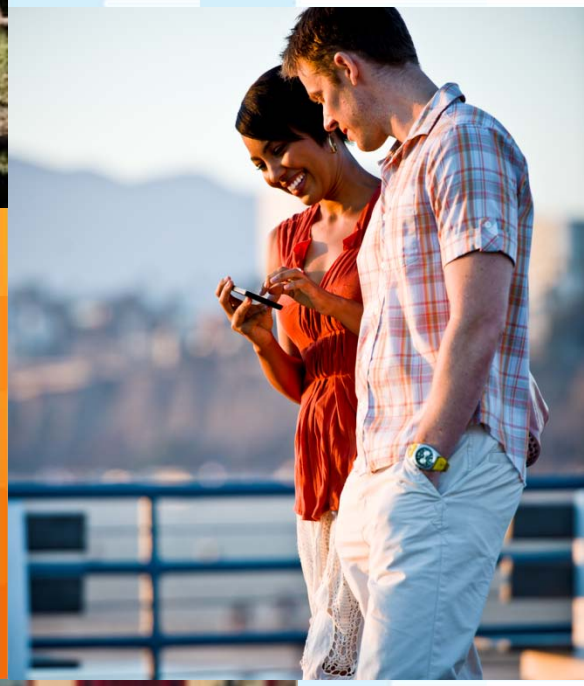


UMTS 900/1800

August 2011

UMTS 900/1800 for Coverage and Capacity Augmentation

- **UMTS 900 is Mainstream**
  Combining excellent coverage of 900 MHz with superior capacity of WCDMA/HSPA+
- **UMTS is an Ideal Choice for Refarming 900/1800 MHz**
  WCDMA augments voice capacity; HSPA+ augments data capacity
- **Multicarrier Further Enhances Performance of HSPA+ 900/1800**
  Combining superior performance of HSPA+ with larger coverage and capacity of 900 /1800 MHz
- **WCDMA+ Frees-up Capacity for HSPA+ Data**
  3x Voice spectral efficiency frees up to 70% of cell data capacity

UMTS 900 is Mainstream

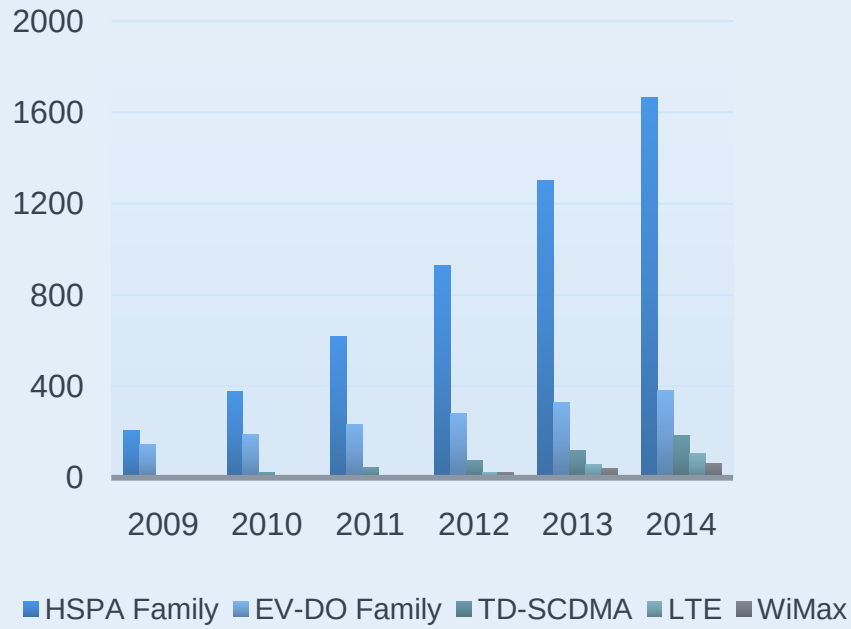
UMTS 900 IS ESTABLASHED

27 Commercial Networks

526 Devices by **81** Vendors

>45 Countries Allow Refarming[1]

HSPA+ IS THE MOBILE BROADBAND LEADER

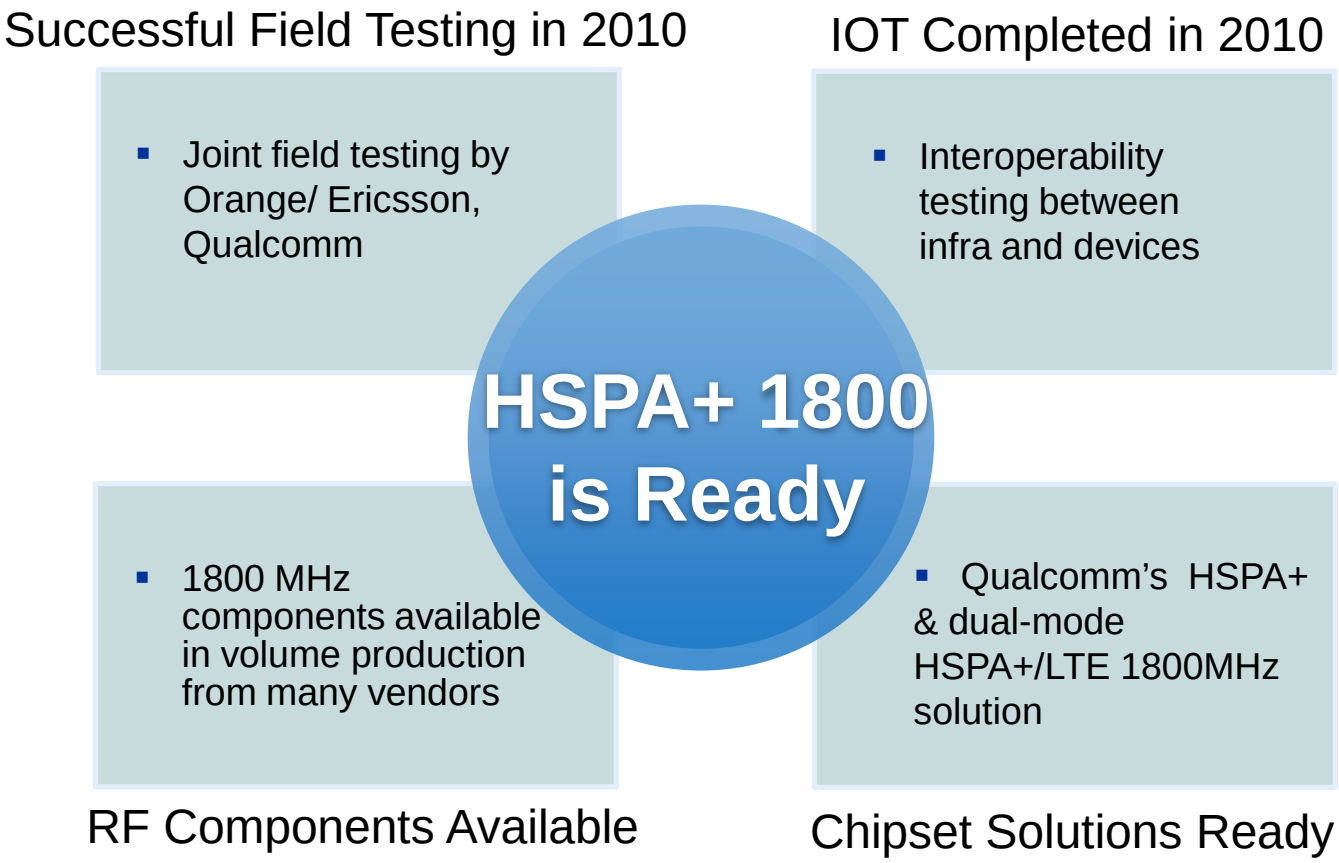


"…UMTS900 is standard in most new devices destined for Europe, the Middle East, Africa, and Asia Pacific markets, with the 900/2100 MHz combination for WCDMA-HSPA increasingly commonplace…"

- GSA

[1] Some countries may not need regulatory approval; Source: www.gsacom.com as of March, 2011

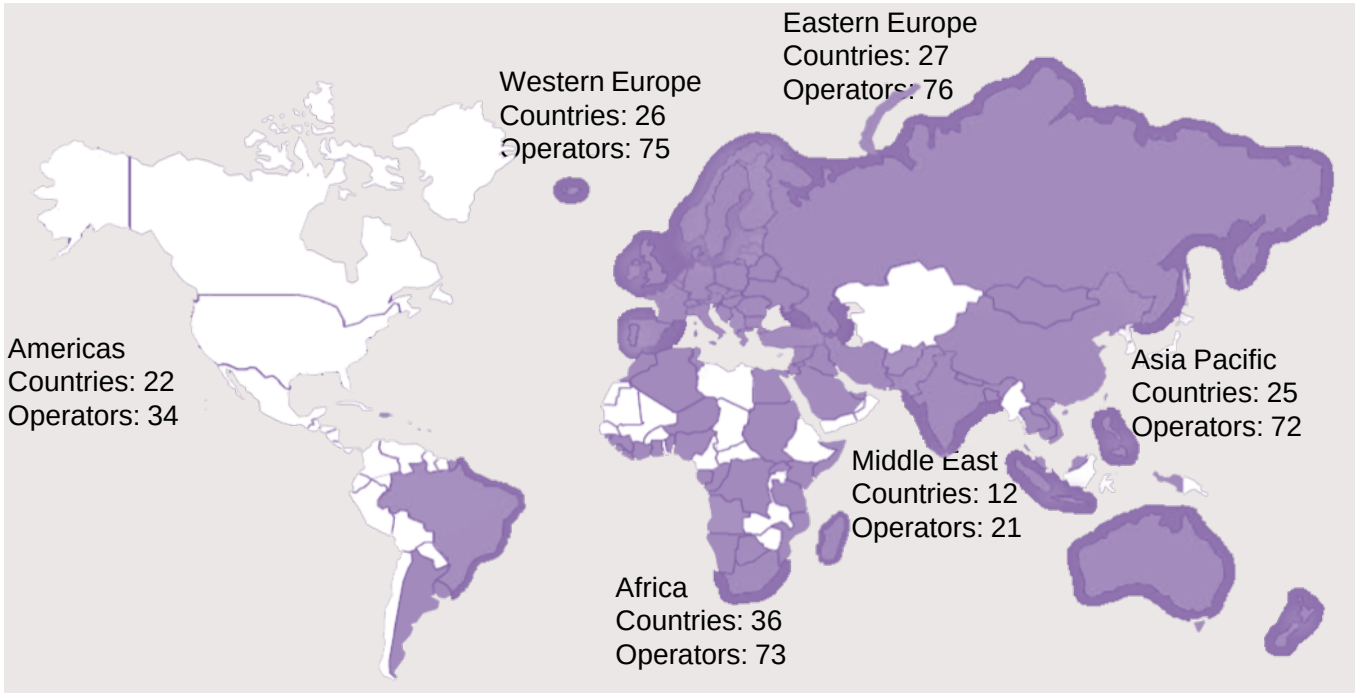
HSPA+ 1800 Expected Commercial in 2011



Several HSPA+ 1800 devices to be launched in 2011

Source: GSMA, and public announcements

HSPA+ 1800 Augments Capacity



1800 MHz
Usage today

351 Operators

148 Countries

Large amount of globally harmonized spectrum*

- 50+ European operators & many in Asia-Pacific region have >10 MHz
- 75 MHz (FDD) defined in 3GPP

Spectrum available in > 5 MHz slots

- E.g. 60% is in 10 MHz or more slots in top 7 European markets

Licenses generally technology agnostic

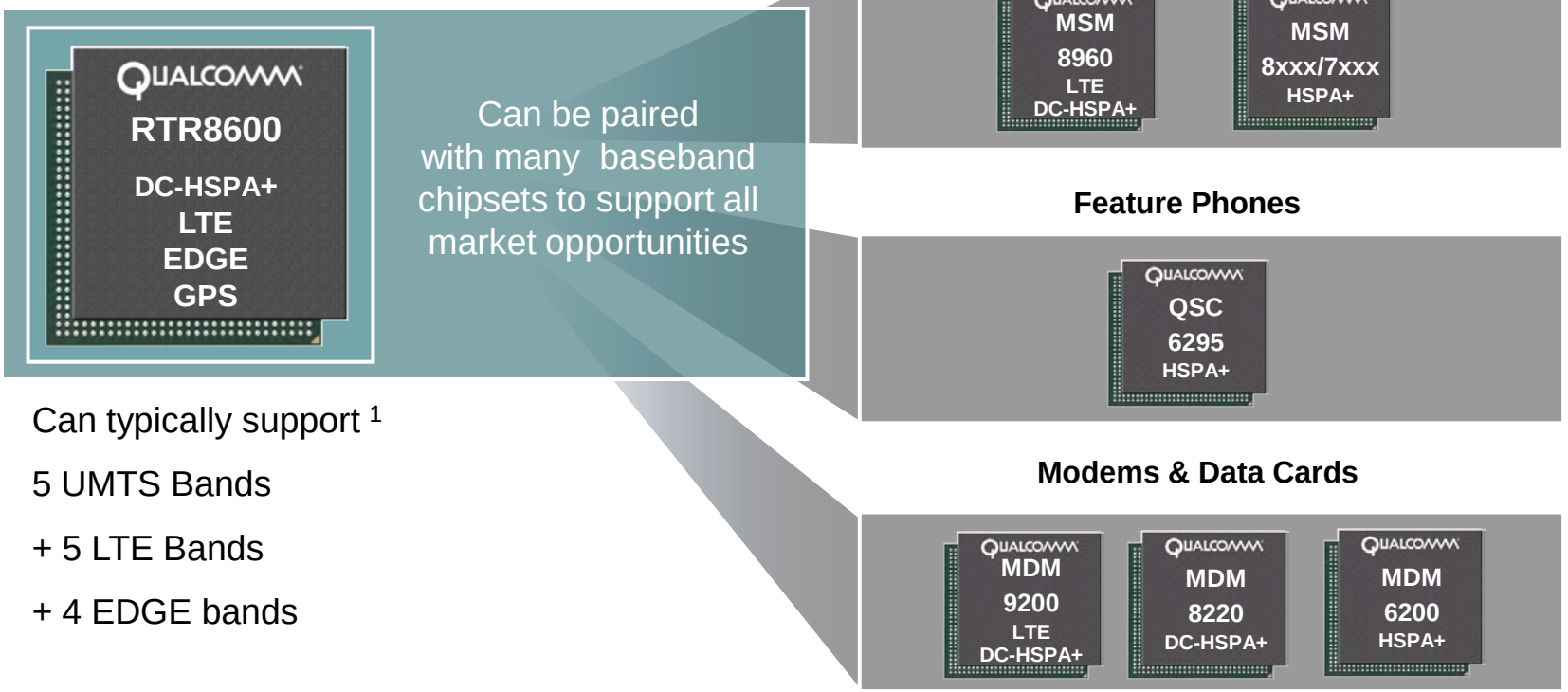
- Minimal regulatory challenge

Source: GSMA whitepaper "Mobile Broadband in the 1800MHz Band", July 2011

Qualcomm's Market Leading 1800MHz RF Solution is Ready

Several HSPA+1800 devices to be launched in 2011

Multi-band/mode RF Transceiver w/ 1800MHz support



Can typically support [1]

5 UMTS Bands

+ 5 LTE Bands

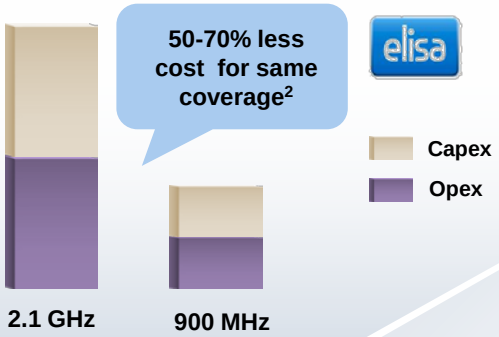
+ 4 EDGE bands

[1]RTR8600 supports wide range of 3GPP bands. In any given configuration, only a subset of the bands are tested and supported by s/w, *Only select baseband chipsets are shown

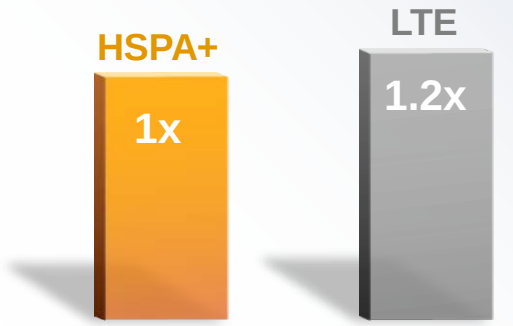
WCDMA/HSPA+: Ideal Choice for Refarming 900/1800 MHz

Combining better coverage of lower bands with higher performance of UMTS/HSPA+

900 MHz band cost-effectively expands coverage

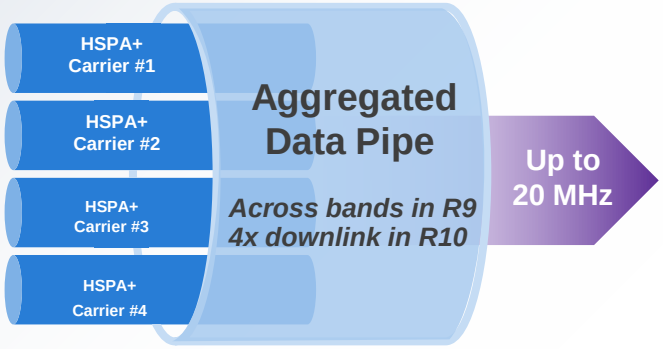


Similar performance as LTE



10 MHz FDD

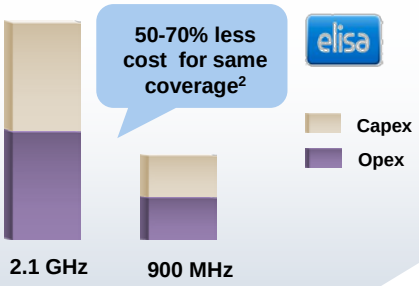
Multicarrier further enhances benefits of 900/1800 MHz



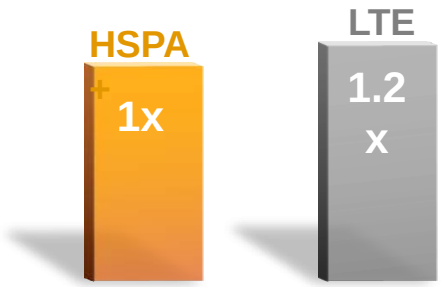
WCDMA/HSPA+: Ideal Choice for Refarming 900/1800 MHz

Combining better coverage of 900 MHz with higher performance of WCDMA/HSPA+

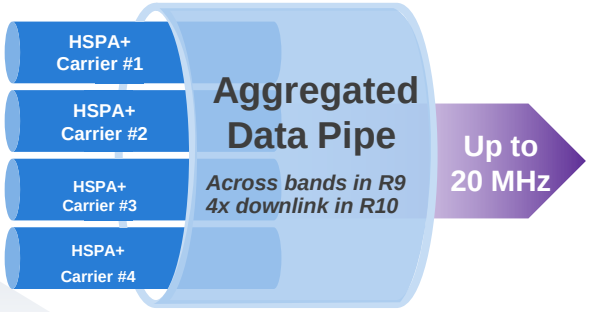
900 MHz band cost-effectively expands coverage



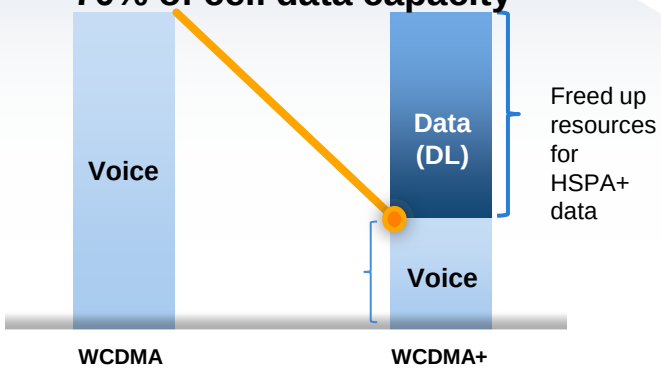
Similar performance as LTE



Multicarrier further enhances benefits of 900/1800 MHz

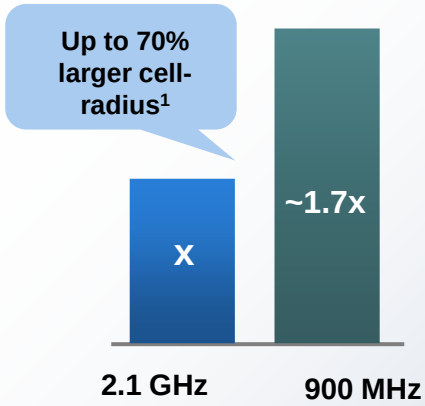


WCDMA+ Frees up up to 70% of cell data capacity



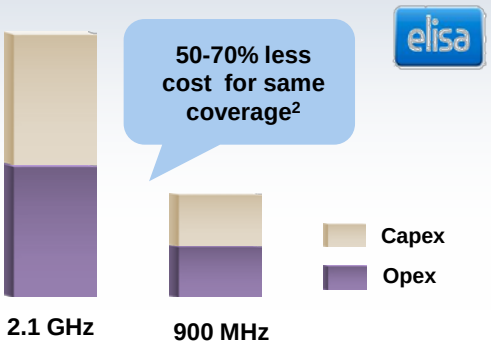
900 MHz Band Cost-effectively Expands Coverage

Better rural coverage



Improved urban indoor coverage

- Better building penetration and street level coverage[3]
- Reduced 3G porosity

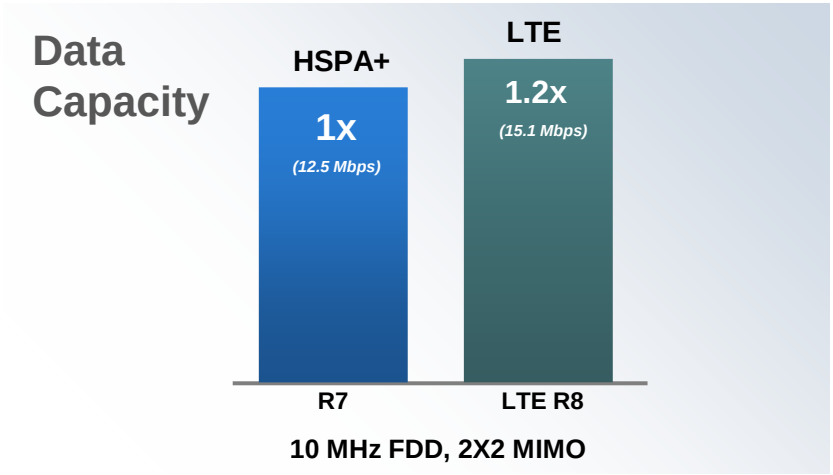


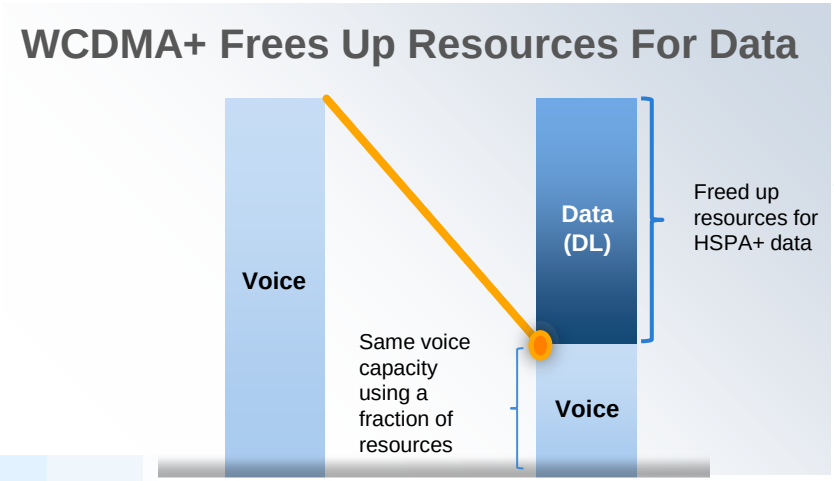
Proven cost-efficiency

[1] Source: Qualcomm simulations and filed testing; [2]Source: GSA whitepaper, 2009; [3] ~ 8 dB less building penetration loss for 900 MHz (based on actual measurements)

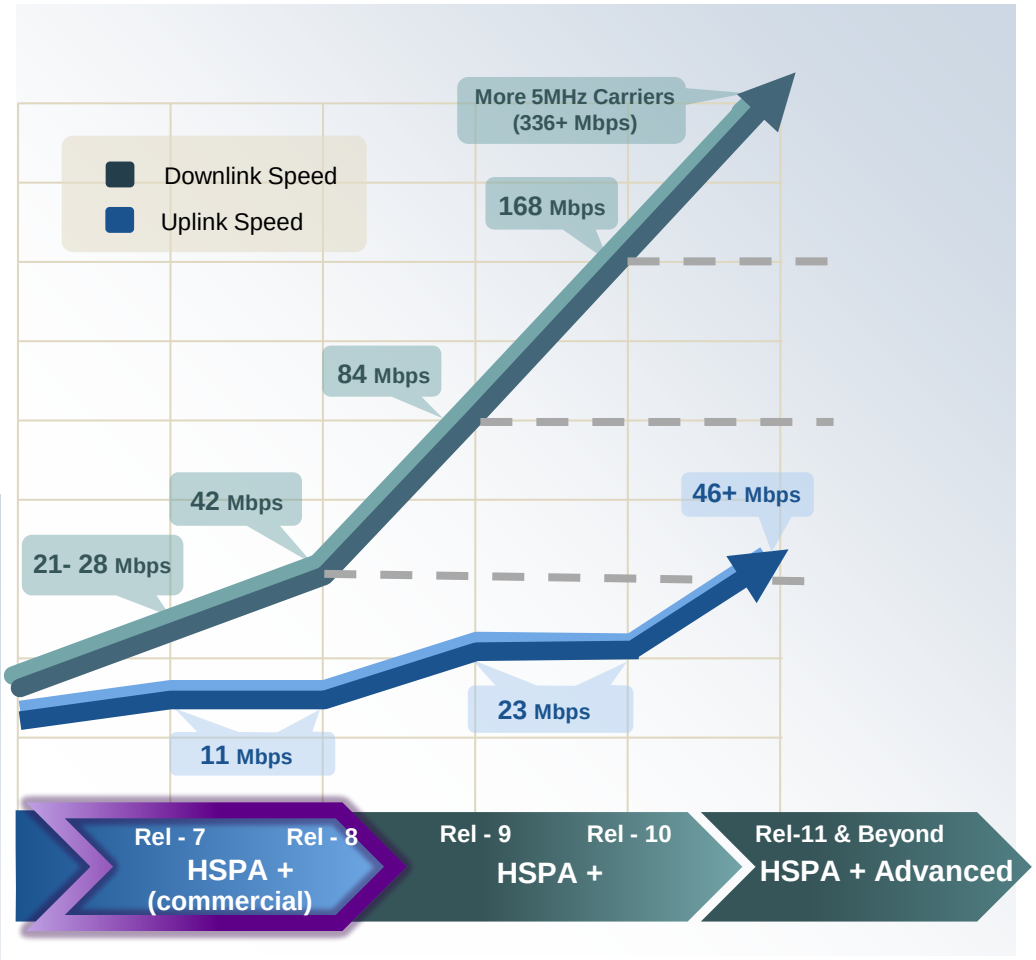
WCDMA+/HSPA+: Best Possible Performance in 5 MHz Carriers

EXCELLENT VOICE & DATA CAPACITY





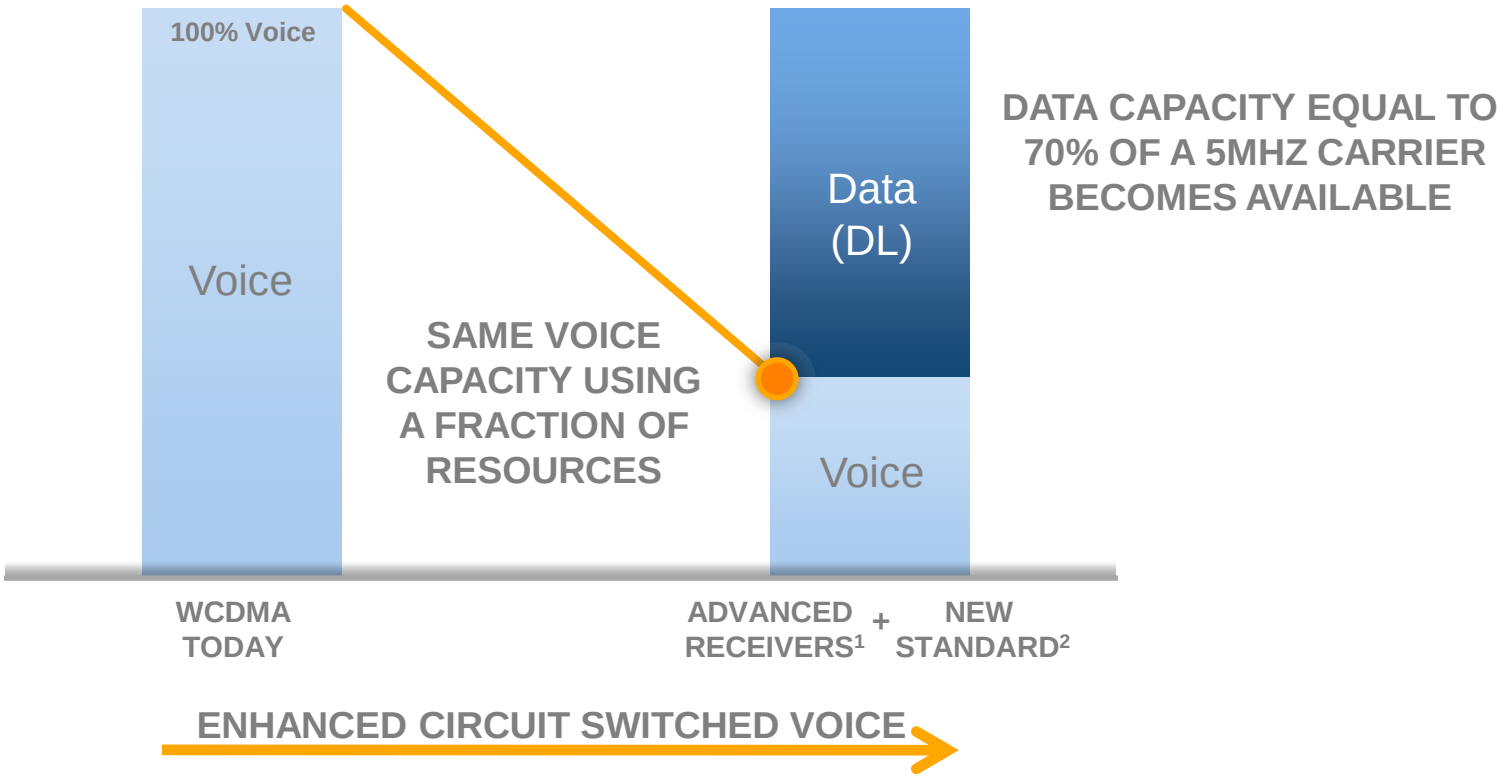
STRONG EVOLUTION PATH



Source: Qualcomm simulations

WCDMA+ Frees Up Resources For Data

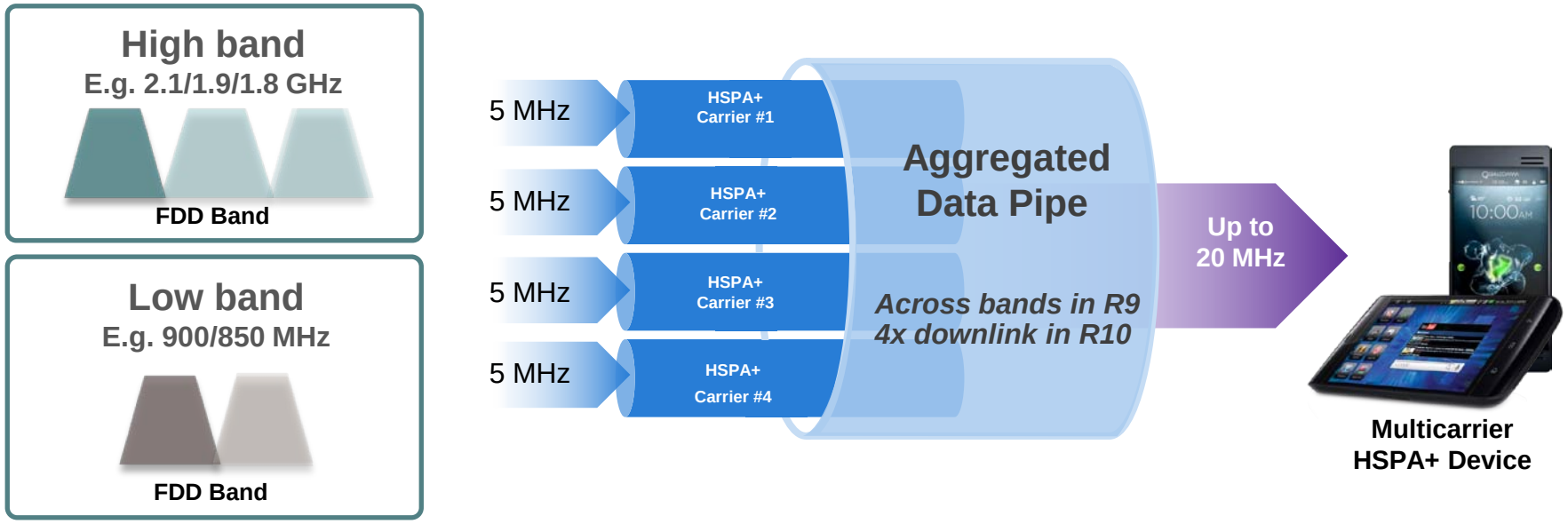
3X IMPROVED SPECTRAL EFFICIENCY FOR VOICE



[1]Handset Equalizer and interference cancellation. [2]Improvements such as overhead optimizations, early termination and slower power control. Qualcomm plans to submit enhancements to 3GPP R12.

Multicarrier Further Enhances the Performance of HSPA+ 900/1800

Rel. 9 supports aggregation across bands



Higher data rates and lower latency for all

- Doubled data rates with Rel.9, even for cell-edge users
- Better user experience

Higher capacity for bursty applications (e.g. web browsing)

- Even higher capacity leveraging fatter data pipe
- Can also be traded off for even better user experience

Better utilization of all spectrum resources

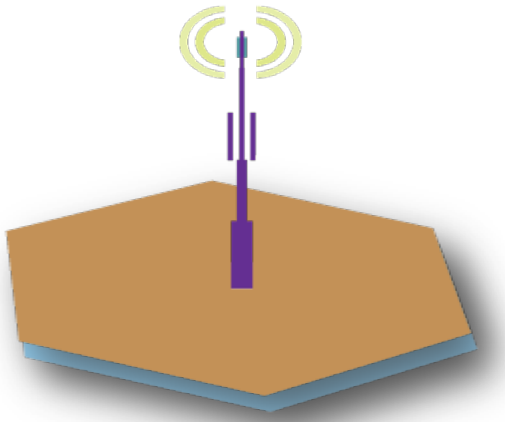
- Providing better coverage with HSPA+ 900 and adding capacity with HSPA+ 1800

WCDMA/HSPA+ 900/1800 Co-exists with GSM

HSPA+ 900/1800 GSM900

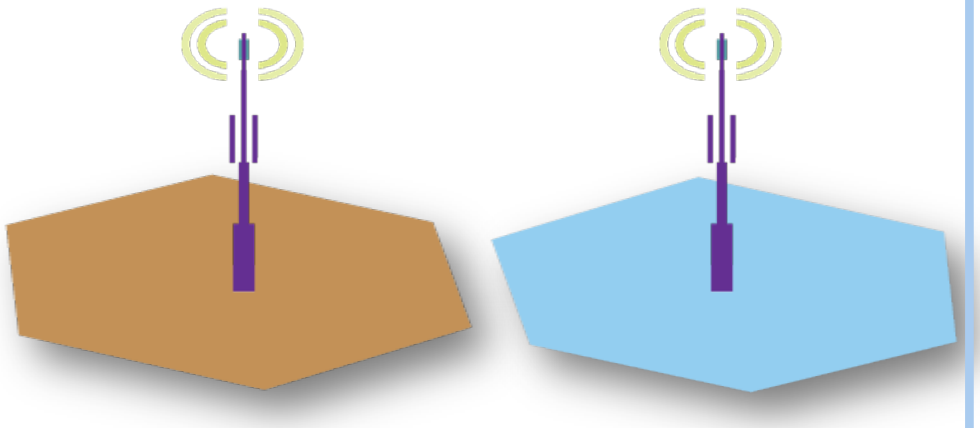
“Coordinated”

Sites collocated



“Un-Coordinated”

Sites not collocated



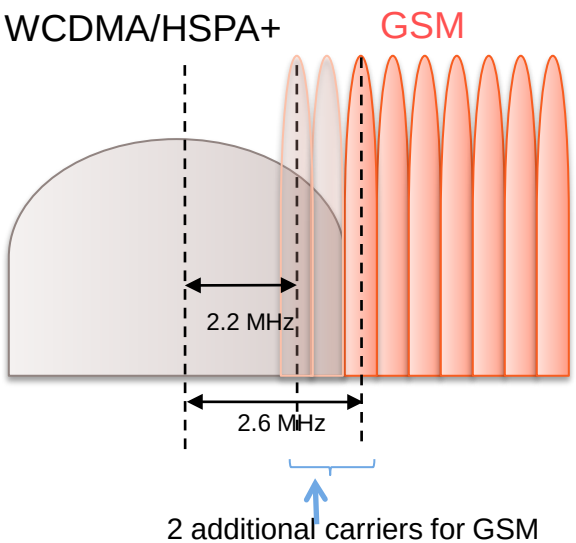
Co-existence is Fully Supported by 3GPP

Collocation Needs Least Amount of Spectrum to Introduce WCDMA/HSPA+ 900/1800

Collocation

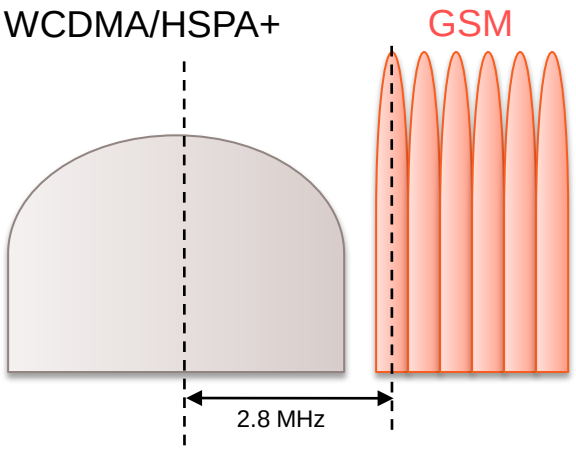
3GPP recommends 2.6MHz separation

- 2.2 MHz possible with up to 5% capacity loss



Non-Collocation

Needs min. 2.8 MHz separation



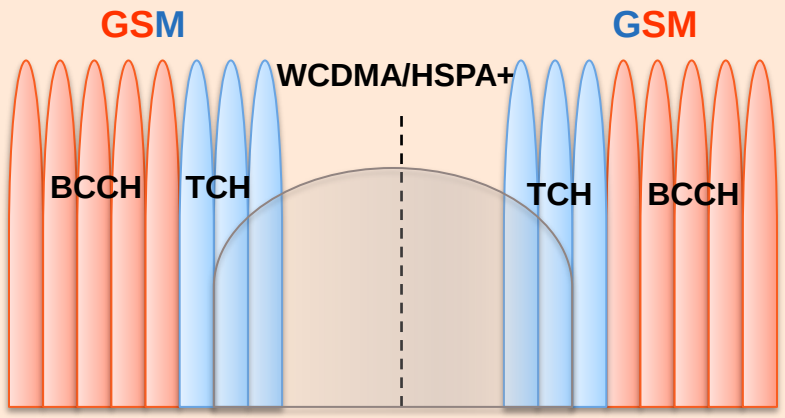
More spectrum available for GSM with collocation

Sources: 1. Compatibility Study for UMTS Operating within the GSM 900 and GSM 1800 bands – ECC/CEPT
2. Paper titled "Frequency coordination between UMTS and GSM systems at 900 MHz" submitted by Qualcomm and Huawei to 8th Annual IEEE International Symposium (PIMRC '07)

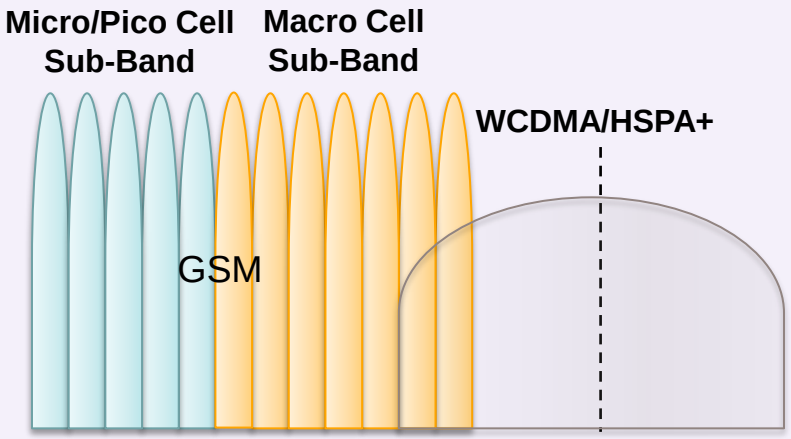
Intelligent Frequency Planning Increases Capacity

By minimizing interference between systems

- "Sandwiched" frequency assignment increases spectrum available for GSM
  - Minimizes interference between operators
- Assigning overhead (BCCH) carriers away from WCDMA/HSPA spectrum reduces impact on signaling



- Assigning GSM micro/pico cell sub-band away from WCDMA/HSPA spectrum minimizes interference
  - Operators usually reserve a part of the spectrum (sub-band) for micro/picocells



Source: Compatibility Study for UMTS Operating within the GSM 900 and GSM 1800 bands – ECC/CEPT

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