Prüfungsamt
Stand:20.04.2015 **Fachbereich Wirtschaftswissenschaften**

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

Professur / Chair: Chair for Mobile Business & Multilateral Security

Sommersemester / *Summer Semester* 2016

Matrikelnummer / *Student ID number:* _____

Bitte auch auf jedes Blatt oben rechts eintragen! / *Please also write on each page top right.*

Modulkürzel / *Module Code*: MOB1

Prüfer / *Examiner:* *Prof. Dr. Kai Rannenberg*

Modultitel /*Module Title:* Mobile Business I - Technology, Markets, Platforms, and Business Models

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- You have taken notice that you are responsible to **hand in your examination orderly before you leave** the examination room. This includes that you **remain quietly seated** until all examinations have been collected and don't leave the room until the examinations have been counted and it is determined that all examinations have been submitted.
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Ergebnis / *Result*	**Aufgabe** / *Question*	1	2	3	4	5	6	7	8	9	10	**Summe** / *Sum*
	Punkte / *Points*											

Punkte *Points*	**Note** *Grade*	**Unterschrift des Prüfers** *Signature of the Examiner*

Matrikelnummer / *Student ID number:* _____

1: Economic Basics (22 points)

a) Discuss briefly about the role of device manufacturers and network operators in the mobile market, as well as the relationships between them. Take an example from real life. **(7 points)**

b) Name and briefly discuss about the motivations for mobile operators to allow MVNOs on their networks in relation to the different strategies that they enable. **(6 points)**

Motivations for mobile operators (MO) to allow MVNOs on their networks:

- **Segmentation-driven strategies**: MOs often find it difficult to succeed in all customer segments. MVNOs are a way to implement a more specific marketing mix, whether alone or with partners and they can help attack specific, targeted segments.
- **Network utilisation-driven strategies:** Many MOs have capacity, product and segment needs. An MVNO strategy can generate economies of scale for better network utilisation.
- **Product-driven strategies:** MVNOs can help MOs target customers with specialised service requirements and get to customer niches that MOs cannot get to.

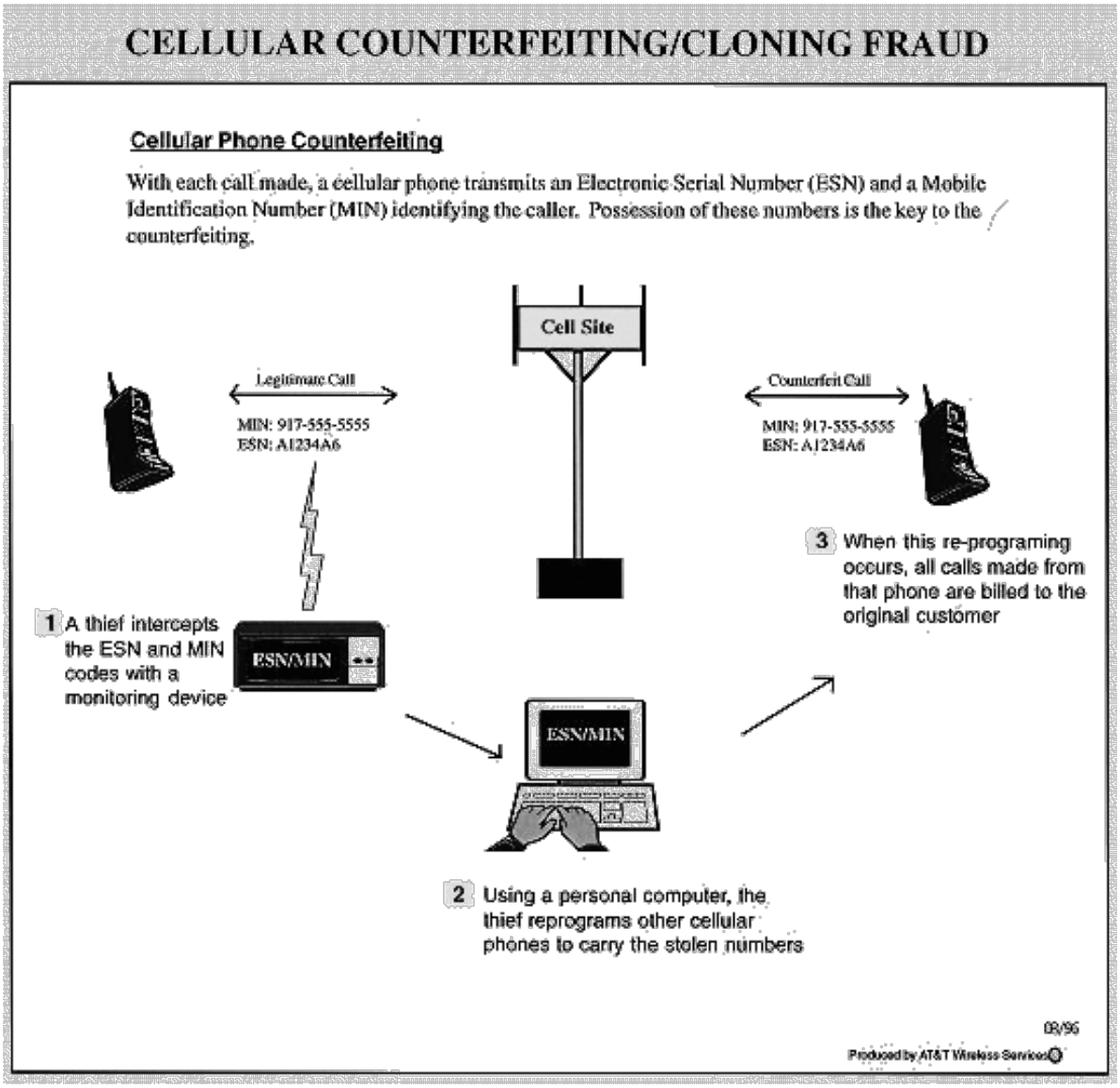
c) Discuss briefly about the classical business models (I and II) for mobile network operators. Explain briefly the "reverse approach" at the new business model. **(5 points)**

d) Fill in the table below with the example of a revenue model for an app-provider. (4 points)

	direct revenues	indirect revenues
transaction dependent	In-App sales	In-App Advertising
transaction independent	In-App subscription sales	Commission from App Store

2: Smart cards and infrastructures (10 points)

a) Describe briefly how (the steps) an attacker can counterfeit calls by utilizing a flaw in the CDMA network. Mention the type of information the attacker needs and the consequences of such a design flaw for the legitimate user. Feel free to draw the steps if you prefer. **(5 points)**



b) Discuss briefly about the characteristics of eSIM and provide a criticism on its (positive and negative for which market participants) potential influence on the market. **(5 points)**

- Characteristics of the embedded SIM (eSIM)
  - Embedded as a secure element in hardware (mobile devices, cars, household devices – to enable the deployment of IoT)
  - Likely implemented with a programmable ROM
  - Probably a "game changer"
    - Easy to switch providers/operators
    - Tariffs can be programmed/limited programmatically to devices, e.g. a 2-year contract can limit update to the card until the end of contract.
- Global standard being drafted by the GSMA
- Will require new terminal hardware
- German market situation
  - Telekom announced plan to introduce eSIM in 2016
  - Vodafone opposed the eSIM concept
- Uncertainties
  - Fears of limited customer choice of operator/tariff (preselected list of operators)
  - Business models (shifting the power from the network operators to device vendors)

3. Mobile devices (13 points)

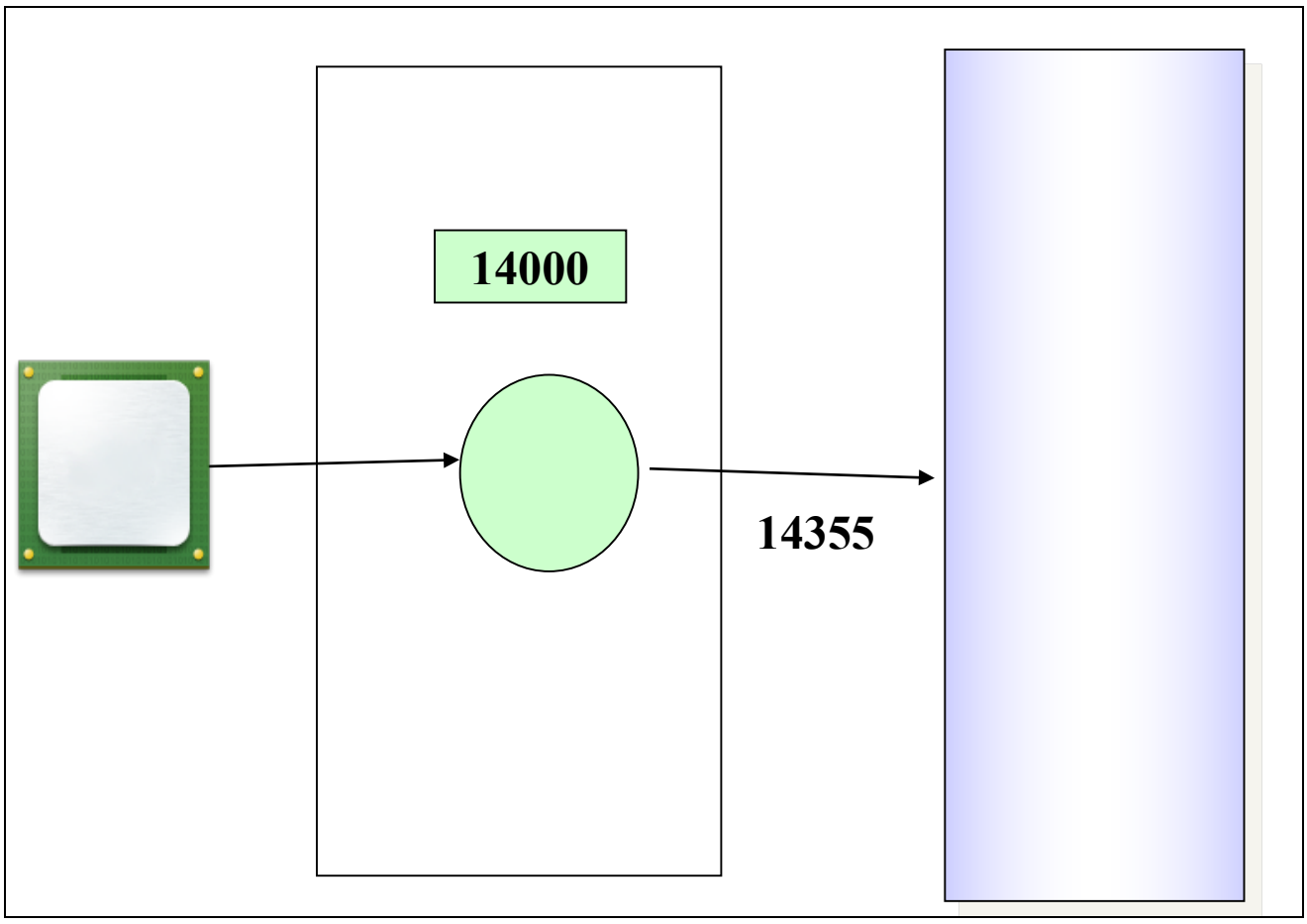
a) What is the Fair Phone about? Name and briefly discuss the basic idea, key aspects and whether it is 100% "fair". **(5 points)**

- Grounded in the idea to develop and market smartphone hardware and software designed and produced with minimal harm to people and planet.
- Strict observation of:
  - Type of raw materials (ecological aspects)
  - Origin of raw materials (political aspects)
  - Lifespan of components and easy repair (durability aspects)
- It is *"not possible to produce a 100% fair phone yet, but by aiming toward this end seeks to raise awareness among consumers and in the mobile industry."*

b) Organic Light Emitting Diodes (OLED) screens come in two main types based on their driving electronics. Name these two types and briefly describe their differences as well as where they are more used. **(4 points)**

- Two main types (based on the driving electronics)
  - PMOLED (Passive-Matrix OLED)
    - Simpler electronics, no storage capacitor
    - Lower cost
    - Lower lifetime (due to the higher voltage needed)
    - Limited size and resolution
    - Mostly used for simpler displays, e.g. mp3 players, mobile phone sub-displays, etc.
  - AMOLED (Active-Matrix OLED)
    - Contains storage capacitor to maintain the pixel line state
    - No restrictions on size and resolution
    - More costly
    - Used for higher quality screens, such as mobile phones (Blackberry Priv, HTC One A9, Samsung Z3, Microsoft Lumia 950 XL, etc.)

c) Put the following items in the correct boxes in the memory mapping figure below: *MMU, CPU, +, Memory, logical address, physical address*. Find the logical address and fill it in the correct place. **(4 points)**



4. Mobile Networks and Services (26 points)

a) Explain the term "Digital dividend". Why is the digital dividend important for the telecommunications industry? **(2 points)**

- Frequency spectrum that was previously used for analogue television transmissions (and is no longer needed) may now be used for mobile telecommunication services, e.g LTE / 4G.

b) List three advantages and two disadvantages of packet-oriented GPRS over circuit switched connections. **(5 points)**

Answer

Advantage of (packet-oriented) GPRS over Circuit Switched Connections (CSD, HSCSD)

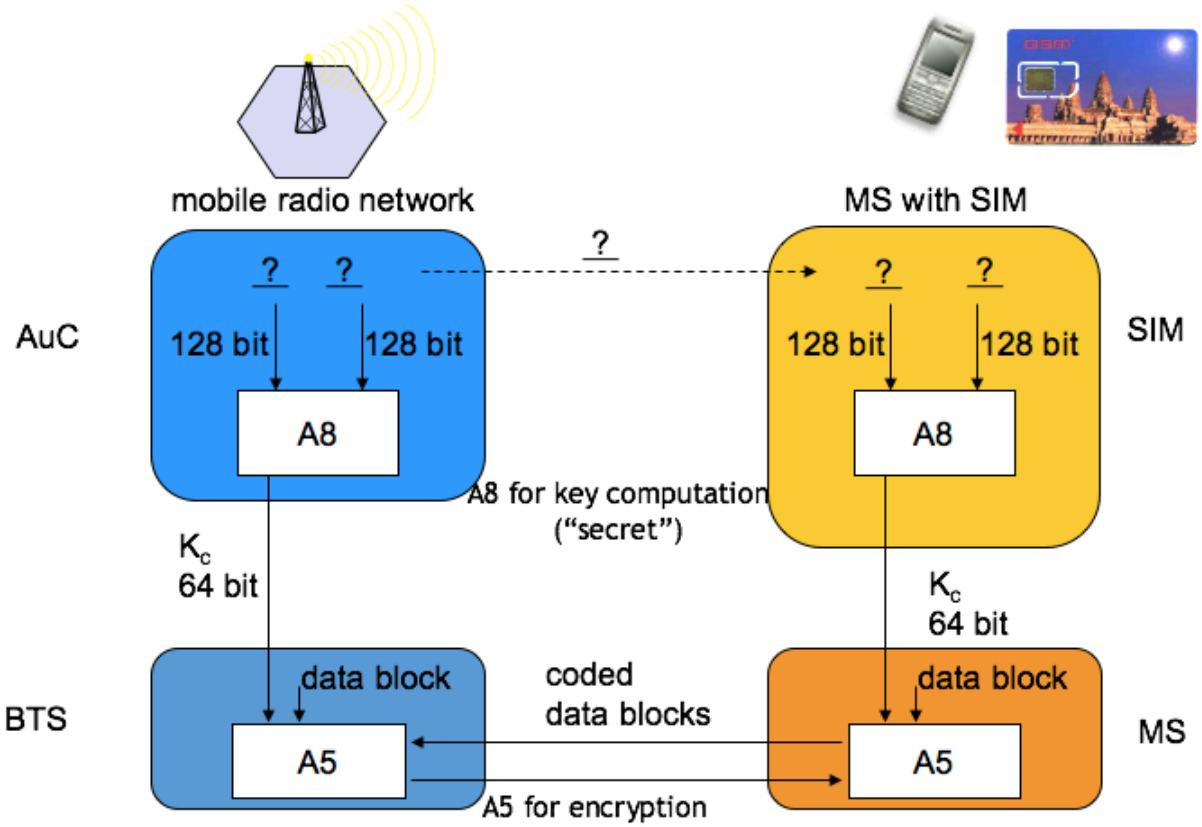
- Economical network utilization
- "Always-online" allows offering new push services.
- New billing methods can be realized (packet-oriented network).

Disadvantages of (packet-oriented) GPRS compared to Circuit Switched Connections (CSD, HSCSD)

- Existing GSM infrastructure must be upgraded implying high investments as well as new terminals

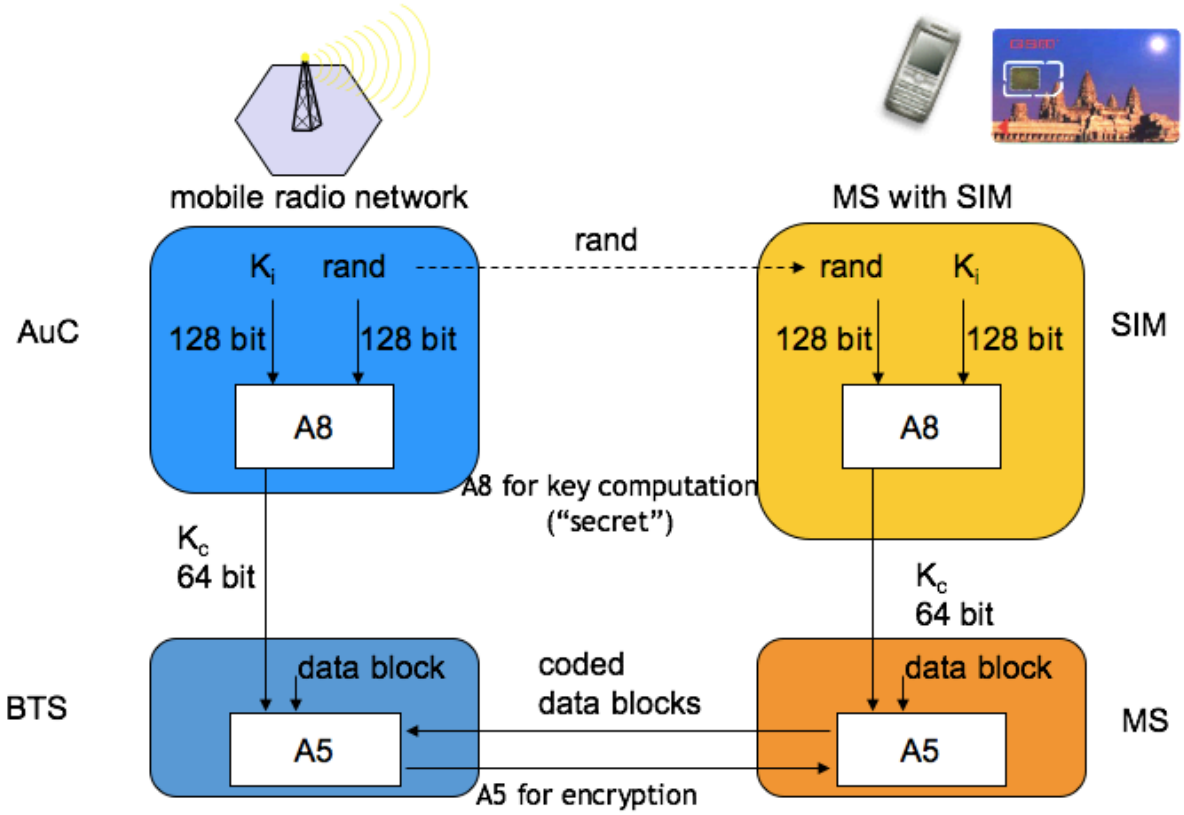
- New push services require new security concepts, e.g. because of unintentional data reception (& payments for these data).

c) GSM provides encryption of voice and data transferred via the air interface. The following illustration shows how this is done. However, important information is missing. Five question marks indicate lines with missing information – please add the missing information to the figure on these five lines and give a detailed step-by-step description of how the encryption of voice and data transferred is achieved (five steps). **(10 points)**



Answer

AuC creates random number rand.
AuC generates the key Kc for the encryption of the transferred data via rand, Ki and A8.
From the two pieces of information VLR transfers only the rand to the SIM.
SIM computes the key Kc using A8, the rand received, and the local Ki
Mobile station and mobile radio network use generated Kc and algorithm A5 for encryption and decryption of sent and received data.



d) Describe three potential application cases, for which 5G networks will become applicable. **(3 points)**

Answer

- Autonomous driving/Connected cars
- Wireless cloud-based office/Multi-person videoconferencing
- Machine-to-machine connectivity (M2M)
    - vehicle telemetric systems (a field which overlaps with Connected cars above)
    - 'connected home' systems (e.g. smart meters, smart thermostats, smoke detectors)
        - consumer electronics and healthcare monitoring.
- Virtual Reality/Augmented Reality/Immersive or Tactile Internet

e) Name two of the necessary components of a Push Email Service. **(2 points)**

Answer

- "Always-on" technology for transmitting new emails by "pushing" them to a mobile device, once they arrive, providing seamless over-the-air synchronization
- Needs a special server software to get emails from a standard email server (using POP3, IMAP, etc.) and push them to the recipient's device

f) Name and briefly describe the two Voice over IP protocols. **(4 points)**

Answer

H.323

- Based on H.320, known from ISDN videoconferencing systems. Without video encoding, H.323 is

used for VoIP.
- Complex, monolithic defined multimedia-concept.
- Limited to telephony- and videoconferencing systems.
- High maturity level (long development history)

SIP

- Based on Internet technologies.
- Seamless integration into the Internet protocol architecture is possible.
- Is limited to signalling an incoming call
- Can be used with other protocols for different purposes. Besides VoIP, SIP can also be used for instant messaging applications.

5. Trusted Mobile Devices (8 points)

1. Name five of the equipment (mobile) identifiers highlighted in the lecture. **(5 points)**

Answer
- IMEI ("international mobile equipment identity")
- IMSI („international mobile subscriber identity")
- Apple Unique Device Identifier (UDID) Combination of 40 numbers and letters
- Google Android ID - Can be changed by user with factory reset
- Trusted Platform Module (TPM)

2. Name six types of mobile market players. **(3 points)**

Answer
- Mobile equipment manufacturers (Mobile) Telecom Operators
- MVNO's
- Content providers
- Application service providers
- Private customers
- Corporate buyers
- Corporate users
- Intelligence agencies

6. Diffusion of Technology (11 points)

a. There are different models to explain the diffusion of technology into the market. One of them is Roger's Diffusion of Innovation (DOI). Name the other two mentioned in the lecture. **(2 point)**

Answer
Theory of Reasoned Action (TRA)
Technology Acceptance Model (TAM)

b. Diffusion of Innovations (DOI) describes the process by which an innovation is accepted by a social system, e.g. a market. The Diffusion of Innovations theory describes the key innovation characteristics that influence the adoption process. Name and explain three key innovation characteristics and provide one example for each characteristic from the innovation adoption of mobile telephony. **(9 points)**

Answer:

Relative Advantage:

- The degree to which the innovation is perceived as being better than the practice it supersedes
- Availability/reachability of the subscriber,
- Communicate (almost) anywhere / anytime,
- Personal device(s)

Compatibility:

- The extent to which adopting the innovation is compatible with what people do
- High compatibility in society, as flexibility and reachability get more and more important.

Complexity:

- The degree to which an innovation is perceived as relatively difficult to understand and use
- Low to medium:
    - Basic functionality (e.g. telephony) can be used by everyone being capable of using a standard, fixed-line telephone.
    - Advanced features (e.g. SMS) need further training to use them.

Trialability:

- The degree to which an innovation may be experimented with on a limited basis before making an adoption (or rejection) decision
    - High: A potential customer can subscribe to a prepaid contract for testing the technology and later on switch to a "normal" subscription based contract.

Observability:

- The degree to which the results of an innovation are visible to others
- Reachability of the customers anytime and anywhere.
- More and more people are using mobile phones and services.
- People using mobile phones can easily be observed by non-users.
- The concept and benefit of mobile telephony is easily observable by non-users.