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# KOMUNIKASI NIRKABEL BROADBAND

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Arsitektur Sistem Komunikasi Nirkabel Broadband  
(Mobile Broadband) – UMTS, LTE, dan Mobile Wimax

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# Why Go Mobile Broadband?

**Broadband,  
But Fixed**



**Mobile, But  
Narrowband**



**Fixed, Portable  
& Mobile  
Broadband**



# Why Go Mobile Broadband?

Fixed  
Wireless DSL

Nomadic  
Hot Zone  
No Handover

Portable  
Hot Zone  
Session continuity

Mobile  
Seamless  
Handover



Feeder  
SME/SOHO Access  
Wireless DSL



WirelessDSL  
Hot Zone  
Nomadicity



Wireless PC  
Portability  
with Simple  
Mobility



Wireless PC  
Full-Mobility

# Mobile Broadband Application

*Mobile Broadband Changes the Future Life*

- Mobile Email
- Netmeeting
- HD Video Conference

Mobile Office

- Video Sharing
- Video Blog
- Video Chat
- Information

Mobile Community

- Video on Demand
- Online Game
- HD video streaming

Mobile Entertainment

- Mobile Shopping
- Mobile Bank
- Mobile Stock

Mobile Business



# Mobile Broadband Technology--Cellular

V · T · E		Cellular network standards	[hide]
List of mobile phone generations			
<b>0G radio telephones (1946)</b>	MTS · IMTS · Altai · OLT · MTA · MTB · MTC · MTD · AMTS · Autotel (PALM) · ARP · B-Netz · AMR		
<b>1G (1979)</b>	<b>AMPS family</b>	AMPS · N-AMPS · TACS · ETACS	
	<b>Other</b>	NMT · C-450 · Hicap · Mobitex · DataTAC	
<b>2G (1991)</b>	<b>GSM/3GPP family</b>	GSM · CSD · HSCSD	
	<b>3GPP2 family</b>	cdmaOne (IS-95)	
	<b>AMPS family</b>	D-AMPS (IS-54 and IS-136)	
	<b>Other</b>	CDPD · iDEN · PDC · PHS	
<b>2G transitional (2.5G, 2.75G)</b>	<b>GSM/3GPP family</b>	GPRS · EDGE/EGPRS · Evolved EDGE	
	<b>3GPP2 family</b>	CDMA2000 1X (TIA/EIA/IS-2000) · CDMA2000 1X Advanced	
	<b>Other</b>	WiDEN · DECT	
<b>3G (2001)</b>	<b>3GPP family</b>	UMTS (UTRA-FDD / W-CDMA (FOMA) · UTRA-TDD LCR / TD-SCDMA · UTRA-TDD HCR / TD-CDMA)	
	<b>3GPP2 family</b>	CDMA2000 1xEV-DO Release 0 (TIA/IS-856)	
<b>3G transitional (3.5G, 3.75G, 3.9G)</b>	<b>3GPP family</b>	HSPA (HSDPA · HSUPA) · HSPA+ (DC-HSDPA) · LTE (E-UTRA)	
	<b>3GPP2 family</b>	CDMA2000 1xEV-DO Revision A (TIA/EIA/IS-856-A) · EV-DO Revision B (TIA/EIA/IS-856-B) · EV-DO Revision C	
	<b>IEEE family</b>	Mobile WiMAX (IEEE 802.16e) · Flash-OFDM · iBurst (IEEE 802.20) · WiBro	
	<b>ETSI family</b>	HiperMAN	
<b>4G (2009) IMT Advanced (2013)</b>	<b>3GPP family</b>	LTE Advanced (E-UTRA) · LTE Advanced Pro (4.5G Pro/pre-5G/4.9G)	
	<b>IEEE family</b>	WiMAX (IEEE 802.16m) (WiMax 2.1 (LTE-TDD / TD-LTE) · WiBro)	
<b>5G (IMT-2020) (Under development)</b>	<b>LTE</b>		
	<b>5G-NR</b>		



# Mobile Broadband Technology—3GPP Standard Release

3GPP RELEASE	RELEASE DATE	SUMMARY
3GPP Release 99	1999	First release of the UMTS standard
3GPP Release 4	2001	This release added features including an all-IP core network. It was originally referred to as Release 2000
3GPP Release 5	2002	This 3GPP release introduced the IP Multimedia Subsystem, IMS and High Speed Packet Downlink Access, HSDPA
3GPP Release 6	2004	This release of the standard integrated the operation of UMTS with wireless LAN networks and added enhancements to IMS (including Push to talk over Cellular), Generic Access Network, GAN, and it added High Speed Packet Uplink Access, HSUPA.
3GPP Release 7	2007	This Release of the 3GPP standard detailed improvements to QoS for applications such as VoIP. The release also detailed upgrades for High Speed Packet Access Evolution, HSPA+, as well as changes for EDGE Evolution and it also provided interfaces to enable operation with Near Field Communication, NFC technology.
3GPP Release 8	2008	3GPP Release 8 provided the details for the LTE System Architecture Evolution, SAE, an all-IP network architecture providing the capacity and low latency required for LTE and future evolutions.
3GPP Release 9	End 2009	This added further enhancements to the SAE as well as allowing for WiMax and LTE/UMTS interoperability.
3GPP Release 10	Estimated 2010	This release of the 3GPP standard detailed the 4G LTE Advanced technology.

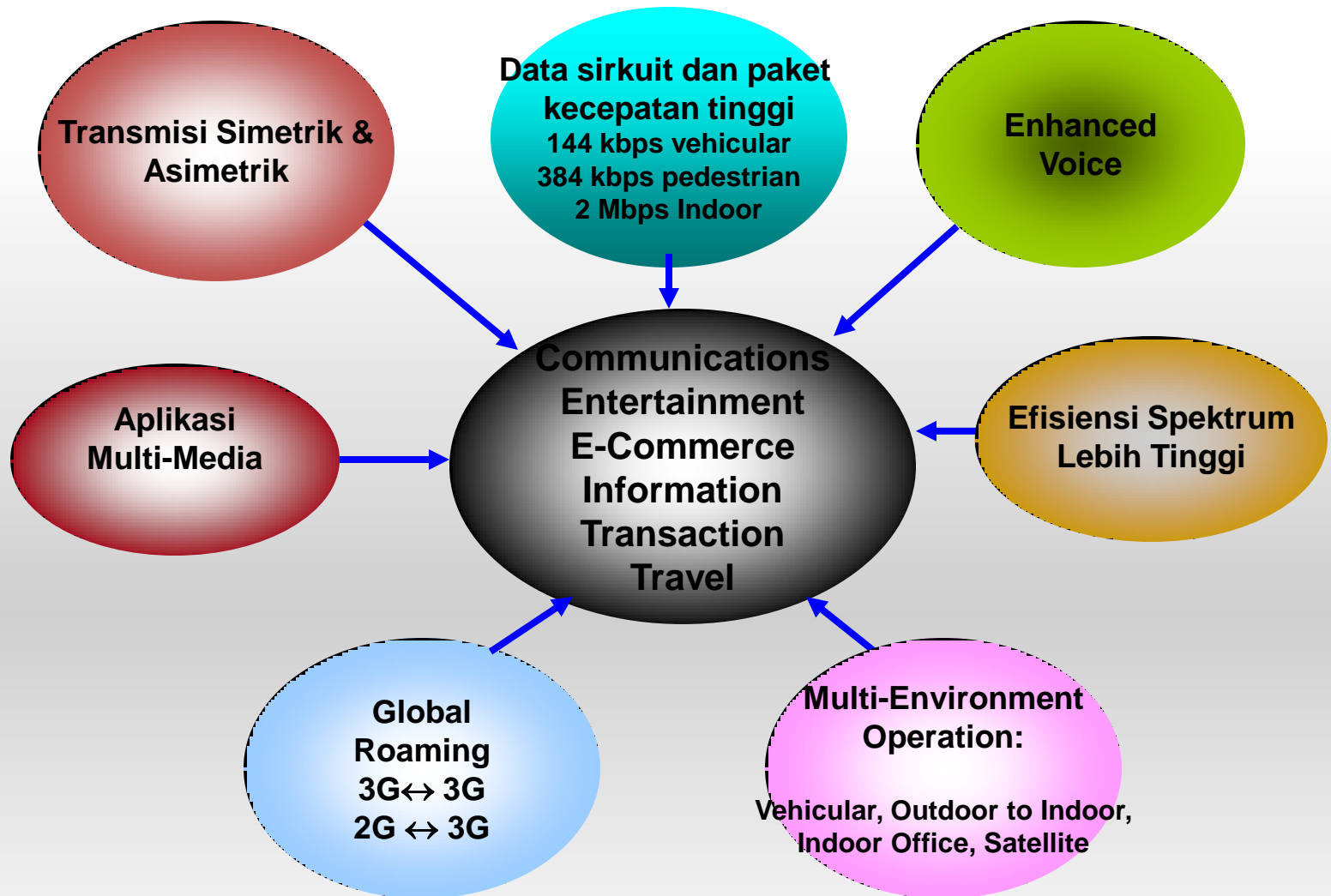


# 3G standard – Why 3G?

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- ❑ Need for universal standard (Universal Mobile Telecommunication System)
- ❑ Support for packet data services
  - ❑ IP data in core network
  - ❑ Wireless IP
- ❑ New services in mobile multimedia need faster data transmission and flexible utilization of the spectrum
- ❑ FDMA and TDMA are not efficient enough
  - ❑ TDMA wastes time resources
  - ❑ FDMA wastes frequency resources
- ❑ CDMA can exploit the whole bandwidth constantly
- ❑ Wideband CDMA was selected for a radio access system for UMTS (1997)

# 3G standard – Requirement

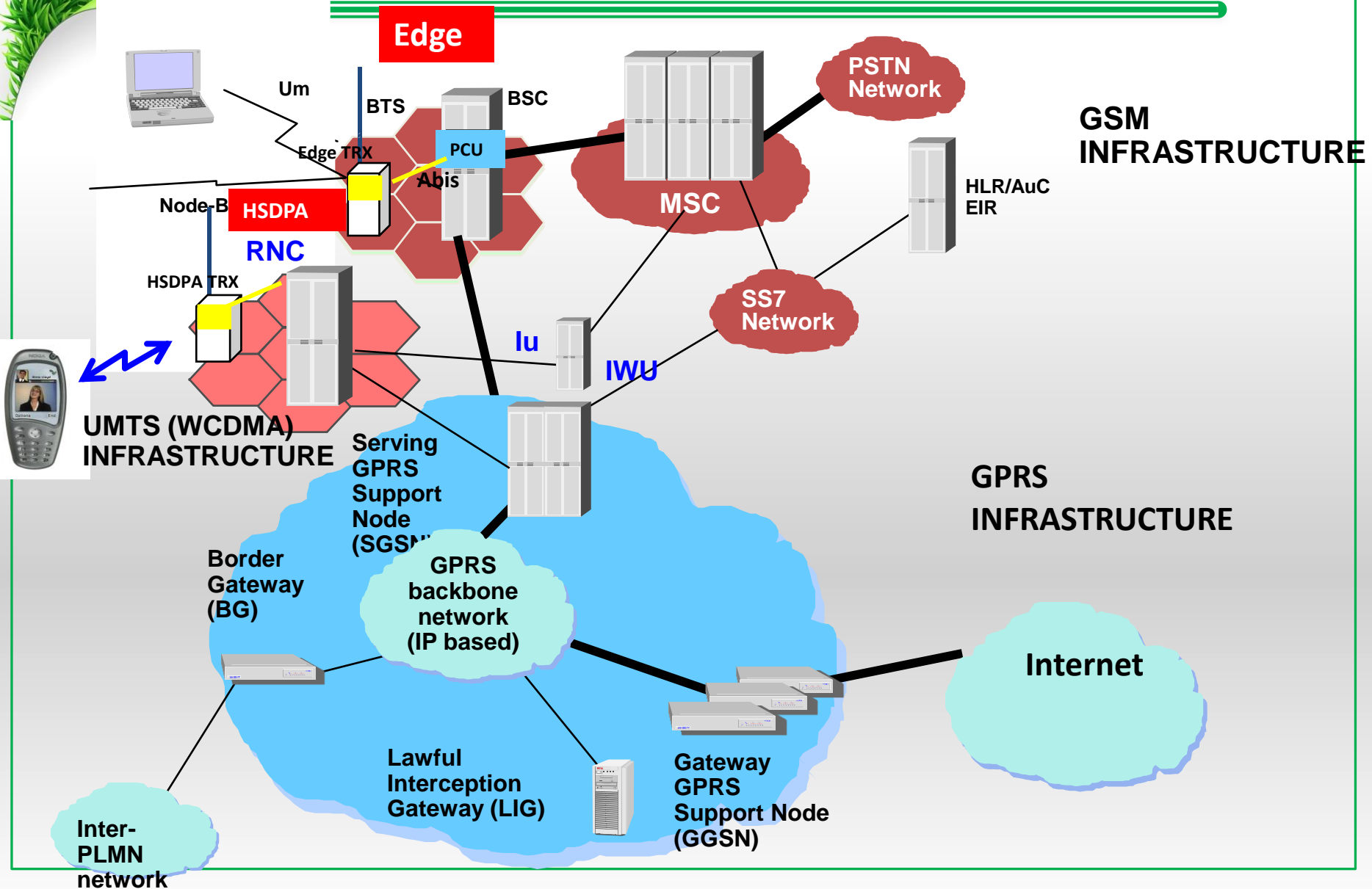




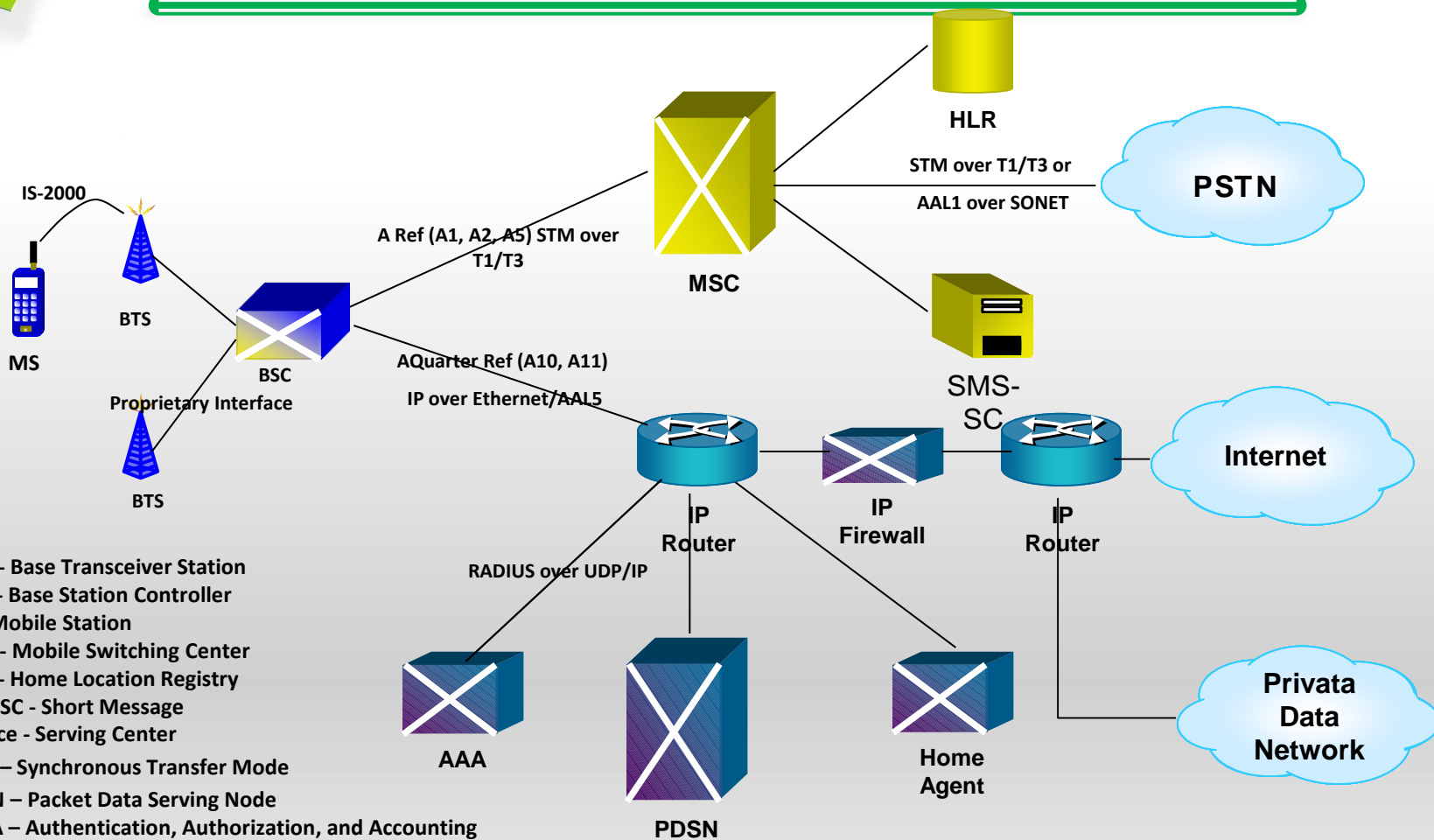
## 3G standard – WCDMA vs CDMA 2000

<b>Parameter</b>	<b>W-CDMA</b>	<b>cdma2000</b>
Carrier spacing	5 MHz	3.75 MHz
Chip rate	3.84 Mcps	3.6864 Mcps
Data modulation	BPSK	FW – QPSK; RV - BPSK
Spreading	Complex (OQPSK)	Complex (OQPSK)
Power control frequency	1500 Hz	800 Hz
Variable data rate implement.	Variable SF; multicode	Repeti., puncturing, multicode
Frame duration	10 ms	20 ms
Coding	Turbo and convolutional	Turbo and convolutional
Base stations synchronized?	Asynchronous	Synchronous
Base station acquisition/detect	3 step; slot, frame, code	Time shifted PN correlation
Forward link pilot	TDM dedicated pilot	CDM common pilot
Antenna beam forming	TDM dedicated pilot	Auxiliary pilot

# 3G standard – GSM GPRS UMTS architecture



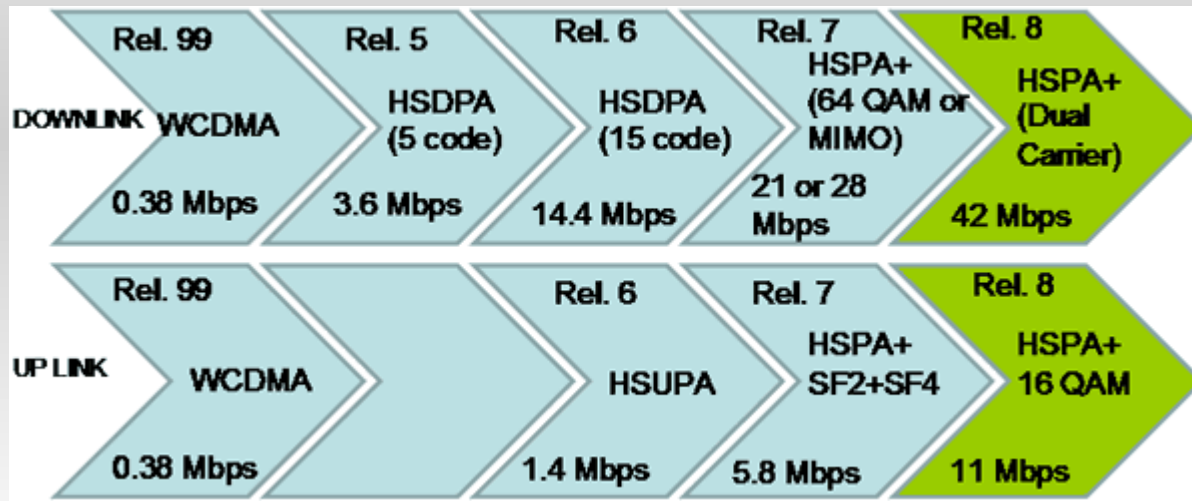
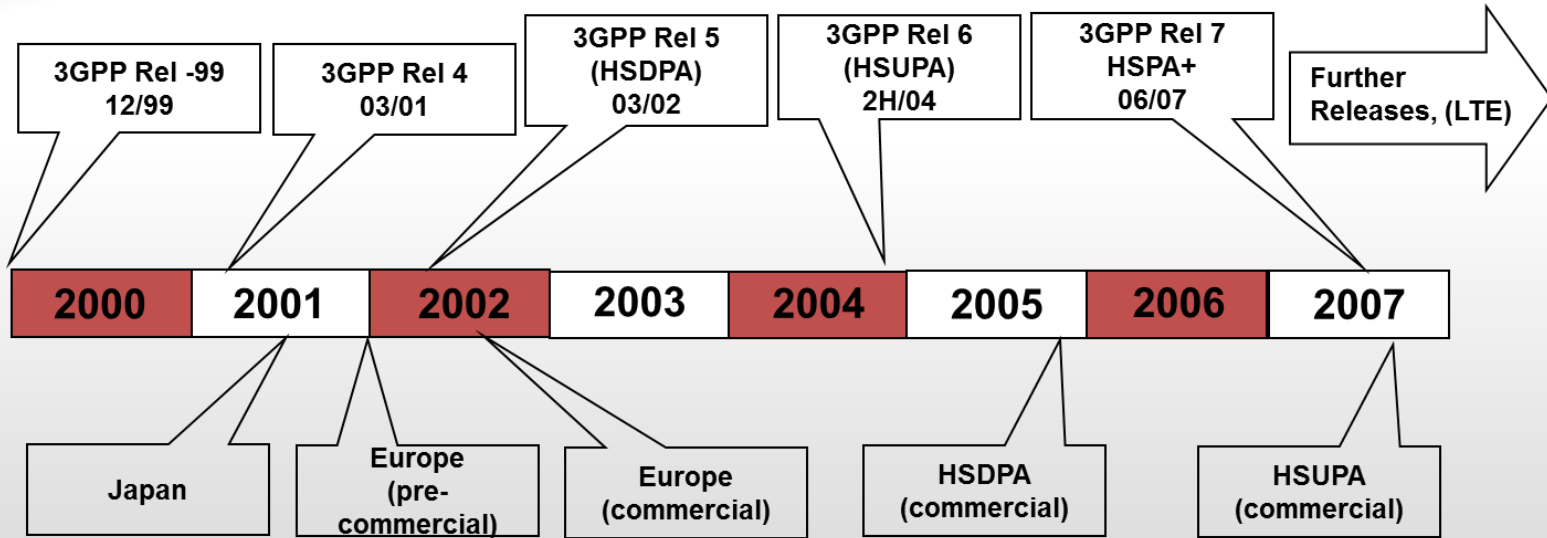
# 3G standard –CDMA 2000 1x architecture



- BTS - Base Transceiver Station
- BSC - Base Station Controller
- MS - Mobile Station
- MSC - Mobile Switching Center
- HLR - Home Location Registry
- SMS-SC - Short Message Service - Serving Center
- STM – Synchronous Transfer Mode
- PDSN – Packet Data Serving Node
- AAA – Authentication, Authorization, and Accounting
- Home Agent – Mobile IP Home Agent

A10 – Bearer interface between BSC (PCF) and PDSN for packet data  
 A11 – Signaling interface between BSC (PCF) and PDSN for packet data

# 3G standard – HSDPA, HSUPA, HSPA+



## 3G standard –HSDPA, HSUPA, HSPA+

### HSDPA

- Adaptive Modulation and Coding (AMC)
  - QPSK or 16QAM
- Multicode operation
  - Support of 1-15 code channels (SF=16)
- Short frame size (TTI = 2 ms)
- Fast retransmissions using Hybrid Automatic Repeat Request (HARQ)
- Fast packet scheduling at Node B
  - E.g. Round robin, Proportional fair

### HSUPA

- Adaptive Modulation and Coding (AMC)
  - QPSK or 16QAM
- Multicode operation
  - Support  $(2 \times SF2) + (2 \times SF4)$
- Short frame size
- Fast retransmissions using Hybrid Automatic Repeat Request (HARQ)
- Fast packet scheduling
- adds a new transport channel to WCDMA, called the Enhanced Dedicated Channel (E-DCH)

### HSPA+

- Higher order modulation (64QAM)
- Multiple Input Multiple Output (MIMO) 2x2
- [Dual-Carrier HSDPA](#) operation

# 3G standard –HSDPA, HSUPA, HSPA+

## Downlink HSDPA

- Theoretical up to 14.4 Mbps
- Initial capability 1.8 – 3.6 Mbps

# of codes	Modulation	Max data rate
5 codes	QPSK	1.8 Mbps
5 codes	16-QAM	3.6 Mbps
10 codes	16-QAM	7.2 Mbps
15 codes	16-QAM	10.1 Mbps
15 codes	16-QAM	14.4 Mbps

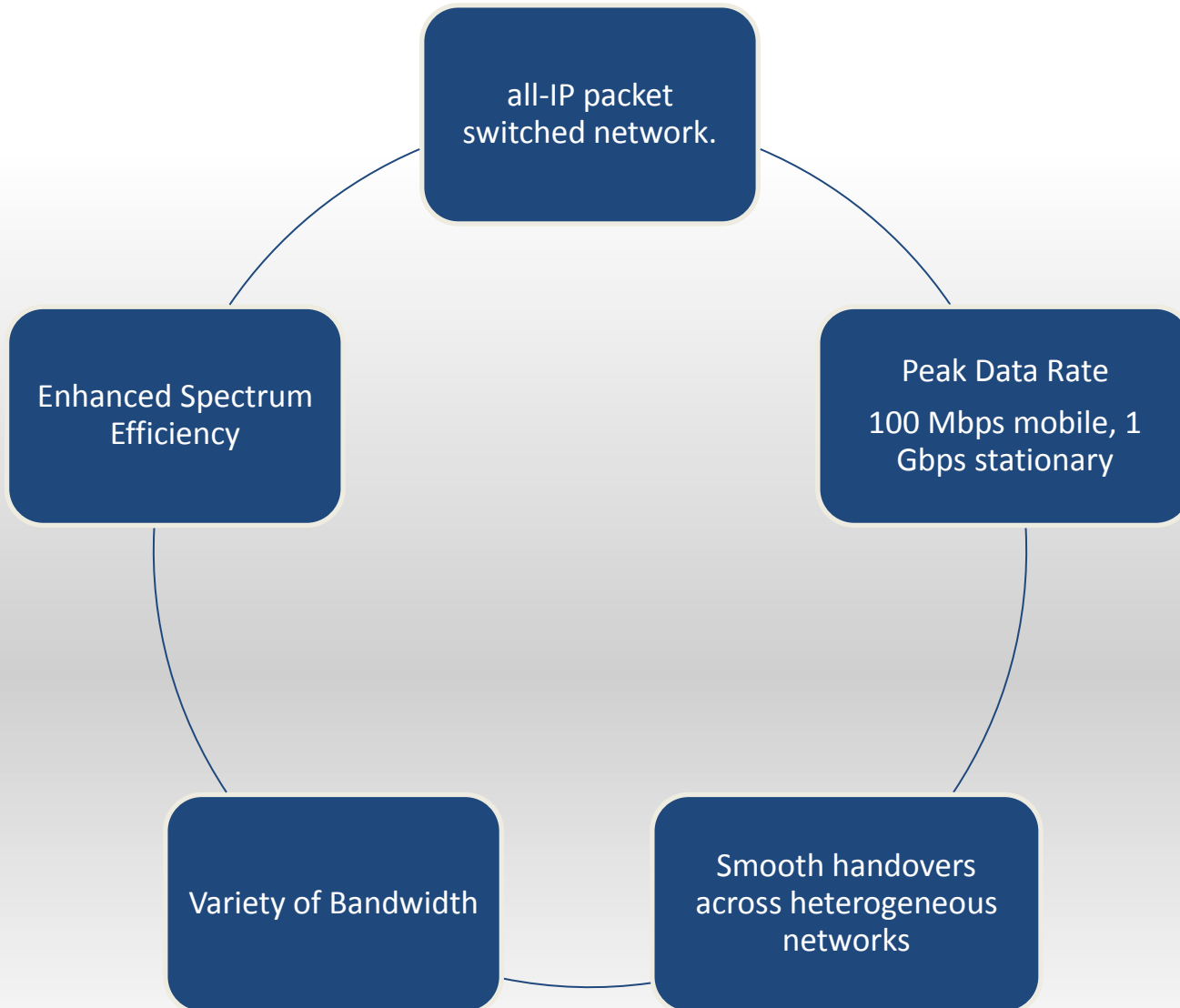
## Uplink HSUPA

- Theoretical up to 5.76 Mbps
- Initial capability 1.46 Mbps

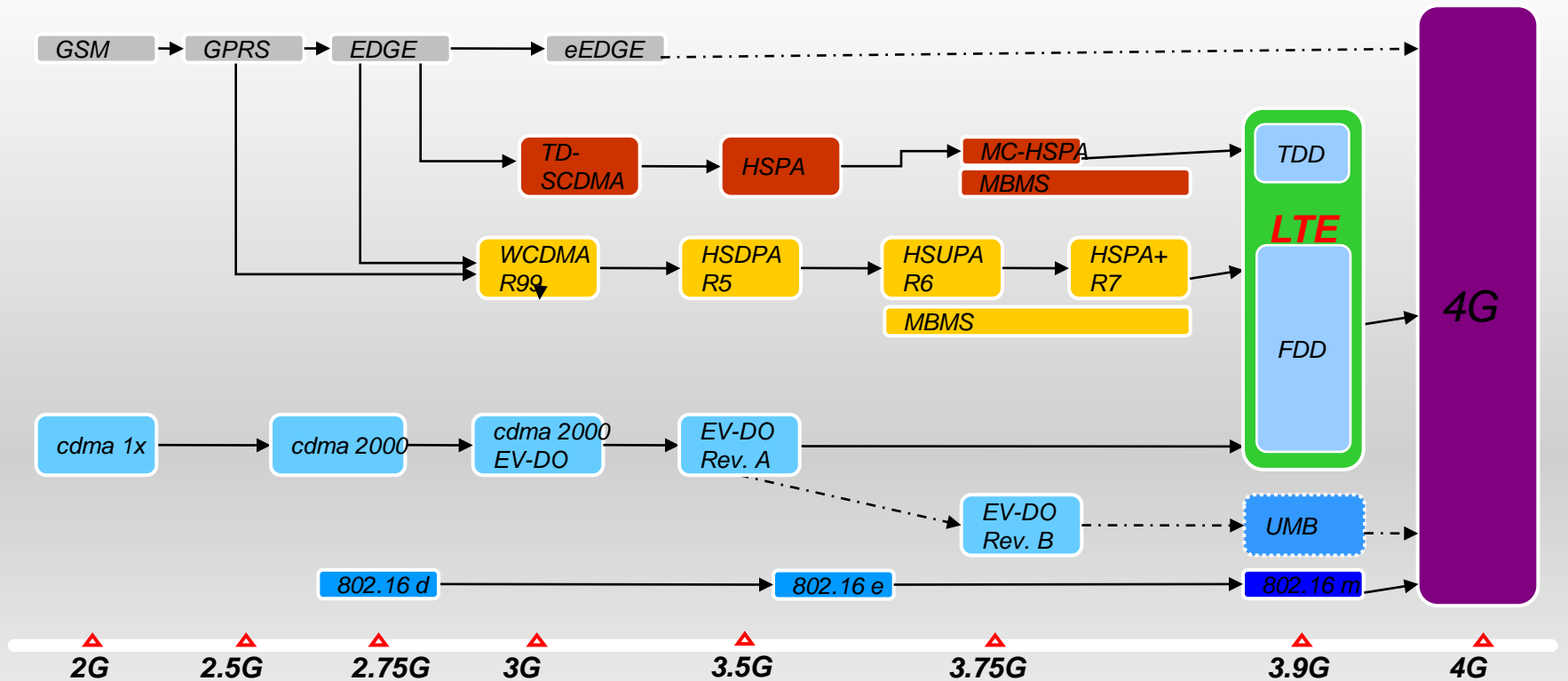
# of codes	TTI	Max data rate
2 x SF4	2 ms 10 ms	1.46 Mbps
2 x SF2	10 ms	2.0 Mbps
2 x SF2	2 ms	2.9 Mbps
2 x SF2 + 2 x SF4	2 ms	5.76 Mbps



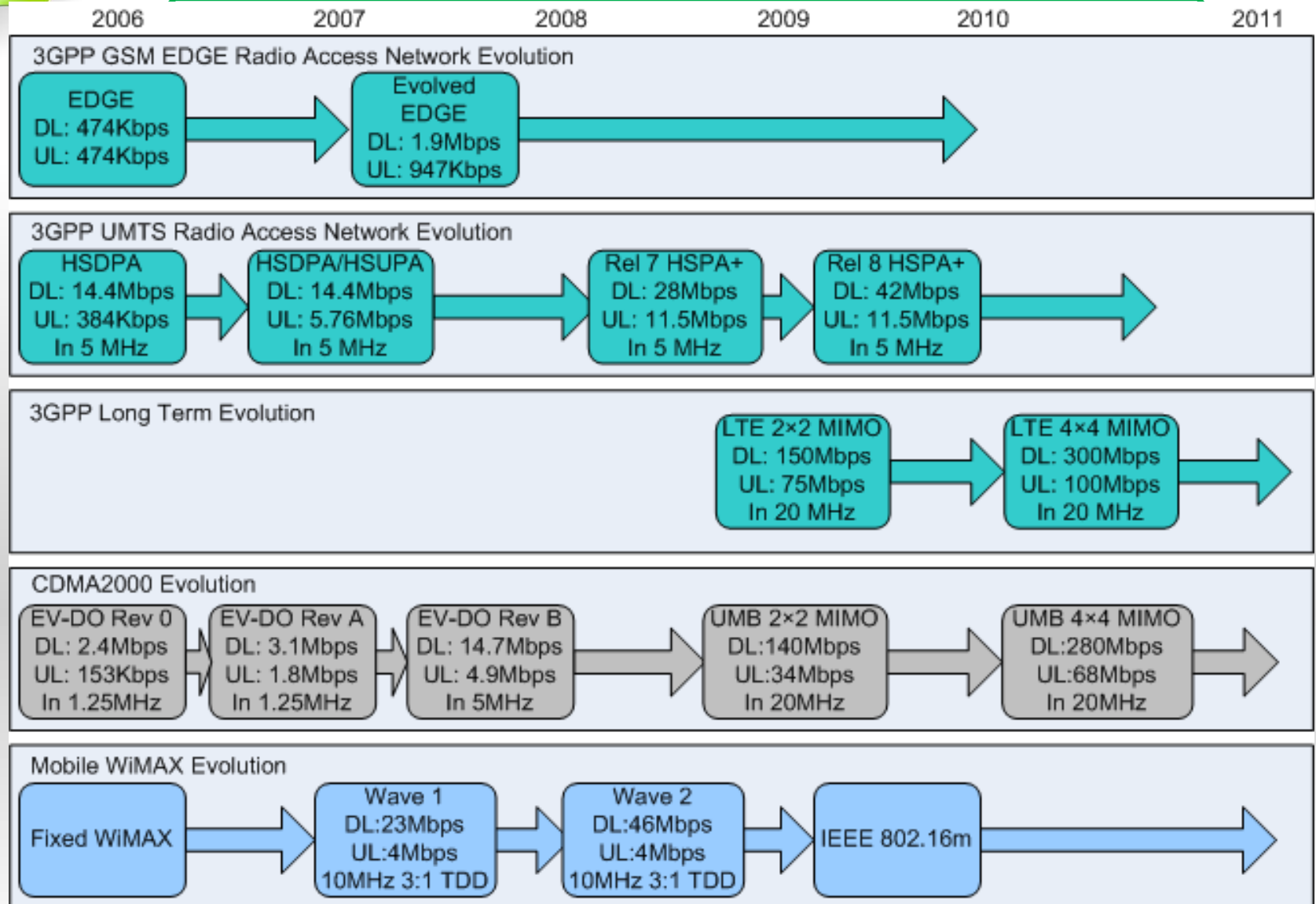
# 4G standard – Requirement



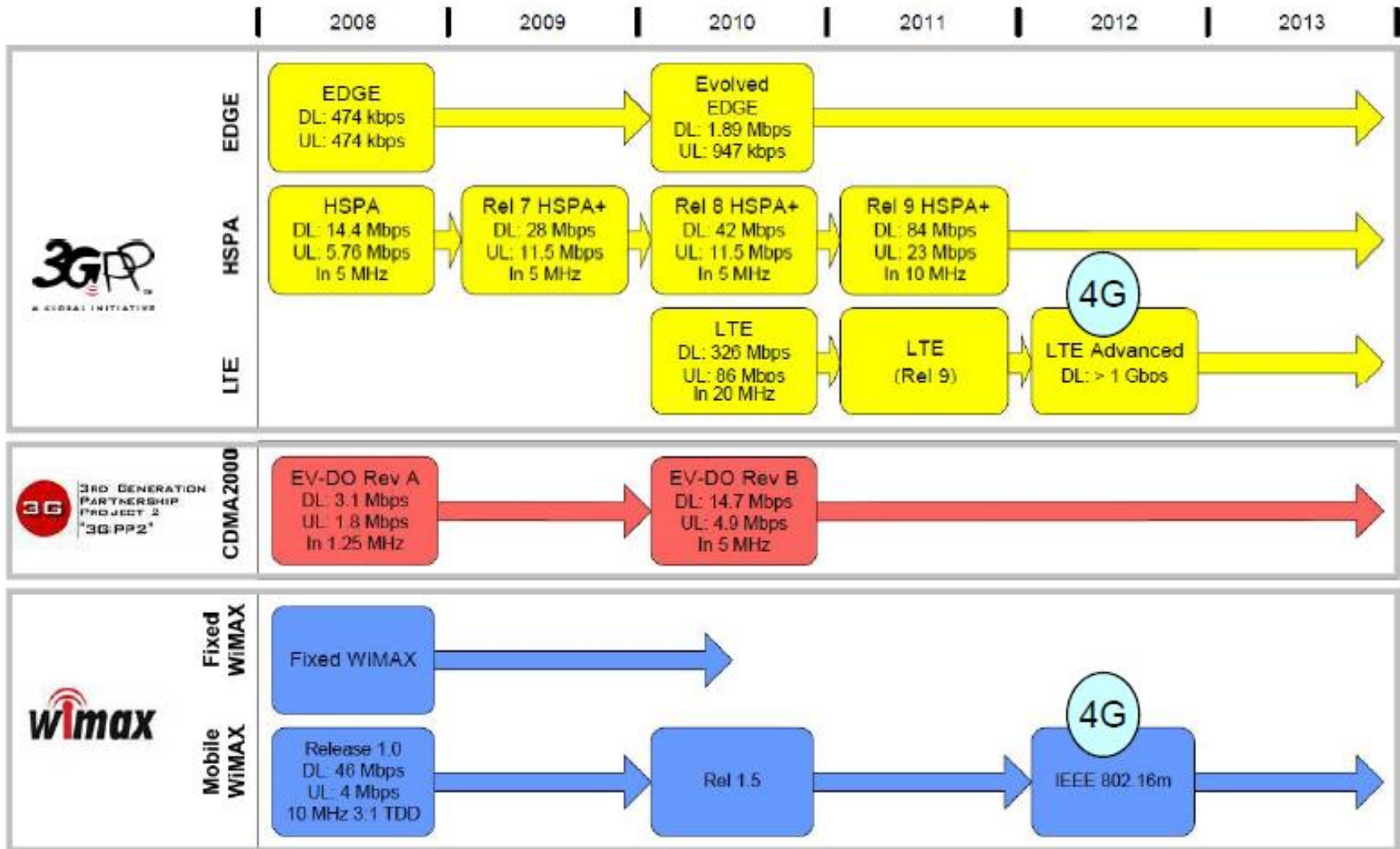
# 4G standard – Evolution



# 4G standard – Evolution



# 4G standard – Evolution



Notes: Throughput rates are peak theoretical network rates. Radio channel bandwidths indicated.

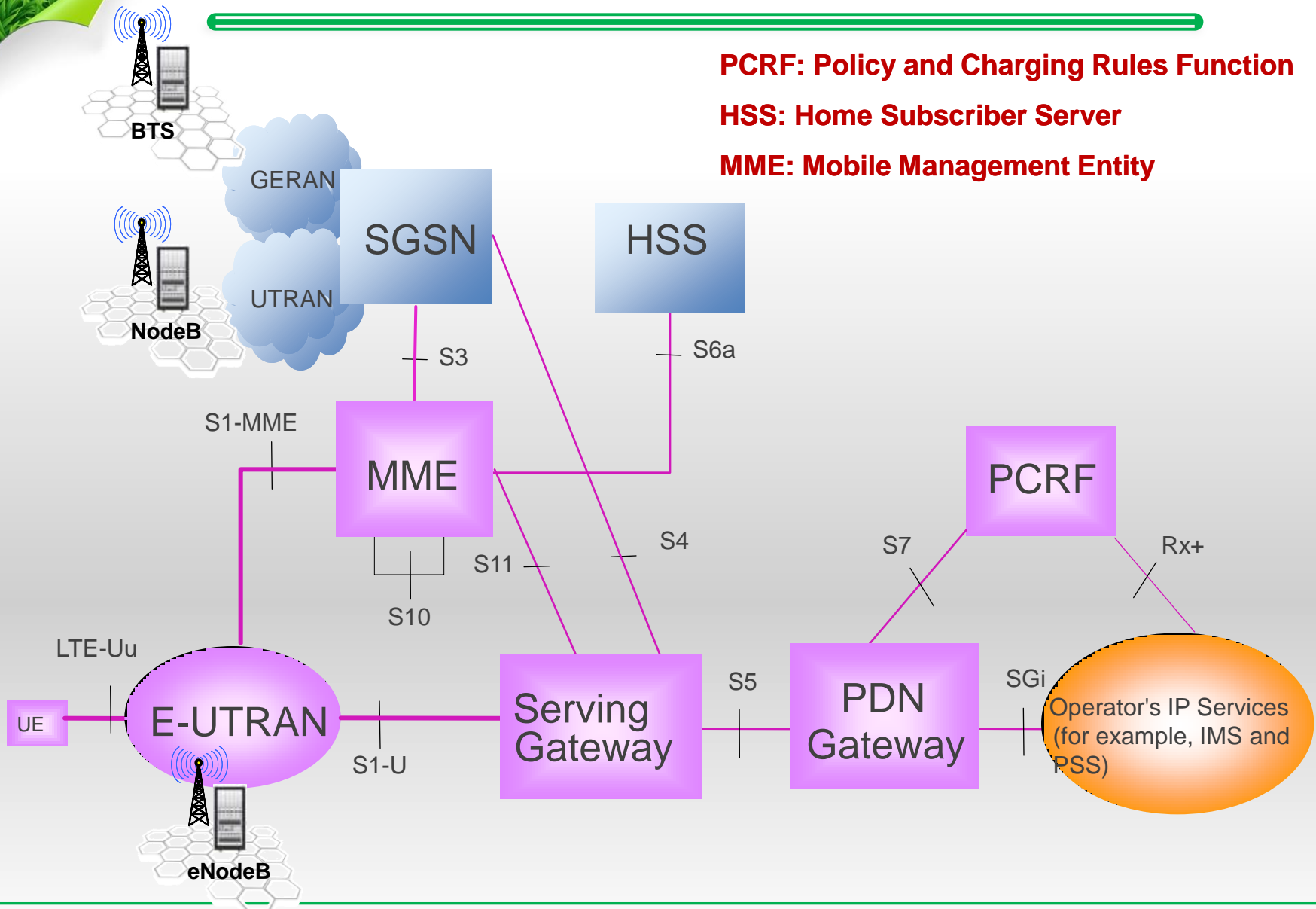
Dates refer to expected initial commercial network deployment except 2008, which shows available technologies that year.

# 4G standard – LTE Architecture

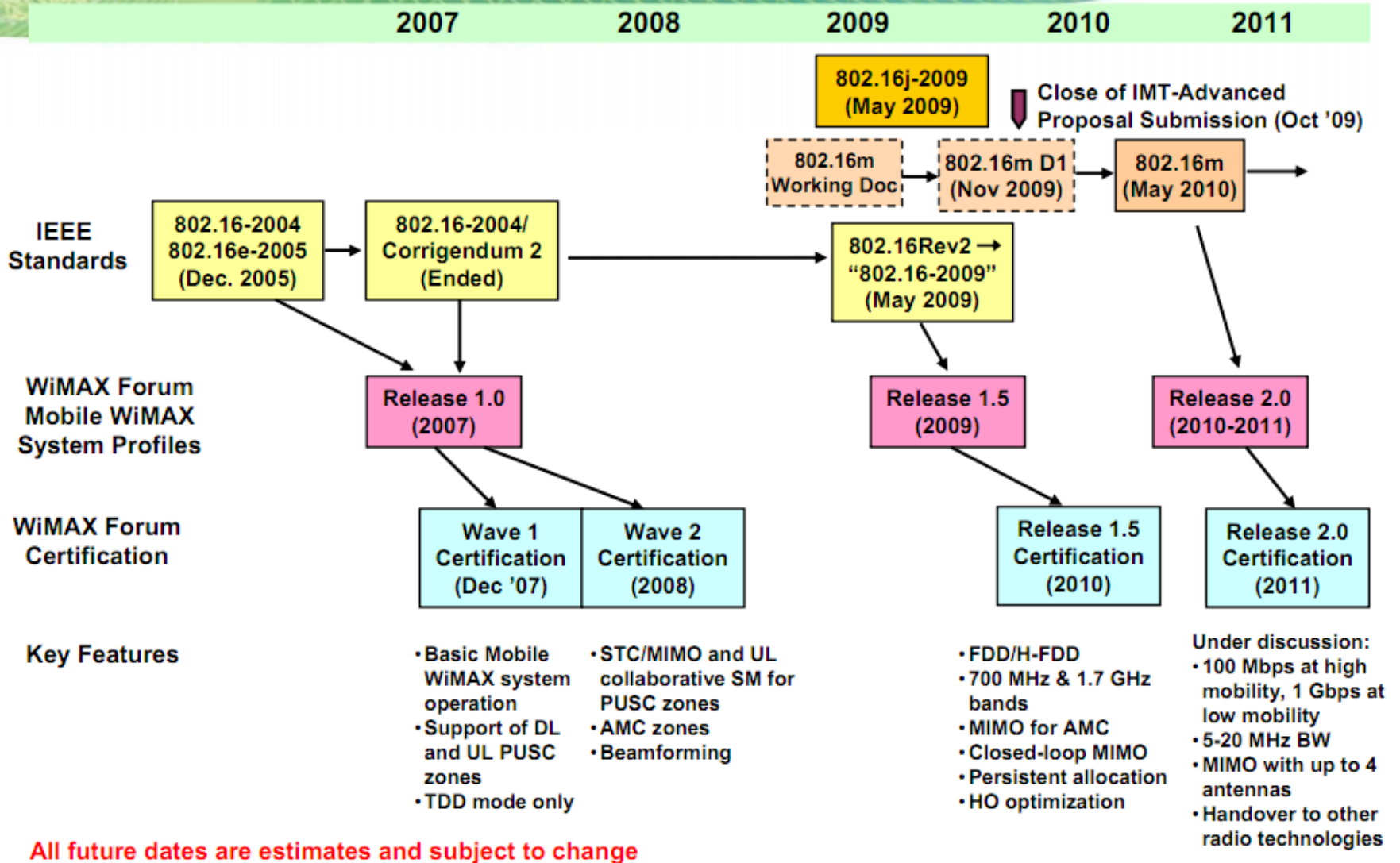
**PCRF: Policy and Charging Rules Function**

**HSS: Home Subscriber Server**

**MME: Mobile Management Entity**



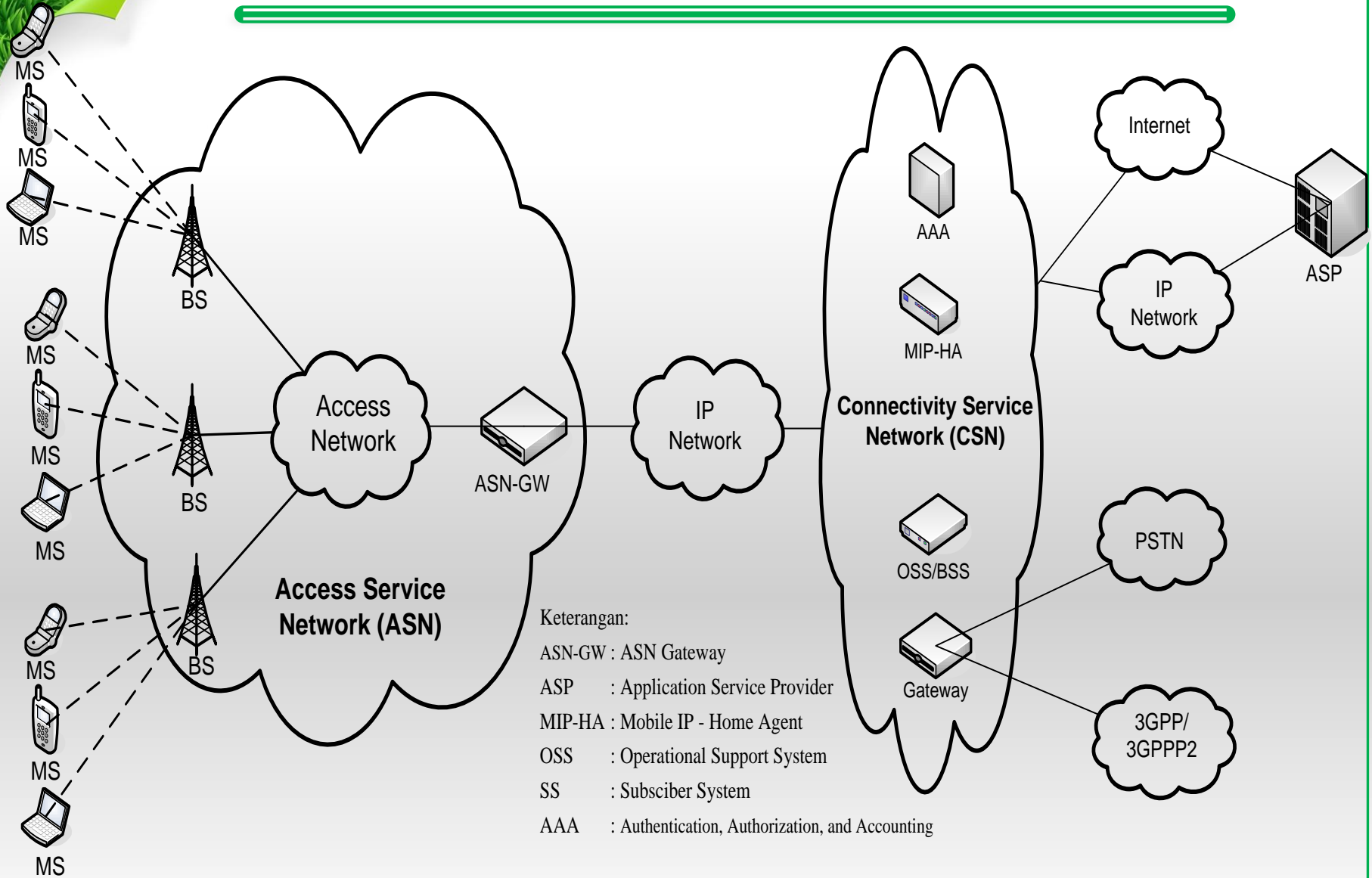
# 4G standard – Evolution



All future dates are estimates and subject to change



# 4G standard – Mobile Wimax architecture



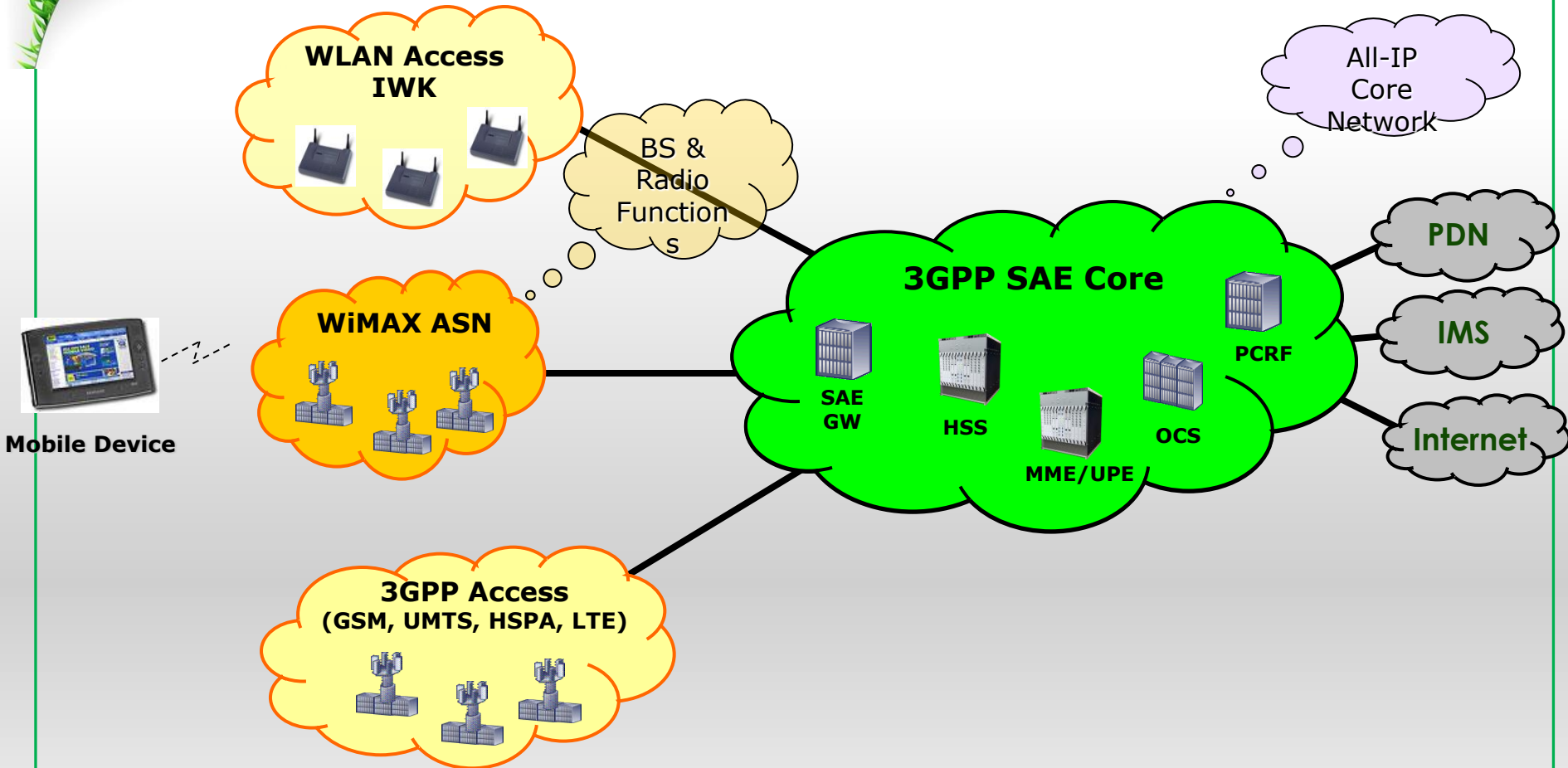


# 4G standard – Mobile Wimax architecture

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- *Mobile Station (MS)*
- *Access Service Network (ASN)*
  - *Base Station (BS)*
  - *Access Network*
  - *Access Service Network Gateway (ASN-GW)*
- *Connectivity Service Network (CSN)*
  - *Authentication, Authorization, and Accounting (AAA)*
  - *Mobile IP-Home Agent (MIP-HA)*
  - *Operational Support System (OSS)*
  - *Gateway*

# 4G standard – Mobile Wimax - 3GPP Interworking



## 4G standard – HSPA+ vs mobile wimax comparison

Parameter	HSPA			WiMAX Air Interface R1.5	
	Rel-7		Rel-8		
Duplexing	FDD			FDD	TDD
Channel BW	2 x 5 MHz			2 x 5 MHz	10 MHz
BS Antenna	(1x2)SIMO	(2x2)MIMO		(2x2)MIMO	
MS Antenna	(1x2)SIMO			(1x2)SIMO	
DL Mod-Coding	64QAM- 5/6	16QAM- 3/4	64QAM- 5/6	64QAM-5/6	
DL Peak User Rate	17.5 Mbps <i>(21 Mbps w/o coding)</i>	21 Mbps <i>(28 Mbps w/o coding)</i>	35 Mbps <i>(42 Mbps w/o coding)</i>	35.3 Mbps	39.9 Mbps <sup>5</sup>
UL Mod-Coding	16QAM-3/4			64QAM- 5/6	64QAM- 5/6
UL Peak User Rate	8.3 Mbps <i>(11 Mbps w/o coding)</i>			17.3 Mbps	11.5 Mbps <sup>6</sup>

## 4G standard – LTE vs mobile wimax comparison

	LTE		WiMAX Air Interface R1.5	
Duplex	FDD		FDD	
Channel BW	2x20 MHz		2x20 MHz	
BS Antenna	(2x2) MIMO		(2x2) MIMO	
DL Modulation	64QAM		64QAM	
DL Coding	5/6		5/6	
DL Peak Channel Rate	144.0 Mbps <i>(172.8 Mbps w/o coding)</i>		144.4 Mbps <i>(173.3 Mbps w/o coding)</i>	
MS Antenna	(1x2) SIMO		(1x2) SIMO	
UL Modulation	16QAM	64QAM	16QAM	64QAM
UL Coding	3/4	5/6	3/4	5/6
UL Peak Channel Rate	43.2 Mbps <i>(57.6 Mbps w/o coding)</i>	72.0 Mbps <i>(86.4 Mbps w/o coding)</i>	82.9 Mbps <i>(110.6 Mbps w/o coding)</i>	138.2 Mbps <i>(165.8 Mbps w/o coding)</i>

# 4G standard – HSPA+, LTE vs mobile wimax comparison

802.16e (WiMAX)

HSPA+

LTE

FEATURE

TDD

OFDMA

MIMO

64QAM

BW: 1.25–20MHz

FDD

WCDMA

MIMO

64QAM DL

16QAM UL

BW: 5MHz

FDD

OFDMA

TDD

SC-FDMA

MIMO

64QAM

1.4 | 3 | 5 | 10 | 20MHz

DATA RATE



63.36Mbps DL  
2\*2 10MHz



28.22Mbps UL  
2\*2 10MHz



42Mbps DL  
2\*2 5MHz



11.5Mbps UL  
5MHz



150Mbps DL  
2\*2 20MHz



75Mbps UL  
2\*2 20MHz

STANDARD



2005.12



New spectrum



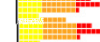
2008. Q3



3G spectrum



2009. Q3



3G spectrum  
New spectrum







**TERIMAKASIH**