Ain Shams University
Faculty of Computer & Information Sciences
Information Systems Department

Mobile Computing

Lecture 3

Mobility Management and SMSs

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Agenda

- Mobility Management
- Handovers
- Short Messages Services (SMSs)
- SMS Architecture
- SMS as an Information Bearer
- Operator-Centric Pull
- Operator Independent Push
- Operator Independent Pull
- Value Added Services through SMS
- SMS VAS Architecture

Mobility Management

- Responsible of all aspects related to the user mobility, i.e. roaming, location management, security/authentication of subscriber.
- LM is concerned with the procedures that enable the system to know the current location of a powered-on mobile station, so that the incoming call routing can be completed.
- When a mobile station is switched on in a new location area or different PLMN, the subscriber must register with the new network to indicate its current location.
- Location update message → VLR → HLR $\xrightarrow{\text{authorized}}$ cancels registration in old VLR.
- Location updating is also performed periodically.
- HLR is referred for incoming calls, VLR is referred for outgoing calls.

Handover

- While a call is in progress in cellular networks, the user may move away or closer to a tower.
- When the user moves away from a tower, the radio signal strength or the power of signal keeps reducing.
- This can result in change of the channel or cell.
- This procedure of changing the resources is called **handover**.
- **4 types of handover in GSM**, which transfers a call between:
  - Channels (time slots) in the same cell.
  - Cells (BTSs) under the control of the same BSC.
  - Cells under the control of different BSCs, but belong to the same MSC.
  - Cells under the control of different MSCs.
- **Internal vs. external** handover.
- **Routing** vs. **Roaming**

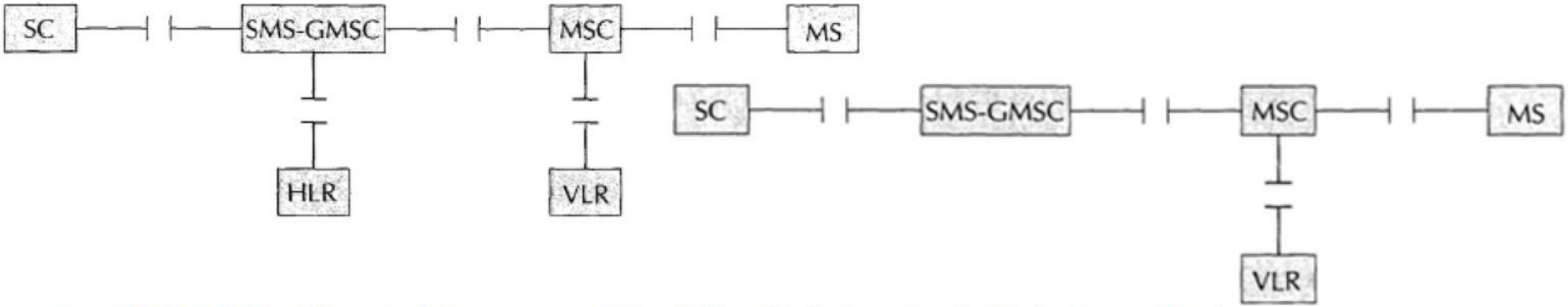
Short Messages Services

- SMS is a data service of GSM to send and receive text messages to and from GSM mobile phones.
- Up to 160 characters in length when English, 70 characters when non-Latin alphabets.
- Strengths of SMS:
  - Omnibus nature of SMS: the only bearer that allows a subscriber to send a long-distance SMS without having long-distance subscription.
  - Stateless, session-less, unidirectional – best bearer for notifications.
  - Asynchronous; even if the recipient is out of service, transmission is not abandoned.
  - Self-configurable and last mile problem resistant.
  - Non-repudiable: the SC address can't be handcrafted.
  - Always connected: is always on, a user can't switch-off, bar, or divert SMSs.

SMS Architecture

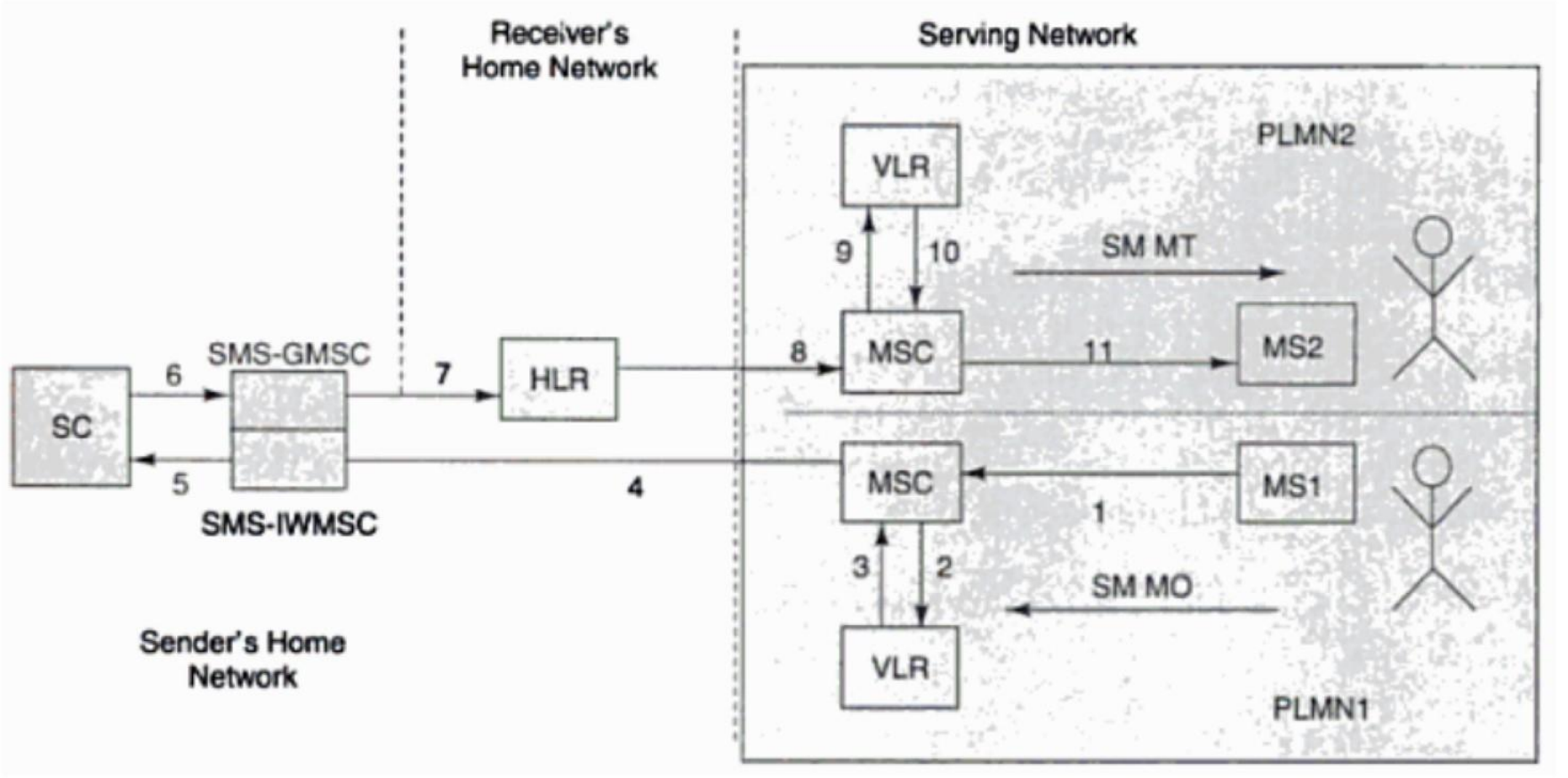
SMS are two types:

- **SM MT**: Short Message Mobile Terminated Point-to-Point.
  - Incoming short message from the network side and is terminated in the MS.
  - Path: SC → MS via HLR and GMSC function of the home MSC.



- **SM MO**: Short Message Mobile Originated Point-to-Point.
  - Outgoing message originated in the MS and is forwarded to the network for delivery.
  - Path: MS → MSC → home SC via VLR and IWMSC function of the serving MSC (as MO) → MS (as MT).

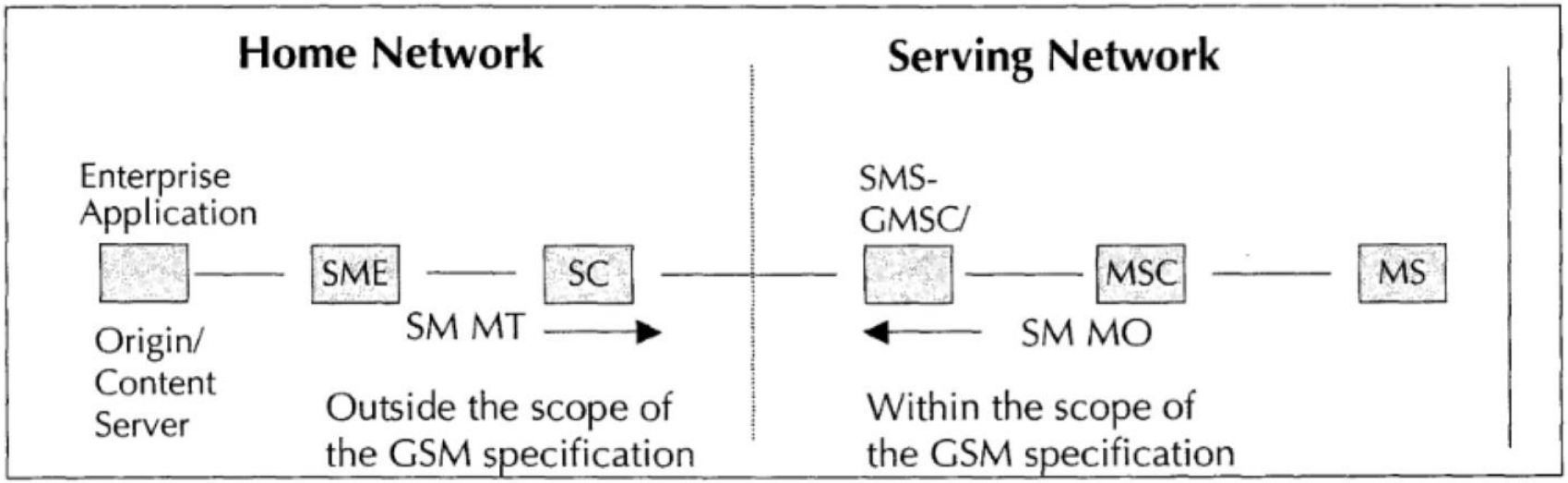
SMS Architecture



The main network structure serving as a basis for the short message transfer

SMS Architecture

- For incoming SMS, the SC of the serving network is never used.
- This implies that an SMS can be sent from any SC in any network to a GSM phone.
- Thus, any SM MT message is mobile operator independent.
- For an SM MO to work, SC must be used



The basic network structure for SMS as information bearer

SMS as an Information Bearer

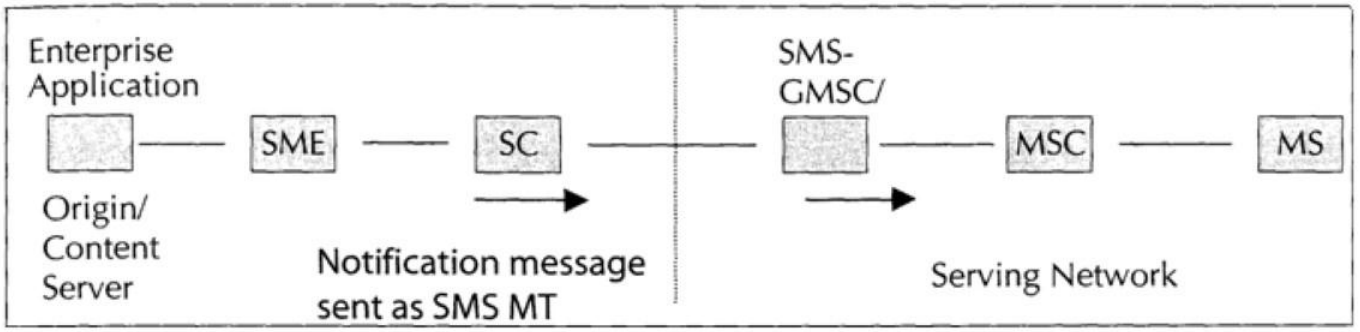
- SMS is very popular bearer in enterprise applications and **notification** services.
- To use SMS as a bearer for any information service, we need to connect the services running on the Enterprise Origin Server to the SC through a short message entity (SME), i.e. **SMS gateway**.
- MVNO (**Mobile Virtual Network Operators**) are service providers that develop different systems, services and applications to offer data services using SMS.
- With respect to SMS, a **GSM subscriber is always in control of the SC in the home network irrespective of the serving network**.
- Thus, any SMS-based data service in the home network will be **available** in any foreign network.

Operator-Centric Pull

- An HSBC customer wants to use the MVNO services of HSBC bank.
- He needs to register for the service, sending his MSISDN of the phone which will be used for this service.
- Once a user is registered for the service, he sends HSBCBAL as MO message to a service number, say 333 in case of Vodafone.
- SC delivers this MO message to the SMS gateway (SME) connected to this service number.
- SME then forwards this message to the enterprise application.
- The response from the enterprise application is delivered to the MS as an MT message from the SME.
- Even if the subscriber is in remote foreign network within GSM coverage, he can send the same service number in his home network.
- Thus **home services are available in foreign networks** – ubiquitous.

Operator Independent Push

- It is possible to send an SMS to any phone in any network.
- Any push (alert, notification, response to a pull msg) can be serviced by any network and delivered to any GSM phone in any network.
- Roaming tie-ups allows operators to have agreement on call forwarding mechanism.
- Thus, an enterprise can use SMS to send business alerts or proactive notifications to its customers anywhere using Operator Independent Push.



Operator Independent Pull

- In Europe, An HSBC bank customer is a subscriber of operator A sends HSBCBAL to 300 to know his balance.
- Another HSBC customer is a subscriber of operator B sends HSBCBAL to 1234 to know his balance.
- HSBC has many customers in the Middle East. The same banking services available in Europe are not available in the Middle East.
- **REASON**: Operators A & B connects to the bank's application through their private SC and SME, whereas the operators in the Middle East don't have an SME to connect to the bank's application.
- The major challenge for implementing ubiquitous services through SMS require operator independent SM MO or **operator independent pull** services, i.e. 1-800 services.
- As SME is always connected to the home network's SC, it is impossible to route SMS MO to any application or any SME using the conventional framework. Operator Independent Pull service is required.

Value Added Services through SMS

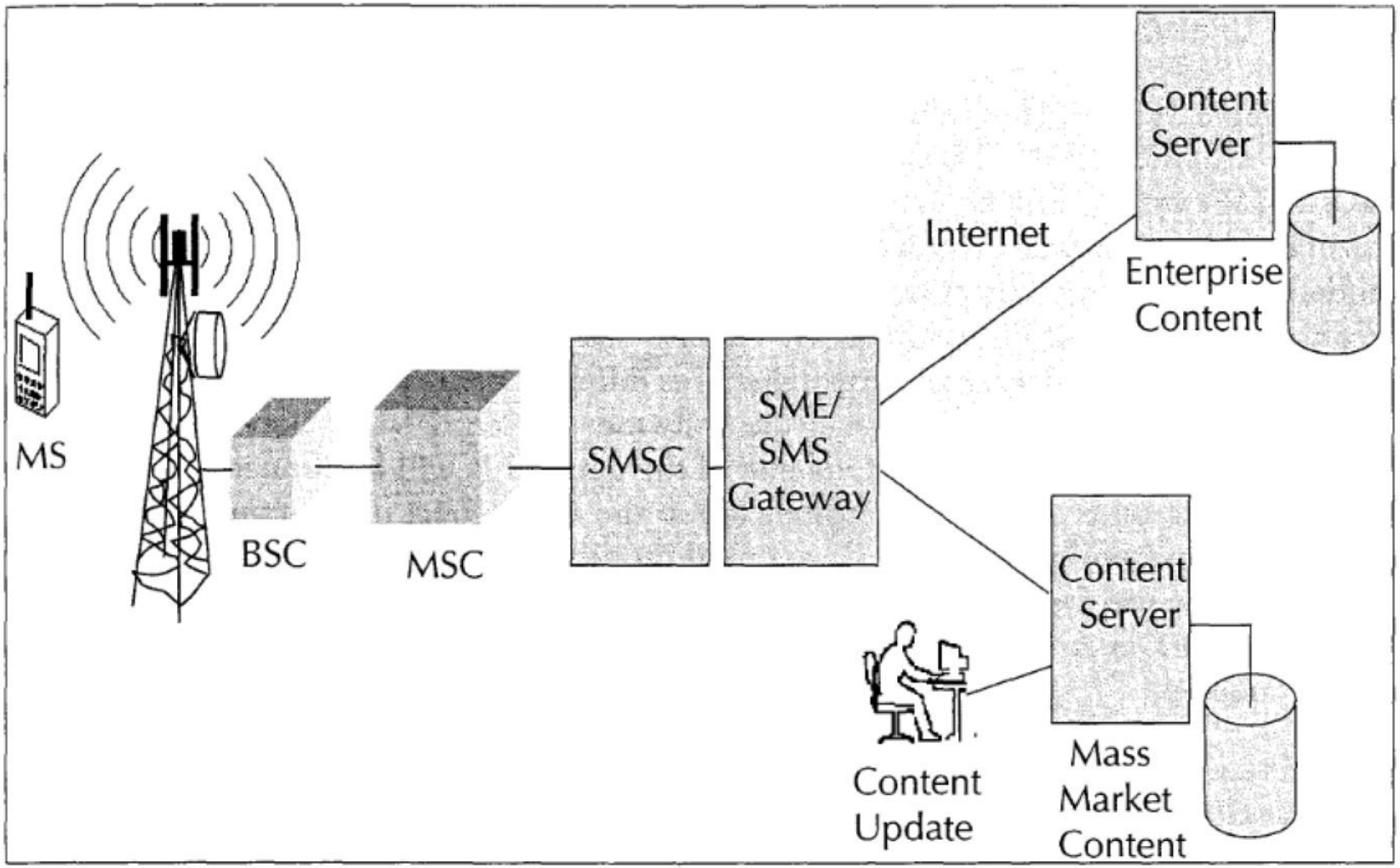
- Voice and SMS are basic services provided by a GSM operator.
- Offering different other services using SMS as a bearer will be a VAS.
- Most popular VAS over SMS are Entertainment and Information on Demand (static, dynamic, or real-time).
- SMS use short transaction model.
- For an SMS-based service, the user interface is always keyword-based.
- The first word is the keyword (command) and the rest are the parameters for the command. Ex: mail abc@xyz.com call me back.
- The response from a service can be split into multiple messages – broken at word boundary – ordered as 1/3, 2/3, 3/3 if more than 160 characters.
- Ex: News, session-based chat, emails, health care, micro-payments.

VAS Services through SMS

- **Alert Services:**
  - Time-based: proactive alerts sent at a pre-assigned time of the day.
  - Watermark-based: whenever updates occur, alert the subscriber.

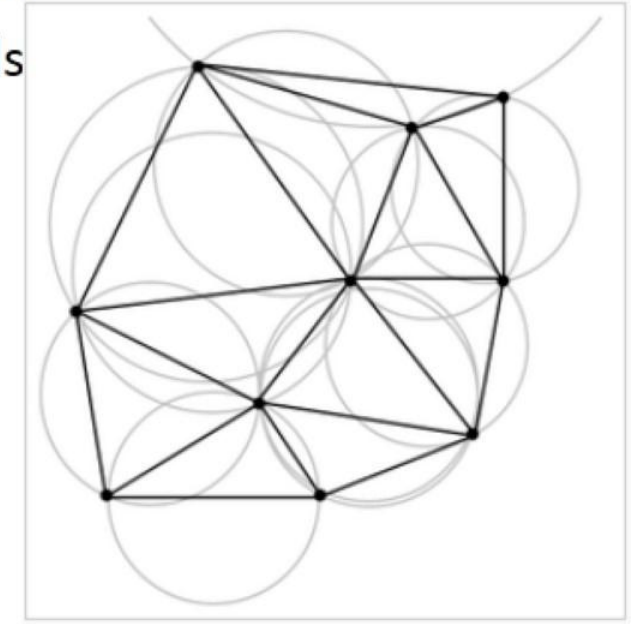
- **Location-based Services:**
  - Only the information relevant to the current location of MS is provided.
  - Could be road direction, restaurant guide, shopping alerts… etc.
  - Some location-aware VAS services provide shopping alerts as well.
  - The precise location of user needs to be determined, either from the:
    - **Network**: using Time Advancing techniques within the BTS.
    - **Device**: Device-specific location awareness technologies, i.e. Cell ID (CID)-based system and Global Positioning (GPS)-based System.

SMS VAS Architecture



CID-based System

- The Cell ID of the current BTS is determined.
- It needs a mapping of the cell ID to the geographical location.
- To handle the growing subscribers, new cell sites are added and the CIDs are re-configured.
- The mapping between locations vs. CIDs needs to be synchronized.
- The signal strength from all the different CIDs are extracted from the device and sent to the server through an SMS.
- The location of the user is determined using the signal strength and triangulation algorithms.



GPS-based System

- The location is determined through a GPS receiver installed in the device.
- GPS provides facility to compute position, velocity, and time of a GPS receiver.
- From velocity, it can determine the direction of a moving user.
- GPS-based system is independent on the network operator.

Lecture References

- Mobile Computing, Second Edition by Asoke K. Talukdar, Tata MacGraw Hill, 2010
  - Chapter 6

- Mobile Communications, by Jochen H. Schiller, Addison-Wesley, 2003
  - Chapter 4

Thank you

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For the next lecture: What is GPRS?