

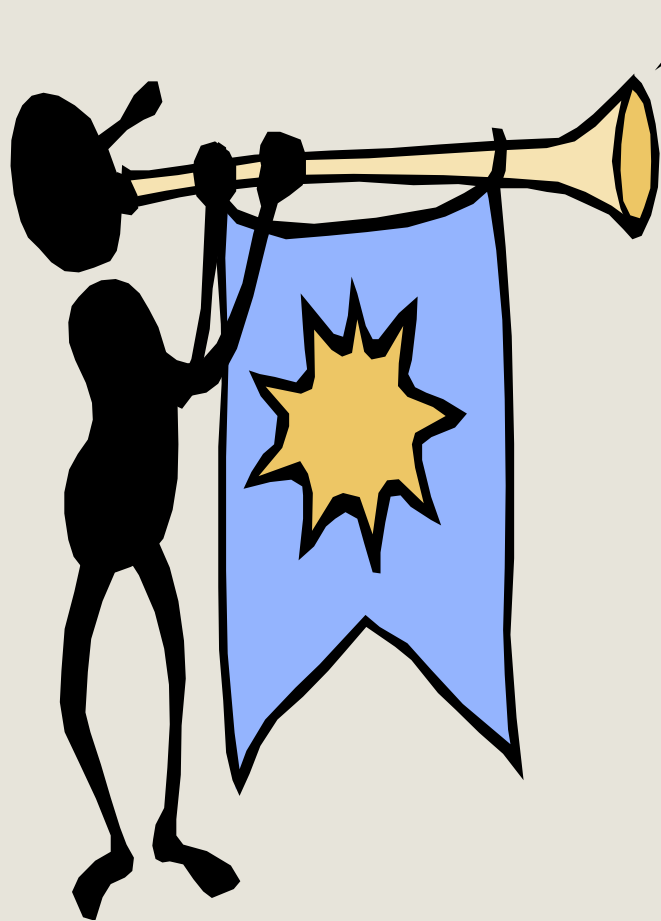
Session Initiation Protocol

INSE 7110 – Winter 2007

Value Added Services Engineering in Next Generation Networks

Lecture 3, Week 4

Outline



1. Introduction
2. Core SIP
3. Selected Extensions
4. Third Generation Cellular Networks

SIP: Introduction

A set of IETF specifications including:

- SIP core signalling:
 - RFC 2543, March 1999
 - RFC 3261, June 2002 (Obsoletes RFC 2543)

- SIP extensions (e.g. RFC 3265, June 2002 - Event notification)
 - May have nothing to do with signalling

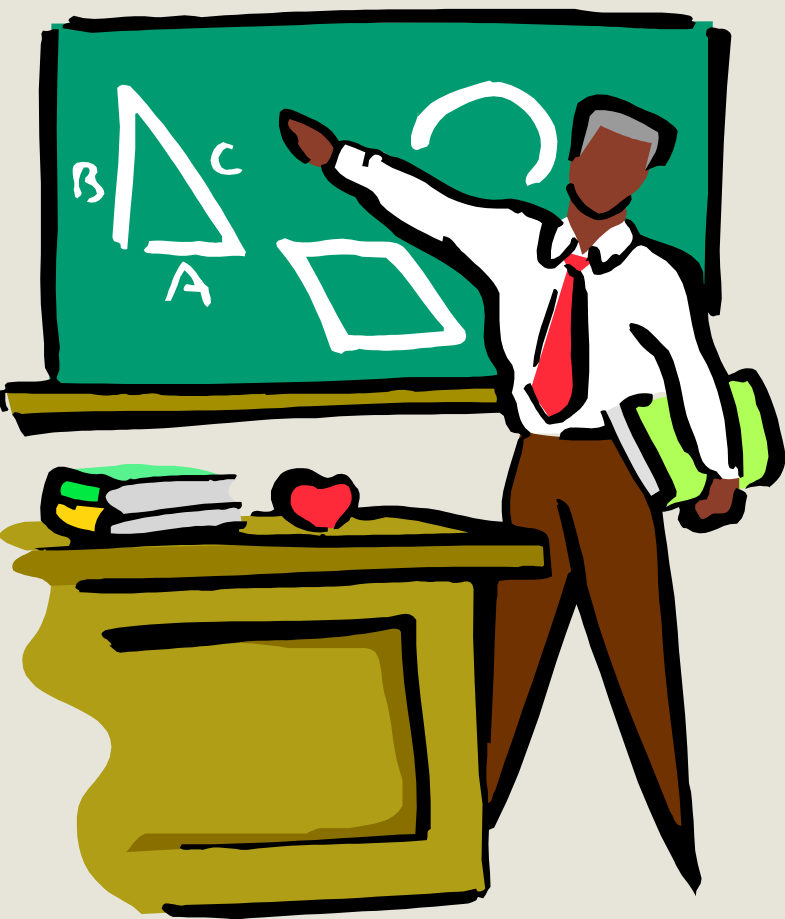
- Used in conjunction with other IETF protocols
 - QOS related protocol (e.g. RSVP)
 - Media transportation related protocol (e.g. RTP - RFC 1889)
 - Others (e.g. SDP - RFC 2327)

SIP: Introduction

Prime signaling system because adopted by all key next generation networks:

- 3GPP
- 3GPP2
- PacketCable:

Session Initiation Protocol (SIP) - Core



1. Introduction
2. Functional entities
3. Messages
4. A digression on SDP
5. Examples

SIP: Introduction

SIP core Signaling

- A signalling protocol for the establishment, modification and tear down of multimedia sessions
- Based on HTTP

A few key features

- Text based protocol
- Client/server protocol (request/response protocol)

SIP: The functional entities

User agents

- End points, can act as both user agent client and as user agent server
 - User Agent Client: Create new SIP requests
 - User Agent Server: Generate responses to SIP requests
- Dialog: Peer to peer relationship between two user agents, established by specific methods

Proxy servers

- Application level routers

Redirect servers

- Redirect clients to alternate servers

Registrars

- Keep tracks of users

SIP: The functional entities

State-full proxy

- Keep track of all transactions between the initiation and the end of a transaction
- Transactions:
 - Requests sent by a client along with all the responses sent back by the server to the client

Stateless proxy

- Fire and forget

SIP: The messages

Generic structure

- Start-line
- Header field(s)
- Optional message body

Request message

- Request line as start line
 - . Method name
 - . Request URI
 - . Protocol version

Response message

- Status line as start line
 - . Protocol version
 - . Status code
 - . Reason phrase (Textual description of the code)

SIP: The messages

Request messages

- Methods for setting up sessions
 - . INVITE
 - . ACK
 - . CANCEL
 - . BYE

- Others
 - . REGISTER (Registration of contact information)
 - . OPTIONS (Querying servers about their capabilities)

SIP: The messages

Response message

- Provisional
- Final

Examples of status code

1xx: Provisional

2xx: Success

6xx: Global failure

A digression on SDP ...

Session Description Protocol

- Convey the information necessary to allow a party to join a multimedia session

 - Session related information

 - Media related information

- Text based protocol

- No specified transport

 - Messages are embedded in the messages of the protocol used for the session

 - Session Announcement Protocol (SAP)

 - Session Initiation Protocol (SIP)

A digression on SDP ...

Session Description Protocol

- <Type> = <Value>
- Some examples

Session related

v= (protocol version)

s= (Session name)

Media related

m= (media name and transport address)

b= (bandwidth information)

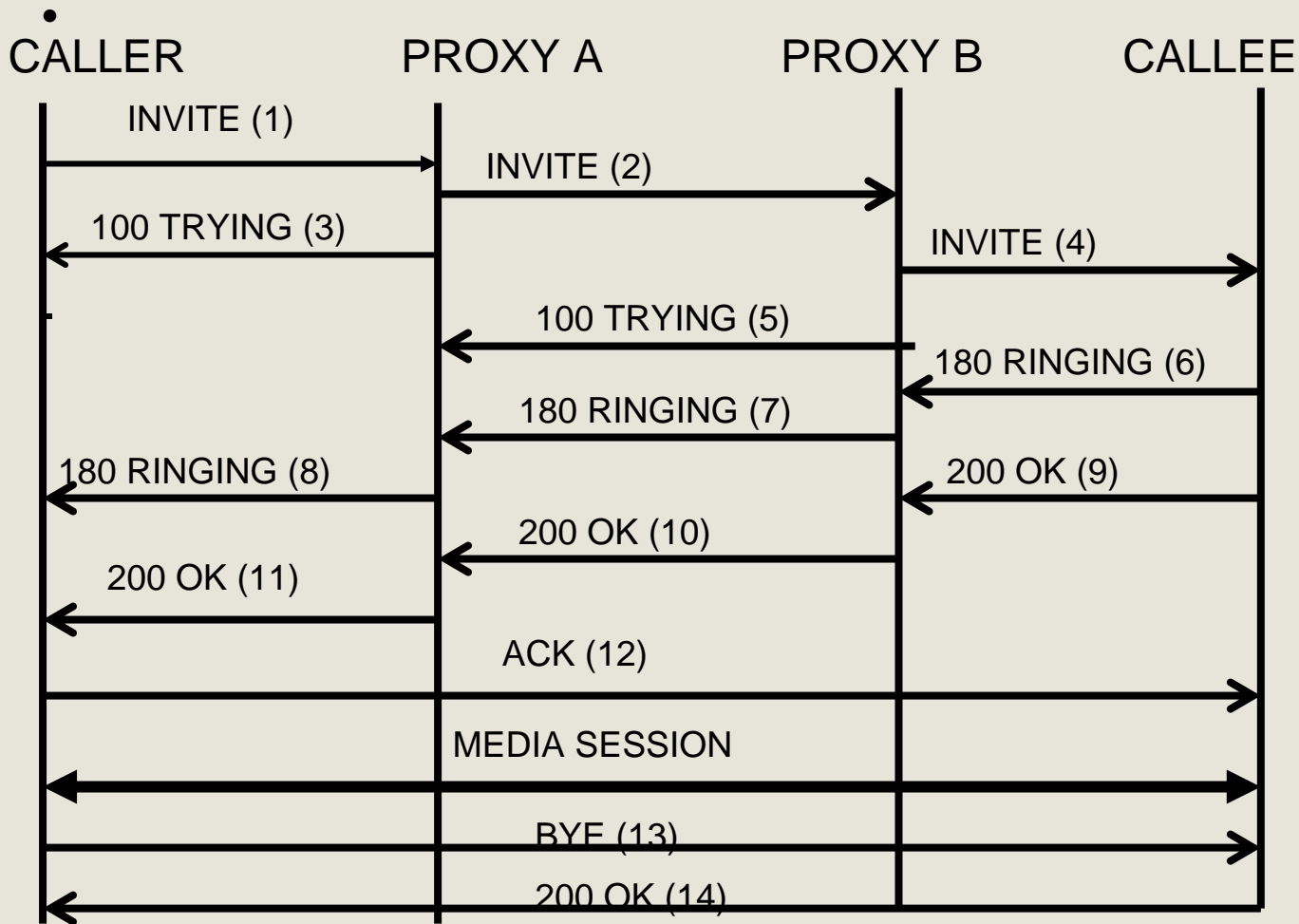
A digression on SDP ...

Session Description Protocol

Use with SIP

- Negotiation follows offer / response model
- Message put in the body of pertinent SIP messages
 - INVITE Request / response
 - OPTIONS Request / response

SIP: A simplified call case



SIP: Examples of messages from the RFC

An example of an INVITE

INVITE sip:bob@biloxi.com SIP/2.0

Via: SIP/2.0/UDP pc33.atlanta.com;branch=z9hG4bK776asdhds

Max-Forwards: 70

To: Bob <sip:bob@biloxi.com>

From: Alice <sip:alice@atlanta.com>;tag=1928301774

Call-ID: a84b4c76e66710@pc33.atlanta.com

CSeq: 314159 INVITE

Contact: <sip:alice@pc33.atlanta.com>

Content-Type: application/sdp

Content-Length: 142

SIP: Examples of messages from the RFC

An example of an OPTIONS message

```
OPTIONS sip:carol@chicago.com SIP/2.0
Via: SIP/2.0/UDP pc33.atlanta.com;branch=z9hG4bKhjhs8ass877
Max-Forwards: 70
To: <sip:carol@chicago.com>
From: Alice <sip:alice@atlanta.com>;tag=1928301774
Call-ID: a84b4c76e66710
CSeq: 63104 OPTIONS
Contact: <sip:alice@pc33.atlanta.com>
Accept: application/sdp
Content-Length: 0
```

SIP: Examples of messages from the RFC

An example of RESPONSE to the OPTIONS request

SIP/2.0 200 OK

Via: SIP/2.0/UDP pc33.atlanta.com;branch=z9hG4bKhjhs8ass877
;received=192.0.2.4

To: <sip:carol@chicago.com>;tag=93810874

From: Alice <sip:alice@atlanta.com>;tag=1928301774

Call-ID: a84b4c76e66710

CSeq: 63104 OPTIONS

Contact: <sip:carol@chicago.com>

Contact: <mailto:carol@chicago.com>

Allow: INVITE, ACK, CANCEL, OPTIONS, BYE

Accept: application/sdp

Accept-Encoding: gzip

Accept-Language: en

Supported: foo

Content-Type: application/sdp

SDP: Examples of messages from the RFC ...

Session Description Protocol

An example from the RFC ...

v=0

o=mhandley 2890844526 2890842807 IN IP4 126.16.64.4

s=SDP Seminar

i=A Seminar on the session description protocol

u=<http://www.cs.ucl.ac.uk/staff/M.Handley/sdp.03.ps>

e=mjh@isi.edu (Mark Handley)

c=IN IP4 224.2.17.12/127

t=2873397496 2873404696

a=recvonly

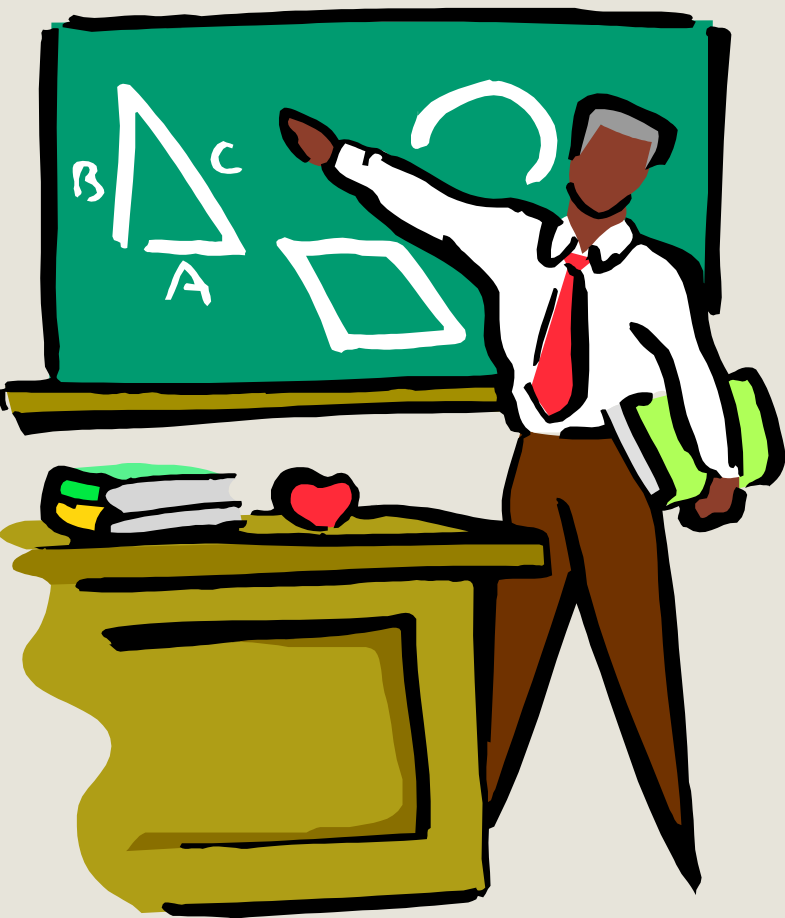
m=audio 49170 RTP/AVP 0

m=video 51372 RTP/AVP 31

m=application 32416 udp wb

a=orient:portrait

SIP – Selected Extensions



1. Extensions for ad hoc networks
2. Event framework
3. Others

Ad hoc networks

(Possibly mobile) heterogeneous nodes communicating without fixed infrastructure and pre-set organization of available links

- Wireless technologies (e.g. Bluetooth, IEEE 802.11)
- Used in scenarios such as:
 - Disaster relief operations
 - Military operations
 - Hot spots ...
- Considered a a new network of 4G
- 4G
 - Co-existing and cooperating networks

Ad hoc networks

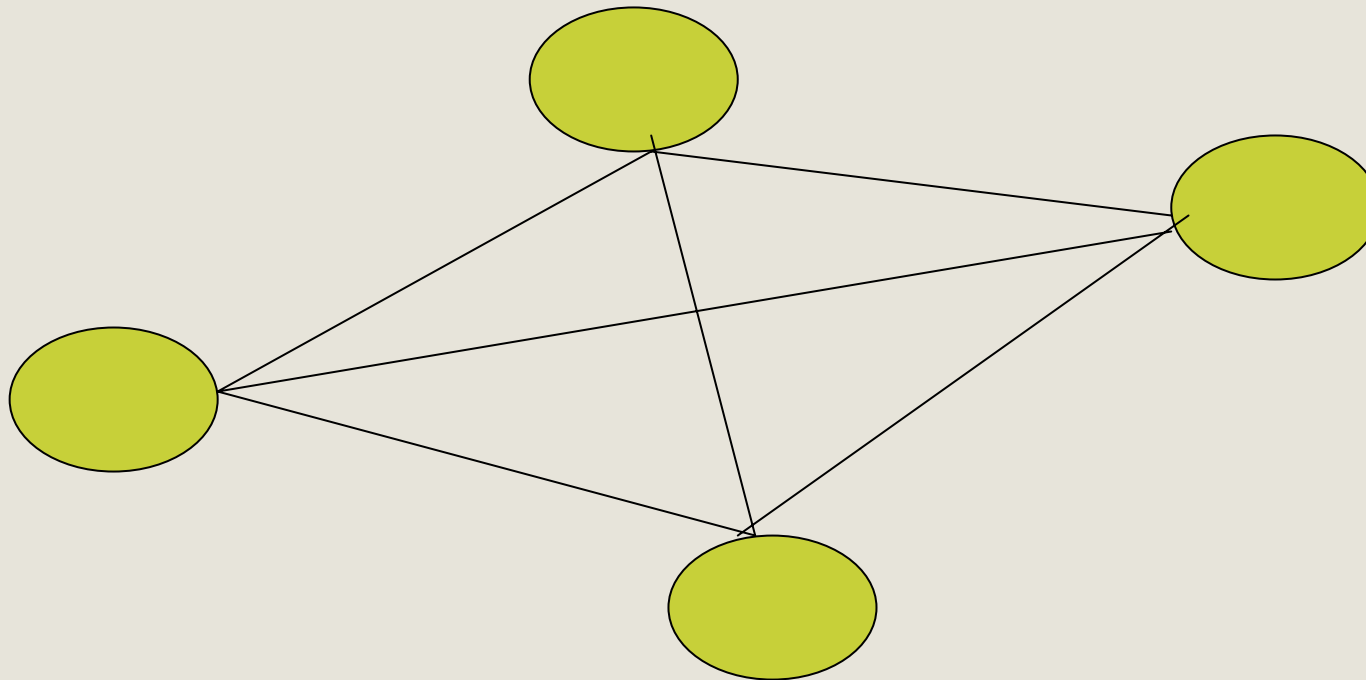
Signalling

- No centralized entity
- Dynamic propagation of session related information
- Scalability
- Lightweight
- Optimal usage of resources

Ad hoc networks

Signalling

- Possible, but not optimal implementation: Full-mesh



Ad hoc networks

Signalling – Extensions made to SIP

- Expired IETF drafts
 - Example of new headers
 - Also: List the participants already connected to the session or trying to connect to it
 - Replace: use in split / merge operation
 - Listed participants should be treated as if they have sent a BYE to the recipient of the message

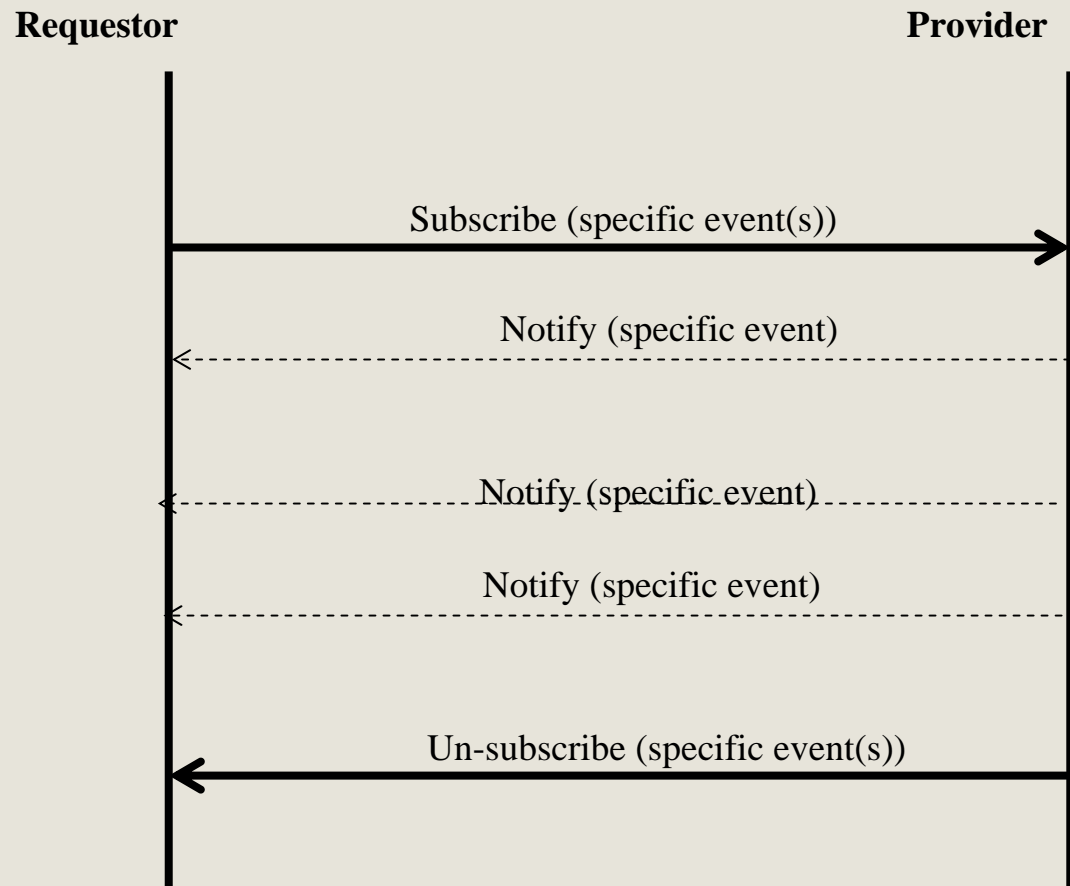
Event Notification

Motivation

- Necessity for a node to be asynchronously notified of happening (s) in other nodes
 - Busy / not busy (SIP phones)
 - A client A can call again a client B when notified that B is now not busy
 - On-line / Off-line
 - Buddy list

Event Notification

Conceptual framework



Event Notification

The SIP Event Notification Framework

- Terminology
 - Event package:
 - Events a node can report
 - Not part of the framework – Part of other RFCs
 - Subscriber
 - Notifier
- New Messages
 - Subscribe
 - Need to be refreshed
 - Used as well for un-subscribing (expiry value put to zero)
 - Notify

Event Notification

The SIP Event Notification Framework

- More on the methods
 - New headers
 - Event
 - Allow-Events
 - Subscription state

Event Notification

An example of use: REFER Method

- Recipient should contact a third party using the URI provided in the CONTACT field
 - Call transfer
 - Third party call control
- Handled as Subscribe / notify
 - REFER request is considered an implicit subscription to REFER event
 - Refer-TO: URI to be contacted
 - Expiry determined by recipient and communicated to sender in the first NOTIFY
 - Recipient needs to inform sender of the success / failure in contacting the third party

Event Notification

Another example of use: Presence

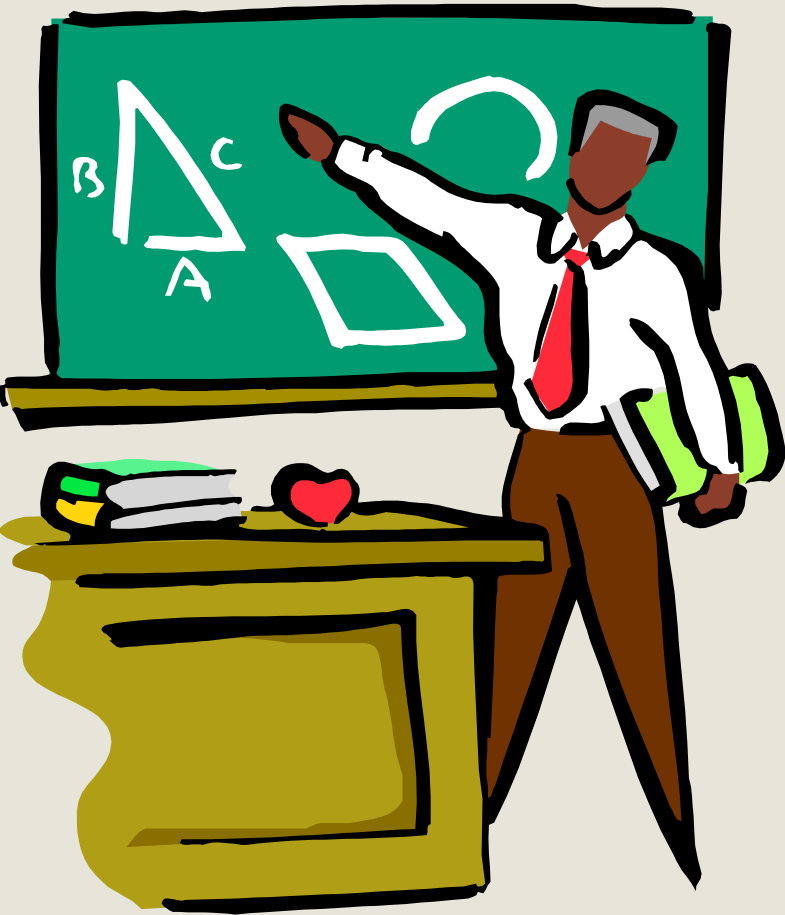
- Dissemination/consumption of presence information (e.g. on/off, willingness to communicate, device capabilities, preferences)
 - Numerous applications
 - Multiparty sessions initiated when a quorum is on-line
 - News adapted to device capabilities
- Several standards including SIMPLE (SIP based)
 - Handled as Subscribe / notify in SIMPLE
 - Watchers / presentities
 - Explicit subscriptions
 - Explicit notifications

INFO Method

Allow the exchange of non signalling related information during a SIP dialog

- Semantic defined at application level
- Mid-call signalling information
 - DTMF digits with SIP phones
- Info carried as
 - Headers and/or
 - Message body

3GPP networks



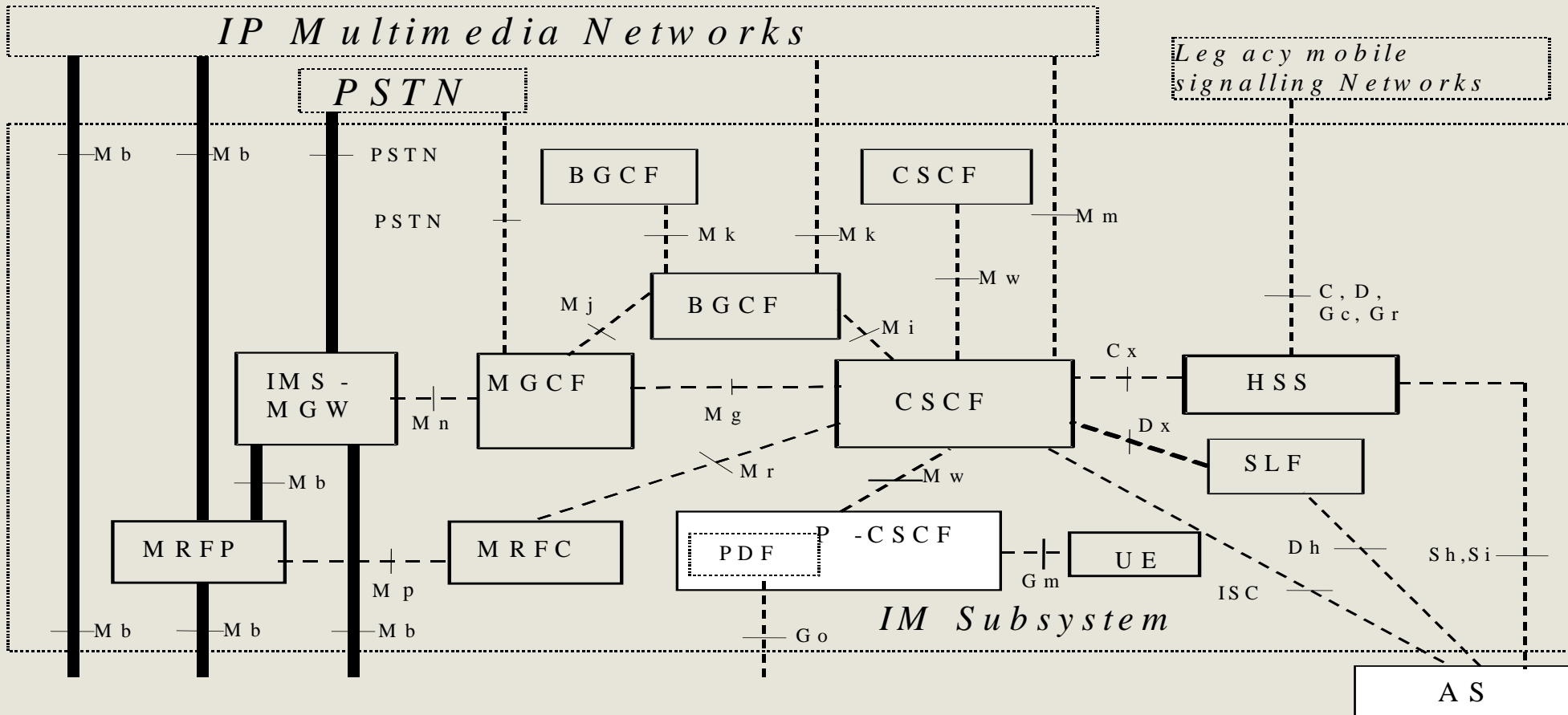
1. Essentials
2. Key definitions
3. Call cases

3GPP networks

Essentials

- Made of:
 - Legacy
 - Circuit switched part (GSM)
 - Packet switched (GPRS)
 - Next generation part (IP multimedia (IM))
 - Inter-working
 - Some of the functional entities are common to both legacy and NGN (e.g. Home Subscriber Server)
 - Adoption/extension of existing NGN specifications:
 - SIP instead of H.323
 - H.248/Megaco

IP multimedia portion



IP Multimedia portion

Some of the functional entities

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

IP Multimedia portion

Media Resource Function (MRF)

- Source of media (media mixing, announcement playing)

- Two parts

Control part: MRFC

Media Part: MRFP

Megaco / H.248: Protocol used between the two

Media Gateway Function (MGF):

Signaling conversion between PSTN/2G and IMS

Media Gateway (MG)

Media conversion between PSTN/2G and IMS

Megaco / H.248: Protocol used between the two

IP Multimedia portion

Some of the functional entities

Call Session Control Function (CSCF) “The switch”

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 decompression of messages

IP Multimedia portion

Some of the functional entities

Call Session Control Function (CSCF)

Interrogating CSCF (I-CSCF):

SIP proxy located at the edge of an administrative domain

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

IP Multimedia portion

Some of the functional entities

Call Session Control Function (CSCF)

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

IP Multimedia portion

Some of the functional entities

Application server (AS)

Most relevant functional entity in the context of this course

Host services and execute services

Communicate using SIP

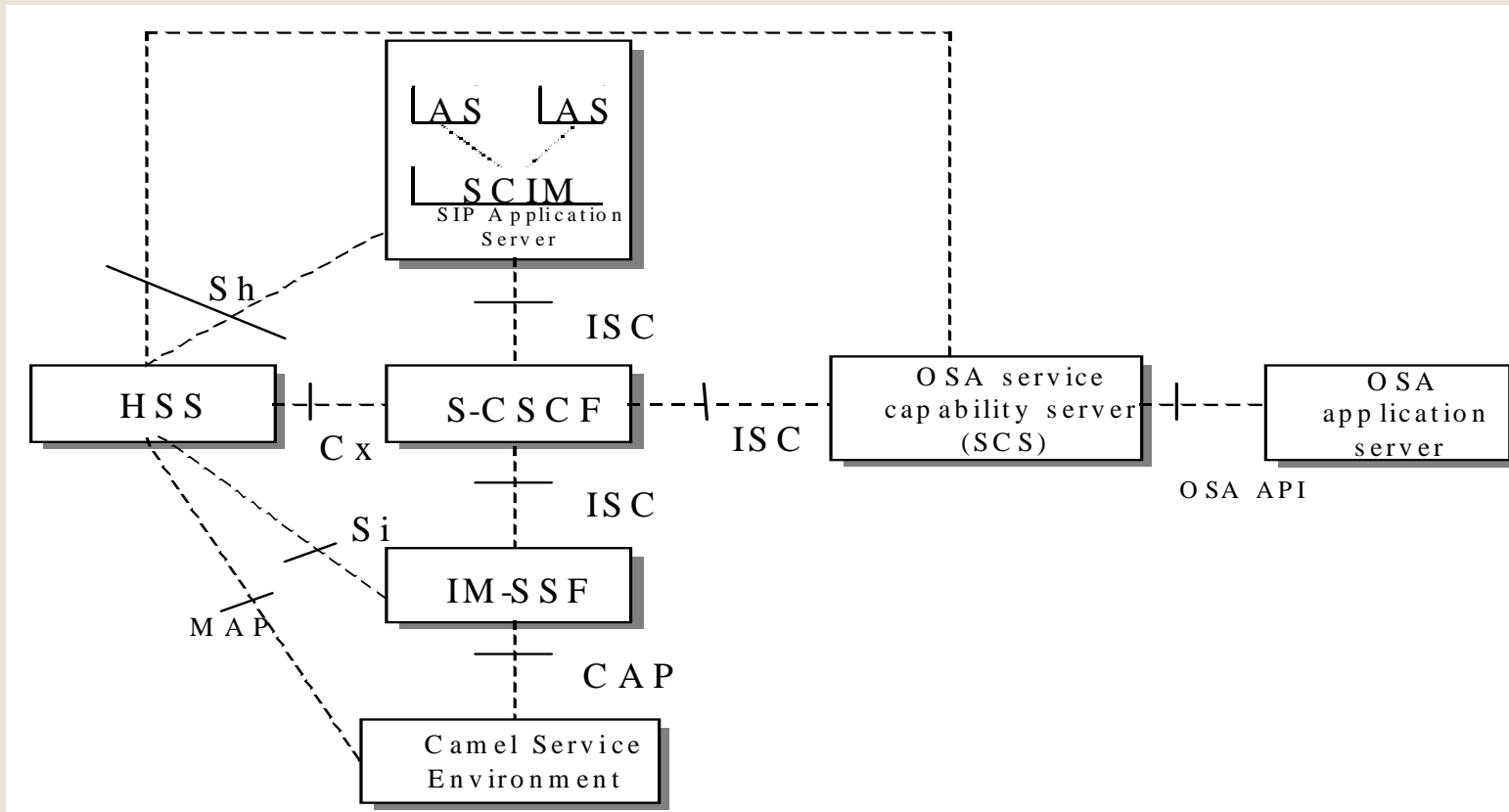
Two types

SIP AS: Signaling specific architecture (Services can work only in SIP environment)

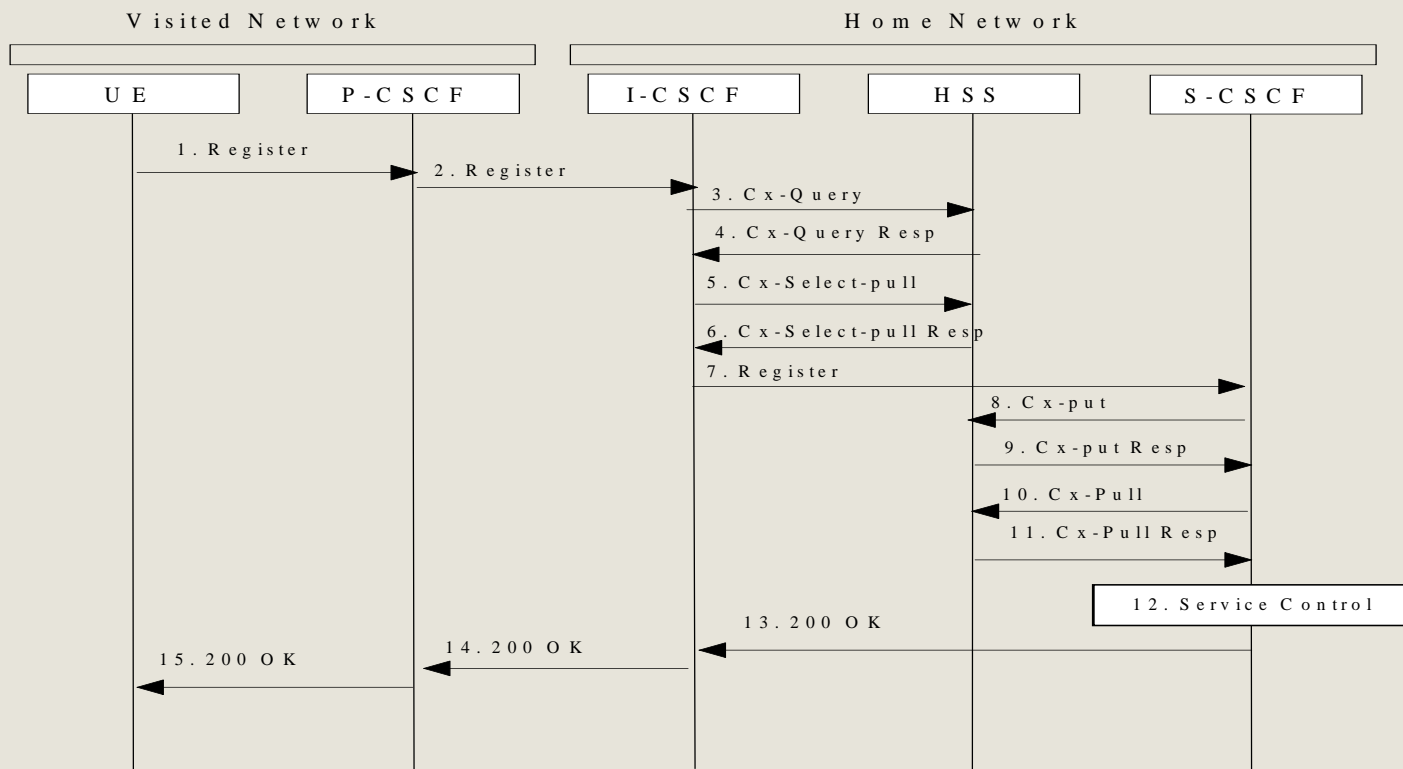
Open Service Architecture – Service Capability Server (OSA/SCS)

- Signaling neutral architecture
- Happens to work in a SIP environment, but can work in other environments

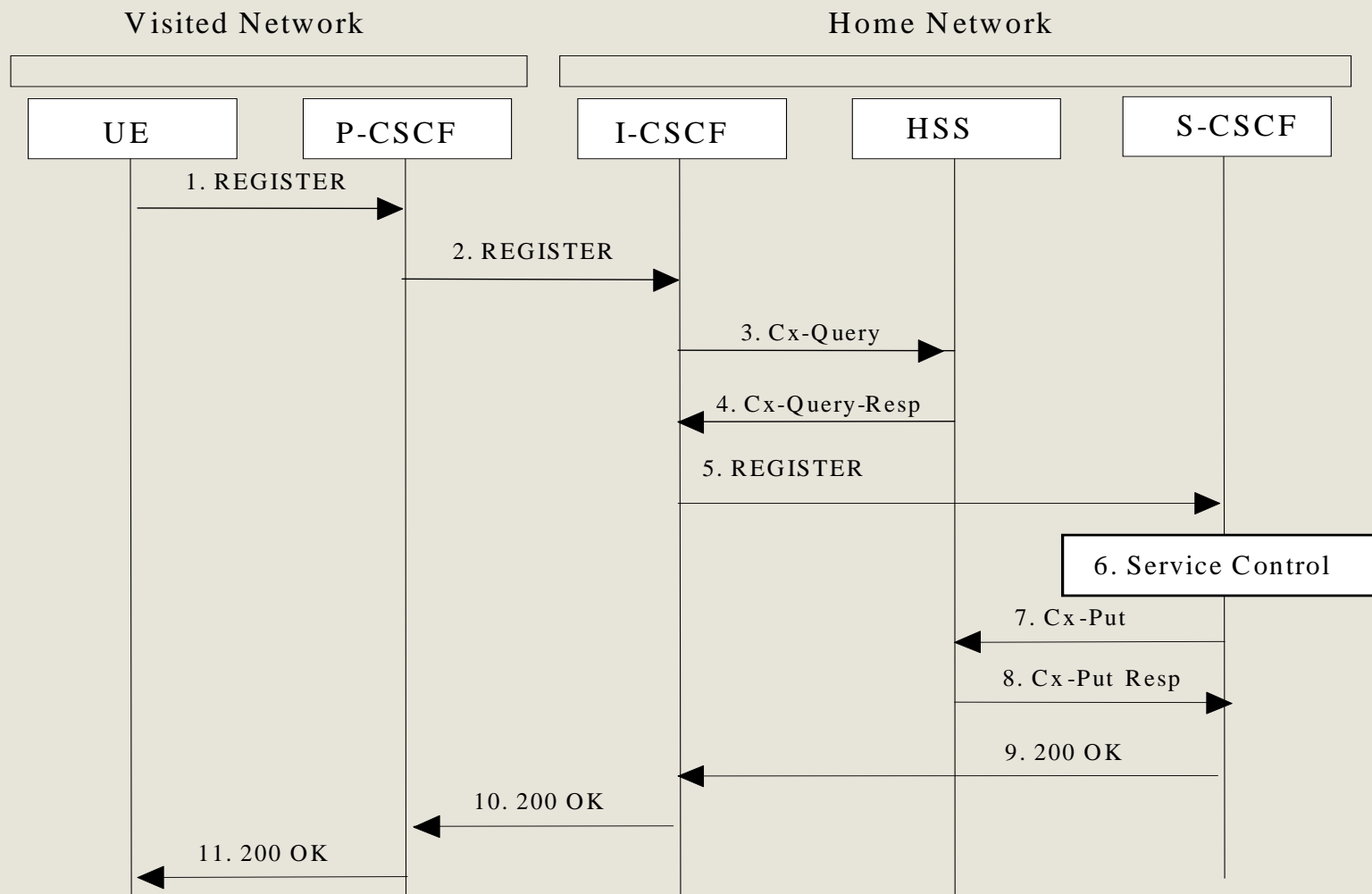
IP multimedia portion



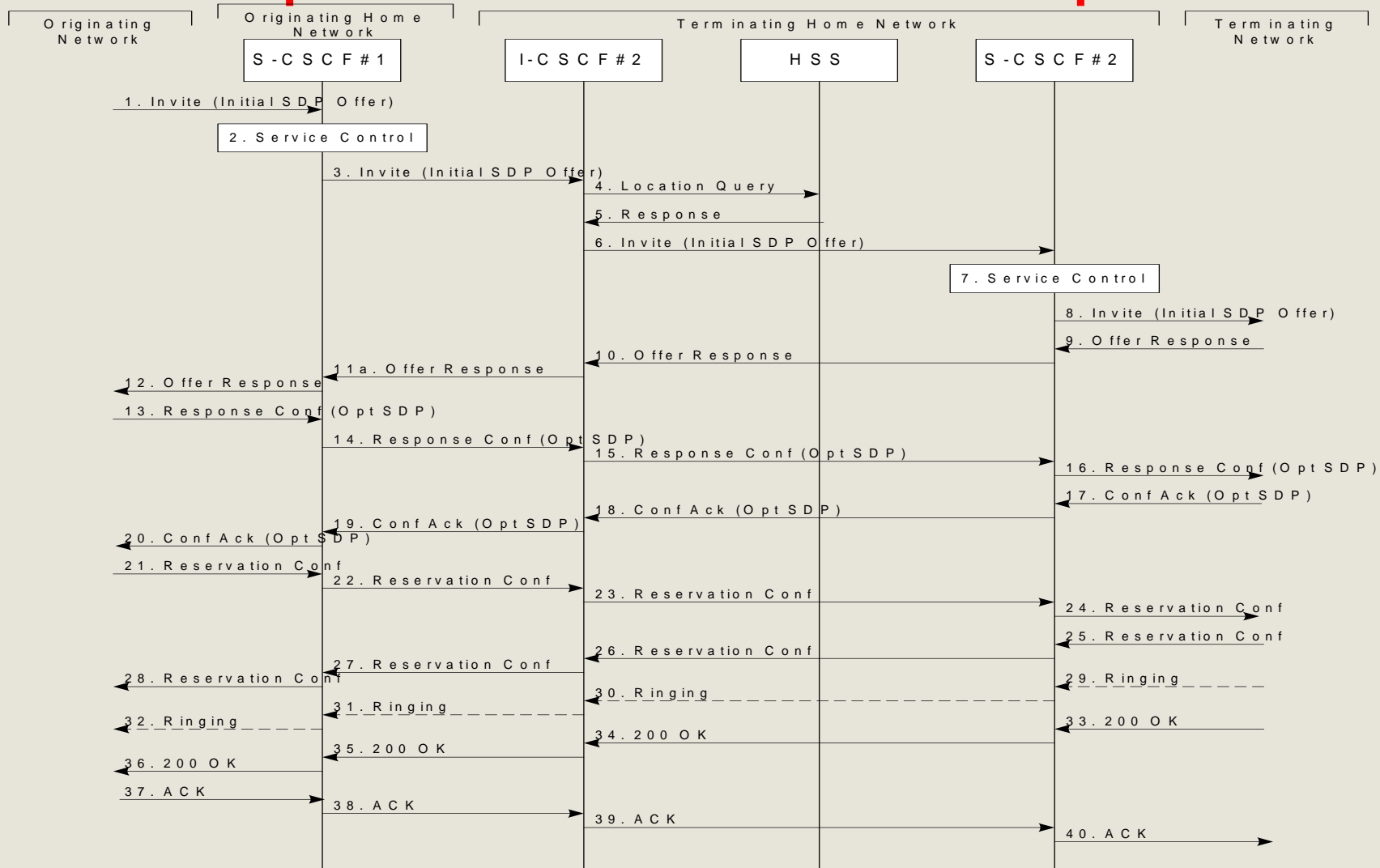
IP Multimedia portion – Registration



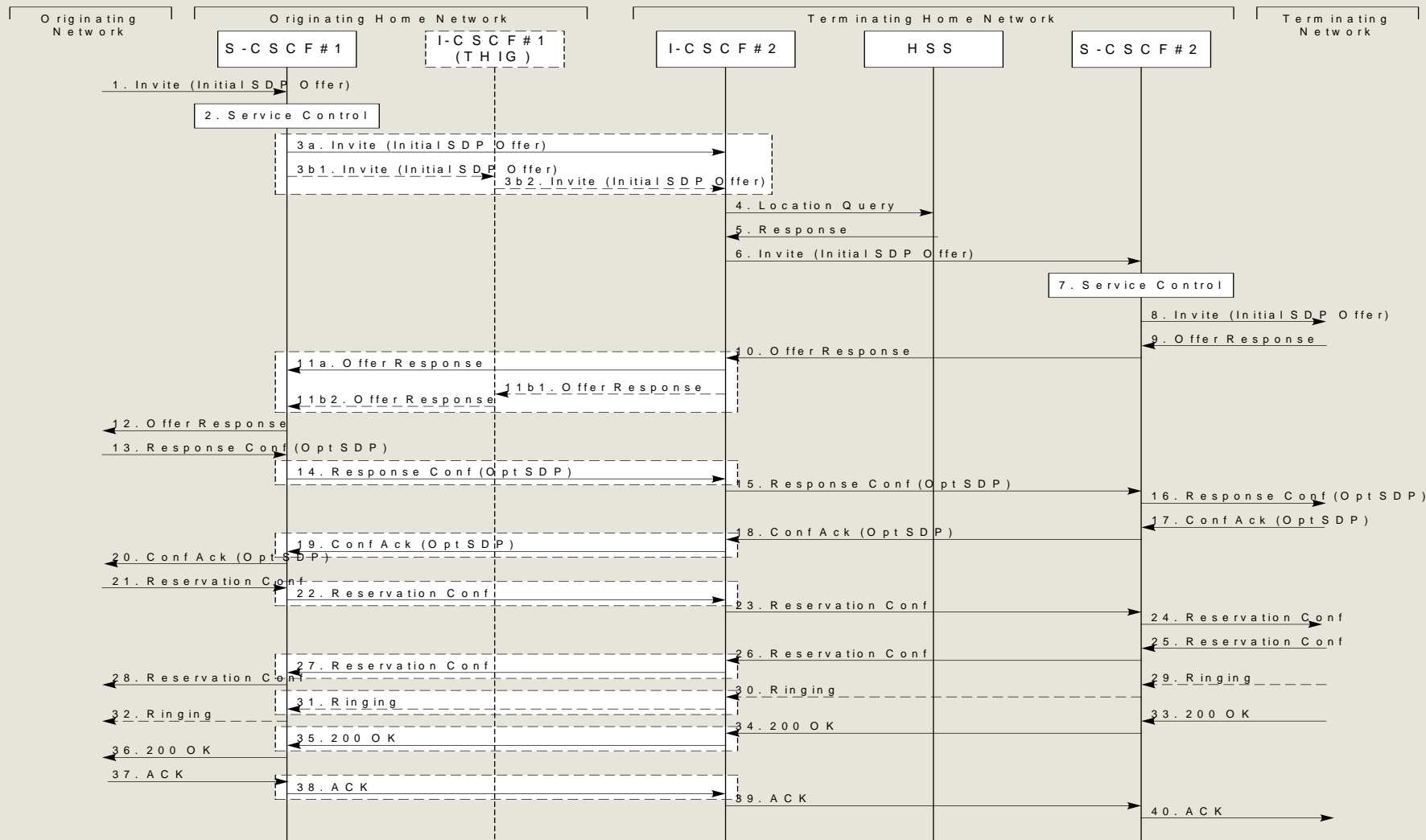
IP Multimedia portion – De-Registration



IP Multimedia portion – Call initiation - Same operator



IP Multimedia portion – Call initiation - Different operators



References

Core SIP

- SIP core signalling:
- H. Schulzrinne, and J. Rosenberg, SIP: Internet Centric Signaling, IEEE Communications Magazine, October 2000
- RFC 3261, June 2002 (Obsoletes RFC 2543)
- RFC 2327 (SDP)

SIP extensions

No overview paper

- RFC 3265, 3515 (Event framework)
- RFC 2976 (INFO Method)

3GPP

- K. Knightson, N. Morita and T. Towle, NGN Architecture: General Principles, Functional Architecture and Implementation, IEEE Communications Magazine , October 2005, Vol.43, No10
- G. Camarillo and M. Garcia-Martin, The 3G IP Multimedia Subsystem, Wiley, 2004 , Part II
- 3GPP TS 23.228
- 3GPP TS 23.002