Protocol Technology

GPRS

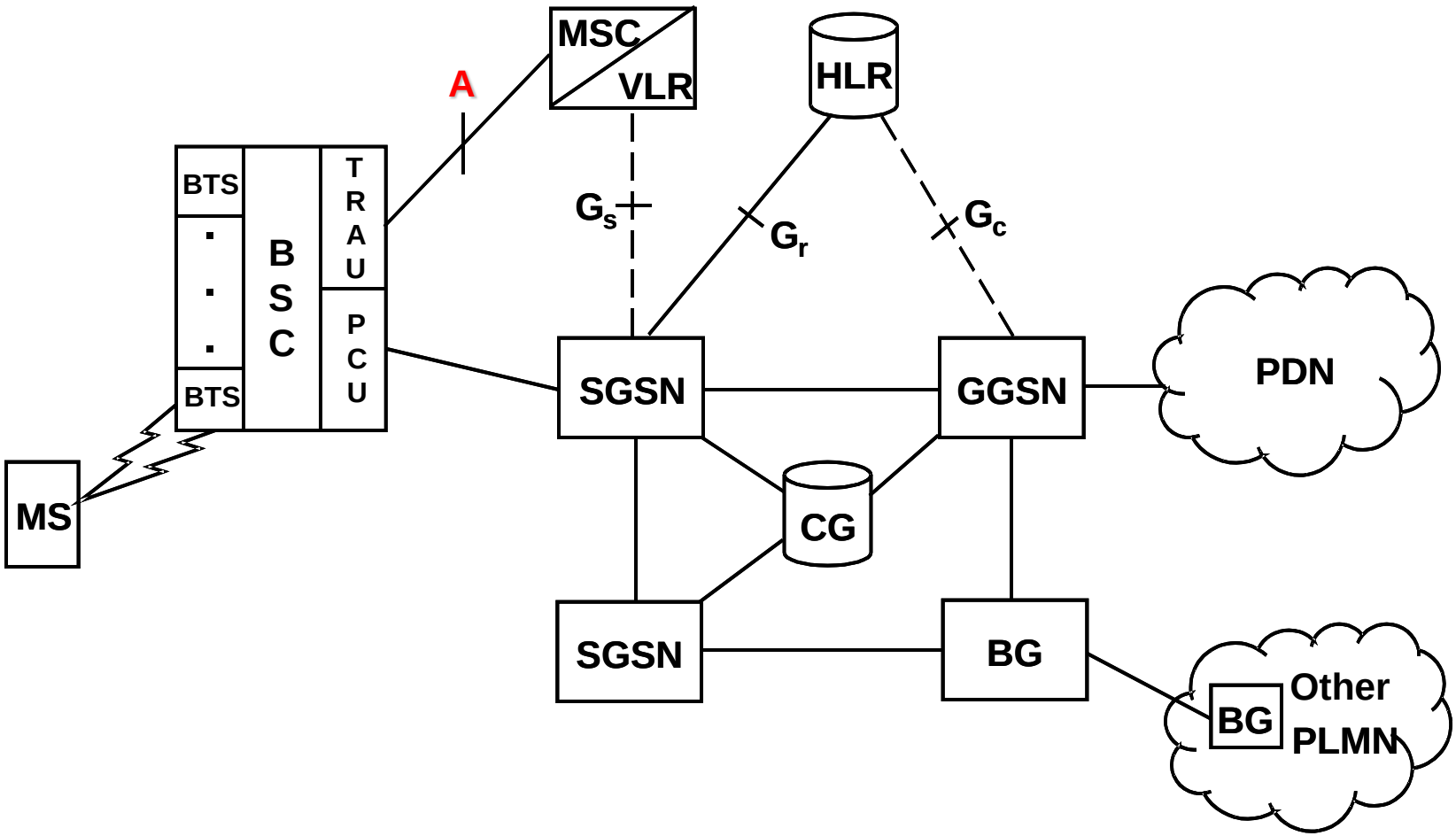
Gusztáv Adamis
BME TMIT
2016

GPRS Networks

- GPRS – General Packet Radio Service
- Extension to GSM networks – for packet switched data transfer
- Not only over GSM, but over UMTS

- GPRS is a Service
  - GPRS Network – is a network, in which GPRS is implemented

Structure of GPRS networks



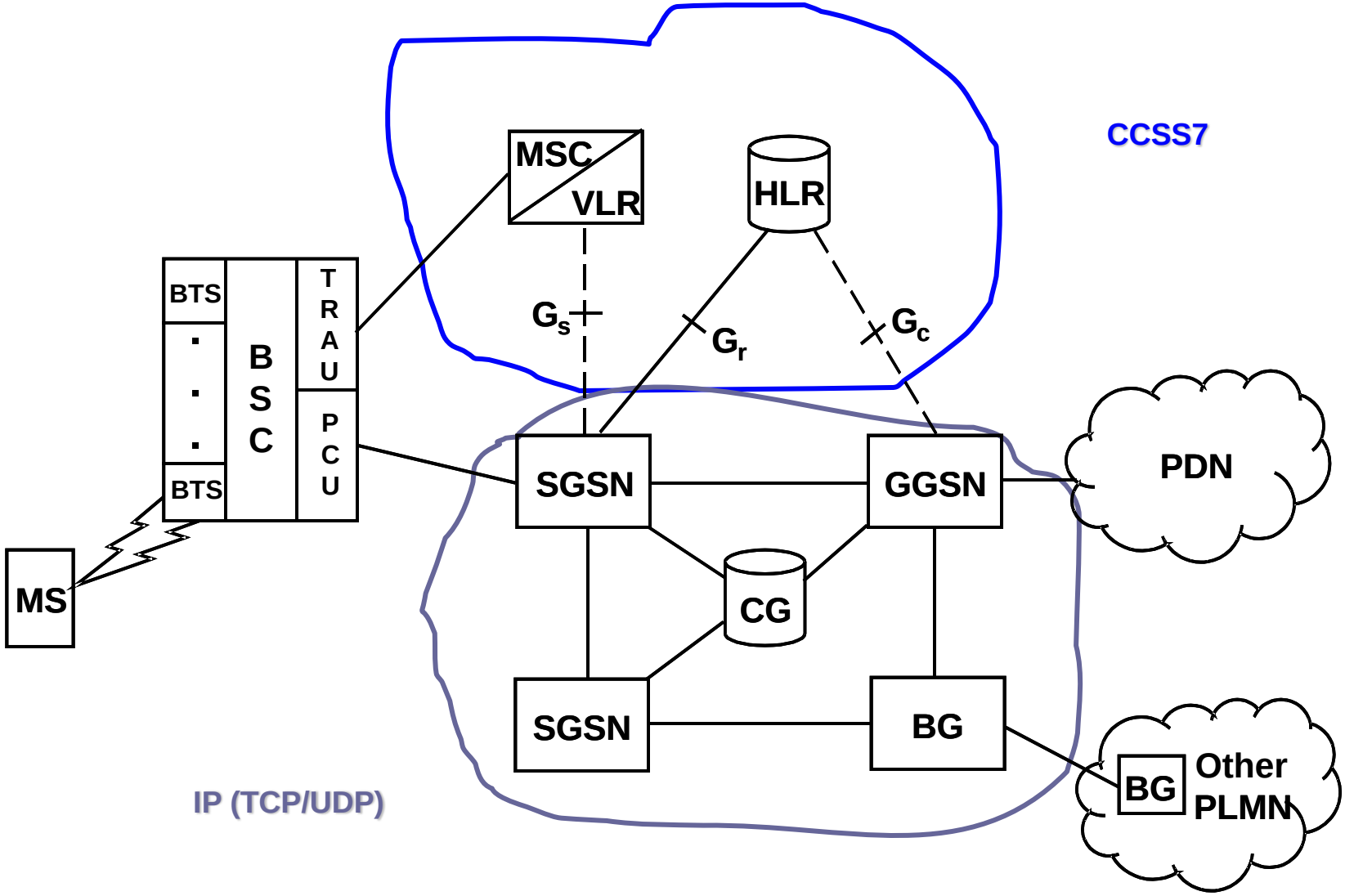
GPRS network elements

- GGSN: Gateway GPRS Support Node
  - connection to a PDN (Packet Data Network – e.g. Internet)
- SGSN: Serving GPRS Support Node
  - packet switch
  - ciphering – layer 2, NOM II – III – with different K_c
  - mobility management (~ VLR functionality)
  - to be able to report to HLR – G_r IF
  - optional G_s IF toward VLR
    - not necessary to connect to GPRS and to GSM separately (NOM I)
- CG: Charging Gateway
  - SGSN: charge of using GPRS
  - GGSN: charge of using „outer” PDN
- BG: Border Gateway
  - connection to other GPRS PLMN

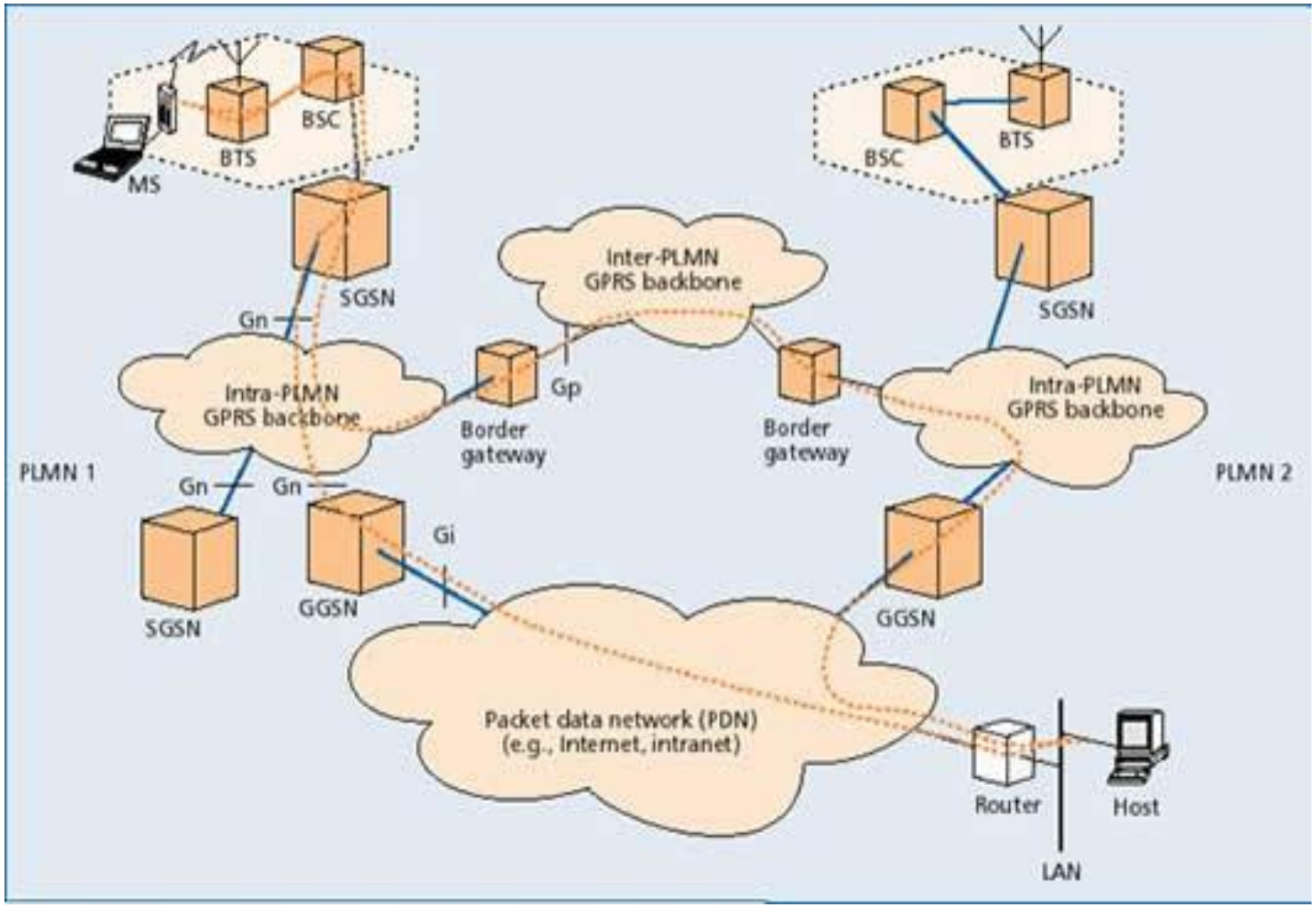
Extensions of GSM network elements, new IF-s

- Extension to BSS
  - PCU – Packet Control Unit
- Extension to HLR
  - stores which MSC and ***which SGSN*** serves a mobile station
  - stores the tel. number of SGSN – to be able to transmit messages toward it through G_r IF (SCCP Global Title)
  - stores the IP address of SGSN IP – network should be able to send data packets to it
- CCSS7 interfaces
  - G_r (mandatory) SGSN-HLR: GPRS location update
  - G_c (optional) GGSN-HLR: to get routing info for MT GPRS data transfer
  - G_s (optional) SGSN-VLR: NOM I common connection procedure (GPRS/IMSI attach)

GPRS protocols



Overview of GPRS networks



APN – Access Point Name

- Network + operator identifier code
- Used to choose the GGSN toward the destination data network
  - Stored in HLR in user profile
  - Transmitted to SGSN during a „GPRS Location Update” (similarly, how the user profile was transmitted to MSC/VLR in GSM)
  - May be fixed or elective – depending on subscription

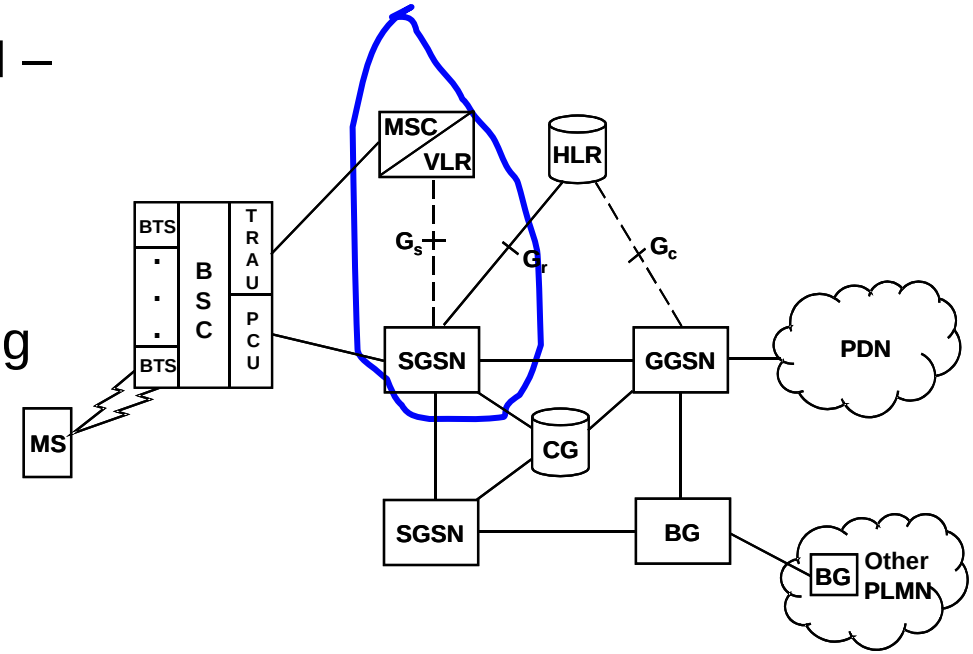
- www.t-mobile.hu
- internet.t-mobile
- internet.mnc030.mcc216.gprs

GPRS mobile stations

- Class A
  - can handle GSM/GPRS fully in parallel
  - can accept a call attempt even if there is an ongoing of the „other type”
- Class B
  - can monitor the GSM/GPRS call attempts in parallel
  - but only if there is NO ongoing connection
  - ongoing GPRS connection: GSM call can be indicated – user can decide
  - ongoing GSM connection: GPRS call can not be indicated
- Class C
  - can connect to GSM *OR* GPRS network
  - if to GPRS: not necessary to be able to receive even an SMS
  - every GSM-only MS: Class C

Network Operation Modes

- Is there an IF between SGSN – VLR (G_S)
- At radio IF common or separated GSM/GPRS Paging channel
  - PCH – Paging Channel
  - PPCH – Packet Paging Channel
- NOM I
- NOM II
- NOM III



NOM I

- If between SGSN – VLR G_s IF is established
  - this MUST be used
- At switching on/off: not necessary to attach to GSM (IMSI Attach/IMSI Detach) and GPRS (GPRS Attach/GPRS Detach) separately,
  - only to GPRS, SGSN can inform VLR
- During movement not necessary to inform both networks about location change
- MT (voice) call can be indicated by SGSN (Paging), so no need for a separated physical PCH/PPCH!
- That's the main advantage: MS shall monitor only one physical signalling channel (CCCH – Common Control Channel or PCCCH)
- Or even 0: during GPRS data transfer (PDCH – Packet Data Channel), Paging message can be inserted in between data packets!

NOM II

- No G_s IF between SGSN – VLR, about
  - attach/detach
  - location change

both networks must be informed separately

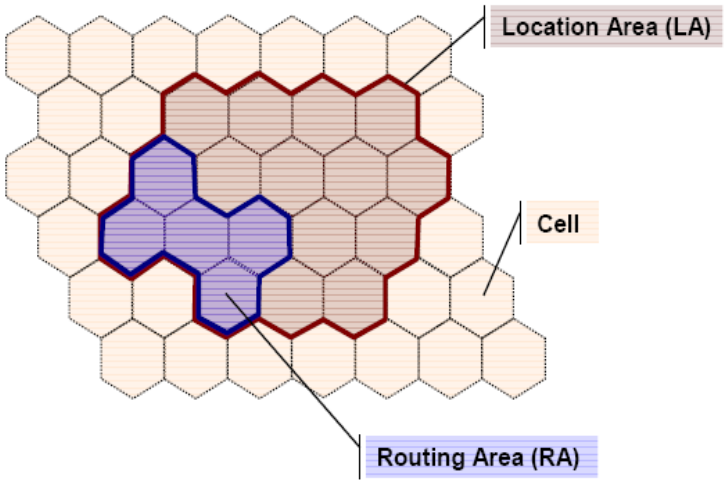
- Circuit switched Paging – MSC at A IF
- Packet switched Paging – SGSN
- BUT: Common PCH at radio interface
  - only this must be listened to
  - but even during ongoing GPRS data transfer!

NOM III

- Same as NOM II,
- BUT:
  - separate PCH and PCCH
  - the Class B mobiles that can listen to only one signalling channel falls back to Class C
- The worst for MS
- BUT requires the smallest change comparing to GSM

Routing Areas (RA)

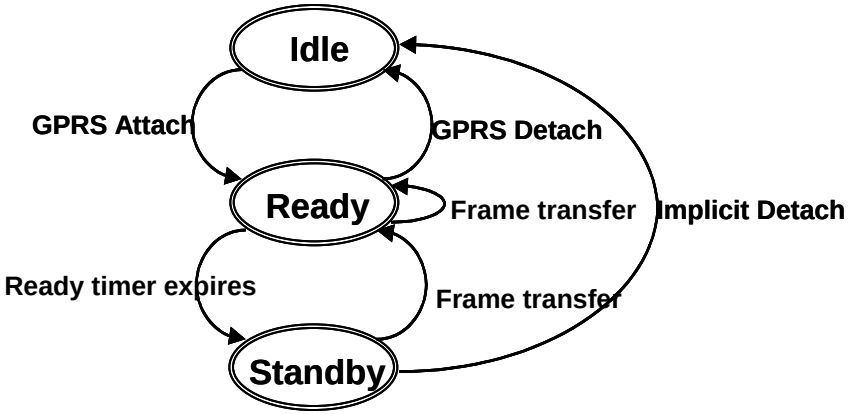
- Paging – Mobility Management „signalling balance”
- Characteristics of data transfer is different: „burst”, between them large breaks
  - meanwhile user can move
  - more paging even during ONE data call
  - smaller paging areas
  - RA – Routing Area
  - Null Routing Area



Cell ∈ Routing Area ∈ Location Area

GPRS mobility management states

- Goal:
  - as few Paging as possible – reduce the load of channels
  - so downlink data transfer can be increased
- Idle: not connected to GPRS (no active PDP context)
- Ready: „dat transfer” (Ready timer T3314 – 44 s; can be set by SGSN between 2 s and 3 h 6 m)
  - reports every cell change
  - no need for packet switched Paging
  - NOM I circuit switched Paging is in only 1 cell (not in every cell of a LA!)
- Standby: active connection, but data transfer
  - reports only RA change
  - packet switched Paging in the whole RA-ban (but only at the 1st packet -> Ready)
  - circuit switched Paging in a RA (not in a LA)



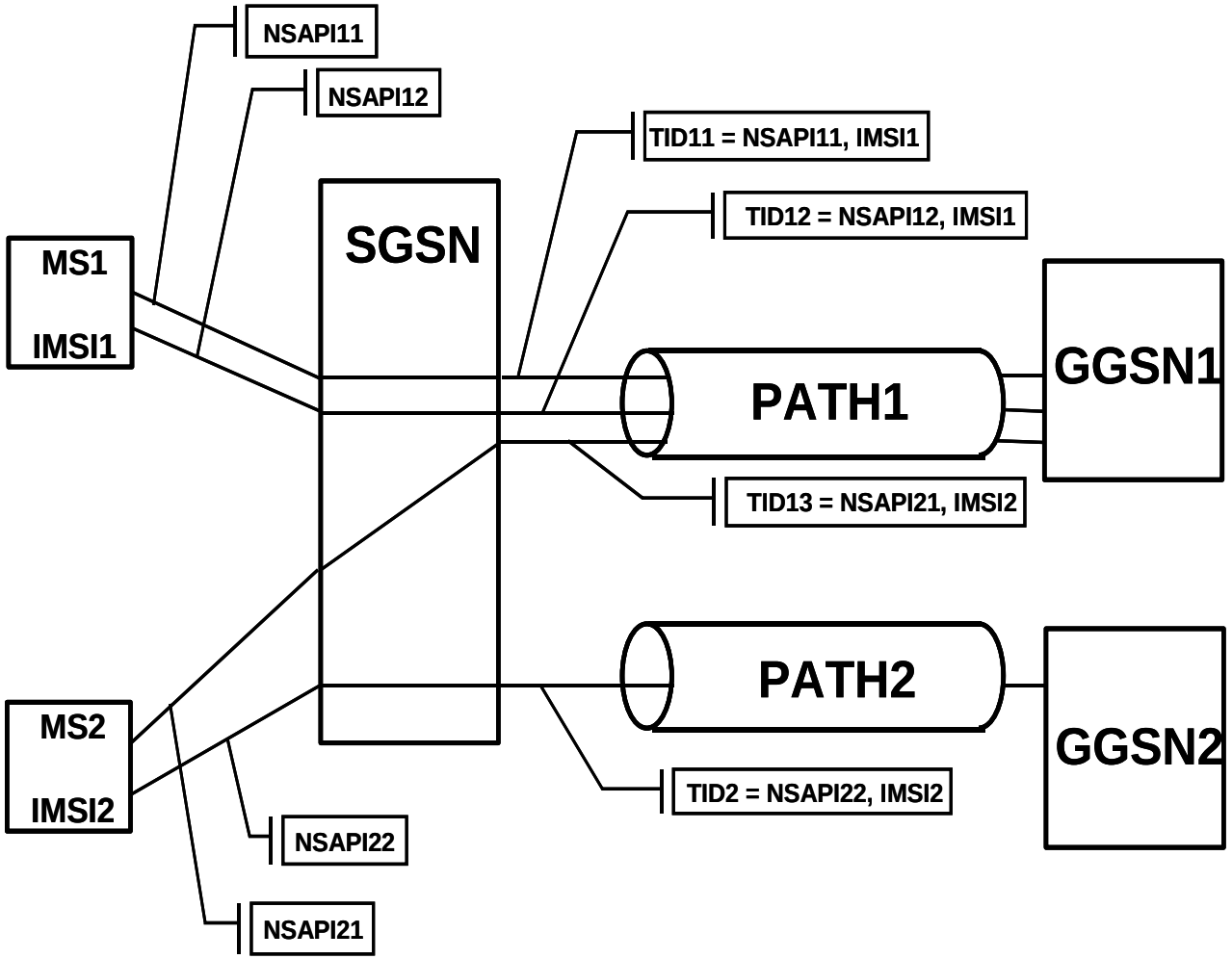
GPRS identifiers

- RAI – Routing Area Identifier
  - RAI = LAI + RAC = MNC + MCC + LAC + RAC
  - RAC: one octet (2 digits) extension
- P-TMSI – Packet TMSI
  - P-TMSI: starts with 11
  - TMSI: starts with 00, 01, 10
- NSAPI – Network Service Access Point Identifier
  - may be between 5-15
  - At PDP Context activation (MO/MT) MS assigns to the connection
  - to be able to ditinguish between (parallel) connections

GTP – GPRS Tunneling Protocol

- Routing of IP packets between GGSN and serving SGSN (may be in an other PLMN!)
- Over GTP IP TCP/UDP
- Between SGSN – GGSN
  - path, if there is at least 1 active PDP context between the two endpoints
    - identified by source/destination IP addresses and és port numbers
  - inside paths: tunnels transacts traffic of 1-1 PDP context
    - TID – Tunnel Identifier: identified by IMSI+NSAPI
  - inside tunnels: 4 flows
    - 1-1 data and signallig flow in both directions
    - identified by a „Flow Label”

GTP example

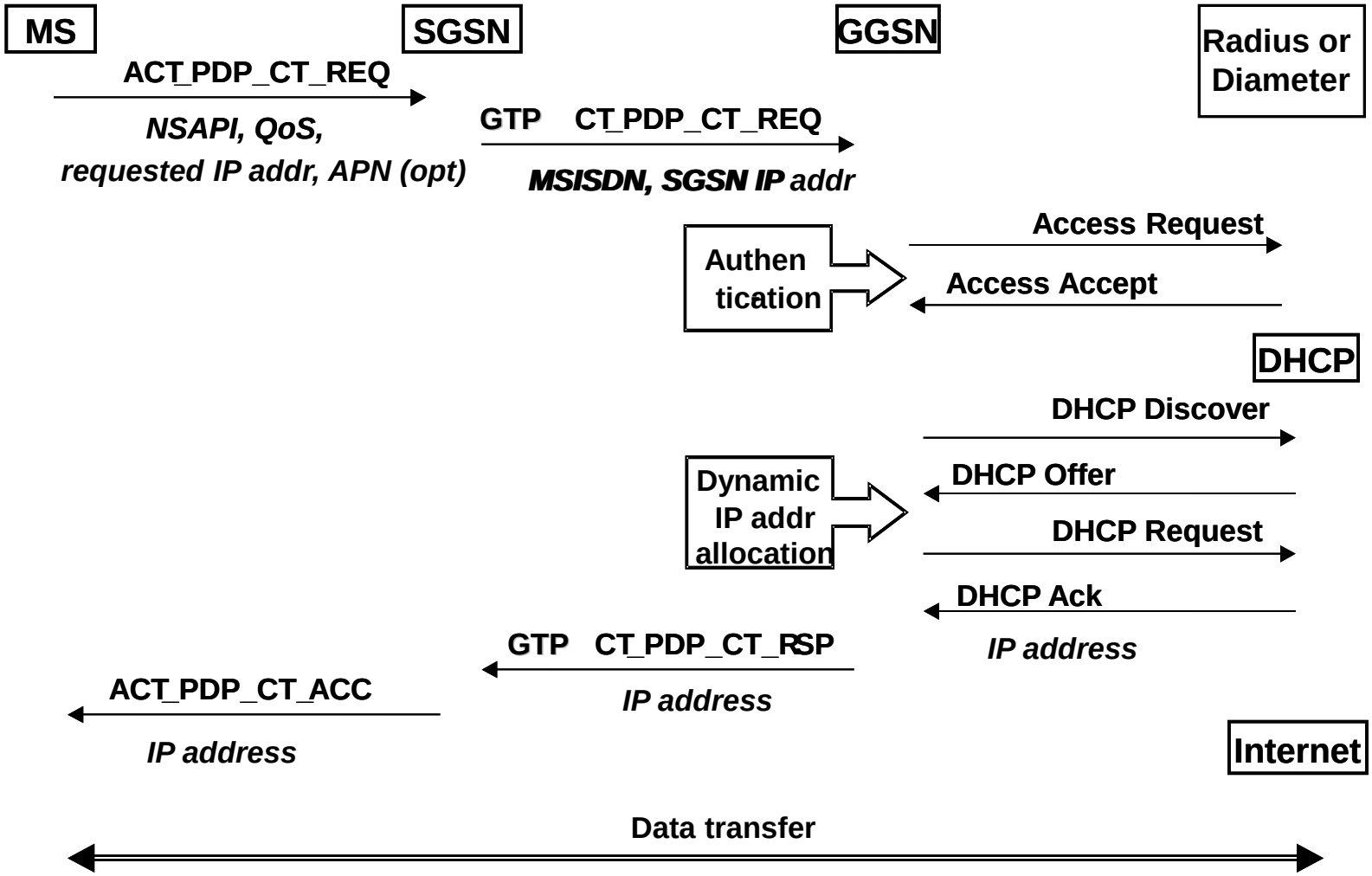

NSAPI11
NSAPI12
TID11 = NSAPI11, IMSI1
TID12 = NSAPI12, IMSI1
SGSN
MS1
IMSI1
GGSN1
PATH1
TID13 = NSAPI21, IMSI2
PATH2
MS2
IMSI2
GGSN2
TID2 = NSAPI22, IMSI2
NSAPI22
NSAPI21

APN – Access Point Name

- Network + operator identifier code
- Used to choose the GGSN toward the destination data network
  - Stored in HLR in user profile
  - Transmitted to SGSN during a „GPRS Location Update” (similarly, how the user profile was transmitted to MSC/VLR in GSM
  - May be fixed or elective – depending on subscription

- www.t-mobile.hu
- internet.t-mobile
- internet.mnc030.mcc216.gprs

MO GPRS connection



MT GPRS connection