Beyond 3G

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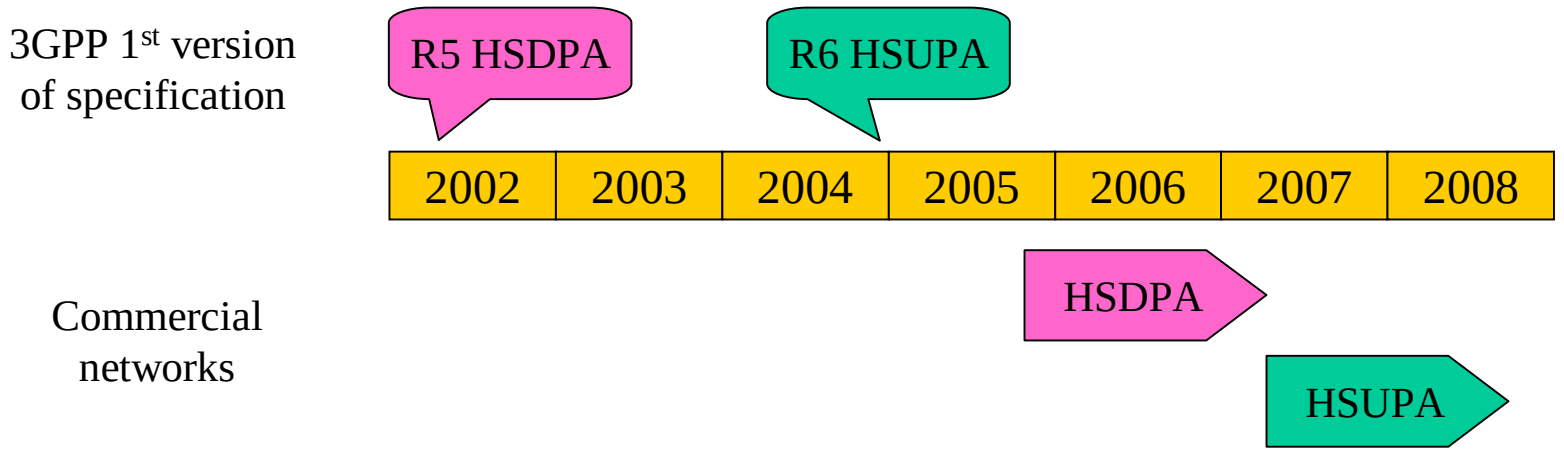
Overview

- HSPA
  - HSDPA
  - HSUPA
- MBMS
- LTE

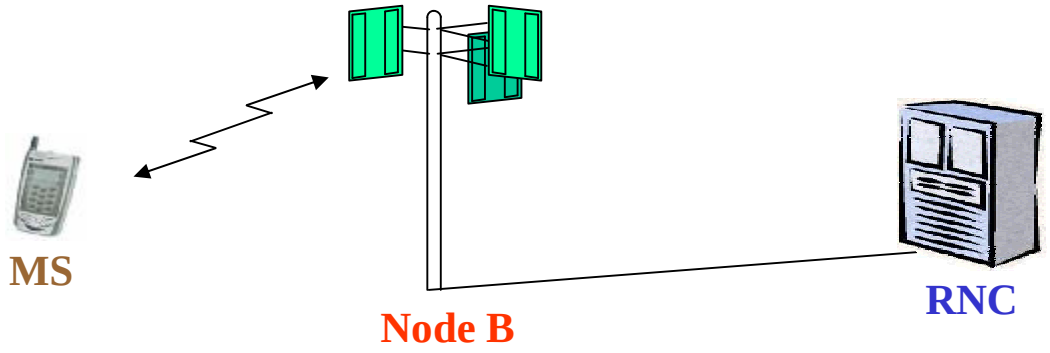
HSPA (1/2)

- **HSDPA** (**H**igh **S**peed **D**ownlink **P**acket **A**ccess)
- **HSUPA** (**H**igh **S**peed **U**plink **P**acket **A**ccess)
  - Ø E-DCH (Enhanced Uplink Dedicated Channel)



HSPA (2/2)

- Companies involved in the initial studies
  - Ø Motorola, Nokia, Ericsson, T-Mobile, NTT DoCoMo, …
- Deployed of HSPA in the WCDMA network
  - Ø Same carrier
  - Ø Another carrier
- HSPA modifications
  - Ø **Node B**, **RNC**
  - Ø **HSPA terminals**



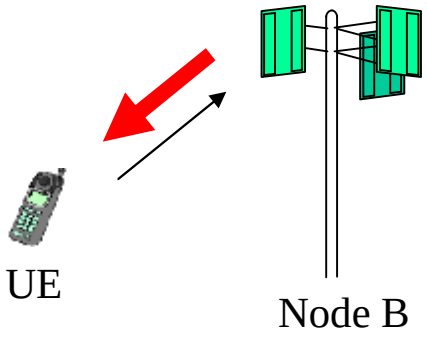
HSDPA (1/2)

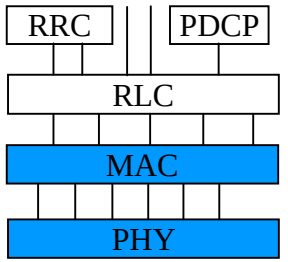
HS**D**PA ….High Speed **Downlink** Packet Access

- Introduce in Release 5 (2002)

- 14,4 Mbit/s (downlink)
- Efficient user scheduling
- Reduce radio delay

- Modification - 1 and 2 layers

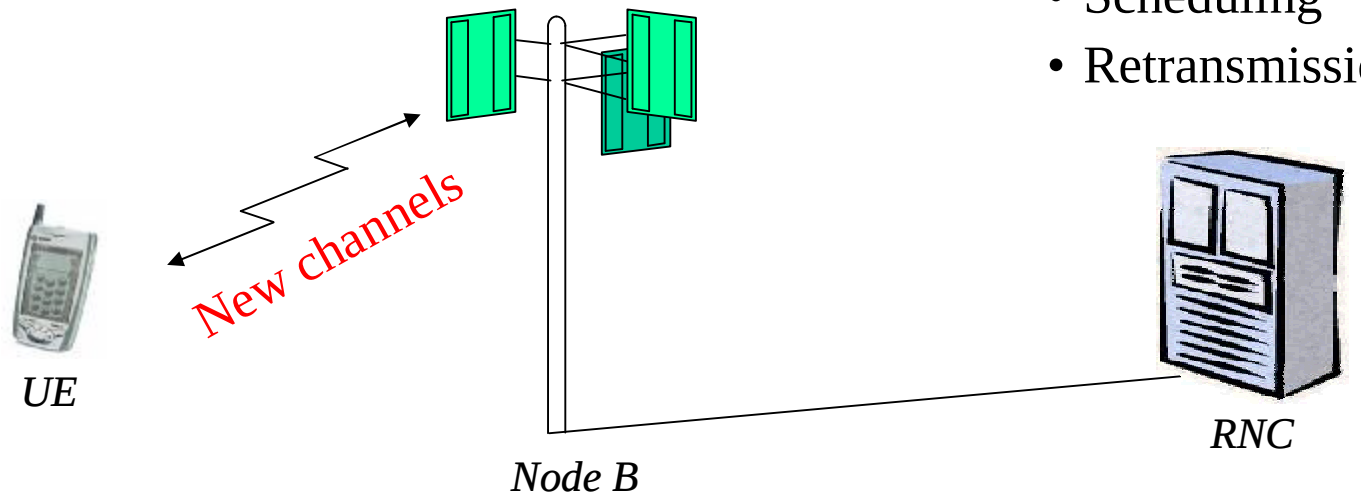




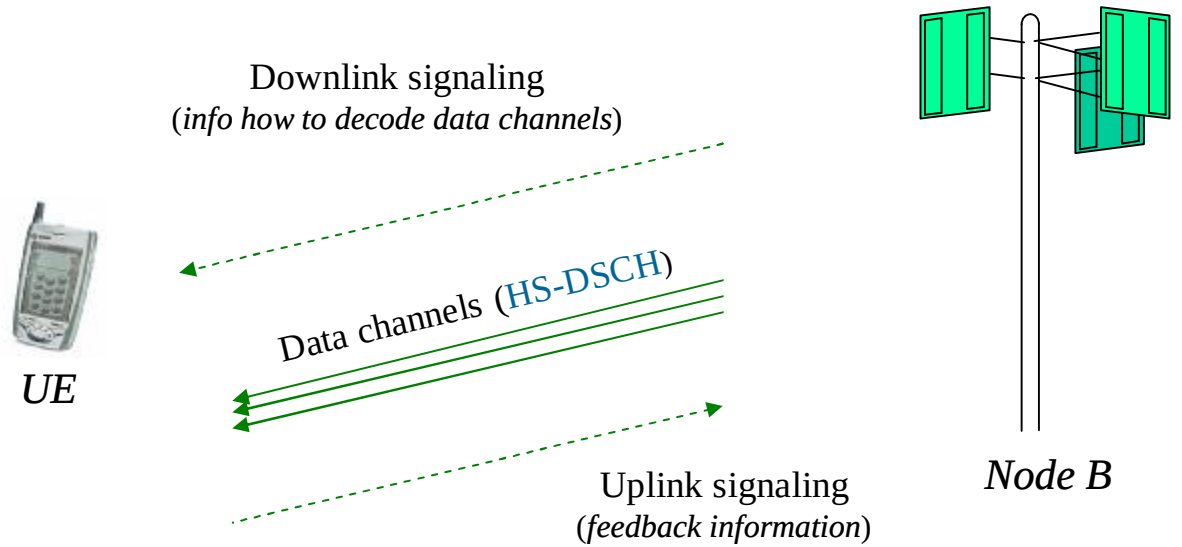
HSDPA (2/2)

- Scheduling
- Fast Retransmission ($HARQ_{MAC}$)
- Adaptive Modulation and Coding

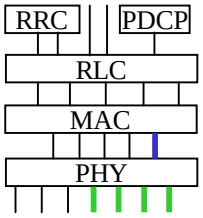
- Scheduling
- Retransmission (ARQ_{RLC})



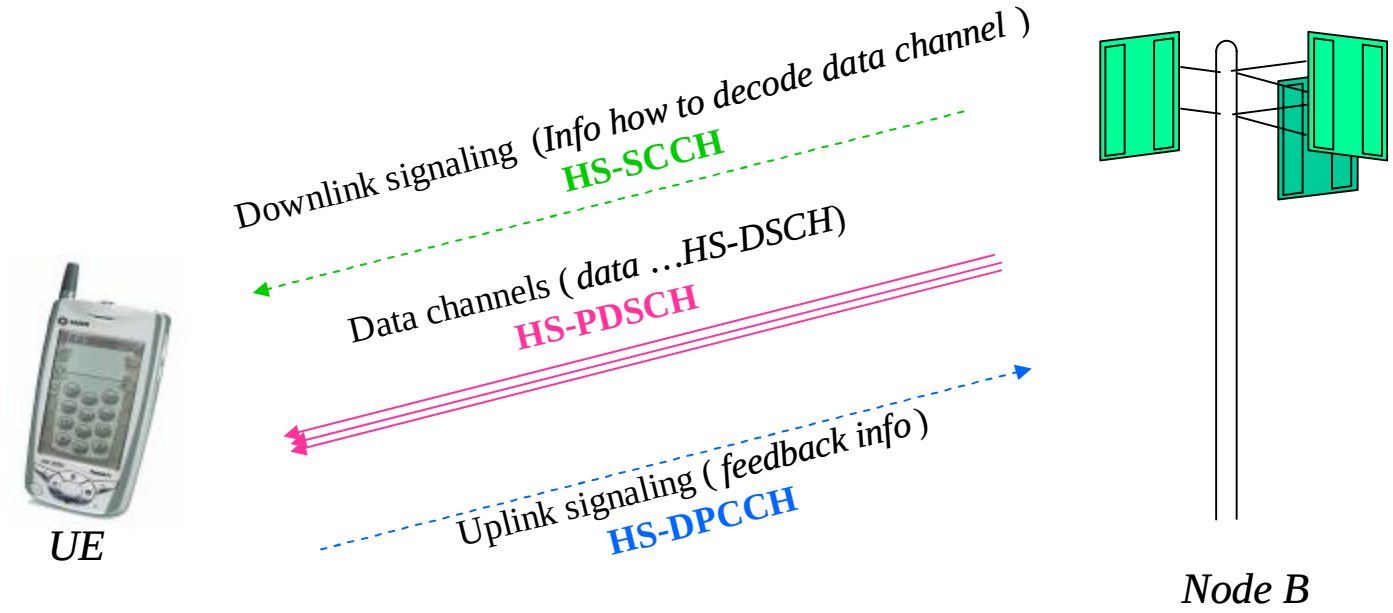
New channels



- Transport channel HS-DSCH (High Speed-Downlink Shared Channel)
- Several physical channels …*downlink, uplink*



Physical channels

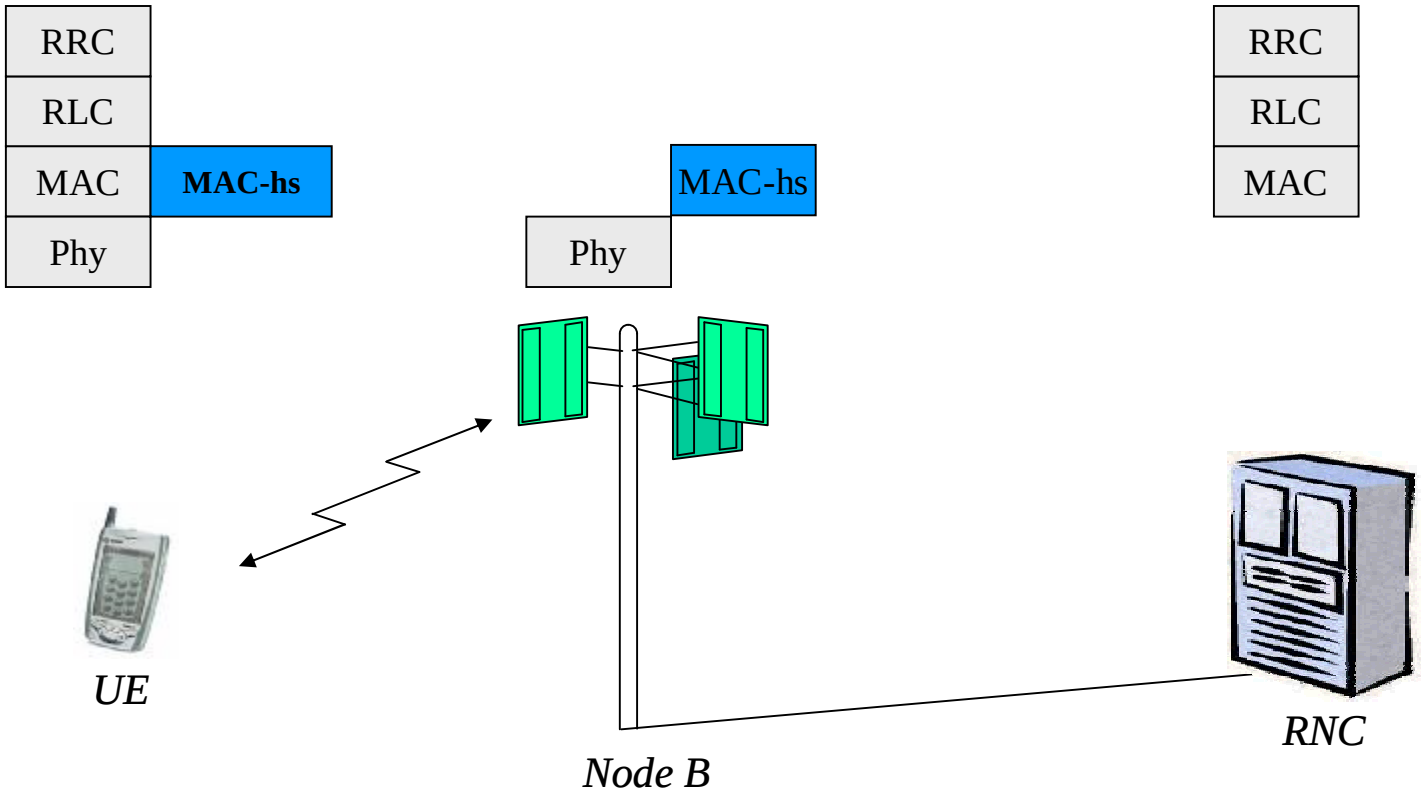


HS-SCCH: HS Shared Control Channel

HS-PDSCH: HS Physical Downlink Shared Channel

HS-DPCCH: A Dedicated Physical Control Channel

New MAC entity



MAC-hs controls the transport channel HS-DSCH

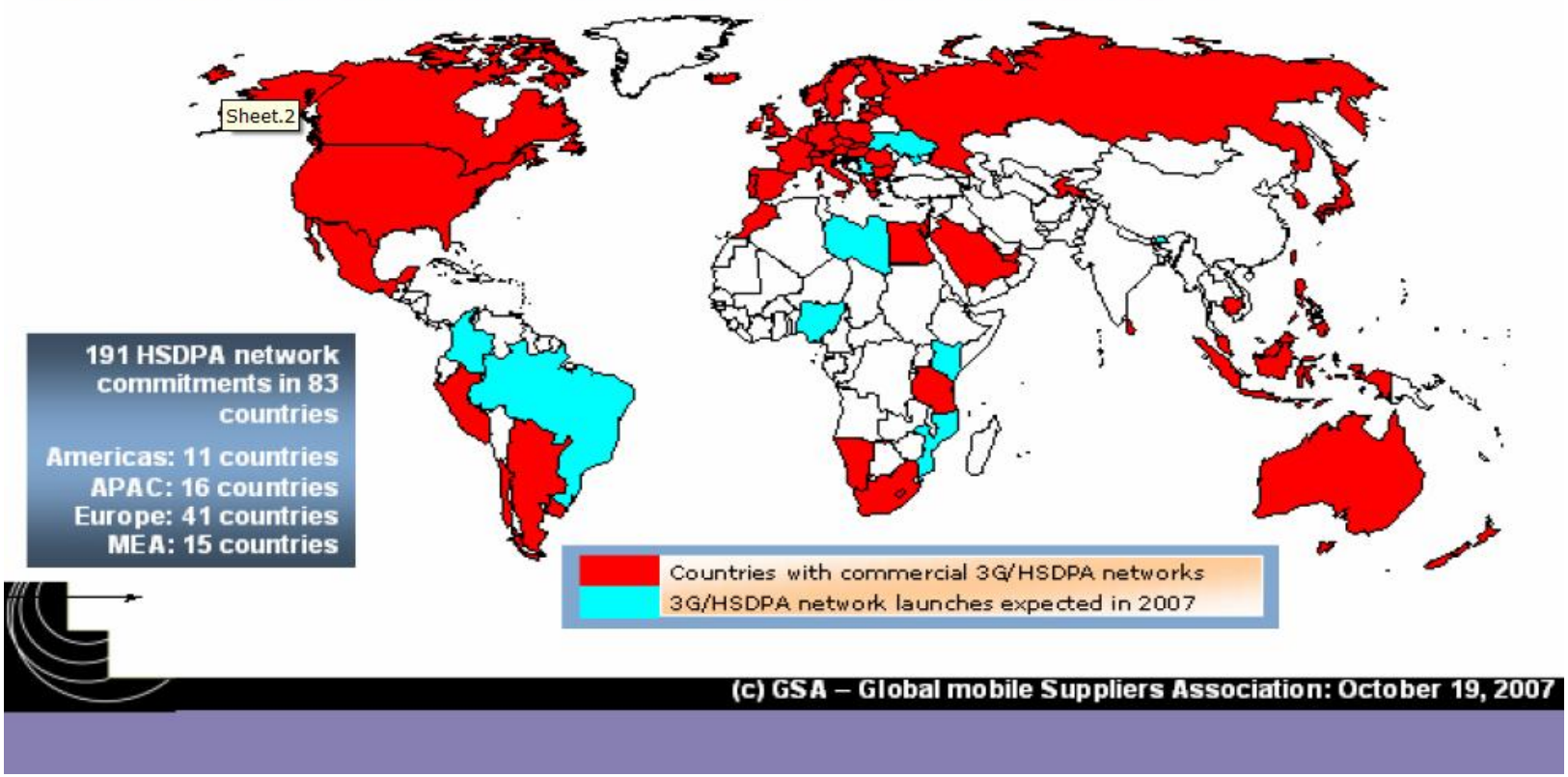
Commercial HSDPA networks

147 commercial HSDPA networks in 69 countries/territories:

- **Americas** (Argentina, Canada, Chile, Mexico, Peru, Puerto Rico, Uruguay, USA)
- **APAC** (Australia, Cambodia, HK, Indonesia, Japan, Macau, Malaysia, NZ, Philippines, Singapore, S. Korea, Sri Lanka, Taiwan)
- **Europe** (Austria, Belgium, Bulgaria, Croatia, Czech R., Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Isle of Man, Italy, Jersey, Latvia, Liechtenstein, Lithuania, Luxembourg, Madeira, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovak Republic., Slovenia, Spain, Sweden, Switzerland, Tajikistan, and UK)
- **Middle East and Africa** (Bahrain, Egypt, Israel, Kuwait, Morocco, Namibia, Saudi Arabia, South Africa, Tanzania, UAE)

GSA

www.gsacom.com



HSUPA (1/2)

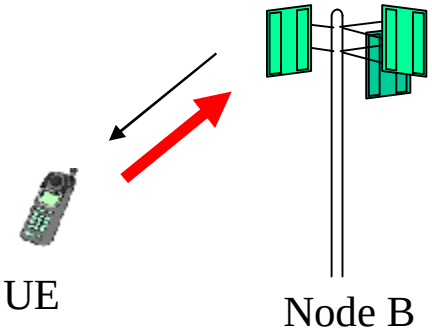
HS**U**PA ….High Speed **Uplink** Packet Access

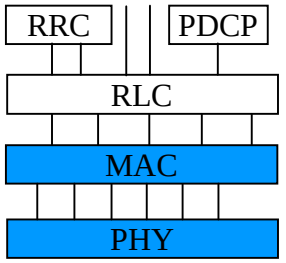
- Ø E-DCH (Enhanced Uplink Dedicated Channel)

- Release 6 (2004)

- 5,8 Mbit/s (uplink)
- Reduce radio delay

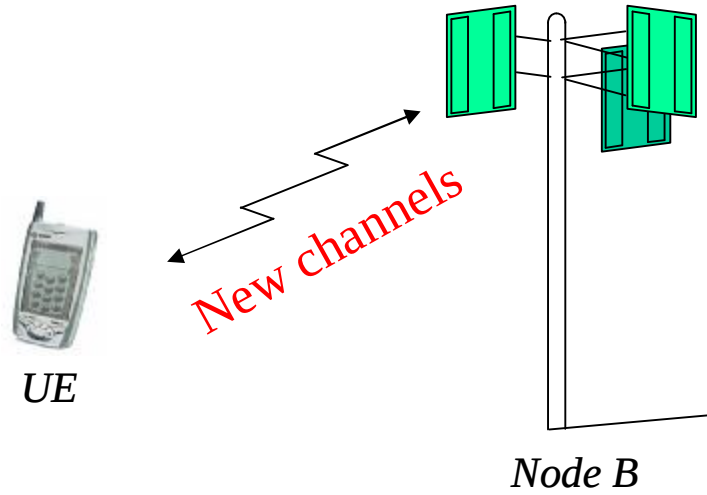
- Modification - 1 and 2 layers



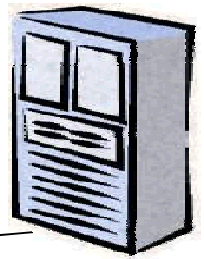


HSUPA (2/2)

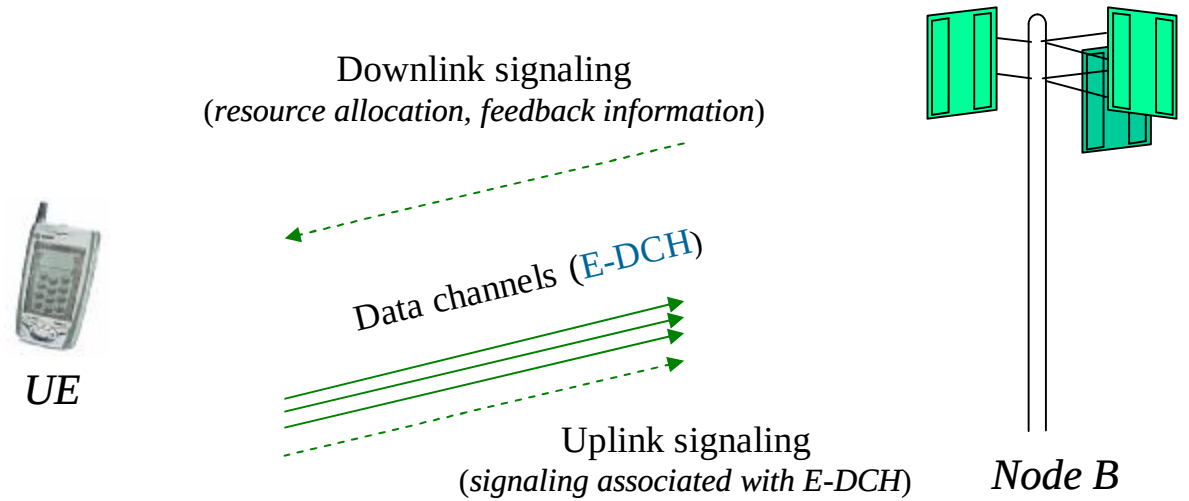
- Scheduling
- Fast Retransmission ($HARQ_{MAC}$)



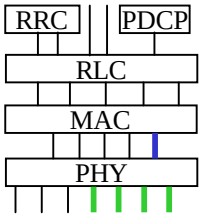
- Scheduling
- Retransmission (ARQ_{RLC})



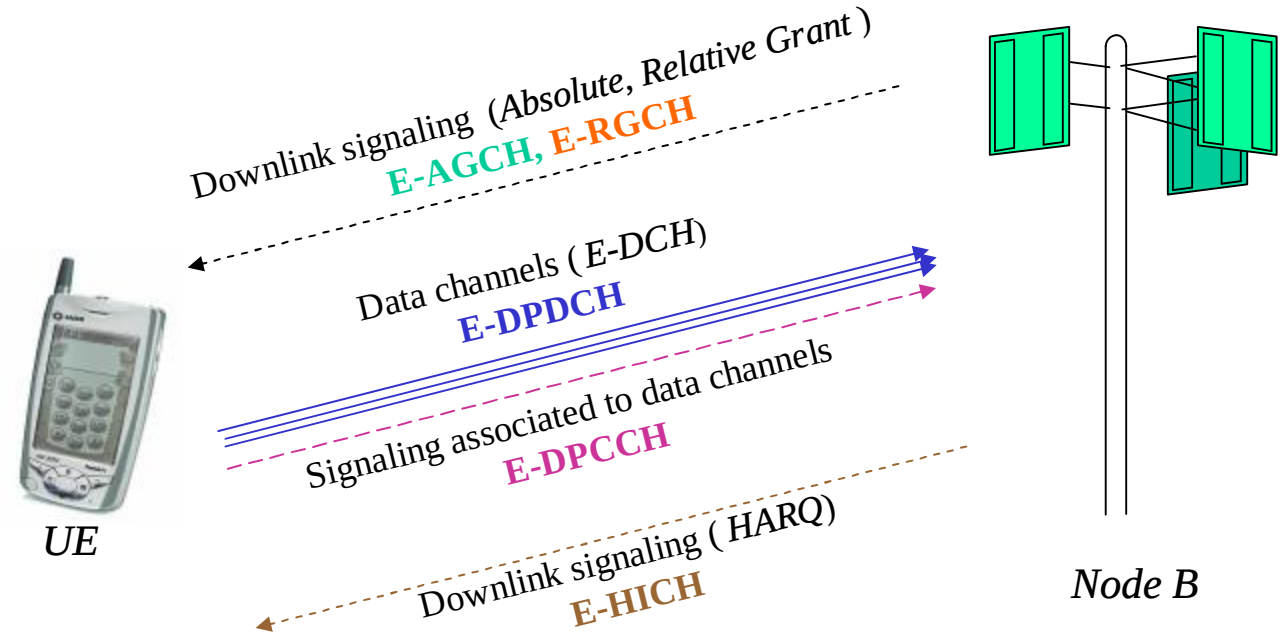
New channels



- Transport channel **E**-DCH (**Enhanced** Dedicated Channel)
- Several physical channels …*downlink, uplink*

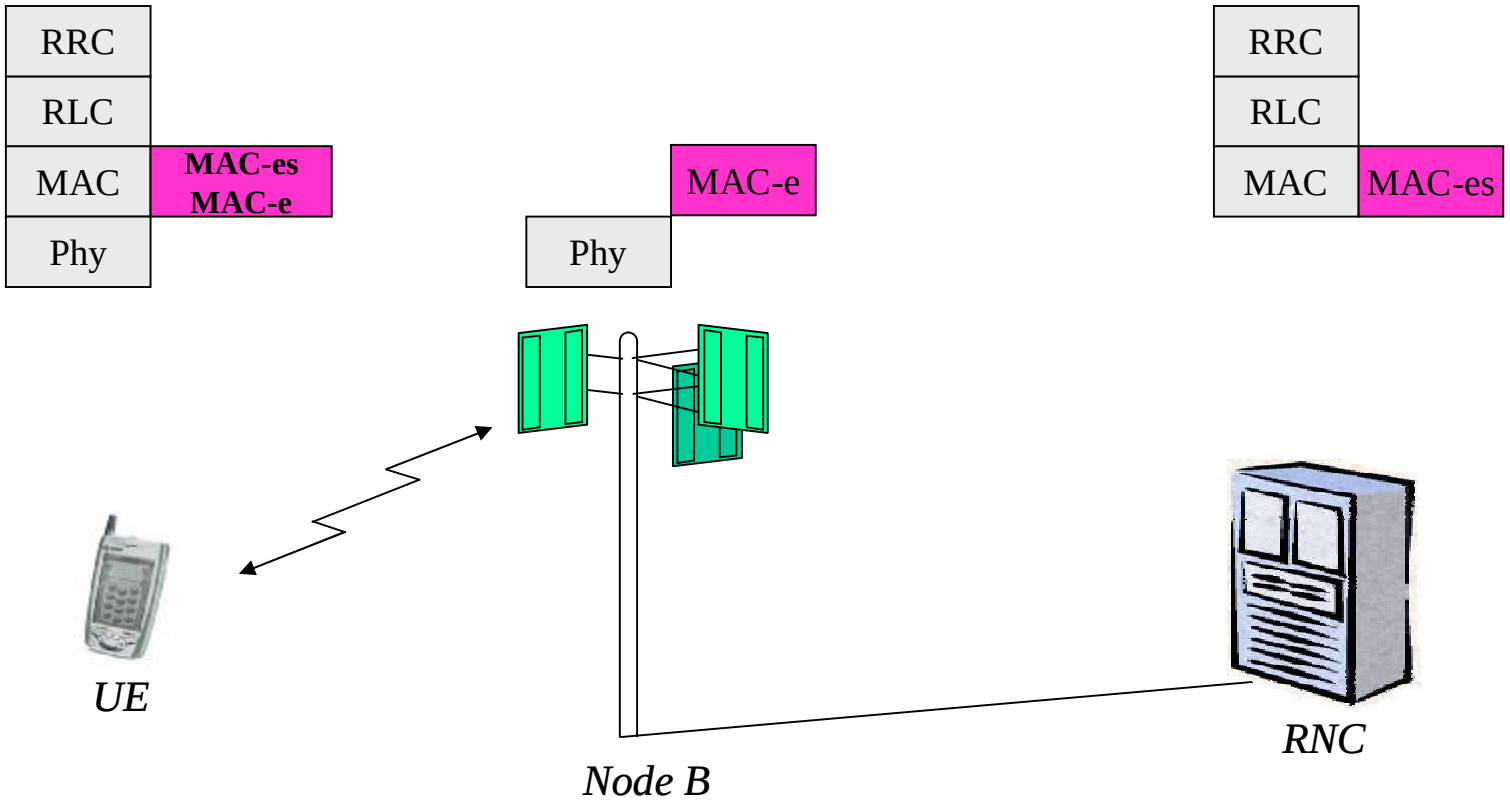


Physical channels



E-AGCH: E-DCH Absolute Grant Ch.
E-RGCH: E-DCH Relative Grant Ch.
E-HICH: E-DCH Hybrid ARQ Indicator Ch.
E-DPDCH: E-DCH Dedicated Physical Data Ch.
E-DPCCH: E-DCH Dedicated Physical Control Ch.

New MAC entities



MAC-e controls access to the E-DCH
MAC-es handles function that are not managed by MAC-e

HSDPA vs. HSUPA

	HSDPA	**HSUPA**
Introduced	Release 5	Release 6
Improve data rates	Downlink	Uplink
Peak data rate	14,4 Mbit/s	5,8 Mbit/s
Transport channel	Shared (HS-DSCH)	Dedicated (E-DCH)
	TTI = 2 ms	TTI = 2 ms, 10 ms
Features	HARQ	HARQ
	Scheduling	Scheduling
	Adaptive modulation and coding	-
Spreading factor	Fix (=16)	Variable
Modification	UE, Node B	UE, Node B, RNC
New MAC entities	MAC-hs	MAC-e, MAC-es

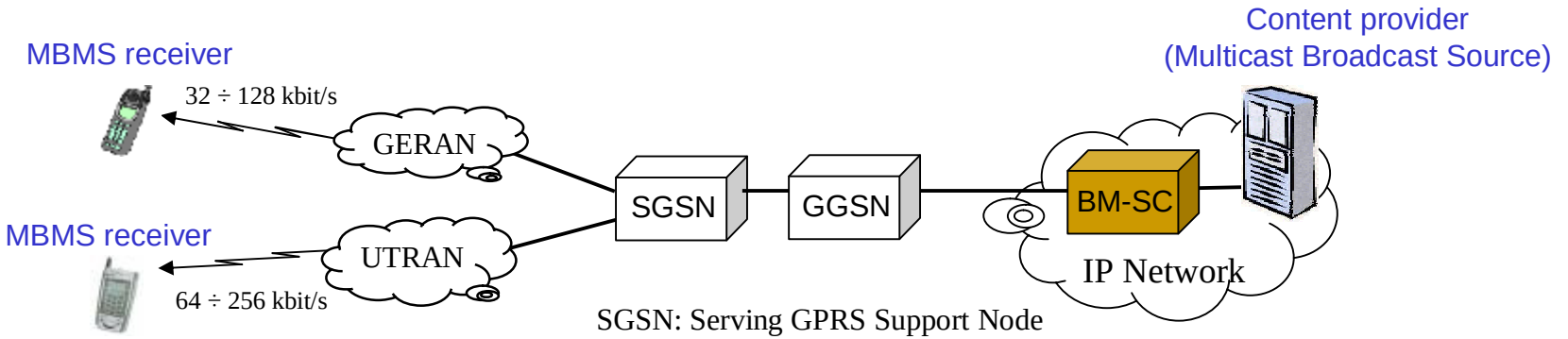
MBMS

MBMS … *Multimedia Broadcast/Multicast Service*

- Release 6 (2004)

Goal: to enable the multimedia content delivery to many users simultaneously in the efficient way with the respect to the network/radio resources and capacity.

- Point-to-multipoint service
- Application
  - Ø Mobile TV (competition with DVB-H)
  - Ø Distribution of multimedia (news, weather video clips, etc.)
  - Ø Localized services (hotels, restaurants, etc.)



SGSN: Serving GPRS Support Node
GMSC: Gateway MSC
BM-SC: Broadcast Multicast Service Centre

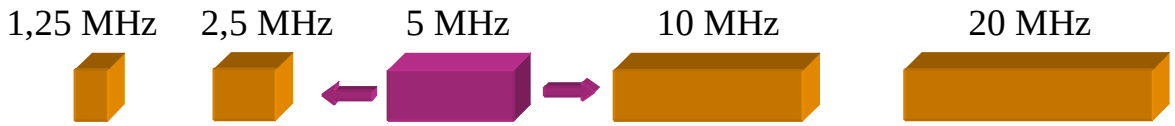
Long Term Evolution (LTE)

- 3G LTE (Long Term Evolution)
  - Ø UTRAN LTE, Evolved UTRAN
  - Ø 3GPP 25.913, 3GPP 25.813

- Why
  - Ø HSPA …should be competitive for several years
  - Ø **But**, to ensure competitiveness in an longer time (beyond 2015), a long-term evolution of mobile networks needs to be considered (… rates, latency, coverage, operator's cost, etc.)

Features of LTE (1/3)

- Scalable bandwidth

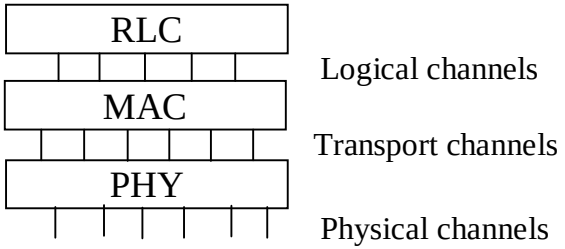


- Data rates
  - Ø Downlink: 100Mbit/s (within 20 MHz)
  - Ø Uplink: 50Mbit/s (within 20 MHz)

- Throughput
  - Ø Downlink: 3x or 4x Release 6 (HSDPA)
  - Ø Uplink: 2x or 3x Release 6 (HSUPA)

Features of LTE (2/3)

- No CS, only PS domain
  - Ø # transport channel s is reduced
  - Ø Dedicated channels → shared channels



- Latency
  - Ø < 5 ms (…HSDPA ~ 11ms)

- …
  - Ø More users per cell
  - Ø Enhanced IMS
  - Ø Enhanced MBMS

Features of LTE (3/3)

- Radio interface
  - Ø Downlink: OFDM
  - Ø Uplink: SC-FDMA
- Network architecture
  - Ø User plane ⇒ fewer nodes (2 nodes)
    - One node - Base station
    - Second node - Handling CN + some UTRAN functions
  - Ø Control plane ⇒ more intelligence implemented in Base station

UMTS vs. 802.16e vs. LTE

	UMTS	802.16e	LTE
Access method	CDMA	OFDMA, SOFDMA	OFDM
Frequency band	~ 2 GHz 2,5 ÷ 2,7 GHz	2,3 GHz 2,5 GHz 3,5 GHz	
Channel bandwidth	5 MHz	1,75 MHz ÷ 20 MHz	1,75 MHz ÷ 20 MHz
Data rates	2 Mbit/s (Rel 4) 14,4 Mbit/s (Rel 5) 5,8 Mbit/s (Rel 6)	63 Mbit/s (↓) 28 Mbit/s (↑)	100 Mbit/s (↓) 50 Mbit/s (↑)
Modes	FDD, TDD	FDD, TDD	
Handover	Ano	Ano	
Power control	Ano	Ano	
Support of QoS	Ano	Ano	