mobile business

Lecture 5

Mobile Communication Services

Mobile Business I (WS 2016/17)

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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

mobile business

Overview
Mobile Communication Services

- Classic Mobile Communication Services
  - Voice / Fax
  - Short Message Service (SMS)
  - Mobile Data Services
- Mobile Multimedia Services
  - Multimedia Messaging Service (MMS)
  - Wireless Application Protocol (WAP)
  - i-mode
  - Mobile Broadcast TV
  - IP Multimedia Subsystem (IMS)
- IP-based Mobile Services
  - Push Email Services
  - Voice over IP (VoIP)
  - Rich Communication Suite – enhanced (RCS-e/joyn)
  - Mobile IPTV
- Annex: Wireless Application Protocol (WAP) and Wireless Markup Language (WML)

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 addressee)
    - *Point-to-multiple SMS* (several addressees)
    - *Cell broadcast SMS* (all users in a cell are addressees)
  - 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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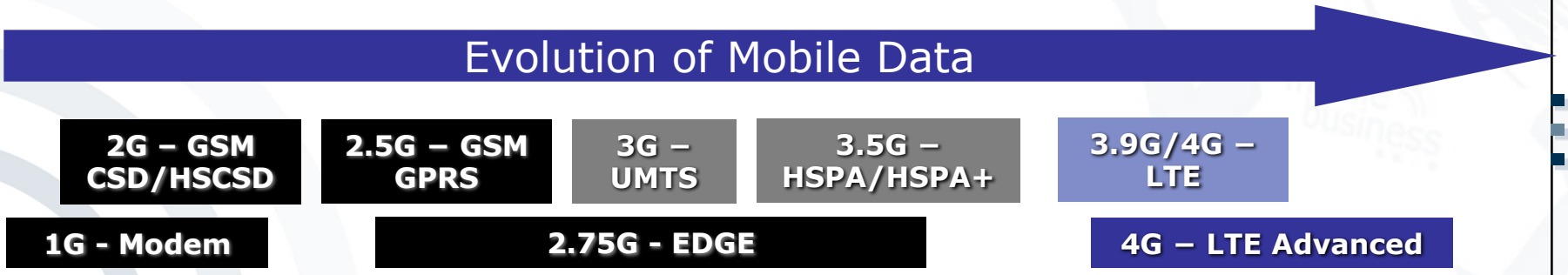
Mobile Data Services

- **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
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.

Mobile Data Services
General Packet Radio Service (GPRS)

- First packet-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.
- Packet orientation implies the introduction of new billing methods.

[Sauter 2008]

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).

[Sauter 2008]

Mobile Data Services - Enhanced Data Rates for Global Evolution (EDGE)

- Basic idea of EDGE was the implementation of networks with 3G-like 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) and LTE (3.9/4G) networks are rolled out throughout Europe, more and more GSM networks are still upgraded with EDGE technology. The reason for this is that frequency bands below 1 GHz (GSM often uses 900 MHz) facilitate adequate network coverage especially inside buildings.
- EDGE can also be implemented in mobile networks that do not use the GSM standard, such as TDMA in America.

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Mobile Multimedia Services
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.
- Used by companies such as Deutsche Bahn and Air Berlin because of reliability (e.g. for ticketing).

DB Mobility Networks Logistics

airberlin

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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 [HungKuChang 2003]

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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 packet-based data transmission.

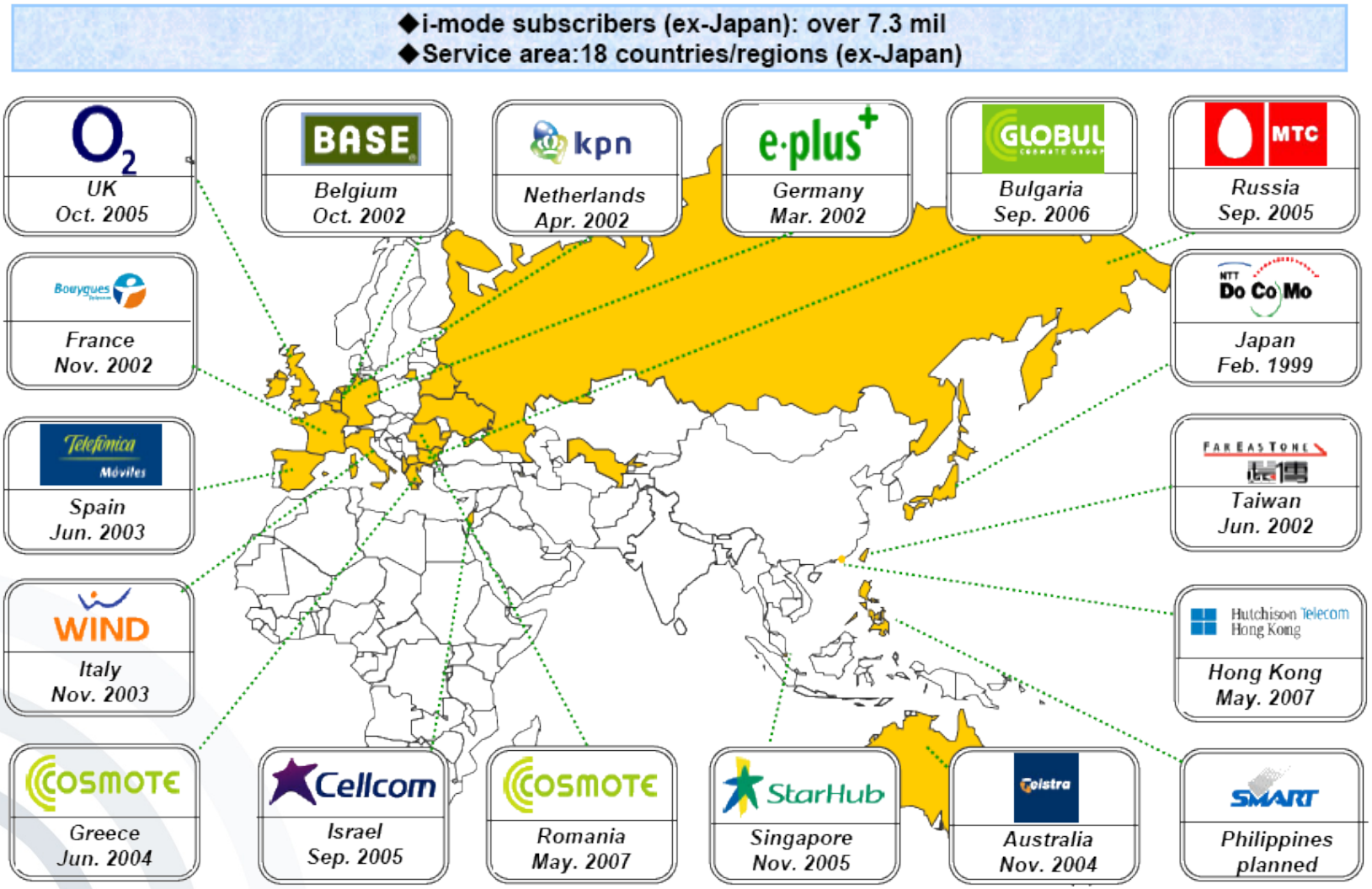
  ➲ Requires special i-mode devices

  ➲ Advantages

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

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

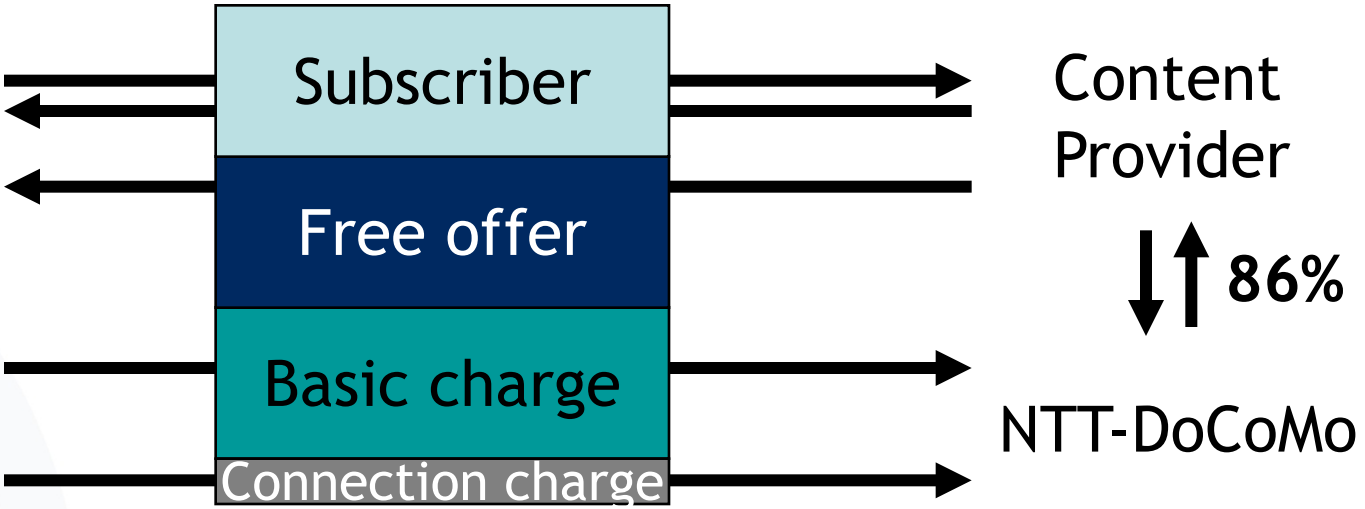
Mobile Multimedia Services
i-mode Services around the world



Dates indicate service launch [NTTDoCoMo 2007]

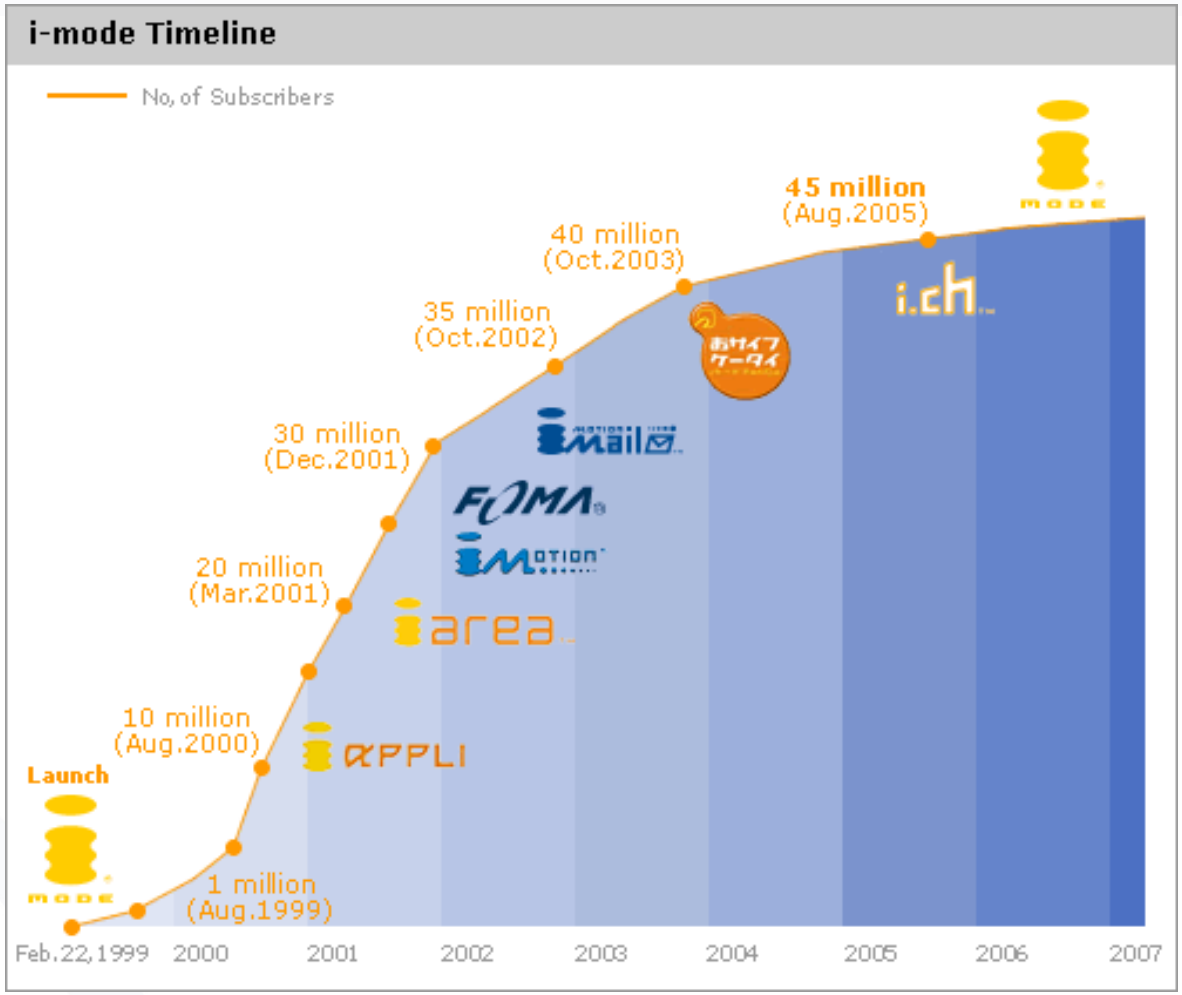
Mobile Multimedia Services
i-mode

- 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:



Mobile Multimedia Services

i-mode Users Base Development (worldwide)



[NTTDoCoMo 2007]

- 2015: i-mode is an important part of the market for DoCoMo's traditional flip-phones

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

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

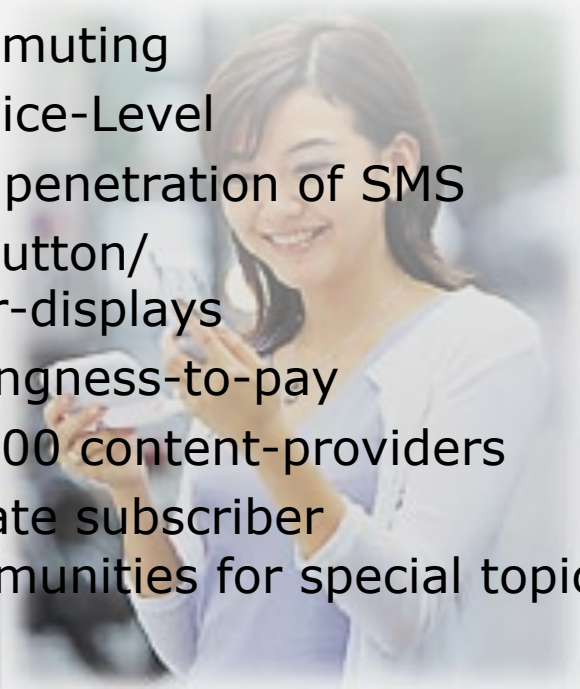
- 2008-04-01 i-mode service ended by E-Plus

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

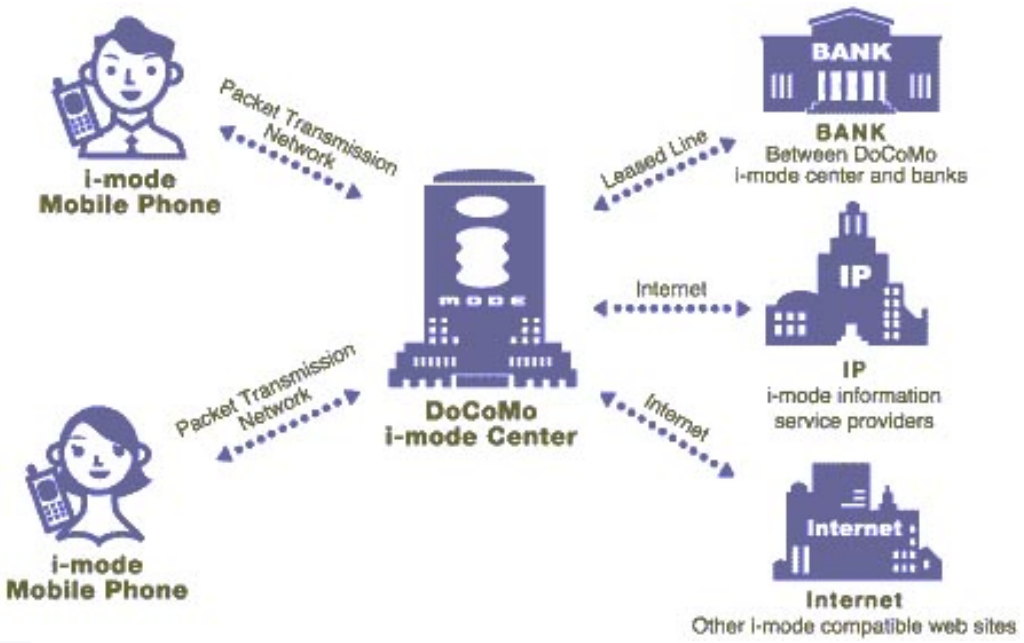


Germany:

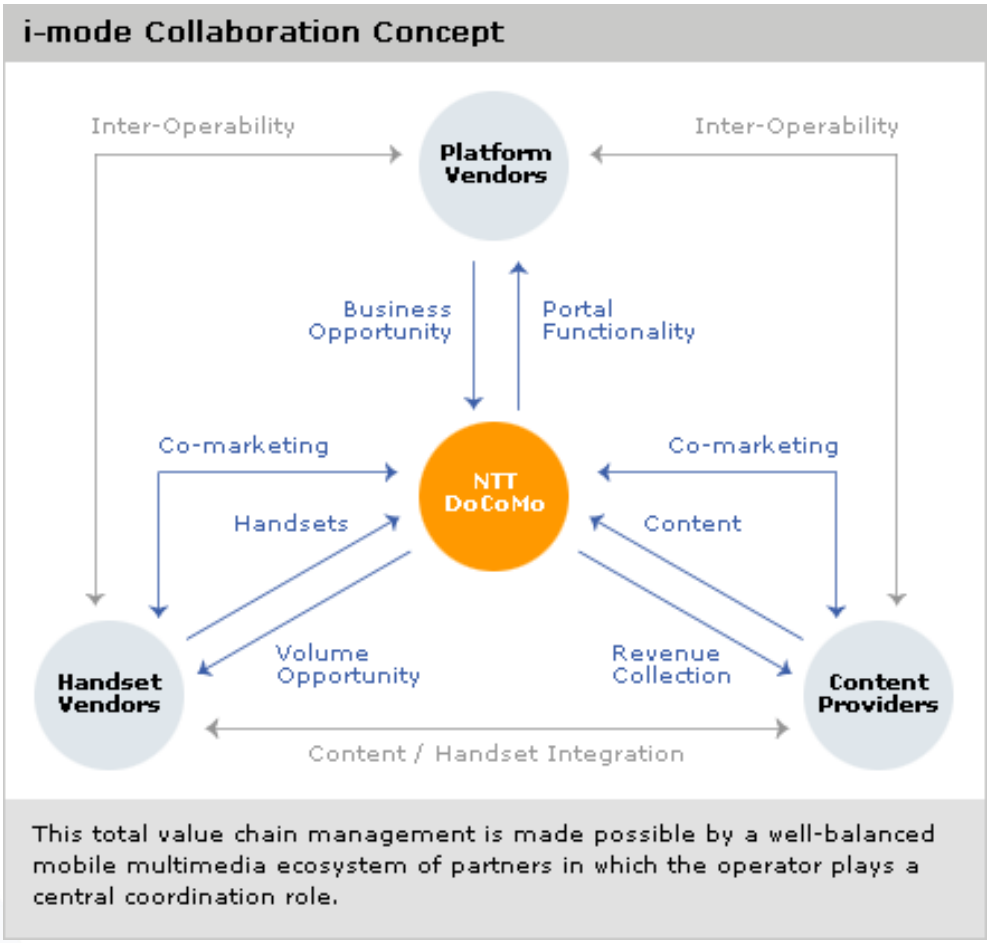
- Primarily voice + SMS
- About 160 content providers
- Skepticism
- SMS

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



[NTTDoCoMo 2007]

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Mobile Multimedia Services
Mobile Broadcast TV

- Digital Video Broadcast (**DVB-H** for handheld devices) and Digital Multimedia Broadcasting (**DMB**) were tested and launched in some markets (Italy, Austria), but failed economically and were hence switched off.
- Multimedia Broadcast Multicast Service (**MBMS**), a technology to broadcast Mobile TV through UMTS/3G networks, was published in Release 6 from 3GPP, but not deployed by any network operator.
- **Evolved** Multimedia Broadcast Multicast Service (**eMBMS**) – or short "LTE Broadcast" – was published in Release 9 from 3GPP and might see commercial launches in the future. Tests by MNOs in 2014, e.g. by
  - Vodafone in Düsseldorf football stadium in May 2014 [Voda2014] and at Kieler Woche [Connect2014];
  - KPN at the Amsterdam Arena stadium in 2014 [KPN2014].

3GPP A GLOBAL INITIATIVE

LTE

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Mobile Multimedia Services
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:
  - Push Email Services
  - Voice over IP (VoIP), e.g. Skype
  - Rich Communication Suite – enhanced (RCS-e/joyn)
  - Mobile IPTV
- Other IP-based mobile services:
  - Instant Messaging
  - Online Games
  - Automotive Communication

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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, 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 recipients device
- Currently, the most popular implementations are proprietary (e.g. RIM Blackberry, Microsoft Exchange ActiveSync, Apple iCloud).
- However, **more open standards** also exist:
  - Push-IMAP (with IMAP-IDLE command)
  - Synchronization Markup Language (SyncML)

Microsoft Exchange 2013

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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.
    H.323 Plus: an open-source project for H.323.
  - The IETF (Internet Engineering Task Force) on the other hand follows an Internet-based approach by using **SIP** (Session Initiation Protocol).
    Opal: an open-source project for SIP.

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 have switched 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).

VoIP telephony in Long Term Evolution networks

- LTE networks are **IP-based** (all-IP networks)

- Four different approaches to provide telephony services in Long Term Evolution networks:
  - CSFB (Circuit Switched Fallback)
  - **VoLGA** (Voice over LTE via GAN – Generic Access Network)
  - **VoLTE (Voice Over LTE)** based on the IP Multimedia Subsystem (IMS) network.
  - SVLTE (Simultaneous Voice and LTE, handset-based approach)

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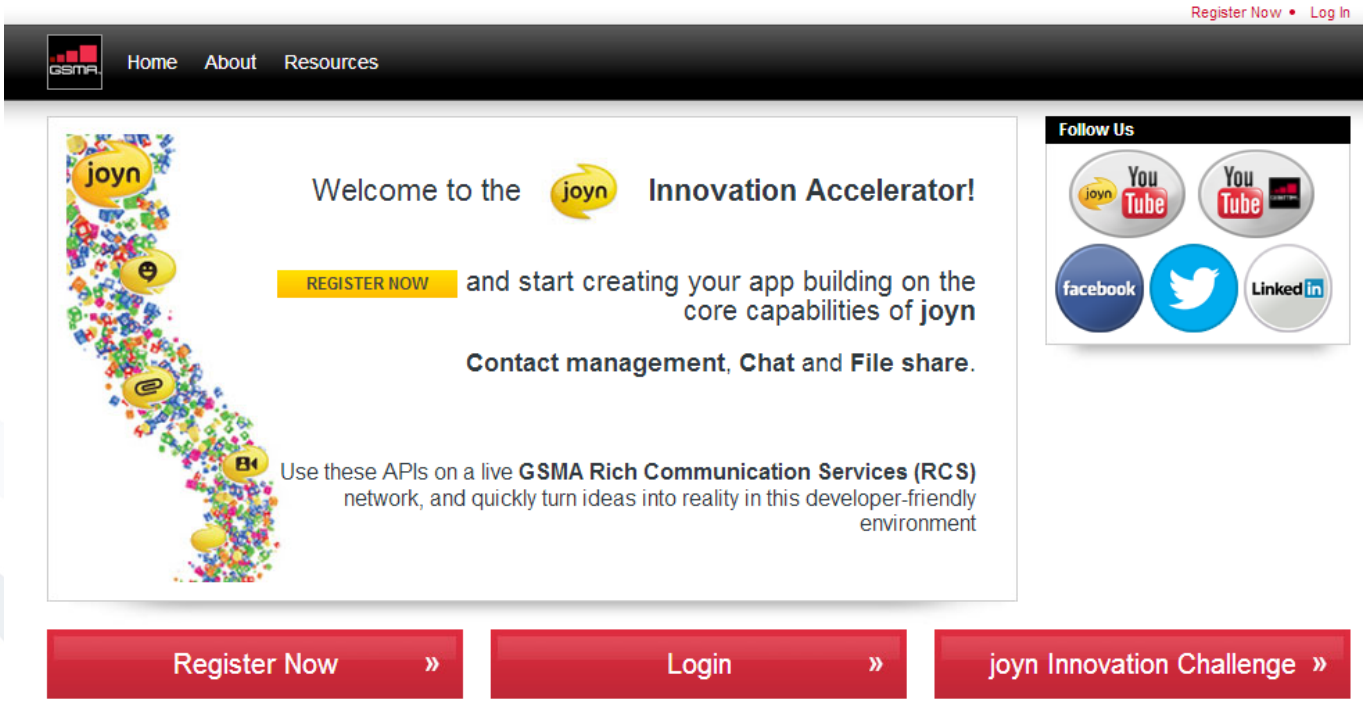
IP-based Mobile Services
RCS-e/joyn

Rich Communication Suite – enhanced (RCS-e)

- Cross-carrier ecosystem developed in a **global initiative by the GSMA**
- GSMA supports mobile network operators in their effort to market the service using **brand name** joyn (Message+) to application developers and end users.



joyn Innovation Accelerator website, http://rcs.oneapi-gw.gsma.com, accessed on 2013-10-11.

IP-based Mobile Services
RCS-e/joyn Features*

- "Enhanced Phonebook": Automatic update of contacts (network converged address book), social presence information (status, available services)

- "Enhanced Messaging": 1-to-1 and group chat, file transfer, sending location data

- "Enriched Calls": Voice connections can be enhanced by IP-based communication (e.g. video calls). In LTE networks: Voice over IP/LTE, Video over IP/LTE.

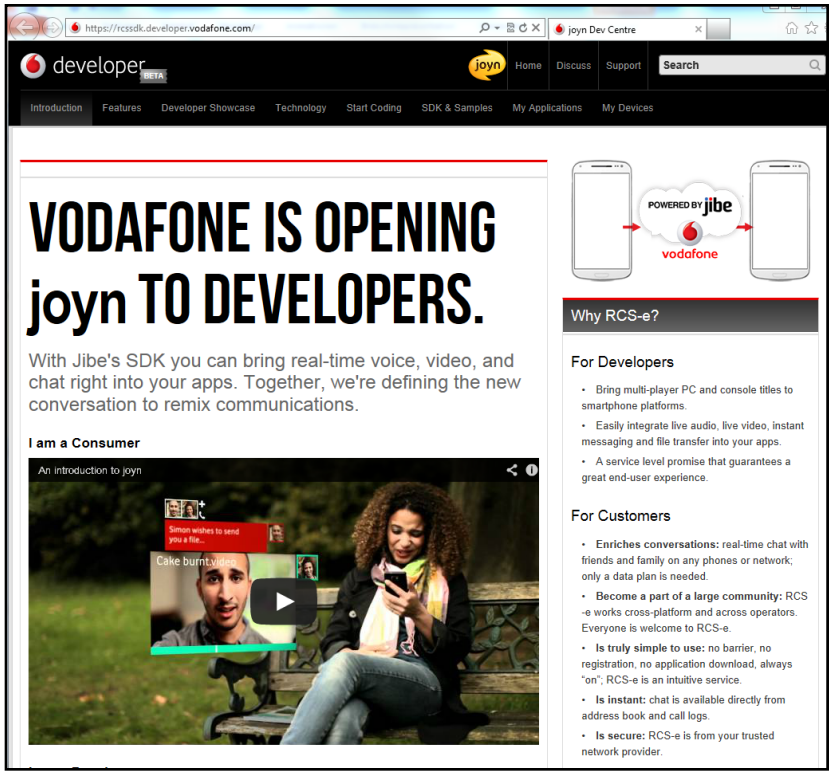
* RCS-e specification Release 5

IP-based Mobile Services
RCS-e/joyn MNO Perspective

- **Wide range of IP-based services** are implemented into the network infrastructure.
- Built upon the capabilities of the **IP Multimedia Subsystem (IMS)** – like Voice over Long Term Evolution (VoLTE)
- Provides *"Mobile Network Operators (MNOs) with a means of transitioning voice and messaging services into an all-IP and LTE world"*. [Wiki 2013]
- **Global interoperability** (interworking between networks) and development and distribution of user-friendly und secure **RCS-e client software** for smartphones users using various **mobile OS** platforms among biggest challenges

IP-based Mobile Services
RCS-e/joyn User Acceptance

- User acceptance depends especially on
  - availability of user-friendly apps and stable smartphone client software for the users' mobile OS,
  - interoperability throughout most networks,
  - pricing and pricing transparency.



https://rcssdk.developer.vodafone.com, accessed on 2013-06-05.

- Therefore MNOs encourage developers to implement joyn features into 3rd-party software

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IP-based Mobile Services
Mobile IPTV

- IPTV is originally targeted to set-top boxes. How to make IPTV *mobile*, i.e. available on smartphones and tablets?
- Unicast or Multicast?
  - Linear TV programme or streaming of individual content (web streaming)?
  - Both suffer from bandwidth limitations of the mobile network and a wireless link being sensitive to interferences
- 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 (WLAN)
  - WiMax
- „Enabler“ for new (data) services

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Wireless Application Protocol (WAP)

- In 1997, Ericsson, Motorola, Nokia and Unwired Planet founded the WAP Forum.
- The WAP Forum is a nonprofit-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)

WAP

ANNEX

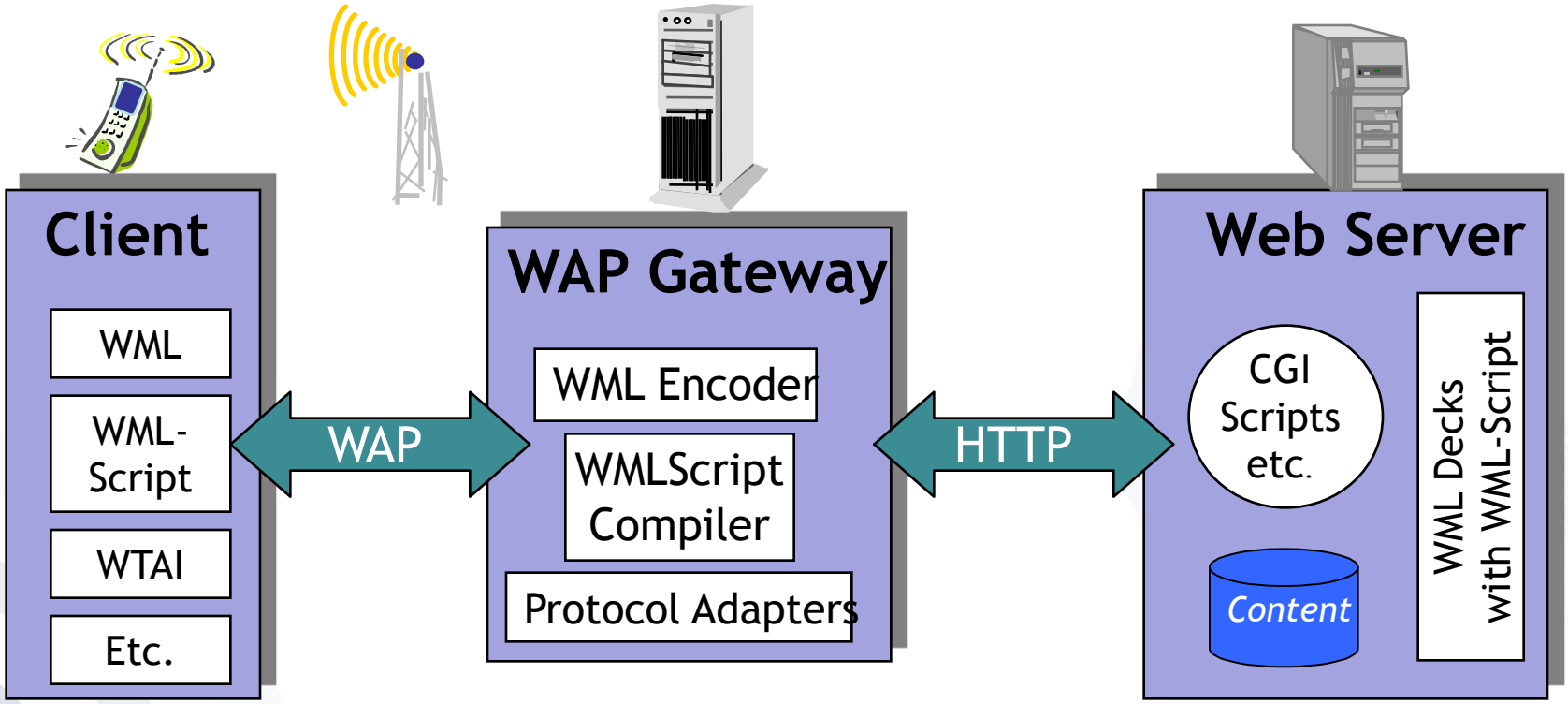
- Protocol-family, developed by the WAP forum to provide internet contents on mobile devices
- Universal use, independent from used network technology (GSM, UMTS, etc.)

ANNEX

- **Objectives**
  - Interoperability (support of devices from different manufacturers)
  - Scalability (services have to be extendable on demand)
  - Efficiency (quality of services should be as good as possible in wireless networks)
  - Reliability (consistent & predictable platform)
  - Security (Protection of integrity & confidentiality)

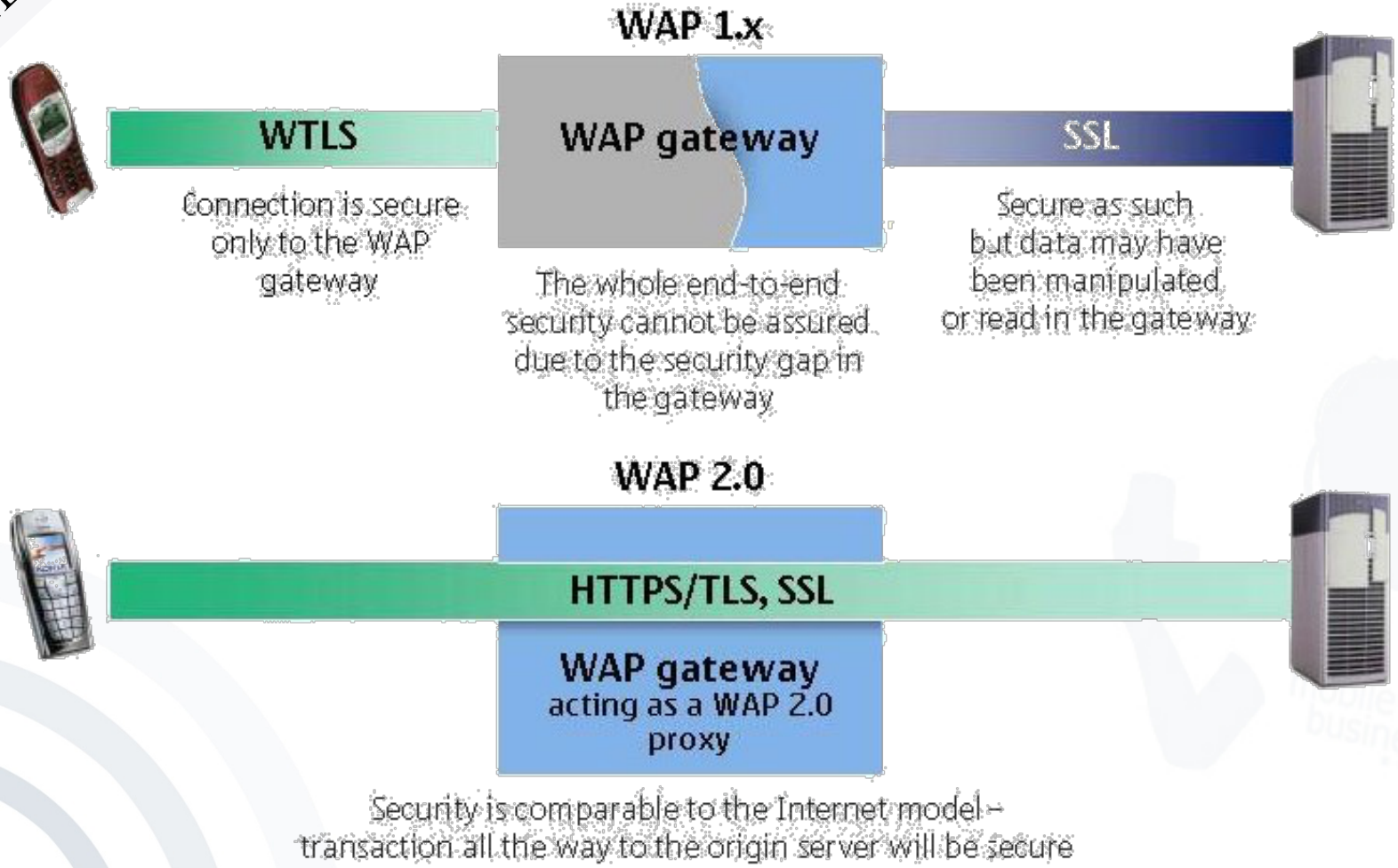
ANNEX

- **Application environment: WAP Gateway**



Comparison of Infrastructures WAP 1.x vs. WAP2

ANNEX



Example: WML vs. WWW Services

ANNEX

wap.bahn.de

pda.bahn.de

ANNEX

- **Wireless Markup Language (WML)**
  - Markup language used to define contents which are transmitted via WAP
  - Specified in 1998 by W3C as XML-document type
  - Challenges:
    - Attributes of mobile devices
    - Bandwidth of mobile networks

WML

ANNEX

- Small language (in comparison with HTML) to manipulate the display.
- Segmentation of WML documents in cards & decks (n:1)
- Navigation between Cards inside a WML document
- Navigation between Decks by opening a new WML document

ANNEX

- **Demo**


```
<?xml version="1.0"?>
<!DOCTYPE wml PUBLIC "-//WAPFORUM//DTD
WML 1.2//EN" "http://www.wapforum.org/DTD/
wml_1.2.xml">
<wml>
<head>
  <meta name="Author" content="Jan Muntermann"/>
  <meta name="Description" content="IWI Home"/>
</head>
<card id="startPage">
 <p align="center">
 <img src='images/iwi.wbmp' alt='Body'/>
 </p>
 <p align="center">
  Institut für Wirtschaftsinformatik<br/>
  <small>WAP-Demopage</small><br/>
  &#187;<a href="navigate.asp">weiter</a>&#171;<br/>
 </p>
  </card>
</wml>
```

mobile business

Literature

- [Connect2014] Connect, Vodafone: Per Smartphone aus dem Cockpit senden, http://www.connect.de/news/vodafone-lte-tdd-broadcast-videouebertragungen-kieler-woche-2392497.html, accessed 2014-09-03.
- [KPN2014] KPN Corporate - KPN test succesvol LTE broadcast in Amsterdam ArenA http://corporate.kpn.com/pers/persberichten/kpn-test-succesvol-lte-broadcast-in-amsterdam-arena.htm
- [HungKuChang2003] Hung, S.-Y., Ku, C.-Y., Chang, C.-M.: *Critical factors of WAP services adoption: An empirical Study*, Electronic Commerce Research and Applications, No. 2, pp. 42-60, 2003.
- [NTTDoCoMo 2007] NTT DoCoMo, www.nttdocomo.com, accessed 2007-09-05.
- [Sauter 2008] Sauter, M. (2008): Grundkurs Mobile Kommunikationssysteme (3., erweiterte Auflage), Vieweg, Wiesbaden.
- [Voda2014] Vodafone B2B Hub – Fernsehfunk der Zukunft im Test: LTE-Broadcast (02.06.2014), http://b2b.vodafone.de/fernsehfunk-der-zukunft-im-test-lte-broadcast/, accessed 2014-09-03.
- [Wiki 2013] Wikipedia: Rich Communication Services. http://en.wikipedia.org/wiki/Rich_Communication_Services, accessed 2013-10-11.