Course Overview

- Motivation
- Standardization issues
- UMTS architecture basics
- UE, UTRA, UTRAN, PS Domain
- Basic functionalities
- Mobility
- QoS
- Security and charging
- IMS
- Example signaling flows
- Business considerations
- UMTS - what comes next?

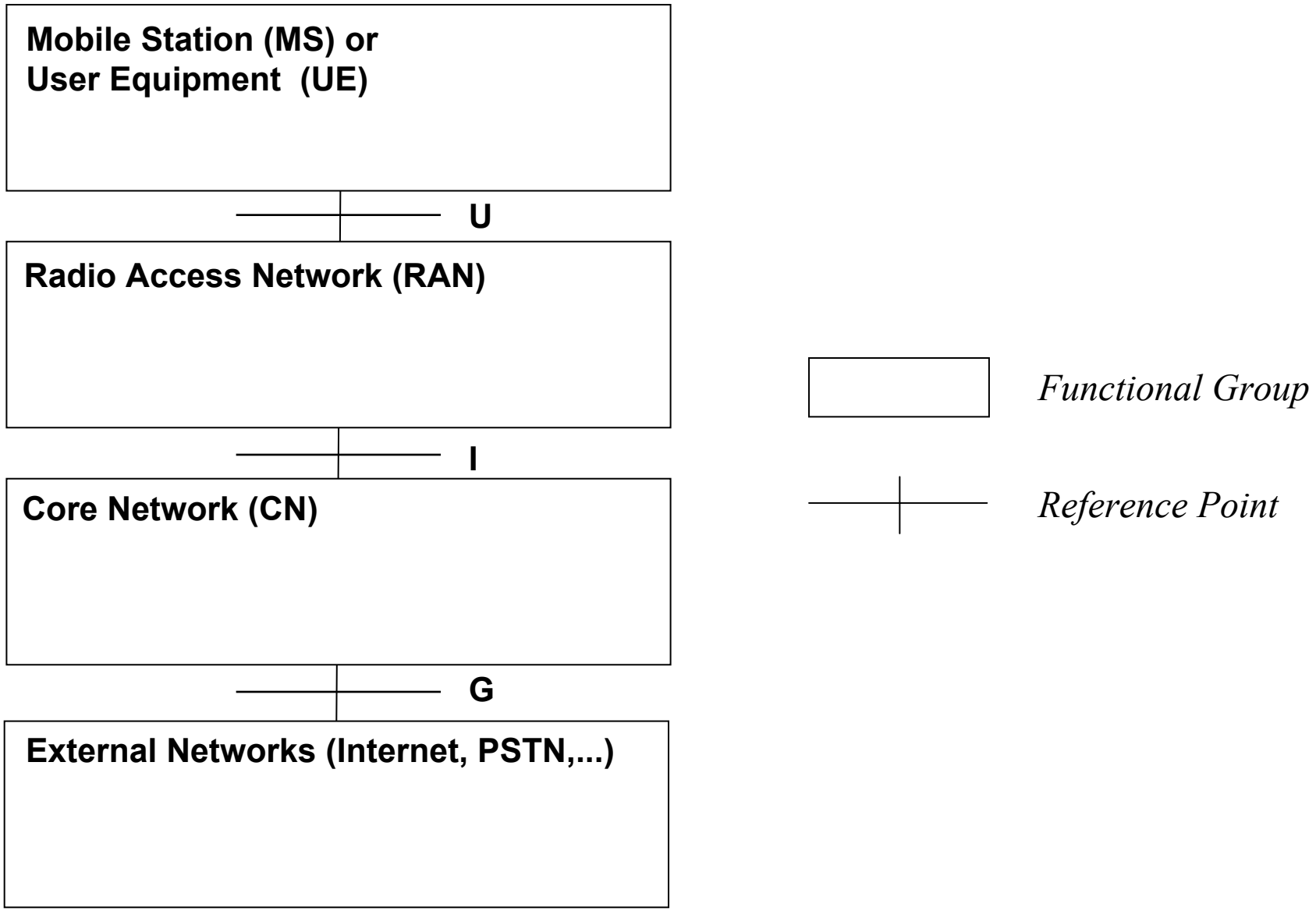
UMTS architecture basics

- Principles of network architectures
- For comparison: GSM architecture
- For comparison: GPRS architecture
- Conceptual UMTS architecture
  - UE
  - UTRAN
  - PS Domain
  - CS Domain
  - IMS

Principles of network architectures

- A network architecture is defined by
  - functional groups
    - defined by a set of functions
  - reference points
    - conceptual points separating functional groups
- The concept of functional groups may be applied in a hierarchical manner
- The functions of a functional group may be performed by one or more physical piece of equipment
- In a specific implementation, not all functions need to be implemented
- A reference point may represent a physical interface between pieces of equipment

Principles of network architectures
High level view of a mobile network architecture



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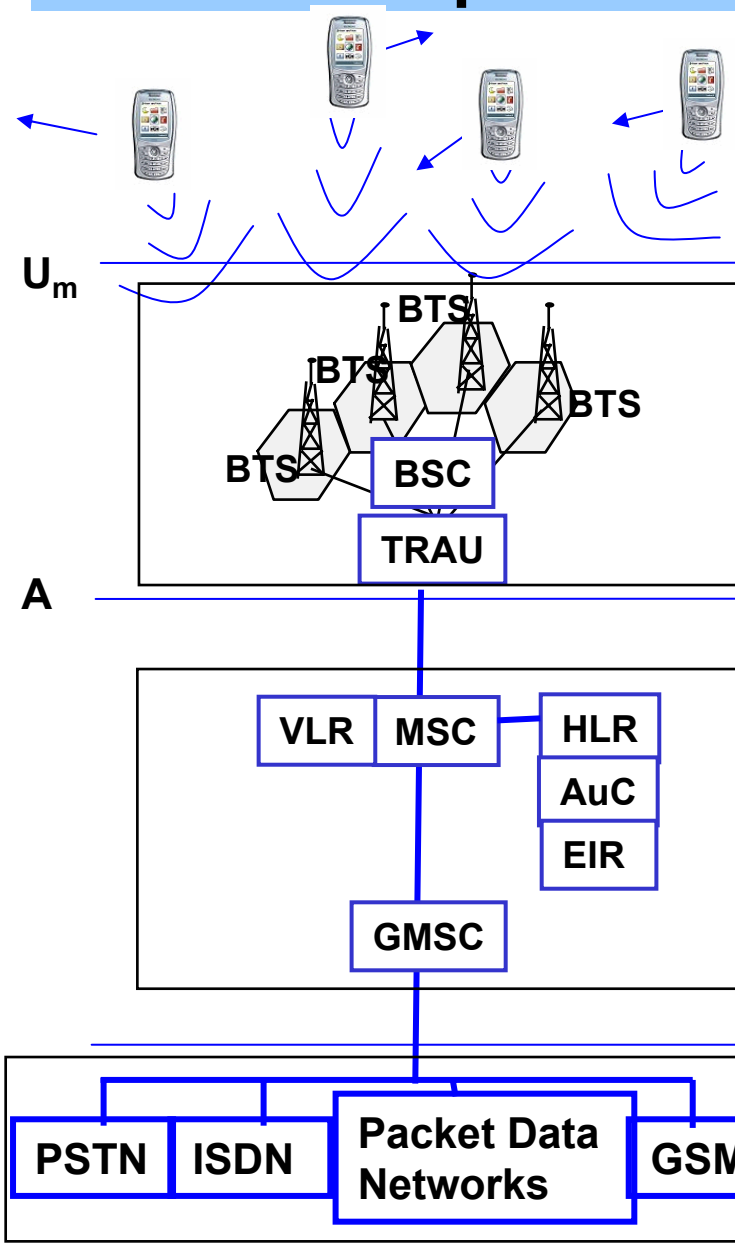
For comparison: GSM

- GSM is a *circuit switched* network
  - as opposed to packet switched networks based e.g. on IP
  - for all services (e.g. voice, fax, wap, sms) an end-to-end connection is established
  - all services are reserved the identical bandwidth
    - wasteful particularly on radio interface
  - all services are charged on a per-time unit basis

Simplified GSM architecture



Mobile Station (MS)

- User interface and Radio interface
- Service control
- User Identity Module (unique identification of user)

Base Station Subsystem (RAN)

- receive / send data from / to MS via radio link (BSS)
- control Radio specific signaling (BSC)
- Radio resource management (BSC)
- Transcoding and rate adaptation (TRAU)

Core Network (CN)

- Routing (MSC)
- Mobility management (MSC)
- Collection of charging information (MSC)
- Subscriber management (MSC)
- Interworking with external networks (GMSC)
- Data storage (suscriber profiles, current MSC (HLR, AuC, EIR / VLR)

External Networks

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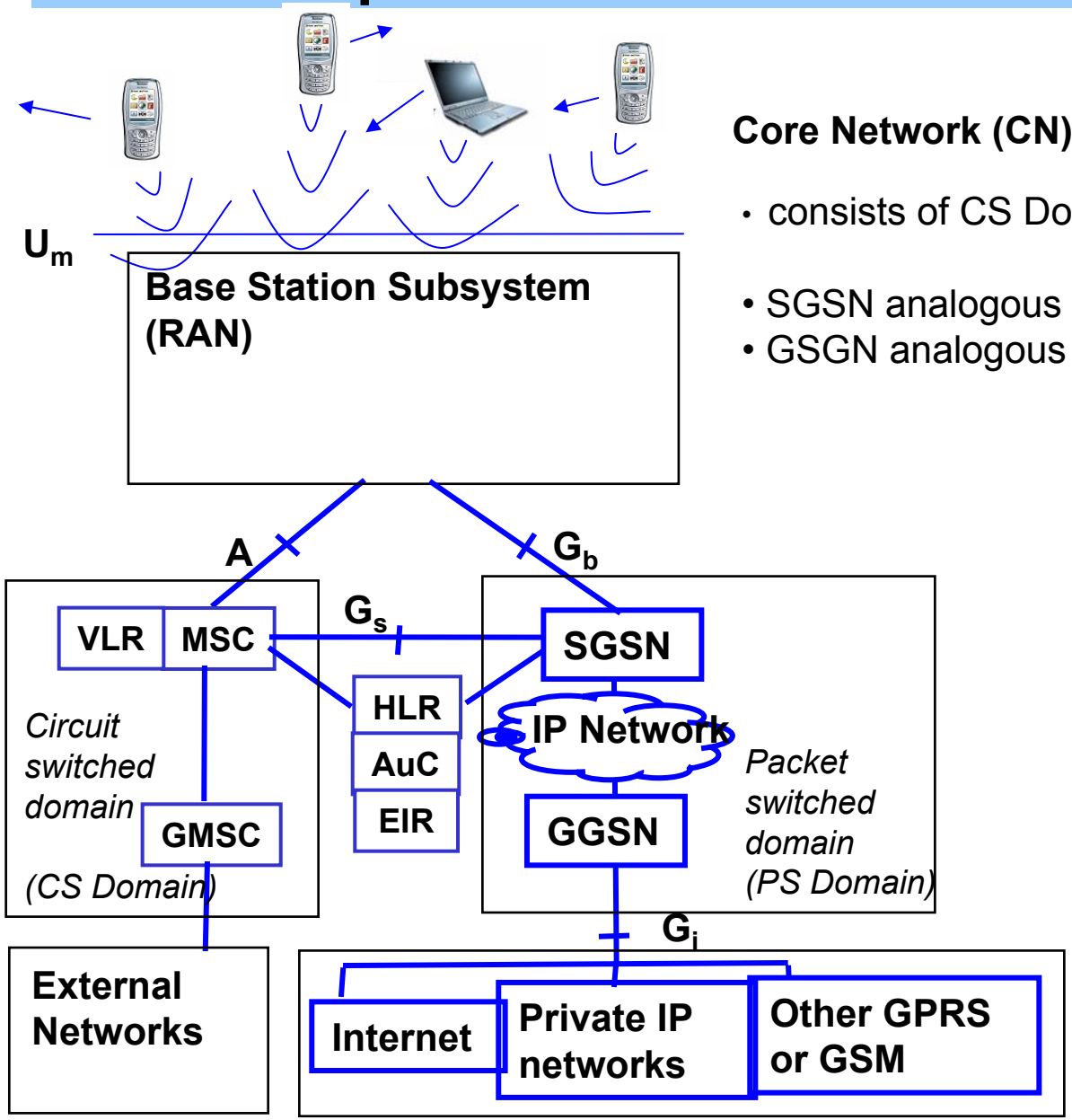
For comparison: GPRS

- GSM is a *circuit switched* network
- since an overall increase of *data traffic* is expected, GSM was evolved to become more flexible -> GPRS (General Packet Radio Service)
- GPRS is called 2.5 Generation
- GPRS adds technology for supporting data traffic:
  - a packet switched domain to the core network
  - a shared channel on the radio link
    - shared channel means several users share the same radio channel
    - as opposed to a dedicated channel as in GSM

  => more efficient usage of resources,because of statistical multiplexing
  - higher transmission rates (max 171,2 kb/s)
    - GSM originally has up to 14,4 kb/s
  - allows a direct connection to e.g. the Internet
  - charging per data volume possible
    - in GSM always charging per time unit

Simplified GPRS architecture I



Core Network (CN)

- consists of CS Domain and PS Domain in parallel

- SGSN analogous to MSC; but packet switched
- GSGN analogous to GMSC, but packet switched

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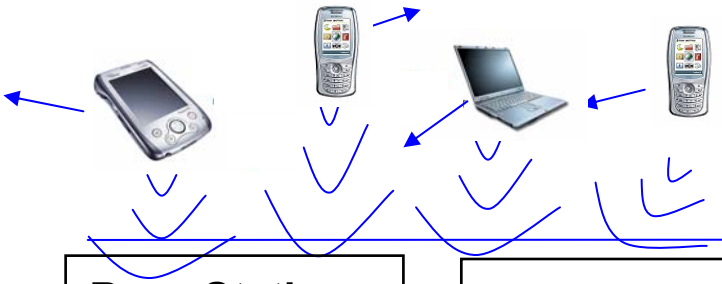
UMTS - Main changes from GPRS

- Add a new radio access network, the UTRAN
  UTRAN - UMTS Terrestrial Radio Access Network
  - UTRAN and GSM radio access network can coexist and connect to the same Core Network
- The CS Domain may also be based on packet based transport
  - slow evolution towards „all-IP“ -- may be some day abandon the circuit switched domain all together
- Introduction of the IMS IMS - IP Multimedia Subsystem
  - support of IP-based multimedia services
    - multimedia services are e.g.
      Video, voice, possibly simultaneously with data etc.
      - e.g. IMS vital for locating IP-address of addressees
    - the PS domain just provides QoS,
      it does not provide multimedia services (app. layer)
    - the PS domain serves as access system to the IMS
      - the IMS in principle is access-system independent
      - the PS domain hides mobility from the IMS

UMTS basic network architecture



User Equipment (UE)

Base Station Subsystem from GSM

UMTS Radio Access Network (UTRAN)

Radio Access Network (RAN)

Radio link between UTRAN and UE is called UTRA

A

$I_{u\text{-}ps}$

$I_{u\text{-}cs}$

G_b

Core Network (CN)

circuit switched domain
CS Domain

packet switched domain
PS domain

G_i

G_i

IP Multimedia Subsystem (IMS)

External Networks (Internet, PSTN,...)

Summary

- The mobile networks we are looking at consist of
  - UE / MS, RAN and CN
  - they provide access to external networks
- GSM is circuit switched
- GPRS adds support for packet switching
- UMTS evolves from GPRS by
  - adding a new RAN
  - adding the IMS
- A UMTS Network consists of
  - UE
  - UTRAN
  - Core Network (CS Domain, PS Domain and IMS)

Accumulated Abbreviations

1G, 2G, 3G	1st Generation,...3rd Generation
3GPP	3rd Generation Partnership Project, produces UMTS standard
3GPP2	3rd Generation Partnership Project 2, produces cdma2000 standard
AuC	Authentication Center
B3G	Beyond 3rd Generation
BSC	Base Station Controller, controlling node in GSM RAN
BTS	Base Station Transceiver, network element, incl antenna in GSM RAN
cdmaOne	One of the 2nd Generation Systems, mainly used in Americas and Korea
cdma2000	member of the IMT-2000 family for 3G, successor of cdmaOne
CS Domain	Circuit-switched Domain, one of the UMTS functional groups
CN	Core Network; in UMTS consisting of CS Domain, PS Domain and IMS
EDGE	Enhanced Data Rates for GSM Evolution
EIR	Equipment Identity Register
GGSN	Gateway GPRS Support Node, network element in the PS domain
GMSC	Gateway MSC, network element in CS Domain, gateway to external networks
GPRS	General Packet Radio Service, 2.5 Generation system
GSM	Global System for Mobile Communications, European 2G System
HLR	Home Location Register, main subscriber database in GSM and GPRS
HSCSD	Hich Speed Circuit Switched Data, higher data rate for GSM
ID	Internet Draft, working document of the IETF, becomes RFC when generally accepted
IETF	Internet Engineering Task Force, responsible for Internet Standardization

Accumulated Abbreviations

IMS	IP Multimedia Subsystem, one of the UMTS functional groups
IMT-2000	International Mobile Telecommunications at 2000 MHz, 3G concept by ITU
ITU	International Telecommunication Union, international standardization body
IS-95	= cdmaOne, one of the 2nd Generation Systems
MS	Mobile Station (term used in GSM and GPRS)
MSC	Mobile Switching Center, network element in CS Domain
PS Domain	Packet-switched Domain, one of the UMTS functional groups
PSTN	Public Switched Telephone Network
R99	UMTS Release 1999
RAN	Radio Access Network
RFC	"Request For Comment", Specification by IETF
Rel4, Rel5..	UMTS Release 4,..
SGSN	Serving GPRS Support Node
TRAU	Transcoding and Rate Adaptation Unit
TS	Technical Specification, Standard by 3GPP
QoS	Quality of Service
UE	User Equipment (term used in UMTS)
UMTS	Universal Mobile Terrestial System, member of the IMT-2000 family for 3G, successor of GSM
UTRAN	UMTS Radio Access Network
UTRA	UMTS Radio Access; Radio link between UTRAN and UE
VLR	Visited Location Register, network element in GSM and GPRS, stores user data in visited network