POMI 2010

Emergence of Mobile Internet & Enabling Technologies

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Intel's Vision of Mobile Internet

Technology For Mobile Internet Connectivity

Transparent Affordable Internet Access Wherever* You Are

Wi-Fi + WiMAX = Mobile Internet

WiMAX connectivity requires a WiMAX enabled device and subscription to a WiMAX broadband service. Availability of WiMAX is limited, check with your carrier for details on availability.

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What is the killer application?*

Яndex   facebook   Rambler   וואלה now.walla.co.il   skype

Google   mixi βversion   FC2 fc2.com   Pathfinder   @mail.ru

WIKIPEDIA   Blogger   tom.com   flickr LOVES YOU   腾讯网 QQ.com

NAVER   myspace.com a place for friends   eHarmony   orkut

YAHOO!   ebay   REALTOR.com   Baidu 百度

sina.com.cn
播客最热机构风云榜单
设定本页为浏览器首页   KANGWON ILBO   You Tube Broadcast Yourself™   தினமலர்   blocket.se Sveriges största Köp & Sälj marknad

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Anything Internet Can Provide & More

Key Ingredients for Mobile Internet Success

True &
affordable flat-rate
charging

Rational Roaming
Charges

Ubiquitous
Connectivity

Device Retail
Model
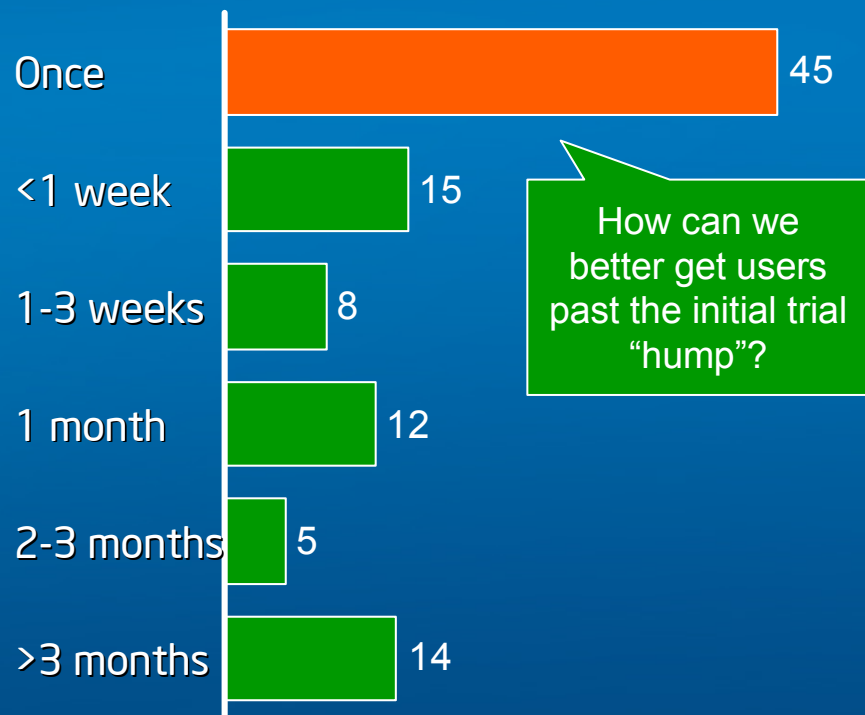
True Internet
not
Mini-Internets

Open and PC-like
Mobile Devices

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Users Desire "Mobile PC" Internet Experience
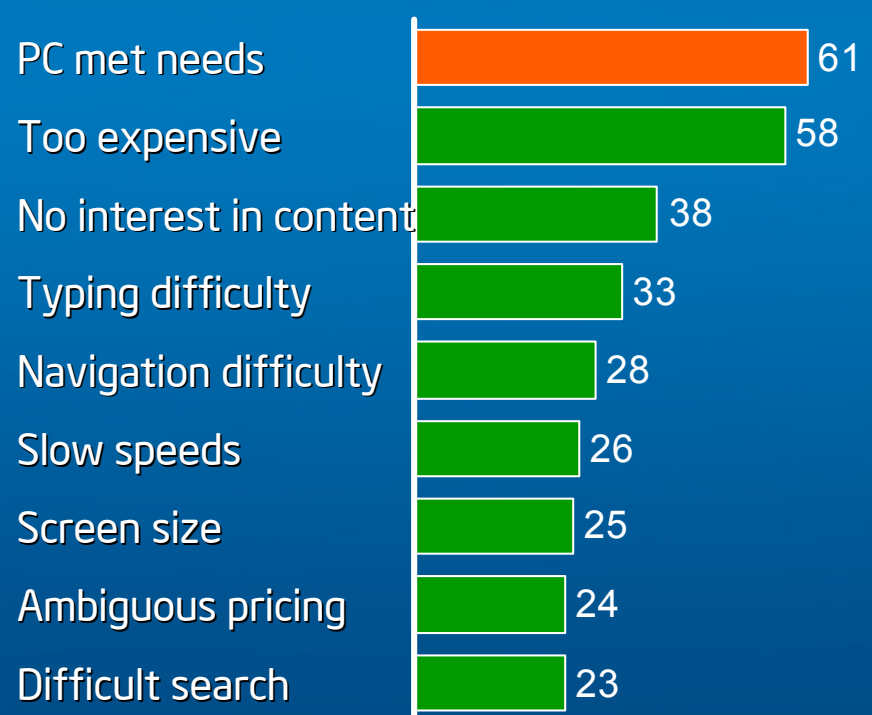## *Not a Mobile Phone Internet Experience*

The majority of churners generally leave after the first use of mobile data.

Length of trial before churn
Percent of total mobile data churners**

Period	Percent
Once	45
<1 week	15
1-3 weeks	8
1 month	12
2-3 months	5
>3 months	14

> How can we better get users past the initial trial "hump"?

The main reason for churn was that their PC already met their needs .

Reasons for churn
Percent churners in strong agreement**

Reason	Percent
PC met needs	61
Too expensive	58
No interest in content	38
Typing difficulty	33
Navigation difficulty	28
Slow speeds	26
Screen size	25
Ambiguous pricing	24
Difficult search	23

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* North American consumer mobile subscribers
** Percent answering "top 2 box"
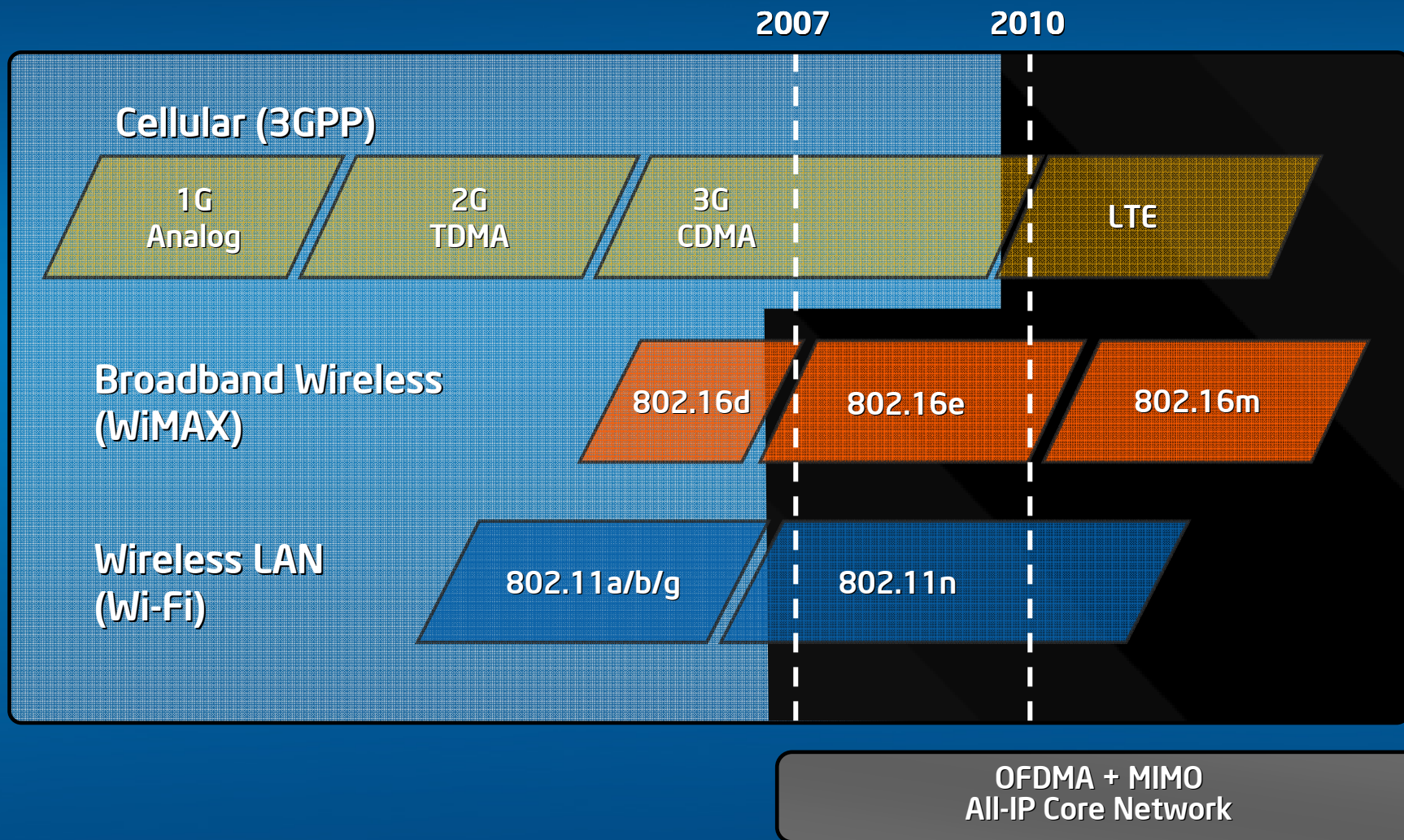Source: Mckinsey Wireless Panel, 2007

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4G Devices – Intel View

- It's not about phones
- Smaller PCs will be the primary access device
- A whole new class of Mobile Internet Devices (MIDs)
  - Small form factor
  - Good battery life
  - Mass market affordability
  - PC-like application processing power (service transparency)
  - Full-fledged Microsoft/MAC/Linux OS support (application transparency)
  - Always on experience
- Opportunity for Internet enabled consumer electronics (cameras, VoIP phones, portable music players, etc.)

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Mobile Broadband Evolving to OFDM/MIMO + All-IP

2007   2010

Cellular (3GPP)

| 1G Analog | 2G TDMA | 3G CDMA | LTE |

Broadband Wireless (WiMAX)

| 802.16d | 802.16e | 802.16m |

Wireless LAN (Wi-Fi)

| 802.11a/b/g | 802.11n |

OFDMA + MIMO
All-IP Core Network

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WiMAX Scales for Future Mobile Internet Traffic Demands

Technology	Peak Data Rate (Shared)*		Spectrum
	Downlink	Uplink	
1X-EVDO Rev B (hw upgrade) 10 MHz	14.7 Mbps	5.4 Mbps	licensed
HSPA (3GPP Release 7) 10 MHz	14 Mbps	5.8 Mbps	licensed
WiFi (802.11a/b/g) 20 MHz WiFi (802.11n, 3x3 40 MHz)	54 Mbps 450 Mbps		unlicensed
Mobile WiMAX Release 1.0 (2x2 MIMO) 10 MHZ	72 Mbps		licensed
Mobile WiMAX Release 2.0 (4x4 MIMO) 20 MHZ	As much as 300 Mbps**		licensed

Rule of thumb: the actual capacity (Mbps per channel per sector) in a multi-cell environment for wireless technologies is ~ 20-30% of the peak theoretical data rate.

* Peak data rates are theoretical and assume zero path loss – similar to "100 Mbps Ethernet." Data rates are calculated directly from the indicated air interface specification.

** IEEE 802.16m Systems Requirements Document sets 300 Mbps as the minimum peak data rate for the given configuration. Intel estimates rates could reach 400 Mbps.
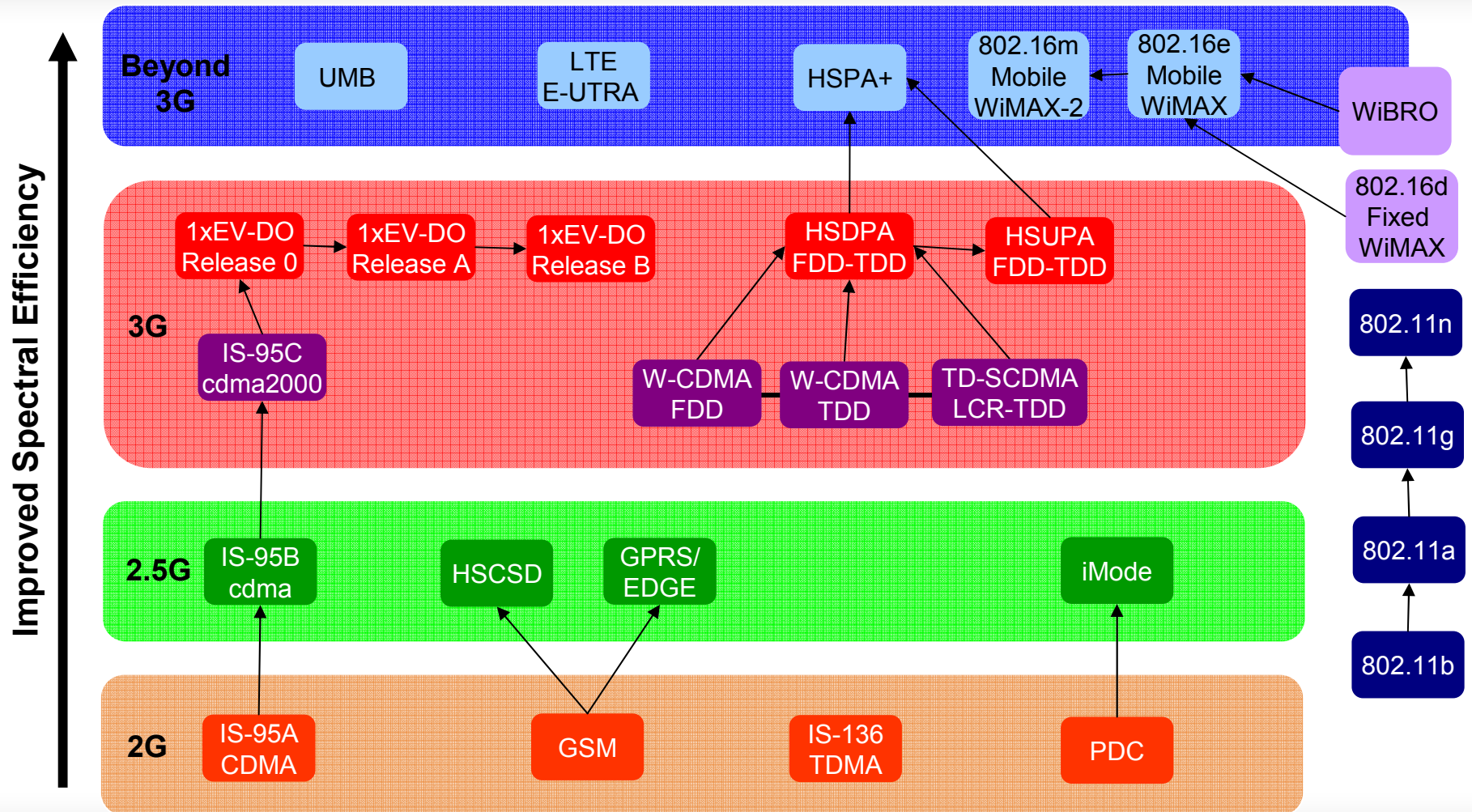
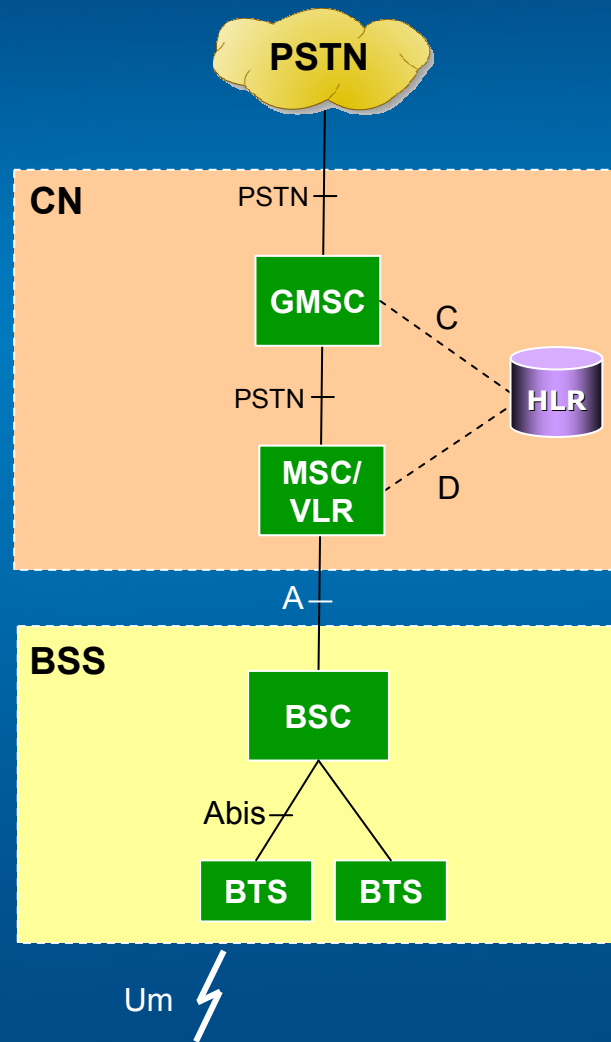(intel)

Backward Compatibility

- Definition: Ways to make new and legacy technologies share radio and/or core network resources

- Backward compatibility at air-interface level:
  - Allows new RAN to co-exists with the old one at the same frequency channel

- Backward compatibility at core network level:
  - Allows new RAN to share the same core network elements (e.g. gateways) with the legacy RAN

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Evolution of Air-Interface Technologies

Improved Spectral Efficiency (vertical axis, upward arrow)

Beyond 3G

UMB

LTE E-UTRA

HSPA+

802.16m Mobile WiMAX-2

802.16e Mobile WiMAX

WiBRO

802.16d Fixed WiMAX

3G

1xEV-DO Release 0 → 1xEV-DO Release A → 1xEV-DO Release B

HSDPA FDD-TDD

HSUPA FDD-TDD

IS-95C cdma2000

W-CDMA FDD

W-CDMA TDD

TD-SCDMA LCR-TDD

802.11n

2.5G

IS-95B cdma

HSCSD

GPRS/ EDGE

iMode

802.11g

802.11a

2G

IS-95A CDMA

GSM

IS-136 TDMA

PDC

802.11b

LTE is not an evolution of any 3GPP air-interface technology
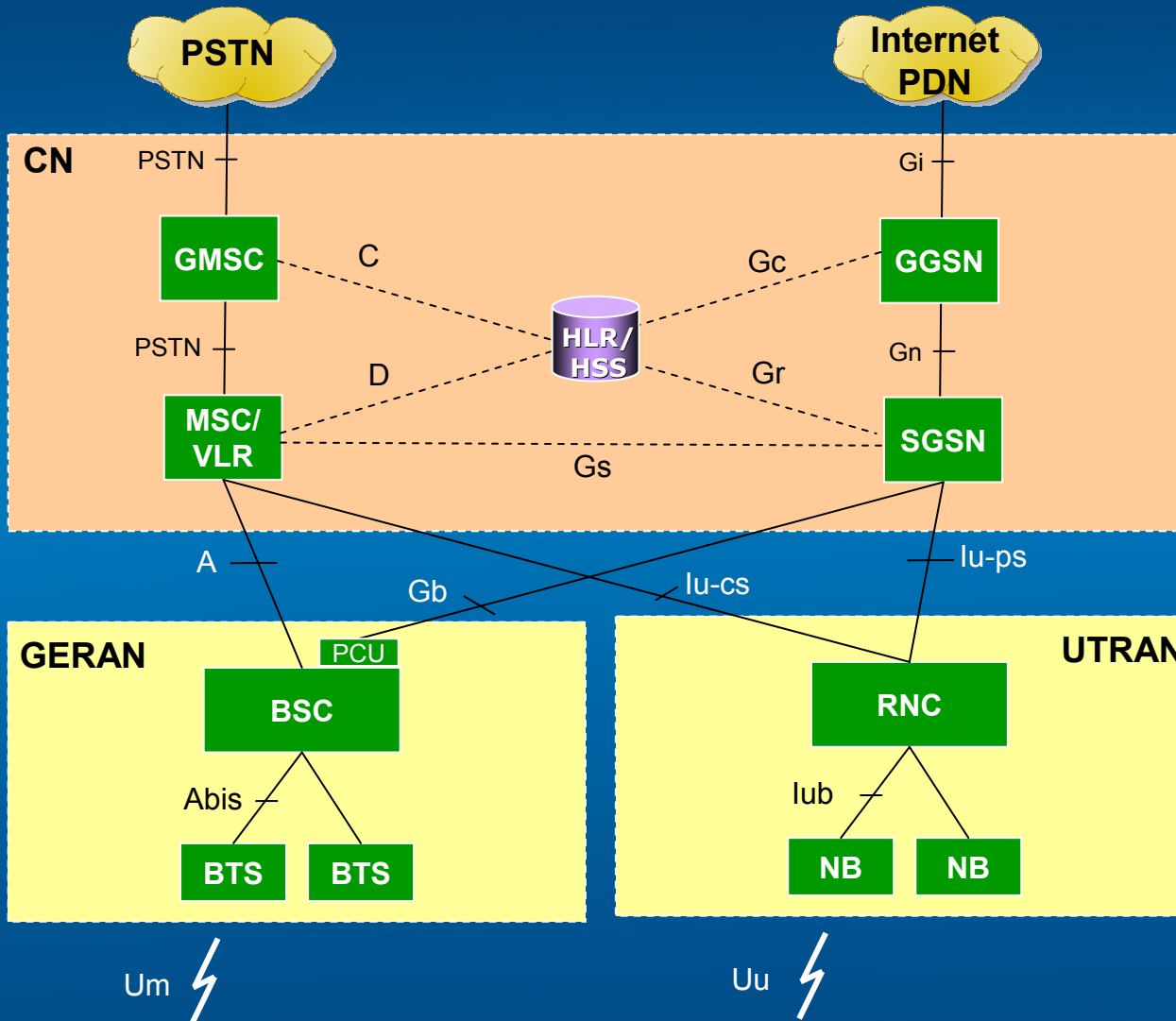
The Good Old GSM

GPRS Introduction
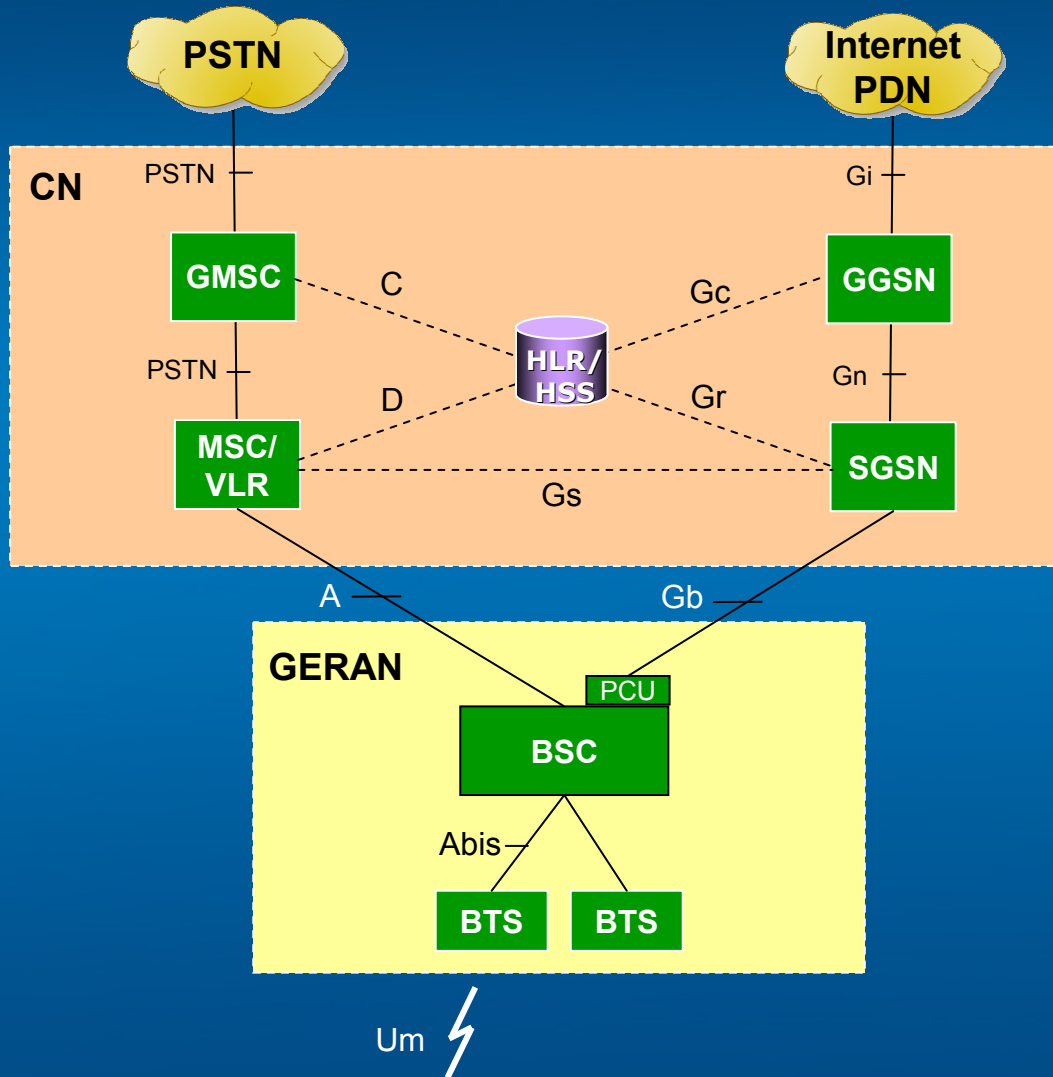
GPRS/EDGE has air-interface backward comparability with GSM
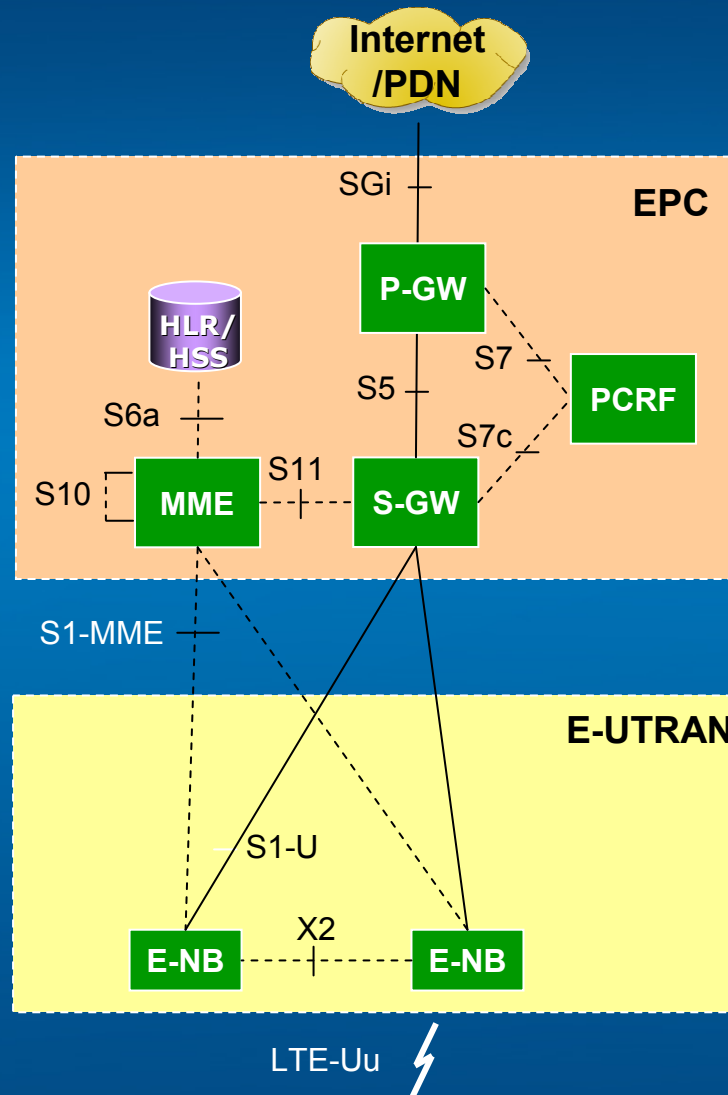But requires a new packet core

3G Introduction

3G has no air-interface backward comparability with 2G
but UTRAN can interwork with legacy packet and circuit cores

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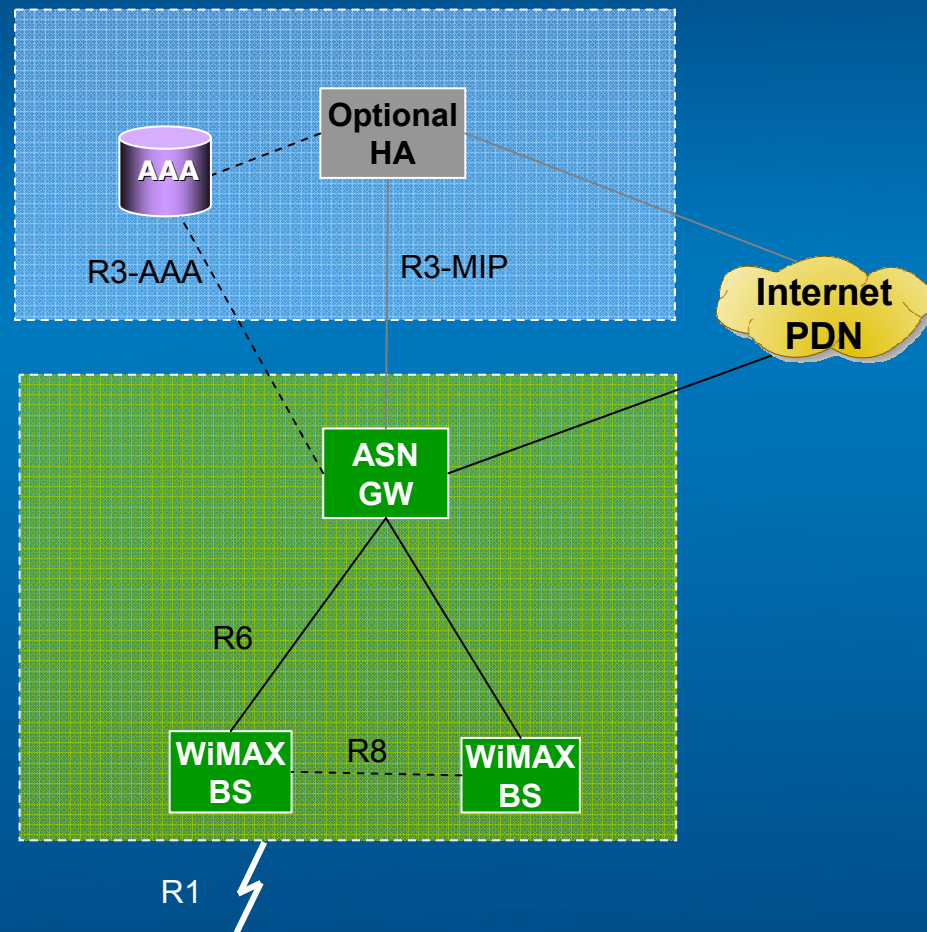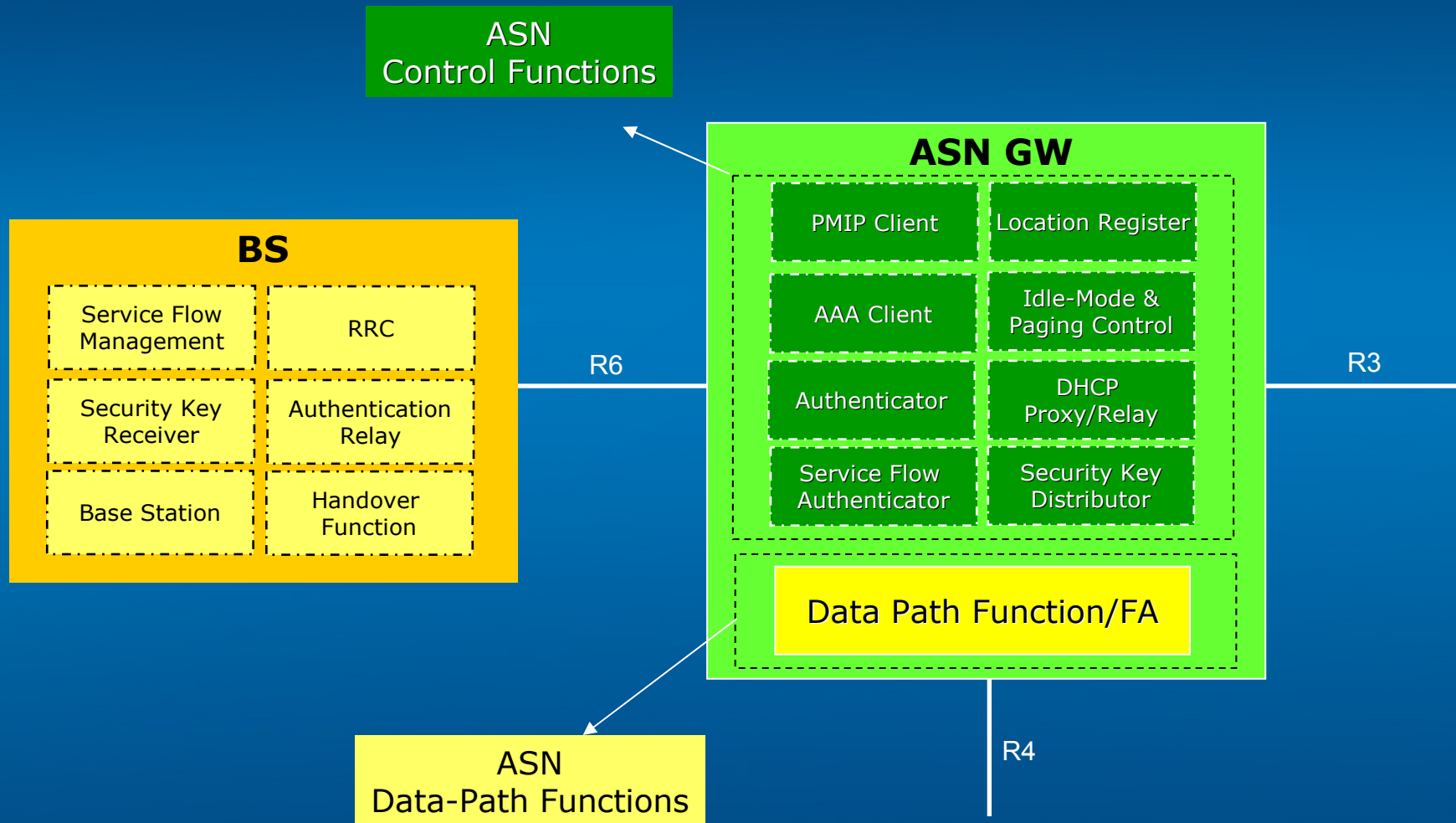# LTE/EPC Network Architecture

Source: 3GPP TS 23.401/402

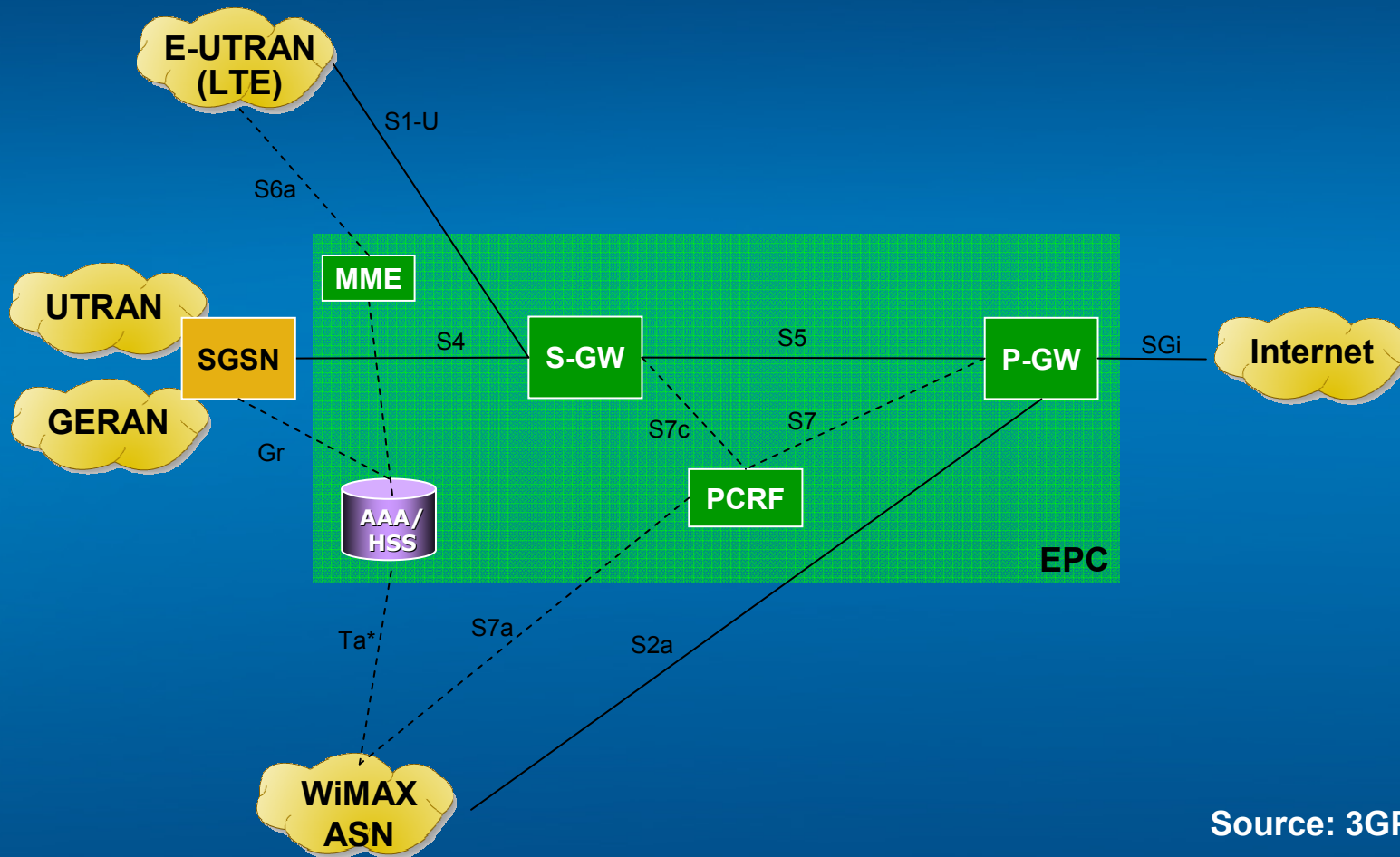LTE has no air-interface backward comparability with 2G/3G and requires a whole new evolved packet core (EPC)

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WiMAX Network Architecture

Simple flat all-IP network

ASN Functional Decomposition

ASN Control Functions

BS

Service Flow Management	RRC
Security Key Receiver	Authentication Relay
Base Station	Handover Function

ASN GW

PMIP Client	Location Register
AAA Client	Idle-Mode & Paging Control
Authenticator	DHCP Proxy/Relay
Service Flow Authenticator	Security Key Distributor

Data Path Function/FA

R6

R3

R4

ASN Data-Path Functions

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Interworking with Legacy Systems

Source: 3GPP TS 23.402

17 LTE and WiMAX interworking with legacy 2G/3G systems identically using the new evolved packet core (EPC)

Summary of Backward Comparability

	Air-interface backward compatibility	Core network backward compatibility	Interworking with legacy systems
2.5G (GPRS/EDGE)	With GSM	Requires new packet core	N/A
3G (WCDMA, HSPA)	None with GSM	Reuses 2G/2.5G core networks	Done via legacy 2G/2.5G core
E-UTRAN (LTE)	None with 2G or 3G	Requires new evolved packet core (EPC)	Possible via EPC
WiMAX	None with 2G or 3G	Requires new evolved packet core (EPC)	Possible via EPC

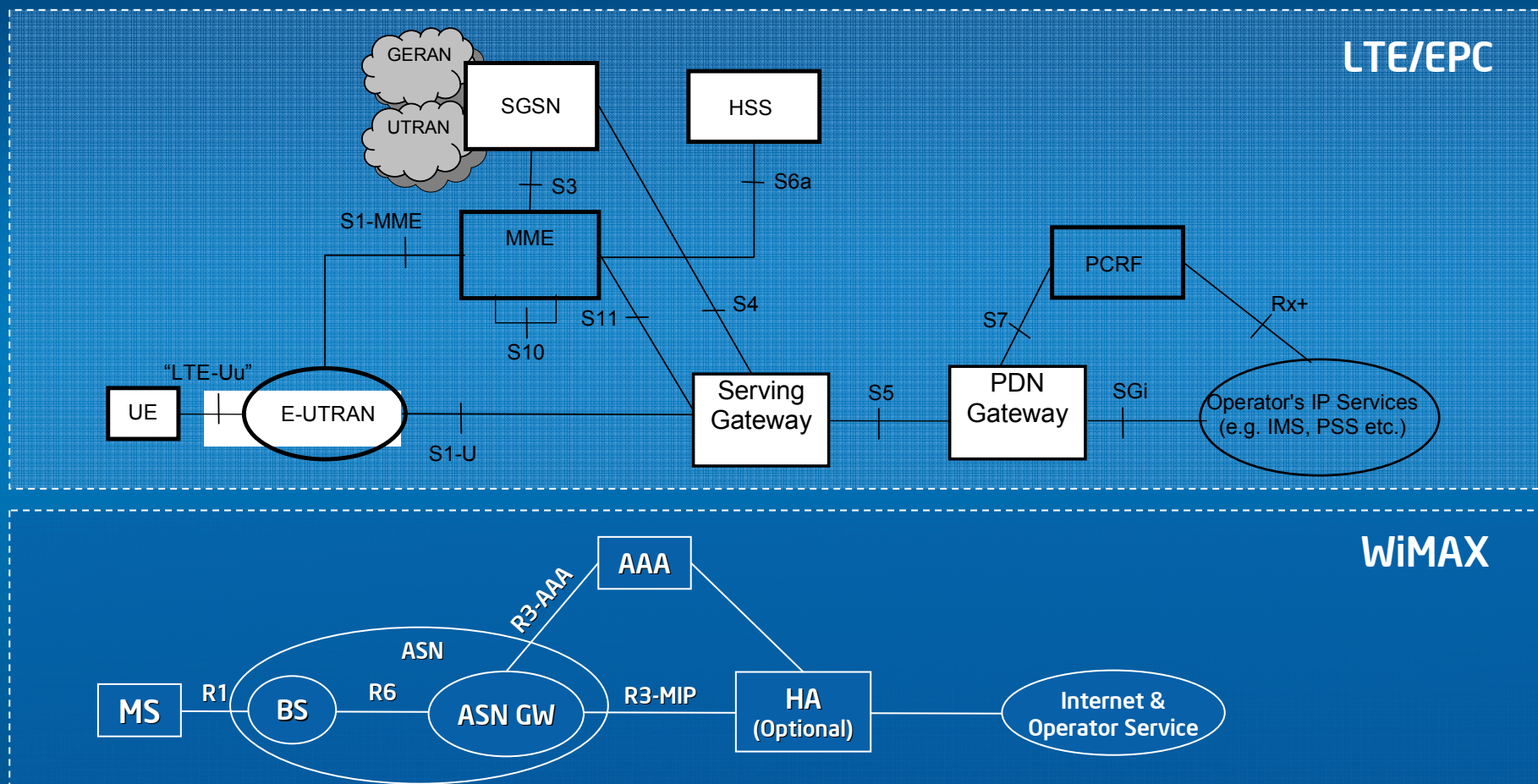(intel)

WiMAX + Wi-Fi for Mobile Internet
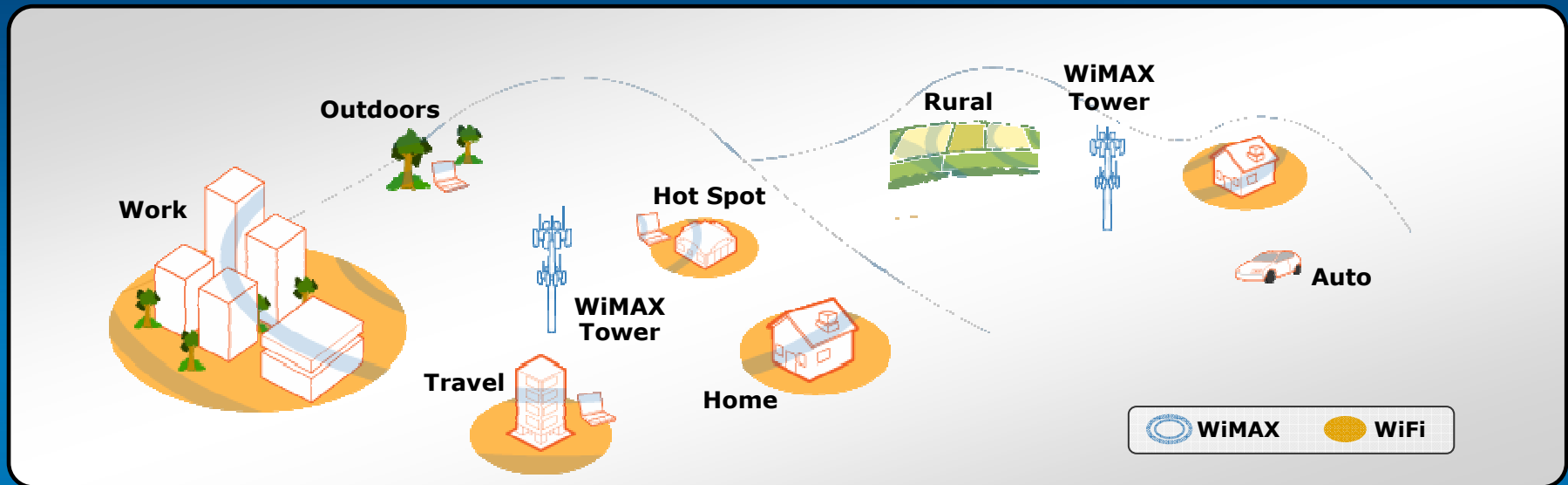
- Wi-Fi -> best solution for local area connectivity
  - With up to 450 Mbps throughput, MIMO-enabled 802.11n enables new local area applications
  - Wi-Fi hotspots easy to find in most places
- Mobile WiMAX -> metropolitan-wide broadband coverage
  - Offers service providers 3x the latest HSPA (3G) capacity today*
  - Potential to scale to over 20x the capacity of today's HSPA via more antennas over time**

* WiMAX Forum, *Mobile WiMAX Performance and Comparative Summary,* Sept 2006.
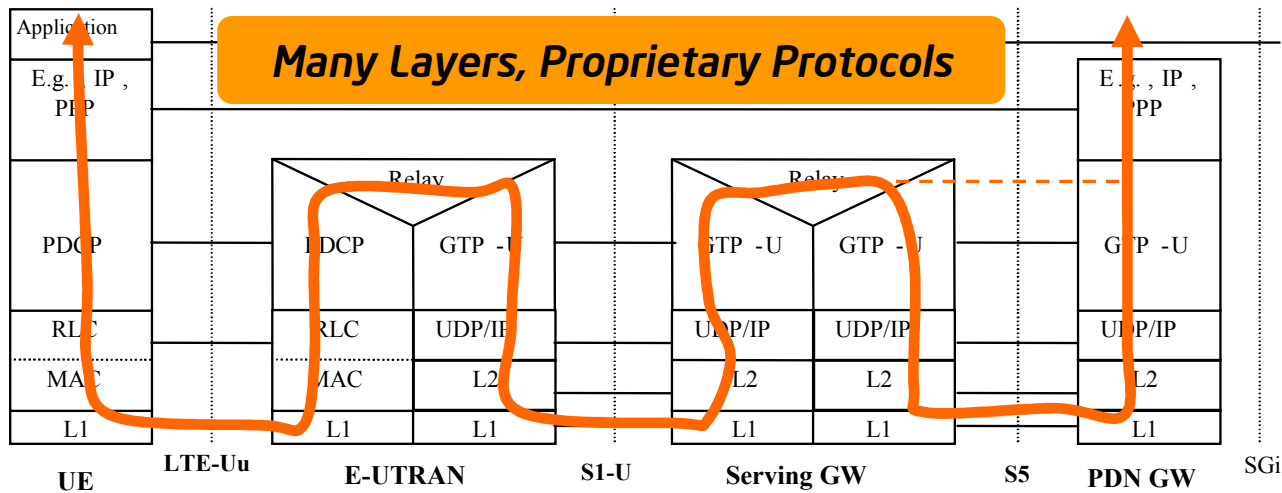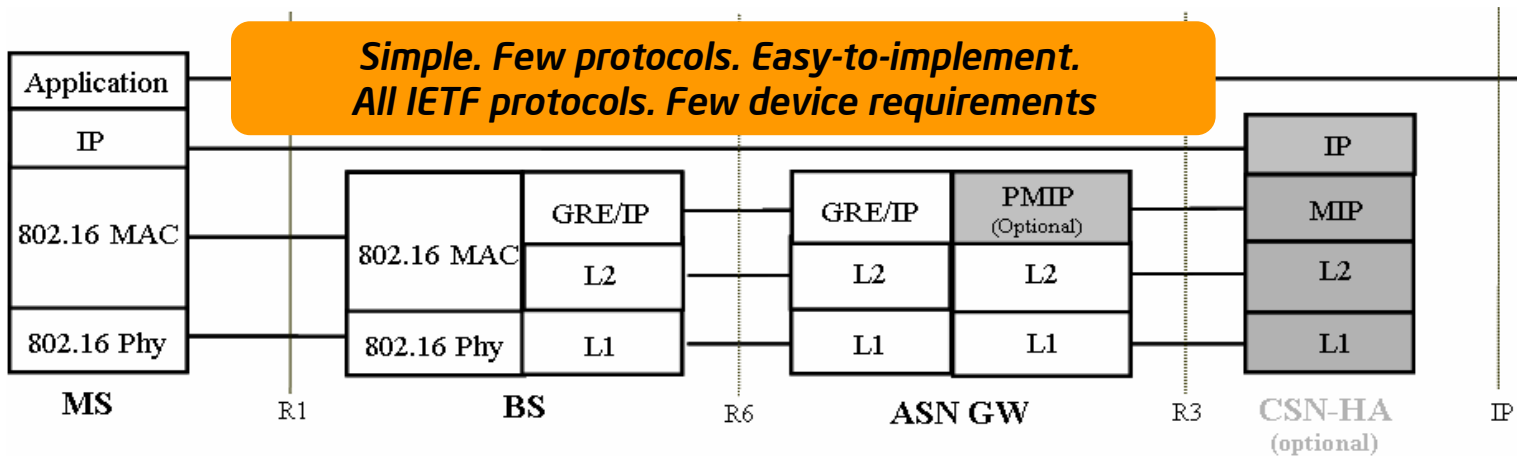** IEEE 802.16m System Requirements Document.

Demo: Wi-Fi & WiMAX Together

Flatter Network Architecture

Telecom vs. Internet Network Architecture

* SAE/LTE diagram source: 3GPP
** WiMAX diagram source: WiMAX Forum Network Spec Release 1.0.

LTE/SAE User Plane and Data Flow -> Identical to 3G Legacy

Many Layers, Proprietary Protocols

| UE | LTE-Uu | E-UTRAN | S1-U | Serving GW | S5 | PDN GW | SGi |

WiMAX User Plane and Data Flow

**Simple. Few protocols. Easy-to-implement.
All IETF protocols. Few device requirements**

* LTE/SAE diagram source: 3GPP
** WiMAX diagram source: WiMAX Forum Network Spec Release 1.0.

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Beyond Access Opportunity

- Old Model: Walled Garden
  - Advantage: complete control for the operator
  - Disadvantage: few applications, no leveraging of creative Internet application

- Broadband Model: Open Internet (Dumb Pipe)
  - Advantage: access to all applications over the internet
  - Disadvantage: operator revenues limited to access

- Mobile WiMAX Model: Smart Pipe (Internet+)
  - Mobile operators partner with content and application providers to deliver enhanced mobile services
  - Advantage: user transparent quality access to Internet applications, opportunity for shared revenue on contents
  - Win-Win!

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Walled Garden Service Approach (IMS)

Highly complex infrastructure

Internet+ Model

Mobile WiMAX Operator

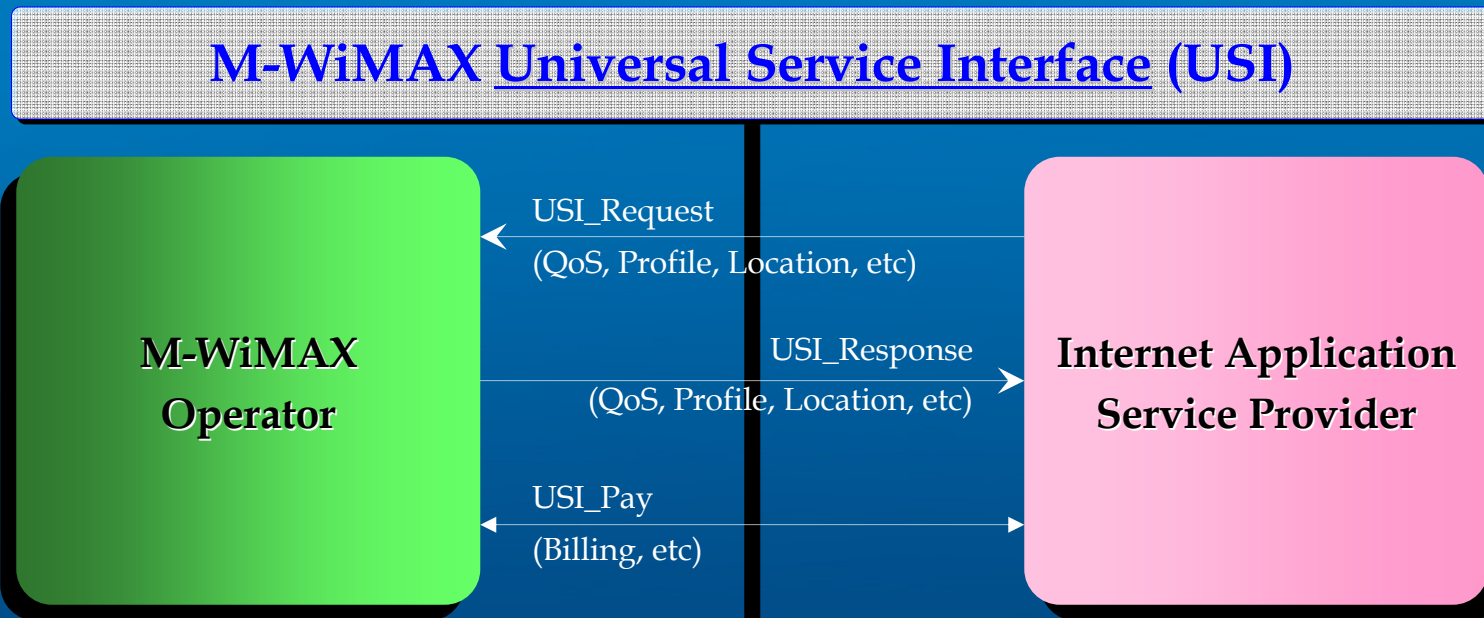**Internet Application Provider**
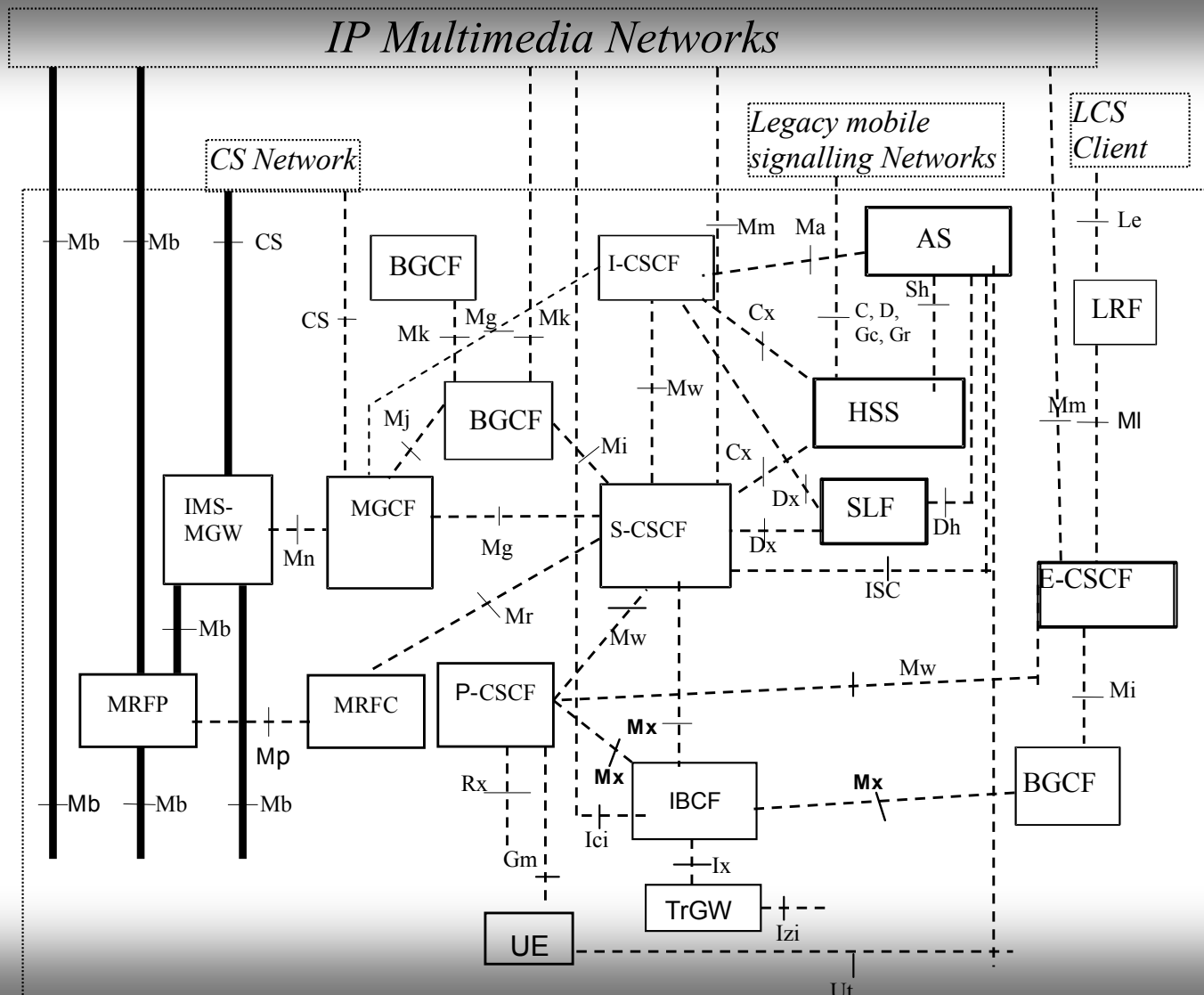
- Large subscriber base
- Real-time knowledge of user's
  - Presence
  - Location
  - Billing relationship
  - Device Capability

- Control of data pipe

- Unlimited application media
- Only major source of data traffic
- Substantial & phenomenal growth
- Control of data content

Win-Win for Mobile WiMAX operator and
Internet application provider

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WiMAX Universal Service Interface (USI)

- SP provides information and capability to be used for value added Internet services (e.g. QoS, location based service)
- iASP & WiMAX operator share revenue
- Simple Internet-friendly interfaces

M-WiMAX Universal Service Interface (USI)

M-WiMAX Operator

Internet Application Service Provider

USI_Request
(QoS, Profile, Location, etc)

USI_Response
(QoS, Profile, Location, etc)

USI_Pay
(Billing, etc)

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Closing Statements

- Mobile Internet is driving the need for mobile broadband

- Mobile broadband solutions all have the same ingredients (OFDMA/MIMO, all-IP networks). Following physics law, they will have similar performance

- Emerging mobile broadband technologies require all new packet core network and the legacy networks are not reusable

- There is no backward compatibility of emerging mobile broadband air-interfaces with legacy (2G/3G) air-interfaces

- Identical interworking is possible with the legacy 2G/3G systems regardless of the mobile broadband technology of choice

- Available today, WiMAX/WiFi offer a cost-effective solution for enabling ubiquitous mobile Internet that can interwork with legacy 2G/3G systems

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Thanks for listening...