HSPA+

Building Global Momentum: Success in the 3GPP Evolution of HSPA

Chris Pearson, President

3G Americas

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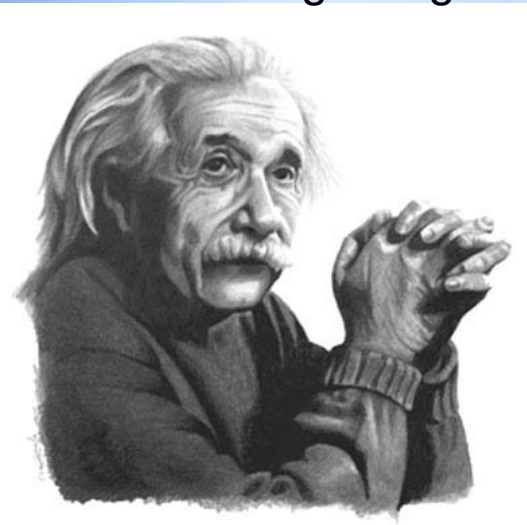
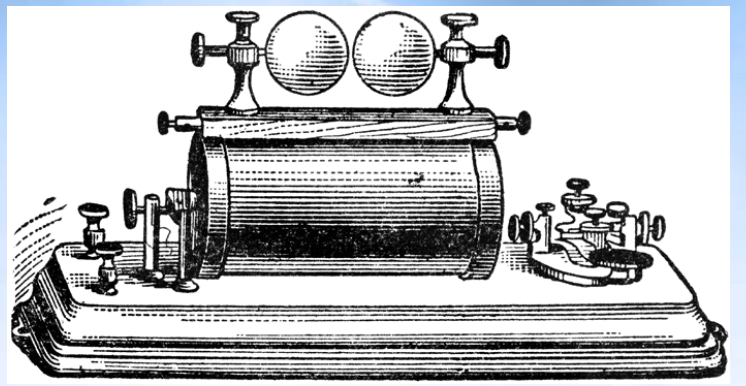
The Wireless World

From Humble Beginnings…



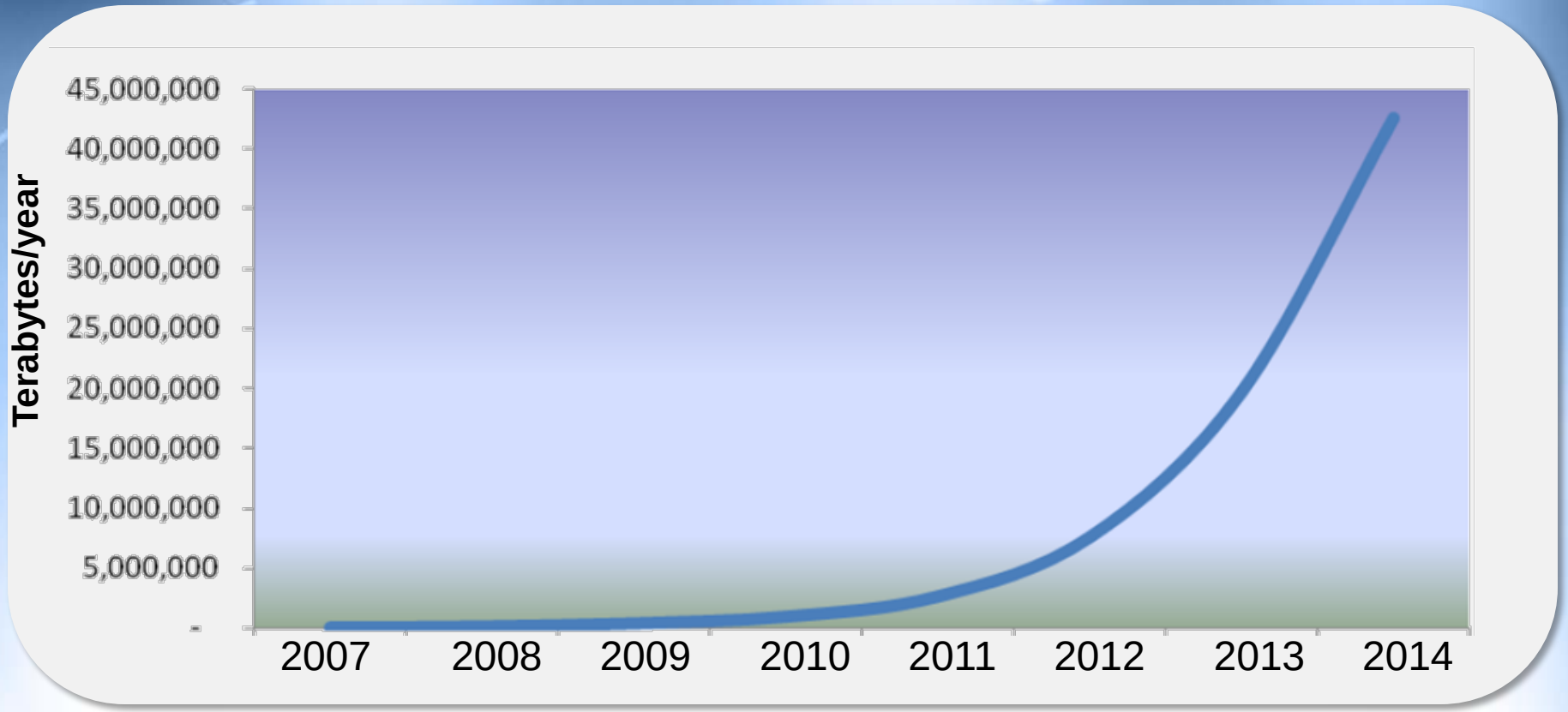
Albert Einstein



"The wireless telegraph is not difficult to understand. The ordinary telegraph is like a very long cat. You pull the tail in New York, and it meows in Los Angeles. The wireless is the same, only without the cat…."

Source: http://www.pewinternet.org/~/media//Files/Reports/2008/PIP_FutureInternet3.pdf.pdf

US Mobile Data Traffic Growth 2007-2014



Source: Chetan Sharma Consulting, July 2009

HSPA: The Foundation for HSPA+

Global UMTS-HSPA Today

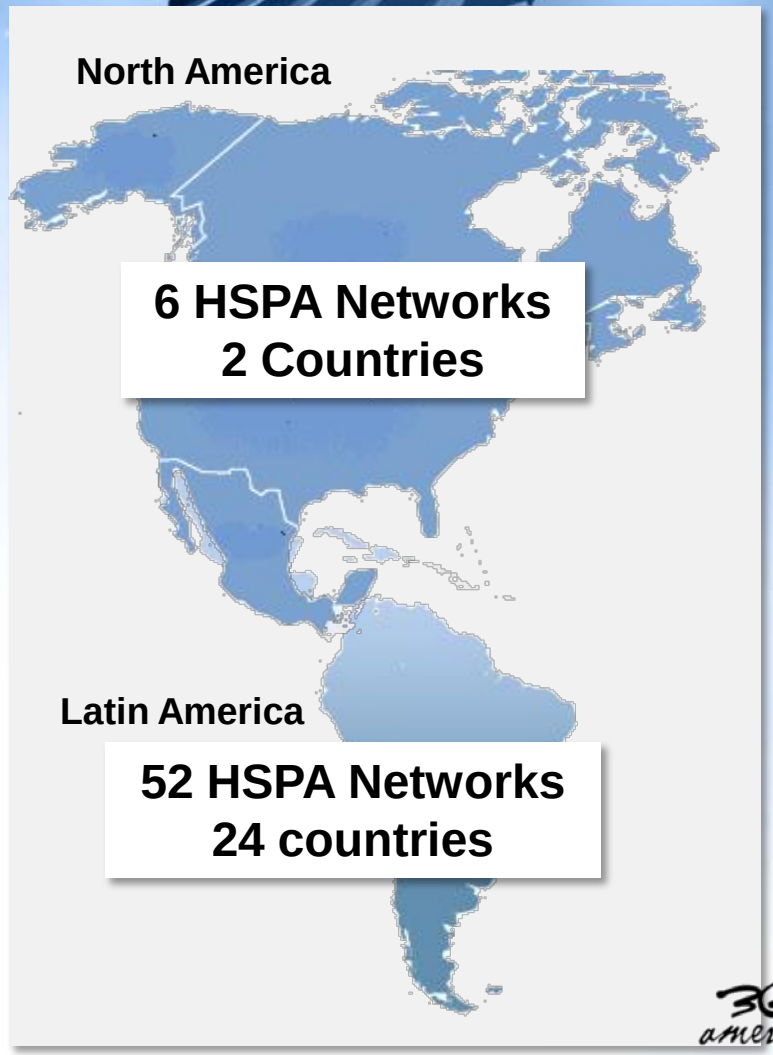
318
Networks In Service

135
Countries

88
Networks Planned/In Deployment

453
Million Subscribers

1,800+
Devices Launched Globally



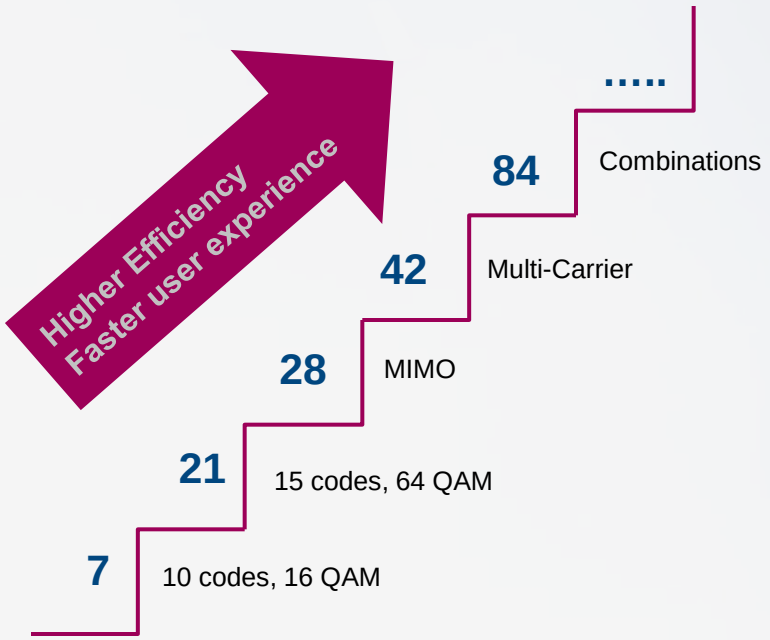
Source: Informa Telecoms & Media, WCIS+, Dec 2009 and Public Announcements

Why HSPA+ and why now?

HSPA+

- Easily overlay existing footprint
- Utilize existing spectrum blocks
- Backward compatibility with existing network
- HW is HSPA+ ready
- Device ecosystem is ready now

Peak Rate in Mbps

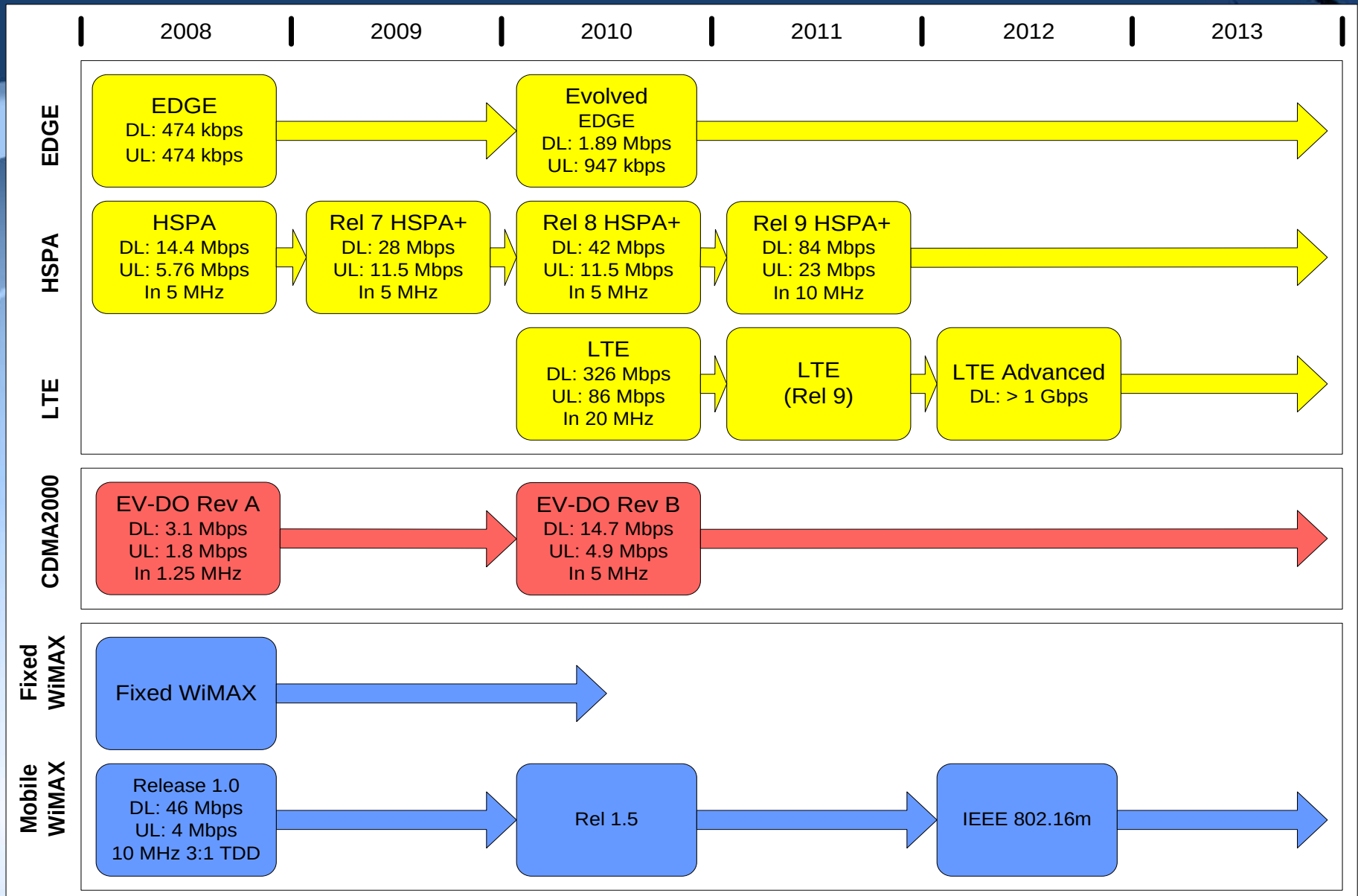


HSPA+ Across the Globe

42 commercial launches in 25 countries

- Telstra/ Australia
- mobilkom Austria
- M-Tel / Bulgaria
- Bell / Canada
- Telus / Canada
- VIPNet / Croatia
- Rogers Wireless / Canada
- 3 / Denmark
- Etilisat Misr /Egypt
- DNA / Finland
- Telefónica 02 / Germany
- Cosmote / Greece
- Vodafone / Greece
- SmarTone / Vodafone / HK
- CSL / Hong Kong
- PCCW / Hong Kong
- Telecom Italia / Italy
- eMobile / Japan
- Zain / Kuwait
- Maxis / Malaysia
- ERA / Poland
- Polkomtel /Poland
- Sferia/Aero2 / Poland
- Optimus/ Portugal
- TMN / Portugal
- Vodafone / Portugal
- ZAPP/ Romania
- STC Al Jawal/ Saudi Arabia
- M1/ Singapore
- Starhub/ Singapore
- Movistar / Spain
- Vodafone / Spain
- 3 / Denmark / Sweden
- Swisscom / Switzerland
- Avea / Turkey
- Turkcell / Turkey
- Vodafone / Turkey
- BendBroadband / USA
- T-Mobile / USA

Mobile Network 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.

Summary

- HSPA+ is a simple upgrade to HSPA and protects investment
- HSPA+ delivers speeds 3-5 times faster than early 3G Systems
- HSPA+ utilizes current spectrum
- HSPA+ has a strong ecosystem of infrastructure and devices

Thank you!

Questions? Go to…… WWW.3GAMERICAS.ORG

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The Real-World HSPA+ User Experience

drive test results and network implications

February 17, 2010

SiGNALS Research Group

HSPA+ Market and Technology Update

- HSPA+ Market and Technology Update
  - Operator Interest – what and why
  - Infrastructure Suppliers Roadmap
  - Chipset Suppliers Roadmap
- Present methodology and results for the HSPA+ drive test from Melbourne, Australia in May 2009 (results published in July 2009).
- HSPA+ in an LTE and Mobile WiMAX World

SiGNALS Research Group

A quick introduction to Signals Research Group, LLC.

- Signals Research Group, LLC offers thought-leading field research and proprietary consulting services on the wireless telecommunications industry.

- Our flagship research product, a research newsletter entitled “Signals Ahead,” includes more than 70 corporate subscribers on five continents across the entire wireless ecosystem.

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Operator Interest and the Key HSPA+ Features

	HSPA+ Features						
	CPC, etc	Enhanced FACH	64-QAM	MIMO	64-QAM + MIMO	DC-HSPA	CS over HSPA/VoIP
Operator 1	Very Interested	Very Interested	Interested	Mildly Interested	Mildly Interested	Mildly Interested	Mildly Interested
Operator 2	Very Interested	Very Interested	Mildly Interested	Mildly Interested	Mildly Interested	Very Interested	Mildly Interested
Operator 3	Very Interested	Very Interested	Commercial	Mildly Interested	Mildly Interested	Very Interested	Mildly Interested
Operator 4	Very Interested	Interested	Very Interested	Mildly Interested	Mildly Interested	Interested	Very Interested

Source: SRG analysis

- Operator installed base is 235 million subscribers and is spread across three continents
- Operators are primarily interested in 64 QAM, followed by DC-HSPA and then MIMO-related enhancements
- "HSPA+ Lite" features also have a strong following
- Operators generally cautious about using HSPA+ for voice services
- Additional research across a much broader base of operators supports the above findings

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Understanding Operator Interest – Part I

- 64QAM (21Mbps) is relatively easy to deploy in most networks
  - Software upgrade in various touch points throughout the network
  - Does require a backhaul network upgrade – by no means a trivial task
  - Allows operators to promote a better end user experience – less interest in the capacity benefits at the moment
- MIMO (28Mbps) is promising from a performance perspective, but requires a much greater impact on the cell site
  - Additional radio chain and potentially antennas
  - Impacts site leasing agreements; could be prohibited on some sites
  - Some concerns about MIMO's impact on legacy handsets
  - More likely to happen with LTE, which presupposes the use of MIMO

Understanding Operator Interest – Part II

- DC-HSPA (42Mbps and beyond) is promising from both a technical and economics perspective
  - Software upgrade (assumes two radio carriers are present)
  - 2x data rate throughput cell, plus trunking gain, which increases capacity
- HSPA+ Lite features, such as Enhanced_FACH, are a critical part of improving the user experience with handsets/smartphones.
  - Benefits of ultra-high data rates in a small handheld device are questionable
  - Improves battery life
  - Reduces “latency” associated with the first connection to the Internet
  - Reduces the amount of signaling traffic required to “wake up” and receive messages

Leading Infrastructure Supplier Roadmaps

	HSPA+ Features								
	CPC, etc.	Enhanced FACH	CS Voice over HSPA	64-QAM	MIMO	64-QAM + MIMO	DC-HSPA	16 QAM (UL)	Cat 9/10
Alcatel-Lucent	2010	Commercial (2009)	2010	Commercial (2009)	2010	2010+	2010	2010	Commercial (2009)
Ericsson	Q1/10	Yes	-	Dec-08	mid-09	Dec-09	mid-2010	mid-2009	Commercial (Q4/08)
Nokia Siemens Networks	2H/09	2H/09	2H/09	2H/09	2H/09	2010	2010	2H/09	Q1/09

Source: Vendor input and SRG analysis

- Input from all vendors was not available at the time the research was done, but dates are still representative of when the industry will be ready
- Dates subject to change due to customer interest and the availability of chipsets
- Category 9/10 (e.g., 14.4Mbps capabilities) are shown for informational purposes, but are not considered to be HSPA+ features

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Leading Chipset Supplier Roadmaps

	HSPA+ Features								
	CPC, etc	Enhanced FACH	CS Voice over HSPA	64-QAM	MIMO	64-QAM + MIMO	DC-HSPA	16 QAM (UL)	Cat 9/10
Comneon (s/w)	2H/09	Yes	2H/09	2H/09	2H/09	2H/10	2H/10	Yes	commercial
Icera	Q4/09	Q1/10	Q4/10	H2/09	Q3/10	-	H2/10	Q3/10	Q3/09
Infineon	2H/09	Yes	Yes	Q1/10	Q4/10	Q4/10	Q4/10	Q1/10	Q1/10
Nokia (modem)	Yes	Yes	Yes	under eval	under eval	under eval	Yes	under eval	commercial (Cat 9)
Qualcomm	2H/09	Yes	2H/09	2H/08	1H/09	1H/10	2H/09	Yes	2H/08
ST-Ericsson	Q2/09	2010	2010	Q2/09	2010	2010	2010	2010	Cat 9 under eval

Source: Vendor input and SRG analysis

- Input from all vendors was not available at the time the research was done, but dates are still representative of when the industry will be ready
- Commercial availability dates do not necessarily equate to device availability
- Dates vary across chipset suppliers due to their different strategies and target end markets (e.g., handset versus broadband connectivity modems)

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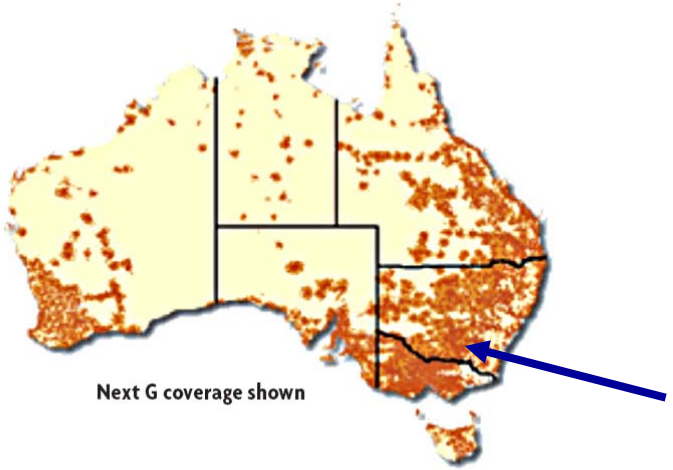
HSPA+ Drive Test Background

- In May 2009 we conducted an independent performance benchmark test of HSPA+ (DL = 21Mbps; UL = 5.7Mbps)
- Independent tests, “funded” by our broad list of Signals Ahead clientele
- The tests leveraged Telstra’s Next G HSPA+ network in Melbourne, Australia
- Telstra provided access to an in-network server and loaned us a couple of the devices/SIM cards but otherwise did not participate in our benchmark tests
- Out of necessity, some vendors were aware of the tests, but they had no influence on the test/test methodology



Source: Telstra Website

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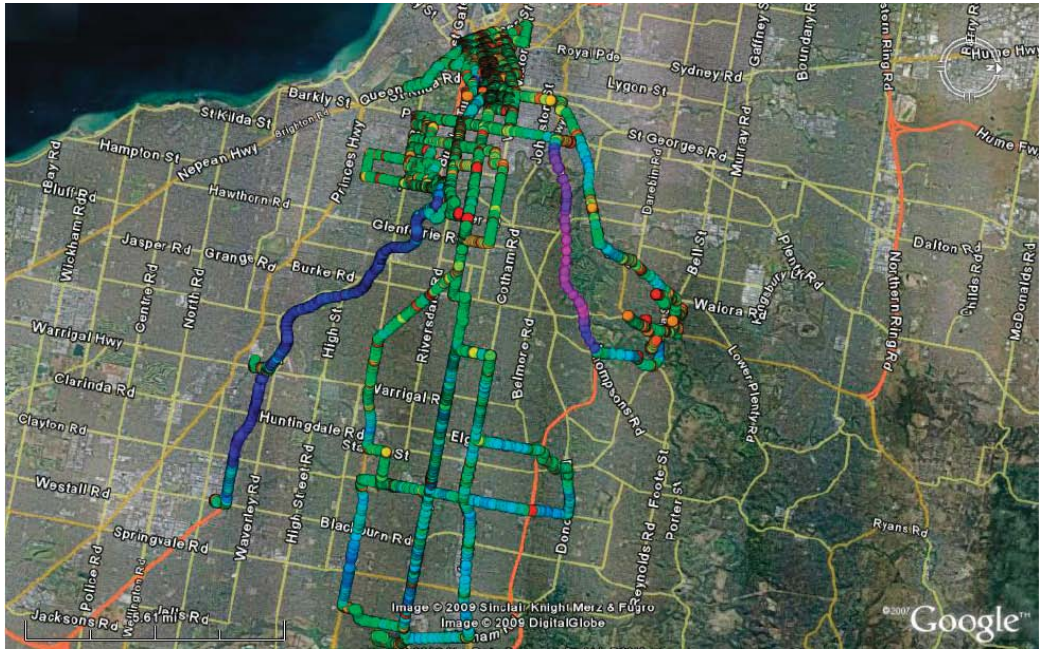
HSPA+ Drive Test Methodology (cont'd)

- During our tests we transferred ~41GB of data
  - $214,164.10 in international roaming charges (if we had used our own SIM cards)
- We drove 400km while conducting tests
  - 90% of all capture data occurred in vehicular mode
- Testing occurred from as early as 0400 until as late as 1900

Oh The Places We Did Go!

Geo plot of all test routes with speed (km/h)



Speed (est.) (km/h)				
100.0	79.2	58.3	37.5	16.7
95.8	75.0	54.2	33.3	12.5
91.7	70.8	50.0	29.2	8.3
87.5	68.7	45.8	25.0	4.2
83.3	62.5	41.7	20.8	0.0

Source: Signals Research Group, LLC

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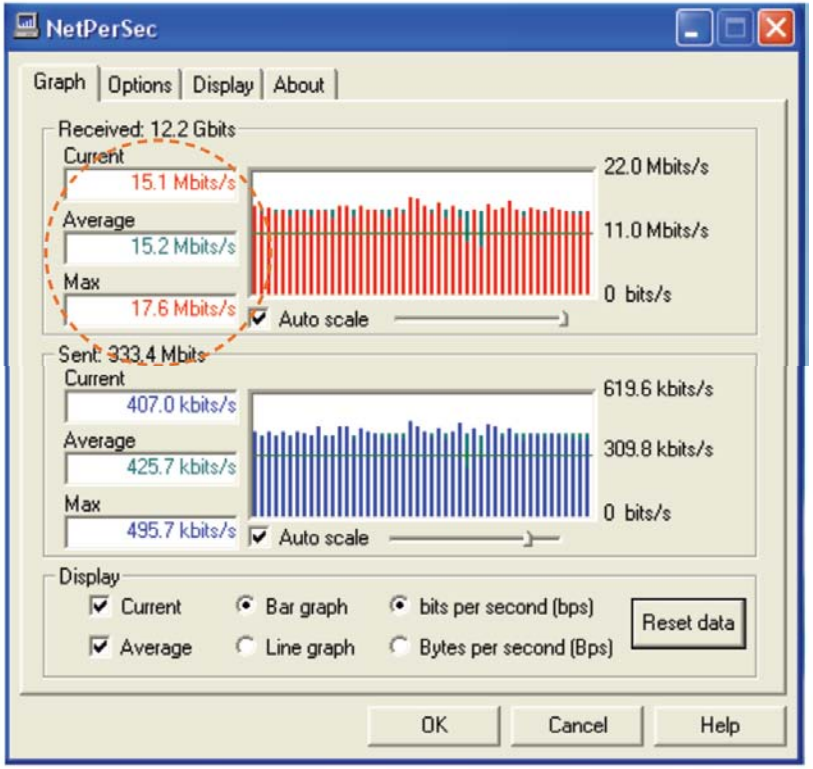
Headline Results (from our Hotel Room)

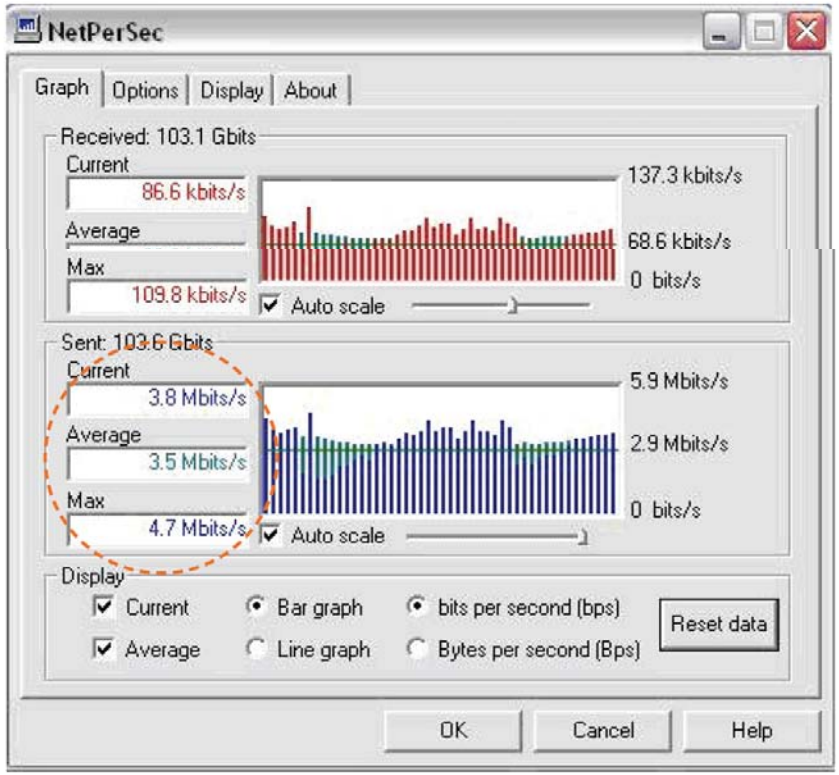
Observed Application Layer Data Rates from the Westin Hotel Room (05/08, 0400hrs)



Source: Signals Research Group, LLC

Observed Application Layer Uplink Data Rates from the Westin Hotel Room

SWIR 888 USB dongle (05/05, 0900hrs)



Source: Signals Research Group, LLC

Peak DL = 17.6Mbps; Average DL = 15.2Mbps
Peak UL = 4.7Mbps; Average UL = 3.5Mbps

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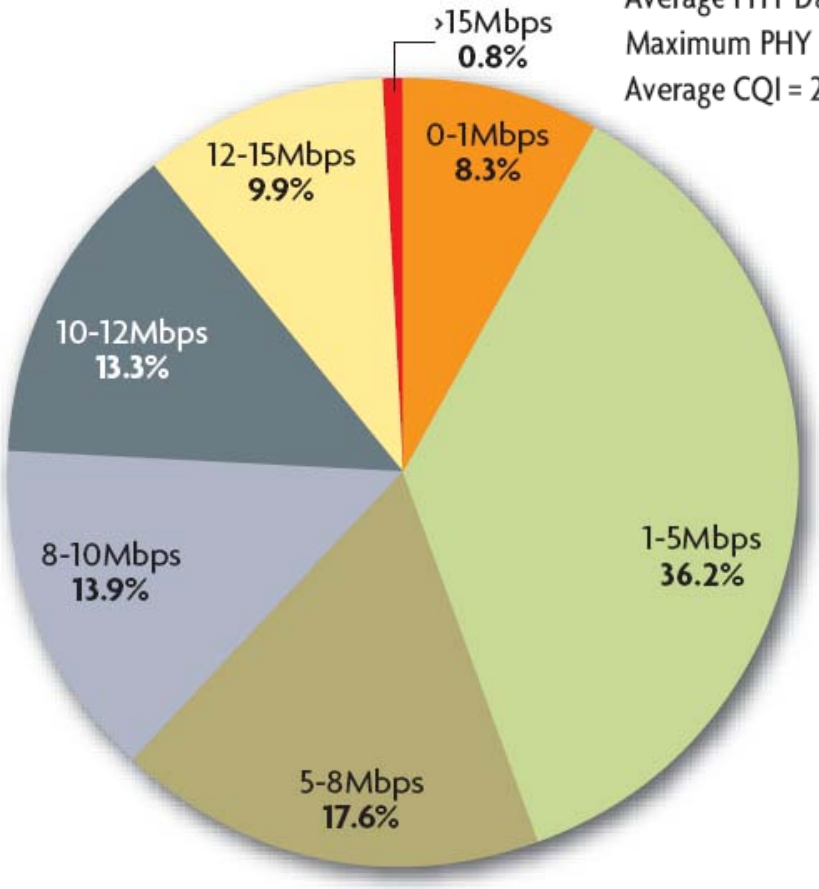
HSPA+ Drive Test – downtown Melbourne during Rush Hour

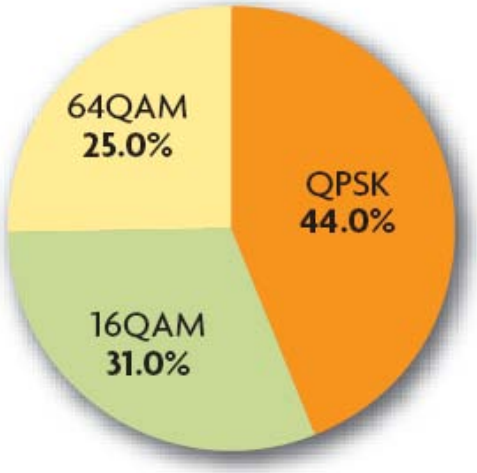
Melbourne CBD Cat 14 versus Cat 9 Drive test (Cat 14 only results)

Distribution of normalized throughput and modulation schemes (05/05, 1845hrs)

Average PHY Data Rate = 5.53Mbps
Maximum PHY Data Rate = 16.5Mbps
Average CQI = 22.6

Average Number of Assigned Codes = 11.8
Percentage >10 codes assigned = 81.8%
Capture Period = ~ 9.1 minutes





Source: Signals Research Group, LLC

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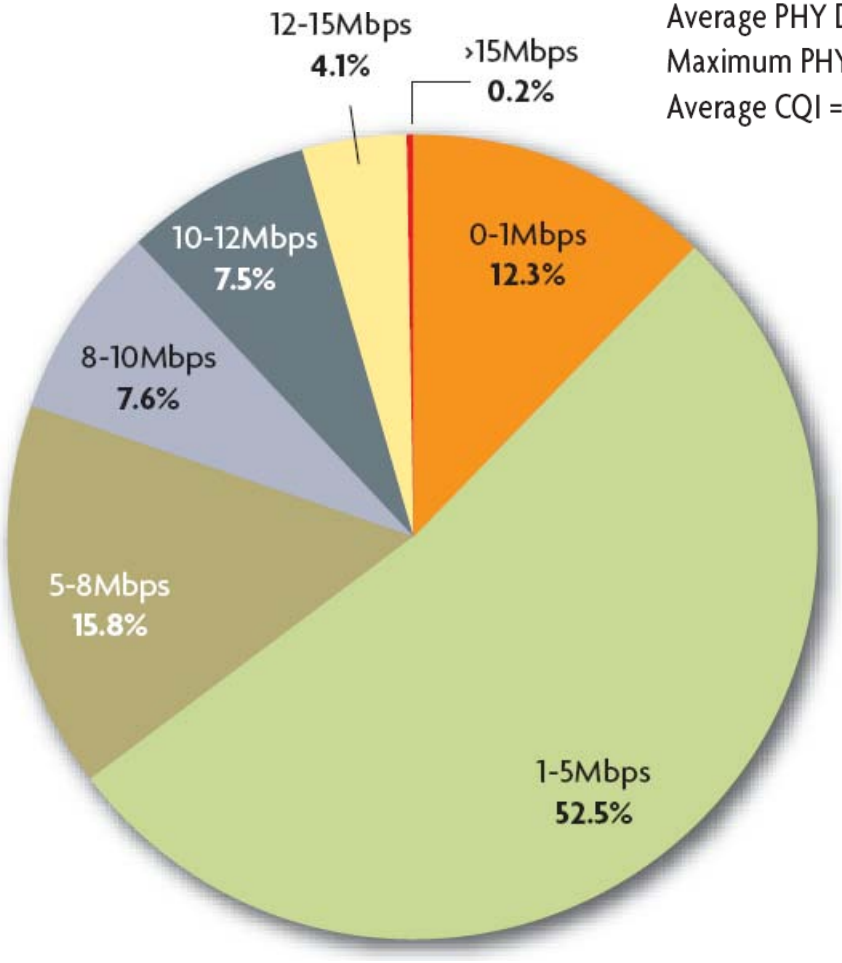
HSPA+ Pedestrian Test – downtown Melbourne mid afternoon

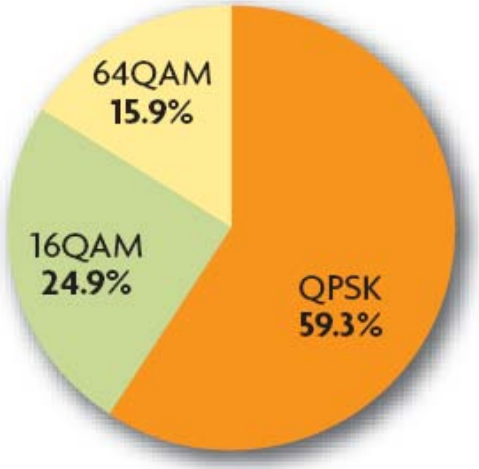
Melbourne CBD Cat 14 Pedestrian Mode

Distribution of normalized throughput and modulation schemes (05/05, 1500hrs)



Average PHY Data Rate = 3.82Mbps
Maximum PHY Data Rate = 15.4Mbps
Average CQI = 20.5

Average Number of Assigned Codes = 10.4
Percentage >10 codes assigned = 62.8%
Capture Period = ~ 23.7 minutes



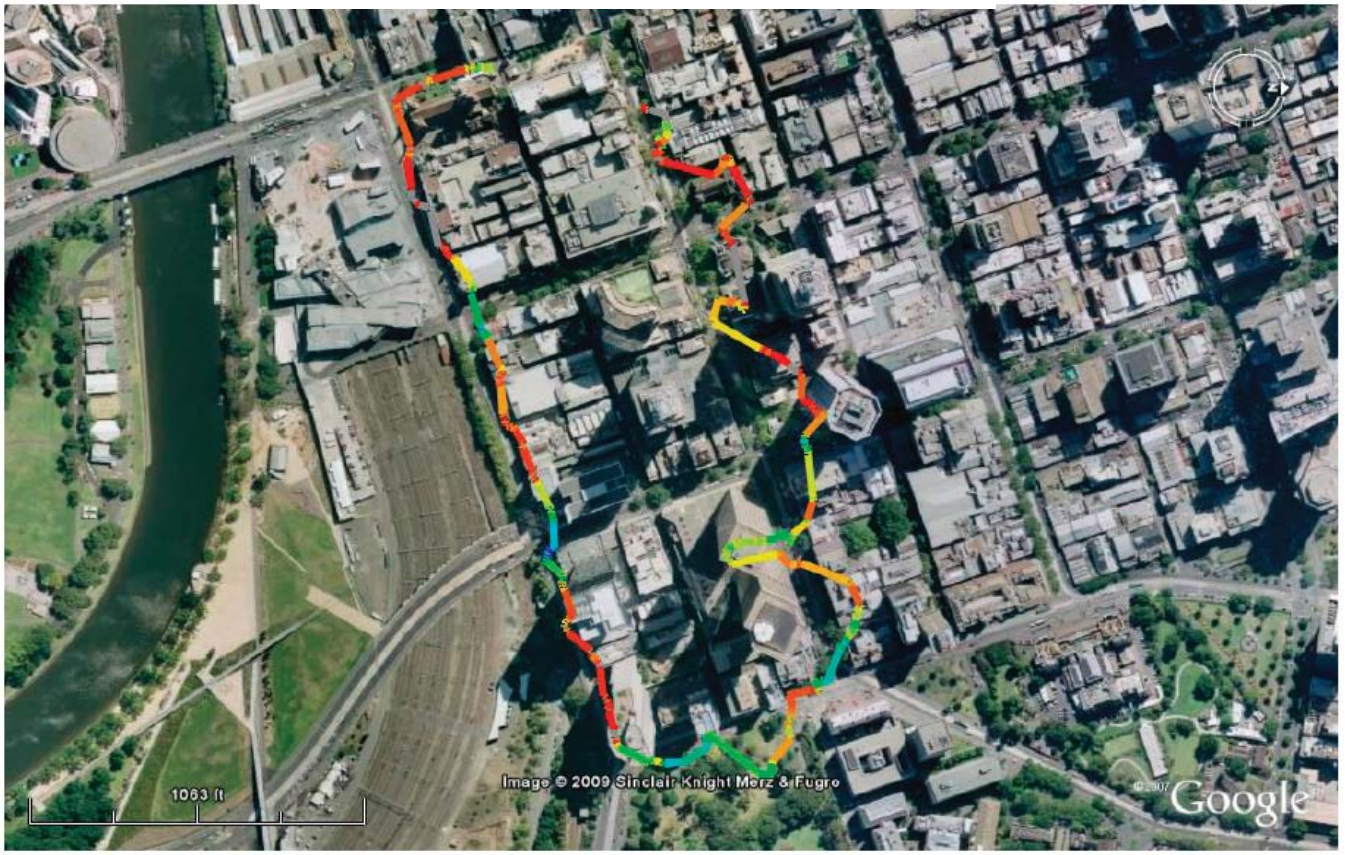
Source: Signals Research Group, LLC

SiGNALS Research Group

HSPA+ Pedestrian Test – downtown Melbourne mid afternoon

Melbourne CBD Cat 14 Pedestrian Mode

Geo plot of average throughput (05/05, 1500hrs)



Avg. Phy. Layer Throughput (Mbps)

15.000	11.000	7.000	3.000
14.000	10.000	6.000	2.000
13.000	9.000	5.000	1.000
12.000	8.000	4.000	

Source: Signals Research Group, LLC

SiGNALS Research Group

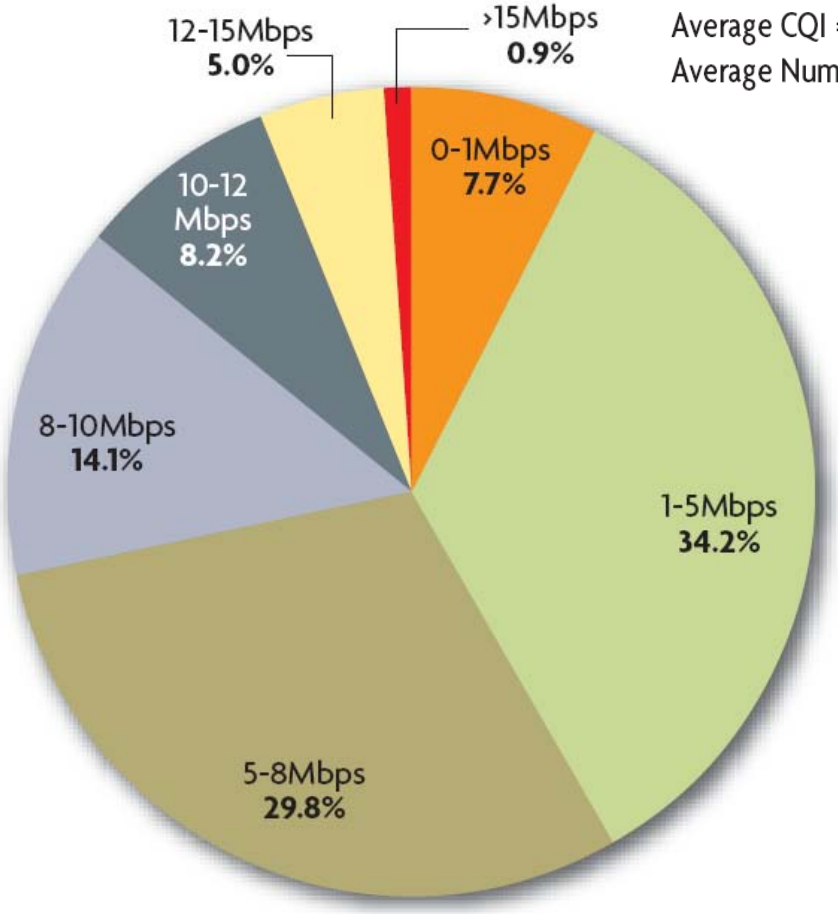
HSPA+ Drive Test – Box Hill #8

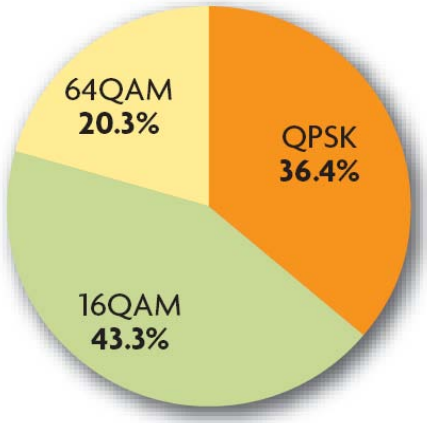
Box Hill #8 Cat 14 Drive Test

Distribution of normalized throughput and modulation schemes (06/08, 0800hrs)

Average PHY Data Rate = 5.09Mbps
Maximum PHY Data Rate = 16.5Mbps
Average CQI = 22.6
Average Number of Assigned Codes = 11.3

Percentage >10 codes assigned = 58.5%
Capture Period = ~ 17.7 minutes
Average Vehicular Speed = 34.6km/h





Source: Signals Research Group, LLC

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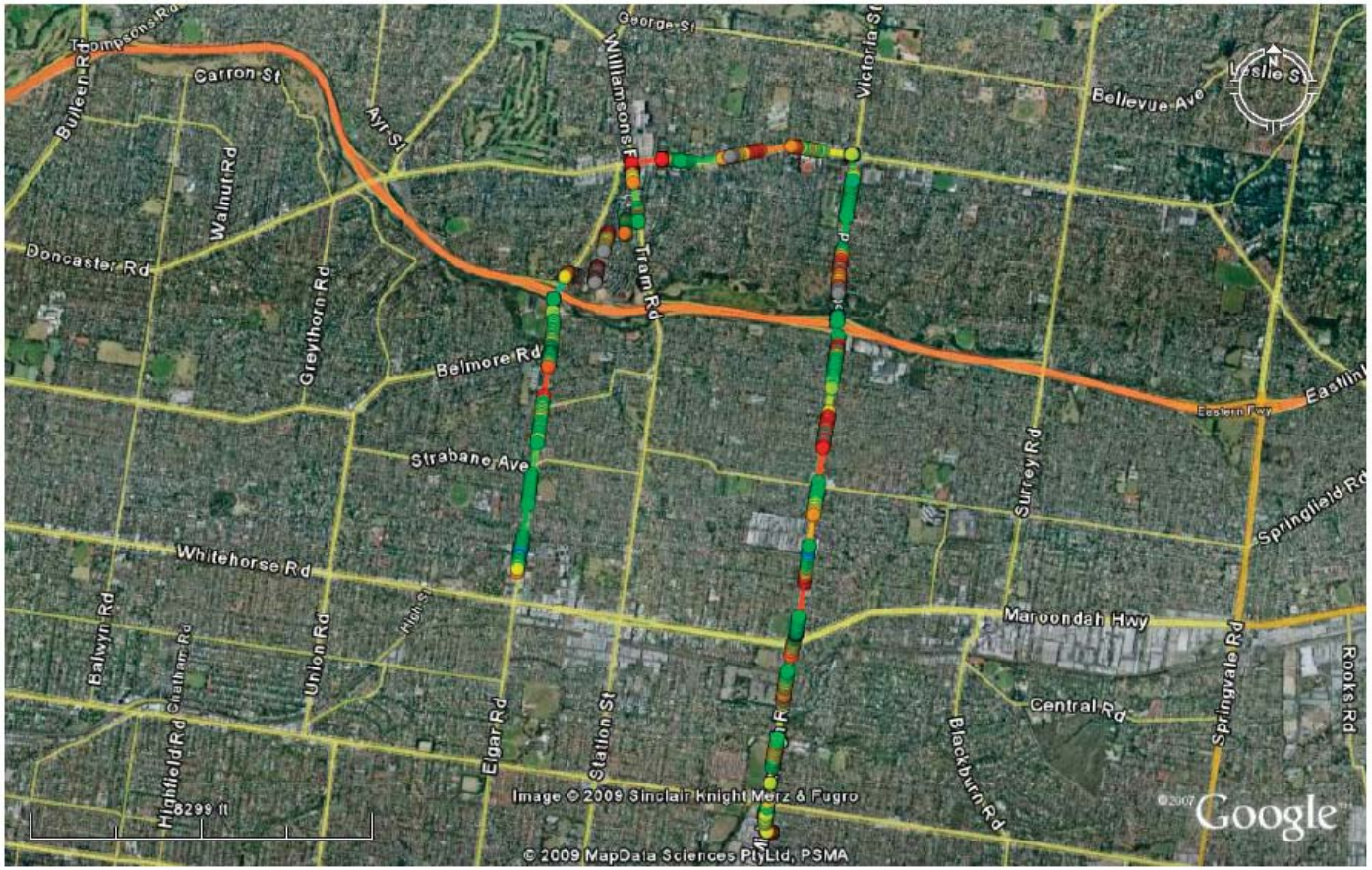
HSPA+ Drive Test – Box Hill #8

Box Hill #8 Cat 14 Drive Test

Geo plot of average physical layer throughput (06/08, 0800hrs)



Avg. Phy. Layer Throughput (Mbps)			
15.000	11.000	7.000	3.000
14.000	10.000	6.000	2.000
13.000	9.000	5.000	1.000
12.000	8.000	4.000	

Source: Signals Research Group, LLC

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HSPA+ in an LTE and Mobile WiMAX World

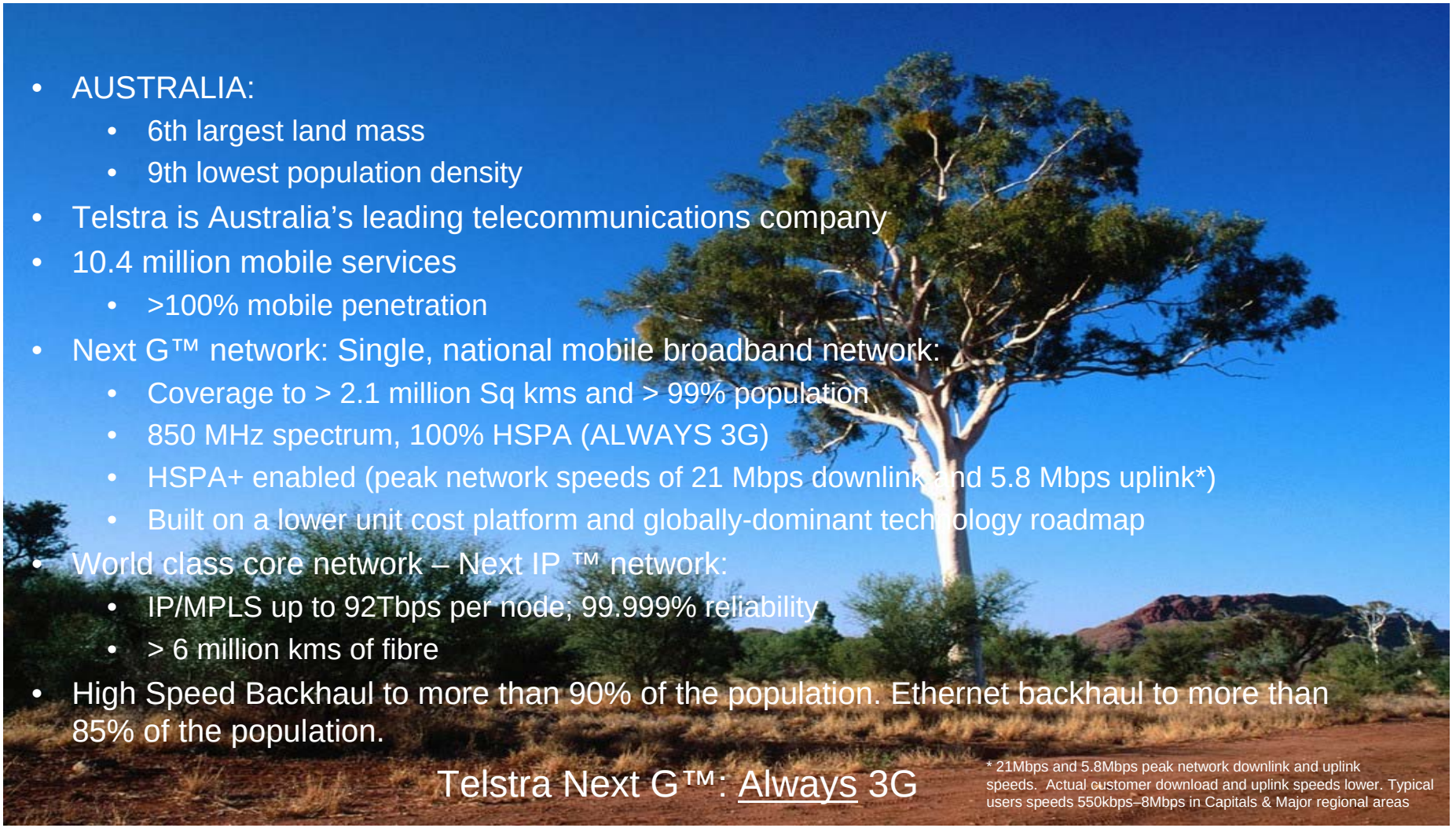
- Operators are basing their decision to deploy HSPA+ and/or LTE based on a number of factors
  - Competitive Landscape
  - Spectrum Availability
  - Maturity of mobile data offering
  - Time to Market requirements
- Operators with HSPA in the ground today are very likely to deploy HSPA+, it is merely a matter of timing
  - HSPA+ will become the de facto technology, just as HSPA is today
  - Operators jumping first to LTE will use multi-RAN base stations
  - UMTS/HSPA will be around for a long time to come
- Mobile WiMAX performs quite well relative to HSPA+, but (as tested) utilizes substantially more spectrum
  - The issue isn't performance but the maturity and health of the ecosystem

www.signalsresearch.com

MOBILE BROADBAND – BRINGING IT UP TO DATE

MIKE WRIGHT
Executive Director
Wireless Engineering & Operations

Telstra Australia business snapshot



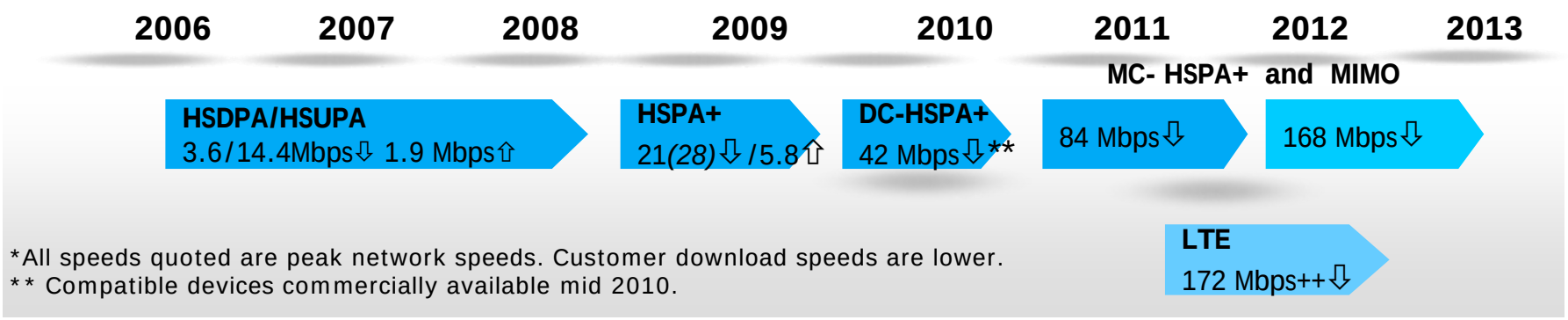
- AUSTRALIA:
  - 6th largest land mass
  - 9th lowest population density
- Telstra is Australia's leading telecommunications company
- 10.4 million mobile services
  - >100% mobile penetration
- Next G™ network: Single, national mobile broadband network:
  - Coverage to > 2.1 million Sq kms and > 99% population
  - 850 MHz spectrum, 100% HSPA (ALWAYS 3G)
  - HSPA+ enabled (peak network speeds of 21 Mbps downlink and 5.8 Mbps uplink*)
  - Built on a lower unit cost platform and globally-dominant technology roadmap
- World class core network – Next IP ™ network:
  - IP/MPLS up to 92Tbps per node; 99.999% reliability
  - > 6 million kms of fibre
- High Speed Backhaul to more than 90% of the population. Ethernet backhaul to more than 85% of the population.

Telstra Next G™: Always 3G

* 21Mbps and 5.8Mbps peak network downlink and uplink speeds. Actual customer download and uplink speeds lower. Typical users speeds 550kbps–8Mbps in Capitals & Major regional areas

Telstra

An ambitious network roadmap



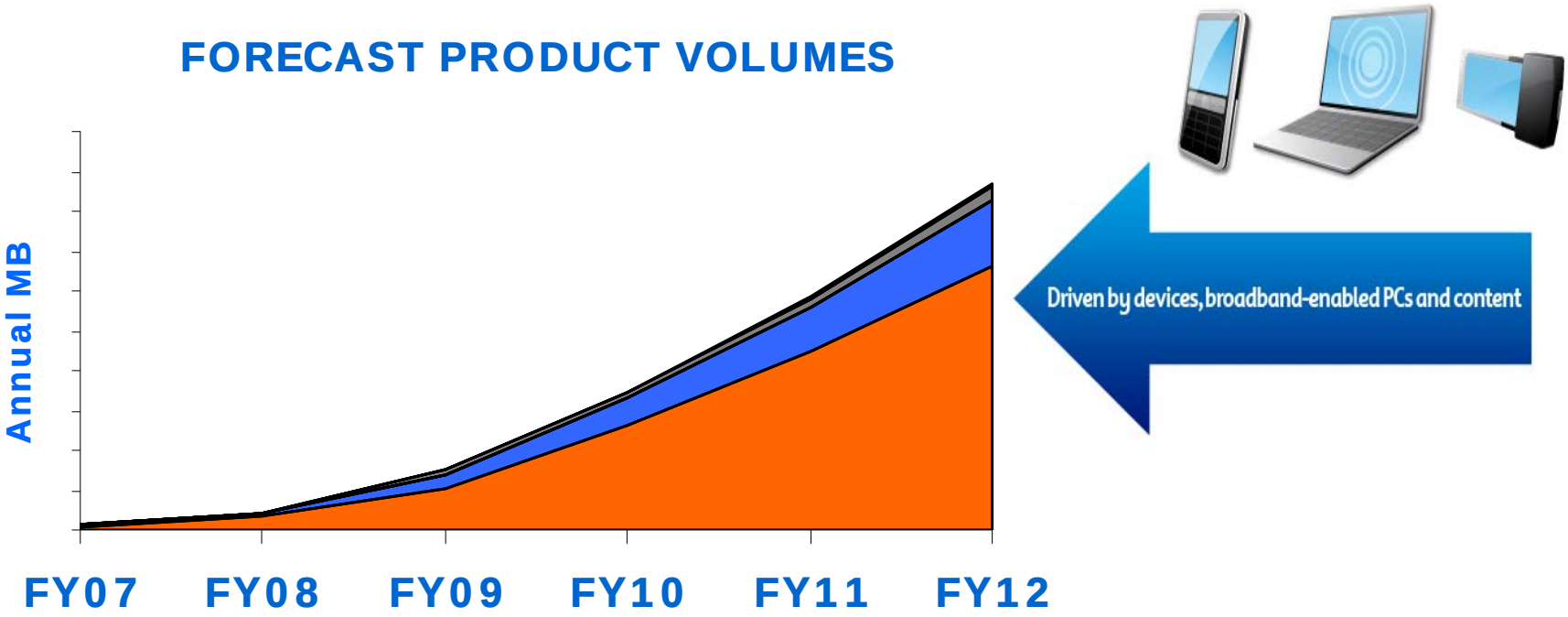
*All speeds quoted are peak network speeds. Customer download speeds are lower.
** Compatible devices commercially available mid 2010.

World firsts:

• 14.4 Mbps* network capability	February 2007
• 200 km cell range in selected cells	February 2007
• MSC Blade Server	July 2008
• 3G Direct Tunnel	July 2008
• HSPA+ 21 Mbps* network capability	December 2008
• HSPA+ 21 Mbps* launch	February 2009
• HSUPA 5.8 Mbps* launch	June 2009
• DC-HSPA+ 42 Mbps* network capability**	December 2009

Telstra

3G driving wireless data traffic



Strong wireless demand driving results

H1 to December 2009, Telstra announced:

- Wireless broadband revenues increased by 31.9% and SIOs grew by 73.2%
- More than 1.3 million wireless broadband SIOs, up from 1 million in June 2009
- Mobile data revenue growth of 20.9% driven by wireless broadband and handheld non-messaging revenues
- Mobile services revenue growth of 4.7% in tough market conditions
- Strong retail mobile SIO growth of 7.0% to 10.4 million services
- More than 7.2 million 3GSM services, which makes up 70% of our mobile customer base

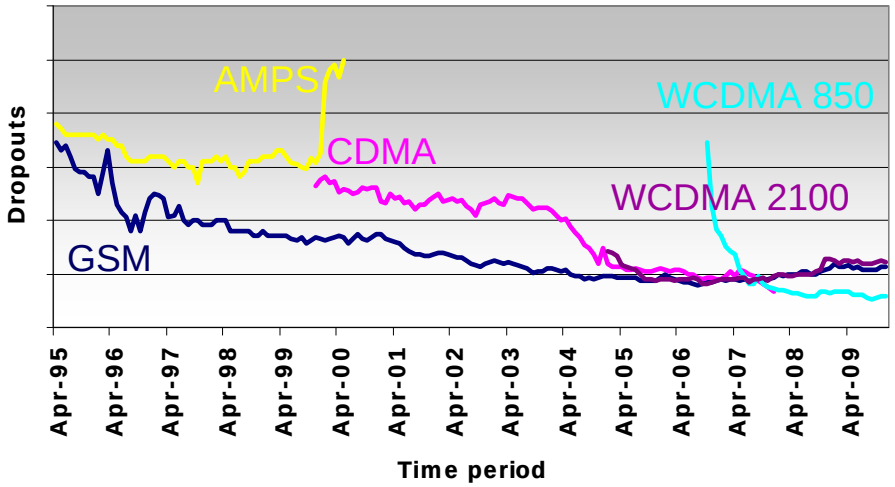
Note: All figures quoted from half-year results December 2009.

Telstra

Next G™ network: Reliable and high-speed performance

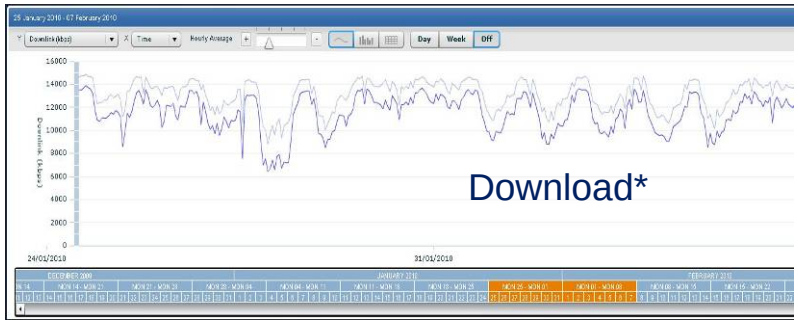
Independent network assessment verify the Next G™ network's speed and performance

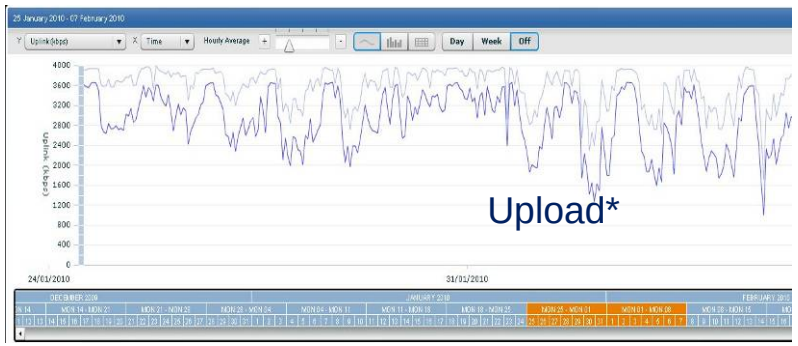
SIGNALS Ahead
Redefining Research



Dropout rate best ever
- well below 1 per cent

HSPA+ devices:
- typical user speeds 550kbps - 8Mbps in Capitals and Major regional areas
- bursts higher



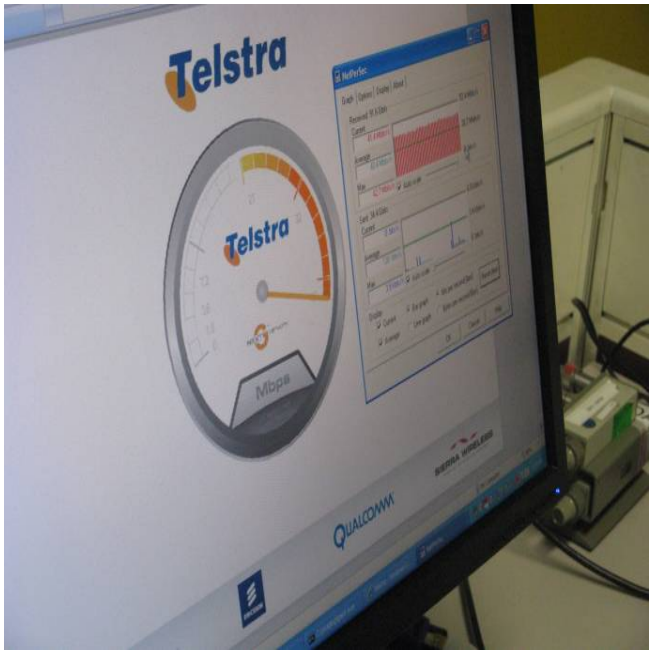


* Example of a typical CBD cell's performance over hourly intervals for a 10-day period

Telstra

Introducing Dual Carrier - HSPA+

- Closed test results: world-first testing outside of vendor laboratories
  - Average of 36Mbps download speeds*
  - Burst speeds of up to 40Mbps*
  - Commercial launch due later in 2010
- See it live:
  - GSMA stand: Hall 8
  - Ericsson stand: Hall 6

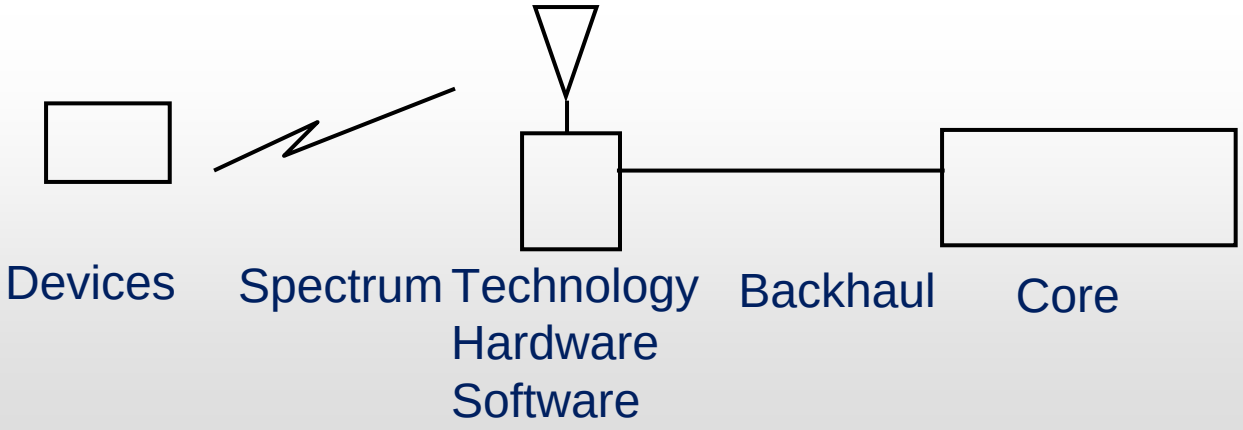


* Achieved with High Speed Packet Access (HSPA+) Dual Carrier technology on our Next G™ dedicated, closed test network, using Qualcomm's MDM8220™ chipset in December 2009.

Telstra

Delivering the best end user experience

Enabling



Maintaining

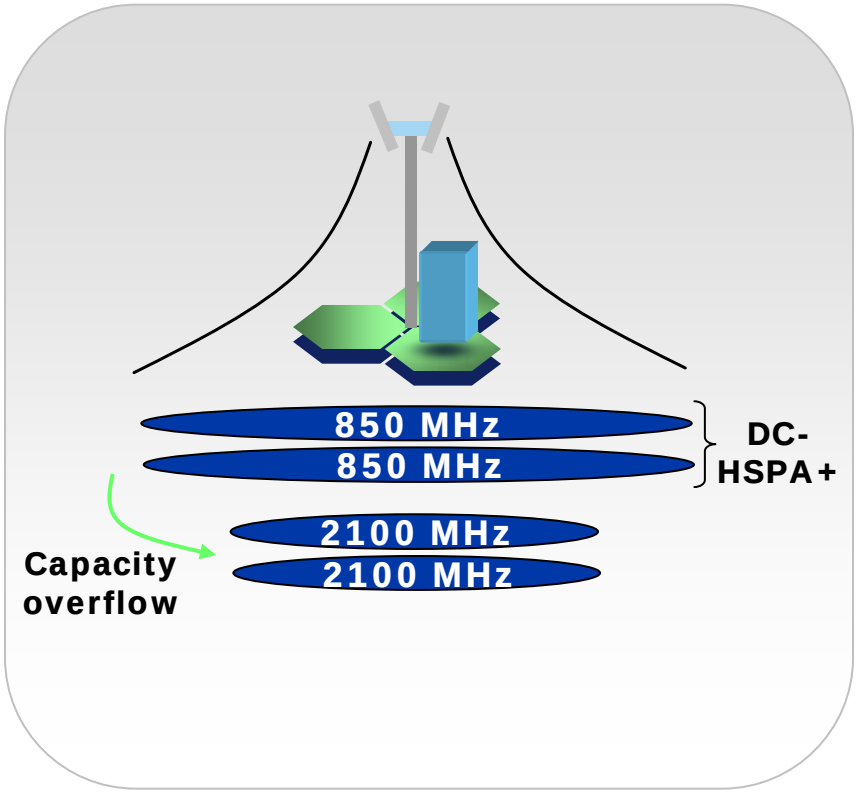
Performance management – tools & optimisation

High penetration of HS devices

- Early adoption of latest technology
  - HSPA/HSPA+/DC-HSPA*
- Optimised design
  - Antenna performance
  - Performance and configuration
- All HSPA Devices
  - Over 6 million HSPA handsets
  - Over 1 million HSPA data modems

* DC-HSPA compatible devices commercially available mid 2010.

Spectrum



- Full Low Frequency 850MHz layer
  - Complete 3G network - ALWAYS 3G
  - Fully HSPA Enabled Antenna performance
  - DC-HSPA in areas of high demand
- Capacity layer on 2100 MHz

Optimal hardware & software configuration

- Fully HSPA capable network hardware
- Latest DC-HSPA+ capable software
  - Ericsson W10A fully deployed December 2009
  - Ethernet backhaul covers more than 85 per cent of the population

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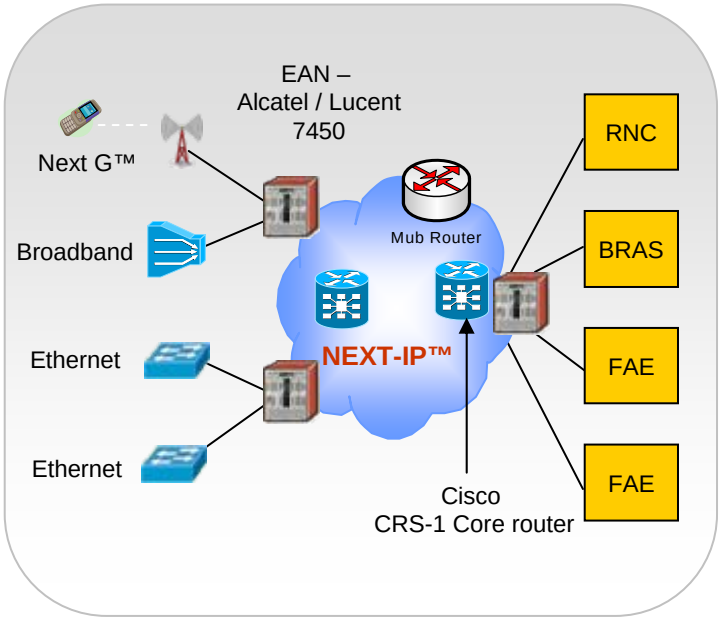
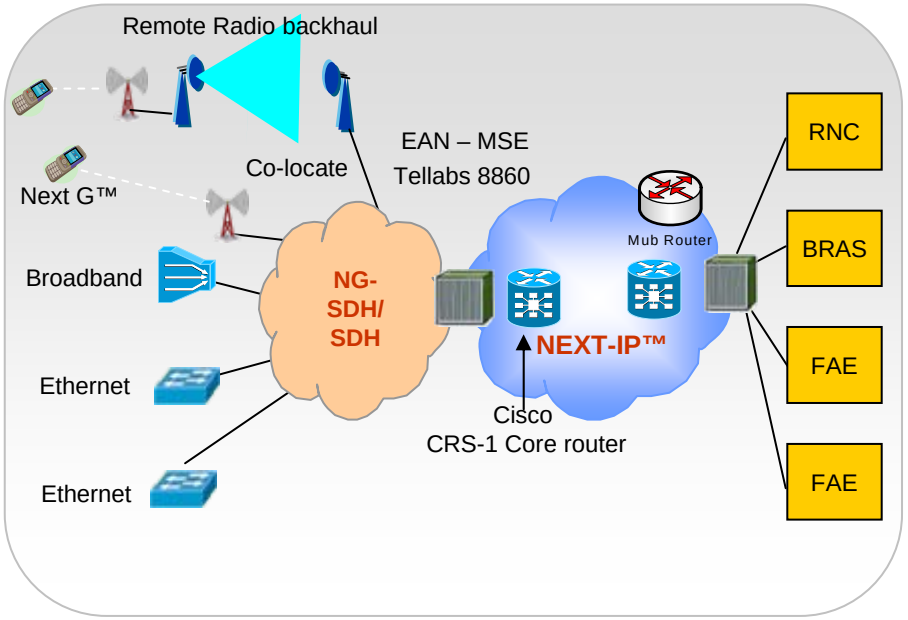
Maximised high speed backhaul

- Extensive Optical Fibre Investment
  - Gigabit Ethernet enabled to more than 85% of the population
- Use of Multiple E1 Elsewhere
- High Speed backhaul to more than 90% of the population

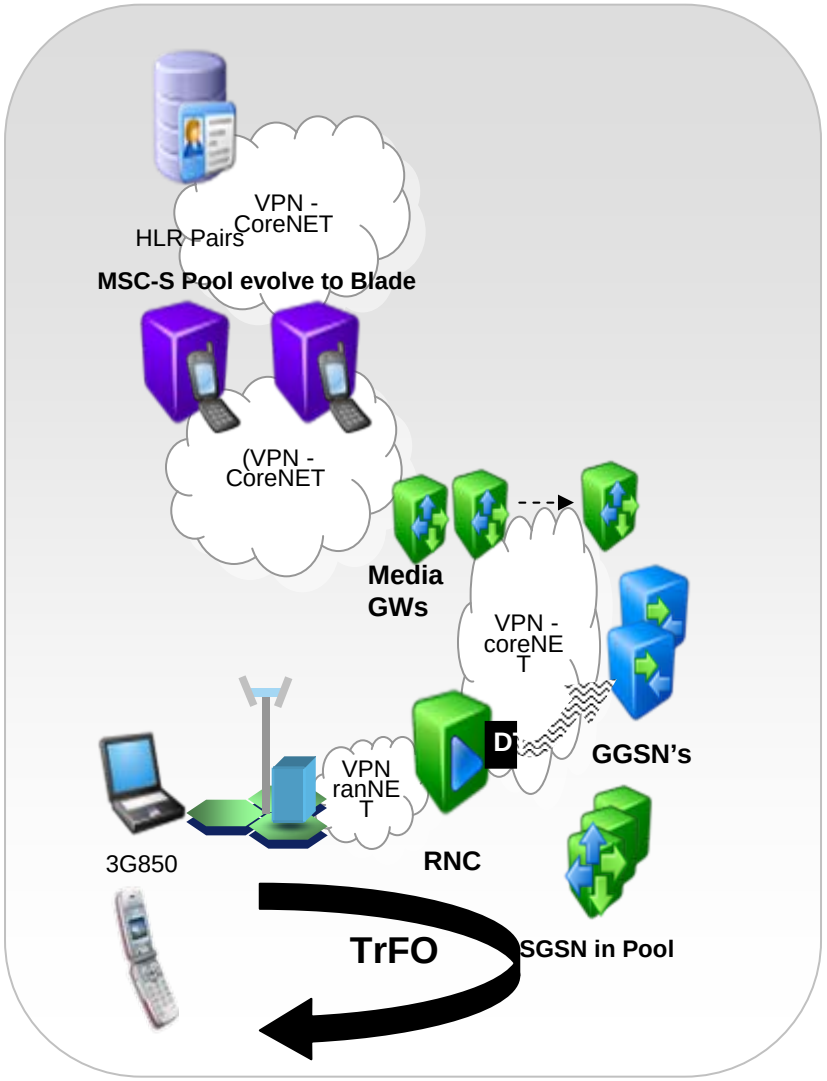


Metro



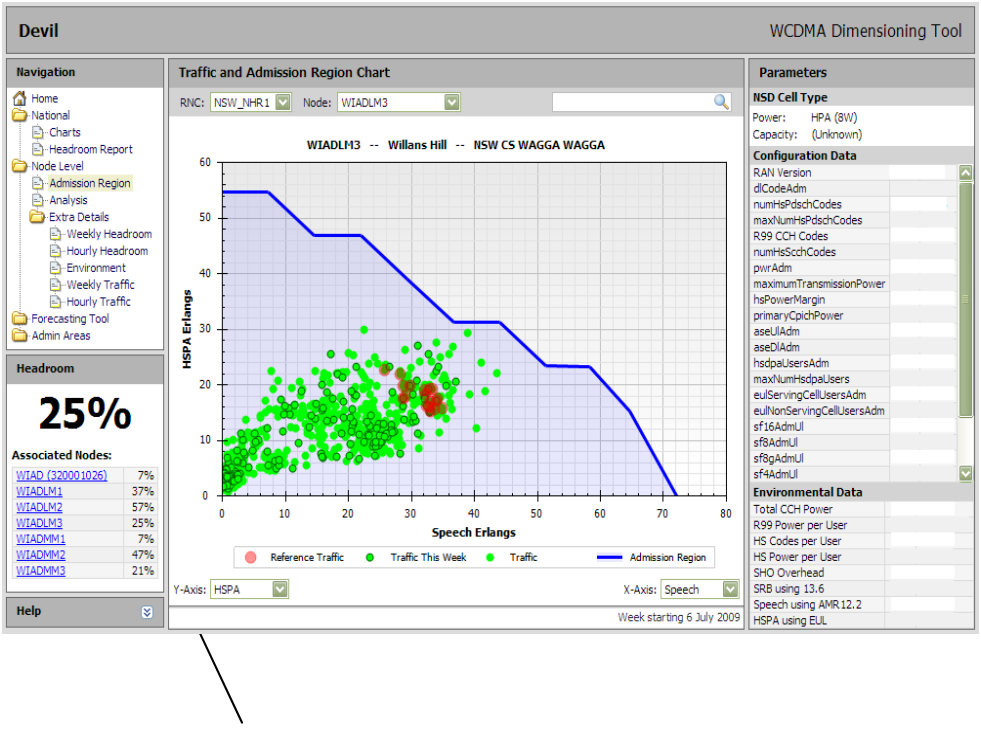
Regional

Extensive modernisation of an all-IP core



- Careful management of engineering thresholds
  - interfaces, processor loads, signalling vs transport
- **3GDT** fully deployed
- Policy Control in deployment
- MSC-Blade Server rollout on Circuit Core
- Full IP interfaces across the core network
- Transcoder Free Operation Ready (TrFO)
  - **HD Voice W-AMR** network capability (deployment and availability later in 2010)

Comprehensive radio capacity management



Utilisation (headroom) tracked for all cells

Devil Analysis Engine

- Multi-dimensional Markov chain simulator, which accurately models:
  - RAN RRM (radio resource management) procedures
  - HSDPA and EUL scheduler behaviour
  - ATM connection admission control and flow control procedures

Services and KPIs

- Signalling Radio Bearer blocking
- Speech blocking
- Video calling blocking
- R99 interactive packet blocking
- HSDPA blocking/ throughput
- EUL blocking/throughput

A services view of performance

2G SGSN	11:45	12:00	12:15	12:30	12:45	13:00	13:15	13:30
GPRS Attach	49	49	49	49	51	53	53	48
Gb Authentication	88	89	88	88	88	89	89	88
PDP Context Activation	99	99	99	99	96	94	93	99
RAU Routing Area Update	83	84	84	84	84	84	84	84
3G SGSN	**11:45**	**12:00**	**12:15**	**12:30**	**12:45**	**13:00**	**13:15**	**13:30**
GPRS Attach	97	97	97	97	97	97	97	97
Iups Authentication	95	95	95	95	95	95	95	95
PDP Context Activation	61	63	62	62	62	61	61	61
RAU Routing Area Update	99	99	99	99	99	99	99	99
GGSN	**11:45**	**12:00**	**12:15**	**12:30**	**12:45**	**13:00**	**13:15**	**13:30**
Create PDP Context	94	91	94	92	65	56	55	93

updated: 28/08/2009 13:57:58

APN	13:15	13:30	13:45	14:00	14:15	14:30	14:45
COMPANY 1	96	96	92	92	91	91	91
COMPANY 2	66	65	64	63	65	64	64
COMPANY 3	96	95	97	97	97	37	97
COMPANY 4	93	93	93	93	93	93	93
COMPANY 5	100	100	100	100	100	100	100
COMPANY 6	100	100	100	100	100	100	100

updated: 11/09/2009 15:13:43

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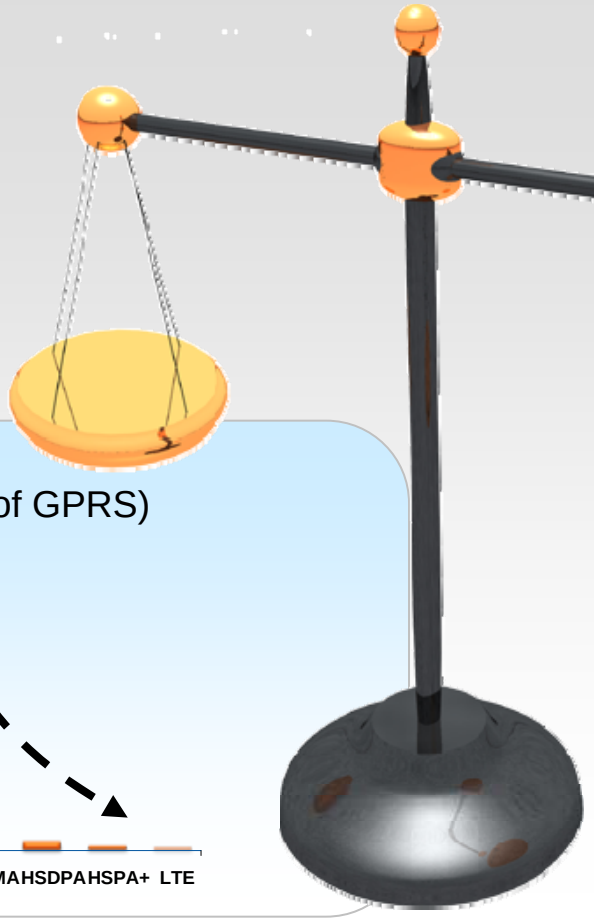
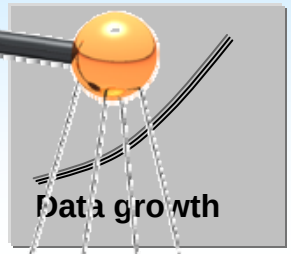
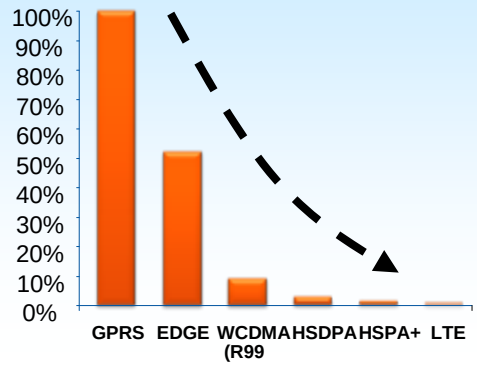
Balancing cost vs revenue



Historically there has been price erosion alongside increasing demand



Estimated Cost*
(per MByte as % of GPRS)



* Telstra derived relative Wireless network unit costs

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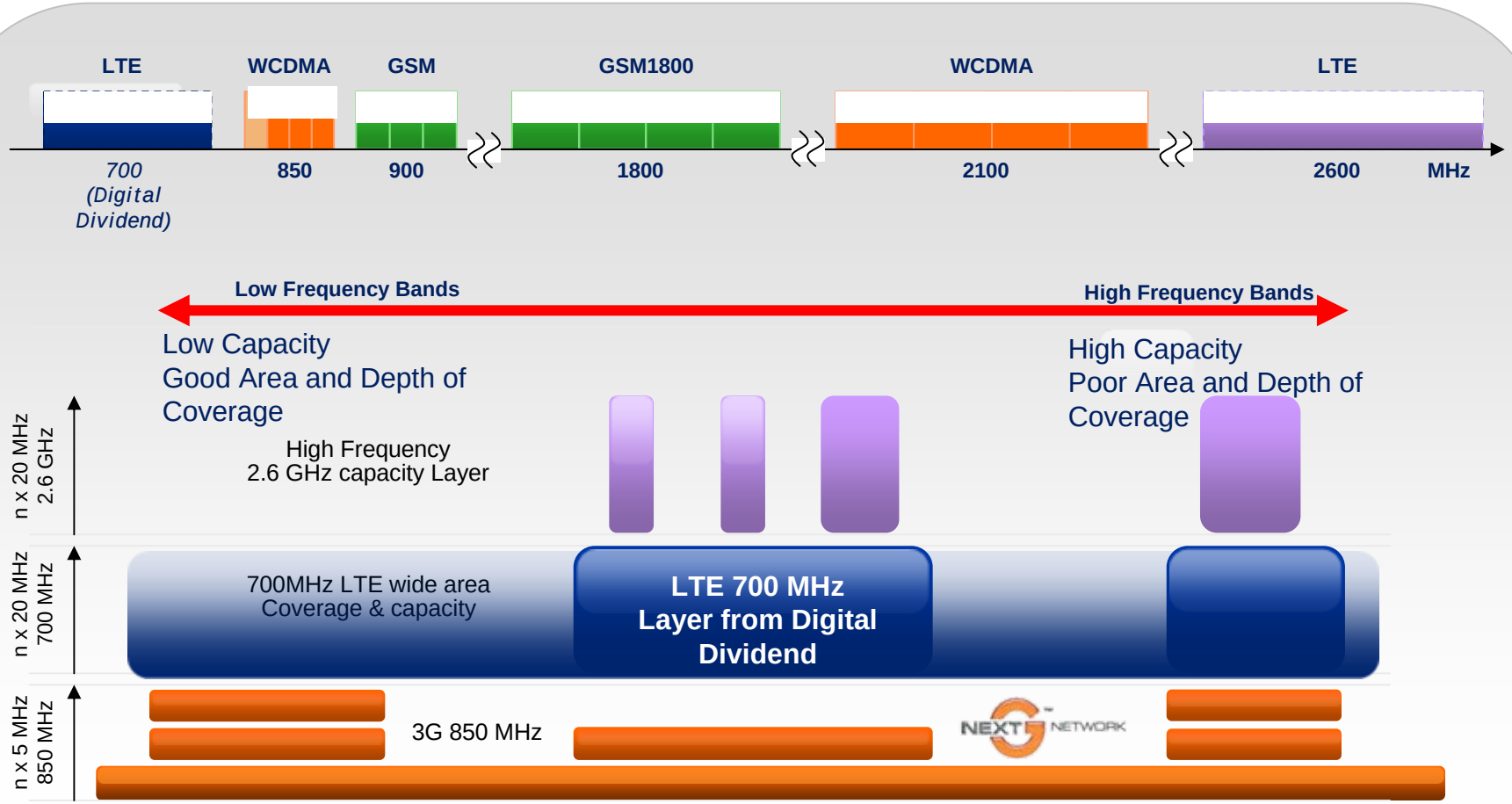
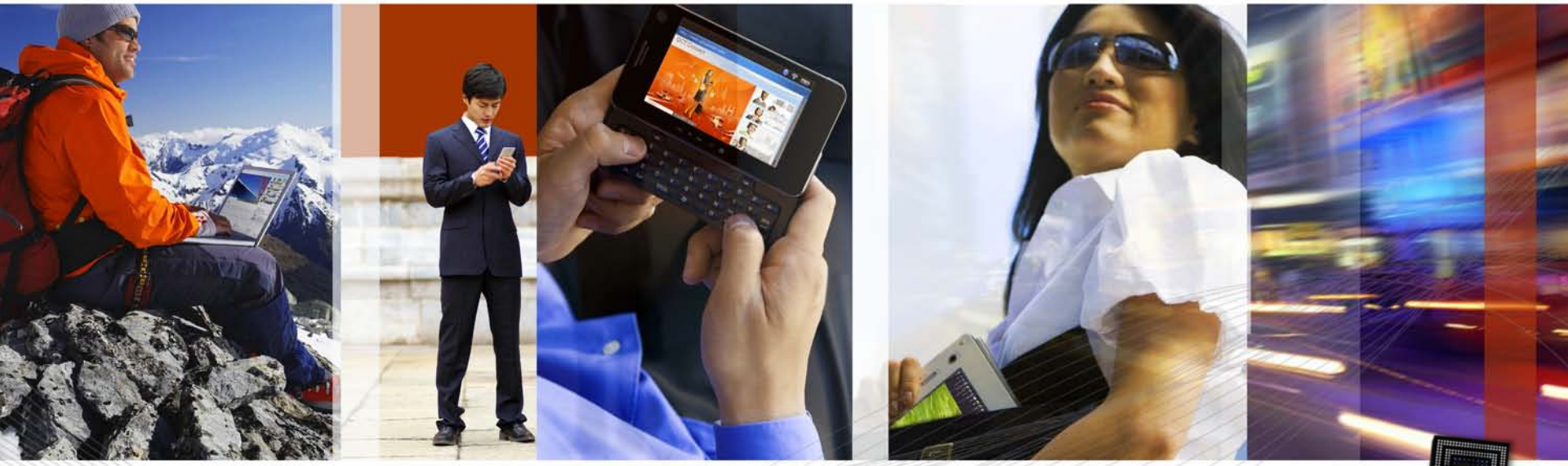
Using the ‘gas’ in the HSPA tank

Demand driving expansion: new bands / LTE





QUALCOMM CDMA Technologies

REDEFINING MOBILITY

HSPA+ Modem Technology and Device Evolution Mobile World Congress 2010

Peter Carson, Sr. Director Product Management

February 2009

Disclaimers

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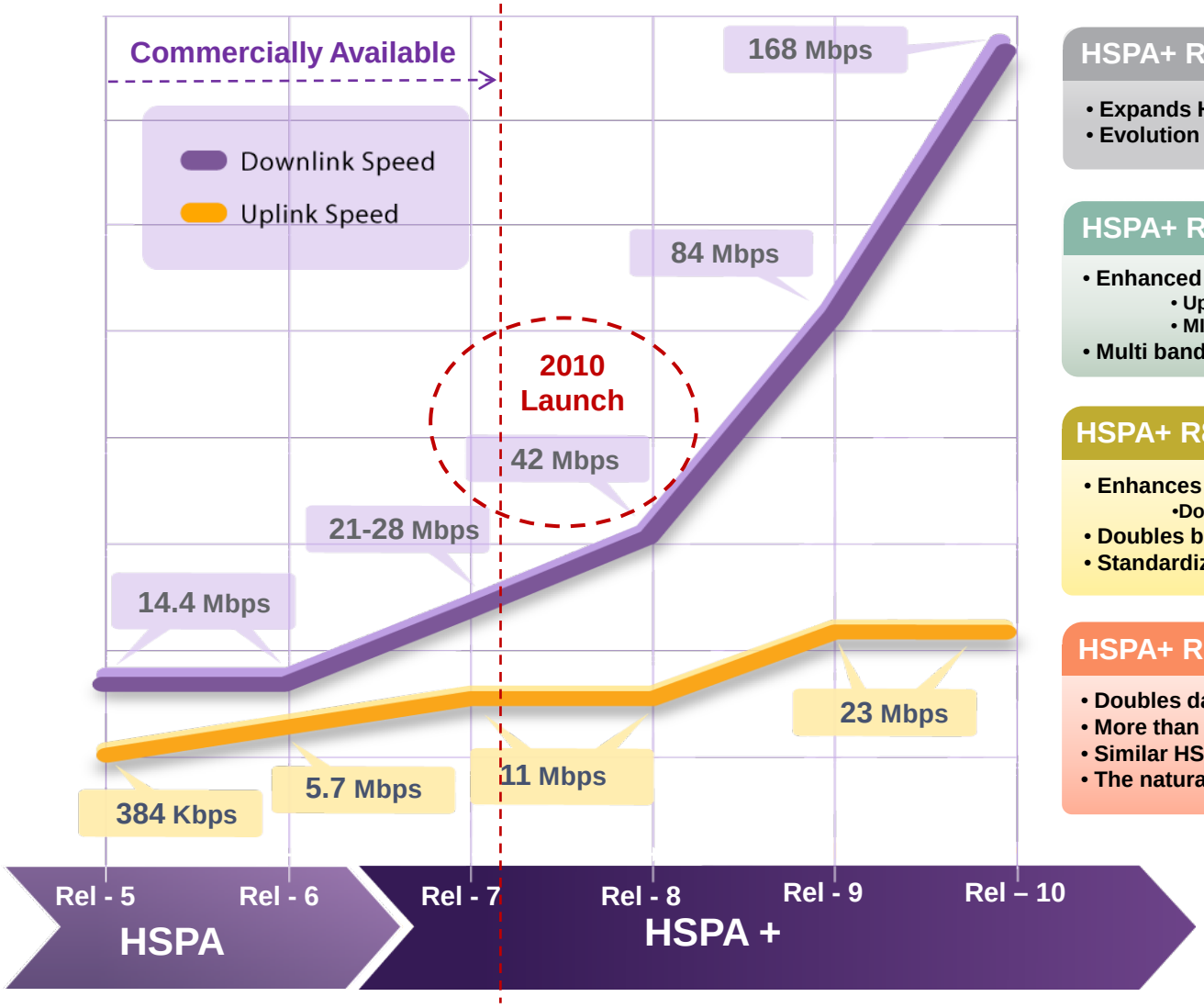
Legal notice: In the territory of the Federal Republic of Germany, the use of the term "Smartbook" in connection with portable computers is reserved exclusively to Smartbook AG, Germany.

HSPA+: A Strong Evolution Path



HSPA+ R10: 20 MHz Multicarrier

- Expands HSPA+ to 20 MHz deployments
- Evolution to femtocell networks

HSPA+ R9: Expands 10 MHz Multicarrier

- Enhanced performance in 10 MHz
  - Uplink multicarrier
  - MIMO support with multicarrier
- Multi band multicarrier—aggregation across bands

HSPA+ R8: 10 MHz Multicarrier

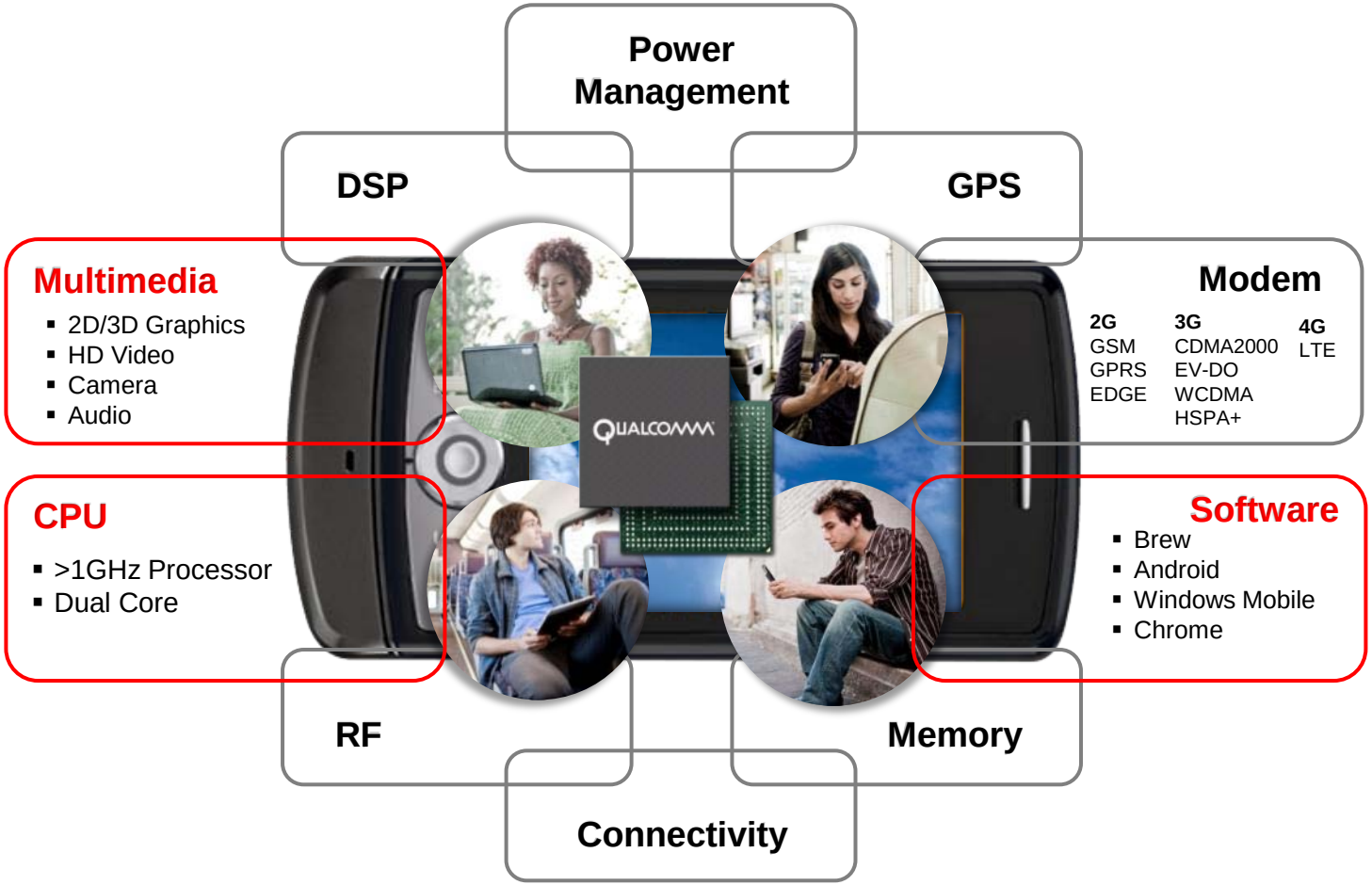
- Enhances broadband experience
  - Doubles data rates to all users
- Doubles bursty application capacity
- Standardized femtocell support

HSPA+ R7: Next Gen. Performance Today

- Doubles data capacity
- More than doubles voice capacity
- Similar HSPA+ and LTE performance
- The natural evolution at a lower cost

Notes: R8 will reach 42 Mbps by combining 2x2 MIMO and HOM (64QAM) in 5 MHz, or by utilizing HOM (64QAM) and multicarrier in 10 MHz. R9 combines multicarrier and MIMO in 10 MHz to reach 84 Mbps peak rates. Uplink multicarrier double the uplink peak data rate to 23 Mbps in 10 MHz in R9. R10 expands multicarrier to 20 MHz to potentially reach 168 Mbps when using MIMO.

Explosion in Smartphone Functionality



Consumer Electronics functions are now "features" on phones (Camera, Music, Video, Navigation, Games)

Advancements in Smartphone Performance and Utility

Leading High Level Operating Systems

brew, Java, Windows Mobile, Android, BlackBerry, palm webOS

Leading Connectivity (HSPA+, GPS, WiFi / BT, FLO TV)

snapdragon™ by Qualcomm

1+ GHz Processor
600 MHz DSP

Leading Multimedia
HD Video
Advanced 3D Graphics

Smartphone Scale Starting to Drive the Mass Market

Transformation of Mobile Broadband Devices

Feature Phones

Smartphones

Growth Driven by Innovation & New Features

Low Price $ → **High Price $**

Smartbooks

Growth Driven by Lower Cost

Netbooks

Notebooks

Consumer Wants	
Battery life	10-12 hours
24/7 connectivity	Embedded 3G
Thinner/ lighter	<20 mm
Access to all web content	▪ Full browser ▪ Flash Player 10.1 ▪ HTML 5 video

MWC Spotlight on Latest HSPA+ Achievements

Demos Enabled By Qualcomm Chipsets

Demos using Commercial Equipment

vodafone

Telstra

SIERRA WIRELESS
HEART OF THE WIRELESS MACHINE®

HUAWEI

ERICSSON

NOVATEL WIRELESS

QUALCOMM

42 Mbps
Dual Carrier HSPA+

Demos using Pre-Commercial Equipment

ERICSSON

HUAWEI

QUALCOMM

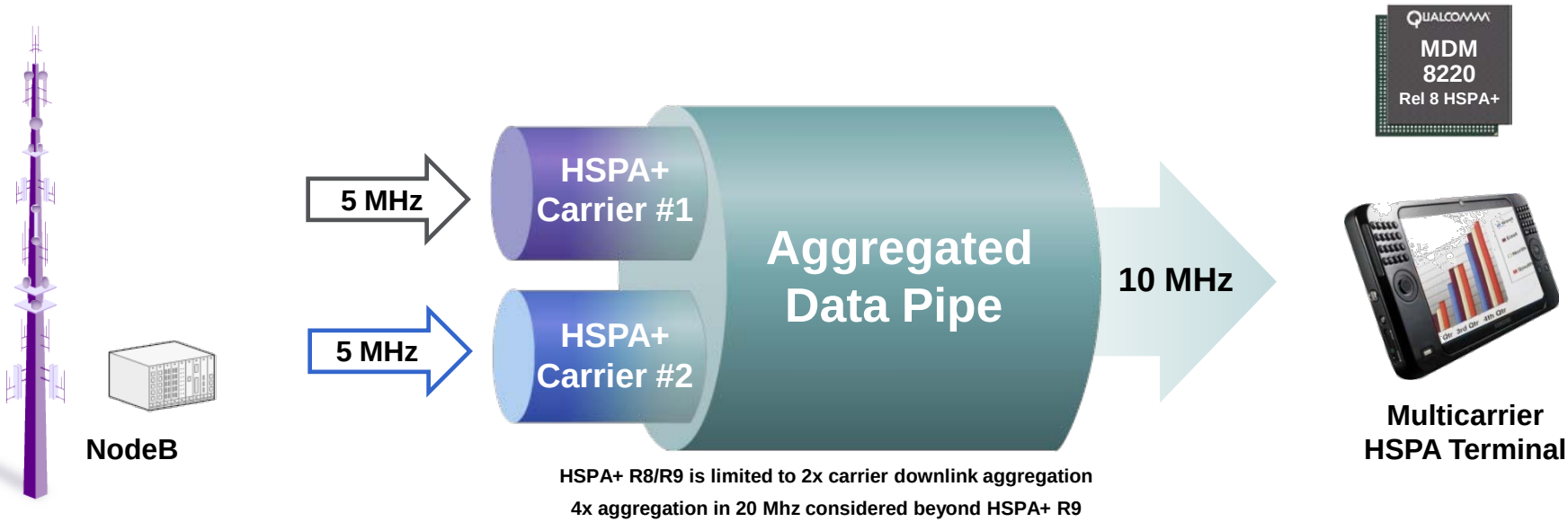
84 Mbps
20 MHz MC-HSPA+

Nokia Siemens Networks

QUALCOMM

112 Mbps
20 MHz MC-HDPA+ with MIMO

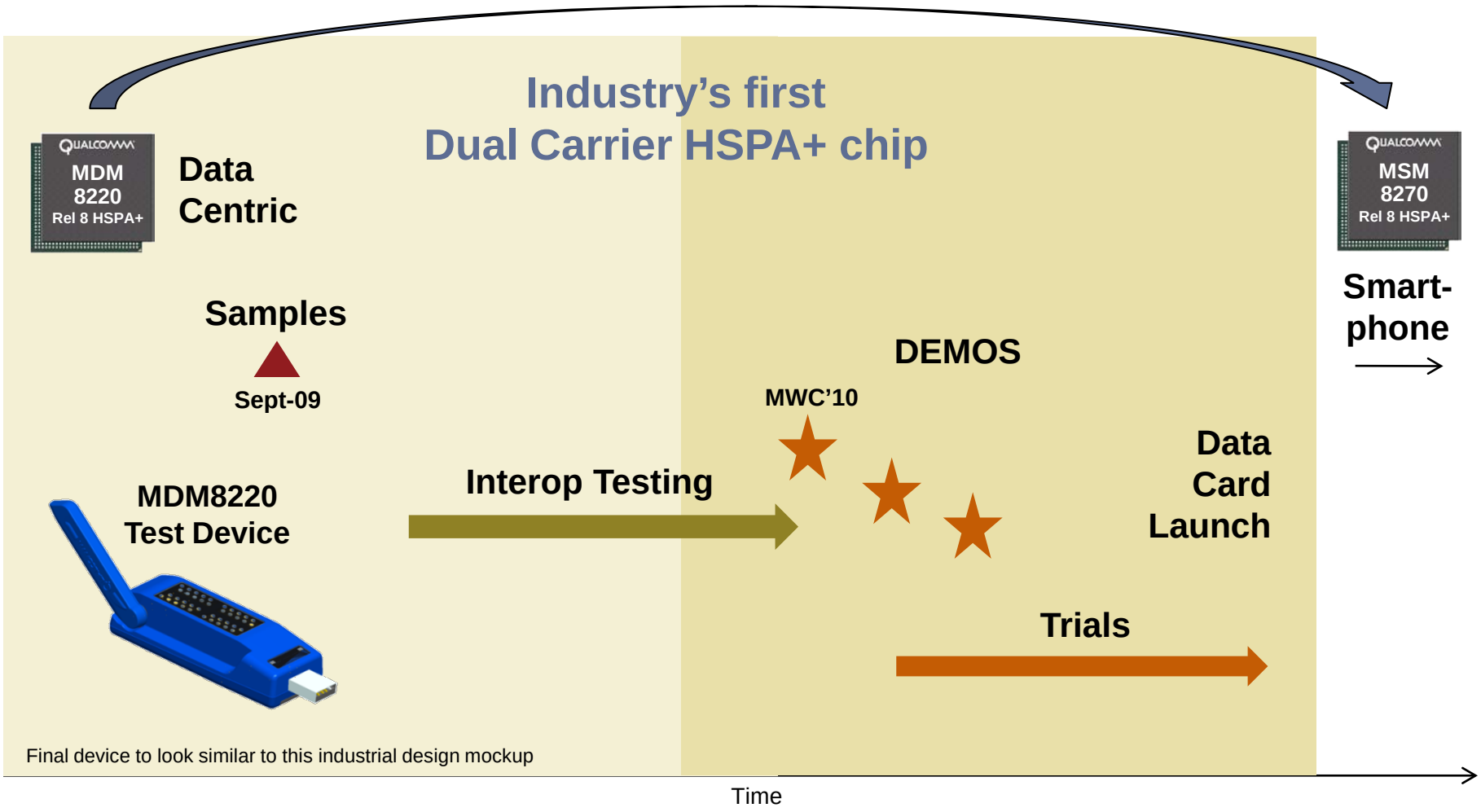
Dual Carrier HSPA+, A Bigger Pipe for All Users



- Doubled data rates across entire coverage area
- Increased capacity for bursty applications
- Dynamic load balancing

Cost-effective network software upgrade to multicarrier

HSPA+ Dual Carrier Device Are Here



Femtocells—Maximizing Return on HSPA+ Investment

Operator Benefits:

Enhanced Coverage and Capacity
Bring network to user—offload macro network

Reduced Churn and Cost
Indoor coverage main churn reason. Reduce backhaul, site cost

New Revenue and Services
Additional ARPU—home tariffs, bundles, home zone services

Femtocell
Your personal
3G access

End-User Benefits:

Enhanced User Experience
Better voice quality and higher data rates with existing devices

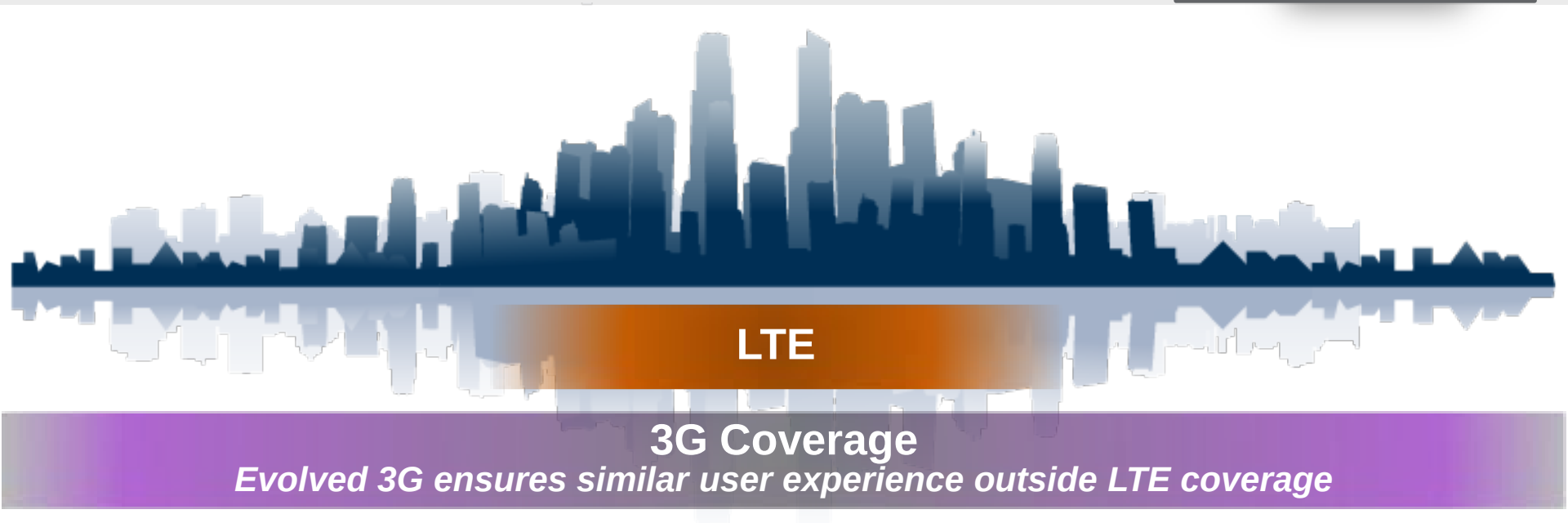
Attractive Home Zone Plans and Bundles
Wireless substitution, one gateway for all home entertainment

New Home Zone Services
Based on location, interaction with home media, etc…

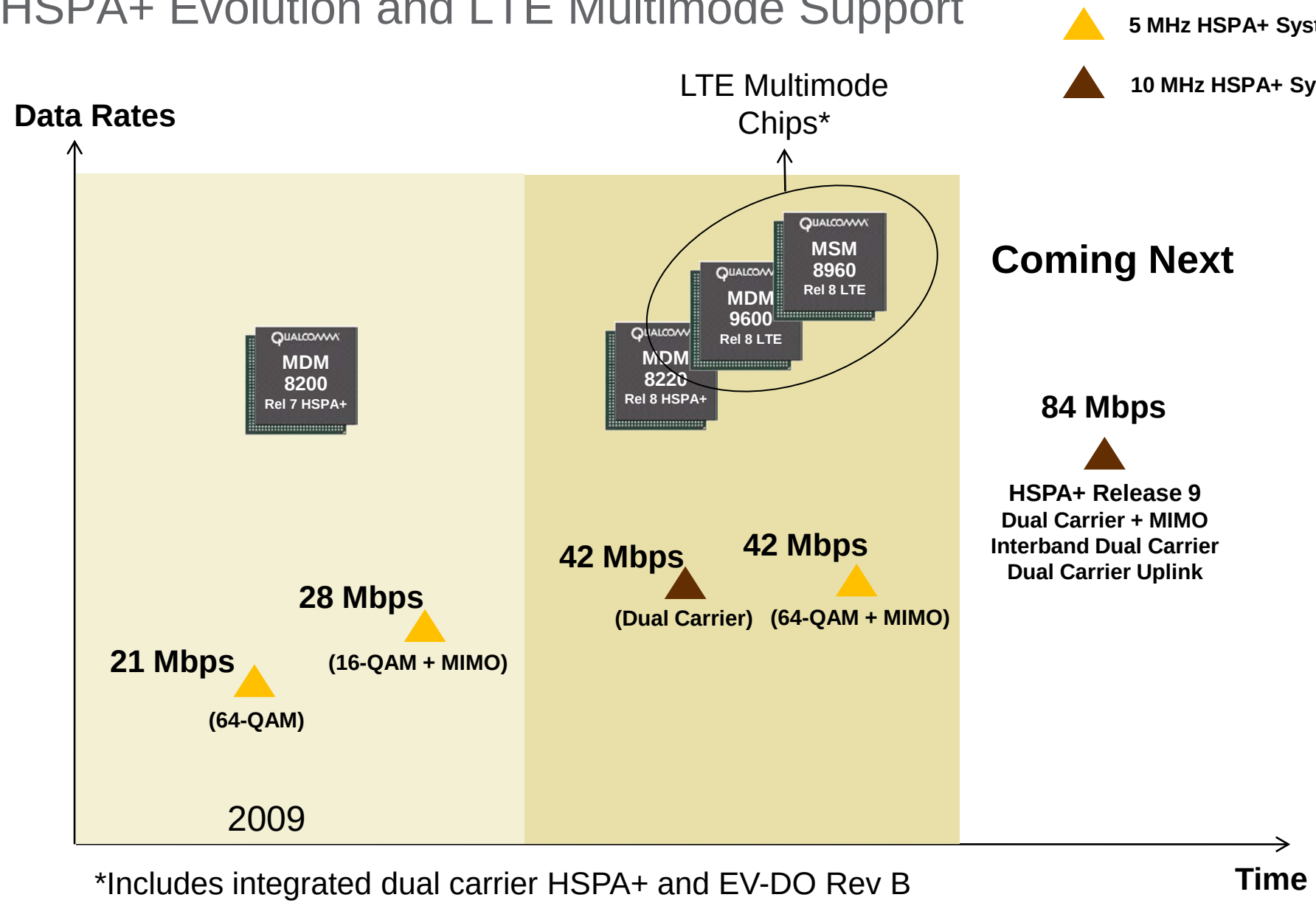
3G Multimode Devices Enable Successful LTE Launch

- Seamless service continuity with 3G from day one
- 3G provides ubiquitous data coverage and voice
- HSPA+ enables consistent experience everywhere

Integrated LTE/3G multimode solutions



HSPA+ Evolution and LTE Multimode Support

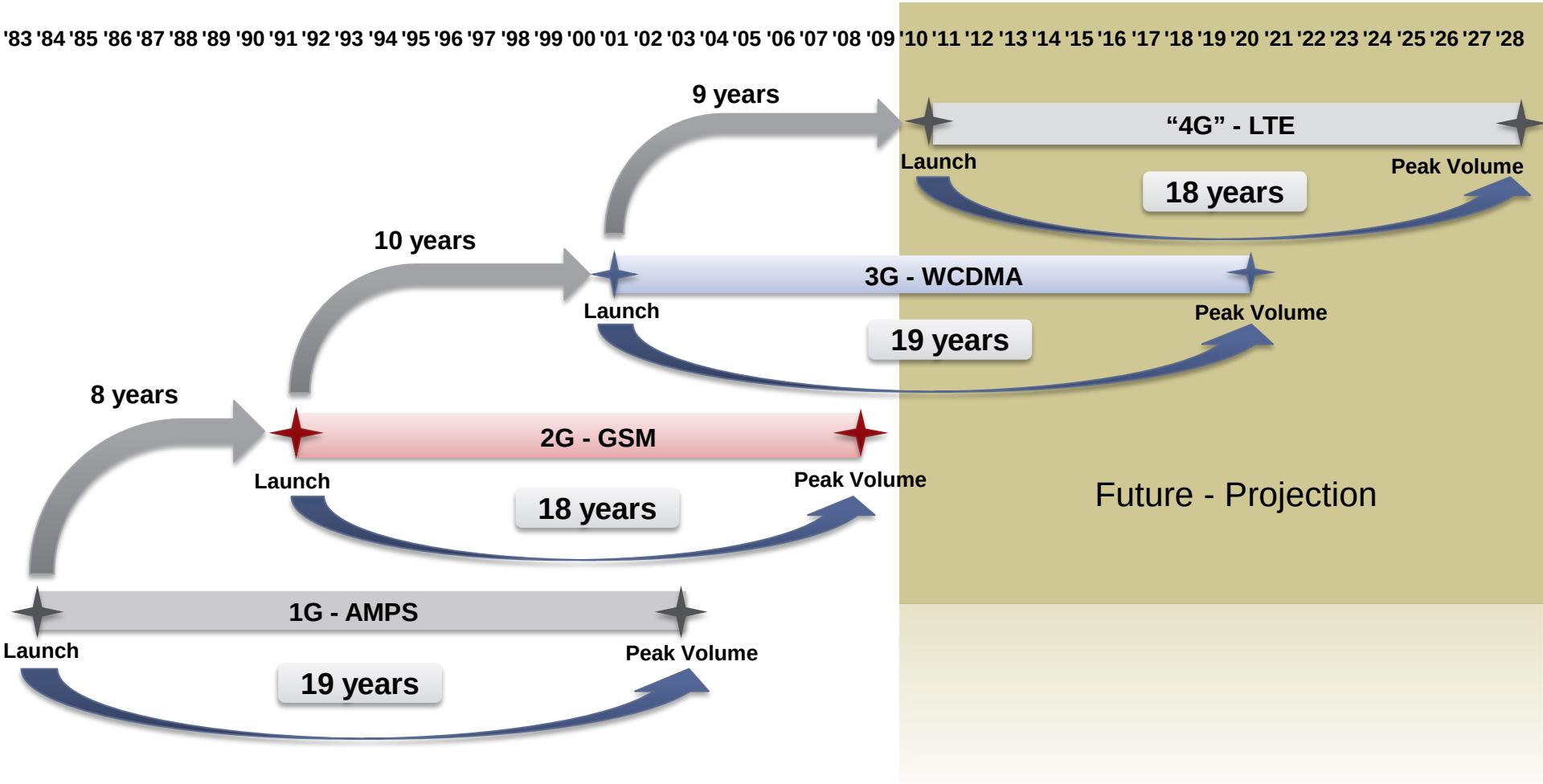


*Includes integrated dual carrier HSPA+ and EV-DO Rev B

Continuing HSPA+ Evolution – Key Drivers

- Competitive Environment
- Spectrum
- Economic Environment
- Network Capex and Device Cost
- User Experience Enhancing Features

Technology Deployment and Adoption Trends



8-10 years between mobile technology generations

18-20 years from initial commercial launch to peak volume

- Thank you!