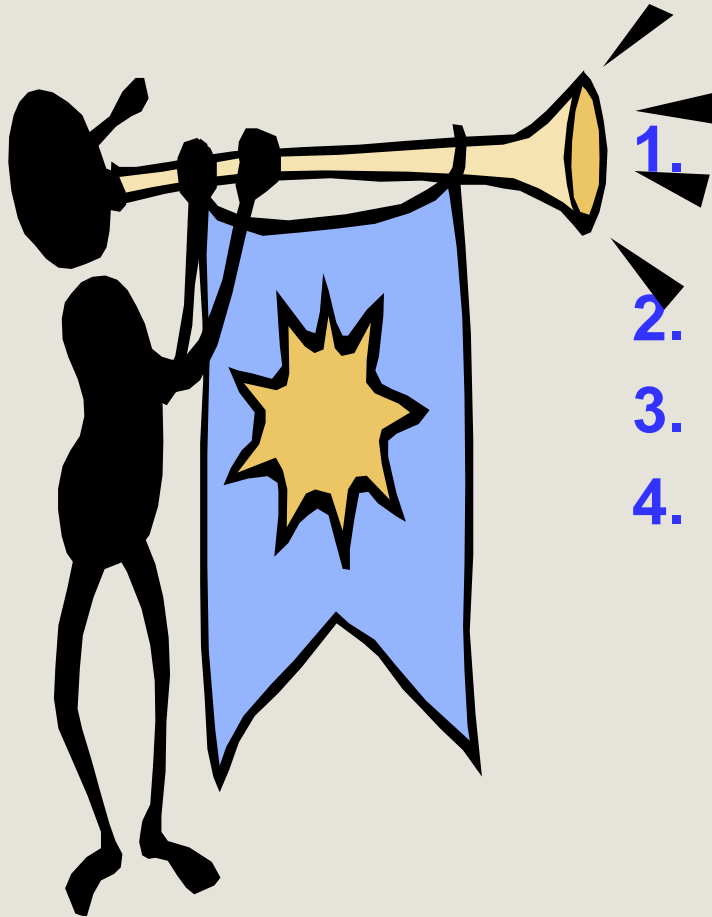


# Session Initiation Protocol

**INSE 7110 – Winter 2004**

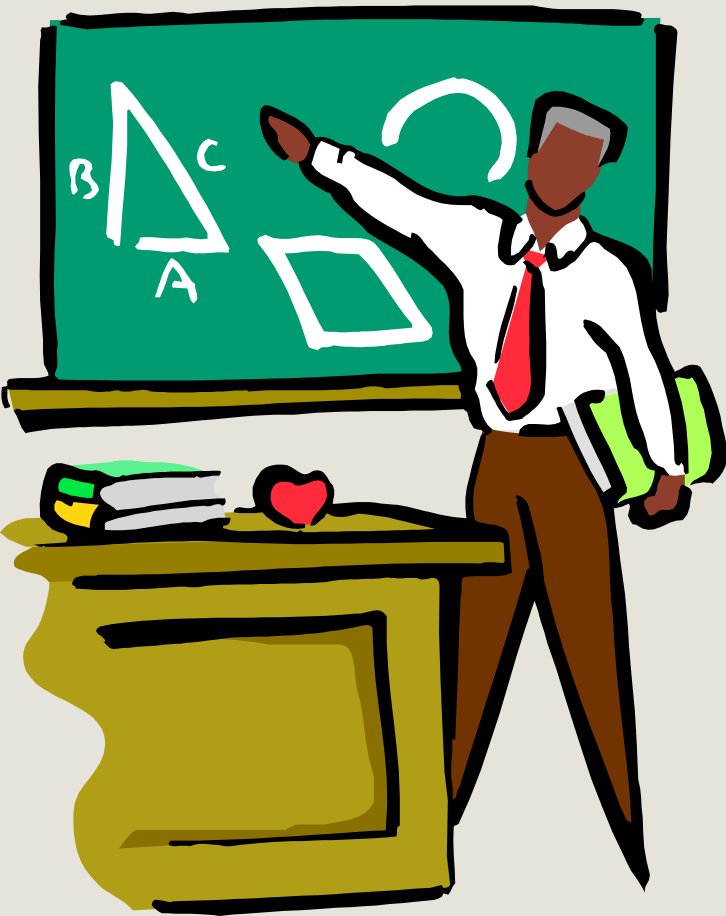
**Value Added Services Engineering in Next Generation Networks  
Week #3**

# Outline



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

# Introduction to Next Generation Networks ...



1. Distinctive characteristics
2. A brief history
3. Some of the protocols

## Distinctive characteristics ...

### Loosely used to refer to:

- Internet Telephony
- 3G
- 3G and Beyond

### Distinctive characteristics

- Packet switching (instead of circuit switching in today's 2G networks)
- QoS enabled (unlike the Internet best effort)
- Voice + data (unlike today's 2G networks which focus on voice)
-

## Circuit switching vs. packet switching

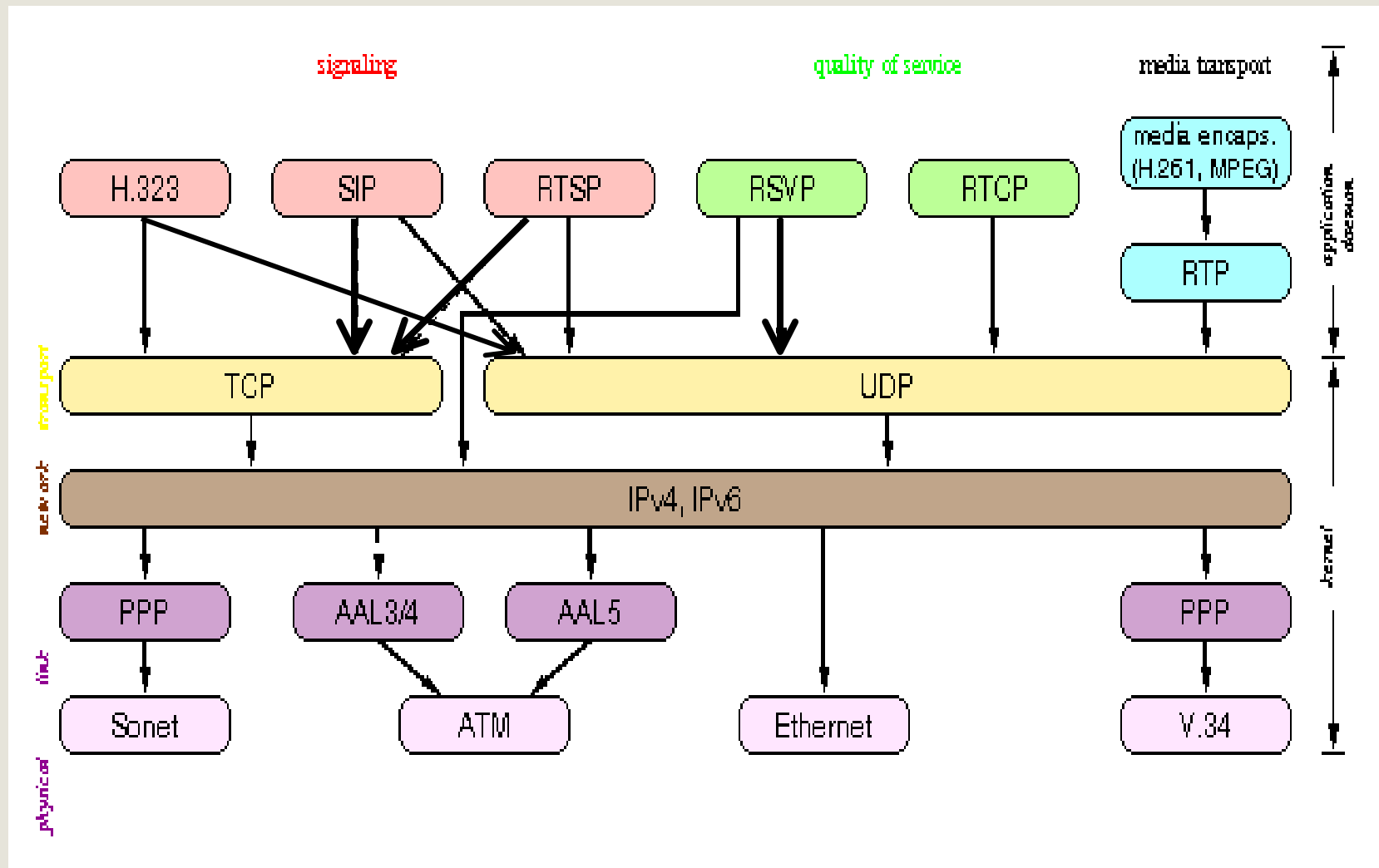
Principal Criteria	Circuit switched	Packet switched
Dedicated Physical path	Yes/No	Yes/No
Derived criteria	Circuit switched	Packet switched
Call set up required	Yes/No	Yes/No
Possibility of congestion during communication	Yes/No	Yes/No
Fixed bandwidth available	Yes/No	Yes/No
Non optimal usage of bandwidth	Yes/No	Yes/No

# A brief history ...

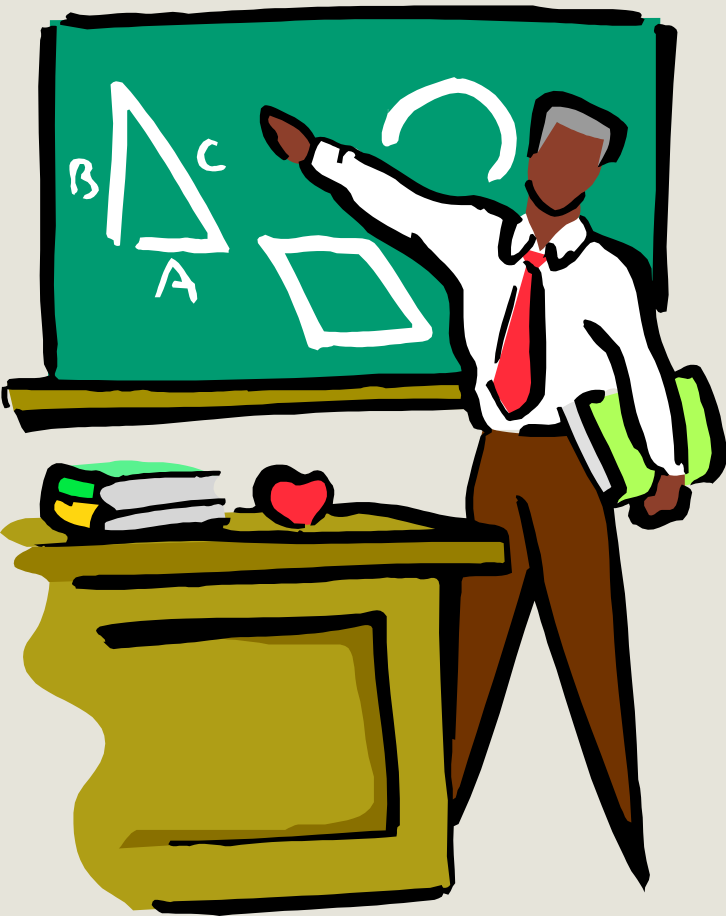
## Milestones

- Late 70s:
  - First two party voice calls over Internet (Network Voice Protocol (NVP - RFC 741 - November 1977))
  
- 80s:
  - Emergence of proprietary systems for Internet Telephony
  
- 90s:
  - Emergence of standards (e.g. SIP, H.323)
  
- 00s:
  - Backing by telcos (e.g. 3GPP specifications)
  - Backing by other new players (e.g. cable industry)

# Some of the protocols ...



# Session Initiation Protocol (SIP) - Core



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



## **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)**
  
- **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

## 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)

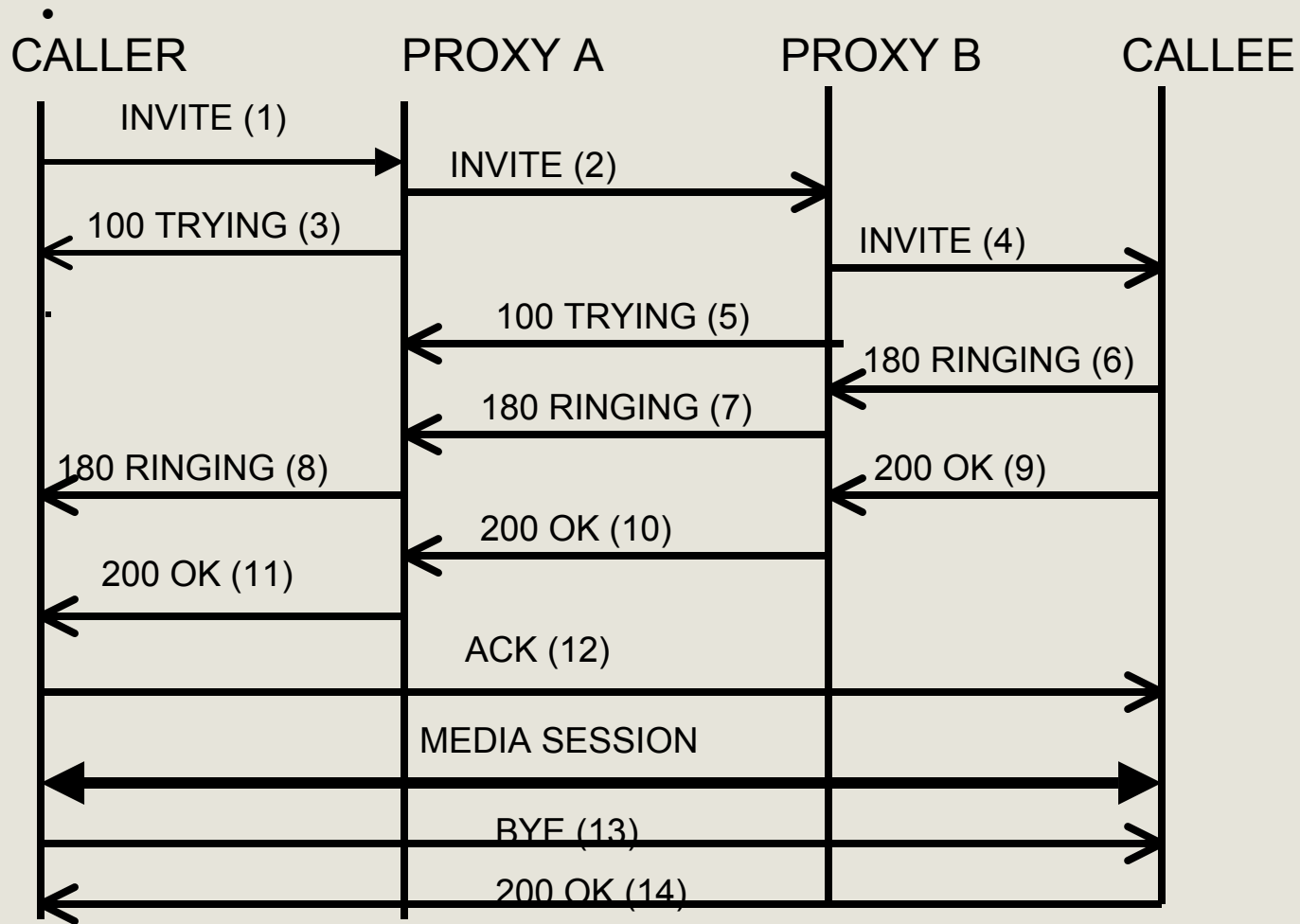
# A digression on SDP ...

## 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

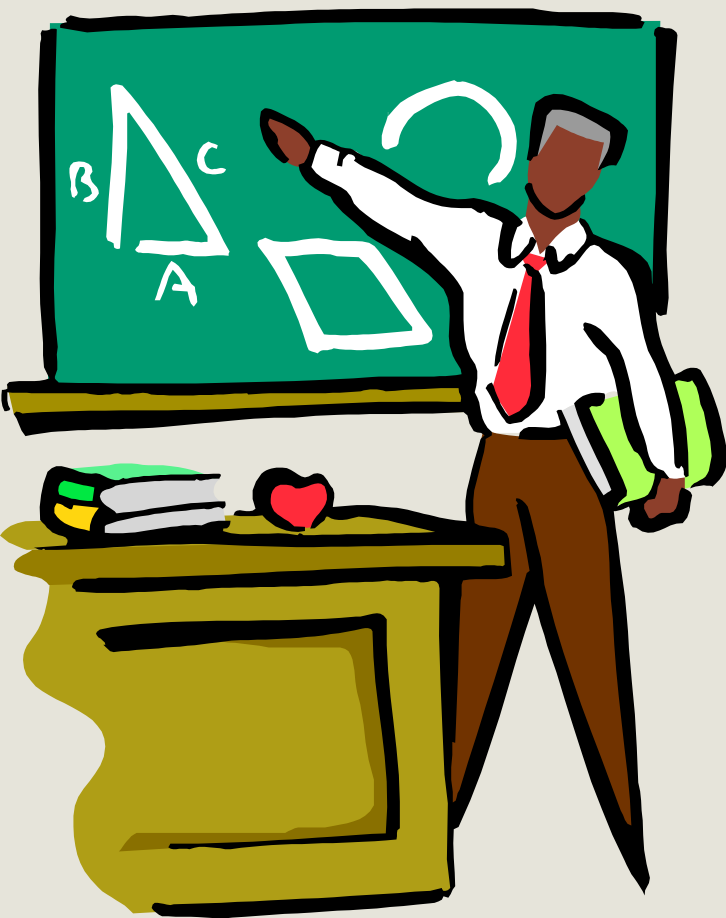
m=audio 49170 RTP/AVP 0

m=video 51372 RTP/AVP 31

m=application 32416 udp wb

a=orient:portrait

## SIP – Selected Extensions



1. Event framework

2. Others



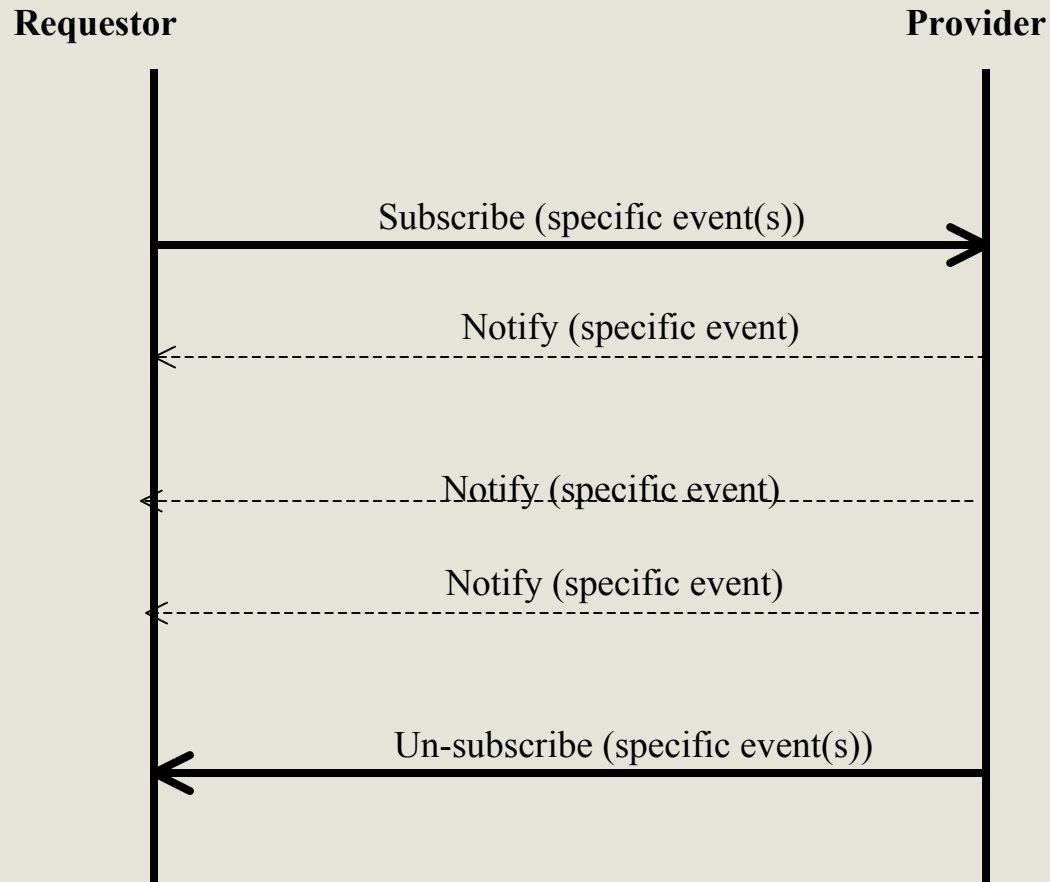
# Event Notification

## 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

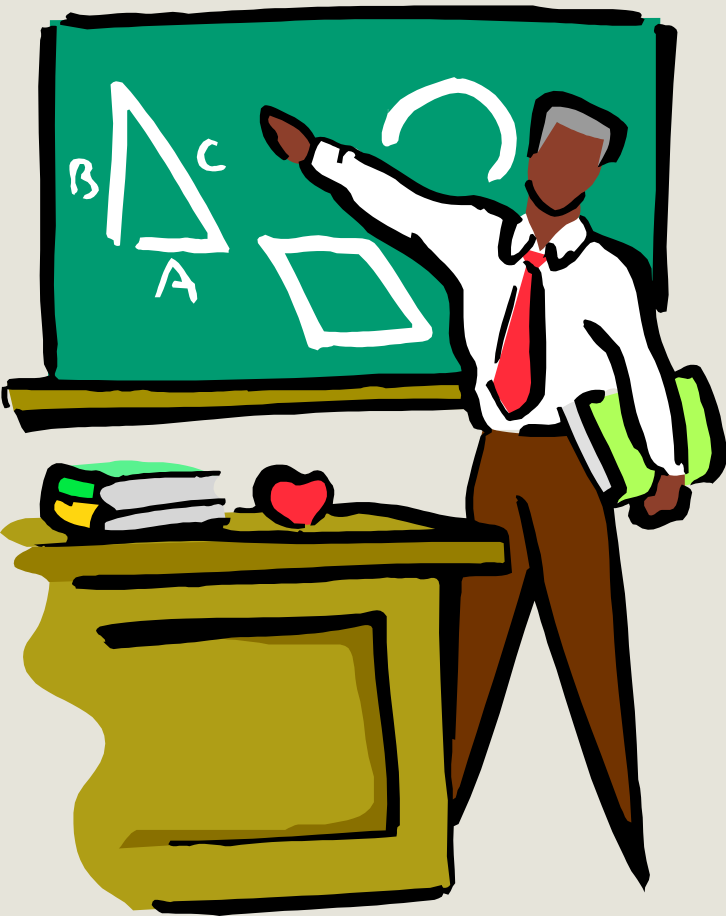
- Dissemination/consumption of presence information (e.g. on/off, willingness to communicate, device capabilities, preferences)
  - Numerous applications
    - Multiparty sessions initiated when a quorum is on-line
    - News adapted to device capabilities
- Several standards including SIMPLE (SIP based)
  - 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

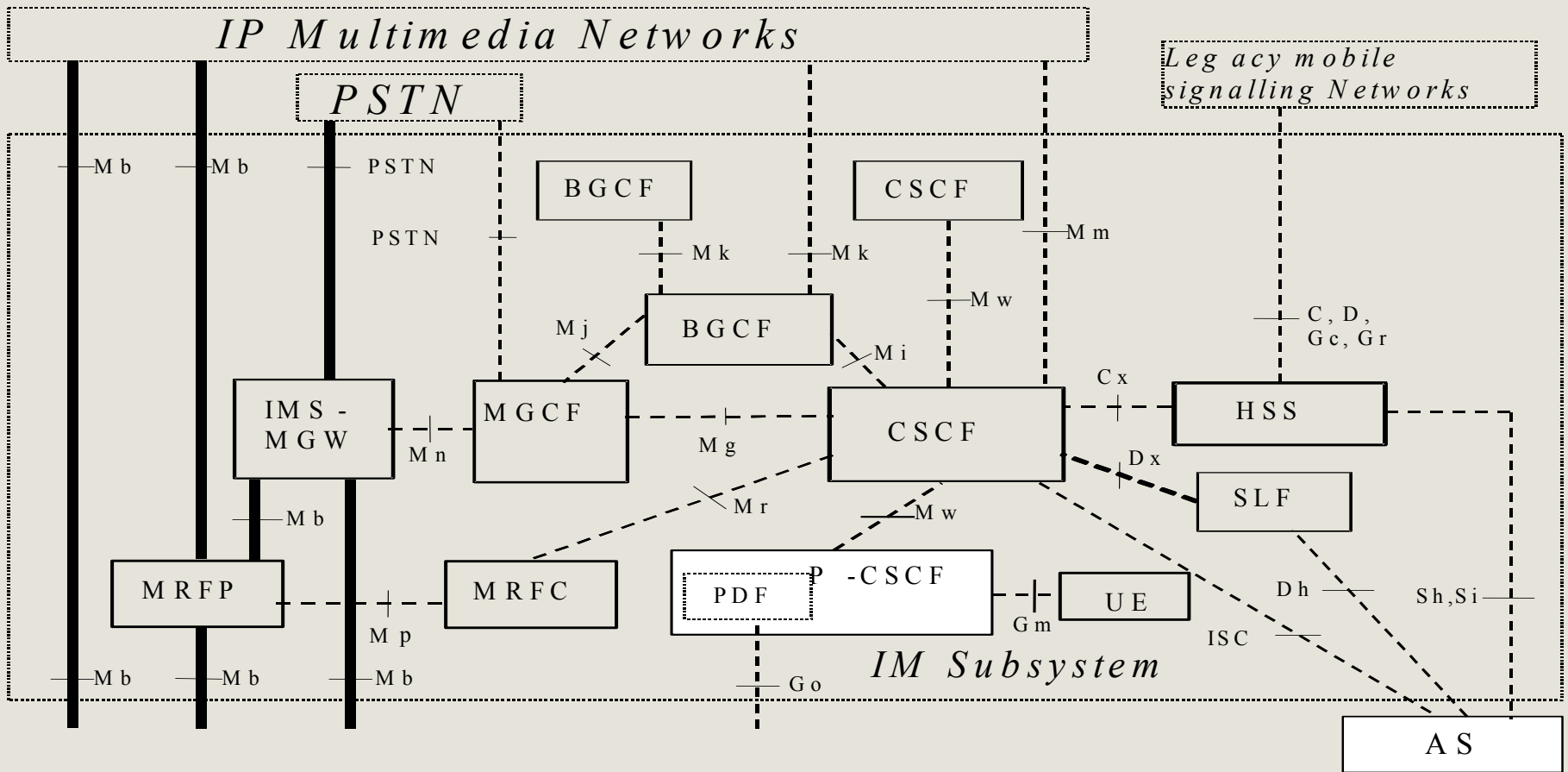


# 3GPP networks

## 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

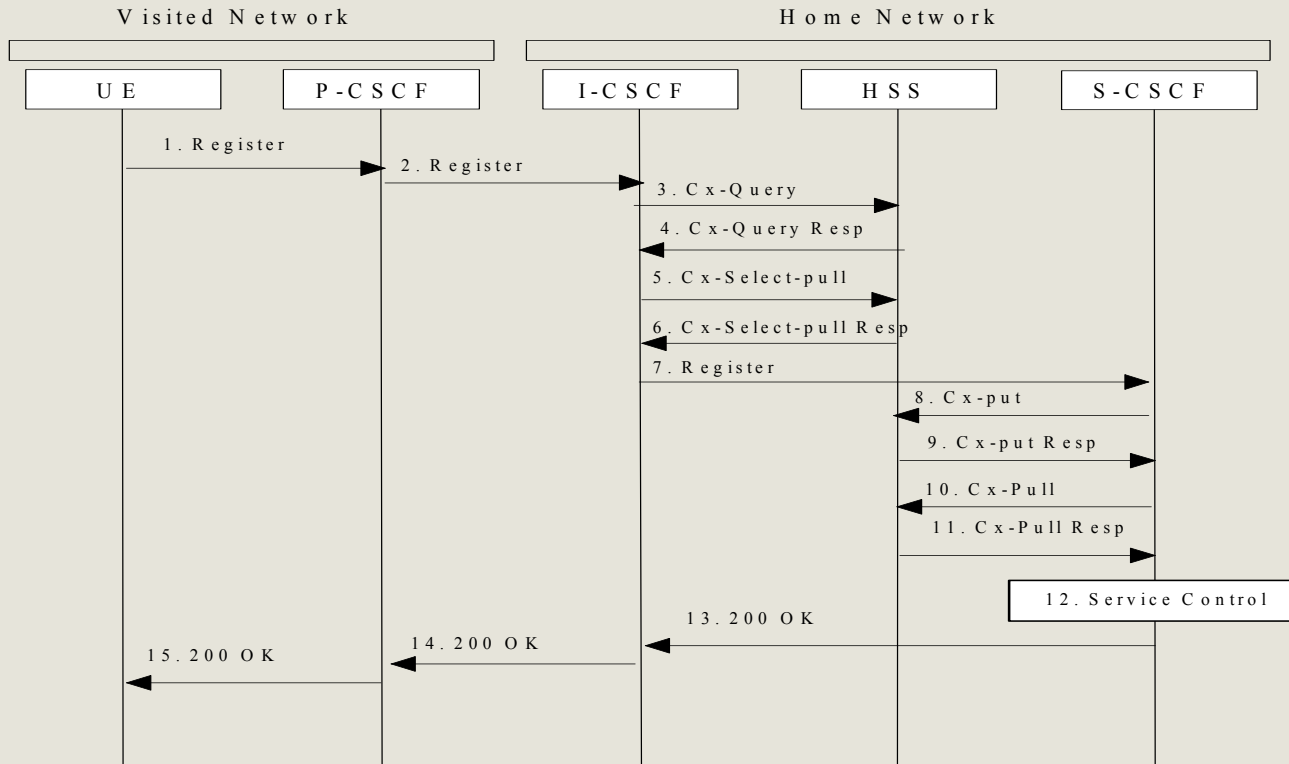
#### Call Session Control Function (CSCF)

- 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)
- 

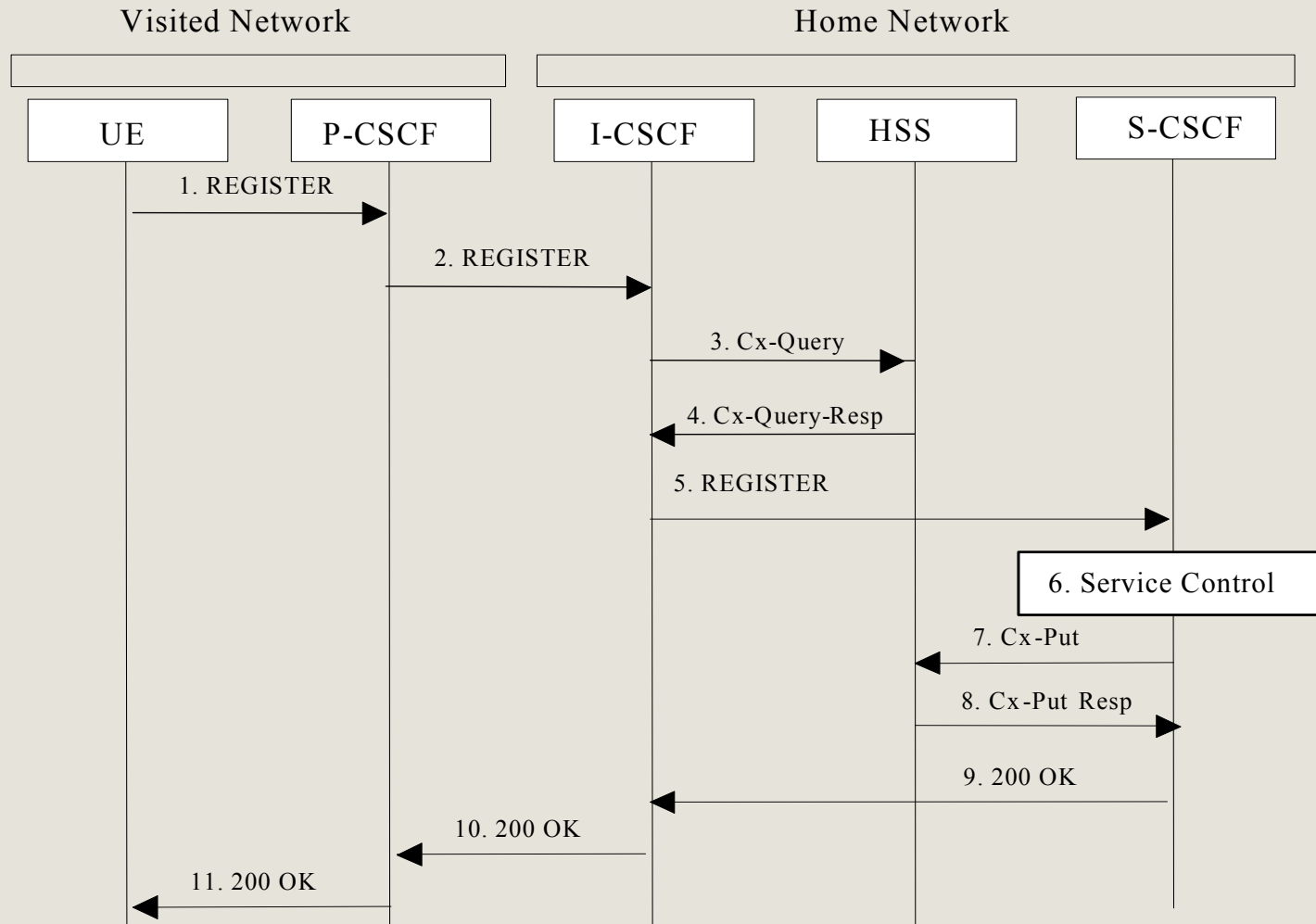
#### Home Subscriber Server (HSS)

- Master data base – subscription / location information

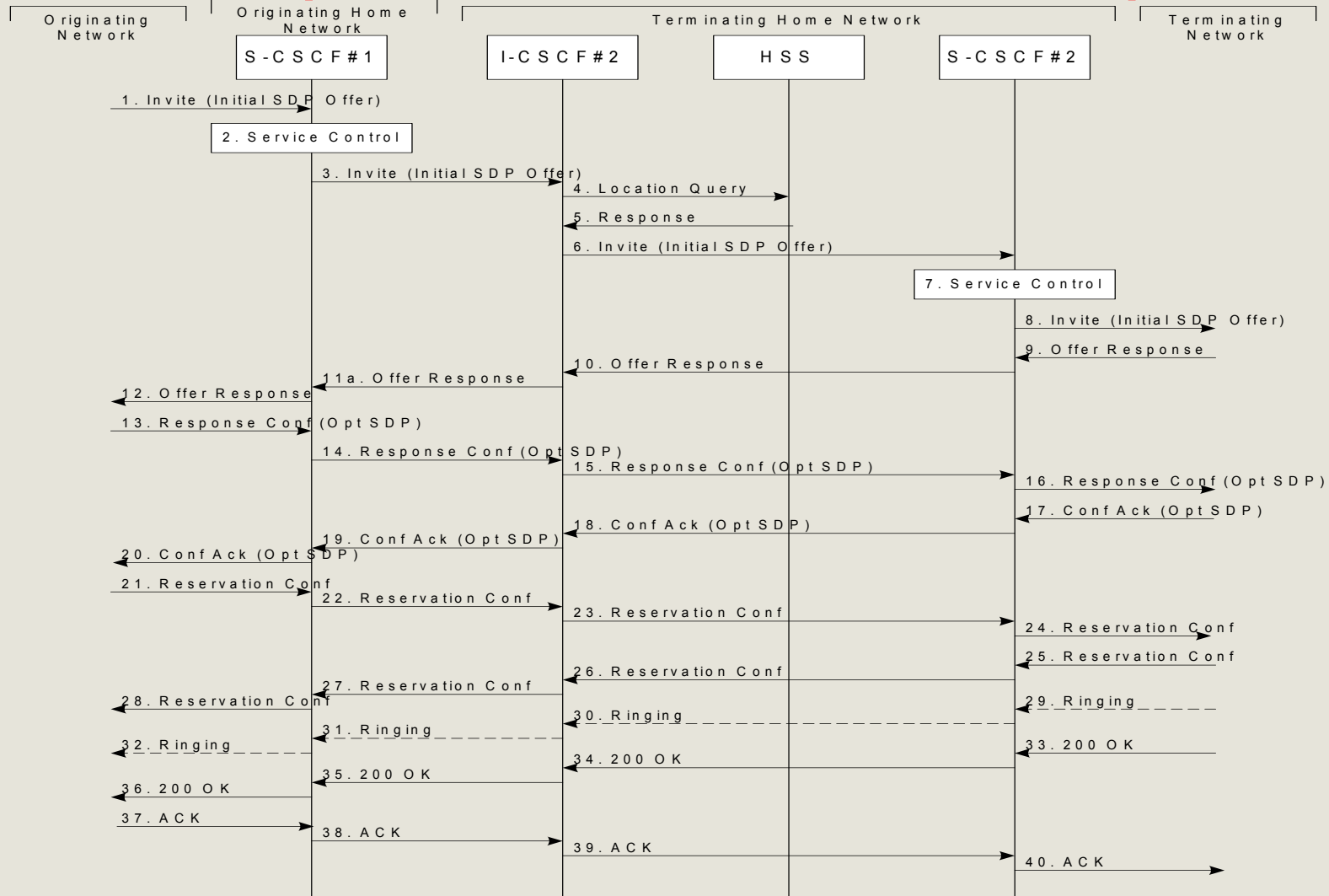
# IP Multimedia portion – Registration



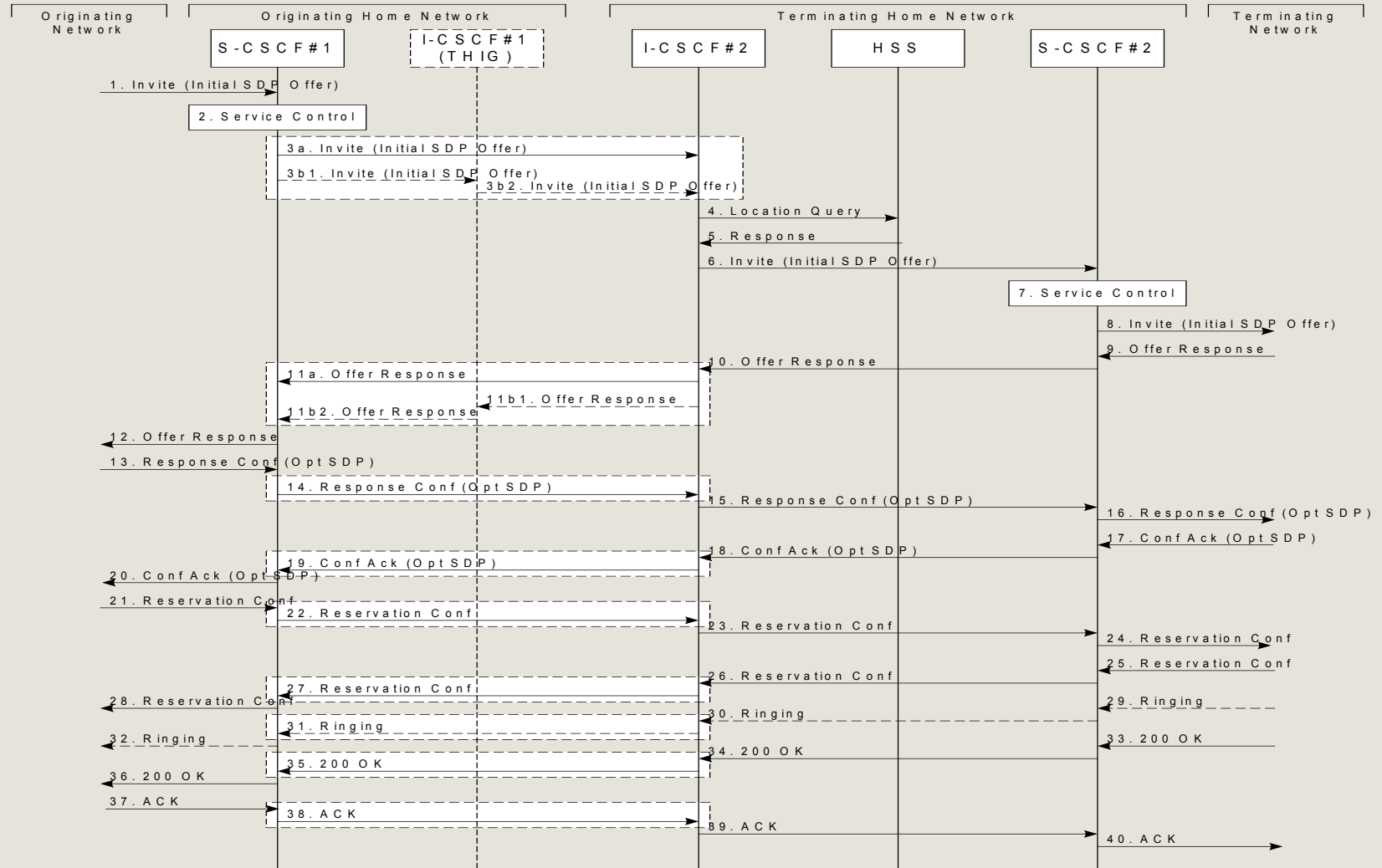
# IP Multimedia portion – De-Registration



# 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**

- **No overview paper**
- **3GPP TS 23.228**
- **3GPP TS 2302**