H.245 Control Signaling

- Used between session participants to establish and control media streams
  - Agree on the media formats and bandwidth
  - Multiplexing multiple media streams
  - No actual media
  - A generic protocol for the control of media streams
    - Not dedicated for VoIP
  - How it works in an H.323?

H.245 Message Groupings

- Requests
  - Require the recipient to perform some action and to send an immediate response
- Responses
  - In reply to Requests
- Commands
  - Require the recipient to perform some action, but no explicit response is required.
- Indications
  - Of an informational nature only (no action and response is expected.)

The Concept of Logical Channels

- A Logical channel
  - A unidirectional media path
  - An IP address and port number
  - Has a number that is specified by the sending entity
- A two-party conversation
  - Two logical channels exist
  - Potentially in different formats
- An endpoint issues Open Logical Channel
  - Logical channel number and media information (RTP payload type)
- Far endpoint responds with Open Logical Channel Ack
  - An RTP port
- Messages over H.245 Control Channel (channel number 0)
  - Permanently open as long as the endpoint is involved a call

Capability Exchange [1/2]

- Share information regarding receive and transmit capabilities
- Indicate a preference
- TerminalCabilitySet message
  - A request message
  - A sequence number plus the types of audio and video formats
- TerminalCapabilitySetAck
  - with a sequence number
- TerminalCapabilitySetReject
  - With a reason for rejection

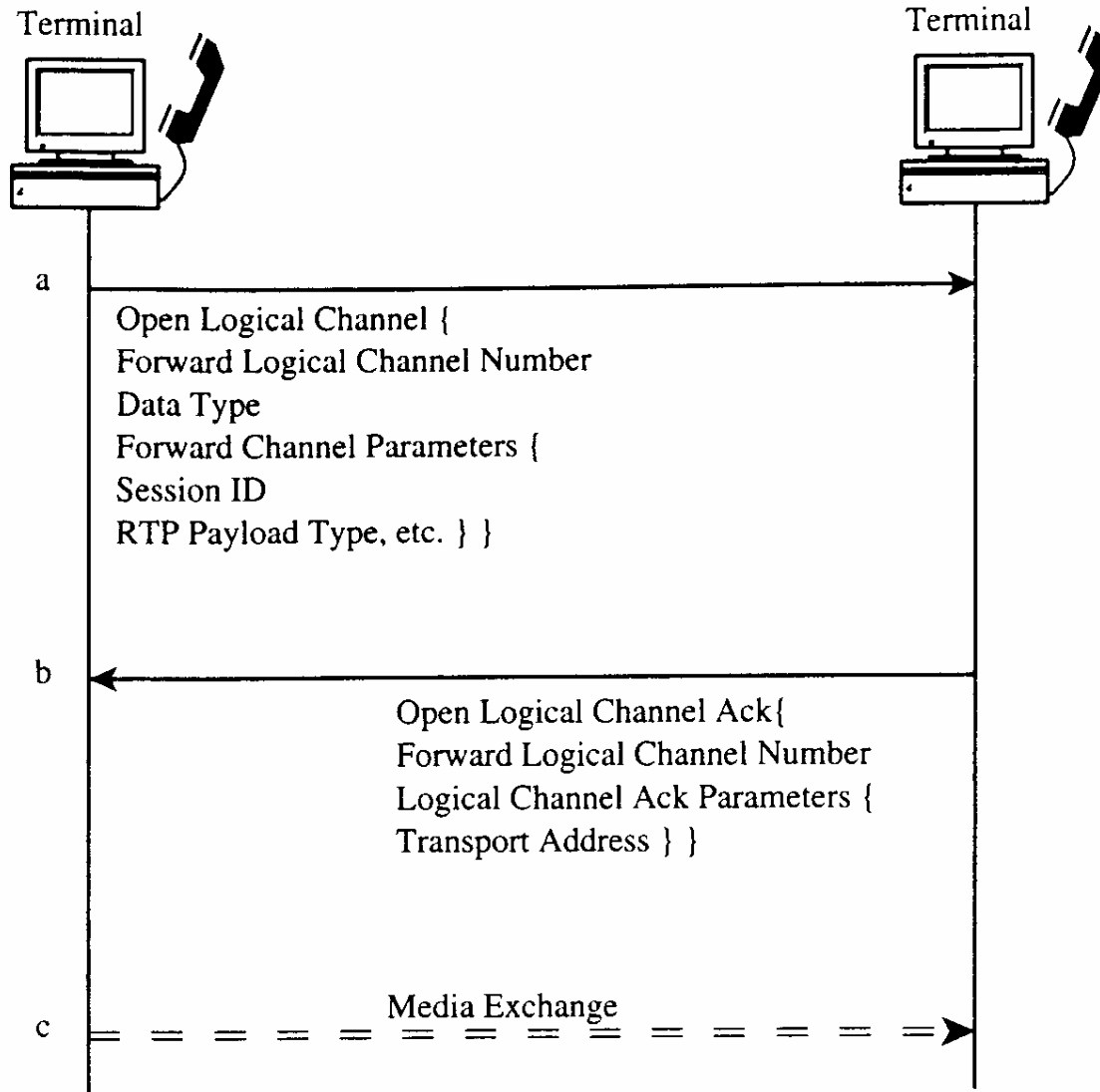# Capability Exchange [2/2]

- **TerminalCapabilitySetRelease**
  - If no response within a timeout period
- **SendTerminalCapabilitySet**
  - Request Terminal Capability information
  - A command message that does not requires a specific response
  - The endpoint that receives the messages should subsequently send a **TerminalCapabilitySet** message.
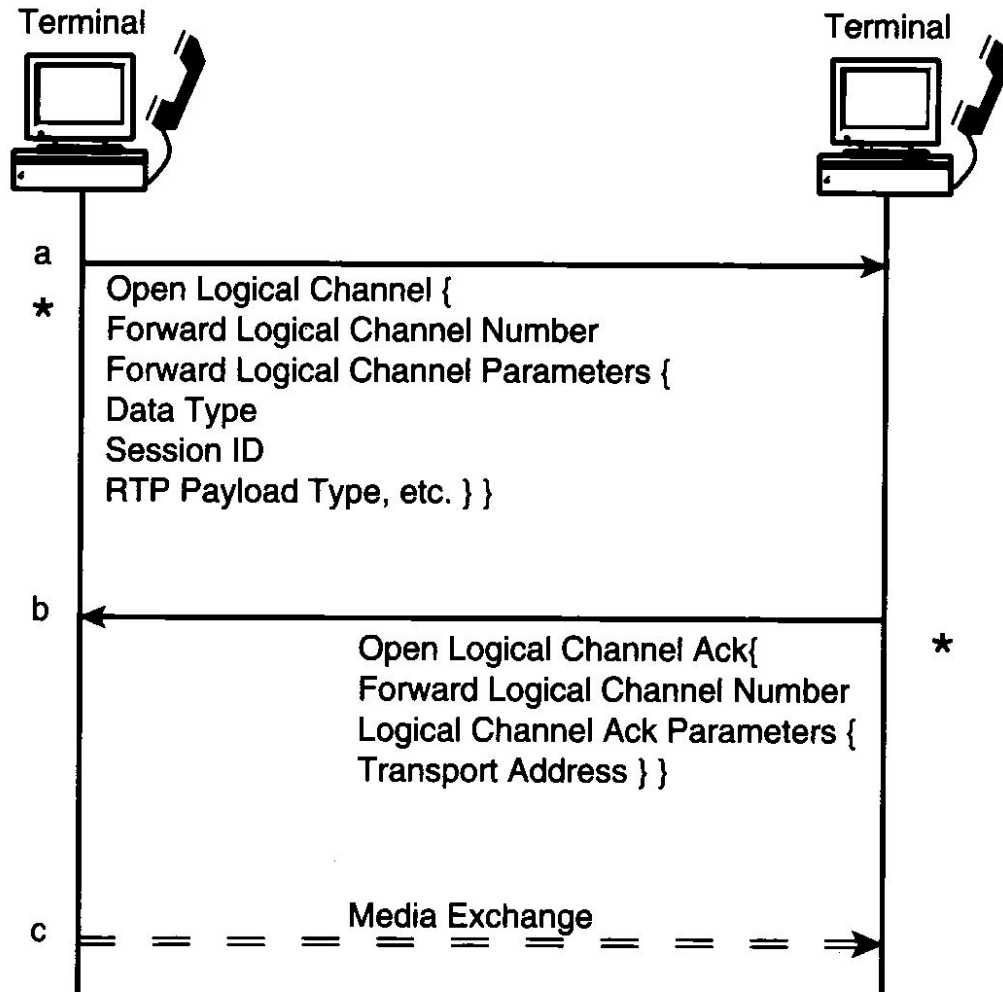
Master-Slave Determination

- One of the endpoints needs to be the master
  - Of particular importance for the setup of a multi-party conference
- Compare two pieces of information at each entity
  - A terminal type value
    - A terminal without an MC: 50
    - A gateway without an MC: 60
    - An MCU for audio, video: 190
    - An MCU managing a conference: 240 (the highest)
  - A random number (1..16,777,215)
- Master-Slave Determination message
- Master-Slave Determination Ack
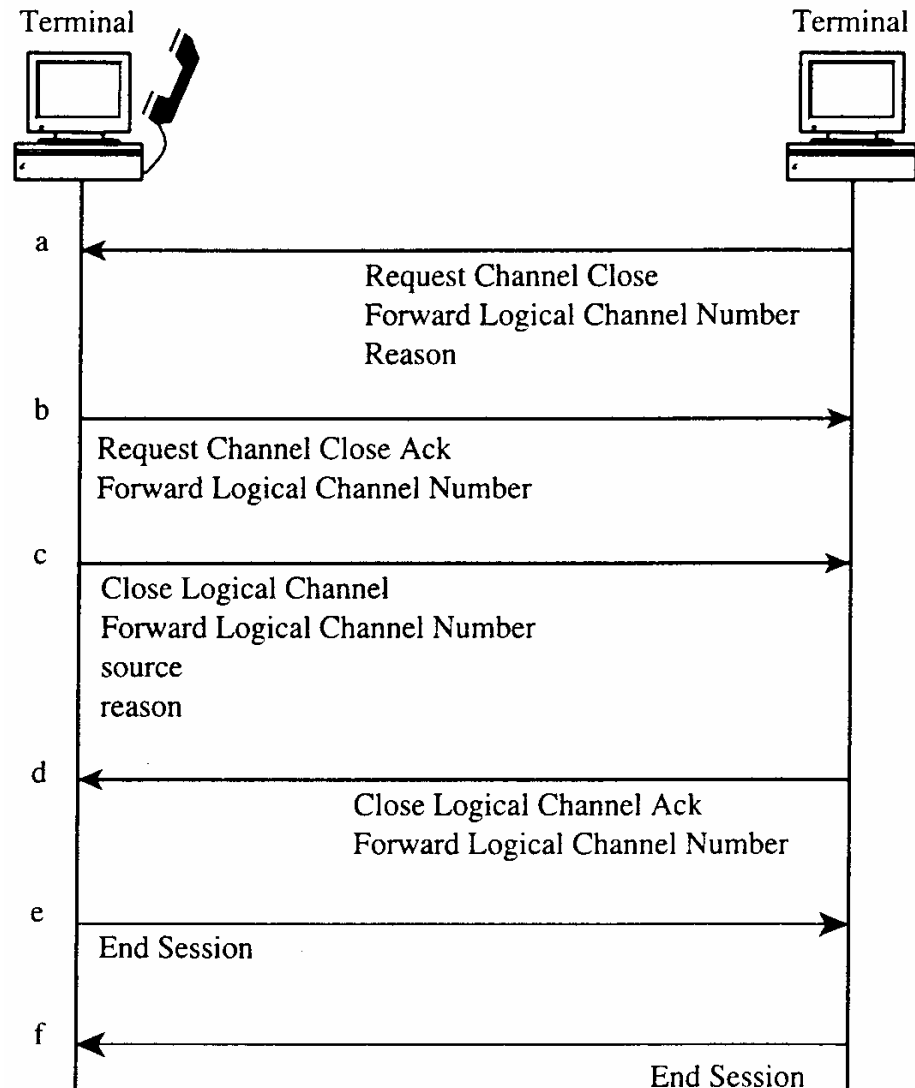 - A "master" or "slave" indication

Open Unidirectional Logical Channel

Terminal   Terminal

a

Open Logical Channel {
Forward Logical Channel Number
Data Type
Forward Channel Parameters {
Session ID
RTP Payload Type, etc. } }

b

Open Logical Channel Ack{
Forward Logical Channel Number
Logical Channel Ack Parameters {
Transport Address } }

Media Exchange
c

Open Bidirectional Logical Channels

Terminal   Terminal

a

*
Open Logical Channel {
Forward Logical Channel Number
Forward Logical Channel Parameters {
Data Type
Session ID
RTP Payload Type, etc. } }

b

Open Logical Channel Ack{   *
Forward Logical Channel Number
Logical Channel Ack Parameters {
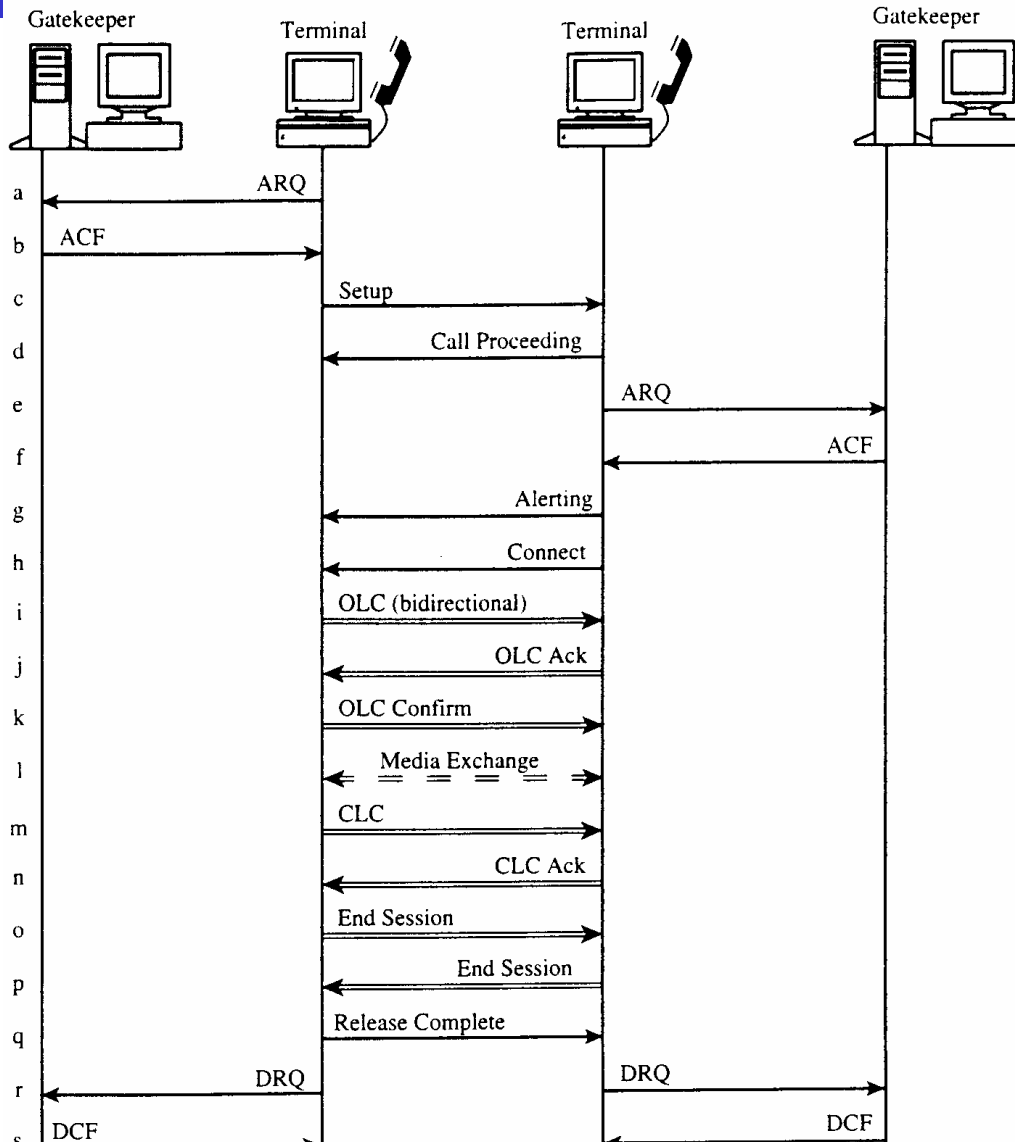Transport Address } }

c   Media Exchange

Closing Logic Channels and Ending a Session

- CloseLogicalChannel, CloseLogicalChannelAck

- Only the initiator can issue

- Or the receiving end can humbly request

- A bidirectional channel can be closed by either end

- Once all logical channels are closed
  - EndSession, EndSession commands

Terminal

Terminal

a — Request Channel Close
Forward Logical Channel Number
Reason

b — Request Channel Close Ack
Forward Logical Channel Number

c — Close Logical Channel
Forward Logical Channel Number
source
reason

d — Close Logical Channel Ack
Forward Logical Channel Number

e — End Session

f — End Session

A Slow Start

Plus
Capability exchange
Master-slave determination

Fast-connect Procedure

- ## Q.931

  - A faststart element : OpenLogicalChannel requests
  - No H.245 control channel
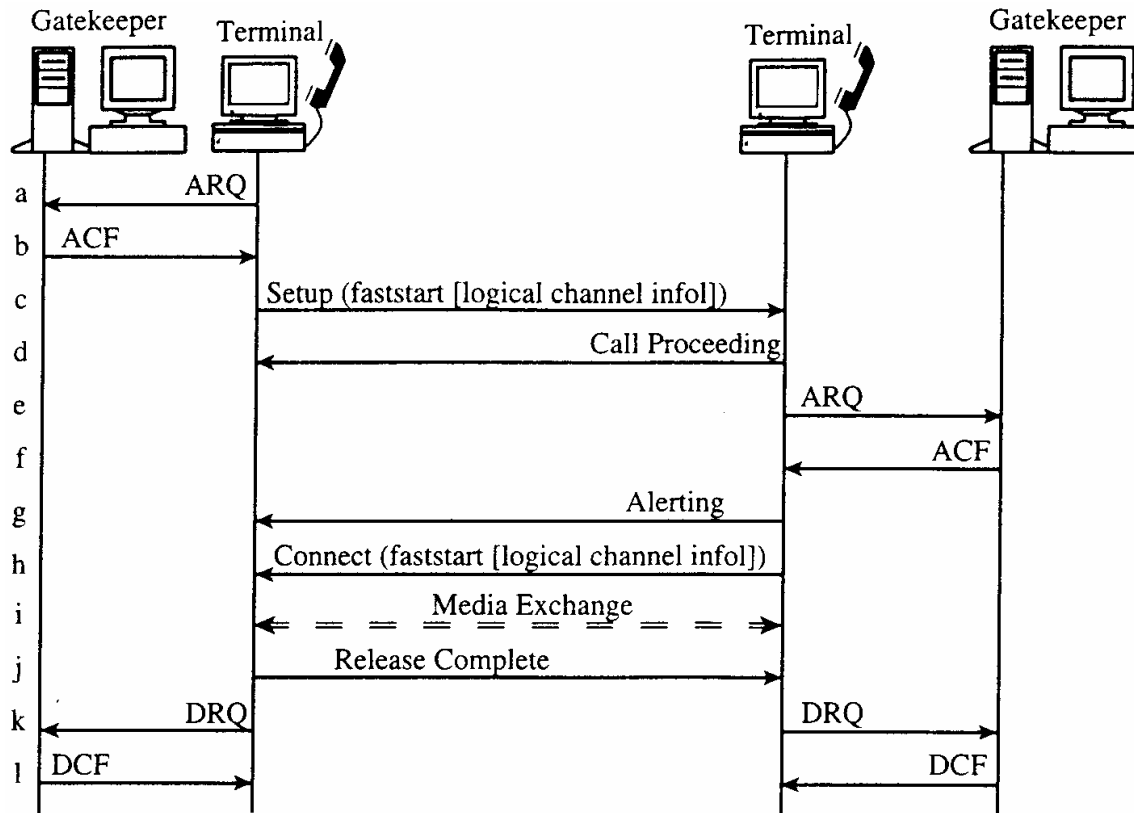
H.254 Message Encapsulation

- H.245 message encapsulated with Q.931 messages as octet strings
  - Set the element h245Tunneling to true
  - The encapsulated data is contained within the h245Control element.

- A conflict exists between encapsulation and fast-start.

- What happens if an endpoint needs to send an H.245 message at a time when it does not have a need to send a Q.931 message?
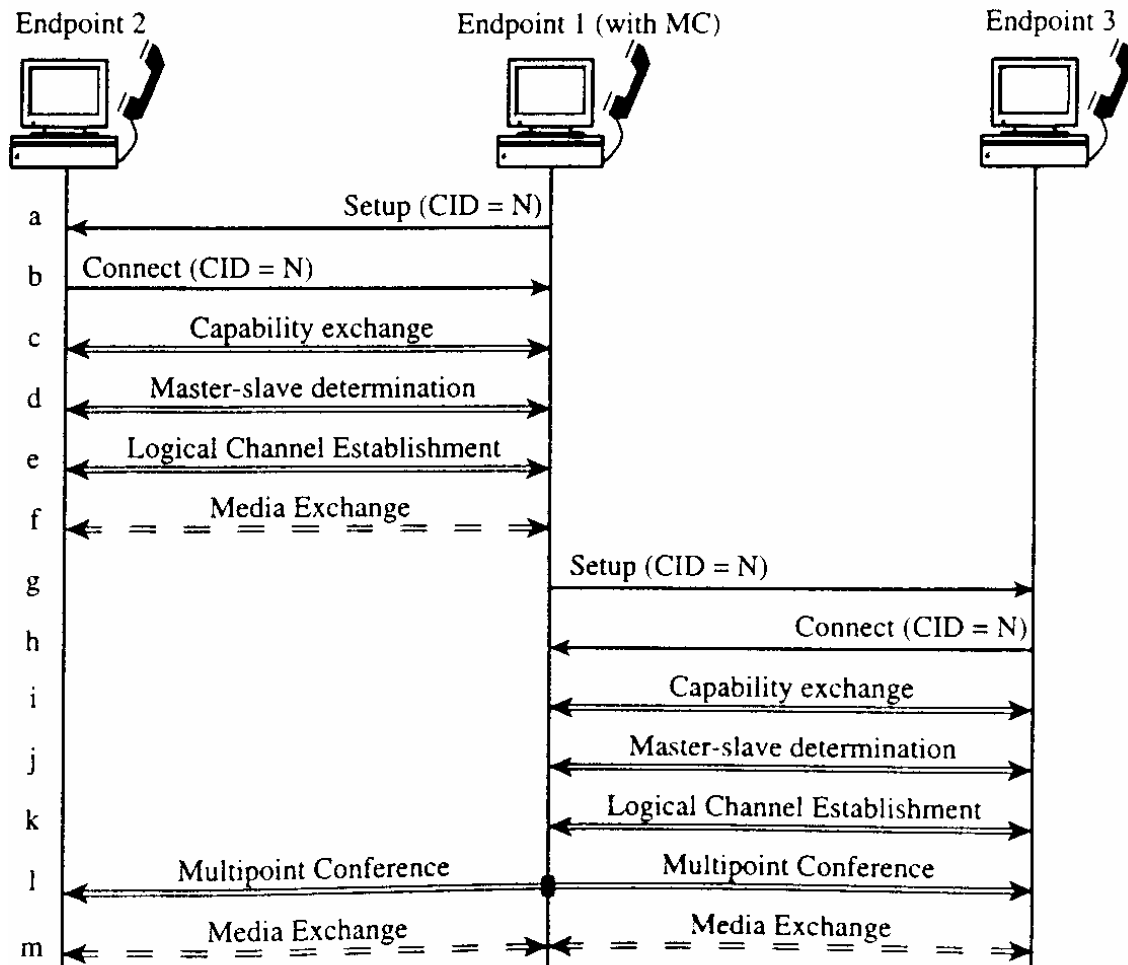
Conference Calls

- MC manages multi-point conference
- A Pre-Arranged Conference
  - Establish a call with the MCU
- The MCU specifies the conference mode (centralized or de-centralized).
  - Communication Mode command (H.245)
 - Specify all the sessions in the conference

An Ad-Hoc Conference

- Expand an existing two-party call to a conference call
  - One the endpoints must contain an MC (master).

Endpoint 2   Endpoint 1 (with MC)   Endpoint 3

a   Setup (CID = N)

b   Connect (CID = N)

c   Capability exchange

d   Master-slave determination

e   Logical Channel Establishment

f   Media Exchange

g   Setup (CID = N)

h   Connect (CID = N)

i   Capability exchange

j   Master-slave determination

k   Logical Channel Establishment

l   Multipoint Conference   Multipoint Conference

m   Media Exchange   Media Exchange

The Decomposed Gateway

- The H.323 gateway can comprise
    - Media Gateway (MG): handles media stream
    - Media Gateway Controller (MGC): performs call control
    - Signaling Gateway (SG): interfaces with external signaling network (e.g., SS7)
- The function of MGC is separate from that of GK.
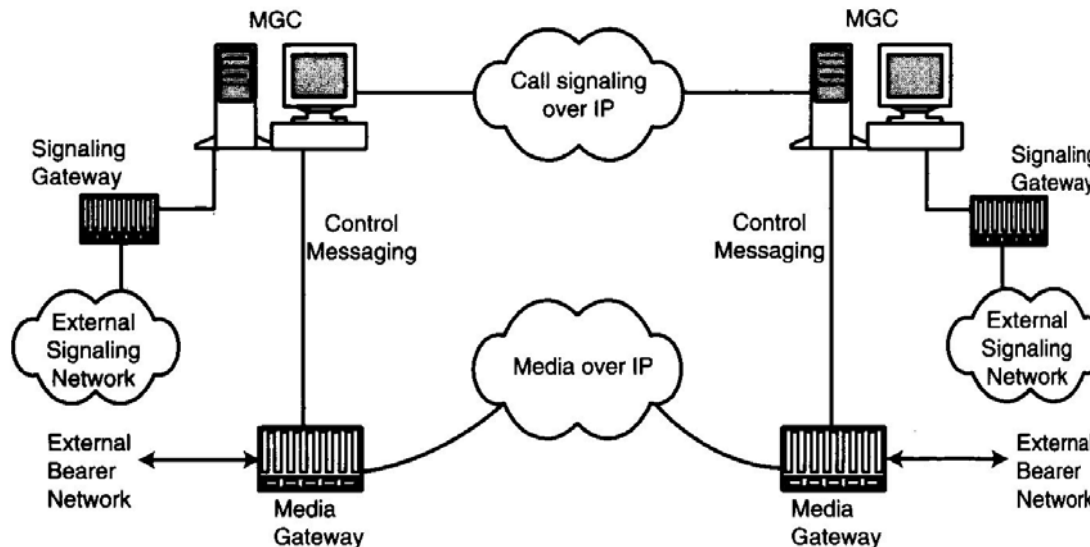
iGSM: VoIP Service for Mobile Network

Introduction to iGSM [1/2]

- A VoIP value-added service for mobile network
- iGSM supports user mobility for GSM subscribers to access VoIP services.
  - With the same identity, a GSM subscriber can receive the service when he changes the terminal from the GSM MS to the H.323 terminal.
  - The GSM network remains the same.
- Terminal Mobility, Session Mobility, Service Mobility

Introduction to iGSM [2/2]

- iGSM Gateway performs the conversion for communication protocols and transmission formats between GSM and H.323 networks.
  - GSM MAP and RAS protocol translation
  - GSM/PSTN/IP call setup and release
- iGSM Gatekeeper records location information as the VLR in GSM network.
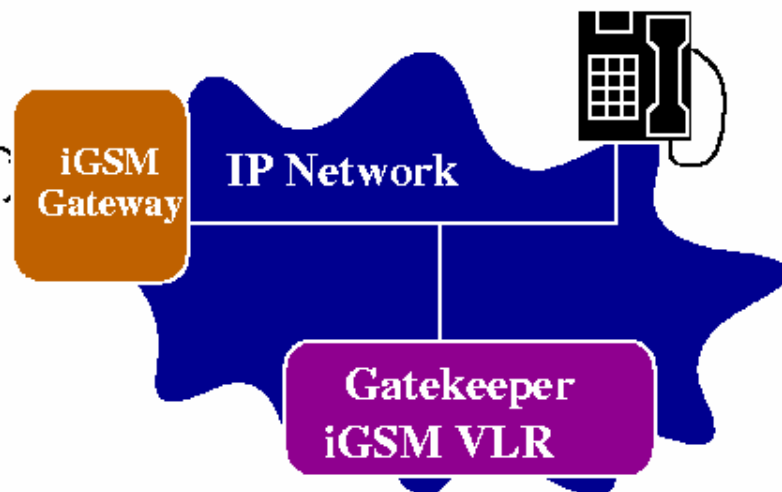
iGSM Architecture

MS

BTS/BSC

VLR

MSC

GSM

HLR

iGSM
Gateway

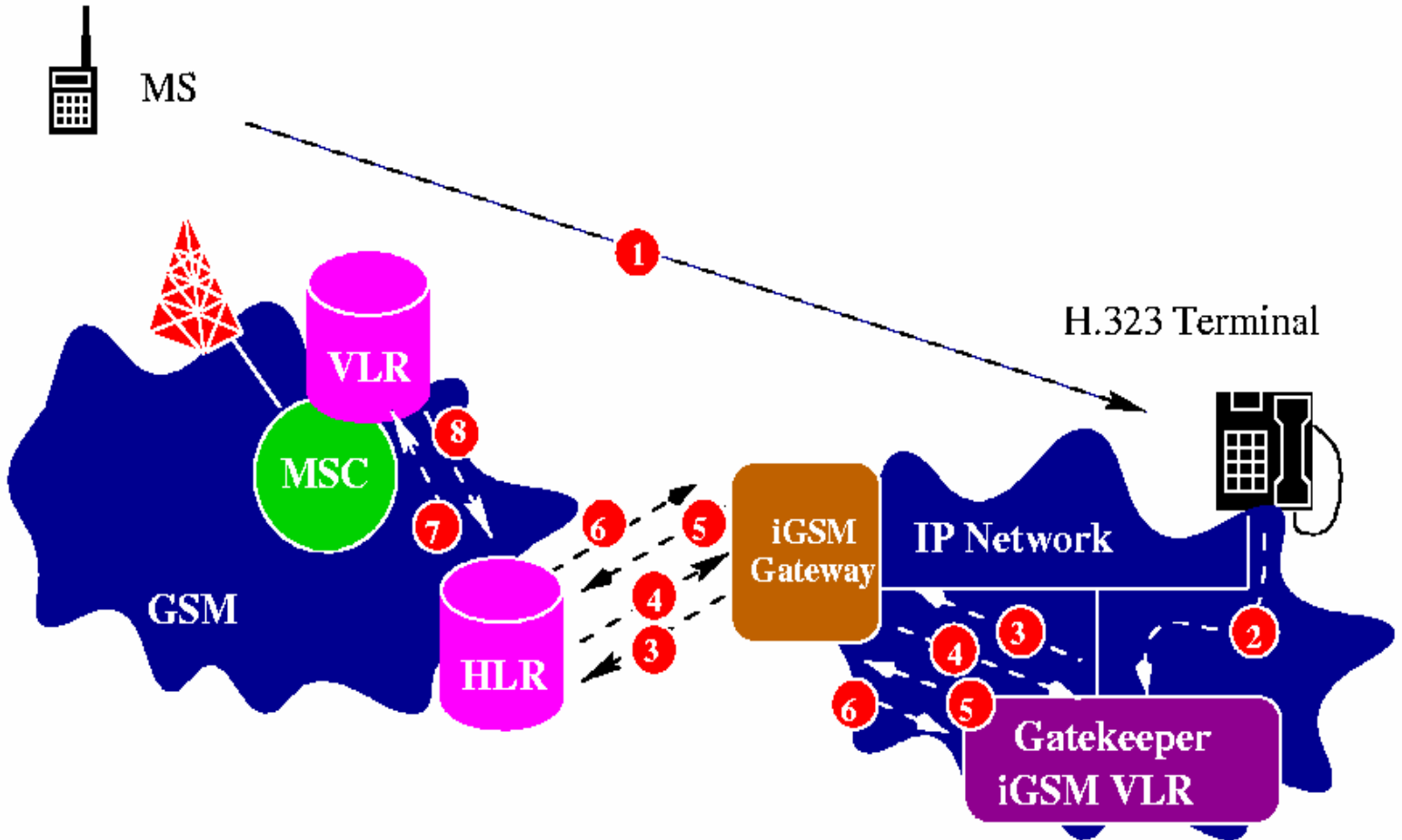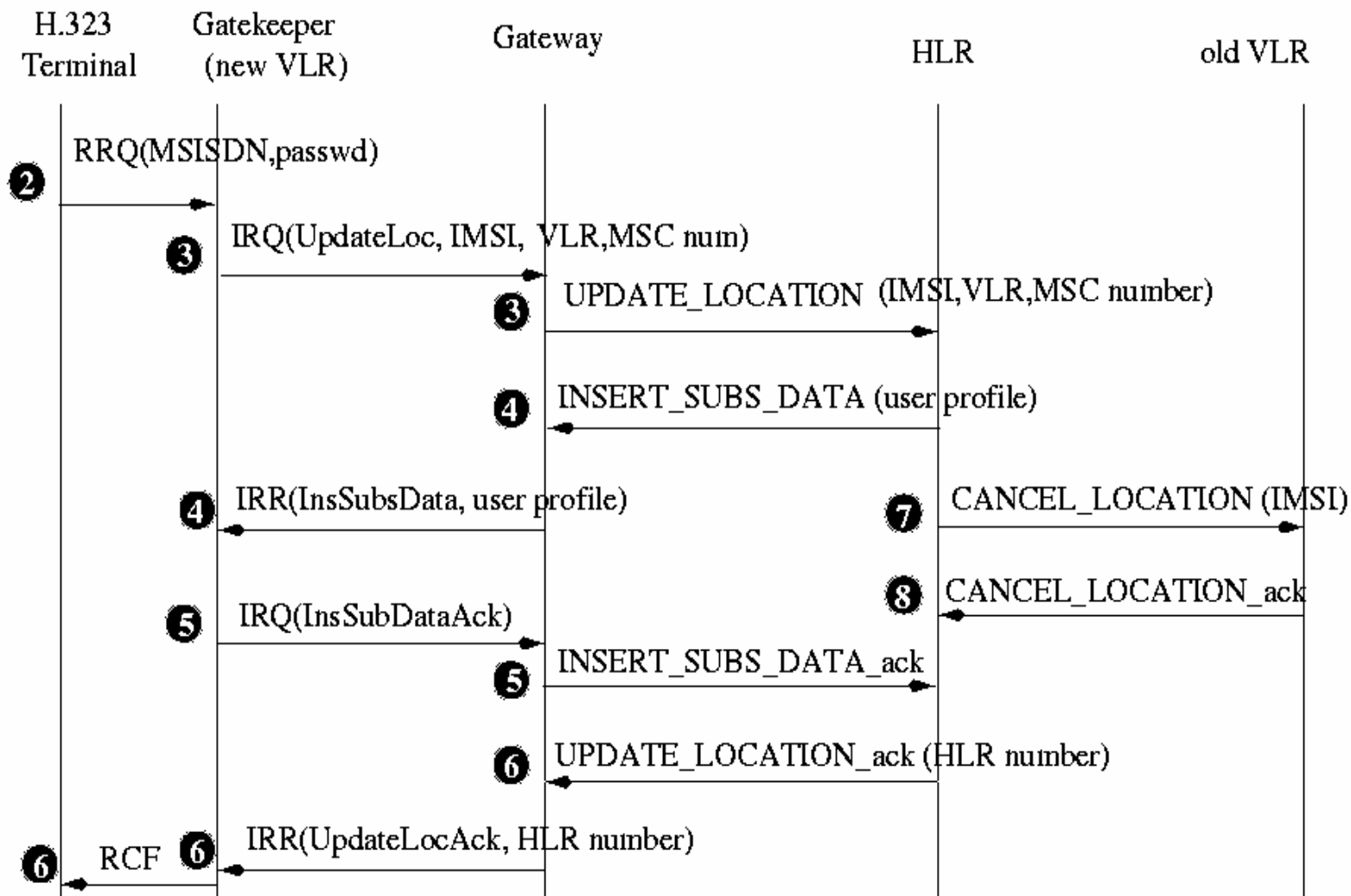H.323 Terminal

IP Network
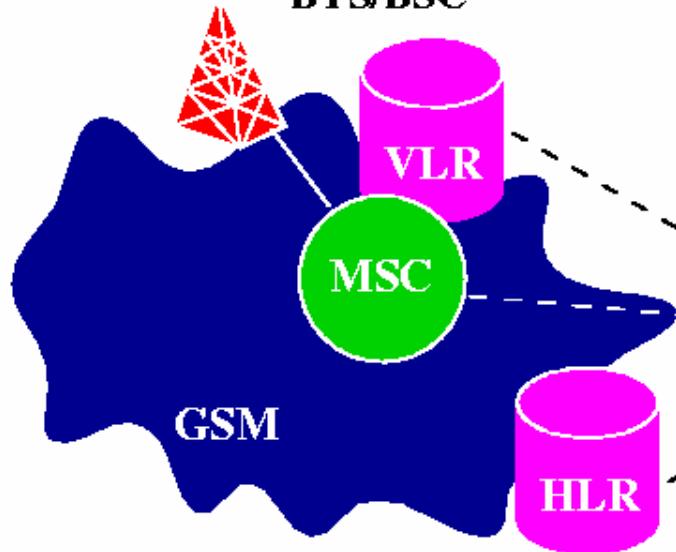
Gatekeeper
iGSM VLR

iGSM Gatekeeper

- The iGSM gatekeeper maintains an database that stores information for all iGSM subscriber.

  - MSISDN of the MS

  - Transport address of the H.323 terminal (MS resides)

  - Password of the iGSM subscriber

  - HLR address of the iGSM subscriber

  - IMSI of the MS

  - User profile that indicates the service features and restrictions of the iGSM subscriber
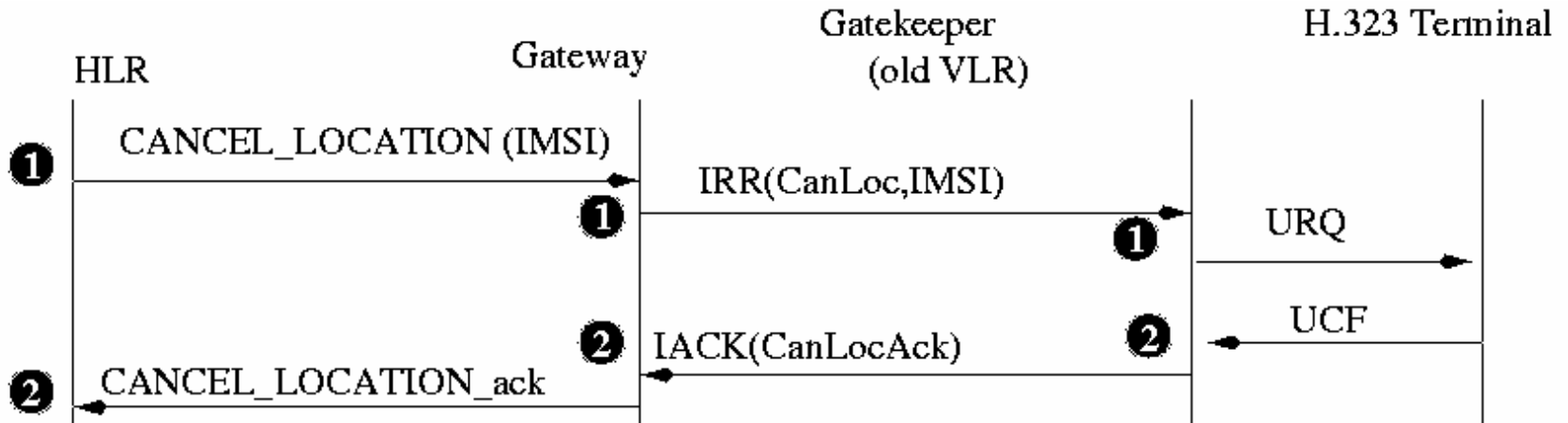
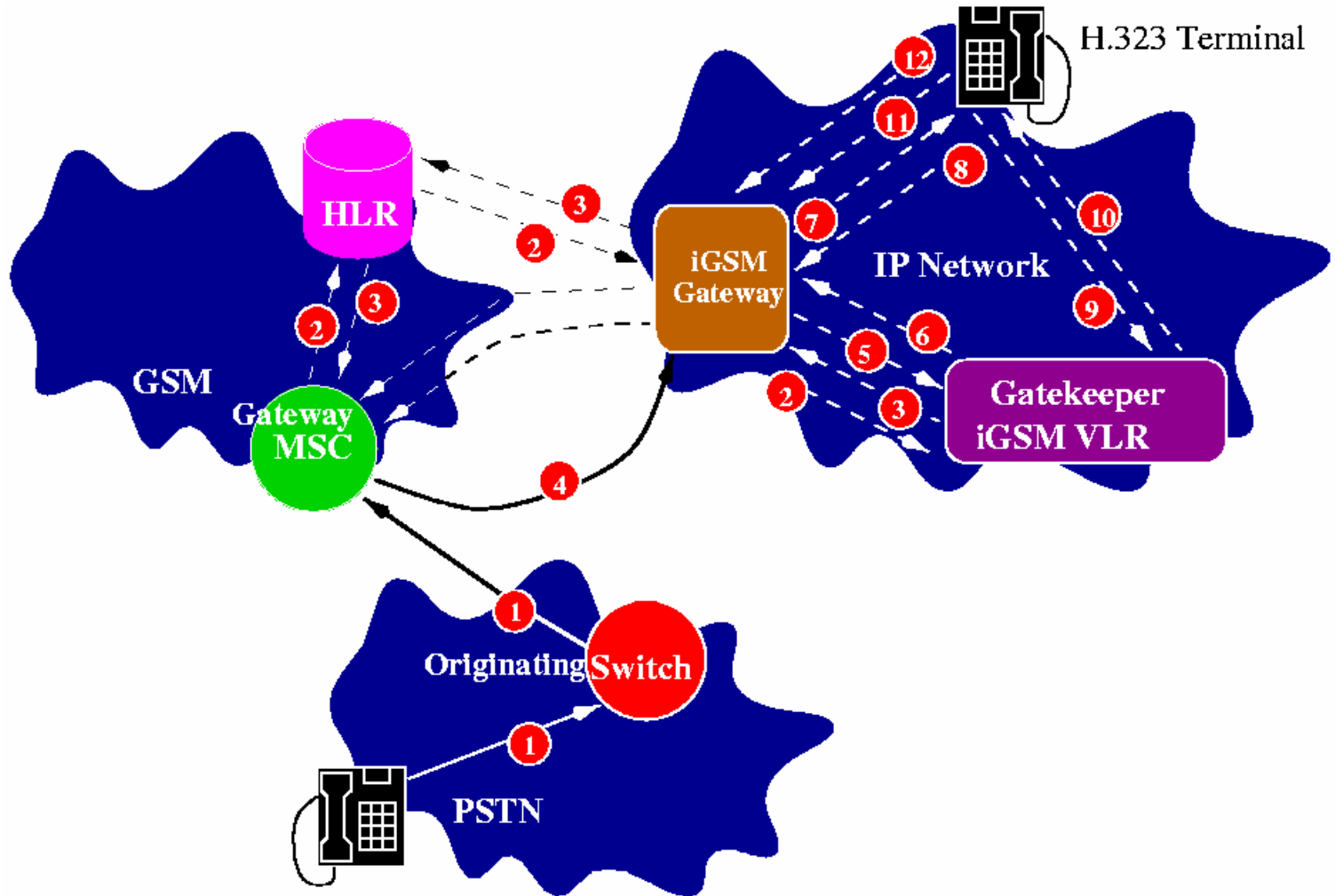 - Presence indication

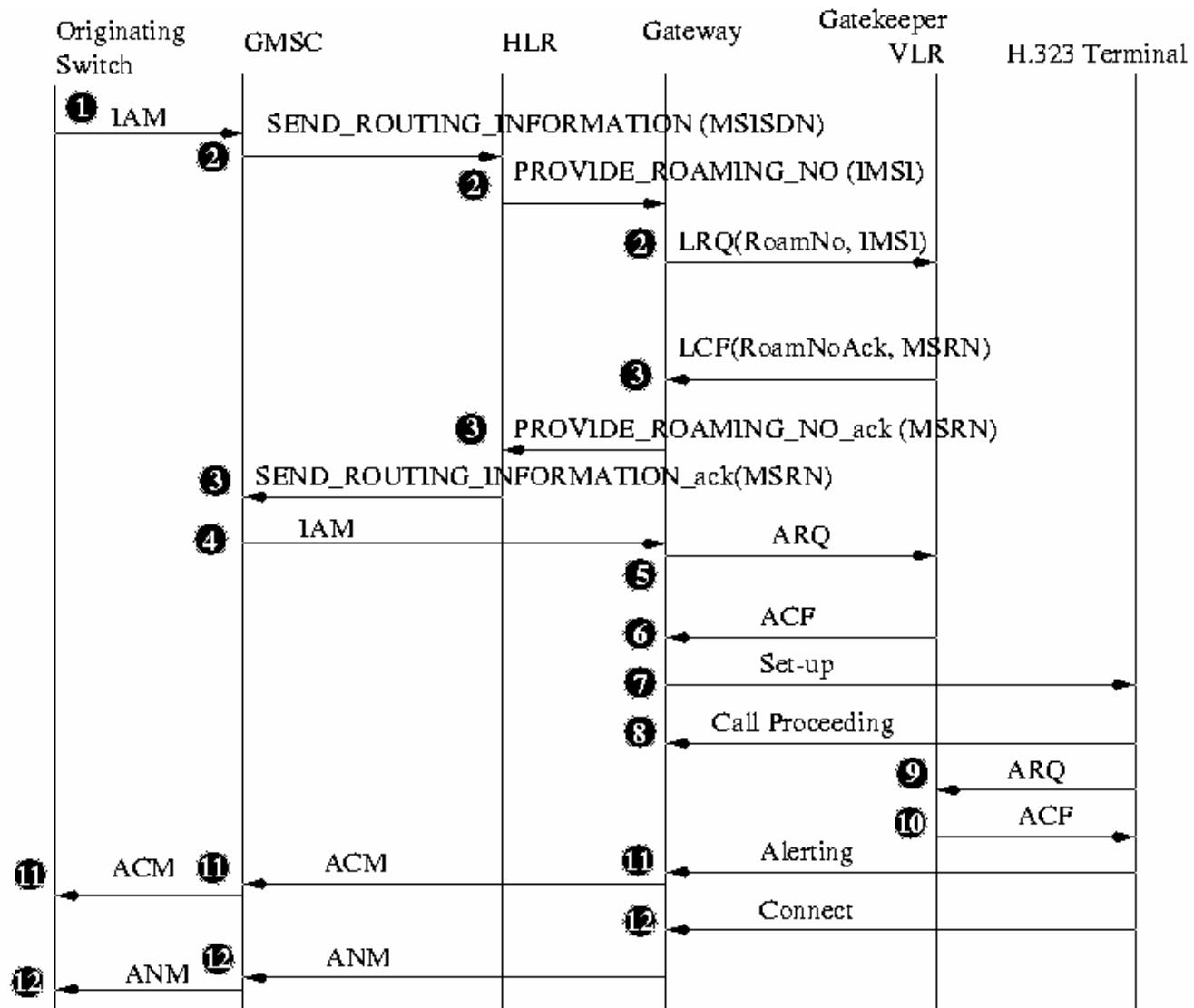# Registration

Message Flow (Registration)

H.323 Terminal — Gatekeeper (new VLR) — Gateway — HLR — old VLR

② RRQ(MSISDN,passwd)

③ IRQ(UpdateLoc, IMSI, VLR,MSC num)

③ UPDATE_LOCATION (IMSI,VLR,MSC number)

④ INSERT_SUBS_DATA (user profile)

④ IRR(InsSubsData, user profile)

⑦ CANCEL_LOCATION (IMSI)

⑧ CANCEL_LOCATION_ack

⑤ IRQ(InsSubDataAck)

⑤ INSERT_SUBS_DATA_ack

⑥ UPDATE_LOCATION_ack (HLR number)

⑥ IRR(UpdateLocAck, HLR number)

⑥ RCF **⑥**

Message Flow (De-registration)

Call Delivery

Message Flow (Call Delivery)

Originating Switch — GMSC — HLR — Gateway — Gatekeeper VLR — H.323 Terminal

① 1AM

② SEND_ROUTING_INFORMATION (MSISDN)

② PROVIDE_ROAMING_NO (IMSI)

② LRQ(RoamNo, IMSI)

LCF(RoamNoAck, MSRN)
③

③ PROVIDE_ROAMING_NO_ack (MSRN)

③ SEND_ROUTING_INFORMATION_ack(MSRN)

④ 1AM   ARQ

⑤

⑥ ACF

⑦ Set-up

⑧ Call Proceeding

⑨ ARQ

⑩ ACF

⑪ ACM   ⑪ ACM   ⑪ Alerting

⑫ Connect

⑫ ANM   ⑫ ANM

Conversation

Mis-routing Scenario [1/2]

(a) Step I

(b) Step II

(c) Step III
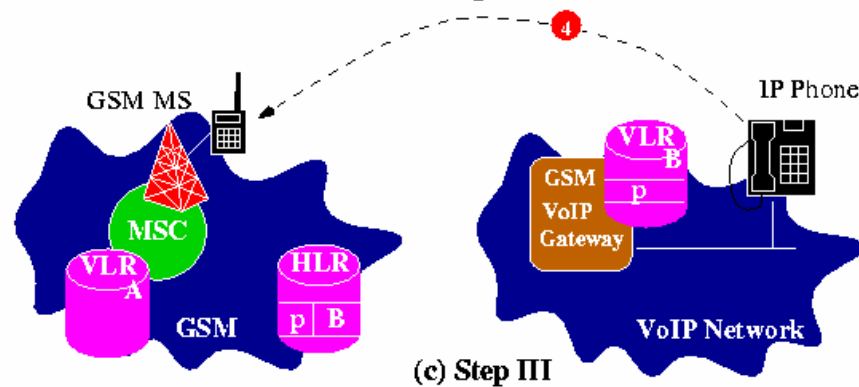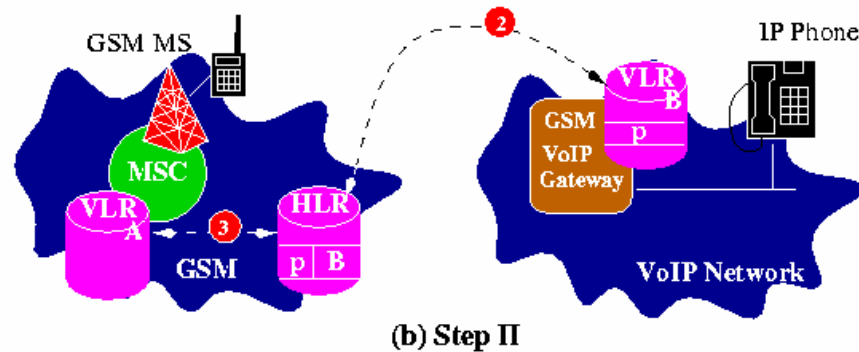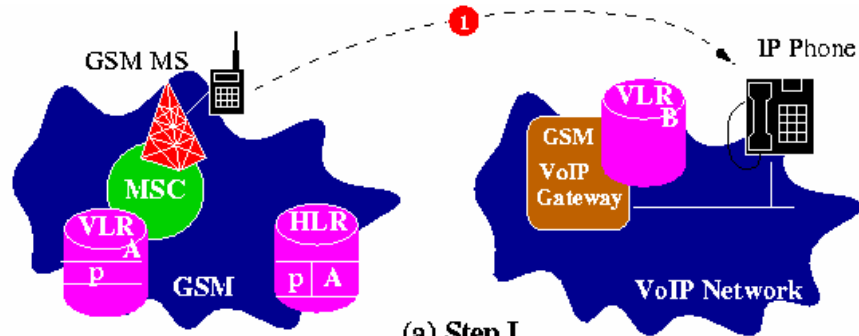
Mis-routing Scenario [2/2]

- The incoming calls to the user are misrouted until one of the following events occurs.
  - The subscriber originates a call.
  - The subscriber moves to another location area (LA).
- We proposed an analytic model to study mis-routing due to user mobility in iGSM.

Summary

- The results indicate that the probability of one mis-routed call delivery is about 1~20%.

- To avoid the mis-routing problem, the iGSM subscriber should turn off their MS when moving to the IP network.
  - The "turn-off" action results in a detach GSM message to de-register the MS.
  - When the subscriber turns on the MS in the GSM coverage area, an explicit registration is performed.

- Mis-routing calls are not necessarily lost. With call forwarding on no reply, these calls can be forwarded to an appropriate destination or mailbox.