Session Initiation Protocol
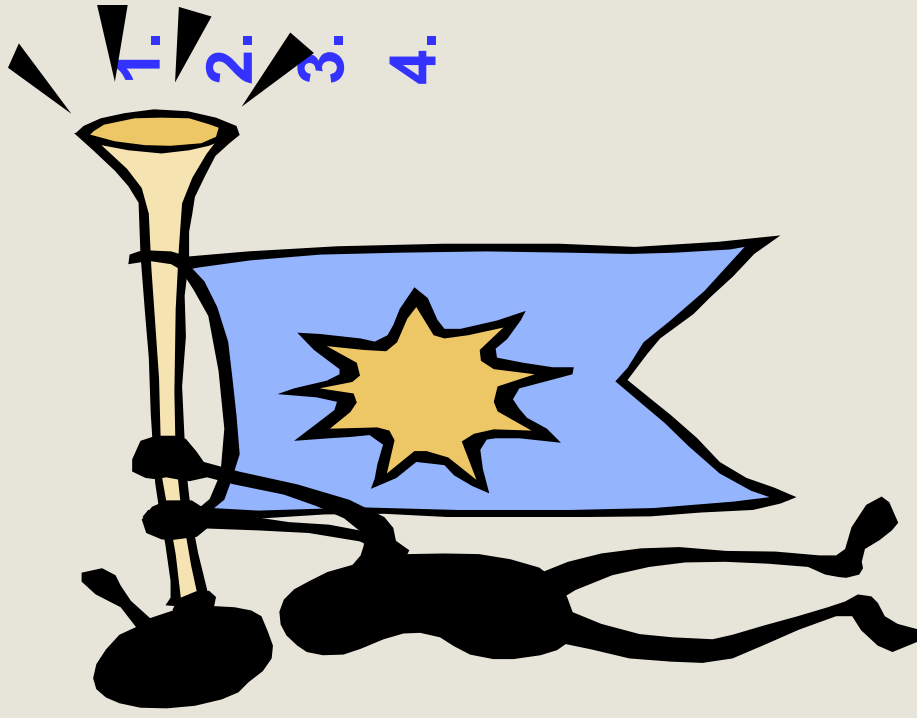
INSE 7110 – Winter 2005

Value Added Services Engineering in Next Generation Networks

Week #3

ERICSSON

Outline

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

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SIP: Introduction

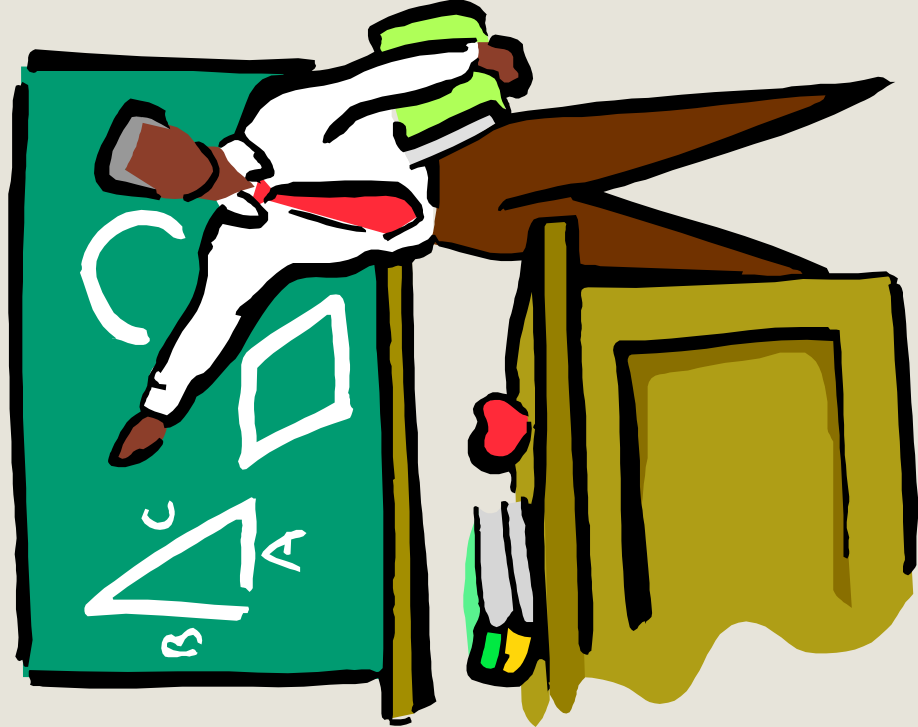## A set of IETF specifications including:

- **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

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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

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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)

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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)

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A digression on SDP …

Session Description Protocol

- <Type> = <Value>

- Some examples

Session related

v= (protocol version)

s= (Session name)

Media related

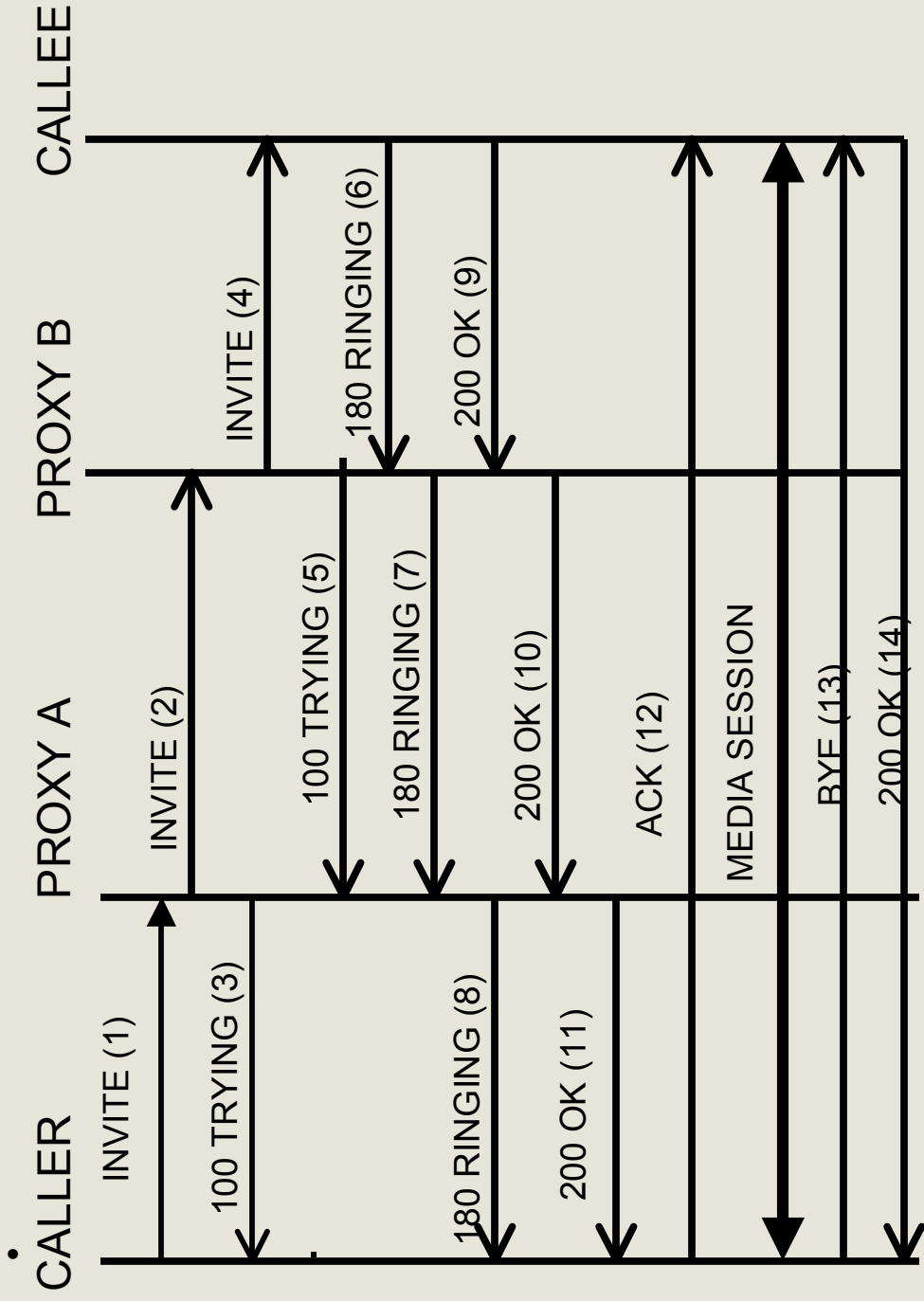m= (media name and transport address)

b= (bandwidth information)

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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

Diagram of SIP message flow between CALLER, PROXY A, PROXY B, and CALLEE:

- CALLER → PROXY A: INVITE (1)
- PROXY A → CALLER: 100 TRYING (3)
- PROXY A → PROXY B: INVITE (2)
- PROXY B → PROXY A: 100 TRYING (5)
- PROXY B → CALLEE: INVITE (4)
- CALLEE → PROXY B: 180 RINGING (6)
- PROXY B → PROXY A: 180 RINGING (7)
- PROXY A → CALLER: 180 RINGING (8)
- CALLEE → PROXY B: 200 OK (9)
- PROXY B → PROXY A: 200 OK (10)
- PROXY A → CALLER: 200 OK (11)
- CALLER → CALLEE: ACK (12)
- MEDIA SESSION
- CALLER → CALLEE: BYE (13)
- CALLEE → CALLER: 200 OK (14)

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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

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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
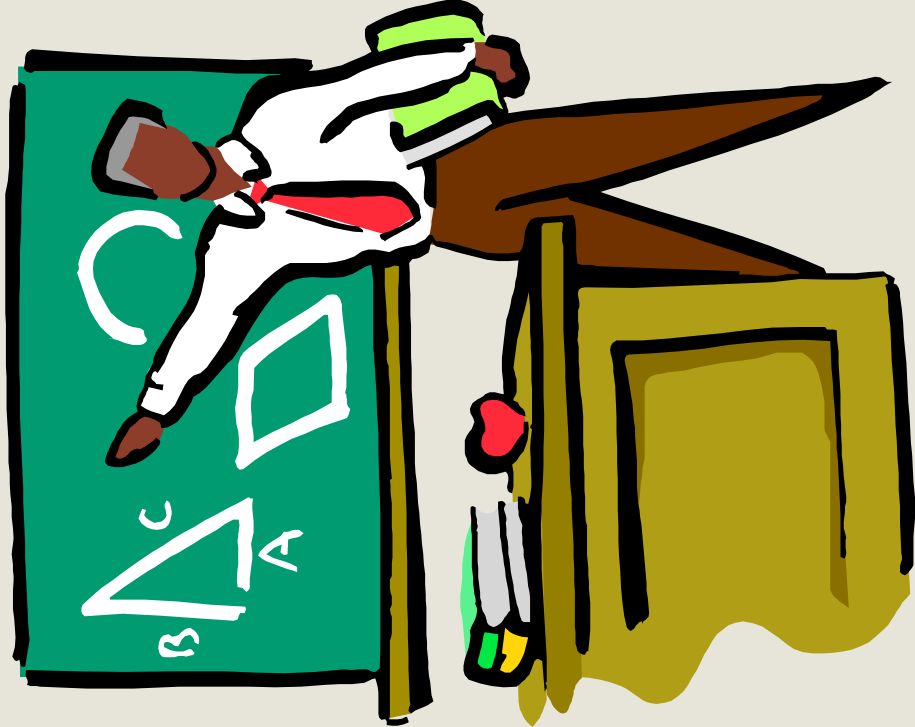
SDP: Examples of messages from the RFC …

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

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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
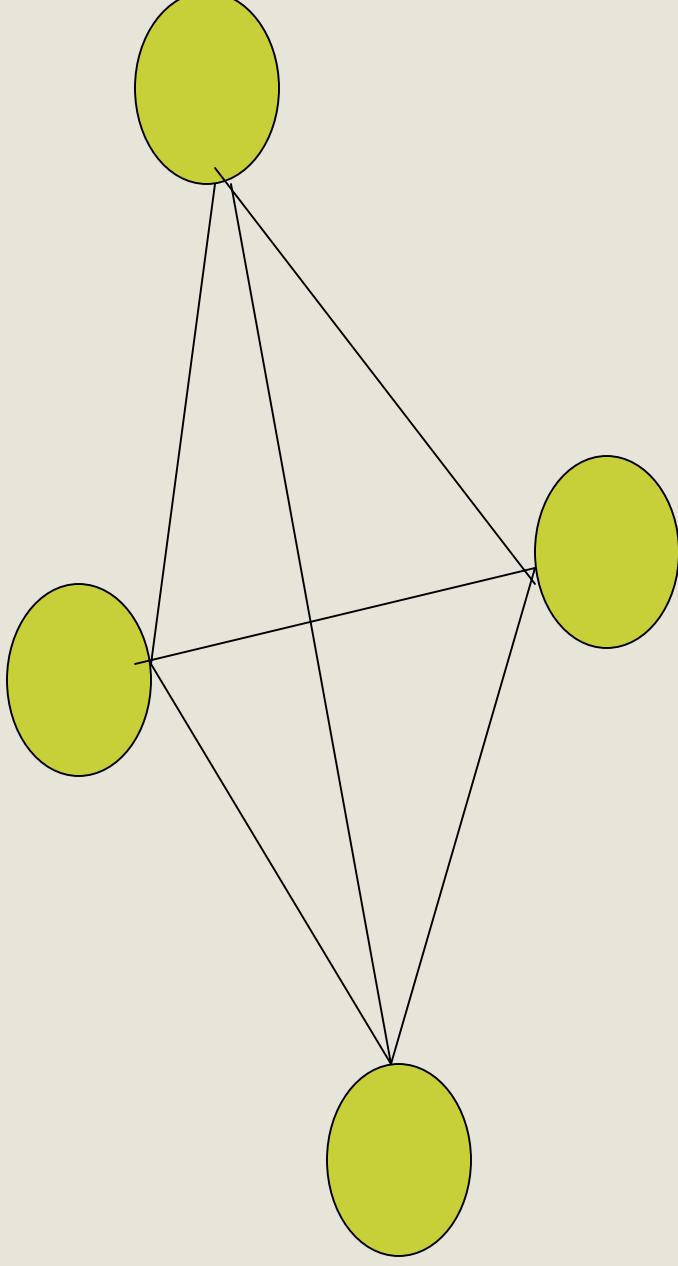 - Co-existing and cooperating networks

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
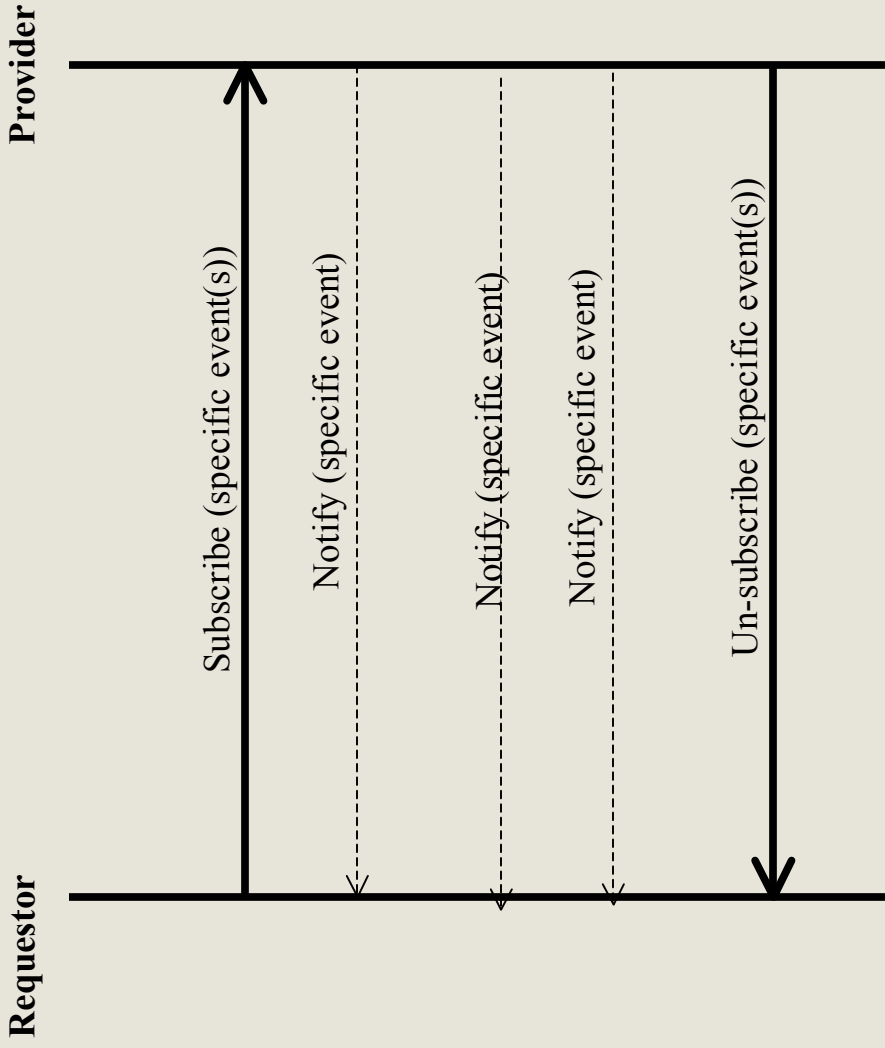
Event Notification

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

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Requestor

Provider

Subscribe (specific event(s))

Notify (specific event)

Notify (specific event)

Notify (specific event)

Un-subscribe (specific event(s))

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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

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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
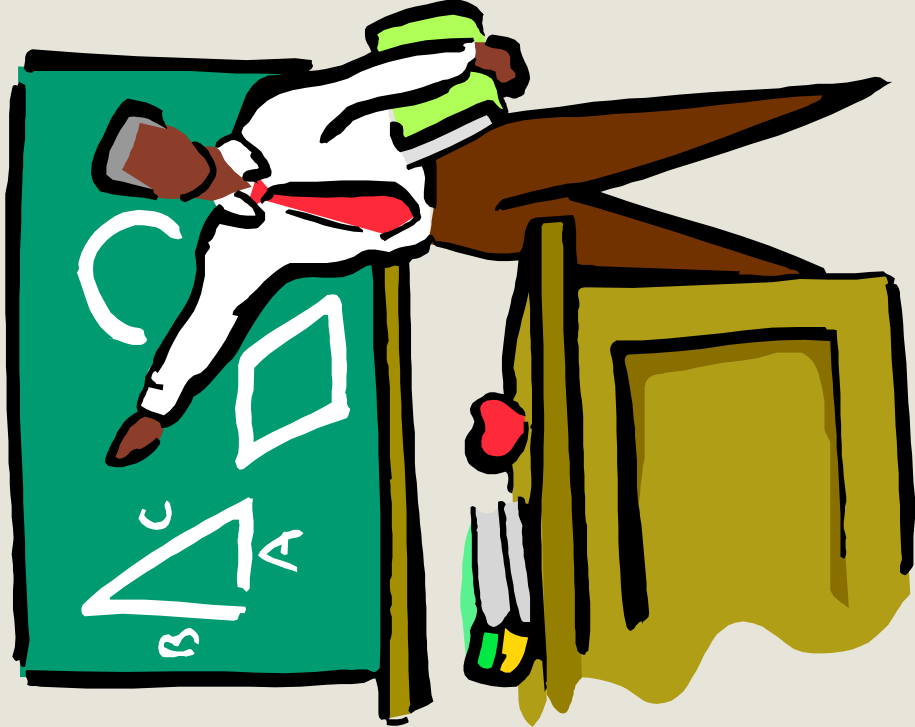
Another example of use: Presence

- 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

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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
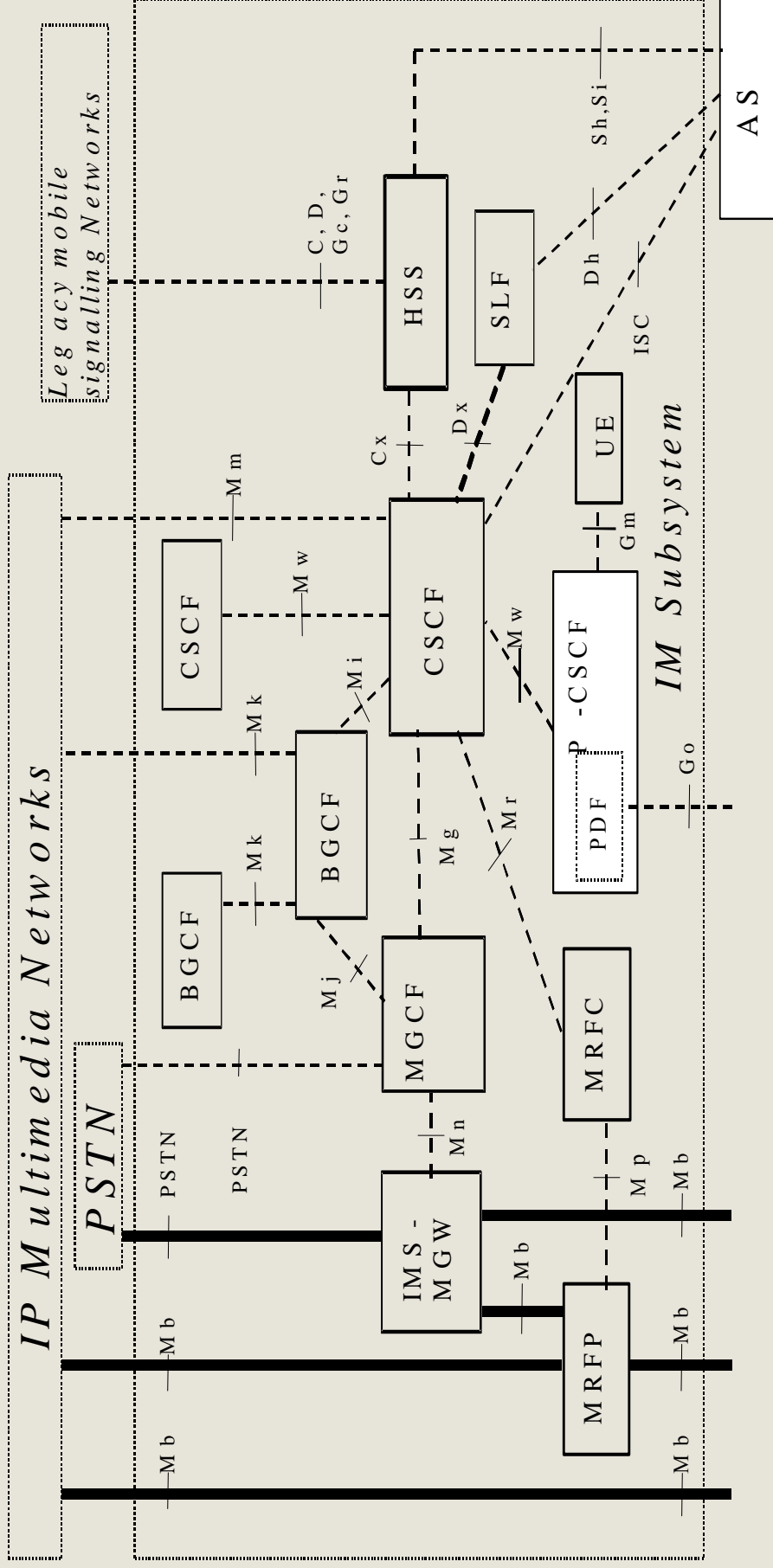 - Headers and/or
  - Message body

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 Networks

Legacy mobile signalling Networks

IM Subsystem

PSTN

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IP Multimedia portion

Some of the functional entities

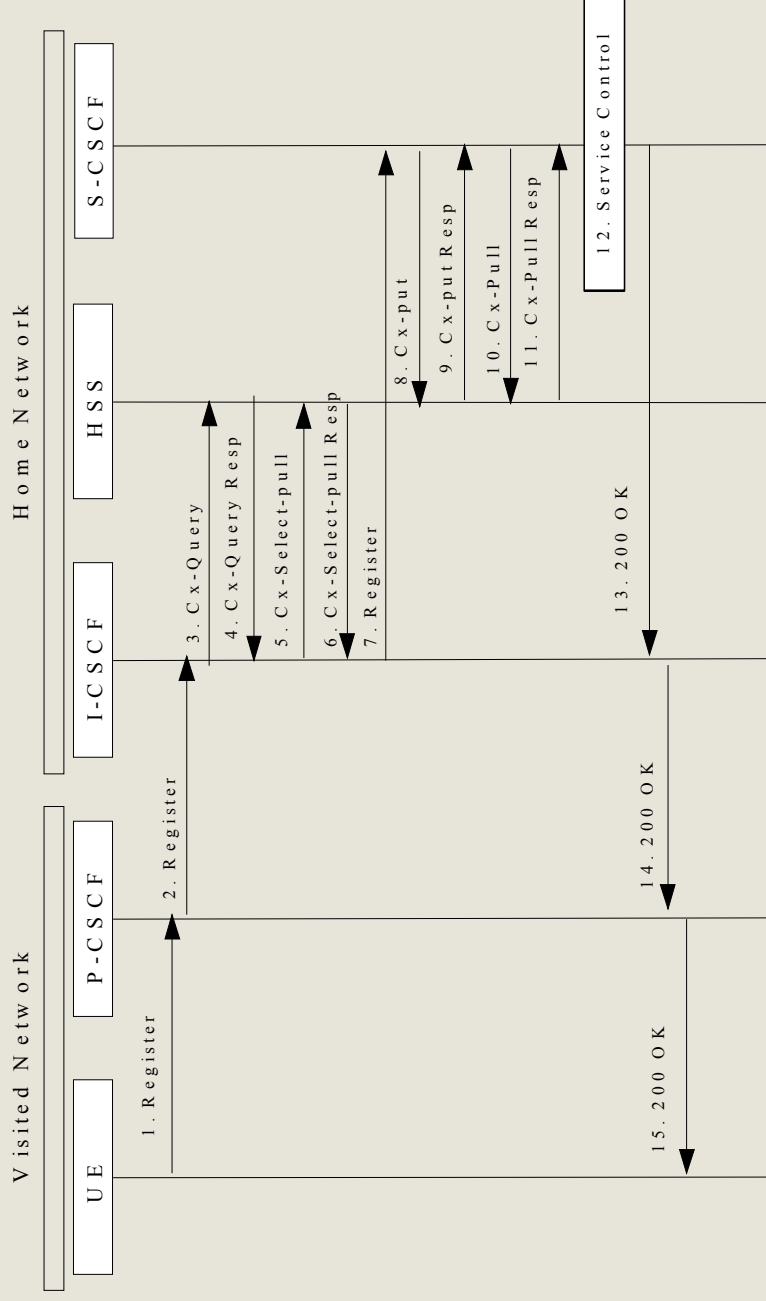Call Session Control Function (CSCF)

- Proxy-CSCF: First contact point in the IM network – Accepts requests and proxies them

- Serving-CSCF: Perform session control for all user entities in the networks including visitors

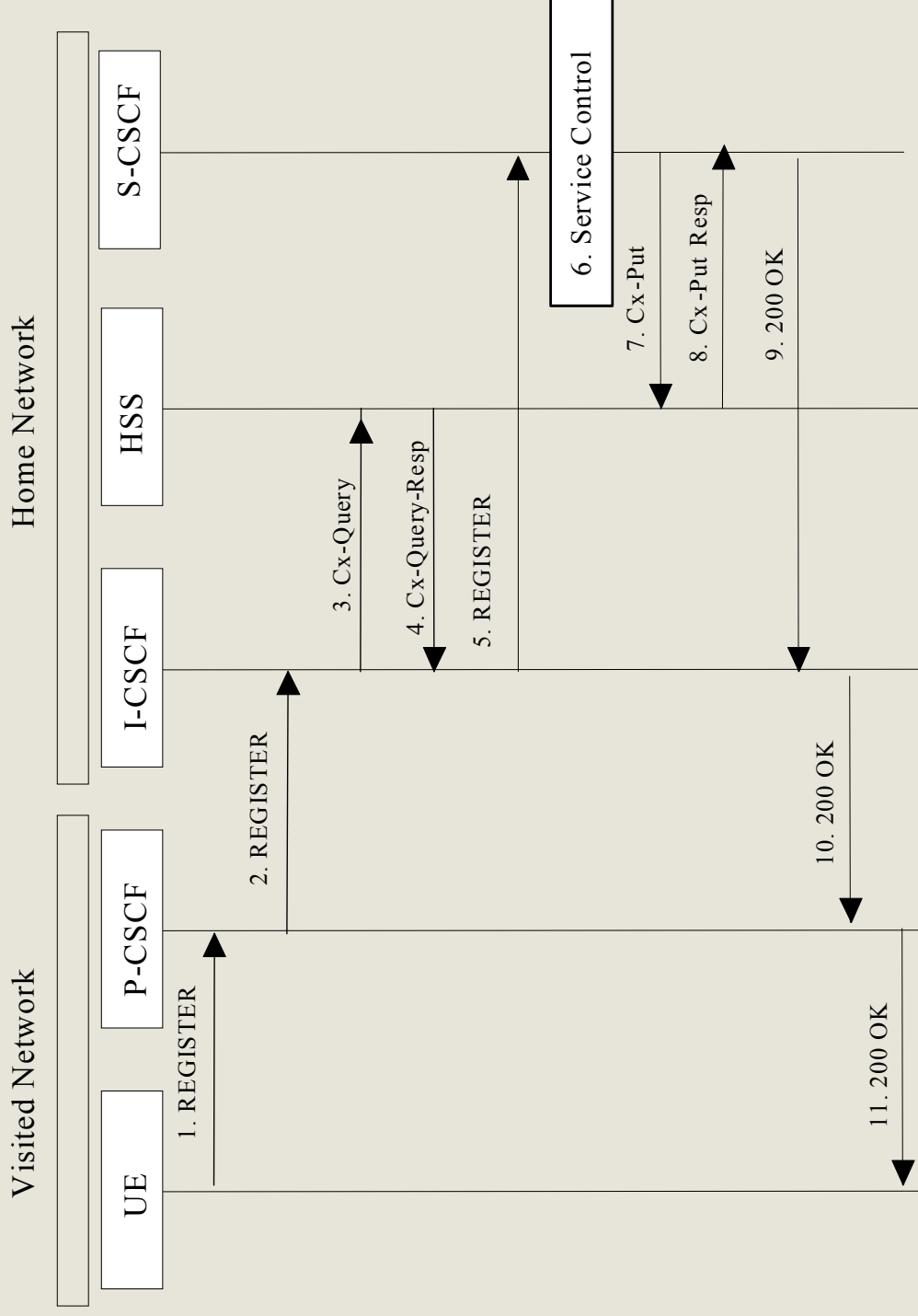- Interrogating CSCF: Contact point in an operator domain for all users (home users, and visiting users)

-

Home Subscriber Server (HSS)

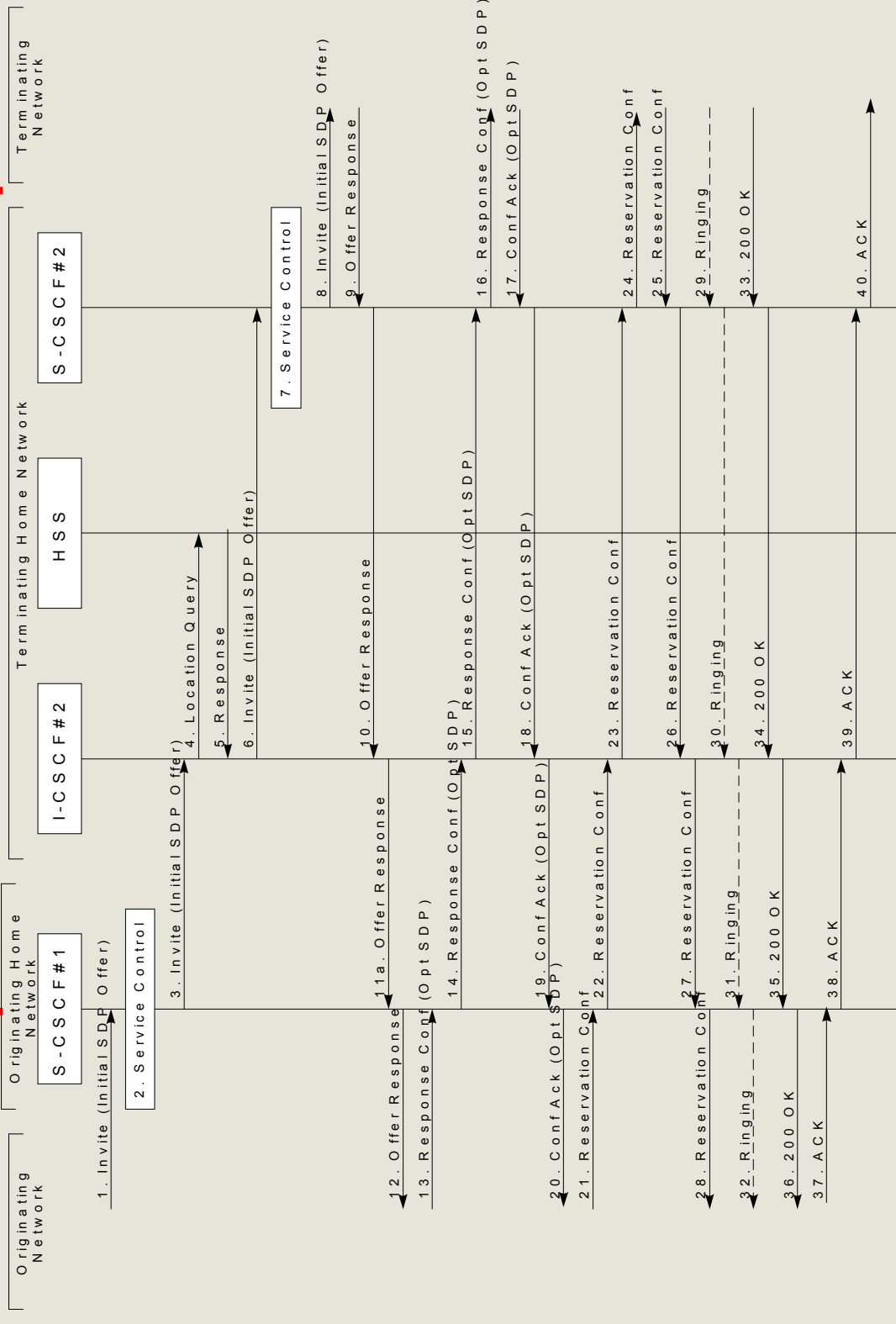- Master data base – subscription / location information

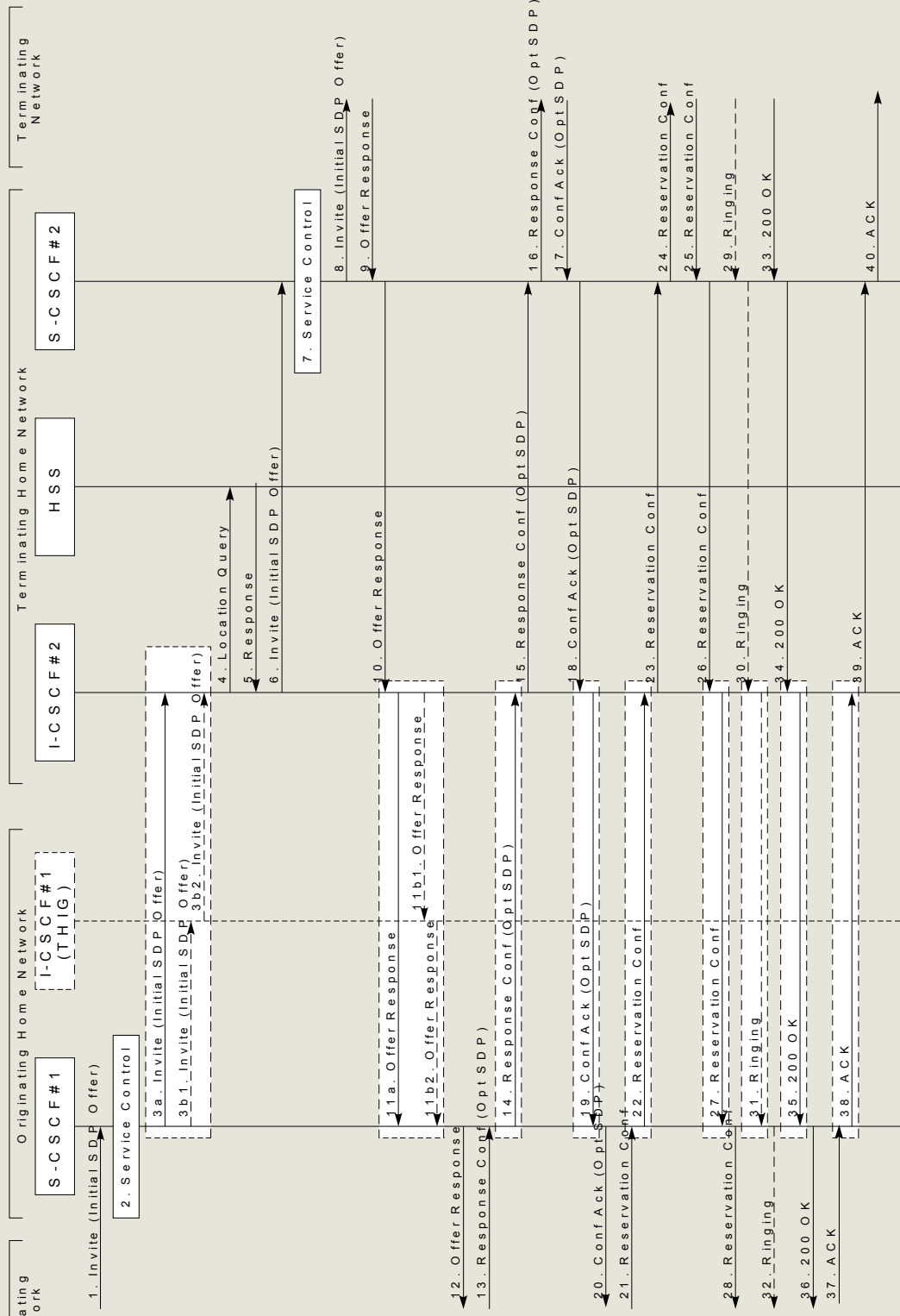# IP Multimedia portion – Registration

IP Multimedia portion – De-Registration

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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

IP Multimedia portion – Call initiation - Same operator

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References

Core SIP

- **SIP core signalling:**
- H. Schulzrinne, an 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**
- **No overview paper**
- **3GPP TS 23.228**
- **3GPP TS 2302**