mobile business

Lecture 14

Exam Preparation Session
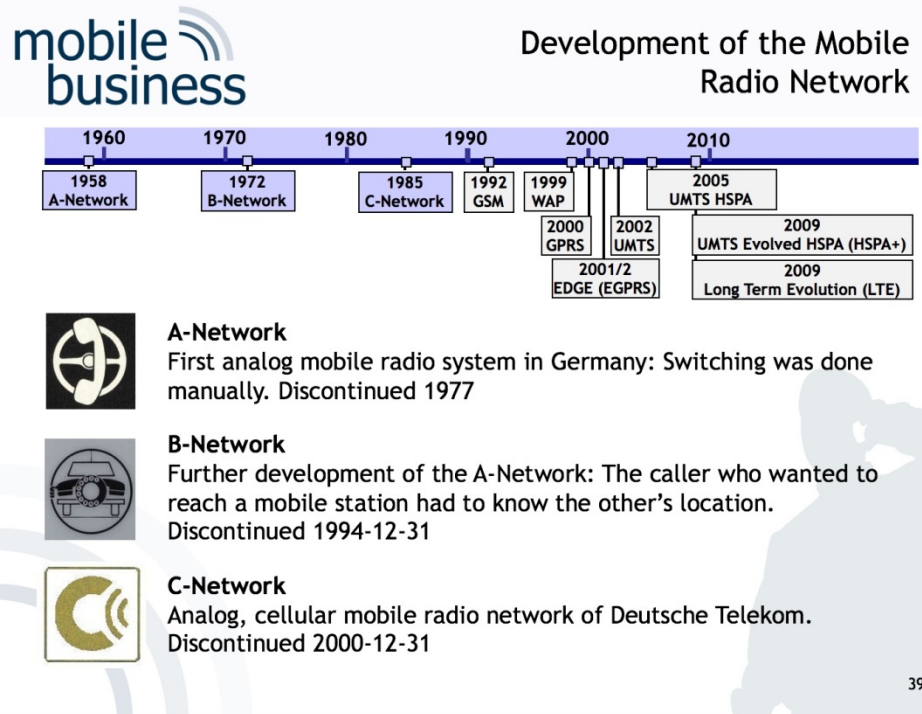
Mobile Business I (WS 2016/17)

Prof. Dr. Kai Rannenberg

Deutsche Telekom Chair of Mobile Business & Multilateral Security
Johann Wolfgang Goethe University Frankfurt a. M.

[Source: T-Mobile]

- Q: *On lecture topic 1/slide 39 its said for the B-network that the caller who wanted to reach the mobile station had to know the others location, however on lecture topic 2/slide 15 the same is said for the A-Network. For which of the networks does the information apply now?*

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Development of the Mobile Radio Network

1960	1970	1980	1990	2000	2010

- **1958** A-Network
- **1972** B-Network
- **1985** C-Network
- **1992** GSM
- **1999** WAP
- **2000** GPRS
- **2002** UMTS
- **2001/2** EDGE (EGPRS)
- **2005** UMTS HSPA
- **2009** UMTS Evolved HSPA (HSPA+)
- **2009** Long Term Evolution (LTE)

A-Network
First analog mobile radio system in Germany: Switching was done manually. Discontinued 1977

B-Network
Further development of the A-Network: The caller who wanted to reach a mobile station had to know the other's location. Discontinued 1994-12-31

C-Network
Analog, cellular mobile radio network of Deutsche Telekom. Discontinued 2000-12-31

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Mobile Telecommunication Infrastructures – History

- **1st mobile radio network in Germany: "A-Netz"**
  - Started in 1958 – decommissioned in 1977
  - Analogue network (Manual switching of calls, frequency range 150 MHz)
  - Price of terminal: 8.000-15.000 DM
  - For a call, the caller has to know the location of the callee (range from 30 to 50 km radius).

- **2nd mobile radio network in Germany: "B-Netz"**
  - Started in 1972 – decommissioned in 1994
  - Analogue network (Automatic dial switching by area code)
  - Caller needs to know the area code of callee
  - Terminal prices comparable with those of the A-Network

15

Q: *Could you please briefly describe the GSM System architecture from lecture No. 2?*
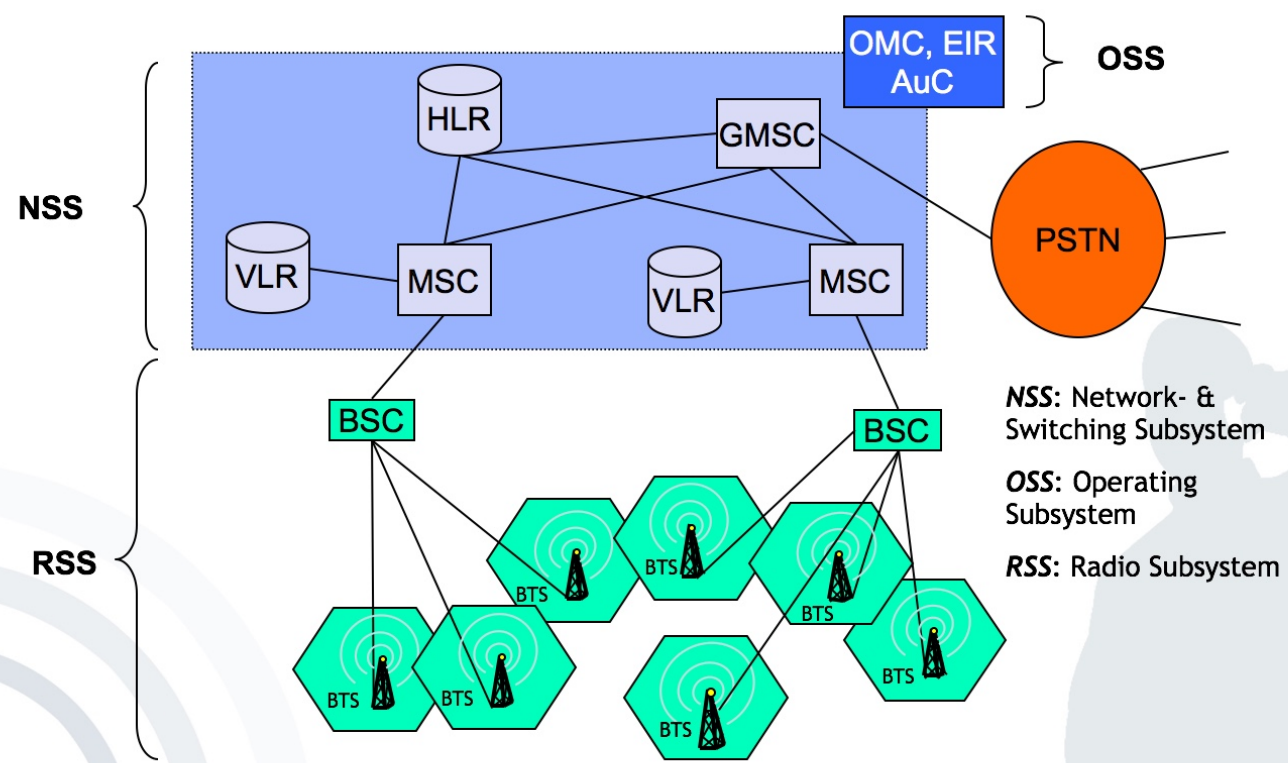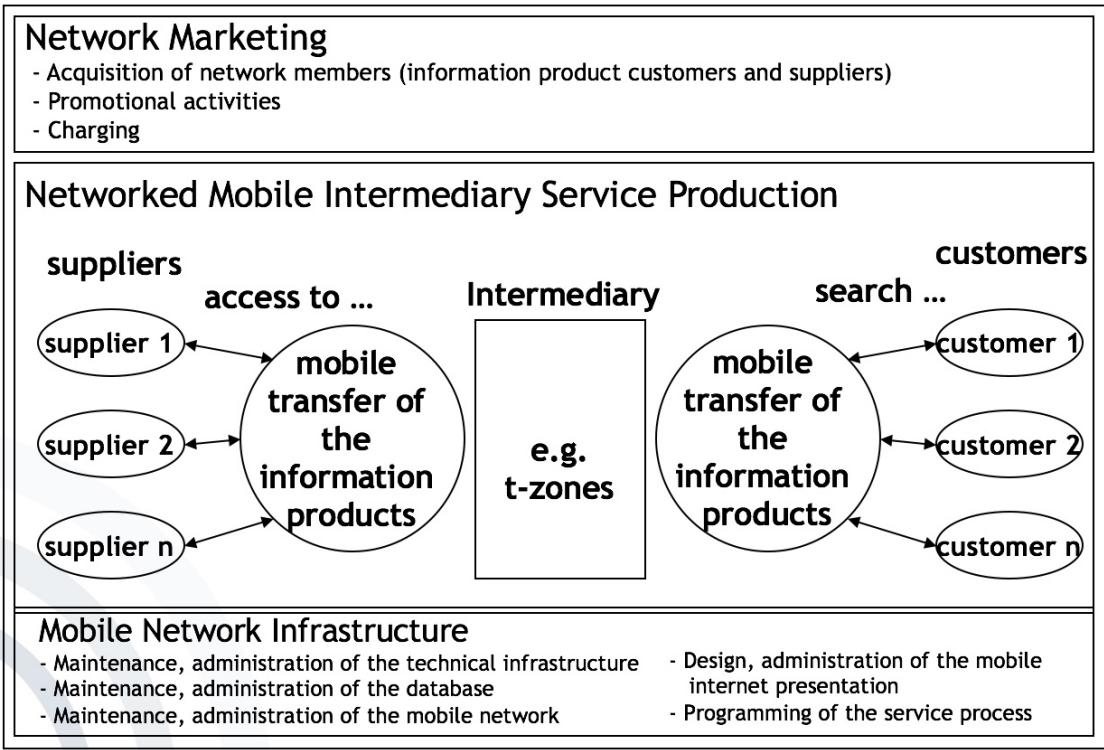
Q: *Do we have to remember the different data rates and bandwidths within the GSM, UMTS and LTE infrastructures? (Was questioned in a former exam)*

Q: *lecture topic 6/slide 42 and 44: What is the underlying rationale of these slides?*
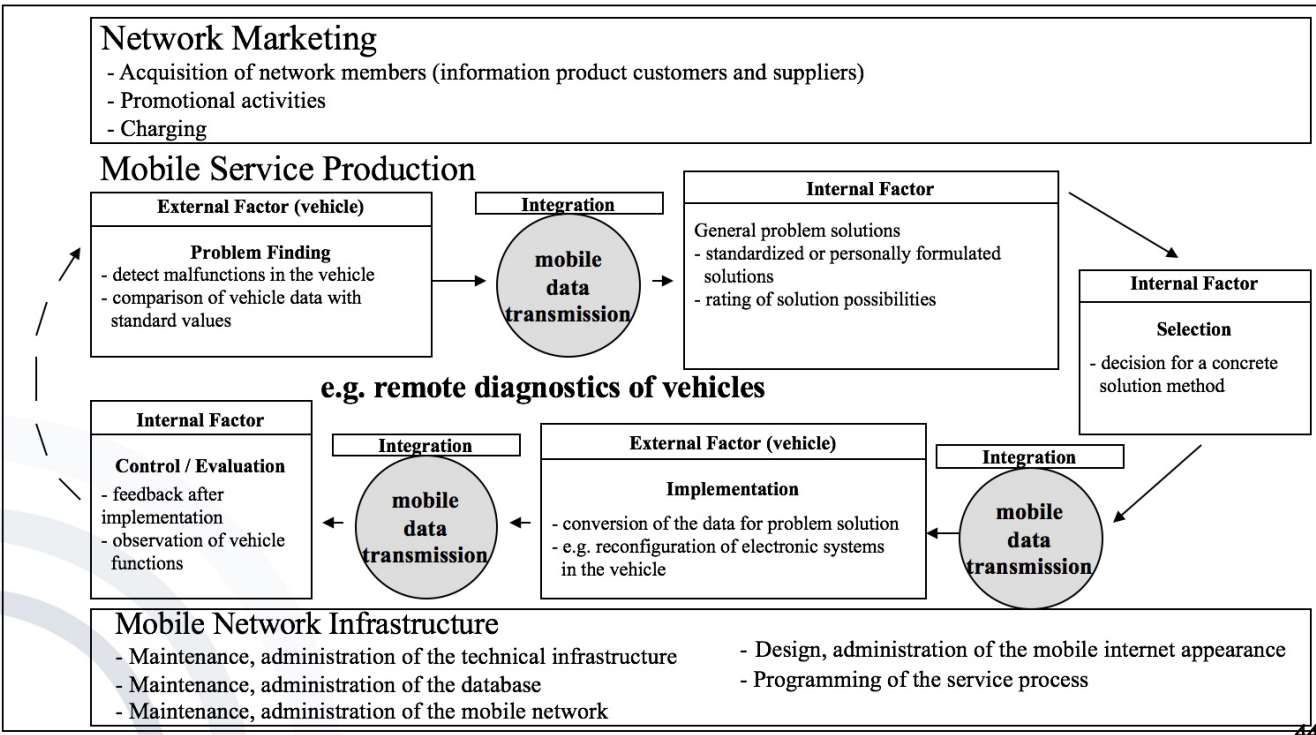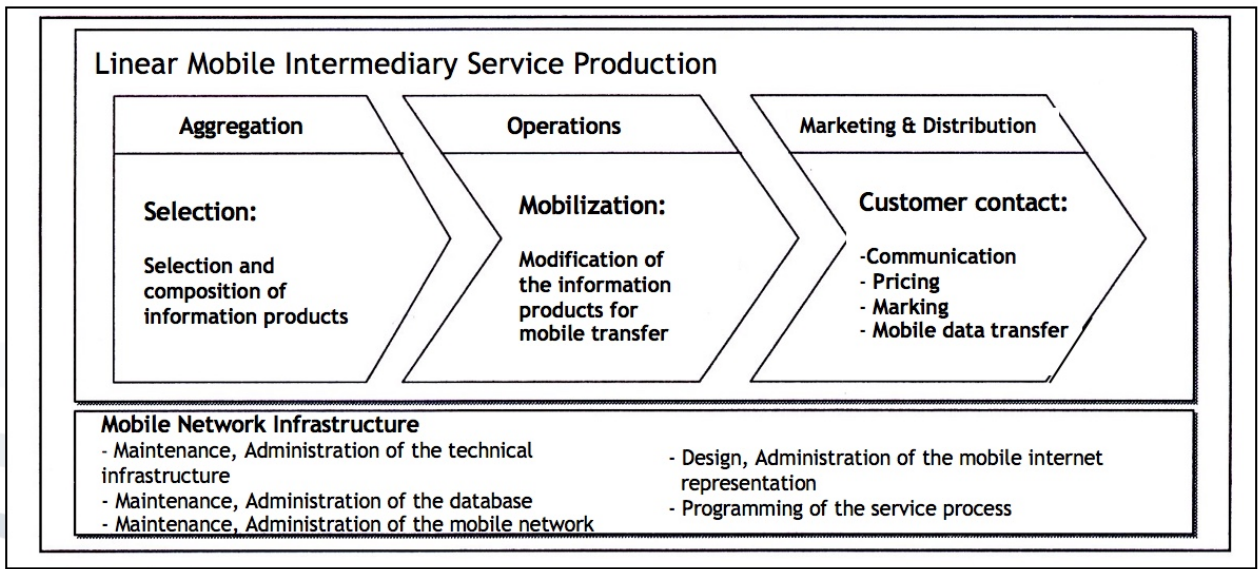
Value Creation

- Value network

[ReicMeieFrem2002]

Network Marketing
- Acquisition of network members (information product customers and suppliers)
- Promotional activities
- Charging

Networked Mobile Intermediary Service Production

suppliers

access to ...

Intermediary

customers

search ...

supplier 1	mobile transfer of the information products	e.g. t-zones	mobile transfer of the information products	customer 1
supplier 2				customer 2
supplier n				customer n

Mobile Network Infrastructure
- Maintenance, administration of the technical infrastructure
- Maintenance, administration of the database
- Maintenance, administration of the mobile network

- Design, administration of the mobile internet presentation
- Programming of the service process

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8

Value Creation

- **Value added shop**   [ReicMeieFrem2002]

Network Marketing
- Acquisition of network members (information product customers and suppliers)
- Promotional activities
- Charging

Mobile Service Production

External Factor (vehicle)

Problem Finding
- detect malfunctions in the vehicle
- comparison of vehicle data with standard values

Integration
mobile data transmission

Internal Factor
General problem solutions
- standardized or personally formulated solutions
- rating of solution possibilities

Internal Factor

Selection
- decision for a concrete solution method

e.g. remote diagnostics of vehicles

Internal Factor

Control / Evaluation
- feedback after implementation
- observation of vehicle functions

Integration
mobile data transmission

External Factor (vehicle)

Implementation
- conversion of the data for problem solution
- e.g. reconfiguration of electronic systems in the vehicle

Integration
mobile data transmission

Mobile Network Infrastructure
- Maintenance, administration of the technical infrastructure
- Maintenance, administration of the database
- Maintenance, administration of the mobile network
- Design, administration of the mobile internet appearance
- Programming of the service process

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Q: *Are the value creation figures from "lecture 6", e.g. p 39, 44, 46 required for the exam, or should we more likely know the major differences and their applicability?*
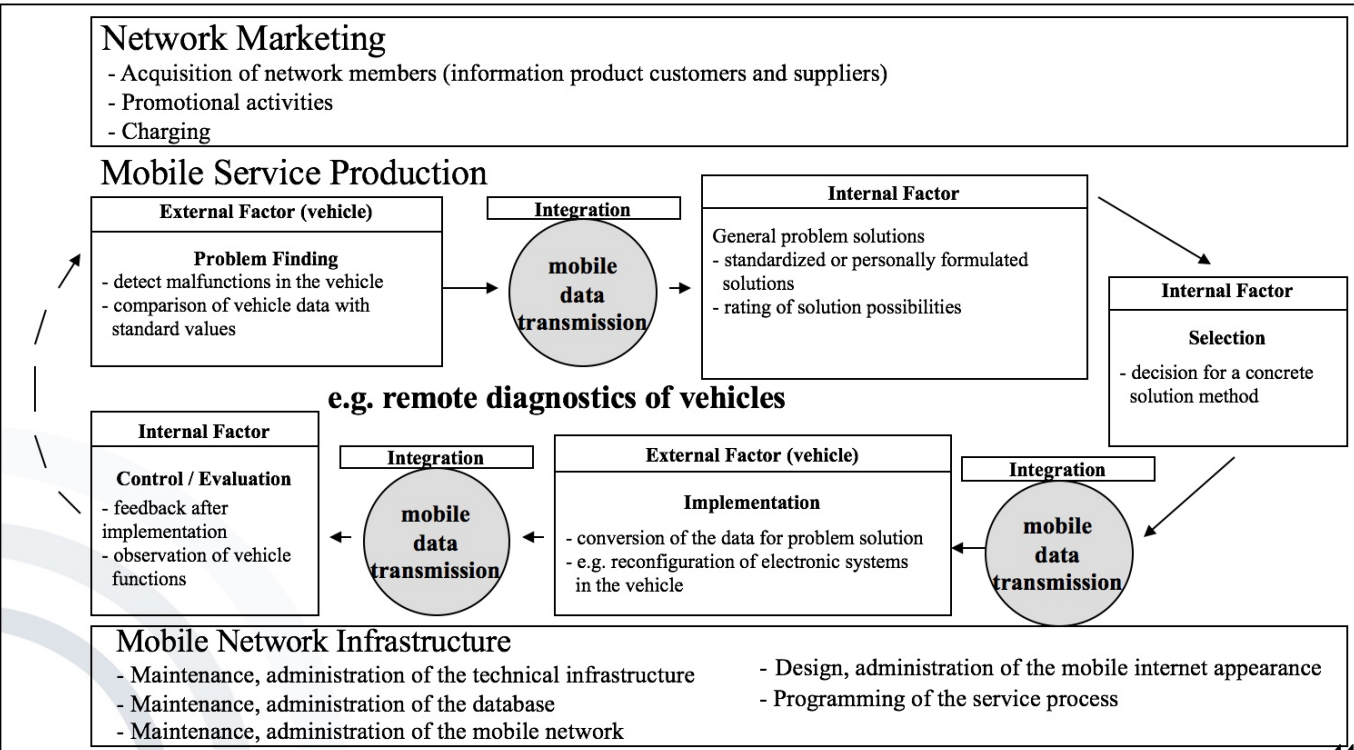
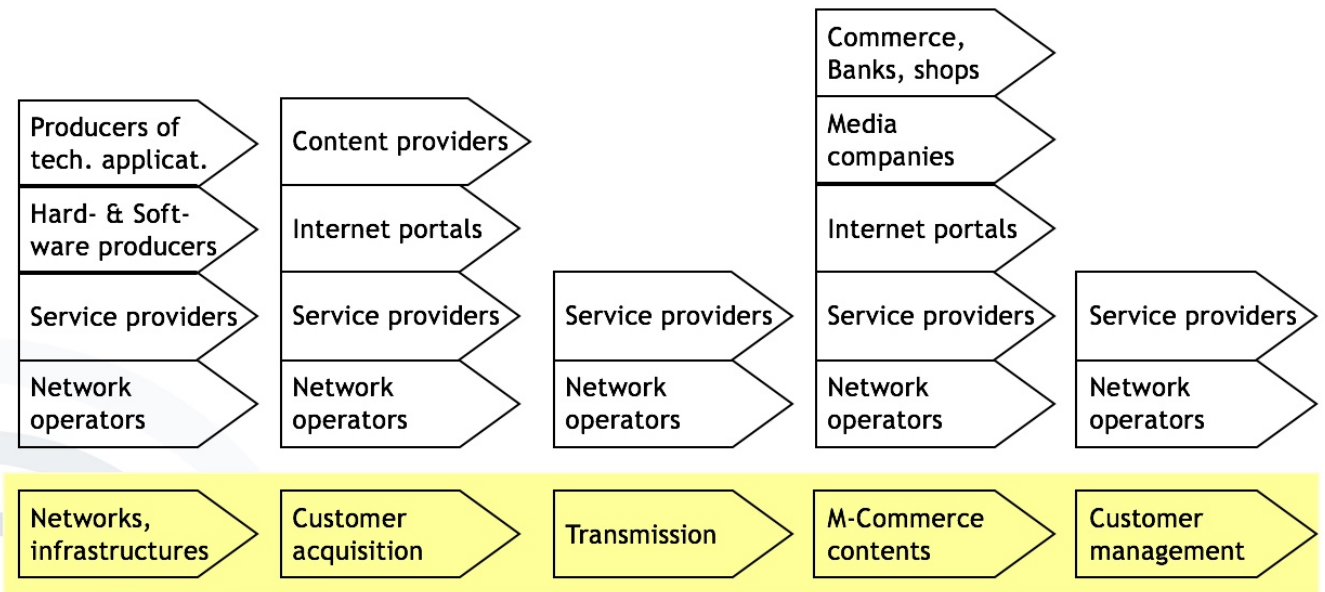## Value Creation

- Modified value chain

Linear Mobile Intermediary Service Production

Aggregation	Operations	Marketing & Distribution
Selection: Selection and composition of information products	**Mobilization:** Modification of the information products for mobile transfer	**Customer contact:** -Communication - Pricing - Marking - Mobile data transfer

Mobile Network Infrastructure
- Maintenance, Administration of the technical infrastructure
- Maintenance, Administration of the database
- Maintenance, Administration of the mobile network
- Design, Administration of the mobile internet representation
- Programming of the service process

[ReicMeieFrem2002]
39

Value Creation

- **Value added shop** [ReicMeieFrem2002]

Network Marketing
- Acquisition of network members (information product customers and suppliers)
- Promotional activities
- Charging

Mobile Service Production

External Factor (vehicle)

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mobile data transmission

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e.g. remote diagnostics of vehicles

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mobile data transmission

External Factor (vehicle)
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Integration
mobile data transmission

Mobile Network Infrastructure
- Maintenance, administration of the technical infrastructure
- Maintenance, administration of the database
- Maintenance, administration of the mobile network
- Design, administration of the mobile internet appearance
- Programming of the service process

44

Value Creation

- **M-value chain**

[PicotNeuburg2002]

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Q: *In which detail must all the different Value Chain concepts be studied? Are there main concepts or should all introduced types of value chains be known in detail? What are the implications for the market structure from "many providers in 2nd row"? (Slide 34)*

Q: *What is meant by disintegration of 1st & 2nd-tier structure? Slide 35*

⮑ Few mobile network operators, many customers

■ Heterogeneous oligopoly (Gutenberg)

- A heterogeneous oligopoly is a market form, in which a market or industry is dominated by a small number of middle-sized sellers with heterogeneous products
- Many (small-sized) customers

Based on [Wied-Nebbeli1997]

- Heterogeneous oligopoly (Gutenberg)
  - Autonomous price interval, in which the respective organisation (operator) can operate…
    - without losing customers to the business competition due to rise in price
    - without acquiring customers from business competition due to cut in price
  - Within price interval only latent increase and loss of demand, e.g. because of switching costs

Based on [Wied-Nebbeli1997]

Autonomous price interval

pcf

p

x
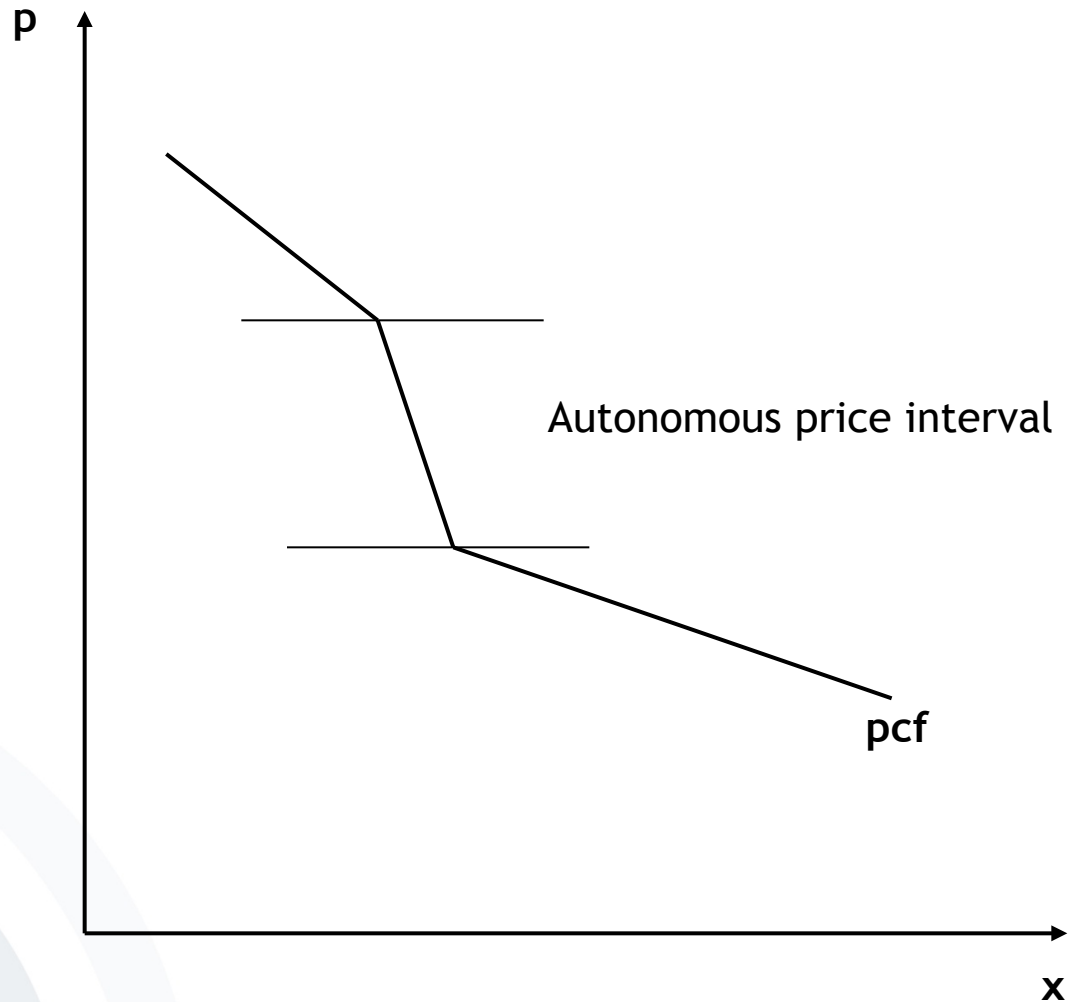
- **Heterogeneous oligopoly (Gutenberg)**
  - Leaving this price interval leads to migration of customers:
    - Prices above price barrier lead to latent and fluctuating loss in demand
    - Reduction in price below the barrier lead to latent increase in demand
  - … as long as competitors do not change prices

  ➲ Partial interdependency

- **Till 2005**
  The mobile market had few network operators (MNOs):
  T-Mobile, Vodafone, Telefonica O2 and Eplus

- **Since 2005**
  By the market entry of MVNOs, the mobile market has changed:
    - Few middle-sized providers (four MNOs)
    - Many small providers, e.g. Tchibo mobil, ALDI TALK, simyo, klarmobil, blau.de

- **Since 2009**
  Convergence of mobile providers and fixed-line providers

- **Soon**
  Only three MNOs left

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Telefonica Deutschland's E-Plus takeover faces legal challenge

- 8.6bn € deal announced July 2014
- Set to create one of Germany's largest mobile networks by customer base (not revenue).
- National and pan-European regulatory authorities, were worried that consolidation in the market would lead to higher prices and reduced competition to the detriment of German consumers.
- Telefonica had to agree to initially sell 20 percent of the combined network's capacity to Drillisch (German MVNO). Drillisch is able to acquire a further 10 percent in the future.
- The concessions are seen as a way to restore competition, giving smaller network carriers the chance to balance the market.
- German regional wireless operator Airdata has challenged the EU's approval of Telefonica Deutschland's acquisition of E-Plus, saying concessions offered to allay competition concerns did not go far enough.
- The European Commission, which cleared the deal, said it would defend its decision in court. The last successful appeal against a merger finding was in 2002.
- The LTE networks will be merged this year which leads to a higher coverage

http://www.zdnet.com/telefonicas-acquisition-of-e-plus-gets-final-approval-from-europe-7000033172/
http://uk.reuters.com/article/2015/06/08/us-germany-telecomunications-m-a-idUKKBN0OO0WH20150608
http://www.7mobile.de/handy-news/o2-und-e-plus-fusion.htm

- ## Price effect:
  - ### Increasing number of sellers (i.e. network operators, MVNOs) in an oligopolistic market ⮱ causes tendency towards competitive market:
    - The price converges to the marginal costs.
    - The output converges to the economically efficient level.
    - Lower MVNO prices due to lower service costs of MVNOs

[Mankiw1999]
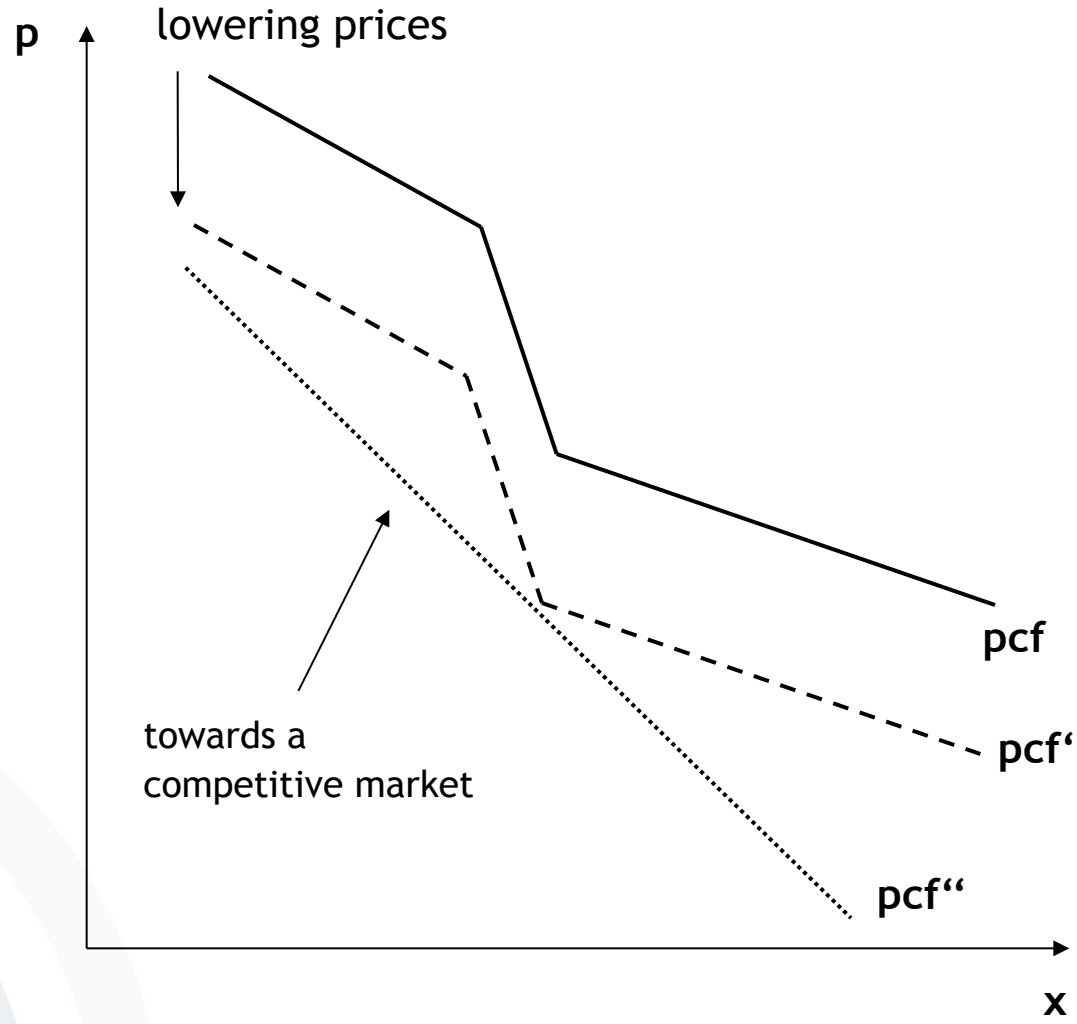
- Also **many providers in the second row** (e.g. content providers)

Considered oligopolistic market

Many customers ↔ Few (mobile) network providers ↔ Many content providers
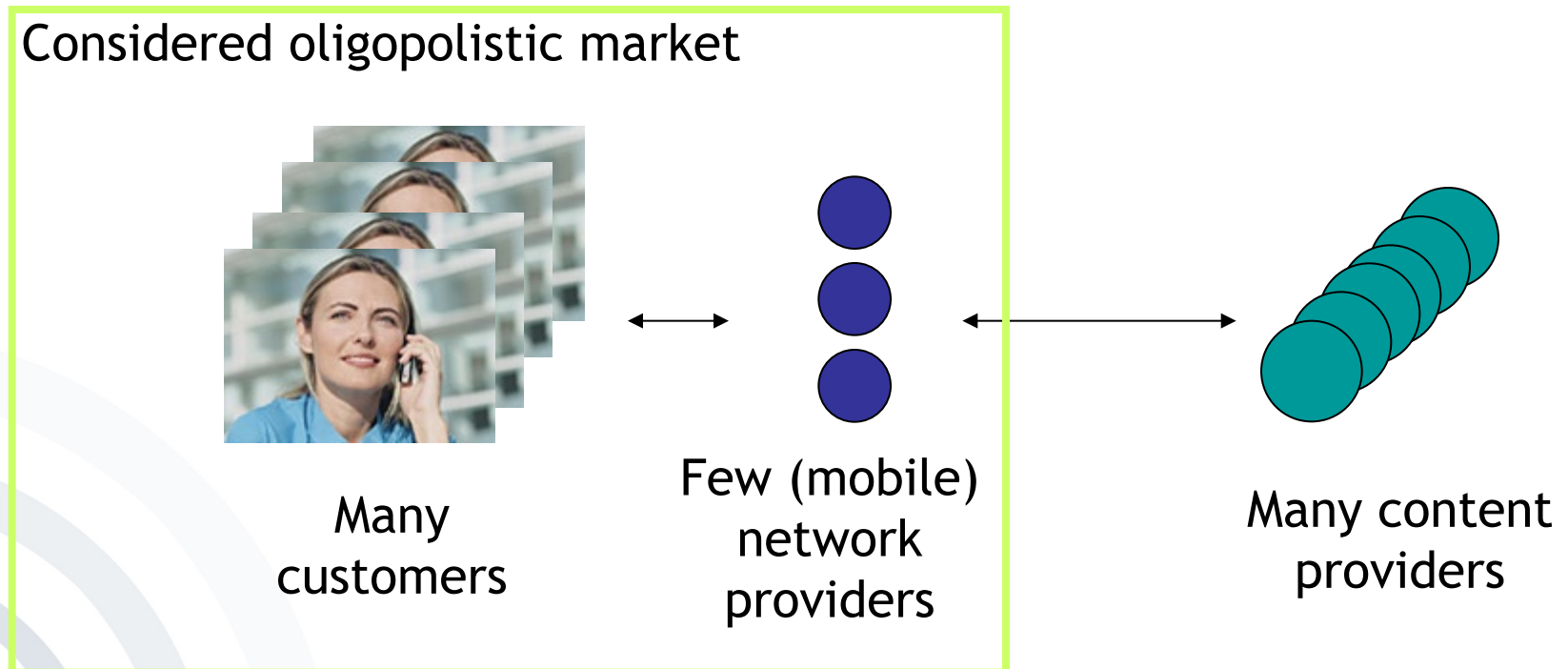
- **Interesting disintegration of 1st-tier-, 2nd-tier-structure**

- Increasing contact between 2nd-tier and customer.

- Q: *lecture topic 7/slide 40: Do we have to calculate in the exam ?*

Classical Business Models: Revenue Models

- **Traditional revenue flows:**
  - **Assumptions:**
    - Customer pays 10€ for 30 MB of data transferred (T-Mobile Data 30)
    - 10% of one million (= 100,000) customers of the operator use **extra services** by a service provider and spend about 20€ per month .
    - 2 million € revenues for the service provider
    - For these services, 30 MB of data transfer is necessary per customer and month
    - ➲ 10 € expenditures per customer and 1 million € revenues for the operator.
    - Service-Provider pays 10% of his receipts as "Service Fee" to the operator.
    - ➲ Revenues of the operator: 1m € + 0,2m € = 1,2m €
    - ➲ Revenues of the service provider: 2m € - 0,2m € = 1,8m €

40

- Q: *lecture topic 7/slide 51: Is there a solution for the question marks on the picture ?*

mobile business

New Business Models: Revenue Models

- New revenue flows

51
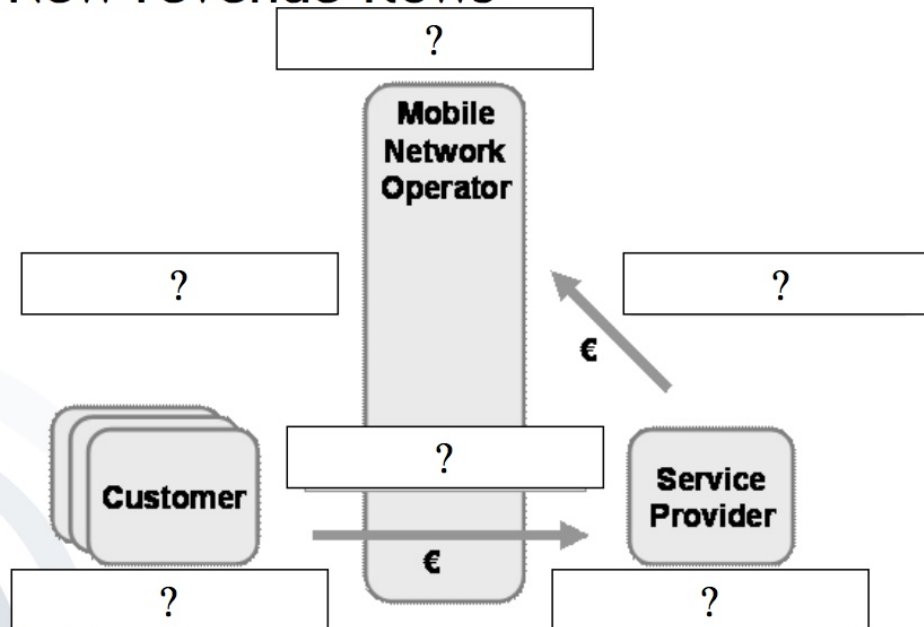
Q1: *Could you please briefly describe the difference between a UICC and a 3G SIM card, especially whether modern Sim cards are also a kind of UICCs?*

Q2: *Could you please highlight once again the difference between "normal" SIM card and USIM? How does the UICC relate to both SIM & USIM?*
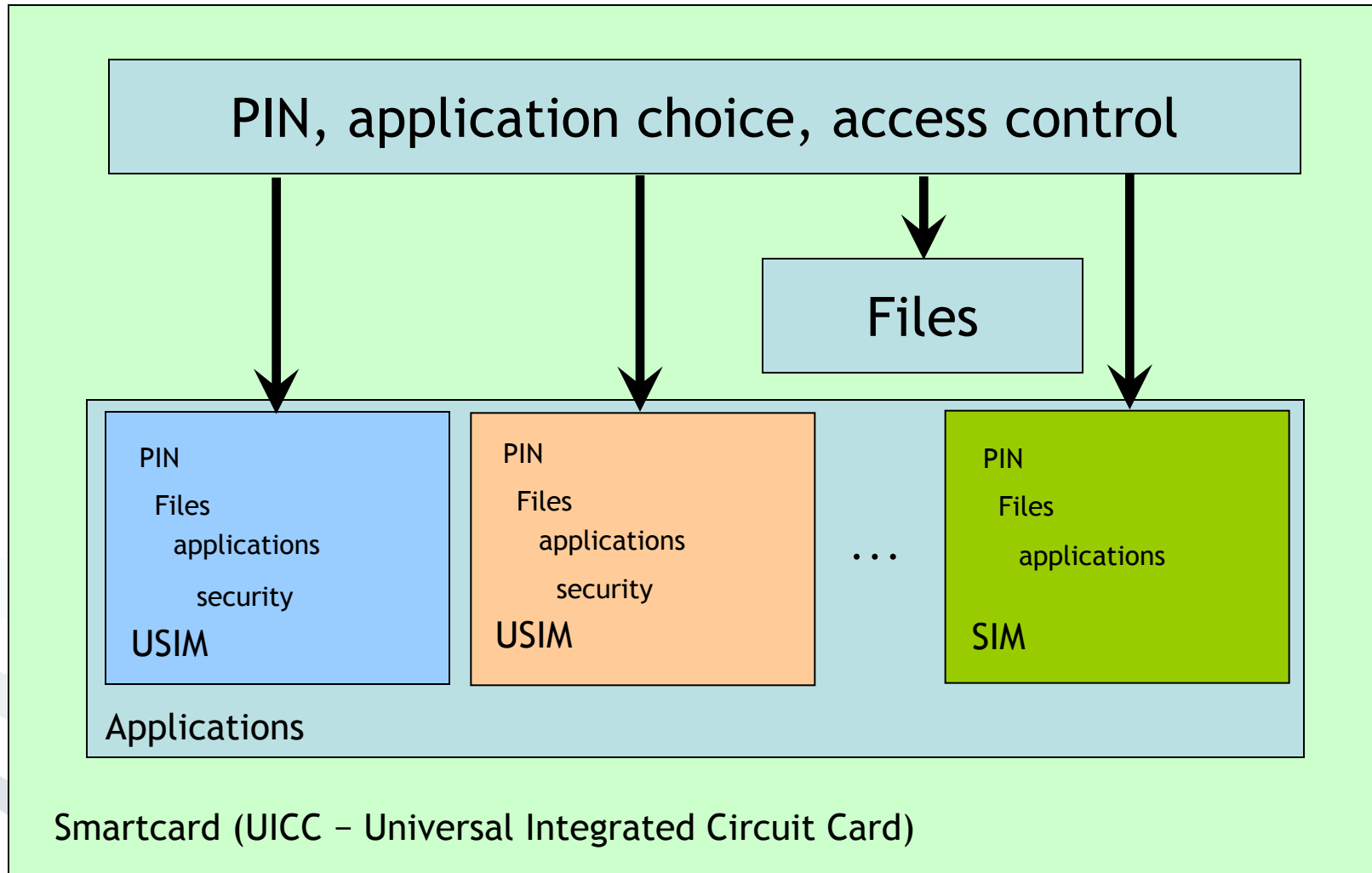
- In GSM and UMTS since 1991, upcoming for WLAN
- **Represents** contract **between subscriber & network operator**
- Authorises **a "phone"** to **use** the network by linking it to a **subscription**
- By November 2016 around **7.9 billion** mobile-cellular subscriptions (forecast to grow to **10 billion** by 2020) [GSMAI2016] vs. **3,9 billion** mobile broadband subscriptions [ITU2016]
- More countries with SIM infrastructure (ca. 239, 2016-Q3) than McDonalds (118, 2016-Q3) and UN-members (193, 2016-Q3) [GSM2016, Wiki2016, UN2016]
- More and more called "Subscriber **Identification** Module" to reflect progress in the general field of **Identity Management**

- **SIM**s are **Smartcards:**
  - **SIM cards** serve as security medium.
  - Tamper-resistance prevents counterfeiting.
  - robust design

- Contain **International Mobile Subscriber Identity (IMSI)** for subscriber identification and the key K_i provided by the mobile operator

- Reliably execute computational functions for the mobile device

cf. [EffingRankl2008]

- SIM serves as „**identity card**" for GSM cellular phone subscribers.

- SIM identifies the **issuer of the card** – important for the **billing of roaming subscribers** by roaming partner.

- SIM allows for **secure billing of roaming subscribers** through SIM-cryptography – important for card issuer.

- SIM contains additional **configuration data** of the GSM system.

- **ETSI GSM 11.11** [GSM2006] specifies electrical as well as software interfaces between SIM and device.
    - A **serial interface is** used for accessing the card.
    - Communication through **SIM commands**
    - Device can access **files** or execute **actions** through SIM commands.
    - „SIM Application Toolkit" allows for implementing of **additional applications** on a SIM.

- Meanwhile SIMs are available in different **form factors**
    - Same size as 'regular' smart cards (Full-size, FF).
    - Mini-SIM (2FF) introduced circa 1996
    - Micro-SIM (3FF) introduced in 2010
    - Nano-SIM (4FF) introduced in 2012

[Wiki2014]

- **Standardised** in 3GPP TS 21.111 and 3GPP TS 31.102 [GSM2006]

- **Successor** of SIM in 3G networks (but 3G networks are downward compatible to many SIMs)

- Supports different „**virtual**" **USIMs** and **SIMs** on one card – i.e. multifunctional smartcard

- Specified as „**UMTS-SIM**", to support authentication, authorisation and computation of future services

- **Support for multiple applications**
- **End-to-end security** from the USIM to the application
- **Authentication of the network** towards the USIM via cryptography
  ➲ **Multilateral Security** is possible!
- **Downward compatible** to SIM
- **Extended phone book** on card:
  - Email addresses
  - Multiple names & numbers for each entry
  - More memory
  - Standardised entries

- **Market entry** of USIM „disguised" **as SIM**
  ➲ UMTS activated by operator

- **Multiple USIMs** – possibly **from competing providers** – can technically coexist on one card. Selection via menu on mobile device
  ➲ Reduction of operator switching cost

- Switching to anonymous prepaid USIM as a privacy option when using privacy sensitive services?

UICCs as Secure Elements

- Secure Elements (SE) are hardware tokens, that offer secure services, e.g. tamper-proof storage and cryptographic operations (cf. Lecture 12).

- UICCs are one form factor of a Secure Element (SE), enabling secure mobile applications and services.

Telekom (D)
1-23456-78900
01230171-3
C/T6   °1

°1
1-23456-78901
23456789-0 A/V3

[DTAG2014]

Q: *Lecture topic 8/slide 26: What is the answer to the question? It has not properly been addressed while in the lecture.*

- **Market entry** of USIM „disguised" **as SIM**
  ➲ UMTS activated by operator

- **Multiple USIMs** – possibly **from competing providers** – can technically coexist on one card. Selection via menu on mobile device
  ➲ Reduction of operator switching cost

- Switching to anonymous prepaid USIM as a privacy option when using privacy sensitive services?

- Q: *IP Multimedia Identity Module: could you please highlight again the various concepts IMPI, IMPU, IMS, Service Profile and their relationship / the setting on the SIM card?*

- An **IP Multimedia Services Identity Module (ISIM)** is an application running on a UICC smart card in a 3G mobile telephone in the IP Multimedia Subsystem (IMS).

- It contains parameters for identifying and authenticating the user to the IMS.

- The ISIM application can co-exist with SIM and USIM on the same UICC making it possible to use the same smartcard in both GSM networks and earlier releases of UMTS.

- It is specified in 3GPP TS 31.103 [3GPP2016] and described in e.g. [GSM2006].

- The ISIM contains:
  - One "IM Private Identity"
  - One or more "IM PUblic Identities"
  - A long-term secret used to authenticate and calculate cipher keys

- The IM **Private** Identity (IMPI)
  - Unique global identifier per IMS subscriber: username@operator.com
  - Assigned by the home network operator
  - Used for e.g. registration, authorisation, administration, and billing
  - Not accessible to the user
  - Only visible to control nodes inside the IMS
  - One ISIM application includes only one IMPI – but an IMS user may have several UICC cards carrying an ISIM application or a UICC card with several different ISIM applications.

- IM **PUblic** Identities (IMPUs)
  - Every IMS subscriber has one or more IMPUs, e.g. user@operator.com, or tel:+1-212-555-12345.
  - Used for requesting communications to other users
  - Visible to the outside, e.g. to be shown on a business card

- # Service Profile
  - identifies the services a user may currently use such as video telephony, VoIP, Presence
  - defined and maintained in the Home Subscriber Server (HSS) of the subscriber's home network

- # Home domain name
  - The ISIM application stores the home domain name of the subscriber securely.
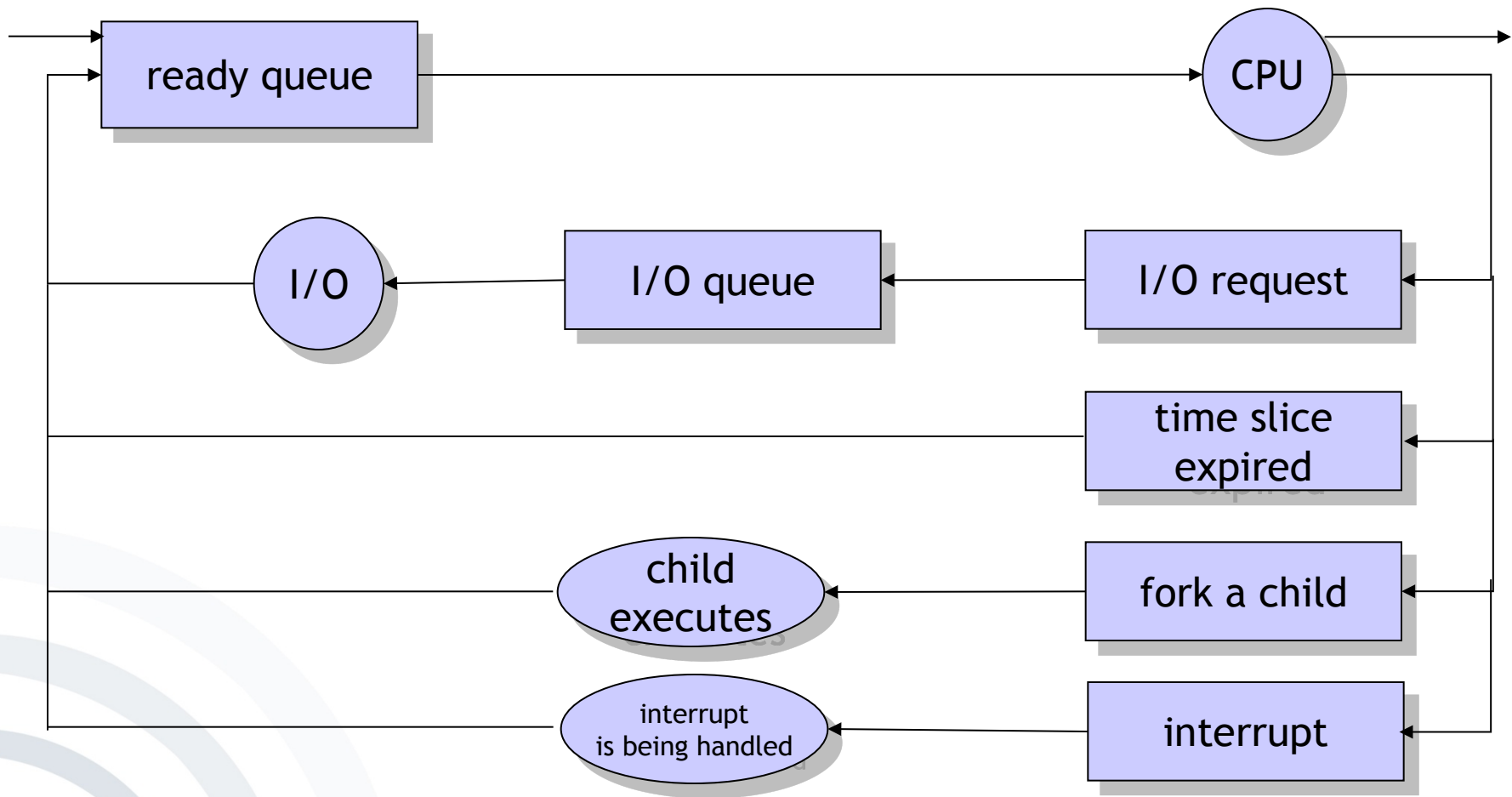 - This can not be changed or modified.
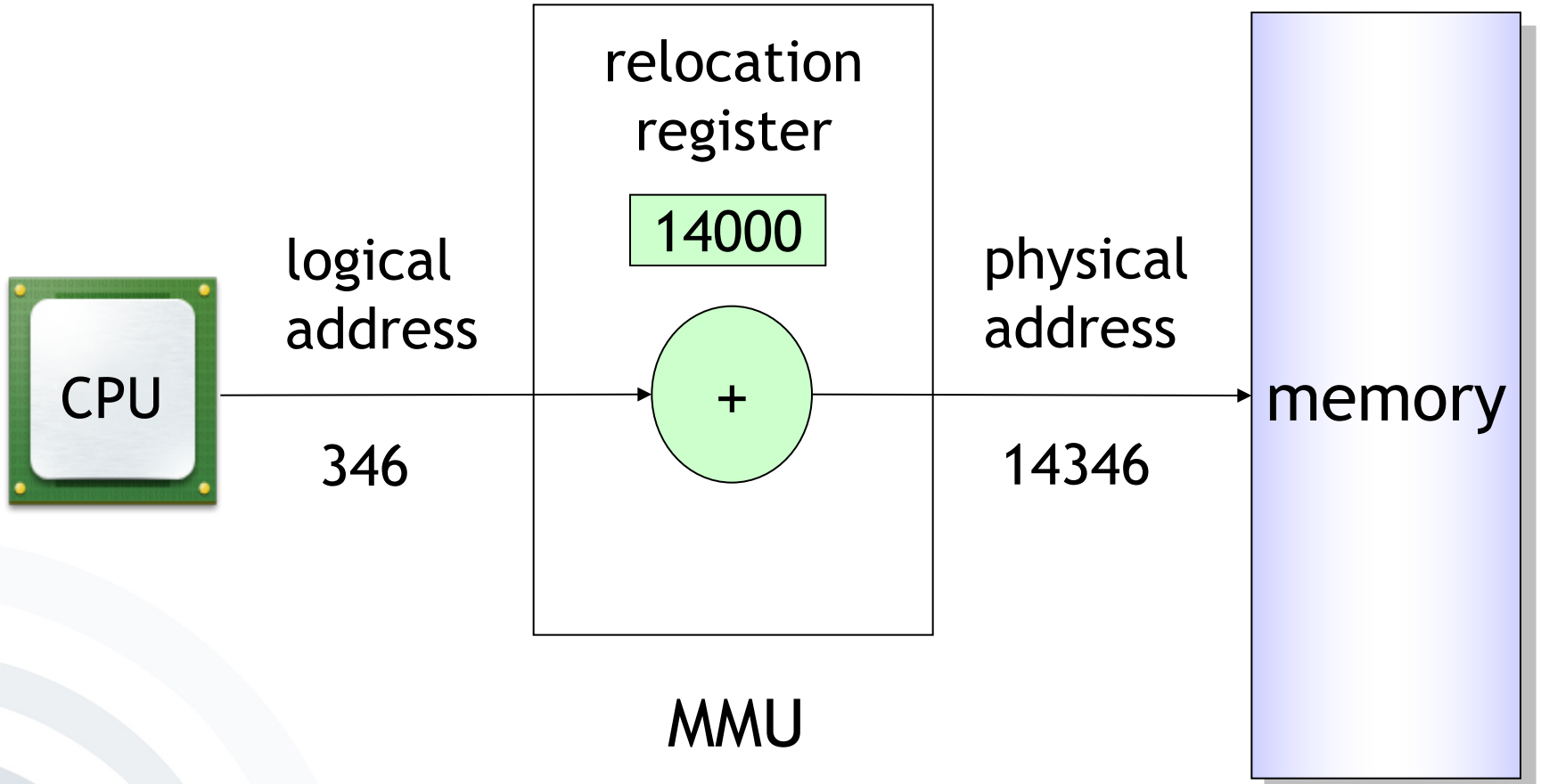
IMPU 1

IMPI 1

IMPU 2

IMPI 2

IMPU 3
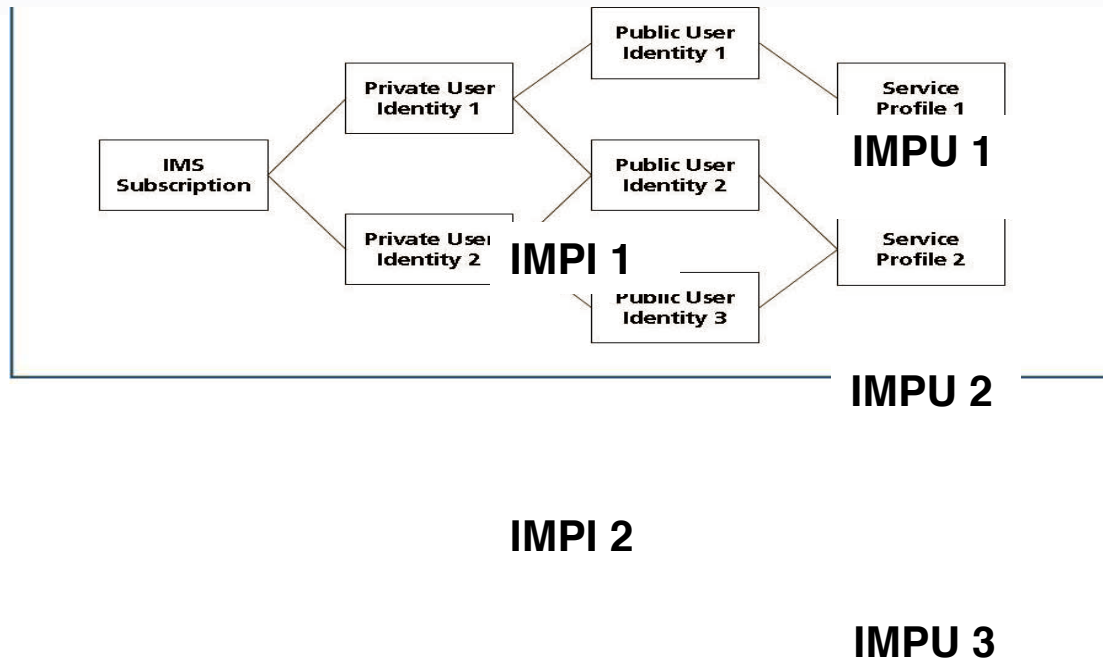
- In case of more than one IMS subscription, there may be a many-to-many mapping of IMPIs to IMPUs.
- Each IMPU is assigned exactly one Service Profile, but a Service Profile may be assigned to more than one IMPU.
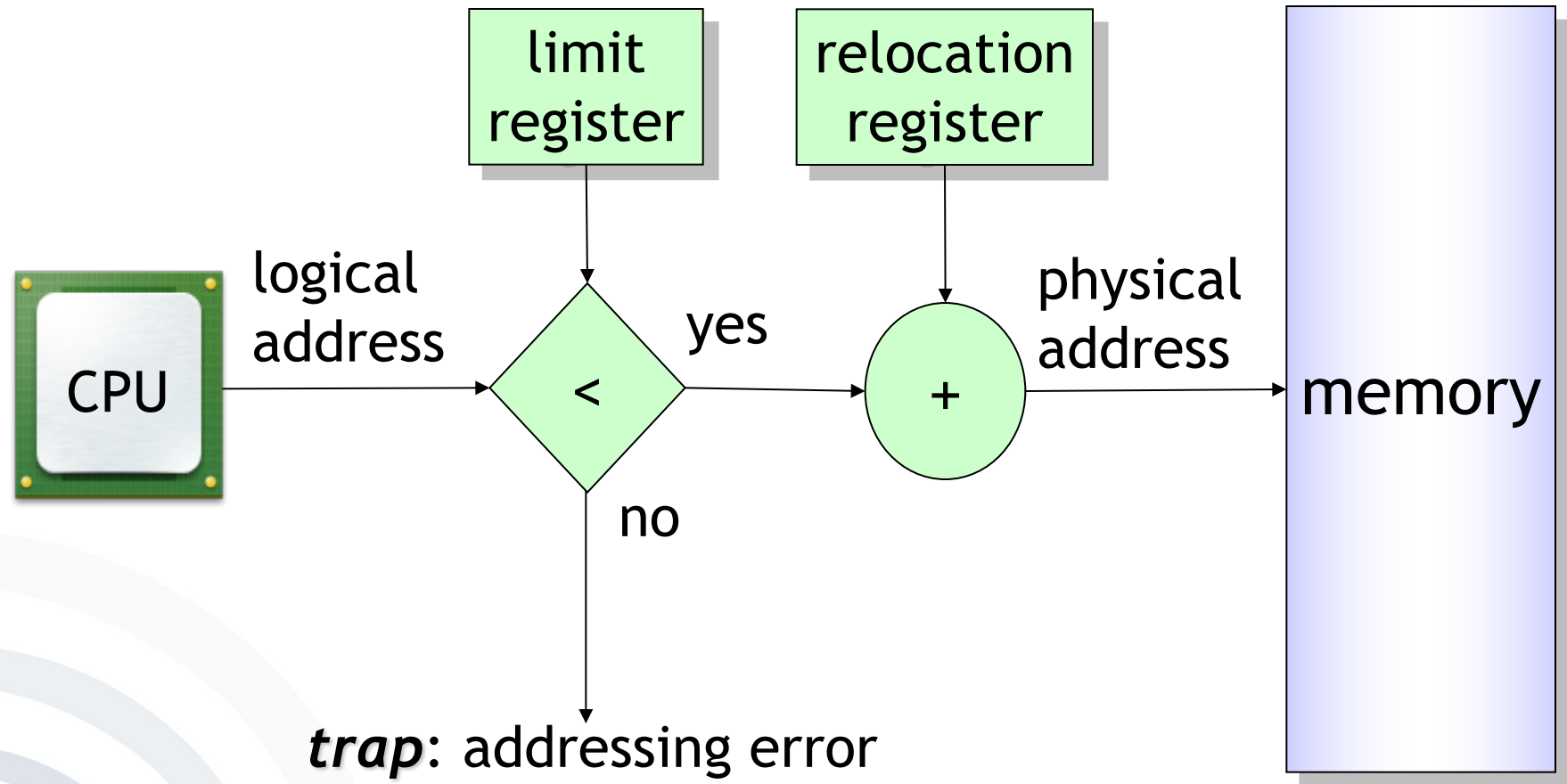
Q: Lecture No. 10 deals with concepts of mobile OS, I would like to know whether such schemes like „scheduling in queues p.16", or figures of processes like mapping, paging etc. are important to remember for the exam?

based on [SilberGalvin1999]

relocation register

14000

logical address

346

CPU

+

MMU

physical address

14346

memory

[SilberGalvin1999]

mobile business

limit register

relocation register

CPU

logical address

yes

<

no

physical address

+

memory

trap: addressing error

logical address

physical address

CPU

| p | d |

| t | d |

physical memory

p {

Search

| f |

Page addresses

page table
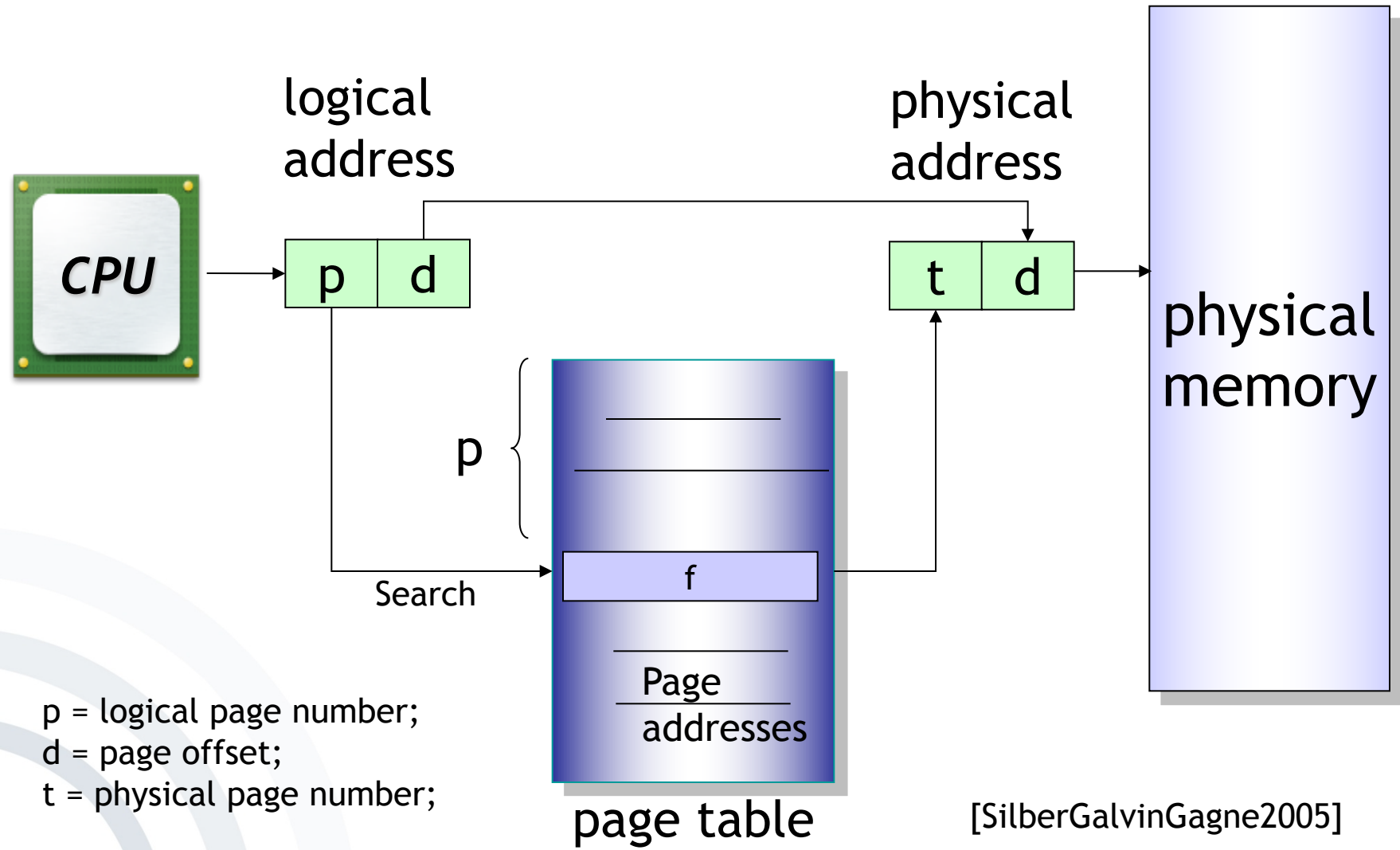
p = logical page number;
d = page offset;
t = physical page number;
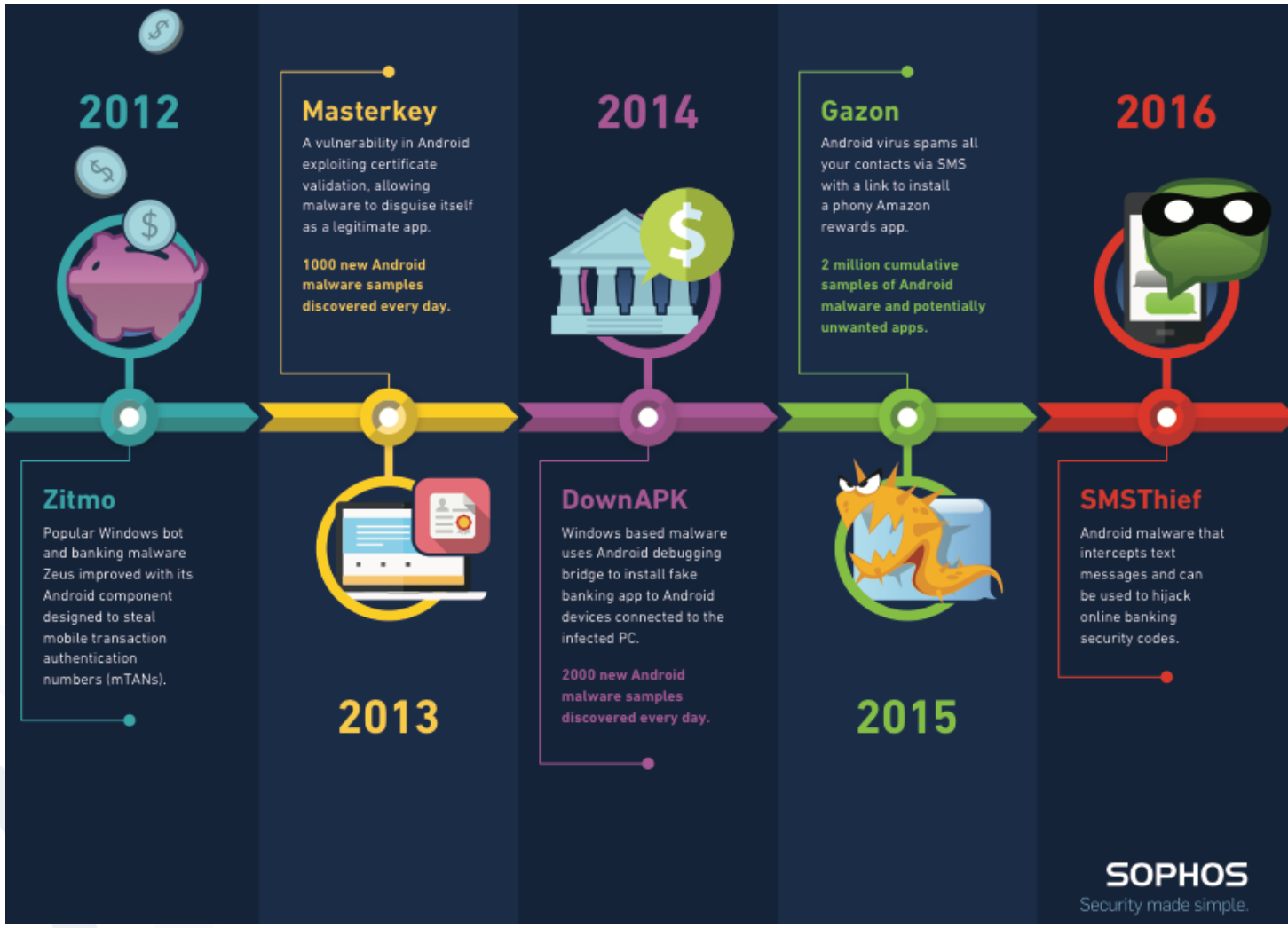
[SilberGalvinGagne2005]

Q: There are several lecture slides which are too blurred to read e.g. lecture topic 12/slide 24 & lecture topic 11/slide 50-54 and therefore can neither be read in digital nor in print: Are they coming up on the exam ? If yes, please provide slides with better quality beforehand.
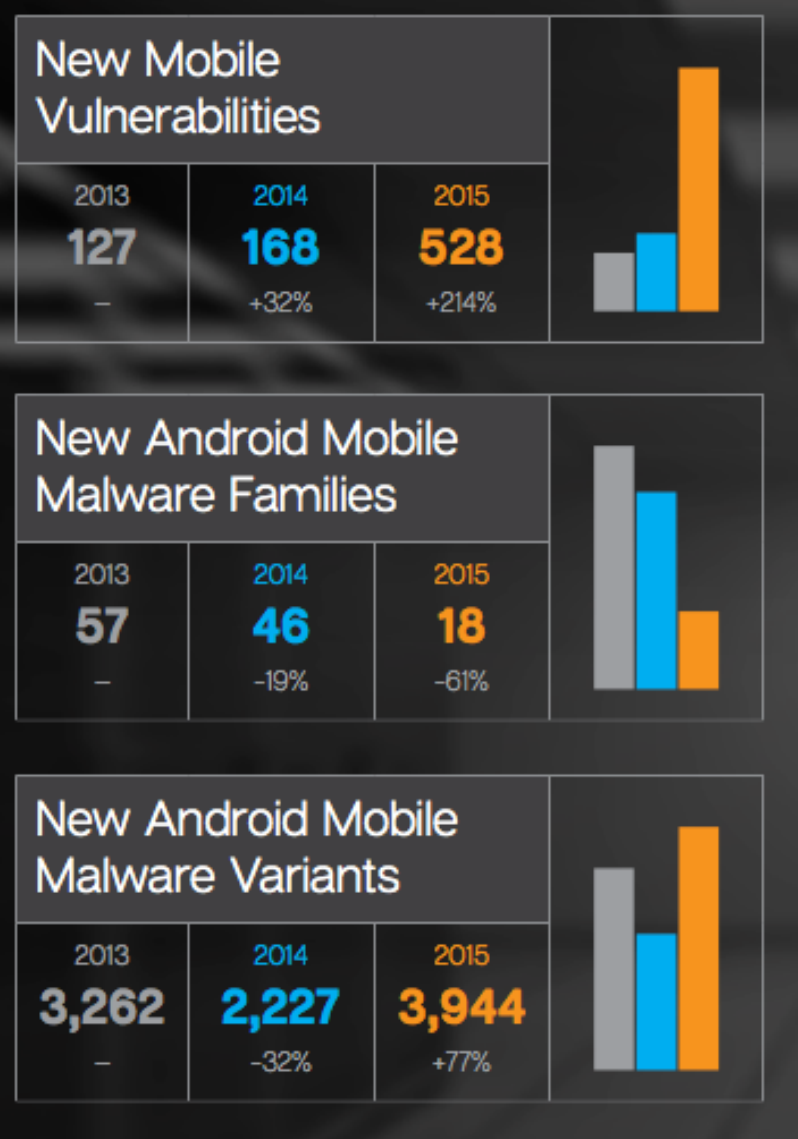
Lecture 11 Slides 50-54

Malware Goes Mobile: Timeline of Mobile Threats, 2004 – 2016

[Sophos2016]

mobile business

2004

Ikee and Duh
Worms affecting jail-broken iPhones using Cydia app distribution system due to a hard-coded password in sshd.

2010

DroidDream
First large attack on Google Play. Over 50 apps containing a root exploit published on the Android market.

Cabir
First worm affecting Symbian Series 60 phones. Spreads from phone to phone by using Bluetooth OBEX push protocol.

FakePlayer
First malware for Android makes money by sending SMS messages to premium line numbers in Russia.

2009

2011

[Sophos2016]

[Sophos2016]

Mobile threats in numbers

	2013	2014	2015
Total Apps Analyzed	6.1 Million	6.3 Million	10.8 Million
Total Apps Classified as Malware	0.7 Million	1.1 Million	3.3 Million
Total Apps Classified as Grayware	2.2 Million	2.3 Million	3.0 Million
Total Grayware Further Classified as Madware	1.2 Million	1.3 Million	2.3 Million
Malware Definition	Programs and files that are created to do harm. Malware includes computer viruses, worms, and Trojan horses.		
Grayware Definition	Programs that do not contain viruses and that are not obviously malicious, but that can be annoying or even harmful to the user, (for example, hacking tools, accessware, spyware, adware, dialers, and joke programs).		
Madware Definition	Aggressive techniques to place advertising in your mobile device's photo albums and calendar entries and to push messages to your notification bar. Madware can even go so far as to replace a ringtone with an ad.		

New Mobile Vulnerabilities

2013	2014	2015
127	168	528
–	+32%	+214%

New Android Mobile Malware Families

2013	2014	2015
57	46	18
–	–19%	–61%

New Android Mobile Malware Variants

2013	2014	2015
3,262	2,227	3,944
–	–32%	+77%

[Symantec2016]

Lecture 12 Slide 24

DOMAINS	Certification Process	Description	Access Rights (Promptings at execution)
Untrusted	None	LOW Security → High Risk ✓ Helps Developers	- No access to very sensitive functionalities - Regular user promptings for all other sensitive functional groups
Trusted	3rd party certification e.g. UTI/Java Verified	MEDIUM Security → Limited Risk through certification programmes	- Access to most sensitive functionalities - User prompting with options to switch off
Operator/ High Trust	e.g. operator managed certification programme	HIGH Security → Very low Risk through enhanced cert prog, contractual relationship with developer	- Access to all functionalities - No user promptings
Manufacturer	OEM	HIGH Security → Very low Risk through enhanced cert prog, contractual relationship with developer	- Access to all functionalities - No user promptings

[GSM2005]

- *Should we write notes or full sentences in the exam?*
  - → In general you should write as precise as possible.
  - → Whether you choose bullet points or full sentences is up to you, but pay attention to how the question (task) is phrased, e.g. *"describe"*, *"describe briefly"*, *"list"*, *"fill in"*, *etc.*
  - → The number of points is a good indicator (90 points for 90 minutes)

- Please note: the exam must be written in English.
- A calculator is not allowed in the exam
- Put your smartphone away! ☺

Thank you for attending the lecture and

all well-deserved success

in the exam

and

later!