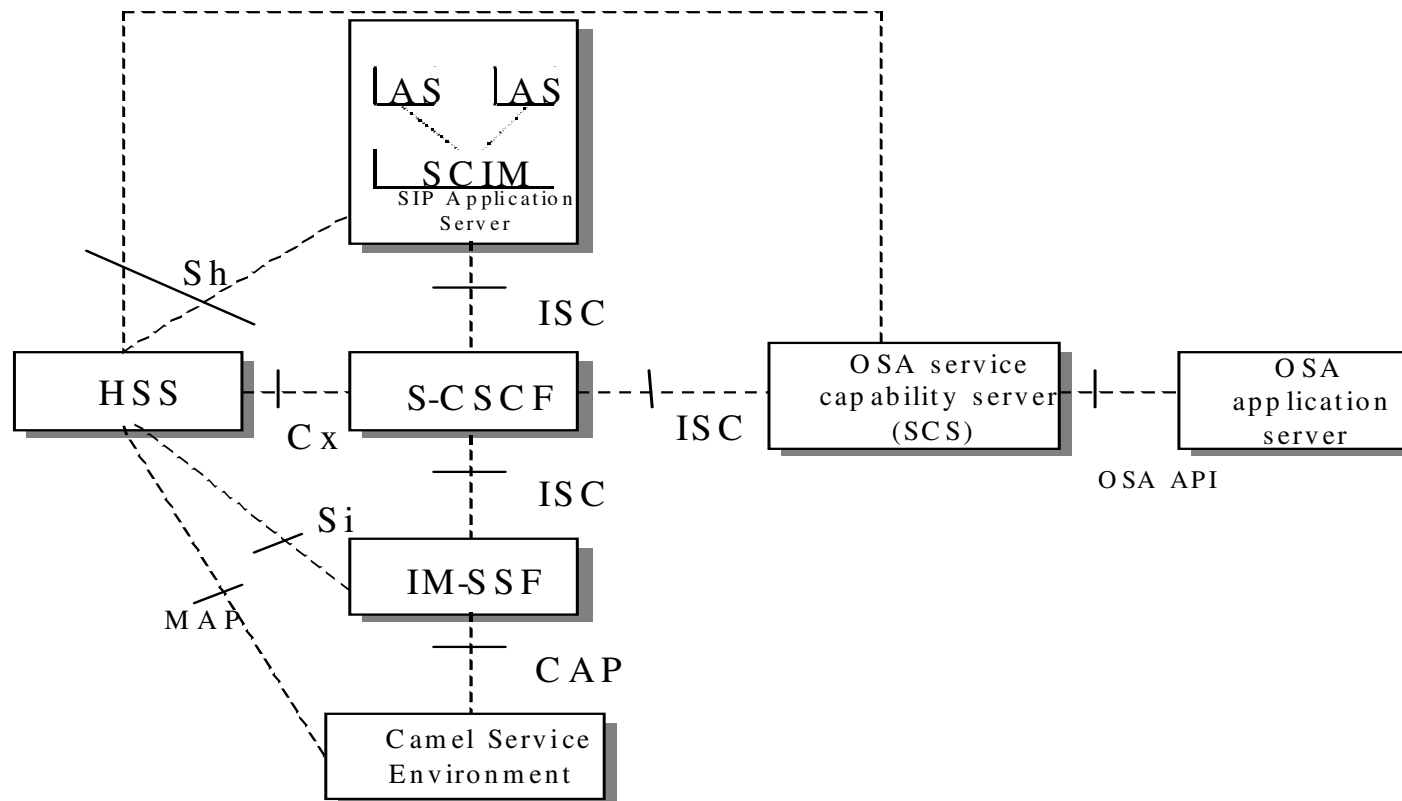Communicate with control layer using SIP (i.e. ISC interface)

Two types

SIP AS:

Open Service Architecture – Service Capability Server (OSA/SCS)

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Functional entities

Functional entities

SIP AS

SIP servlets technology

Open Service Architecture – Service Capability Server (OSA/SCS)

Parlay / OSA technology

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Protocols

ISC

SIP + extensions

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References

3GPP

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- **G. Camarillo and M. Garcia-Martin, The 3G IP Multimedia Subsystem, Wiley, 2004 , Part II**

- M. Toy, H. Stuttgen and M. Ulema, guest editors, IP Multimedia Subsystems (IMS), IEEE Communications Magazine special issue, March 2007

- M. Toy, H. Stuttgen and M. Ulema, guest editors, IP Multimedia Subsystems (IMS), IEEE Communications Magazine special issue, July 2007

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