mobile business

Lecture 4

Mobile Communication Services

Mobile Business I (WS 2011/12)

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Introduction / Motivation

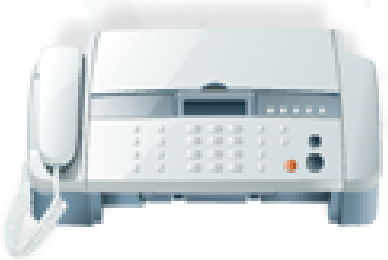
- Classic Mobile Communication Services
  - Introduction with 2G networks (digital networks)
- Mobile Multimedia Services
  - Extension of the classic communication services to enable a richer media experience
- IP-based Mobile Services
  - Internet Protocol (IP) based services influenced by the developments in the stationary Internet

Overview
Mobile Communication Services

- Classic Mobile Communication Services
  - Voice / Fax
  - Short Message Service (SMS)
  - Mobile Data Services
- Mobile Multimedia Services
  - High-Speed Packet Access (HSPA)
  - Multimedia Messaging Service (MMS)
  - i-mode
  - Mobile Broadcast TV
  - IP Multimedia Subsystem (IMS)
- IP-based Mobile Services
  - Voice over IP (VoIP)
  - Virtual Private Networks (VPN)
  - Push Email Services
  - IPTV Mobile

Classic Mobile Communication Services

- **Voice / Fax Service**
  - Regular telephone service and emergency call
  - Speech signals are digitally coded, using a bidirectional, symmetric, full-duplex point-to-point connection.
  - Capable of sending and receiving “Group 3” fax transmissions



Classic Mobile Communication Services

- Short Message Service (SMS)
  - Allows to send and receive short messages of up to 160 characters
    - ***7Bit***: 160 characters (plain text)
    - ***8Bit***: 140 characters (ASCII)
    - ***16Bit***: 70 characters (Unicode)
  - Several SMS types exist:
    - *Point-to-point SMS* (single recipient)
    - *Point-to-multiple SMS* (several recipients)
    - *Cell broadcast SMS* (all users in a cell are recipients)
  - Combination with other value added services (e.g. automated mailbox notification)
  - Messages are sent to an SMS service centre (SMSC) and are processed in a *store-and-forward mode*, meaning that messages that cannot be relayed will be stored and sent again later.

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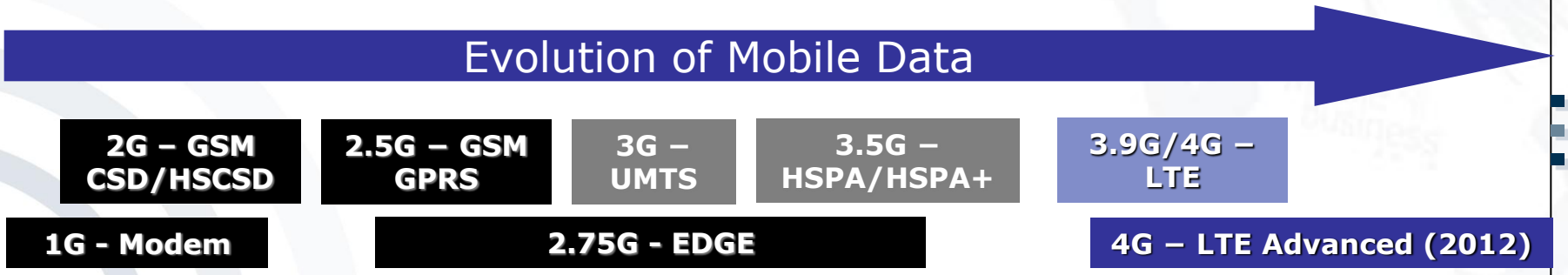
Mobile Data Services

- **Modem** (modulator-demodulator) in analogue mobile networks (300 – 2400 bit/s)
- ***CSD*** (Circuit Switched Data) in GSM networks (9.6 Kbit/s)
- ***HSCSD*** (High-Speed Circuit Switched Data) in GSM networks (57.6 Kbit/s max.)
- ***GPRS*** (General Packet Radio Service)
- ***EDGE*** (Enhanced Data Rates for Global Evolution)



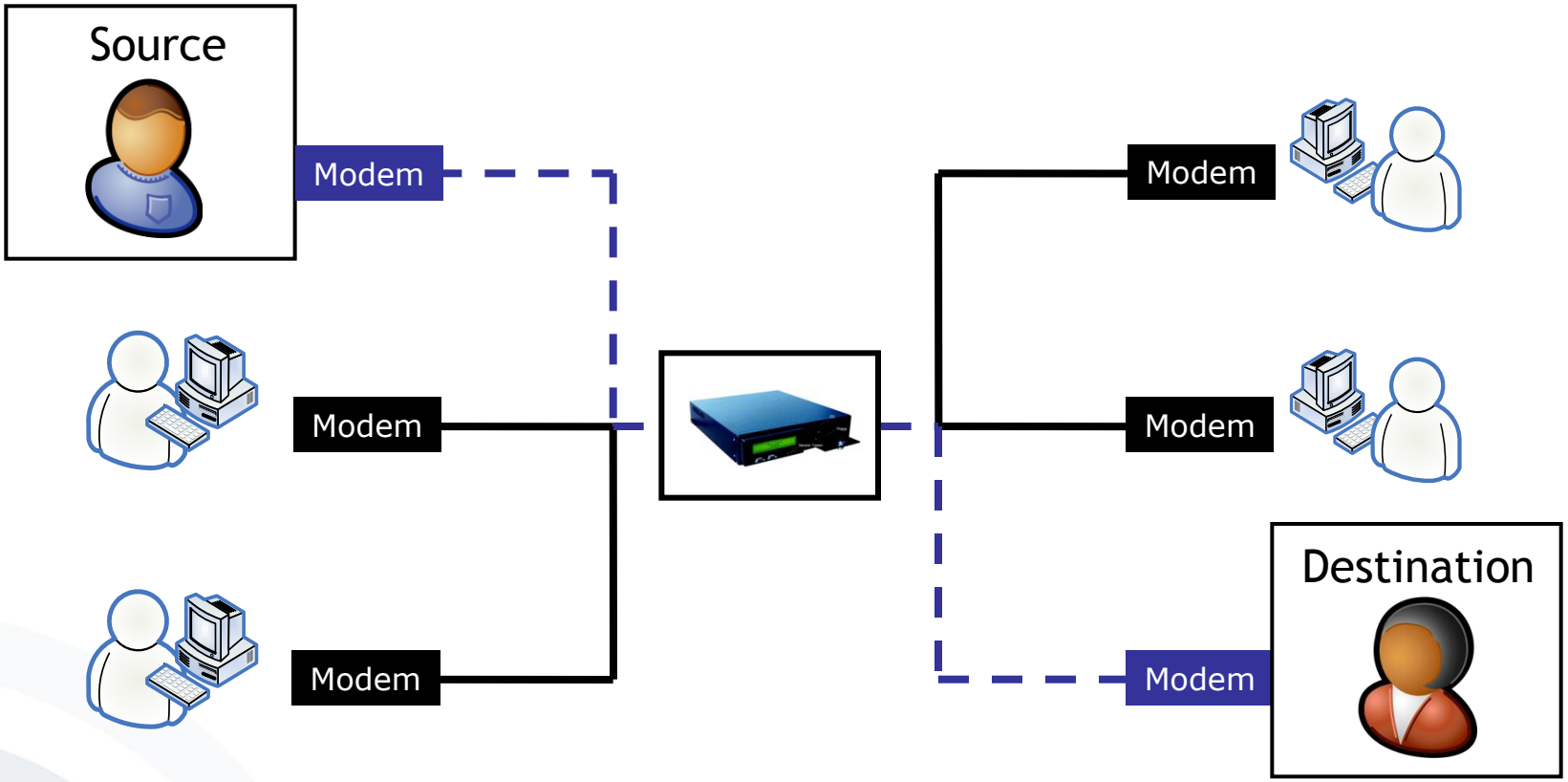
Mobile Data Services : Data Transmission Methodologies

There are 2 methodologies to transmit data via communication Networks:

- ***Circuit-Switched Networks:*** In circuit-switched networks, the communication line is used exclusively for the communicating parties.
  - Connections are **exclusive** ➲ even if no data is transferred, the network resources are used.
  - In reality, the typical usage for voice connections is 30% of the network's capacity - for data transmission it is less than 10%.
  - The ***duration of a connection*** is used for billing purposes
  - Example: *Circuit Switched Data (CSD)* and *High-Speed Circuit Switched Data (HSCSD)* for Mobile Data Services
- ***Packet-Oriented Networks:*** In packet-oriented networks, the communication is divided into several packets, which get addressed and transferred using a **shared** transmission medium.
  - The connection is kept all the time (always on). However, the network is only used when data is transmitted.
  - The capacity of the communication network is allocated dynamically.
  - For billing purposes, the ***amount of transferred data*** is used.
  - Example: GPRS for Mobile Data Services

[Sauter2008]

Mobile Data Services
Circuit-Switched Networks

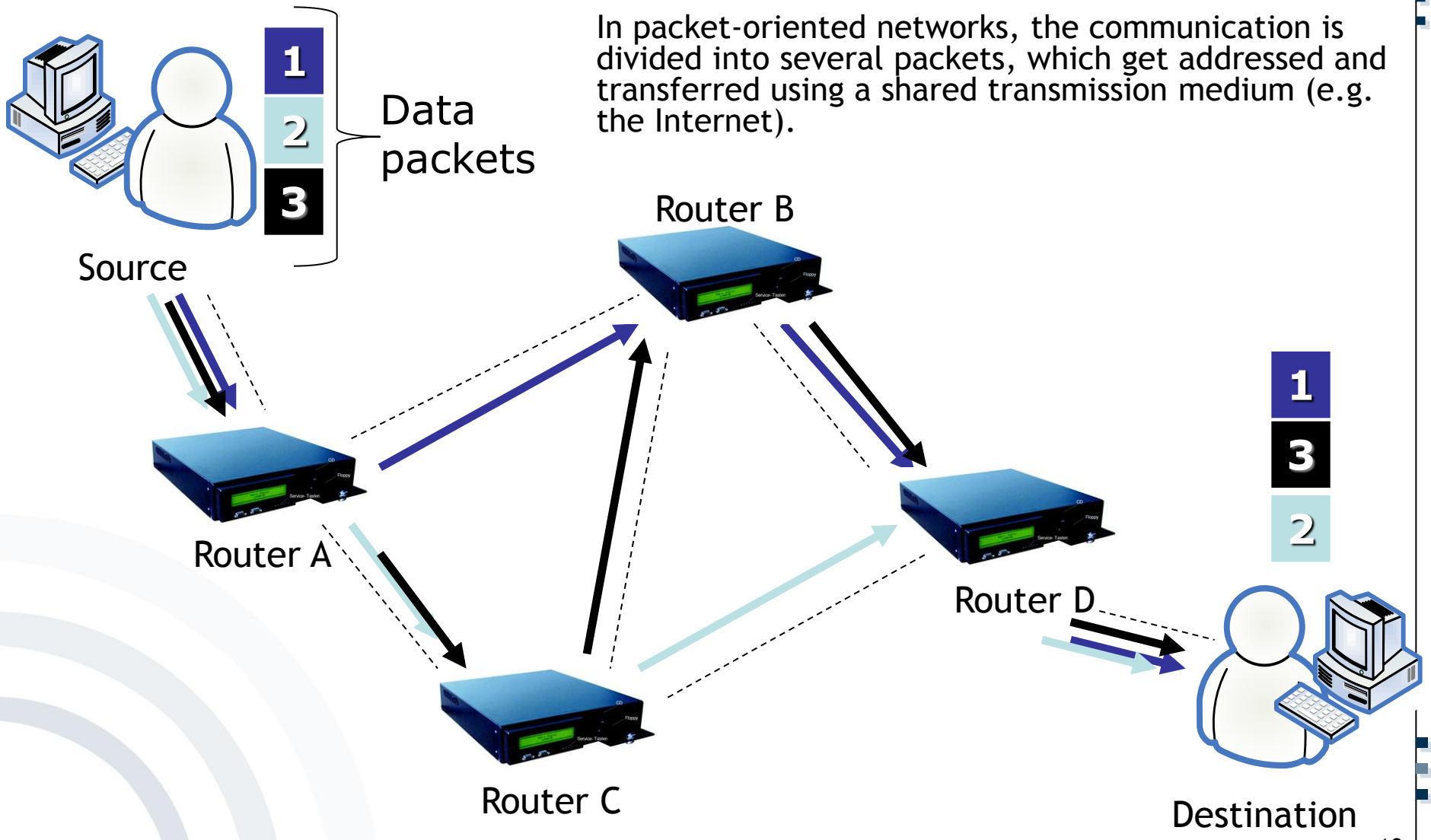


In circuit-switched networks, the communication line is used exclusively for the communicating parties (similar to the phone system, CSD and HSCSD).

[M-Chair]

Mobile Data Services
Packet-Oriented Networks

In packet-oriented networks, the communication is divided into several packets, which get addressed and transferred using a shared transmission medium (e.g. the Internet).



[M-Chair]

Mobile Data Services
Circuit Switched Data (CSD)

Circuit Switched Data (CSD)

- Transmission method originally developed for GSM.
  - Uses a single radio time slot to deliver a constant data stream of 9.6 kbit/s for transferring data.
  - Originally, CSD was designed to support the transmission of fax messages.
  - Not sufficient for “modern” data-services, as WAP over CSD showed

High-Speed Circuit Switched Data (HSCSD)

- Enhancement to Circuit Switched Data
  - Bundling of multiple simultaneous channels, up to 57.6 Kbit/s.

General Packet Radio Service (GPRS)

- First package-based data service
- Employment of time multiplex procedure for data services
- Dynamic allocation of radio channels among the subscribers in a radio cell
- Channels are only blocked when data is actually transferred.
- Package orientation implies the introduction of new billing methods.

[Sauter2008]

Mobile Data Services
General Packet Radio Service (GPRS)

- One up to 8 time slots can be occupied per time frame (at the moment 4 in practice).
- In contrast to Circuit Switched Data, the GPRS data service requires an extensive upgrade of the GSM architecture with new network components.
- In spite of better network utilization and volume based billing at the beginning, the data transfer costs were much higher than those of connection oriented data services (c't 9/2002, S. 100).
- The data transfer costs of GPRS data services have been lowered through new price models (especially free volume with higher basic charge).

[Sauter2008]

Mobile Data Services
General Packet Radio Service (GPRS)

- Advantages 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).

[Sauter2008]

Mobile Data Services
Wireless Application Protocol (WAP)

- In 1997, Ericsson, Motorola, Nokia and Unwired Planet founded the WAP-Forum.
- The WAP-Forum is a non-profit organization with the objective to build up an open standard (protocol) for wireless data-communication.
- More than 300 members worldwide (manufacturers, software industry, computer and telecommunication companies & network-operators)
- Protocol family, developed by the WAP-Forum to provide internet contents on mobile devices
- Universal use, independent from used network technology (GSM, UMTS, etc.)

Mobile Data Services
Wireless Application Protocol (WAP)

- ***Relative advantage:***
  - WAP provides an access channel to many special Internet pages
    - using the Wireless Markup Language (WML)
    - bringing information to mobile devices.
  - However, only a limited amount of content is available.

- ***Compatibility:***
  - High compatibility to previous user experiences, as WAP is based on mobile telephone handsets

  ➲ familiarity

  - However, the displayed WAP pages are only of limited quality:
    - user interfaces lack quality,
    - connection-speeds are low

based on [HungKuChang2003]

Enhanced Data Rates for Global Evolution (EDGE)

- Basic idea of EDGE was the implementation of networks with 3G performance without building up a whole new infrastructure.
- By using advanced modulation technologies, data rates of up to 384 kbit/s are reachable.
- However, these data rates are only reachable in close proximity to base-stations. Therefore more base-stations need to be setup.
- First European EDGE system implemented in Hungary (2003).
- Although UMTS (3G) networks are rolled out throughout Europe, more and more GSM networks are upgraded with EDGE technology.
- EDGE can also be implemented in mobile networks that do not use the GSM standard, such as TDMA in America.

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High-Speed Packet Access (HSPA)

- **High Speed Packet Access (HSPA)** provides higher data speeds for downlink and uplink, e.g.
  - 7.2 or 14.2 Mbit/s **downlink speed (HSDPA)**
  - 1.4 or 5.7 Mbit/s **uplink speed (HSUPA)**
  - Part of release 5 from 3GPP

- **Evolved HSPA (HSPA+)**
  - Uses *Multiple Input Multiple Output (MIMO)* antenna technology → **more antennas**
  - Uses **more cells and channels**
  - Reaches downlink speeds of 21,1 and 42,2 Mbit/s depending on networks and user equipment.
  - Maximum uplink speed of 11.5 Mbit/s
  - Part of release 7 from 3GPP

Multimedia Messaging Service (MMS)

- Similar to SMS, MMS is a message service especially for the transmission of media such as images, videos, or sounds.
- Multimedia Messages can also be sent to email recipients.
- In addition to the SMS service centre (SMSC), a Multimedia Message Service Centre (MMSC) is necessary handle the multimedia content of the messages:
  - Different ways of processing MMS due to different types of used mobile devices → Compatibility tests with the recipients' mobile device are necessary to process the data appropriately.
  - For sending out MMS to email recipients, the MMSC uses the standard Internet protocol (SMTP).
  - Furthermore, the MMSC handles the (optional) receipts for receiving MMS.

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Mobile Multimedia Services
i-mode History

- Established in February 1999 by NTT DoCoMo in Japan as a service for mobile Internet access.
- Proprietary standard, based on package-based data transmission.

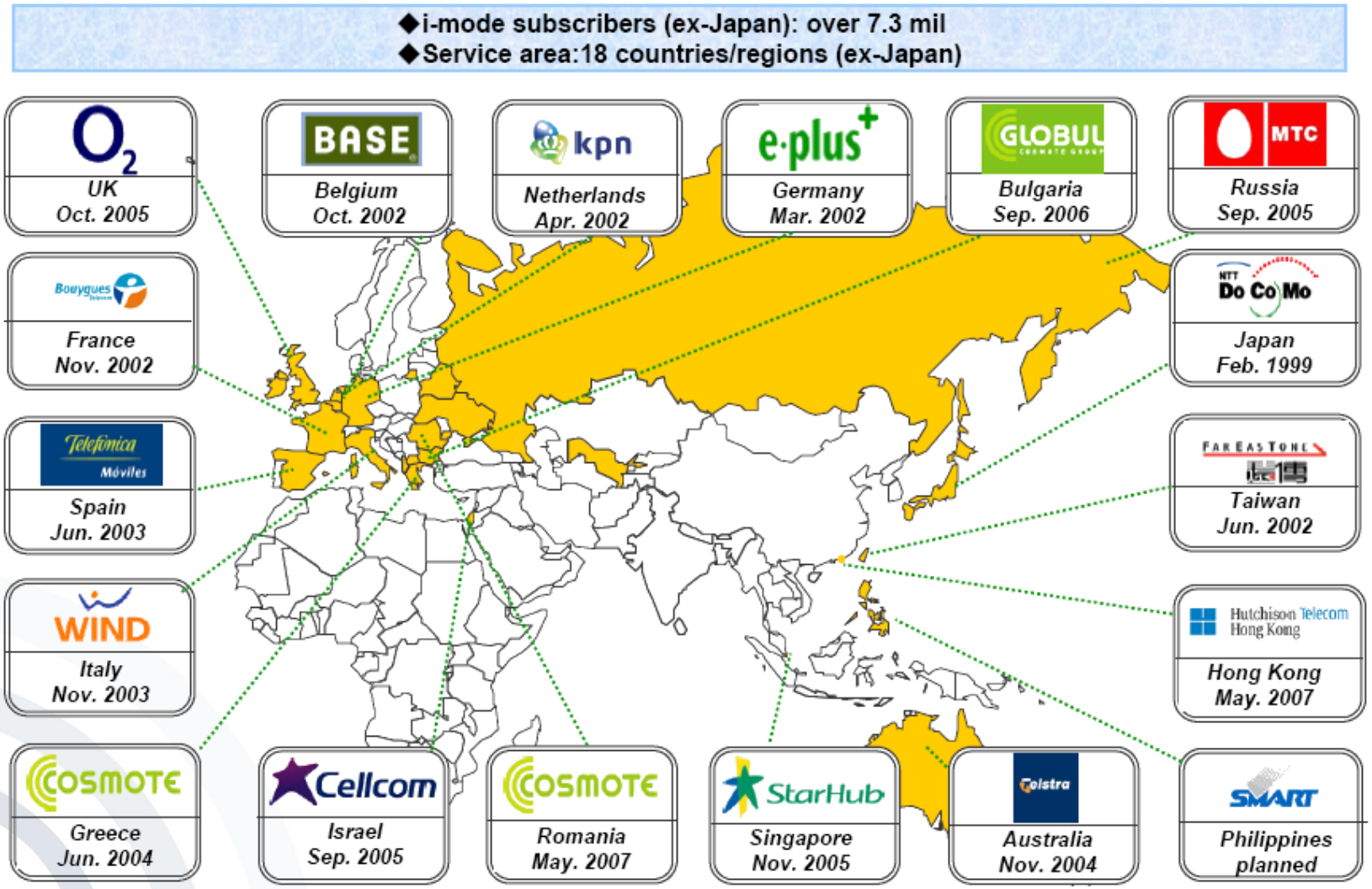
➲ Requires special i-mode devices

➲ Advantages

- "Always-online"-functionality
- Charging based on data volume since 1999

[Samsung SGH-Z320i, Source: Samsung, E-Plus]

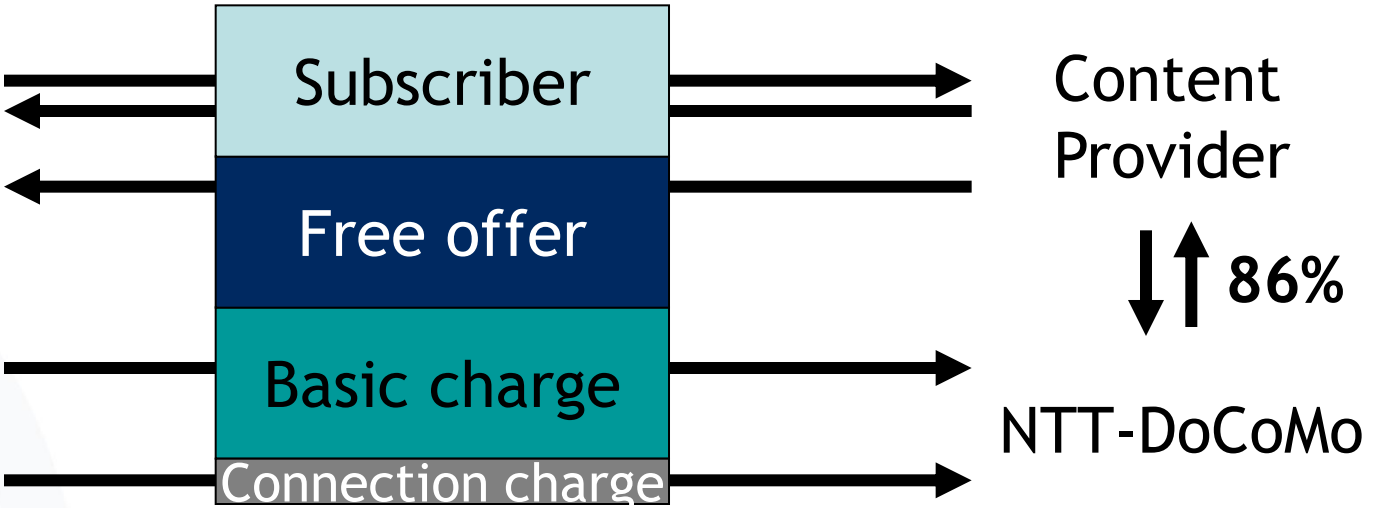
Mobile Multimedia Services
i-mode Services around the world



Dates indicate service launch [NTTDoCoMo2007]

Mobile Multimedia Services
i-mode

- Show case example:
  - i-mode started in Japan in 1999
  - 52 Mio. Users by 07/2007
  - Customers in Germany: about 855.000 users (08/2004).
- Business model:



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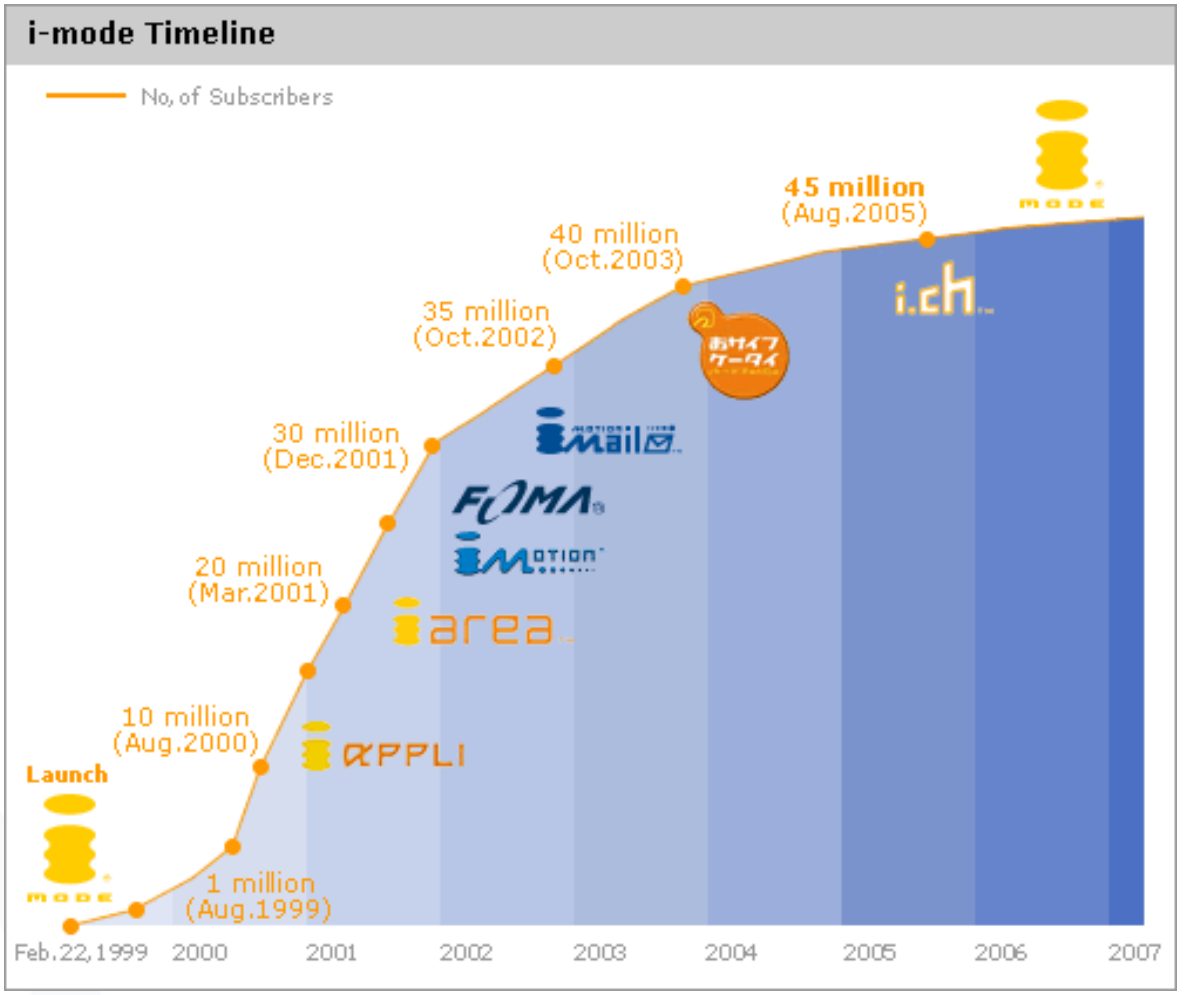
Mobile Multimedia Services

i-mode Users Base Development (worldwide)



[NTTDoCoMo2007]

Mobile Multimedia Services
i-mode User Base Germany

- Number of users in Germany at the beginning of 2003, according to e-plus:
  - Planned: 750.000
  - Achieved: 125.000

[E-Plus 2006]

- Mobile Internet Services Penetration in Germany – Number of users:
  - 500.000
  - 4.500.000
  - 5.500.000

[Handelsblatt 2/2004]

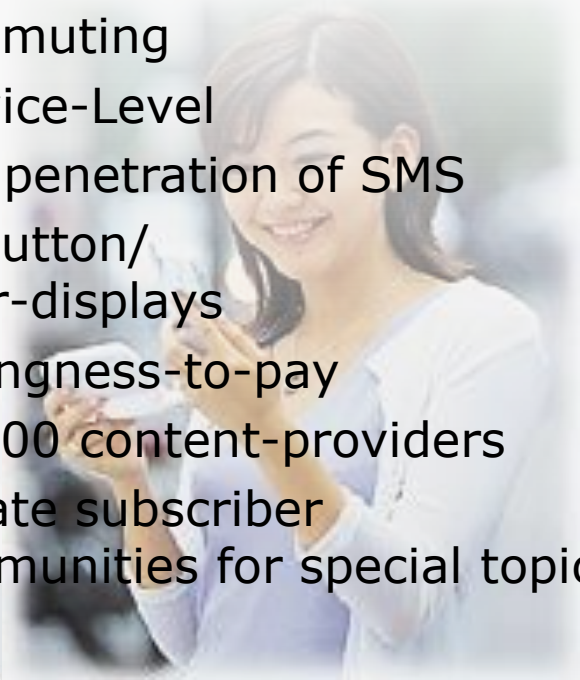
- 2008-04-01 i-mode service ended by E-Plus

Mobile Multimedia Services
i-mode Transferability

Transferability from Japan to Germany?

Japan:

- Low penetration of stationary internet connections
- Commuting
- Service-Level
- Low penetration of SMS
- "i"-button/ color-displays
- Willingness-to-pay
- 77,000 content-providers
- Private subscriber communities for special topics

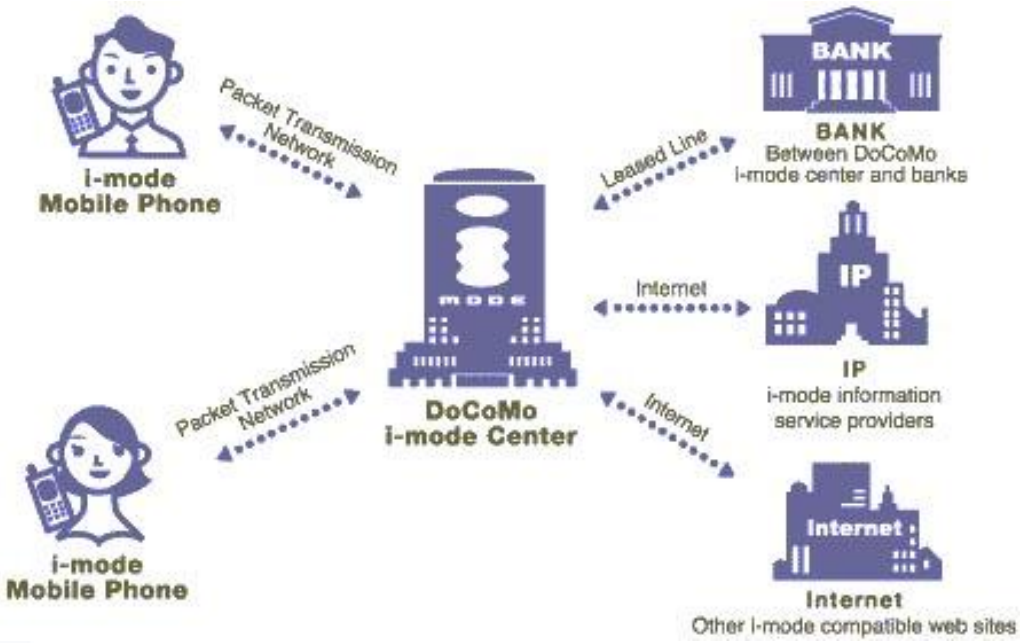


Germany:

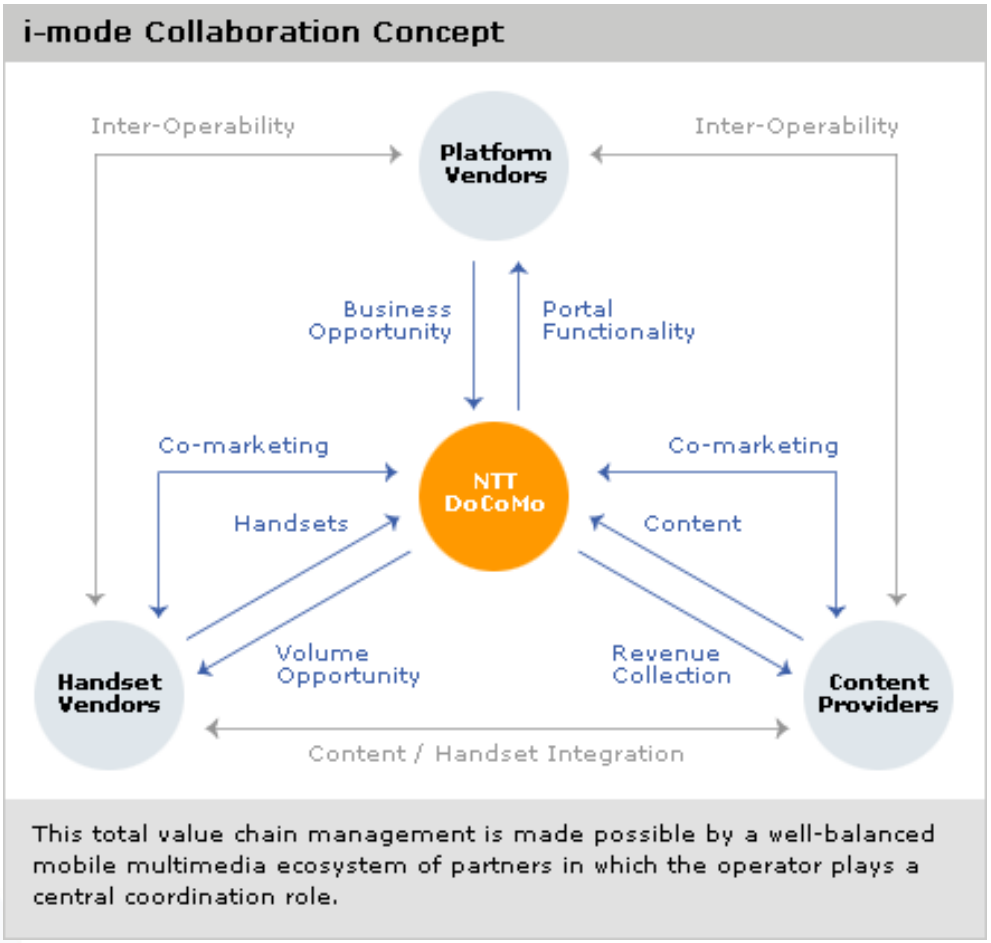
- Primarily voice + SMS
- About 160 content providers
- Skepticism
- SMS

Mobile Multimedia Services
i-mode Characteristics & Architecture

- Focus on entertainment-services (e.g. in order to bridge waiting time)
- Convenient accounting via phone bill
- Integrated push e-mail-service



Mobile Multimedia Services
i-mode Business Model



[NTTDoCoMo2007]

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Mobile Multimedia Services
Mobile Broadcast TV

Multimedia Broadcast Multicast Service (MBMS)

- A technology to broadcast Mobile TV through UMTS/3G networks
- *Point-to-point* or *Point-to-multipoint* broadcast possible, depending on network load within the local cell
- Only limited number of different Mobile TV programmes per cell possible in *Point-to-multipoint* mode (4 – 8 different TV channels)
- Part of release 6 from 3GPP

Mobile Multimedia Services
Mobile Broadcast TV

- **DVB (Digital Video Broadcast)**
  - Denotes a standard/technology for digital terrestrial broadcasting of television and data services:
    - DVB-C, DVB-C2 (cable TV)
    - DVB-S, DVB-S2 (satellite)
    - DVB-T, DVB-T2 (terrestrial)
    - **DVB-H (handheld devices)**

- **Digital Multimedia Broadcasting (DMB)**
  - Denotes a standard/technology for digital broadcasting of television and data services to mobile devices:
    - Terrestrial (T-DMB) or via satellite (S-DMB)
    - Main competing mobile TV standard is DVB-H.

Digital Video Broadcasting – Handheld

- DVB sub-standard, tailored towards the needs of devices with a low power consumption.
- DVB-H is designed to work in the following frequency bands:
  - VHF-III (174-230 MHz, or a portion of it)
  - UHF-IV/V (470-830 MHz, or a portion of it)
  - L-Band (1.452-1.492 GHz)
- DVB-H can coexist with DVB-T in the same multiplex.
- The transmission channel can be used to transfer data
  - Capacity of up to 2mBits (e.g. for IP-data)
  - Can be used as an enhancement of existing telecom infrastructures (e.g. IP-datacasting for multimedia applications)

[DVB consortium 2006]

Digital Video Broadcasting – Handheld

- Standardised by ETSI (EN 302 304) in November 2004.
- **DVB-H trial in Germany in July 2008, completed in October 2008.**
- Only few popular devices were equipped with DVB-H at that time (e.g. Nokia N96, Samsung SGH-P960)
- No market introduction in Germany, but e.g. in
  - Italy by 3 Italia (la3tv.it)
  - Netherlands by KPN MobielTV – *discontinued June 2011*
  - Austria by Orange, 3 AT, Mobilkom Austria/A1 - *discontinued December 2010*
  - Switzerland by Swisscom (Bluewin TV mobile) – *discontinued March 2010*.

[DVB consortium 2006]

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IP Multimedia Subsystem (IMS)

- Architectural framework for delivering Internet Protocol (IP) multimedia services
- **In a nutshell: Internet Protocol (IP) realized as a service based on 2.5G/3G Mobile Networks**
- Originally designed by wireless standards body 3rd Generation Partnership Project (3GPP) as a part of the vision for evolving mobile networks beyond GSM
  - Original formulation (3GPP R5) an approach to delivering “Internet services” over GPRS
  - Later updated by requiring support of networks other than GPRS, such as Wireless LAN and fixed line
- Since it is becoming increasingly easier to access content and contacts using mechanisms outside the control of traditional wireless/fixed operators, the interest of IMS is being challenged.

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Application Scenarios for IP-based Mobile Services

- Internet Protocol (IP) based services:
  - ***Voice over IP* (VoIP)**
  - ***Access via Virtual Private Networks (VPN)***
  - ***Push Email Services***
  - ***Mobile IP Datacasting***
- Other IP-based mobile services:
  - Instant Messaging
  - Online Games
  - Automotive Communication

IP-based Mobile Services
Voice over IP: Overview

- Voice over IP (VoIP) describes a telephony technology, using Internet protocols for transmitting the speech data.
- The data is transferred in a continuous stream of packets (packet-oriented), instead of a dedicated line.
- There are two general application scenarios:
  - ***Internet-based telephony***: Communication between Internet users or communication from the Internet into another communication network (e.g. phone network)
  - ***Intranet-based telephony***: Communication with users in the same network (e.g. company phone system)

IP-based Mobile Services
Voice over IP: Overview

- In order to compensate transmission problems (lost packets, speech disruption, etc.) buffers are used.
- In VoIP systems, users can be identified by their:
  - Nicknames (e.g. Skype, Freeworlddialup)
  - Phone number (Sipgate)
  - Phone number (using ENUM – "***te**lephone **nu**mber **m**apping" for mapping telephone numbers to Internet-addresses* - RFC 3761)

IP-based Mobile Services
Voice over IP: Protocols

- Currently, there are 2 different approaches available for signalling an incoming call:
  - The ITU (International Telecom Union) has released the H.323 standard for packet-oriented networks.
  - The IETF (Internet Engineering Task Force) on the other hand follows an Internet-based approach by using SIP (Session Initiation Protocol).

IP-based Mobile Services
Voice over IP: Protocols

- 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.

IP-based Mobile Services
Voice over IP: The Market

- The market has made its decision:
  - Manufacturers and providers that have used H.323 in the past, now switch to SIP.
  - The UMTS sector also decided to use SIP, although VoIP was not one of the driving factors.
  - Proprietary protocols are also used widely (e.g. Skype). However, in enterprise applications they play a minor role at the moment.
- Switching from one standard (H.323 ⇔ SIP) to the other is easy, since both use the RTP protocol (Real Time Protocol) for transferring and encoding speech data.

IP-based Mobile Services
Voice over IP: Security

- VoIP has to face the same threats (malware, etc.) as all other Internet services.
- The 3 major problems in the mobile environment are
  - The billing
  - For the communication, VoIP “outsources” some of the communication network’s intelligence into the mobile device ➲ VoIP terminals become a target for potential attacks.
  - Since VoIP is using the Internet (a shared medium) it is possible to eavesdrop the communication. However, by using encryption or secured lines, this problem can be solved (e.g. VPN or SSL).

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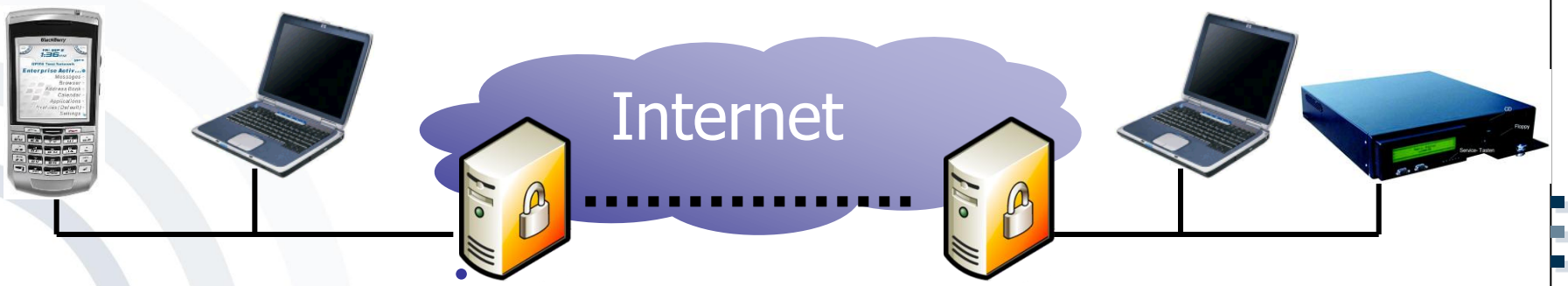
IP-based Mobile Services
Virtual Private Networks (VPN)

- Secure connection between two or more networks over an unsecured transport network like the Internet.
- Several protocols are available (e.g. IPSec, PPTP, L2F, or L2TP).
- Currently the most secure way to establish a communication link (e.g. at universities and companies)
- The whole communication is encrypted end-to-end.



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IP-based Mobile Services
Push Email Services

- "*Always-on*" technology for transmitting new emails by "*pushing*" them to a mobile device, once they arrive
- Needs a special server software to get emails from a standard email server (using POP3, IMAP, etc.) and push them to the recipients device
- Currently, the most popular implementations are proprietary (e.g. RIM Blackberry, Microsoft Direct Push).
- However, more open standards also exist for a more open solution:
  - Push-IMAP (with IMAP-IDLE command)
  - Synchronization Markup Language (SyncML)

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IP-based Mobile Services
IPTV Mobile

- IPTV is originally targeted to set-top boxes. How make IPTV *mobile*?

- Two fora work on this:
  - ITU-T IPTV Focus Group (FG IPTV)
    - Collecting requirements regarding mobility and wireless characteristics
  - Open IPTV Forum
    - Mobility service based on IP Multimedia Subsystem (IMS)

IP-based Mobile Services
Future Scenarios

- Identification of users by using the IP-address of the device:
  - Usage of the Internet Protocol version 6 (IPv6) → includes Mobile IP, once it can be used in a production environment
  - Billing of services and access is possible due to large address space.
- Different communication technologies can be used to transfer data on the back-channel:
  - 3G or 4G communication networks
  - Wireless LAN infrastructure (W-LAN)
  - WiMax
- „*Enabler*“ for new (data) services

Literature

- [NTTDoCoMo2007] NTT DoCoMo, www.nttdocomo.com, accessed 2007-09-05.
- [Sauter2008] Sauter, M. (2008): Grundkurs Mobile Kommunikationssysteme (3., erweiterte Auflage), Vieweg, Wiesbaden.