

Privacy vs. Data: Business Models in the digital, mobile Economy

Lecture 2 Mobile Information & Communication Technology

SS 2017

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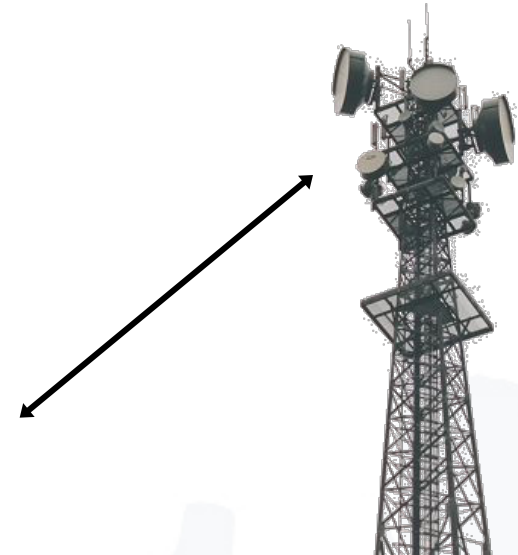
Why is Mobile ICT still in the Center of digitalisation?

- Mobile ICT Innovation becomes highly saturated (e.g. only evolutions rather than revolutions)
- Nevertheless, Mobile ICT (e.g. smartphone) are still a user's „control center“ within a digitalized world.
- Why is that?

- Introduction to Mobile ICT
- Mobile Information & Communication Systems
- Mobile Infrastructure & Ecosystem
- Mobile Information Systems, Apps & Services
- Mobile in the Digitalisation Trend

What is mobile?

- The User?
- The Device?
- The Connection?
- The Information?



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- First digital mobile radio network with high voice quality and reliability (roaming).
- Global diffusion in more than 212 countries with more than 1 billion users.
- In February 2004 the first commercial mobile radio network (based on GSM) was launched in Iraq.
- GSM is the basis of data services like GPRS and EGDE.



Source: Sauter (2008)

- Third-generation (3G) mobile phone technology
- Provides high data transfer rates for multimedia communication services
- Germany's UMTS frequency licenses were sold by auction in 2000 for approx. 50bn €.
- Commercially available in Germany since 2004
- UMTS/3G is the underlying network and the basis of the data services HSPA and HSPA+.



Source: Sauter (2008)

- **LTE:** 100 Mbit/s downlink and 50 Mbit/s uplink speed is possible with the existing LTE technology (LTE-Release 8 User Equipment Category 3).
- **LTE Advanced (from ~2012)** will be backward compatible with LTE, the same frequency band is used.
- **LTE Advanced** will make use of the frequency spectrum more efficiently, resulting in higher data rates (above 100 Mbit/s, towards 1 Gbit/s).
- Like GSM and UMTS/HSPA technologies, **LTE** and **LTE Advanced** are developed by the 3rd Generation Partnership Project (3GPP).



<http://www.3gpp.org/LTE>



<http://www.3gpp.org/LTE-Advanced>



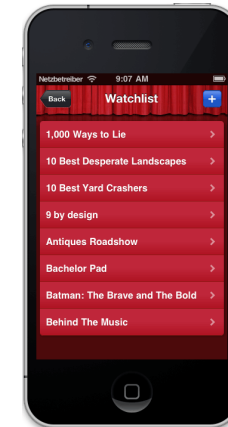
Evolution of Mobile Devices



Mobile Web (Apps) & Apps powering Mobile Devices



Source: prägnanz.de



Source: prägnanz.de





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What is “actually” mobile?

	Stationary wireless	Nomadic wireless	Transportable	Mobile portable
Moving Information	++	++	++	++
Moving device	--	+	+	++
Moving person	--	-	+	++

Legend: ++ applies; -- does not apply



What is “actually” mobile?

- The *stationary wireless* dimension comprises usage contexts in which a mobile user and device are stationary, but information is transmitted via mobile networks (e.g. personal computer attached to Wi-Fi network).
- The *nomadic wireless* dimension represents a stationary, but frequently changing usage context (e.g. mobile sales force person equipped with a notebook).
- The *mobile transportable* dimension encompasses devices, which are connected to transportable objects, but are not moved by the user itself (e.g. car radio, subway TV, etc.).
- The *mobile portable* dimension refers to devices, which are actually carried by users (e.g. mobile phone).



- Time and Location Independence
- “Instant On” of Mobile Devices
- Limited I/O Capabilities
- Location & Context Awareness
- Personal Nature of the Medium
- Identification of Mobile User
- 1:1 Communications
- High Penetration in the Population
- Always On
- Central Media & Communication Hub



What is an Information System?

"A set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and control in an organization."

Source: Laudon, Laudon (2009)



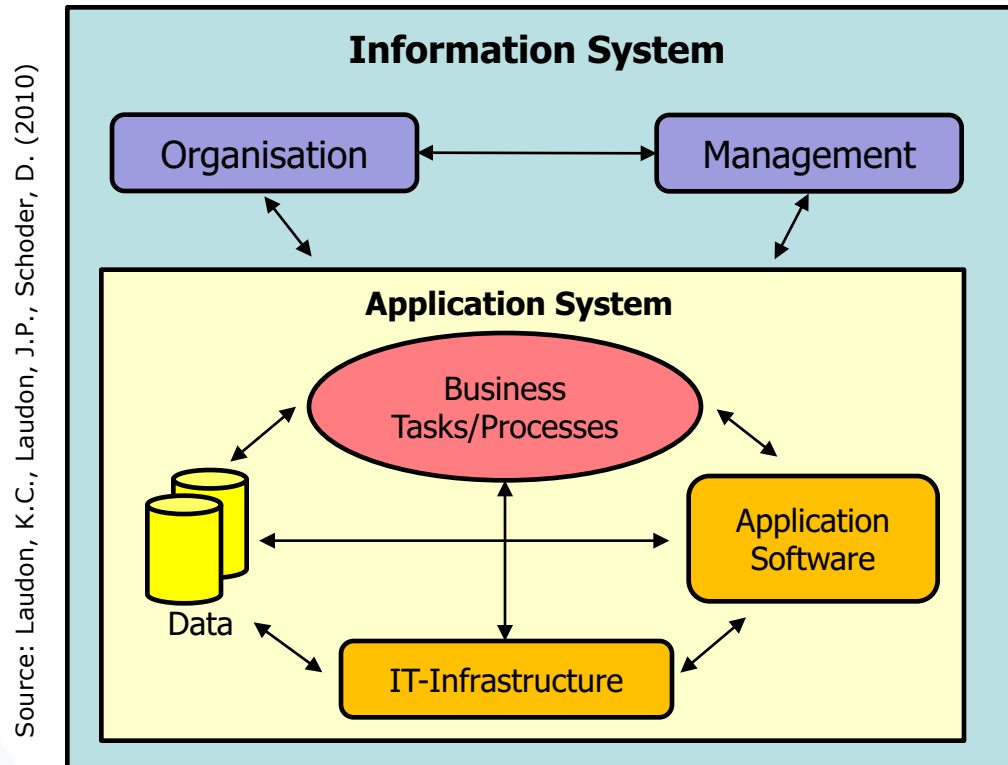
- **Information System (IS):**

A system which was build to be used as part of an enterprise. It contains all relevant application systems and is embedded into the organisation and management of an enterprise.

- **Application System (AS):**

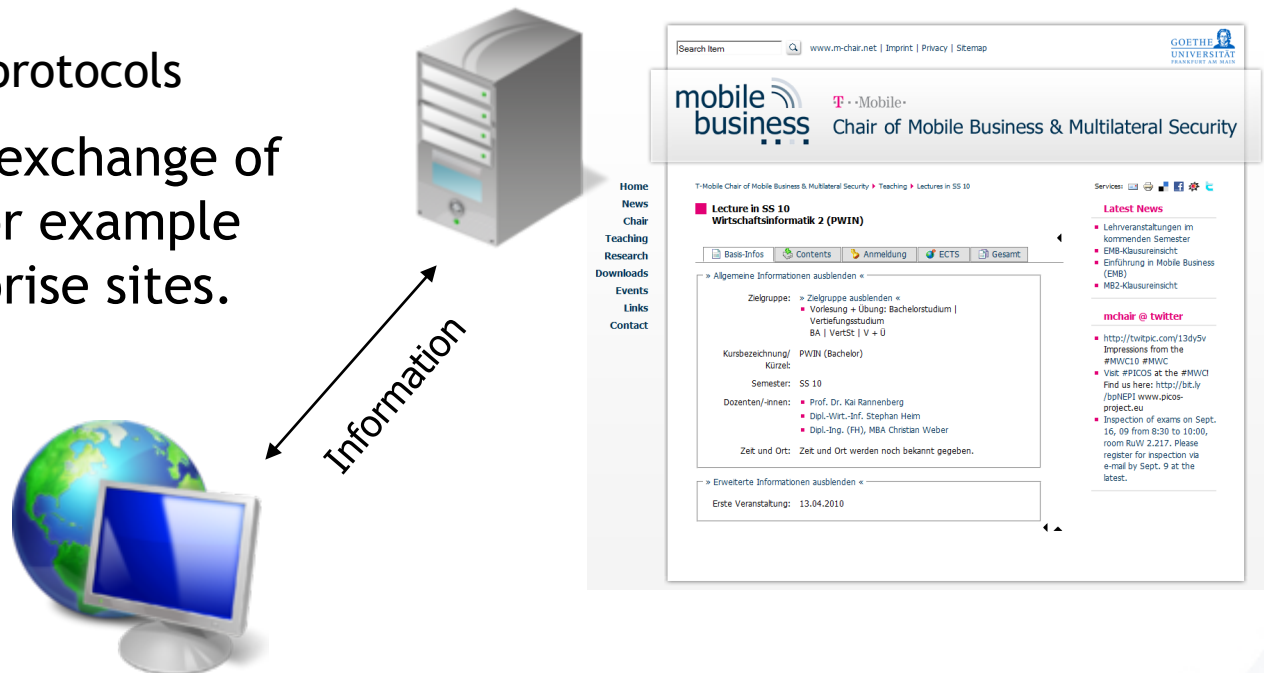
A system, which consists of business tasks and processes it supports, the underlying IT-infrastructure, the application software and the data it requires in order to accomplish its objectives.





- A communication system is a collection of to each other compatible
 - Hardware (terminals, physical network components),
 - Software (operation systems, network protocols, application systems) and
 - Transmission protocols

which allow an exchange of information - for example between enterprise sites.



- Information Systems (organisational orientation)
 - Designed for an specific operational area of responsibility
 - Consider organisational and basic personal requirements
 - Support decision making, coordination, controlling and monitoring in enterprises, but even more aids managers and employees to analyse problems, understand complex business cases and develop new products.
- Communication Systems (technical orientation)
 - Physical networking
 - Transmission media
 - Hardware and software



- **Information System (IS)**

A system which was build to be used in a part of an enterprise. It contains all relevant application systems and is embedded into the organisation and management of an enterprise.

- **Mobile Information System**

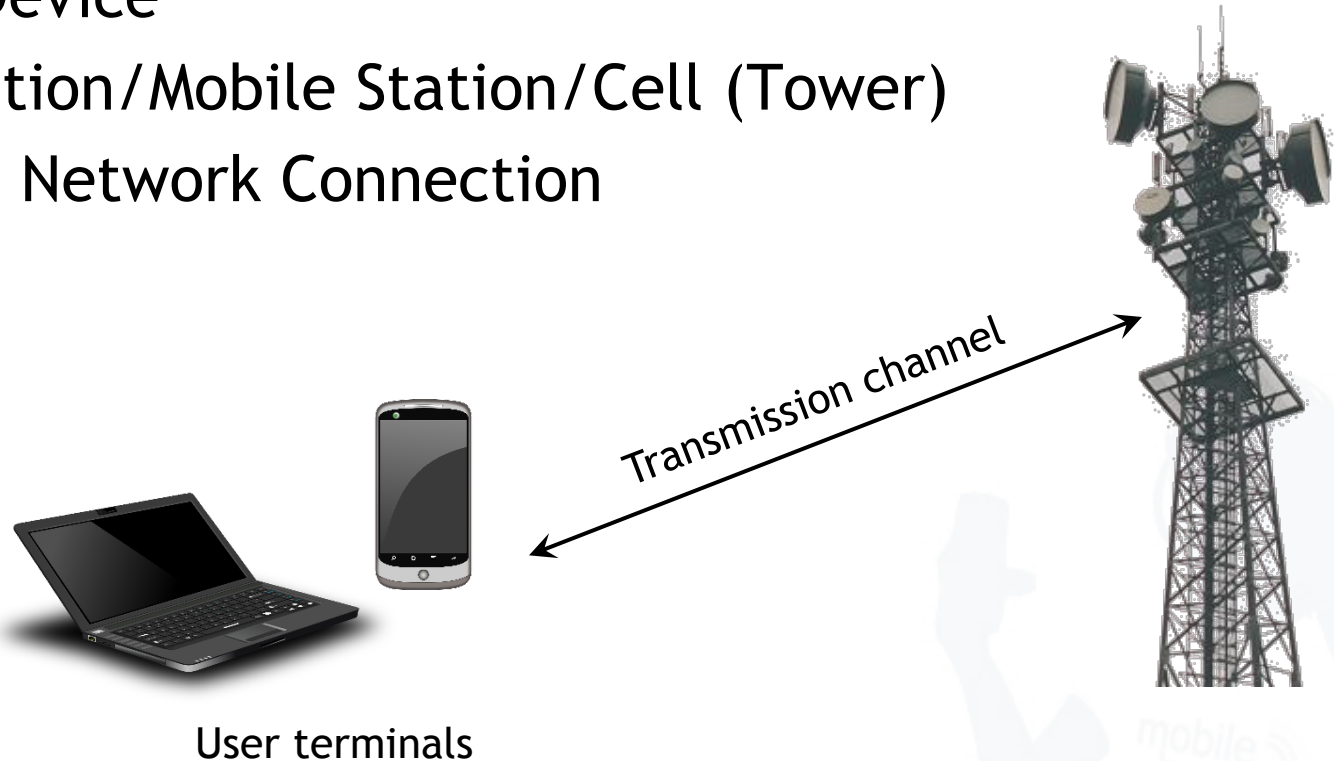
Information systems in which access to information resources and services is gained through end-user terminals that are easily movable in space, operable no matter what the location, and, typically, provided with wireless connection.

Source: Pernici (2006)



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- Mobile Device
- Base Station/Mobile Station/Cell (Tower)
- Wireless Network Connection



Fundamental Mobile Communication Services

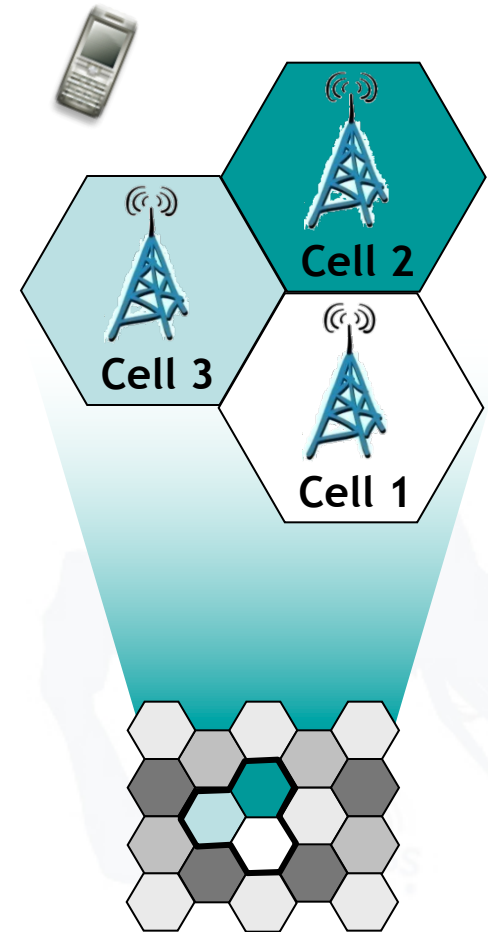
- Mobile Voice
 - GSM, UMTS
- Mobile Data
 - GPRS, EDGE, 3G networks (UMTS, HSDPA), 4G networks (LTE, LTE Advanced)
- Mobile Messaging
 - Text Messaging (SMS), Multimedia Messaging (MMS)
- Mobile Machine-To-Machine
 - GPRS, EDGE, 3G networks (UMTS, HSDPA), 4G networks (LTE, LTE Advanced)

→ The lecture focuses on Mobile Data Communications

Cell-Based Communication (CBC)

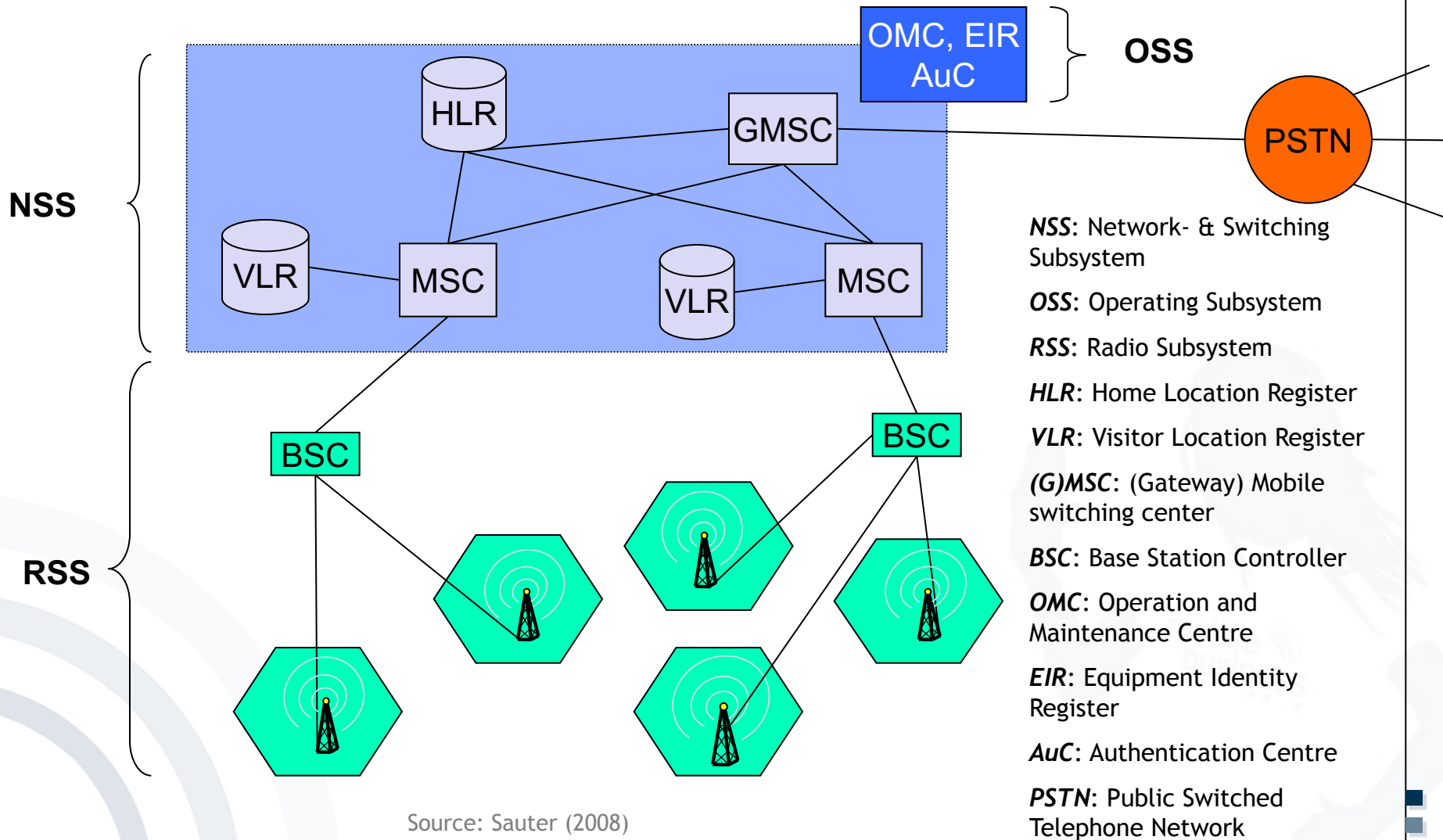
What is a Cellular Network?

- Cellular networks are radio networks consisting of several transmitters.
- Each transmitter or base station, covers a certain area → **a cell**.
- Cell radii can vary from tens of meters to several kilometres.
- The shape of a cell is influenced by the environment (buildings, etc.) and usually neither hexagonal nor a perfect circle, even though this is the usual way of drawing them.



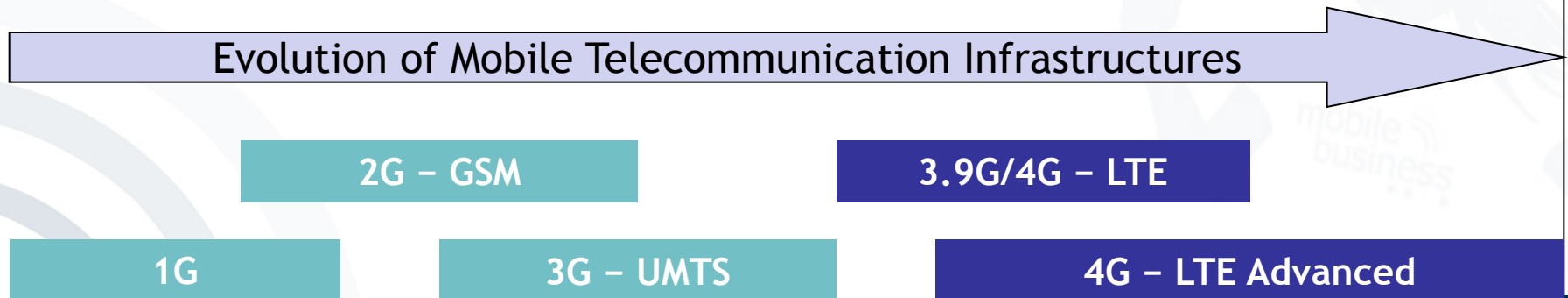
Source: Sauter (2008)

GSM (2G) System Architecture (High-Level View)



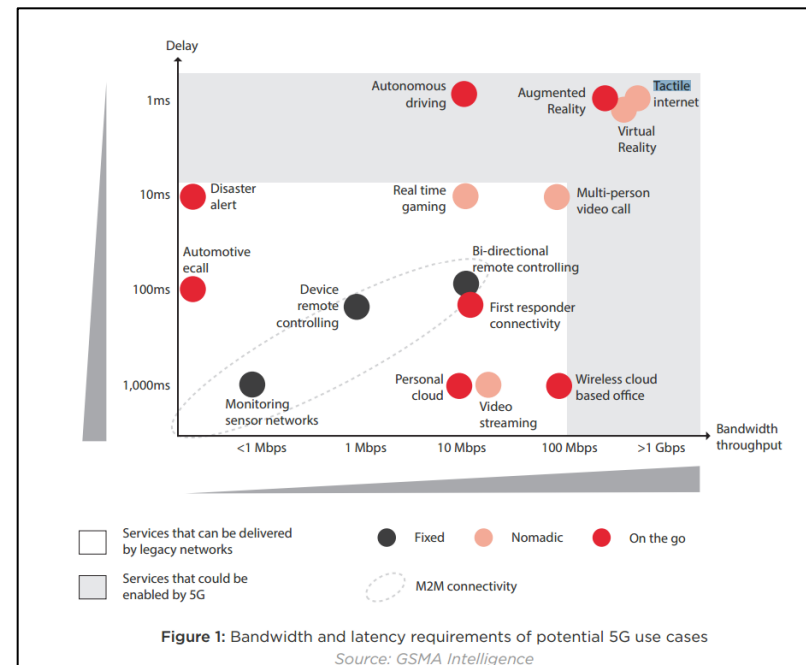
Source: Sauter (2008)

- **1st Generation (1G) - Analogue networks**
- **2nd Generation (2G) - GSM networks**
Global System for Mobile Communications
- **3rd Generation (3G/3.5G) - UMTS/HSPA/HSPA+**
Universal Mobile Telecommunications System
High Speed Packet Access / Evolved HSPA = HSPA+
- **3.9G or 4G - LTE**
Long Term Evolution
- **4th Generation (4G) - LTE Advanced**



- Faster (up to 10 GBit/sec)
- Less latency
- Support for Internet of (Every)thing(s)
- Better (nationwide) coverage
- Less power consumption (up to 90 %)

5G



- Categories of mobile devices
 - Mobile phones (low-end „Feature Phones“)
 - Smartphones
 - Tablet PCs
 - Netbooks
 - Notebook
 - Phablets
 - Smart Glasses
 - Smart Watches
 - ...



- Mobile devices differ in their technical specifications
 - Heterogeneous and fragmented system landscape with regard to
 - Processing power
 - Display resolution/size
 - Web browsers
 - Keyboard
 - Mobile Operating System
 - Application software that can be installed
 - Connectivity (e.g. Wifi, Bluetooth, ...)
 - Other features



Evolution of Mobile Phones Capabilities



- Other Sensors (e.g. temperature, air pressure, etc.)
- Finger Print / Face Sensors
- Near Field Communication (NFC)
- Ability to install Third Party software
- Multimedia applications (MP3, radio, camera, video, TV, etc.)
- Gyroscope Sensors
- Data Services (GPRS, UMTS, LTE Internet connectivity, Wi-Fi)
- Bluetooth
- Interactive Voice Response (IVR)
- Short Message Service (SMS)
- General telephony capabilities

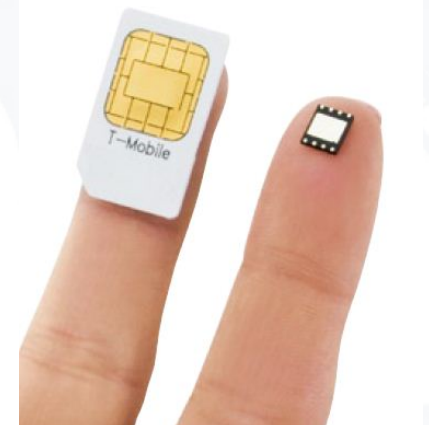


- **SIMs are Smartcards**
 - SIM cards serve as security medium.
 - Tamper-resistance prevents counterfeiting.
 - robust design
- Contain **International Mobile Subscriber Identity (IMSI)** for subscriber identification and the key K_i provided by the mobile operator
- Reliably execute computational functions for the mobile device

Source: Effing and Rankl (2002)

SIM Cards as Subscriber Identity

- In GSM and UMTS since 1991
- **Represents contract between subscriber & network operator**
- Authorises a “phone” to use the network by linking it to a subscription
- SIM cards come in various sizes, e.g. Micro SIM or Nano-SIM
- 3.7 billion unique mobile subscribers (Source: GSMA2015)
- 7.4 billion mobile connections (incl. M2M) (Source: GSMA2015)
- NextGen SIM cards: eSIM Cards
 - Pre-installed in phone and (maybe) provider independent



Source: Telekom 2011

What is a (mobile) operating system (OS)?

- An OS is a program that serves as a mediator between the user and the hardware.
- It enables the users to execute programs
- *Other properties:* Multi-user, multi-thread, high availability, real-time, ...
- ***Primary goal of an OS:*** Easy usage of the actual hardware
- ***Secondary goal of an OS:*** Efficient usage of the hardware

Source: Silberschatz (1999)





■ Controlling of the resources:

- Computation time, real-time processing:
“Who is computing how much? How long does it take?”
- Memory (RAM, Disk):
“Who gets which part of the memory?”
- Power Management



■ Security functions

- Protection of the data (memory, hard disk):
“Who is allowed to access resources?”
- Process protection (computation time, code, isolation):
“Who is allowed to compute?”



■ Communication

- Allocation of I/O-Resources
- Processing of the communication
- User interface (UI)



- iOS (Apple)



- Android (Google)



- Windows Phone (Microsoft)



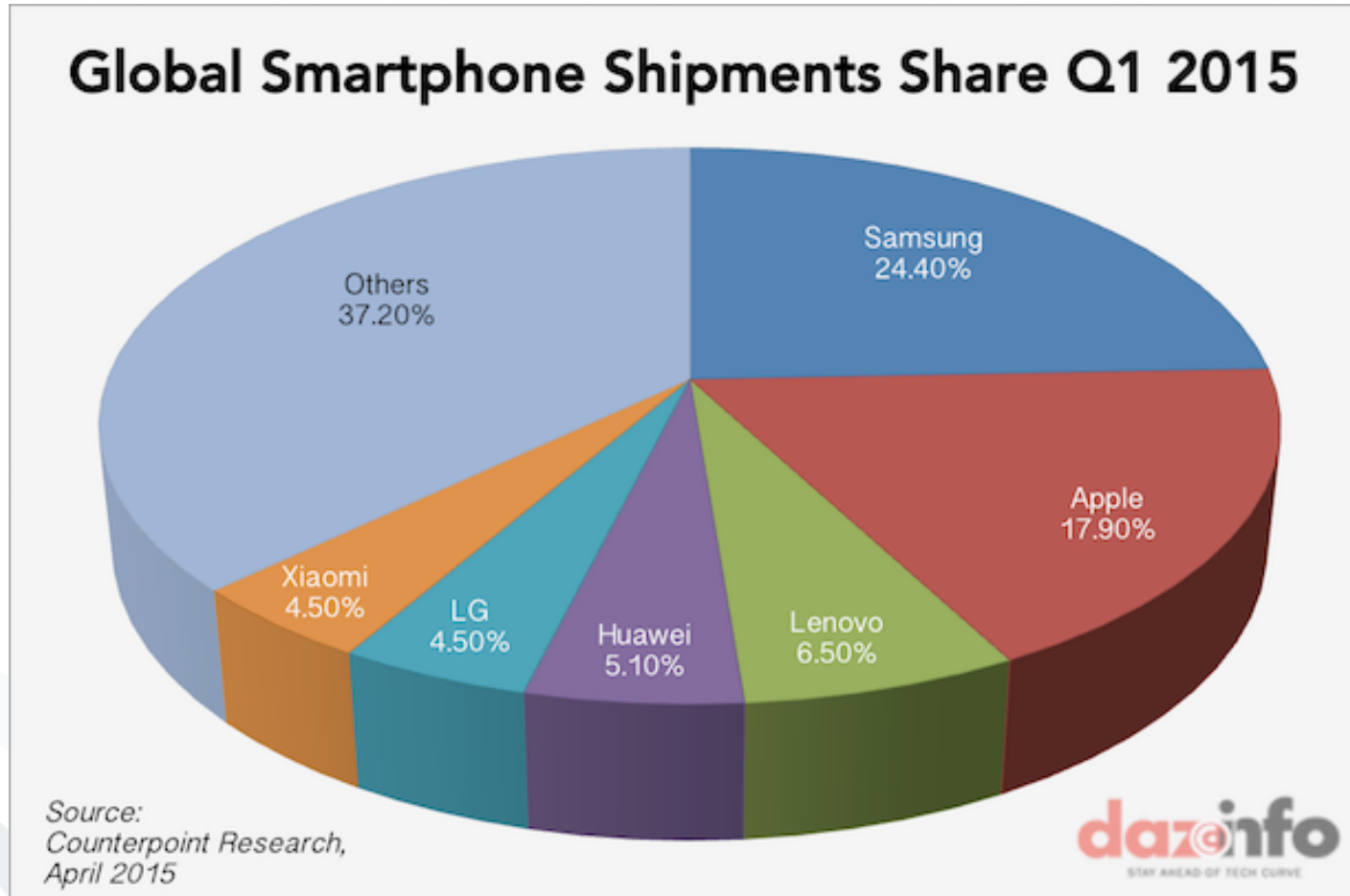
- BlackBerry (BlackBerry)



- Firefox OS (Mozilla Foundation)



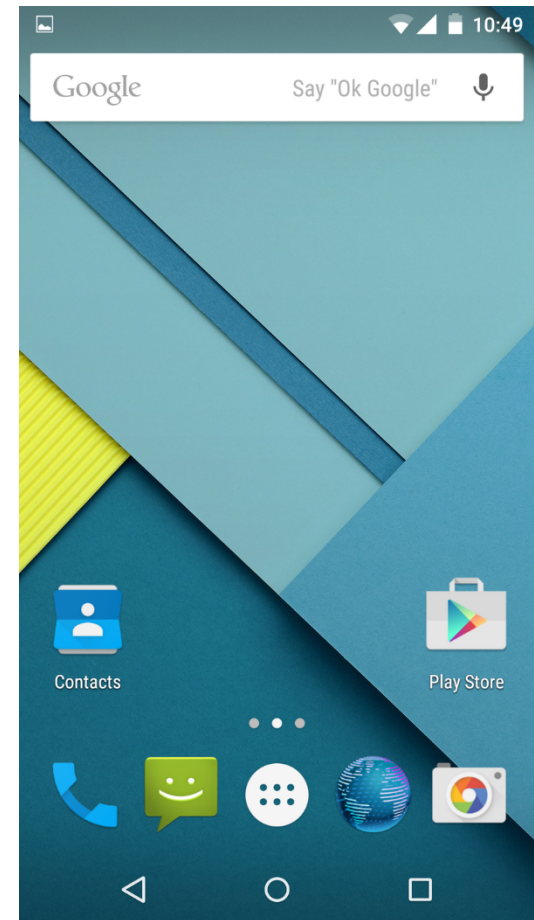
- Tizen (Linux Foundation, Samsung, Intel)



- Developed by Apple for iPhone, iPod Touch, iPad, Apple TV and Apple Watch
- iOS derived from Mac OS X, a Unix-based operating system
- Apple does not permit iOS to run on third-party hardware and is closed source



- Initially developed by Android, Inc., which Google bought in 2005, Android was unveiled in 2007
- Promoted by Open Handset Alliance (OHA) led by Google with 34 members, including mobile handset makers, application developers, some mobile carriers and chip makers.
- Supported devices: Phones, Tablets, Android Auto, Android TV, Android Wear
- Android based on modified version of Linux kernel
- Android is Open Source, although most Android devices ultimately ship with a combination of open source and proprietary software, including proprietary software developed and licensed by Google





- Platform for selling content, services (Apps) and hardware
- Implementation of sales channels in contradiction to the *everything is free* culture of the Internet
- Entered the mobile advertising market with the iAds System

Mobile Strategy of Apple and Google



- „*Mobile First*“
 - Eric Schmidt, CEO Google
- Offering free Google services on mobile devices
- Making the mobile web attractive to build new *advertising pillars*

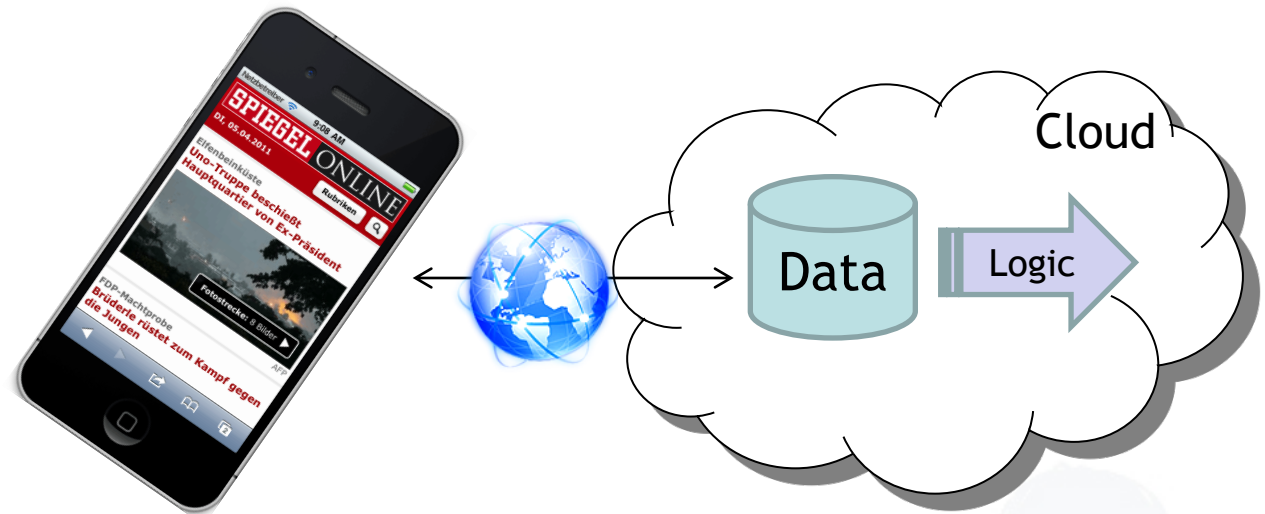
- Mobile App distribution through **App Marketplaces** (“App Stores”)
- App Markets are two-sided markets - a platform where developers publish their apps and users can buy/download them
- Payment, hosting, maintenance and marketing is conducted by the App Market provider



Types of Mobile Apps

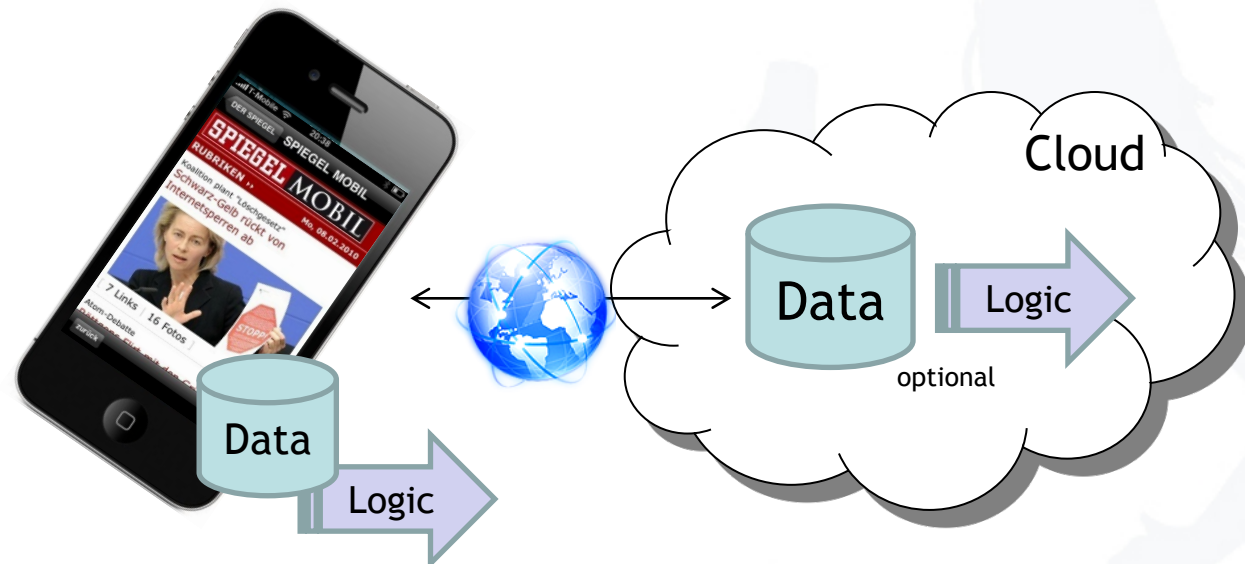
Mobile Web App

- App not installed on the device - runs in web browser
- Data & Logic in the cloud



Mobile App (“Native App”)

- App is downloaded and installed
- Data & Logic on device (and/or in the cloud)



Mobile Web Apps vs. Mobile Apps

Mobile Native App	Mobile Web App
Supports offline use	Needs constant internet connectivity (network coverage)
Can be found easily in App Store(s)	Distribution via URL, e.g. QR-codes
Business Model: Sold in Mobile App Store(s)	Business Model: Often only ad-financed or complementary services (as payment and authentication systems are difficult for mobile web apps)
Can make use of all OS and device functions	Often cannot access OS core functions (e.g. 3D graphic processing or access to local storage)
Platform-specific (native), e.g. iOS or Android	Highly platform-independent, runs in a web browser, porting to other devices/platforms less expensive
Based on Objective-C, C#.Net, Java	Based on HTML5, CSS, Javascript
Updates download through App Store(s)	Updates only the server - and not on the client device

- Wearables are accessories incorporating computer and advanced electronic technologies.
- Currently, most wearables mostly rely on the connection to a smartphone and have a short battery life.
- Some of popular wearables include glasses, fitness/health tracker and watches.
- Mobile Applications may be complemented by Internet of Things (IoT)



- Towards Mobile Web Apps
 - Mobile browsers are likely to gain access to more OS core functionality (e.g. 3D graphics processing; location API already available).
 - The trio HTML 5, CSS, JavaScript is expected to further improve the graphical user interfaces (GUIs) towards native mobile apps as well as to provide more platform independence.
 - It is likely that Mobile Web Apps will become the dominating application type in the future.
- Towards Invisible Apps on Mobile Devices
 - Voice Recognition (Hey Siri, Ok Google)
 - Chat Bots (e.g. Facebook M)
 - Amazon Echo
- Towards pervasive computing / IoT
 - Main part of electronic devices is connected to the Internet (e.g. Smart Home, Vending Machines, Info-Counter, etc.)
 - Mobile devices can interact with these devices either peer-2-peer or via service platforms

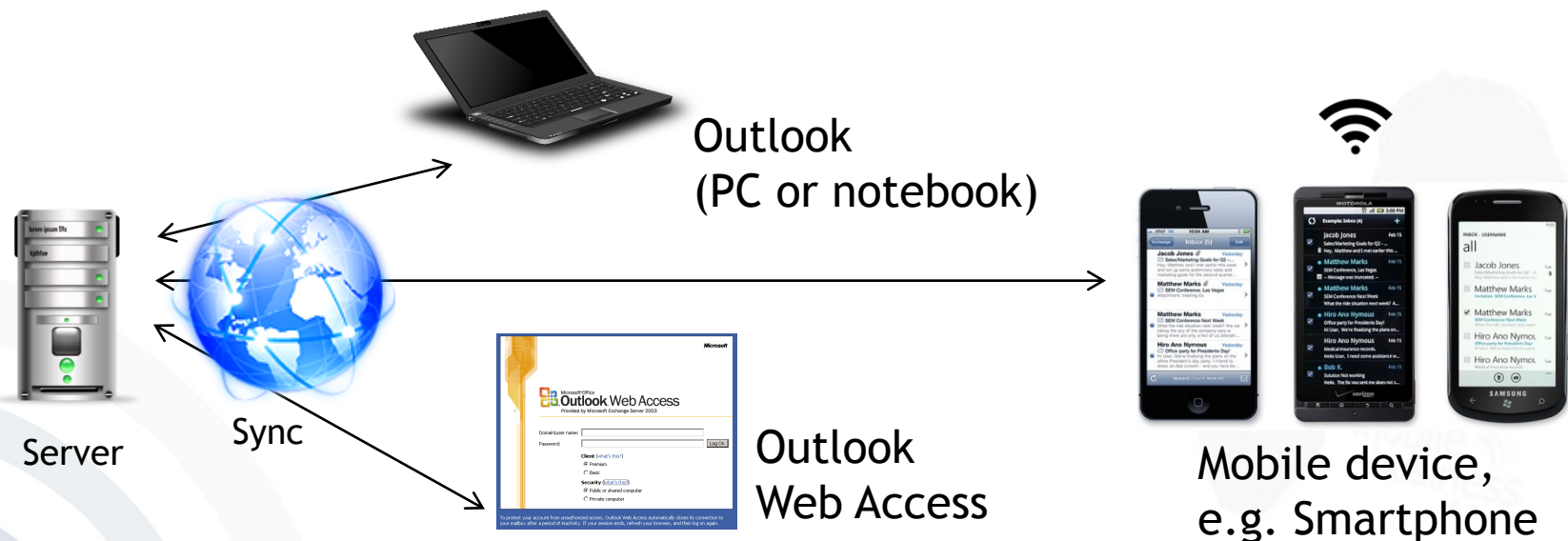
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(Genuine) Mobile Business



Mobile Office (Mail, Calender, Tasks, Notes, Files)

- Mobile devices, e.g. smart-phones, allow access to emails, calendar, tasks, notes and files via wireless networks from the cloud.
- Mobile Office as additional channel, which enables users to access an office infrastructure anywhere and at any time.



- *What about security and privacy for such services?*



Facebook - Posts, Video, Pictures, Messages, ...



Instagram - Pictures



Twitter - Short Messages



Tinder - Mobile Dating



Foursquare - Location Recommendation

Social Networks started on the fixed Internet.

What makes them sometimes even more popular on a mobile device?

 Skype

 WhatsApp

 SnapChat

 Google Hangout

Mobile Messagers killed the SMS message.

Why does it (not) replace e-mail messages for certain user groups?

- Paying via a mobile device - so far not a big success ...

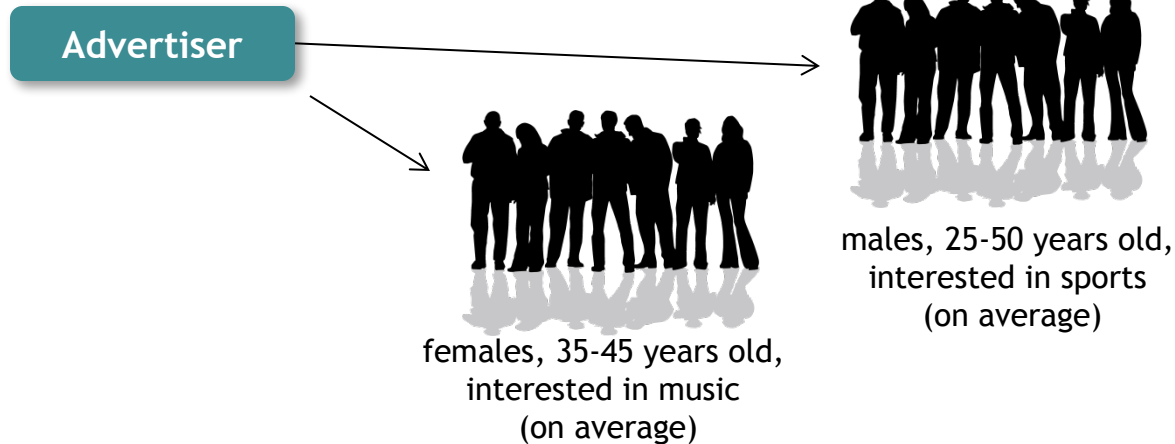


- Once more, Apple could change that ... with Apple Pay.



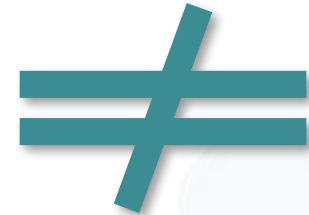
- *What the benefits of Mobile Payment for customers/business?*
- *What are its current issues?*
- *What does Apple try to do differently?*

Traditional Targeting of Mobile Marketing Campaigns

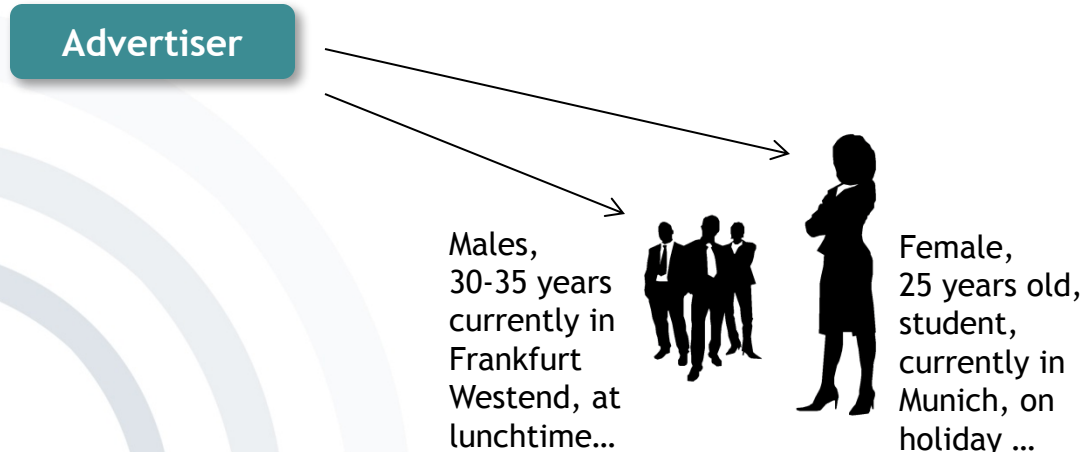


Traditional Information

- Implicit Information about preferences of mobile users
- Typically acquired without mobile user's knowledge



Context-sensitive Targeting of Mobile Marketing Campaigns



Context Information

- Explicit information about the usage situation of mobile users
- To be actively disclosed by mobile users

And there are
many more apps ...



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- Mobile networks as key part of the Internet of Everything
- Mobile devices as important interface in the digital sphere
- Communication happens mainly mobile (voice, messenger, etc.)
- Mobile Web app standards increasingly make native mobile apps obsolete
- 2/3 of Germans are no longer downloading any mobiles apps
- More mobile search than fixed line internet search
- Mobile devices as companions for wearables and other devices
- Innovation progress on mobile device is slowing down (e.g. Apple is rumored to work on an eCar)
- More mobile device usage than usage on PCs
- Mobile devices connecting with physical world on the verge to mass market (e.g. In-Car apps, iBeacon, Wearables, IoT, etc.)
- More revenue with mobile data than voice



- Mobile usage with social impact (e.g. calls in public / people looking at phones while driving)
- Spontaneous parties, no more dates in advance
- Mobile messaging exploding
- Mobile phones as the extension of „us“
- Always on / always reachable
- Mobile entertainment with new media formats
- Mobs & revolutions using mobile ICT
- Mobile computing as main ICT in 3rd world countries
- Mobile payments prevailing in 3rd world countries
- ...



- Leveraging the unique mobile characteristics for mobile applications and services
- Maintaining privacy, trust and security for users
- Coping with device & platform fragmentation
- Coping with limited mobile network bandwidth
- Managing Information Overflow / Always On
- Supporting other channels to a user besides mobile (e.g. often smartphones are used along with other media such as TV)
- ...

- 5G Technology
 - <http://time.com/3736663/5g-wireless-data/>
 - <http://www.funkschau.de/telekommunikation/artikel/125501>
- Trend towards Web Apps
 - <http://arstechnica.com/information-technology/2015/12/the-app-ocalypse-can-web-standards-make-mobile-apps-obsolete/>
 - <https://netzoekonom.de/2014/08/31/zwei-drittel-der-deutschen-laden-keine-apps-mehr-herunter/>
- General Mobile Trends
 - http://www.heise.de/newsticker/meldung/Bitkom-Mobiles-Internet-ueberholt-beim-Umsatz-das-Handygespraech-2557978.html?wt_mc=rss.ho.beitrag.atom
 - <http://arstechnica.com/information-technology/2016/01/how-the-smartphone-changed-everything-or-the-rise-of-byod-in-the-workplace/>

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