Cellular Mobile Networks - GSM
GSM Services

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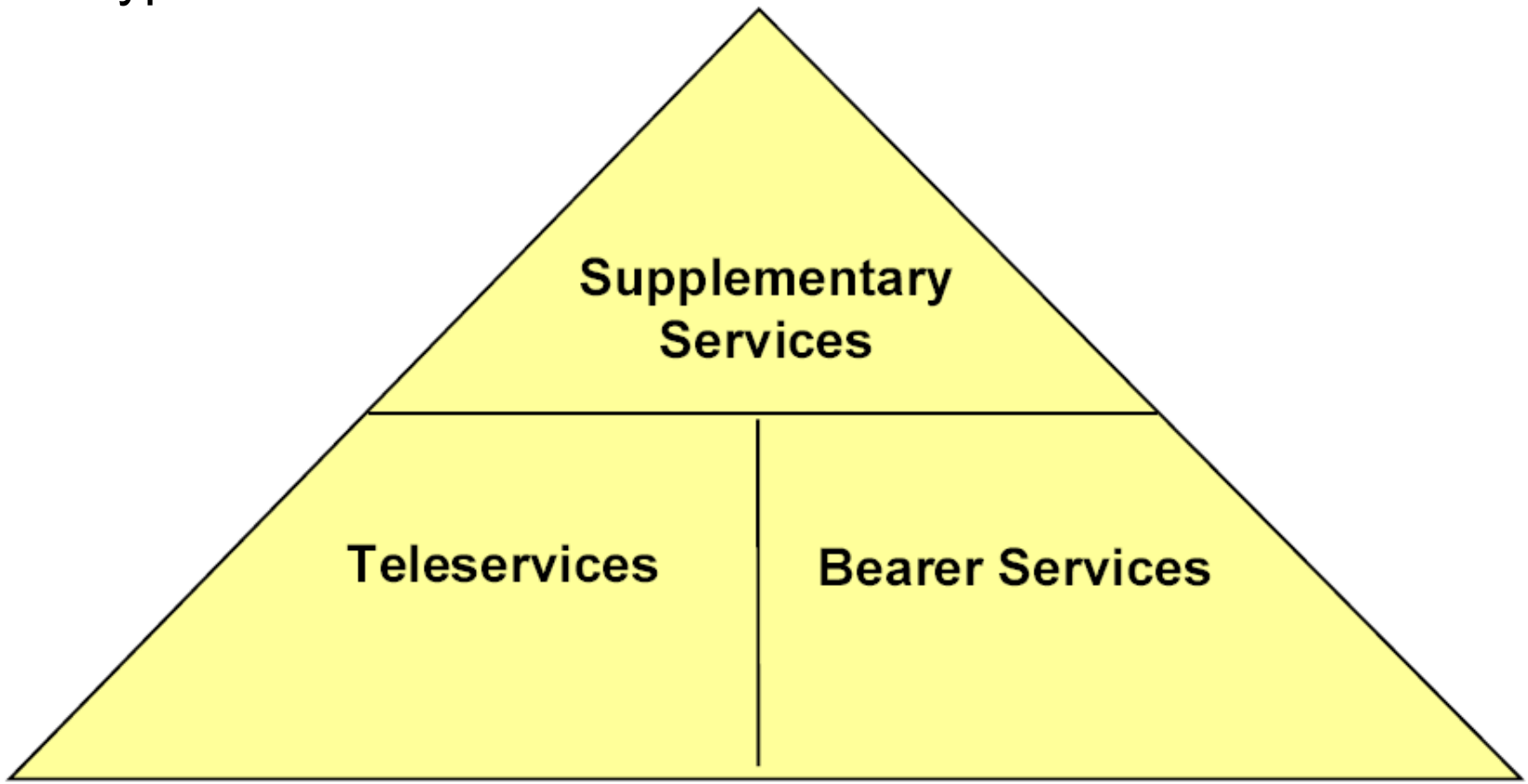
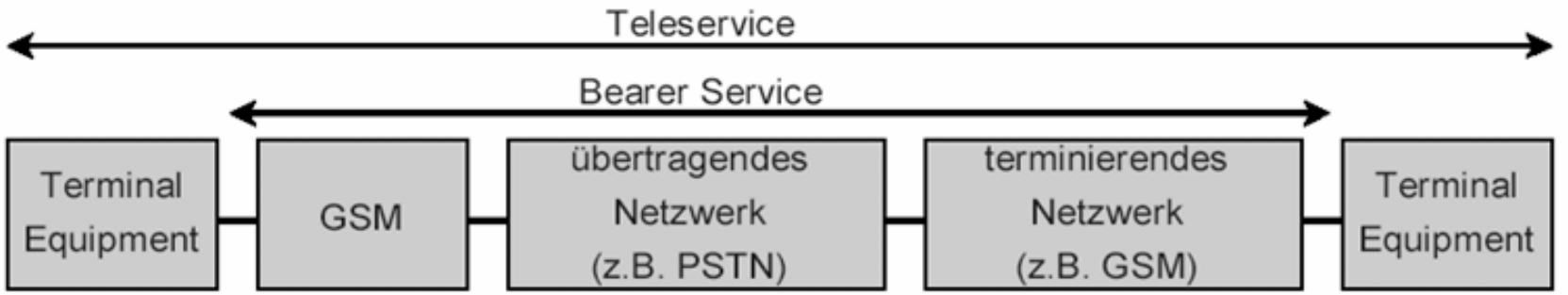
GSM Services - Overview

- GSM services are based on ISDN services
  - mobile network specific extensions and modification of ISDN services
- Service types:



GSM Services - Overview



- Teleservices
  - services between end devices including the end user interface
  - examples: telephony (voice), fax, Short Message Service (SMS)
- Supplementary Services
  - services on top of Bearer Services and Teleservices
  - examples:
    - call forwarding, Calling Line Identification Presentation / Restriction (CLIP/CLIR)
    - call barring (outgoing (international) calls, incoming calls, …)
    - call holding, conference calls
- Bearer Services
  - pure transport services for voice and data
  - example: (data) transport service within the CS domain (GSM phase 1/2)

Bearer Services

- Bearer Services are services, that transport **data** between the user-to-network interfaces (data transport services)
- Bearer Services are specified up to the end device interface corresponding to OSI layers 1-3
- Originally (in GSM phase 1/2) the following transmission rates for data transport services in the CS domain had been defined:
  - data services (circuit switched):
    - synchronous: 1.2, 2.4, 4.8 or 9.6 kbit/s
    - asynchronous: between 300 and 9600 bit/s
  - data services (packet switched with Packet Assembler/Disassembler (PAD)):
    - synchronous: 2.4, 4.8 or 9.6 kbit/s
    - asynchronous: between 300 and 9600 Bit/s
- Today data services with higher bitrates are available for GSM $\Rightarrow$ see chapter “GSM Evolution”

Bearer Services in GSM Phase 1/2

BS No.	Service	Structure	Bitrate [bit/s]	Mode	Transmission
21	line oriented	asynchronous	300	T/NT	UDI / 3.1 kHz
22			1200	T/NT	UDI / 3.1 kHz
23			1200/75	T/NT	UDI / 3.1 kHz
24			2400	T/NT	UDI / 3.1 kHz
25			4800	T/NT	UDI / 3.1 kHz
26			9600	T/NT	UDI / 3.1 kHz
31	line oriented	synchronous	1200	T	UDI / 3.1 kHz
32			2400	T/NT	UDI / 3.1 kHz
33			4800	T/NT	UDI / 3.1 kHz
34			9600	T/NT	UDI / 3.1 kHz
				T/NT	UDI / 3.1 kHz
41	PAD	asynchronous	300	T/NT	UDI
42			1200	T/NT	UDI
43			1200/75	T/NT	UDI
44			2400	T/NT	UDI
45			4800	T/NT	UDI
46			9600	T/NT	UDI
51	PAD	synchronous	2400	NT	UDI
52			4800	NT	UDI
53			9600	NT	UDI
61	alternating speech/data		13000/9600		
81	speech followed by data		1300/9600		

T/NT: Transparent / Non-Transparent
UDI: Unrestricted Digital Information
PAD: Packet Assembler / Disassembler

Teleservices

- Teleservices are services, which enable users to communicate which each other over telephone end systems
- Teleservices offered in GSM (examples):
  - telephony
  - emergency calls (112, 911): free of charge; no SIM needed; mandatory for all operators; highest priority (possibly preemption of other connections)
  - multi numbering: several ISDN numbers per subscriber
  - voice mailbox
  - fax group 3
  - Teletext: according to ITU F.200 between two terminals
  - Short Message Service (SMS):
    - alphanumerical message transmission
    - SMS transmission over signaling channels $\Rightarrow$ simultaneous use of basic services (e.g. telephony) and SMS possible
    - Short Message Service Cell Broadcast (SMS-CB)

Teleservices

Category	TS No.	Service
Speech	11	Telephony; MOC, MTC
	12	Emergency Call
Short Message Service	21	Short Message MT, PP
	22	Short Message MO, PP
	23	Short Message Service Cell Broadcast SMSCB
Teletext transmission	51	Teletext
Fax transmission	61	Alternating speech / fax (Group 3), T/NT
	62	Fax (Group 3) automatic, T/NT

T/NT: Transparent / Non-Transparent

Supplementary Services

- Supplementary services comprise additional service attributes and complement basic services (Teleservices and Bearer Services); they can not be offered without basic services
- GSM Supplementary Services are identical (except for the lower transmission rate) to the ISDN Supplementary Services
- Supplementary Services can be different depending on the network operator or the used protocol version
- Important Supplementary Services (examples):
  - Calling Line Identification Presentation / Restriction (CLIP/CLIR)
  - completion of call to busy subscriber
  - call waiting
  - conference calling
  - call barring (incoming /outgoing calls)

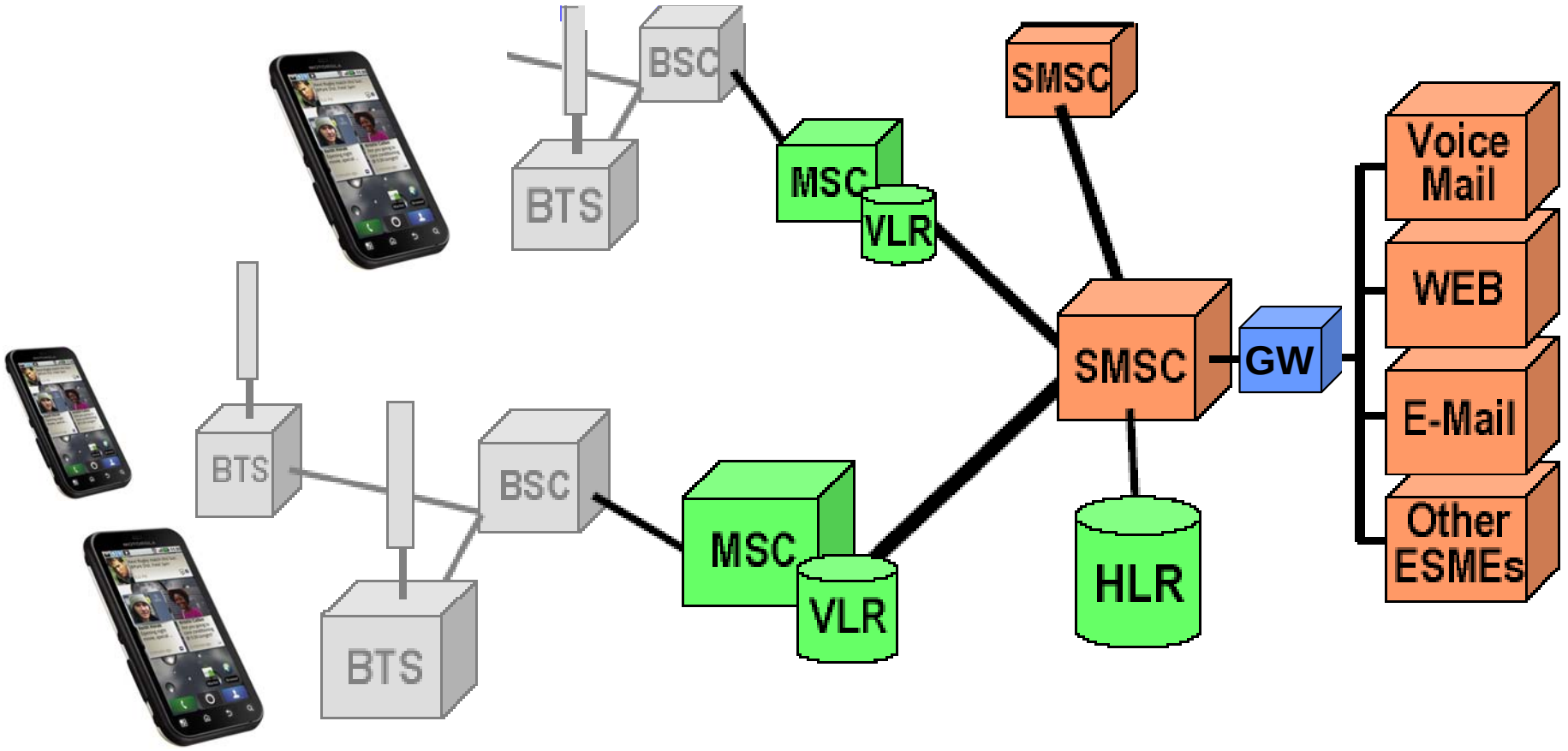
Supplementary Services

Category	Abbreviation	Service
Number Identification	CLIP	Calling Line Identification Presentation
	CLIR	Calling Line Identification Restriction
	CoLP	Connected Line identification Presentation
	CoLR	Connected Line identification Restriction
	MCI	Malicious Call Identification
Call Offering	CFU	Call Forwarding Unconditional
	CFB	Call Forwarding on mobile subscriber Busy
	CFNRy	Call Forwarding on No Reply
	CFNRc	Call Forwarding on mobile subscriber Not Reachable
	CT	Call Transfer
	MAH	Mobile Access Hunting
Call Completion	HOLD	Call HOLD
	CW	Call Waiting
	CCBS	Completion of Call to Busy Subscriber
Community of Interest	CUG	Closed User Group
Call Restriction	BAOC	Barring of All Outgoing Calls
	BOIC	Barring of Outgoing International Calls
	BAIC	Barring of All Incoming Calls
	BOIC-ex HC	BOIC except those to Home PLMN
	BIC-Roam	Barring of Incoming Calls when Roaming outside the home PLMN
Additional Information Transfer	UUS	User-to-User Signaling
Multi Party	3PTY	Three Party Service
	CONF	CONFerence calling
Charging	AoC	Advice of Charge
	FPH	FreePhone Service
	REVC	REVerse Charging

Annex:
GSM Services Examples

Short Message Service - SMS Network Elements

- SMS Network Elements: SMSC and SMS-GW



Short Message Service - SMS Center (SMSC)

- The SMSC is a store & forward network element for short messages
- The SMSC accepts short messages of different origins, for example from the Internet or from other SMSCs
- The SMSC stores the short messages until they are successfully delivered to the destination
  - however a maximum time period exists, which describes how long the short message will be stored at the SMSC; this time period depends on the network operator and can be set between one hour and several weeks
  - if a SMSC can not deliver a short message instantaneously, it starts another delivery attempt later on
  - after exceeding the time period, the short message is deleted and no further delivery attempts will be started

Short Message Service - SMS Gateway (SMS-GW)

- Tasks of the SMS-GW:
  - message type conversion, e.g.
    - SMS → E-Mail
    - E-Mail → SMS
    - SMS → Fax
    - SMS → voice output
  - SMS forwarding to other networks e.g.
    - GSM network → Internet
- The SMS-GW belongs to the infrastructure of the mobile network operator

Short Message Service - Message Length / Character Set

- SMS message length:
  - Point-to-Point SMS:
    - 160 characters (7-Bit encoding)
  - Cell Broadcast SMS (CB-SMS):
    - 93 characters
    - up to 15 CB-SMS can be concatenated
  - remark: the SMS message length might be restricted by the network operator
- SMS character set:
  - letters, numbers and some special characters
  - case sensitive
  - some mobile handsets can also receive/transmit simple graphics and ring tones via a SMS message

Short Message Service - SMS Extensions (EMS)

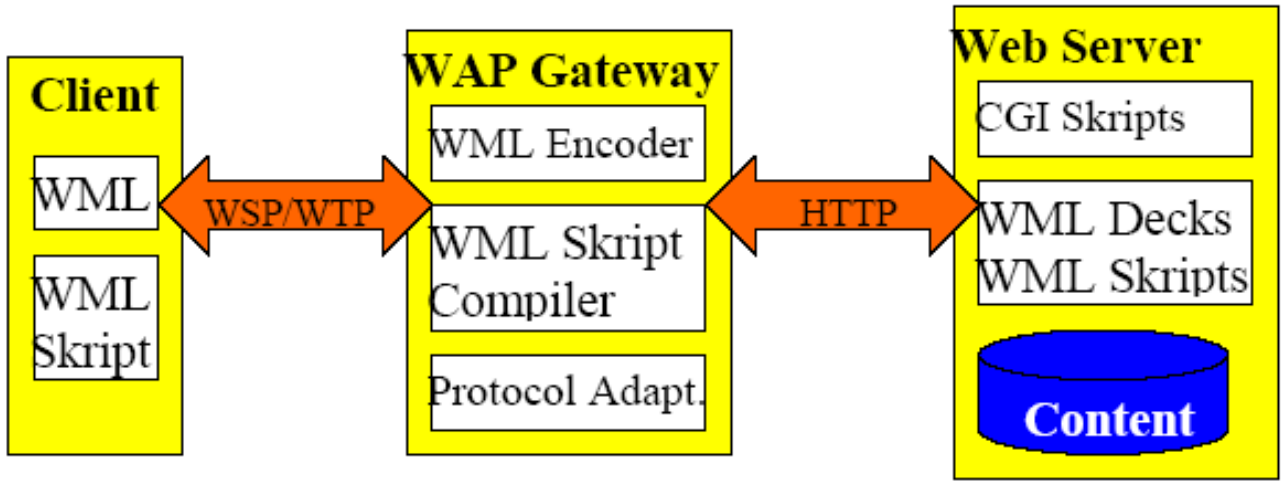
- Enhanced Message Service (EMS): definition of SMS extensions (while continuing the basic SMS service)
- EMS is fully based on the existing SMS standard; therefore an upgrade from SMS to EMS can be realized with low additional cost
- New EMS features (besides of text messages):
  - ring tones
  - pictures / graphics
  - animated graphics
- The message length is not limited to 160 characters any more
  - messages longer than 160 characters are split automatically into standard SMS messages (160 characters length) and are reassembled at the receiver
  - theoretical upper bound for EMS message length: 255 SMS
  - normally an EMS message comprises between 3 to 5 SMS messages

Wireless Application Protocol (WAP)

- Motivation: offering mobile internet services over existing GSM infrastructures
- 1997: foundation of the WAP Forum (by Ericsson, Nokia, Motorola, etc.)
- Reasons for the development of WAP:
  - the protocols used in the Internet, like HTTP and TCP are not efficient in a GSM network, due to the small bitrates offered by GSM → high delay and low throughput
  - standard-HTML sites are not properly displayed on small mobile phone screens

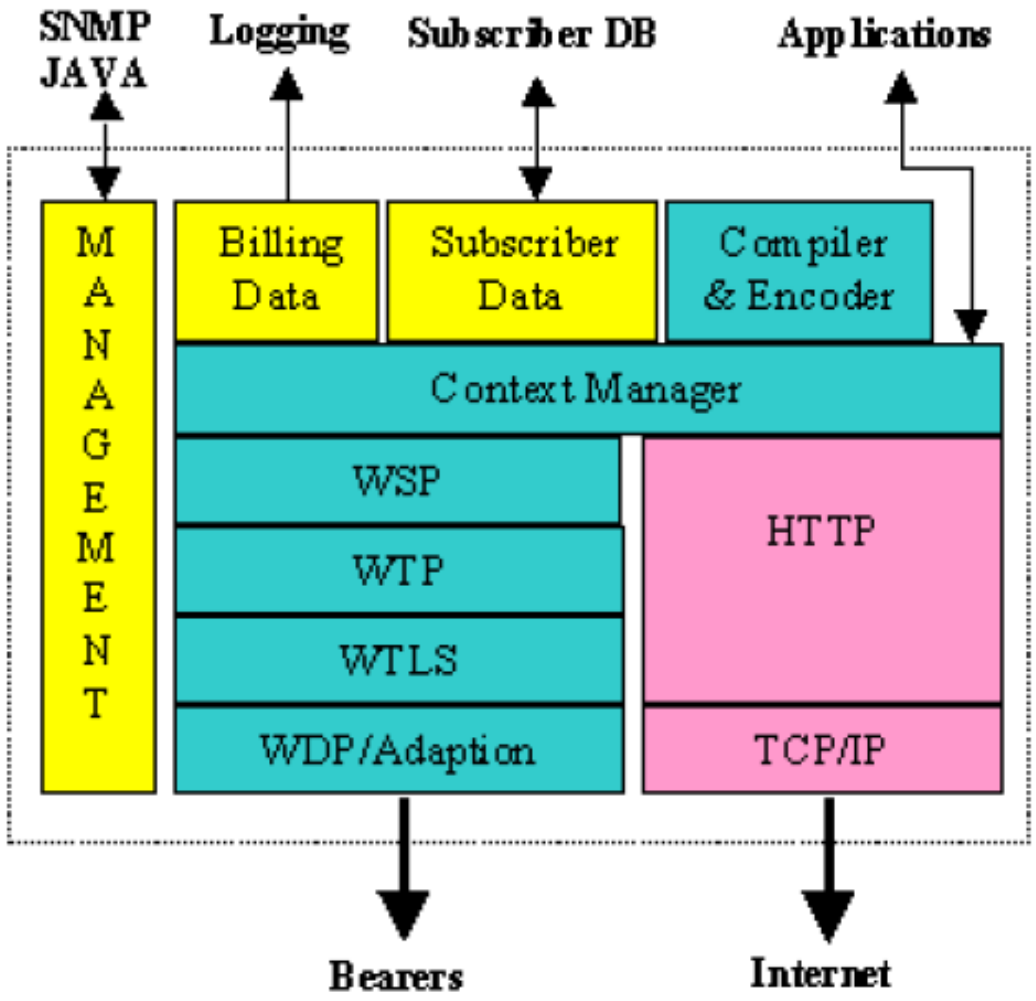
Wireless Application Protocol (WAP)

- WAP sites are programmed with WML (Wireless Markup Language) instead of HTML
- WML is a XML based language, which is optimized for small displays and allows a simple site navigation (with only one hand)
- WAP sites are scalable (the can be viewed on a 2 row display and also on a full graphic capable display)
- WAP service network elements:



Wireless Application Protocol (WAP) - WAP Gateway

- Internal Structure of a WAP Gateway:



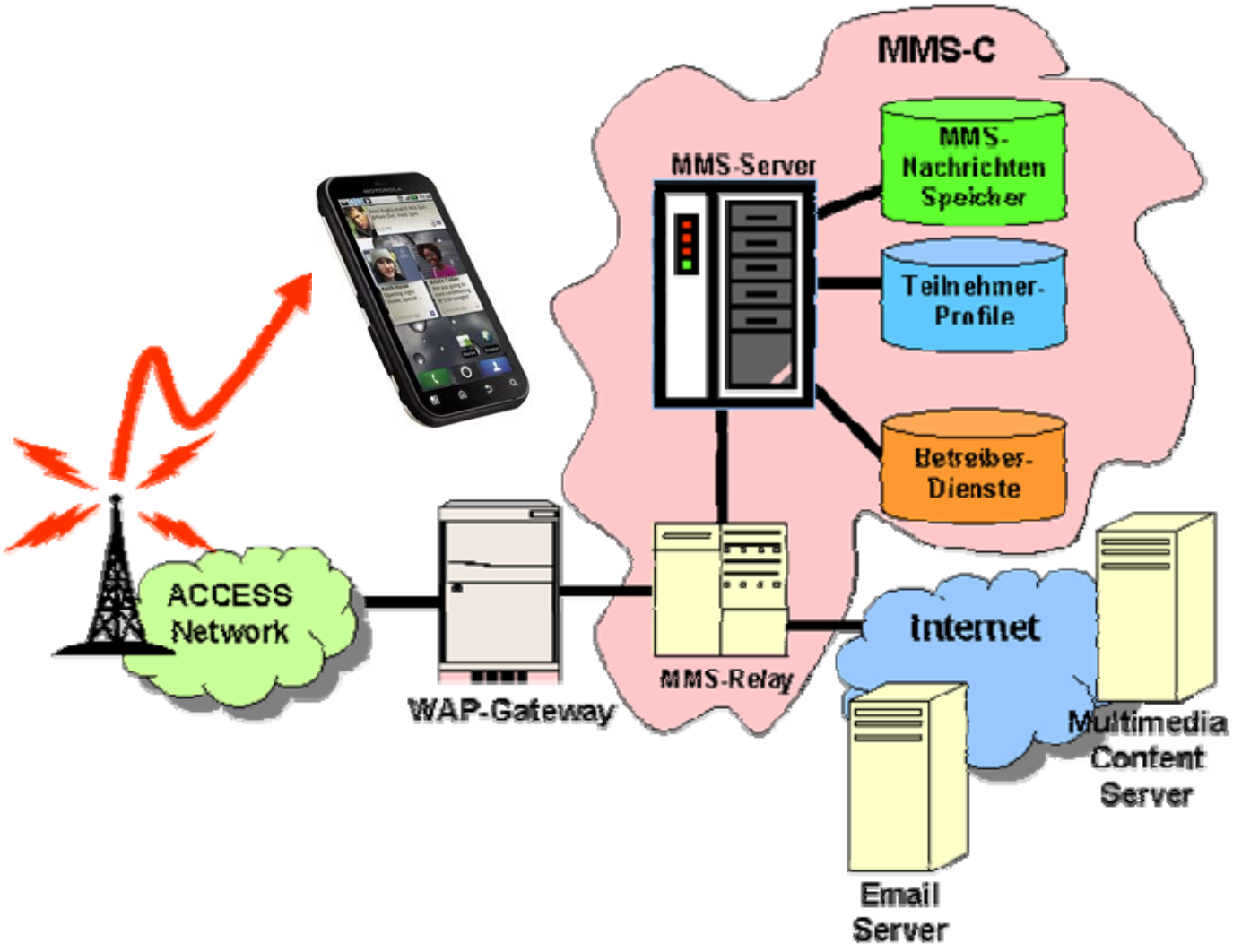
Wireless Application Protocol (WAP) - WAP Gateway

- WAP Datagram Protocol (WDP): transport layer of WAP; WDP can run over different bearers (e.g. SMS, GPRS, CSD (Circuit Switched Data))
- Wireless Transport Layer Security (WTLS): optional layer for security functions (necessary for applications like E-Banking); WTLS supports data integrity, confidentiality, authentication and protection against Denial-of-Service attacks
- WAP Transaction Protocol (WTP): increases the reliability of WDP
- WAP Session Protocol (WSP): enables an efficient exchange of data between applications
- The HTTP interface connects the WAP Gateway to the Internet; it enables the handset to retrieve content from the Internet
- WAP content (WML and WML scripts) is converted into a binary format for the transmission on the air interface

i-mode

- i-mode was launched by NTT DoCoMo in February 1999
- i-mode is technically similar to WAP 2.0
- i-mode sites are programmed with iHTML - iHTML offers a better graphic support than WML
- the following i-mode services had been offered in Germany by E-Plus over GPRS:
  - games and fun
  - news, infos and sport
  - ringtones and logos
  - chat and messaging service
  - i-mode mail

Multimedia Message Service (MMS) - Network Elements



Multimedia Message Service (MMS) - MMS Media Formats

- Text messages: all common character sets and fonts
- Voice: AMR-encoded voice (similar to UMTS)
- Picture files: as JPEG, GIF or BMP
- Music files: MP3, Midi and WAV
- Video files: MPEG4 (simple profile), Quicktime and ITU-T H.263
- Multimedia streaming (only useful for UMTS)