Wireless and Mobile Network Architecture

Chapter 13: VoIP Service for Mobile Networks

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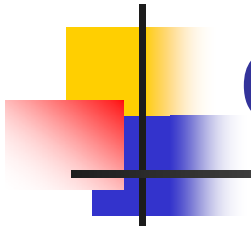
Outline

- Introduction
- GSM on the Net
- The iGSM Wireless VoIP Solution
- iGSM Procedures and Message Flows
- Implementation Issues
- Summary

Introduction

- **T**elecommunications and **I**nternet **P**rotocol **H**armonization **o**ver **N**etwork (TIPHON) specifies the mechanism to provide the service control functions for convergence of IP networks, mobile networks, fixed wireless networks, and the public switched telephone network (PSTN).
- A TIPHON scenario that integrates **mobile** and **IP networks** to support terminal mobility is illustrated in Figure 16.1



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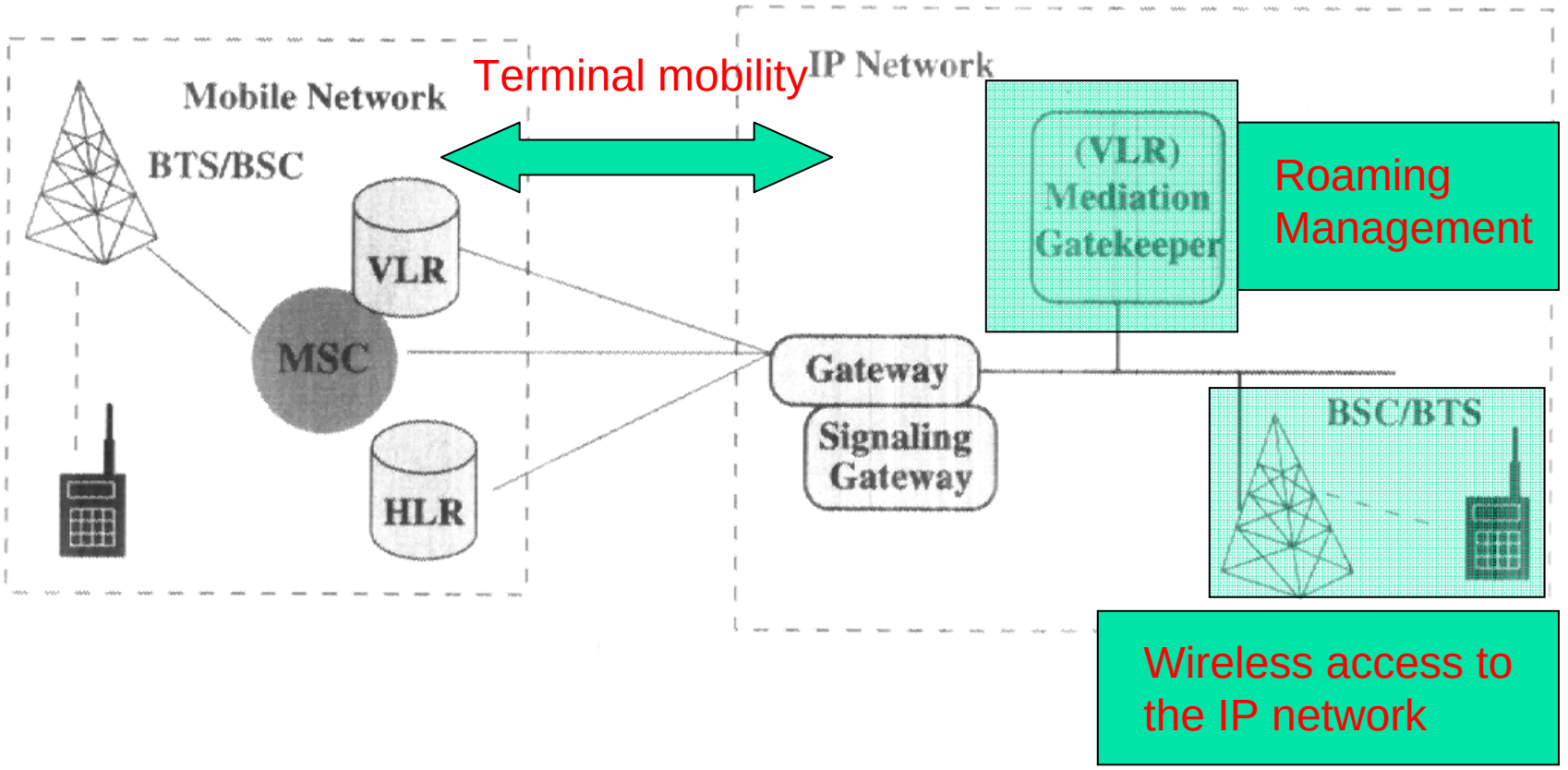
- In this chapter, GSM is used as an example of mobile networks to describe mobile/IP integration
  - Mobile signaling protocol is GSM MAP

Fig 16.1 TIPHON IP and mobile integration scenario



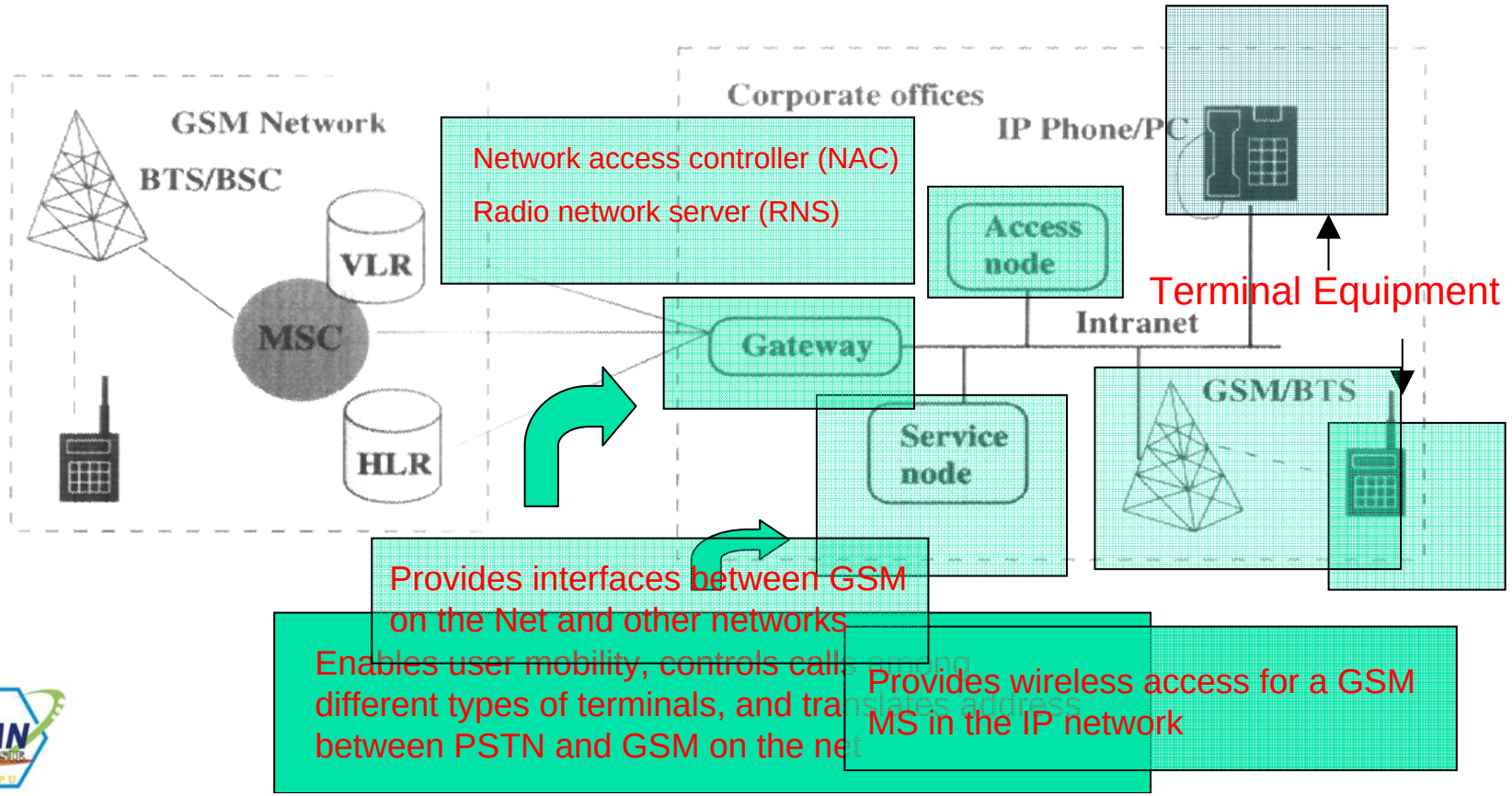
“terminal mobility” & “user mobility”

- “terminal mobility”
  - A terminal can be moved around the service area without losing contact with the system
- “user mobility”
  - Using various types of terminals, a user can move around the service area without losing contact with the system

16.1 GSM on the Net (terminal mobility)

- The GSM on the Net architecture is illustrated in Figure 16.2, which consists of GSM and corporate networks.
- "terminal mobility" & "user mobility"
- The network elements of GSM on the Net are described here:
  - **Service node.**
  - **Access node.**
  - **GSM/BTS.**
  - **Gateway.**
  - **Terminal equipment.**

Fig 16.2 GSM on the Net architecture



16.2 The iGSM Wireless VoIP Solution (user mobility)

- Another TIPHON scenario supporting **user mobility** for GSM subscribers to access VoIP services.
- The iGSM solution is different from GSM on the Net in the following aspects:
  - iGSM is a value-added service to the public GSM networks
  - The iGSM network does not introduce wireless access equipment in the IP network, iGSM is implemented using standard platforms (general IP gateway/gatekeeper).

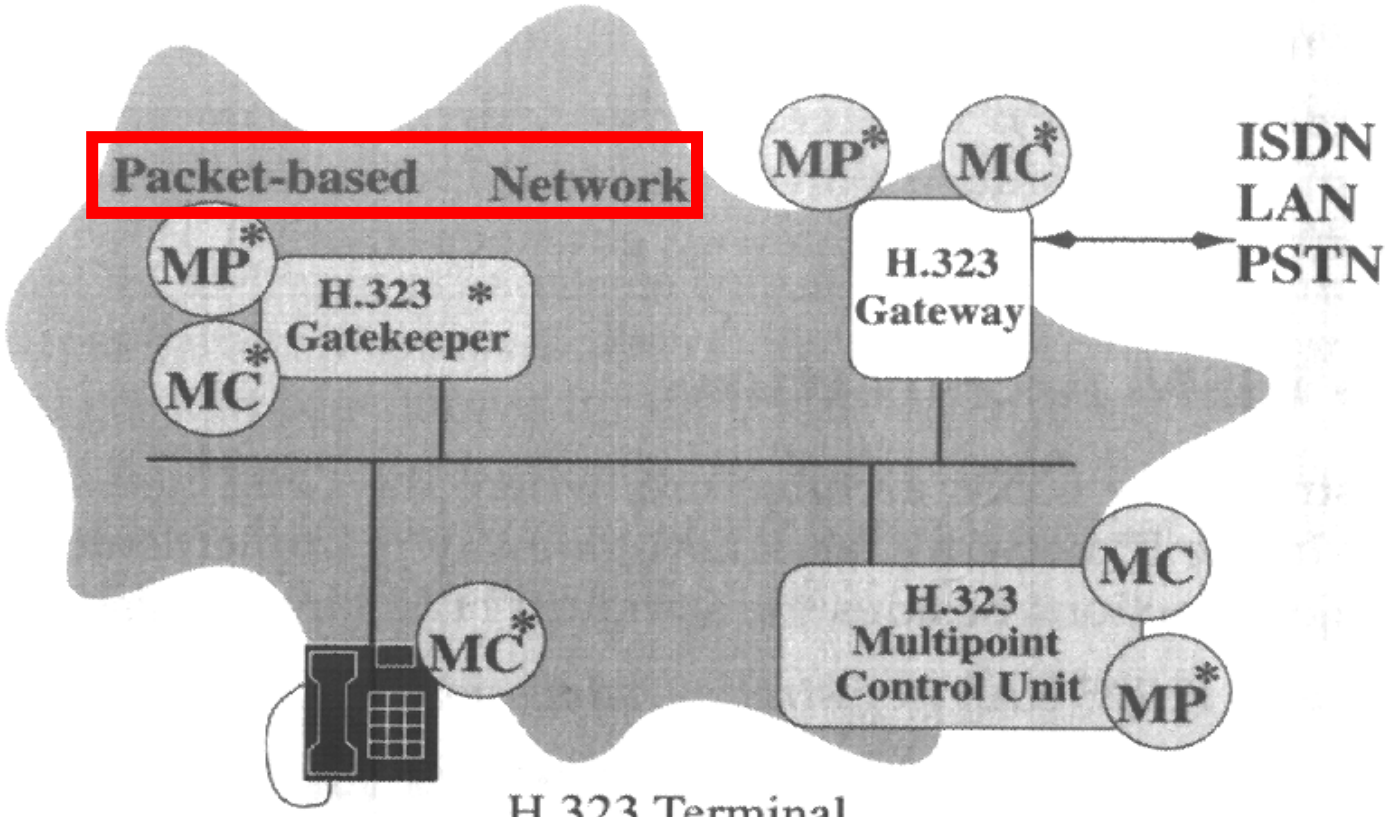
iGSM Service (GSM + H.323 (IP) netorks)

- A GSM subscriber ordering the iGSM service can enjoy the standard GSM service when he or she is in the GSM network
- When the person moves to the IP network (without a GSM mobile station), he or she can utilize an H.323 terminal (IP phone or a PC) to receive an incoming call to his or her MSISDN (mobile ISDN number)
  - The GSM roaming mechanism determines whether the subscriber is in the GSM network or IP network

The H.323 Network

- Figure 16.3 illustrates an H.323 system, where the terminal, gateway, gatekeeper, and multipoint control unit are called *endpoints.*
  - Terminal.
  - Gateway.
  - Gatekeeper.
  - Multipoint control unit (MCU).
  - Multipoint controller (MC).
  - Multipoint processor (MP).

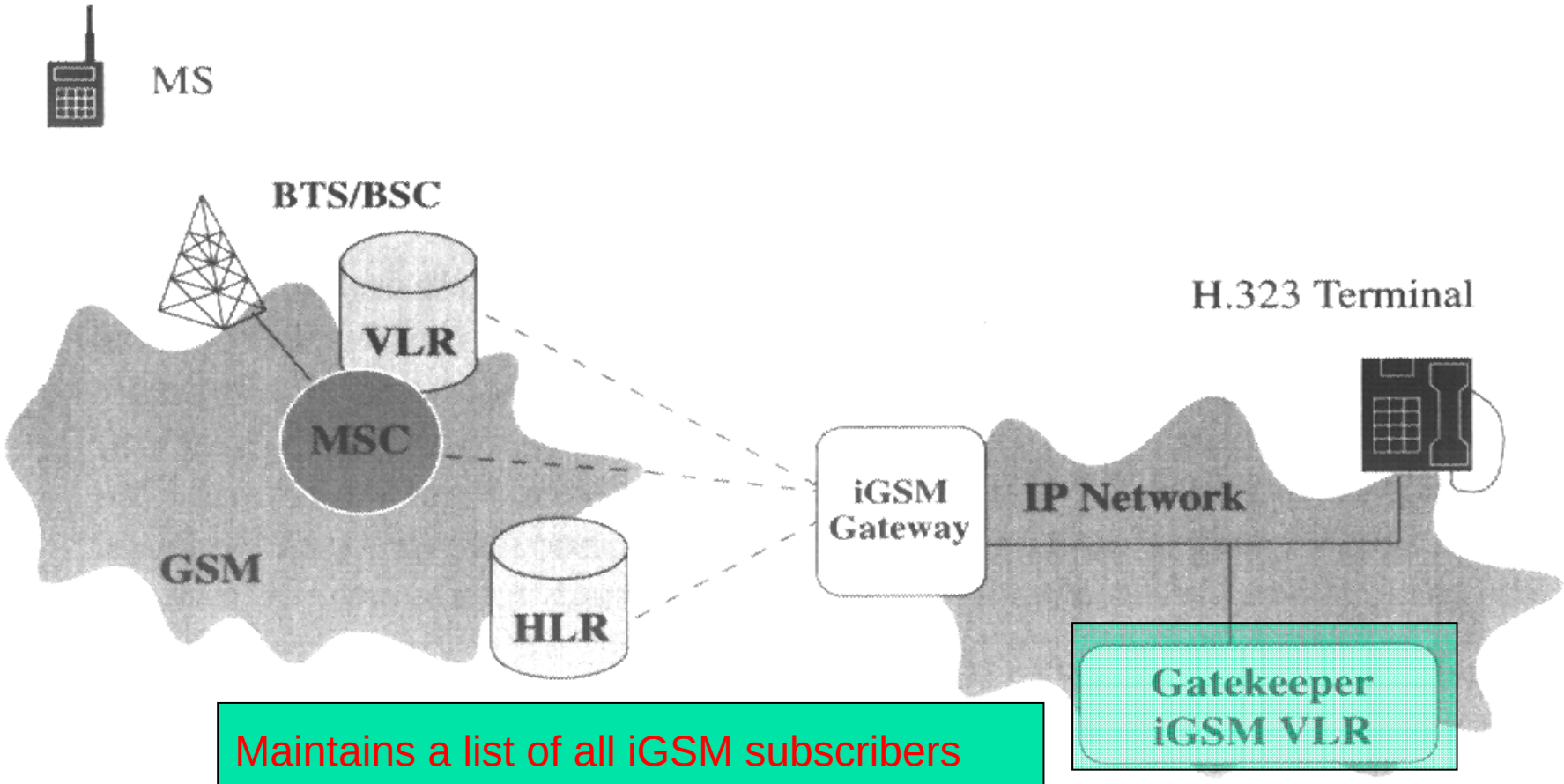
Fig 16.3 H.323 architecture



The iGSM Architecture

- Figure 16.4 illustrates the iGSM architecture, where the GSM network is not modified.
- In the IP network, an iGSM gateway is implemented to perform two major functions besides the standard H.323 mechanisms:
  - GSM MAP and H.225 RAS *(registration, admission, and status*) protocol translation.
  - GSM/PSTN/IP call setup and release

Fig 16.4 iGSM architecture



Maintains a list of all iGSM subscribers

16.3 iGSM Procedures and Message Flows

- Every iGSM subscriber has a record in the database, which consists of the following fields:
  - MSISDN of the MS
  - Transport address of the H.323 terminal for the subscriber in the IP network
  - Password of the iGSM subscriber
  - HLR address (ISDN number) of the iGSM subscriber

Cont.

- IMSI (international mobile station identity) of the MS
- User profile, which indicates the service features and restrictions of the iGSM subscriber
- Presence indication of the iGSM subscriber in the IP network

Registration

- Fig 16.5 Movement from the GSM network to the IP network

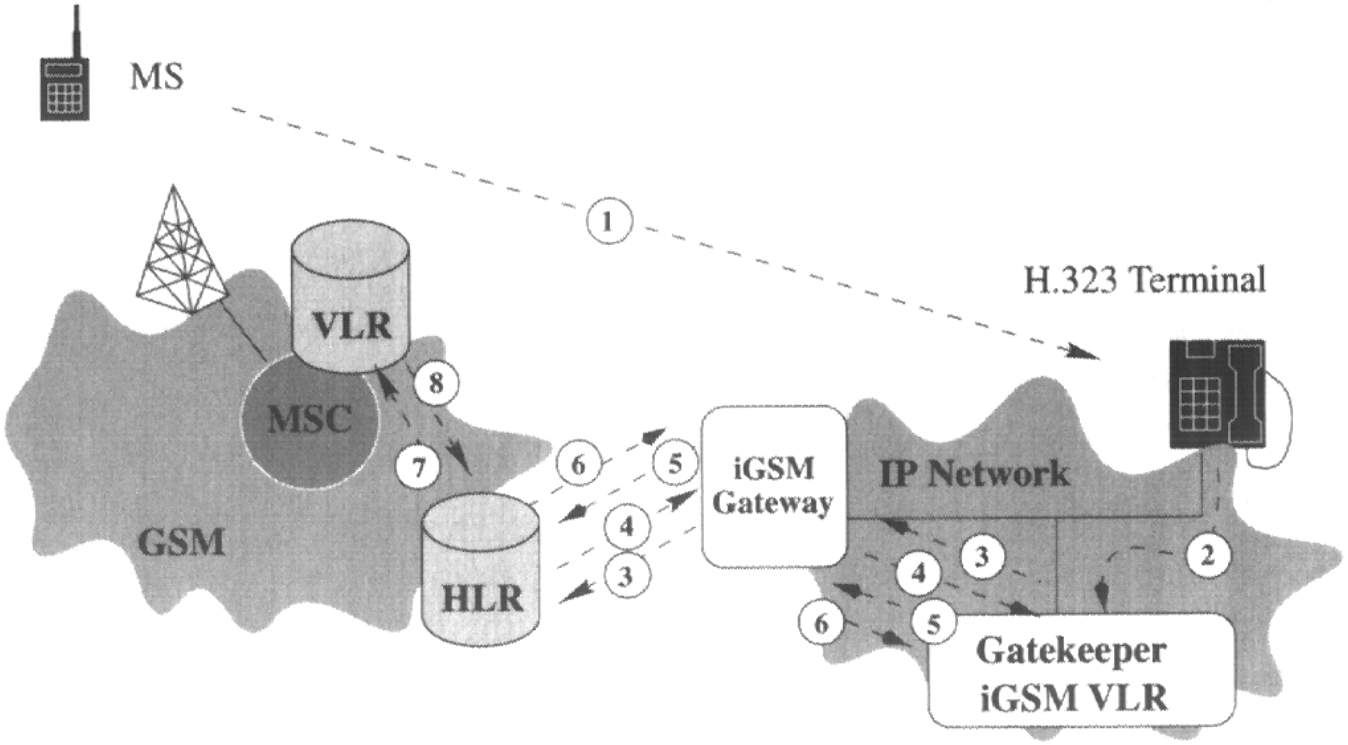
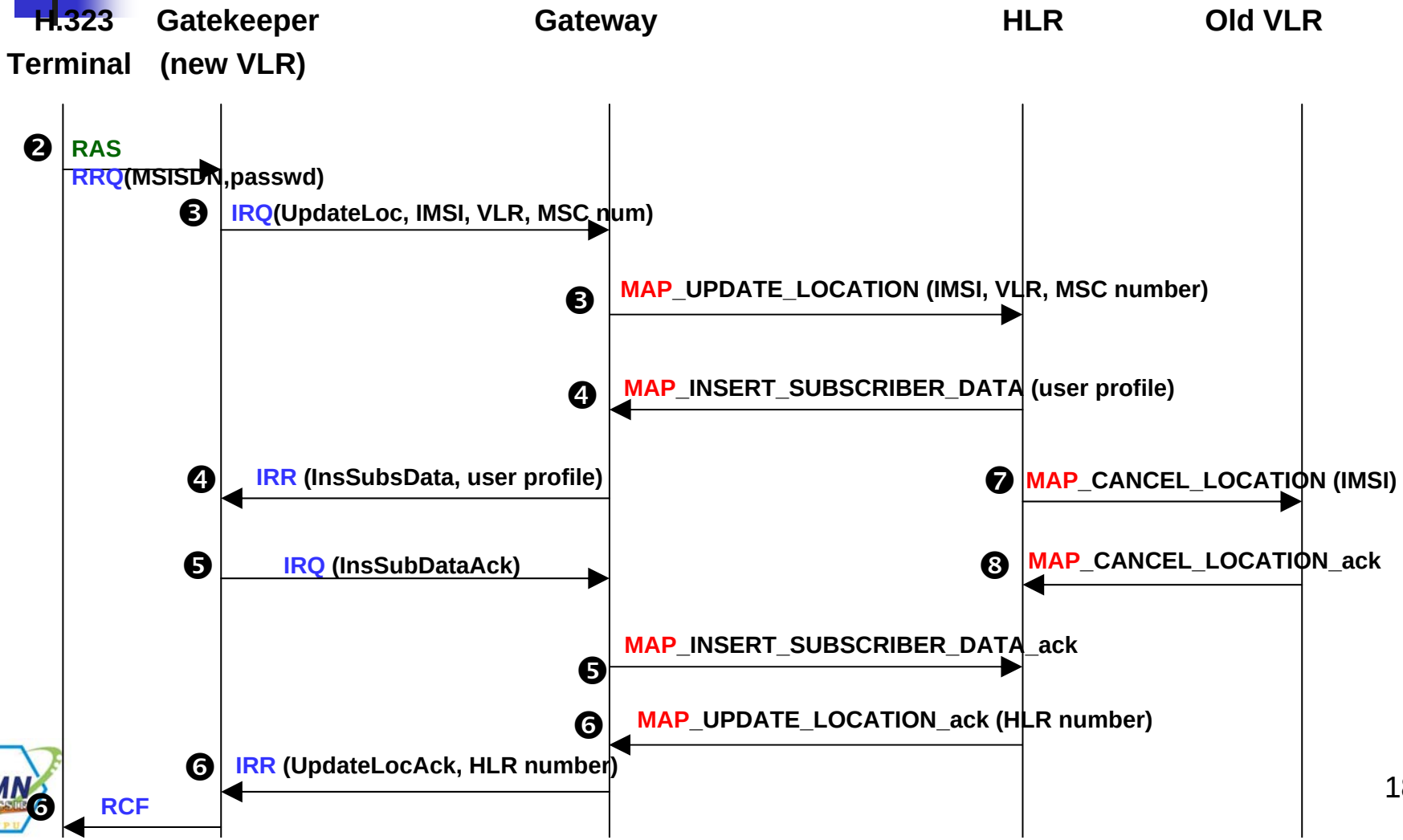


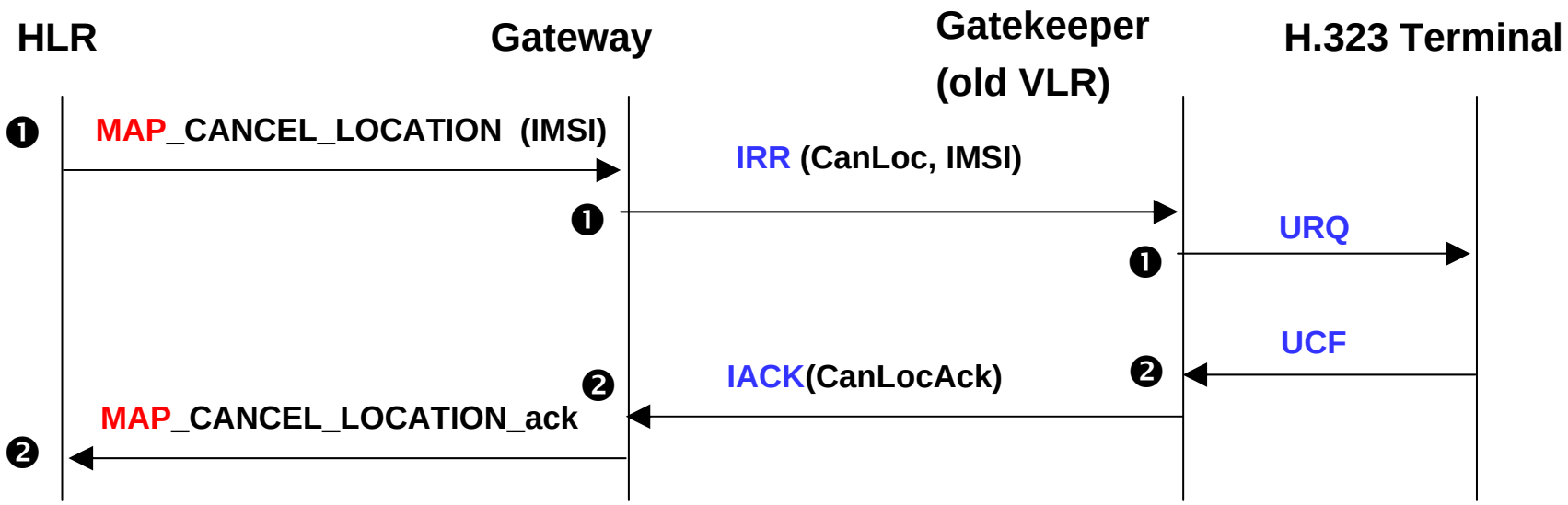
Fig 16.6 Message flow for iGSM registration



Deregistration

- When an iGSM subscriber moves from the IP network to the GSM network
  - He or she performs the registration in the GSM network (misrouting may occur)
  - The iGSM gatekeeper is the “old VLR” and the deregistration actions are modified.

Deregistration



Call Delivery to the IP Network

- When an iGSM subscriber is in the IP network
  - Call origination to the H.323 terminal follows the standard H.323 call setup procedure
- When the iGSM subscriber is in the GSM network
  - Call origination from the MS and call deliveries to the MS follows standard GSM procedure

Call Delivery to the IP Network

- Fig 16.8 Call delivery from PSTN to an iGSM subscriber visiting the the IP network

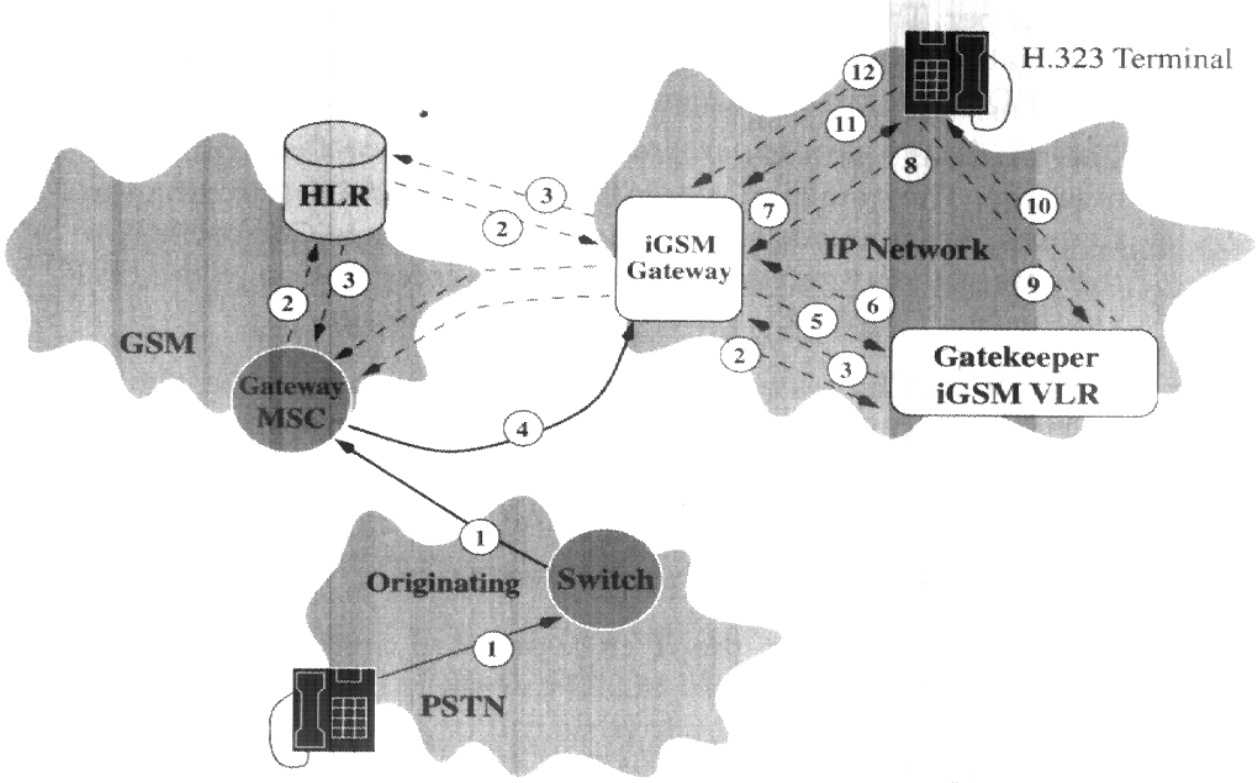
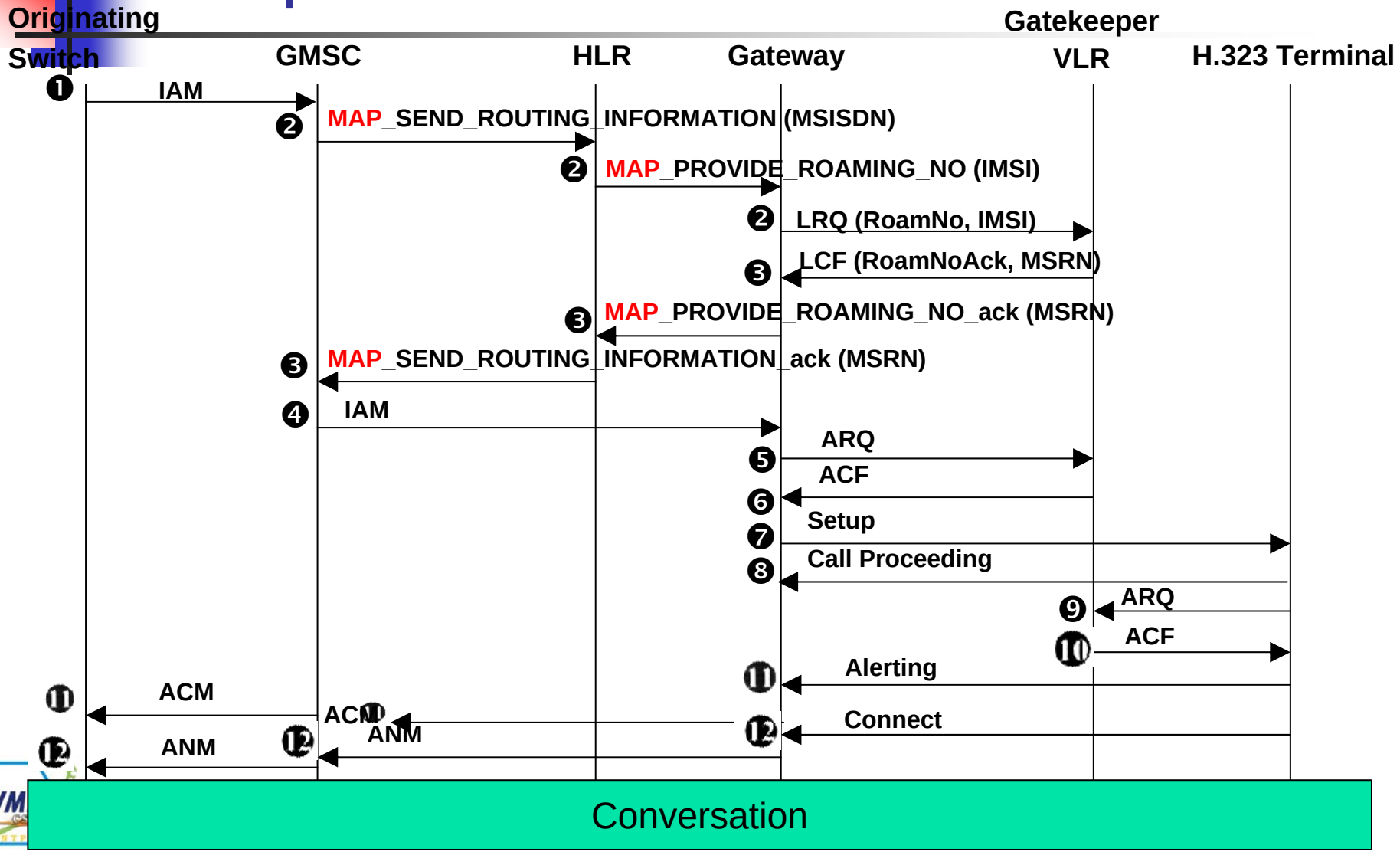


Fig 16.9 Message flow for iGSM call setup

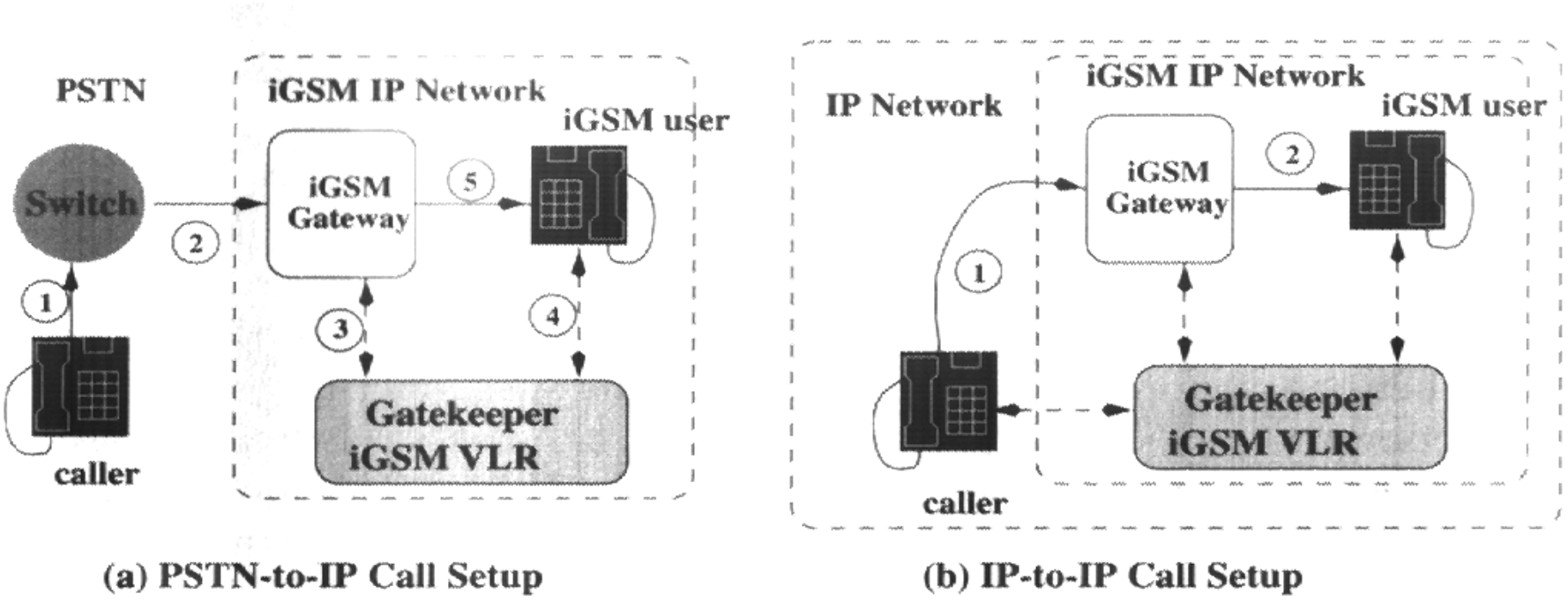


16.4 Implementation Issues

- This section discusses two issues regarding the iGSM implementation:
  - Reducing the GSM tromboning effect
  - Investigating misrouting of user mobility

Reducing GSM Tromboning Effect

- Fig 16.10 Eliminating tromboning effect



(a) PSTN-to-IP Call Setup

(b) IP-to-IP Call Setup

Misrouting Due to User Mobility

- For an iGSM subscriber, misrouting may occur in the following scenario:
  - **Step 1.** The subscriber is in the GSM location area (LA) A and the HLR indicates that the person is in LA A. The subscriber then moves to the IP network (LA B) without turning off the GSM MS.
  - **Step 2.** The subscriber registers in the IP network. After registration, the HLR record is modified.
  - **Step 3.** The subscriber moves back to the GSM MS at LA A. Since the GSM MS is still on, the subscriber does not notice that an explicit registration is required. Thus, the HLR indicates that the subscriber is still in LA B.

Cont.

- Implicit registration occurs in two cases:
  - The subscriber originates a call.
  - The subscriber moves to another LA in the GSM network.

Fig 16.11 Misrouting in user mobility

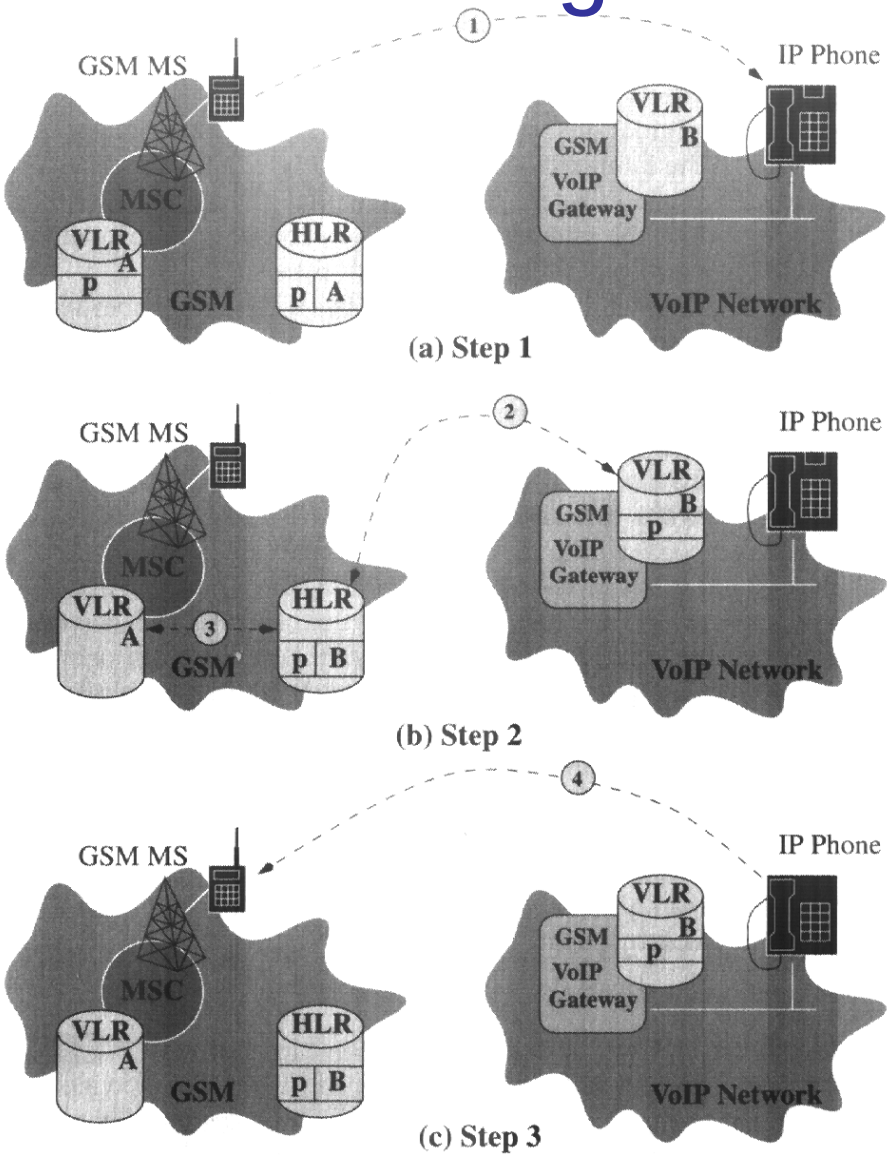
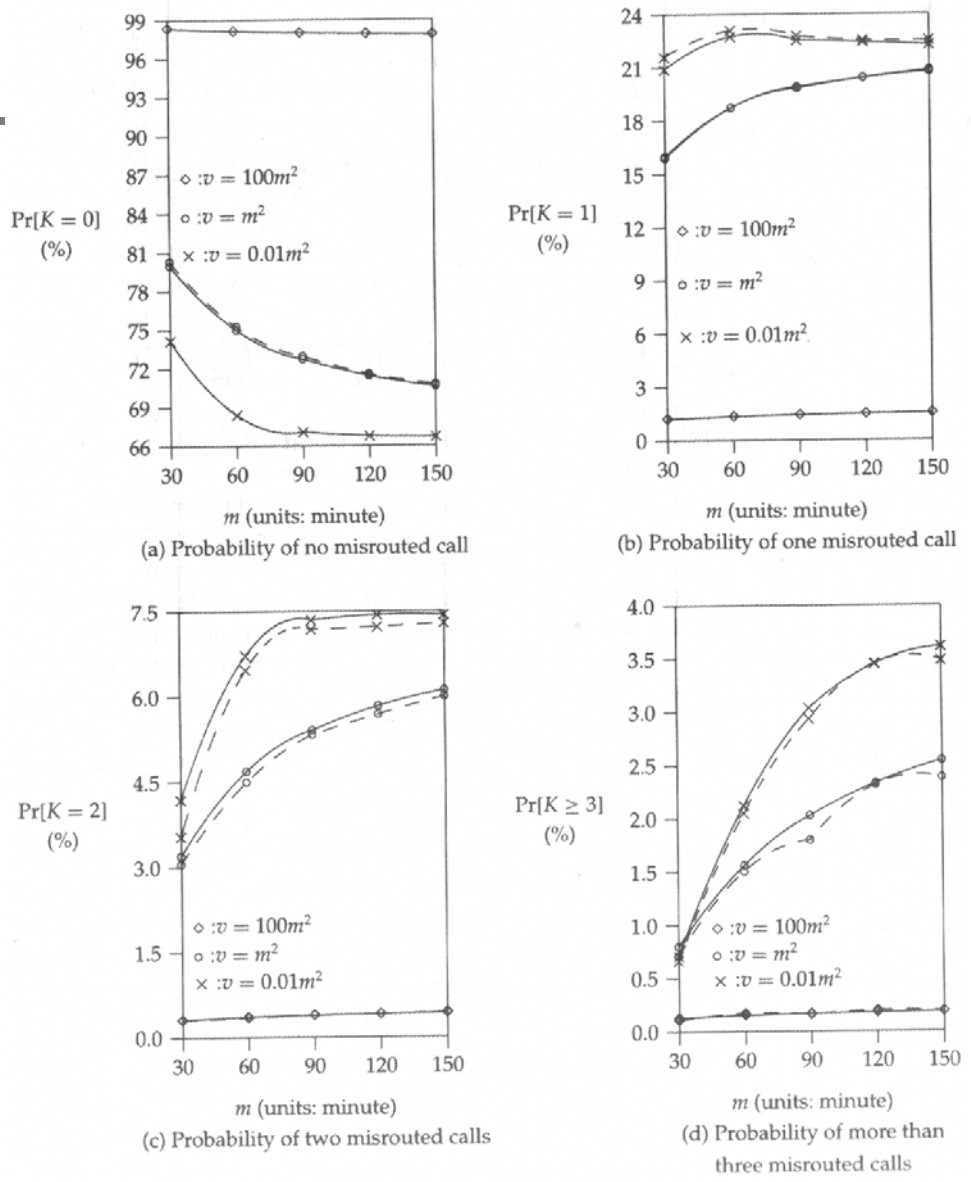


Fig 16.12 Misrouting probabilities (dashed lines: simulation; solid lines: analytic analysis)



16.5 Summary

- This chapter described iGSM, a VoIP value-added service for GSM that supports user mobility.
- To interwork GSM and IP networks, we proposed the iGSM protocol translation mechanism between GSM MAP and H.323.
- iGSM registration, deragistration, and call delivery procedure.
- Tromboning avoided.
- Misrouting problem caused by user mobility.