May 2013

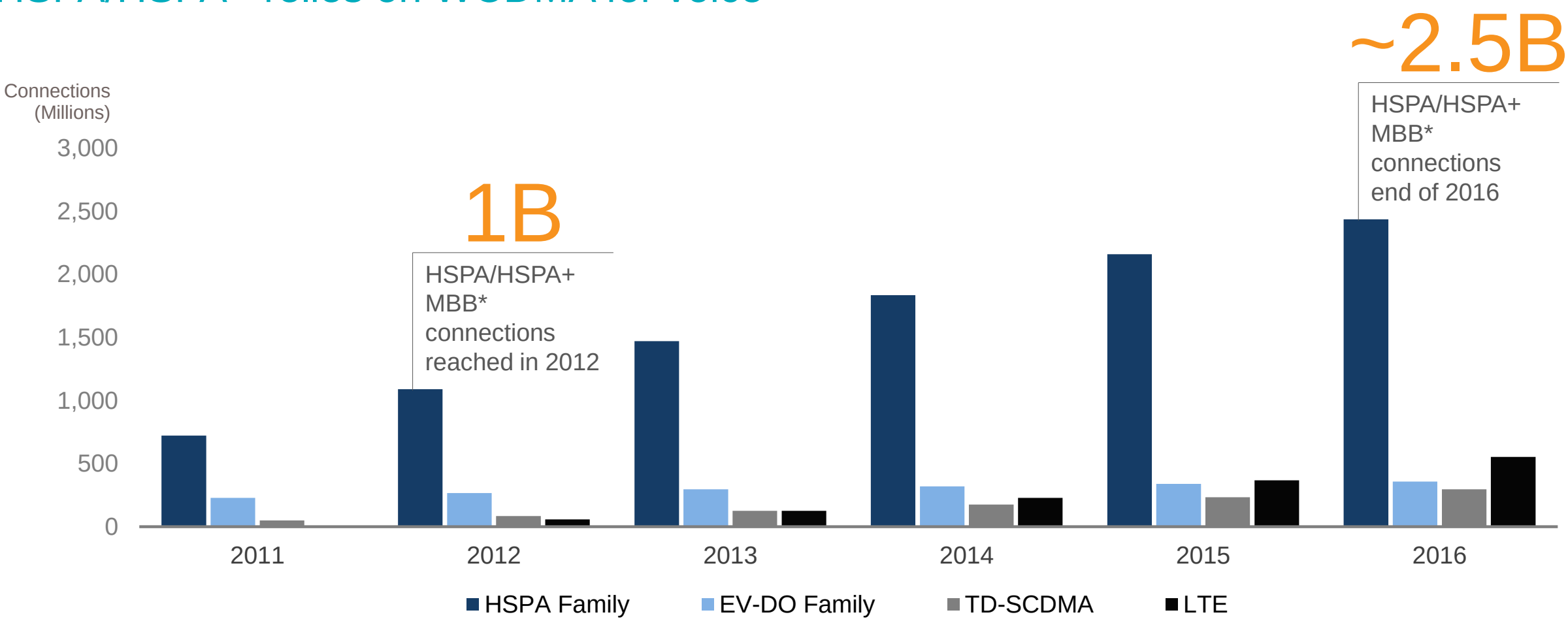
Enhancing proven WCDMA

WCDMA+ Makes Voice More Efficient to Support More Data

QUALCOMM®

Billions of WCDMA voice users for the foreseeable future

HSPA/HSPA+ relies on WCDMA for voice



Source: HSPA, EV-DO ,TD-SCDMA and LTE subs – Wireless Intelligence (Jan '13) . 2,437 Billion HSPA family connections expected Q4 2016

Continued migration from GSM voice to WCDMA voice

UMTS900 Well Established for HSPA+ Data and WCDMA Voice

>64 Commercial Networks

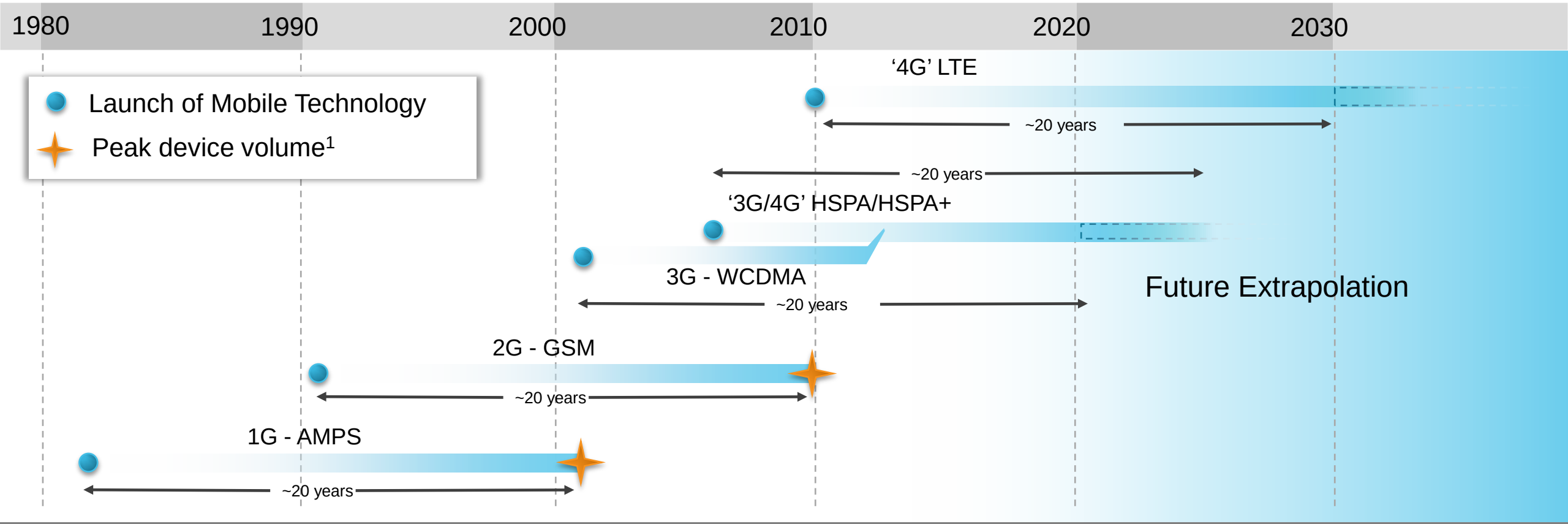
~1000 Devices Announced

>63 Countries Allow Refarming[1]

> *…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, 2013.

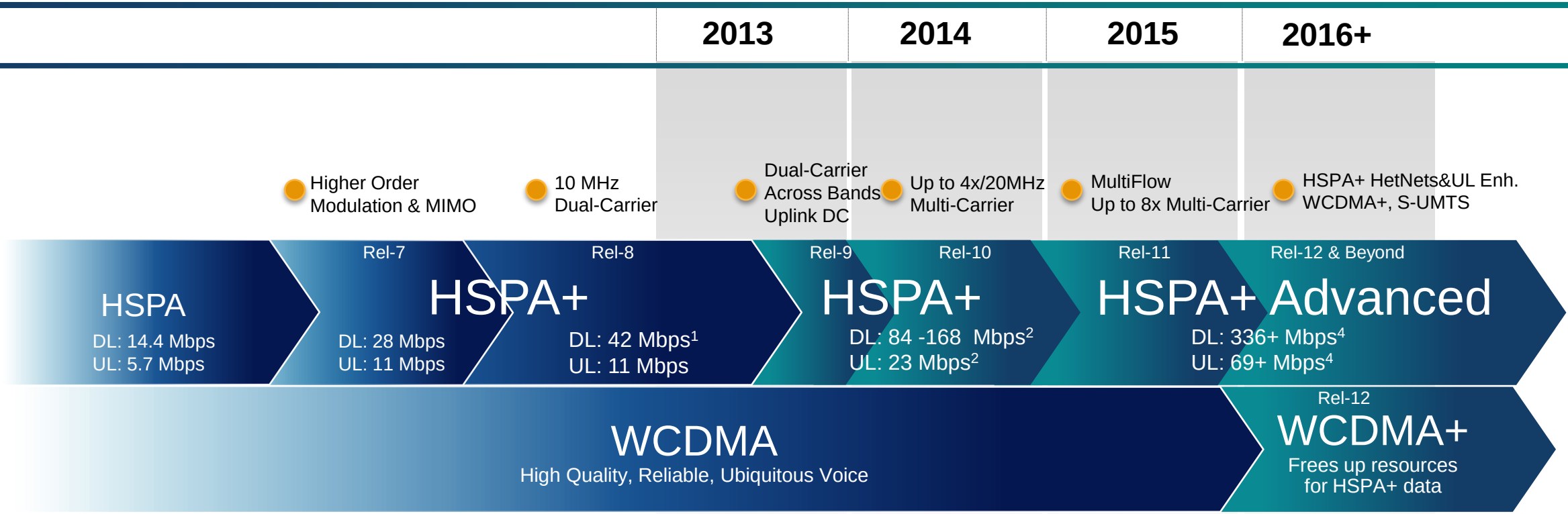
WCDMA has a long life thanks to the success of HSPA+



~20 years from launch of a new mobile technology generation to peak device volume

[1]Sources: ABI June 2011 and Strategy Analytics Sept 2011, devices is only handset. A multimode device is counted only as the latest technology, e.g. a GSM/HSPA+/LTE device is counted as LTE.

HSPA+ continues to evolve



[1]R8 reaches 42 Mbps by combining 2x2 MIMO and HOM (64QAM) in 5 MHz, or by utilizing HOM (64QAM) and multicarrier in 10 MHz.
[2]R9 combines multicarrier and MIMO in 10 MHz to reach 84 Mbps. Uplink multicarrier doubles uplink peak data rate to 23 Mbps in 10 MHz.
[3]R10 expands multicarrier to 20 MHz to reach up to168 Mbps with 2x2 MIMO.
[4]R11 expands multicarrier up to 40 MHz to reach 336 Mbps with 2x2 MIMO, or 20Mhz with 4x4 MIMO. Uplink 2x2 MIMO with 64QAM reaches 69Mbps.

Commercial
Note: Estimated commercial dates.

Created 4/16/2013

WCDMA+ triples voice efficiency to support more data

Frees Up ~2/3 of a Carrier for HSPA+ Data

Extended Talk-Time: ~20% Reduced Current Consumption[1]

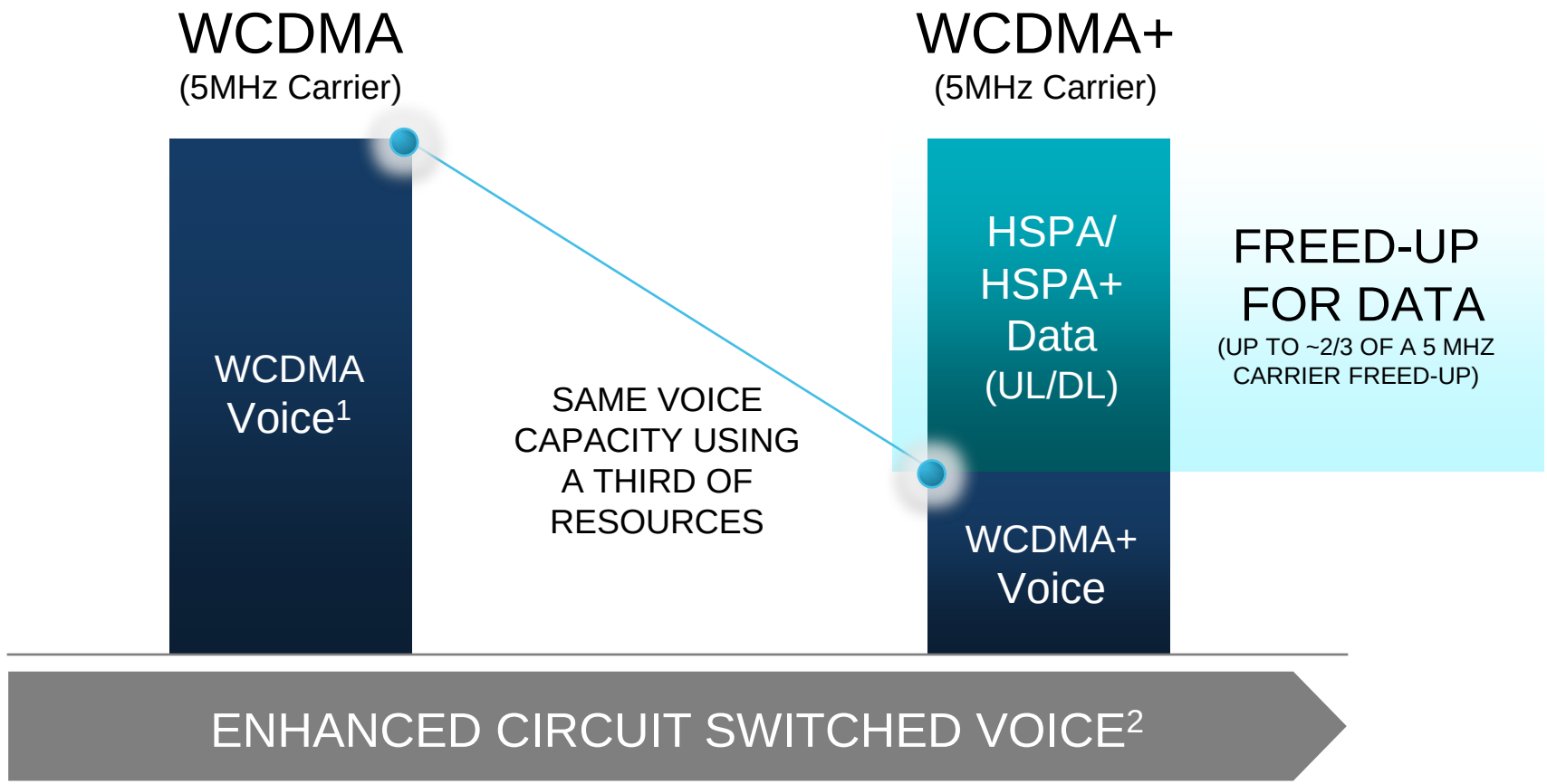
Ensures High Quality, Reliable, Ubiquitous Voice

Cost-Effectively Addresses All Device Segments

[1]Reduction in modem current consumption during an circuit switched WCDMA+ call compared to a WCDMA call

WCDMA+ can free up ~2/3 of a carrier for data

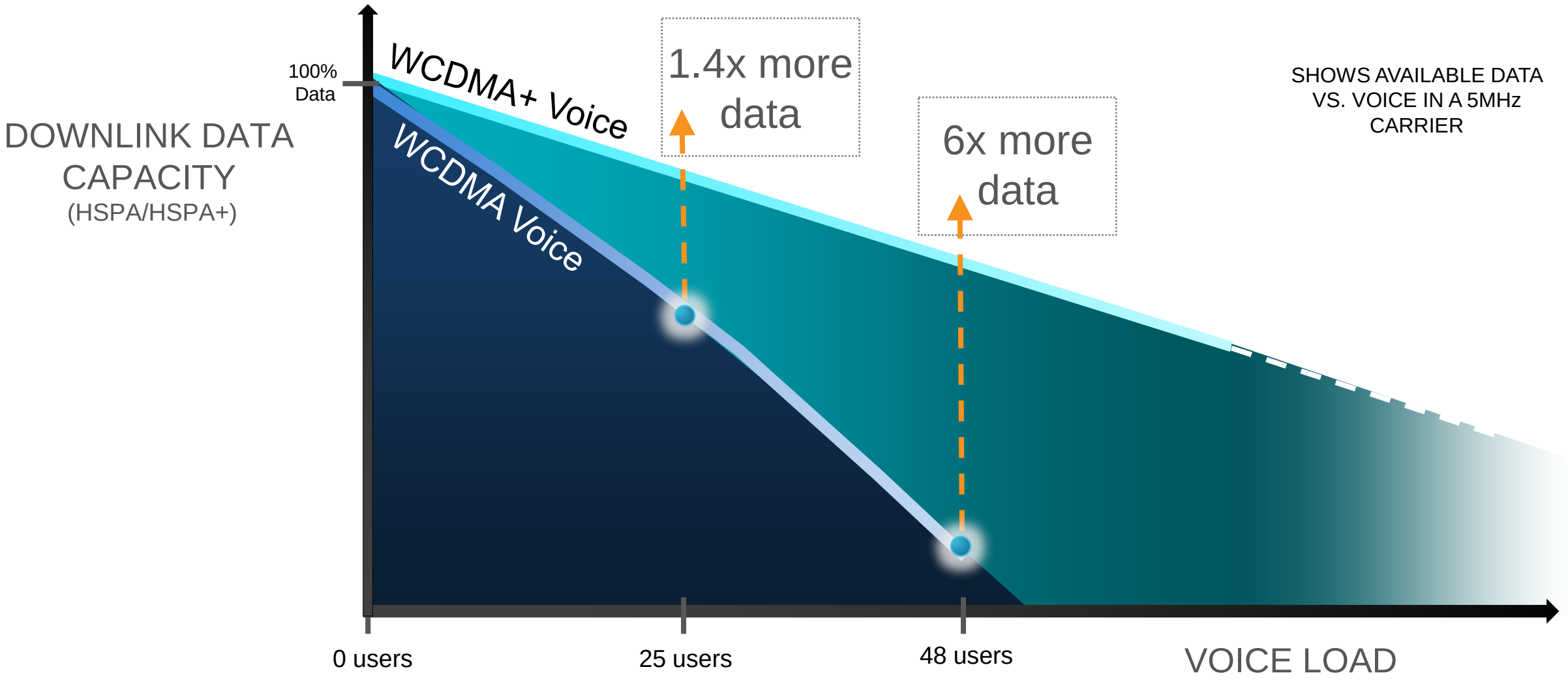
Triples voice spectral efficiency



1 There is ~10% DL data capacity available at max voice capacity not shown in the graph for WCDMA .Assumptions: single receive antenna and rake receiver assumed for voice, dual receive diversity assumed for data. .

2 WCDMA+ is a 3GPP R12 candidate which proposes 1) radio link enhancements and 2) EVS 5.9kbps Source Controlled Variable Bit Rate (VBR) Wideband mode instead of AMR 12.2k vocoder

WCDMA+: more data capacity at all voice loads



Assumptions: Single receive antenna and rake receiver assumed for voice, dual receive diversity assumed for data. This example shows the downlink capacity gain,

WCDMA+ ensures high quality, reliable, ubiquitous voice

Builds on Proven WCDMA Voice[1]

Extended Talk-Time[2]
~30% reduced modem current consumption

Global Roaming in Global Bands

Simultaneous Voice and HSPA+ Data

Leverages Existing Investments

Proven Robustness with Soft-Handover

[1] High quality tanks to soft handover, proven interoperability and 10+ years of WCDMA circuit switched voice optimizations. [2] Current modem consumption reduced by ~30% with WCDMA+ compared to WCDMA.

WDCMA+ cost-effectively addresses all device segments

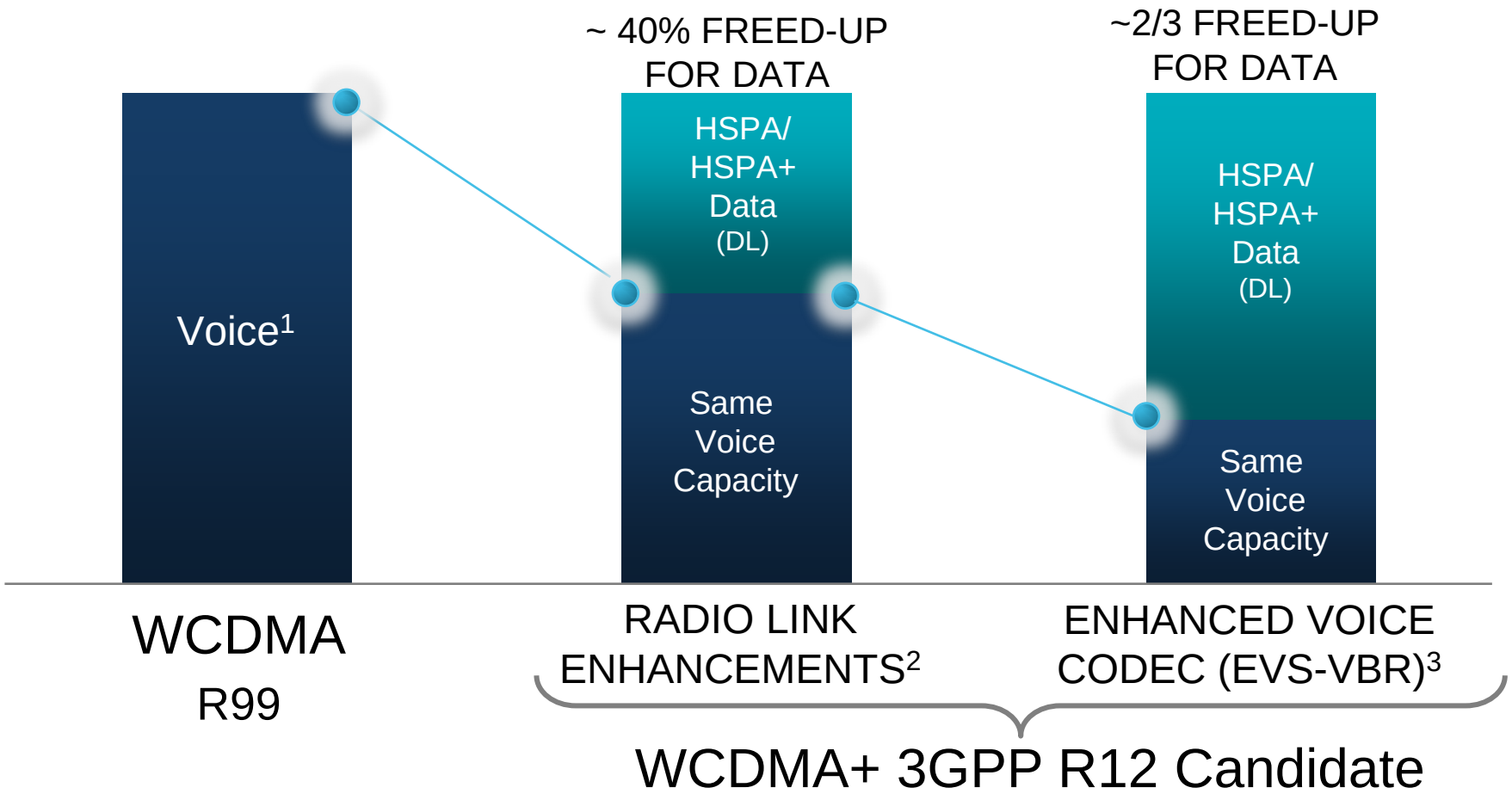
From Feature Phones, Low-End Smartphones to High-End Smartphones

Basic features—e.g. single receive antenna and no HSPA+ required—ensures cost-effective entry/low-end devices

Latest HSPA+ features, dual receive diversity and latest advanced receivers provide best performance for higher en devices

WCDMA+ is being standardized

For improved data capacity and ~20% reduced current consumption



Assumptions: single receive antenna and rake receiver for voice, dual receive diversity for data, shows downlink gain, uplink gain slightly different. [1]There is also a ~10% DL data capacity available at max voice capacity not shown in the graph for WCDMA.

[2] Radio link enhancements such as reduced downlink overhead and early voice frame termination. [3]EVS 5.9kbps Source Controlled Variable Bit Rate (VBR) Wideband mode instead of AMR 12.2k vocoder Wideband mode.

WCDMA+: the secret sauce

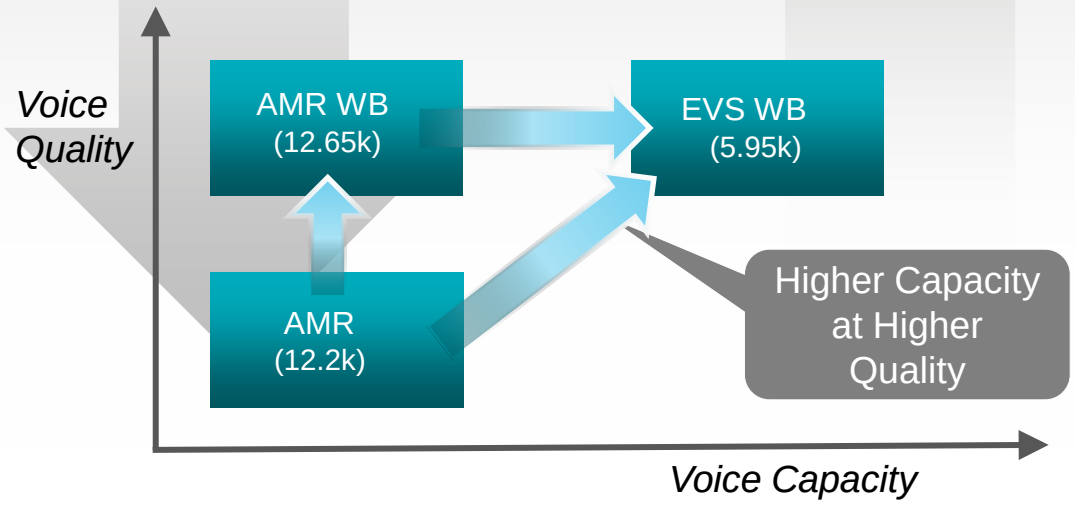
RADIO LINK ENHANCEMENTS

1 REDUCED DOWNLINK OVERHEAD
Remove dedicated downlink pilot to increase capacity[1]

2 EARLY VOICE FRAME TERMINATION
To reduce up and downlink interference to increase capacity and to reduce modem consumption[2]

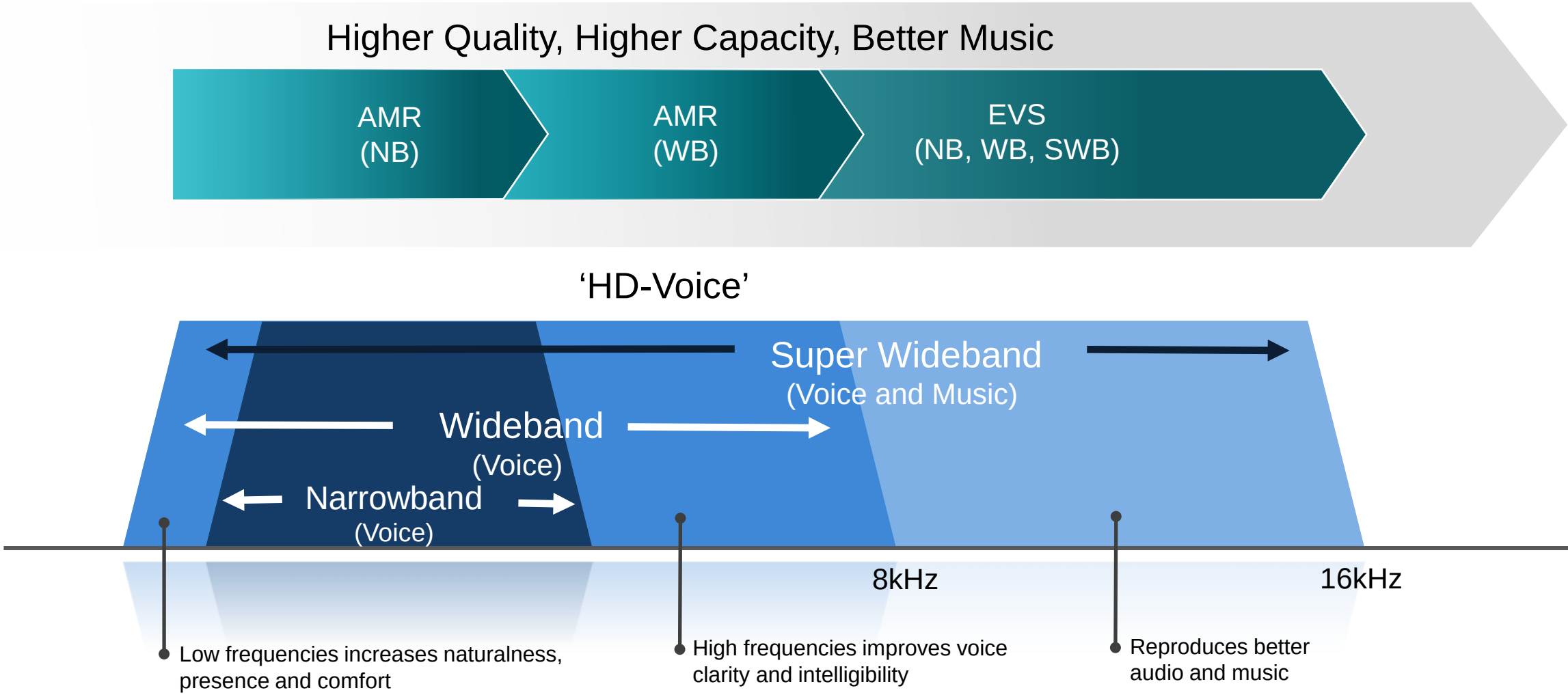
3 SHARED DEDICATED DOWNLINK CHANNEL
Multiplexing two user in one OVSF code to reduce modem consumption

ENHANCED CODEC—EVS 5.95K SC-VBR WB[2]



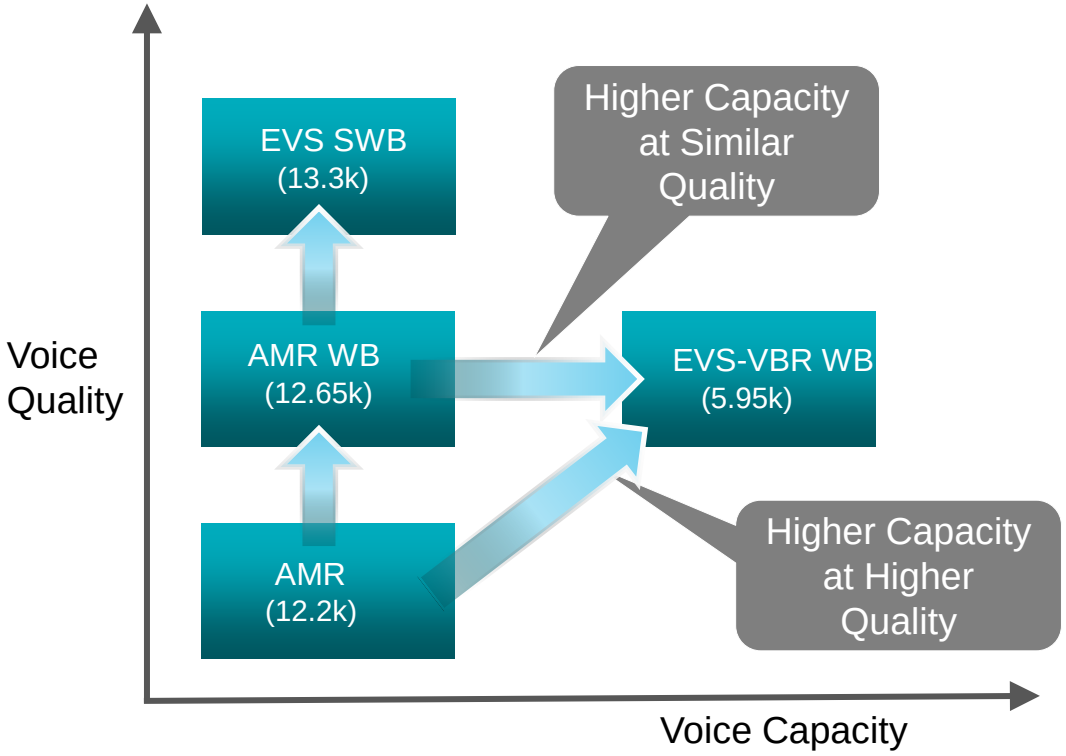
[1]The transmit power control bits are used for signal Interference to noise ratio (SINR) estimation. In addition, the multiplexing of two voice calls on one code in the downlink combined with discontinuous transmission helps to reduce modem current consumption.
[2]The 20 ms voice-frame transmission can be terminated as soon as it is successfully decoded, compared continued to repeating all packets the full 20ms frame. [2]EVS = Enhanced Voice Services, with a source controlled variable bit-rate mode, aka EVS-VBR.

Continuously enhanced codecs



Note: EVS has additional modes not shown that are optimized for music, stereo and even wider bandwidths.

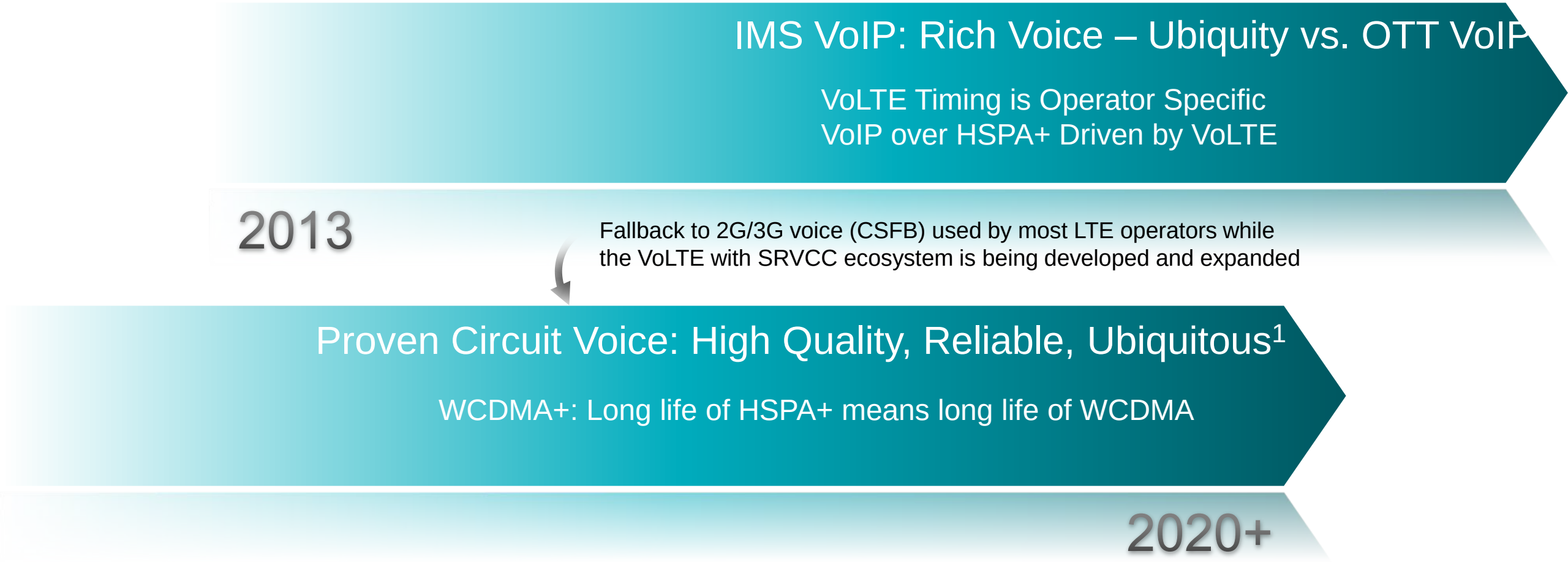
Enhanced Voice Service (EVS): better quality, capacity or both



- Designed with VoIP in mind and targets VoLTE. Expected to be Commercial in 2014
- EVS-VBR for WCDMA+: 5.95kbps Wideband Source Controlled Variable Bitrate Codec
- Opportunity to Support EVS across all voice networks for seamless quality (CS and VoIP)

Note: EVS has many additional modes not shown that are optimized for music, stereo and even wider bandwidths.

Circuit switched voice has a long life during the transition to richer, carrier grade VoIP



[1] Thanks to soft handover, proven interoperability and 10+ years of 1X/WCDMA optimizations. OTT=Over-The-Top, voice just like any data service without Quality of Service

Summary: triples voice efficiency to support more data

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Driving network evolution

www.qualcomm.com/1000x

to learn more about 1000x

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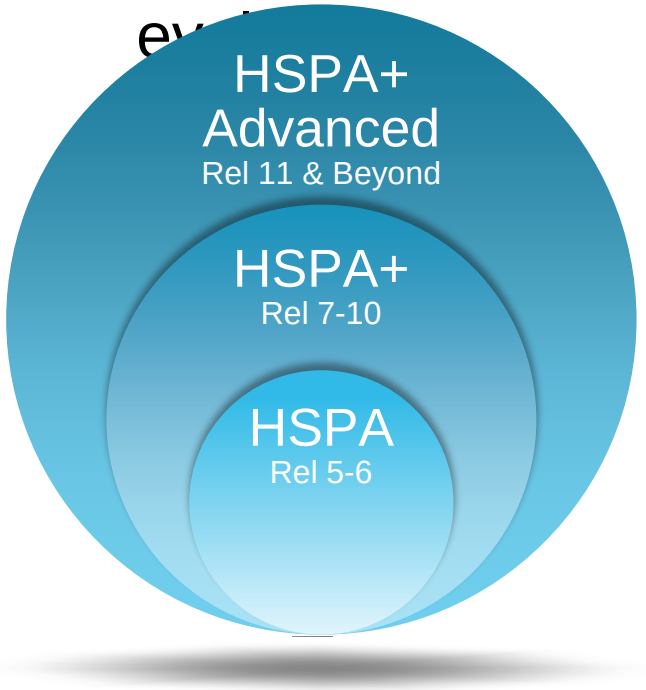
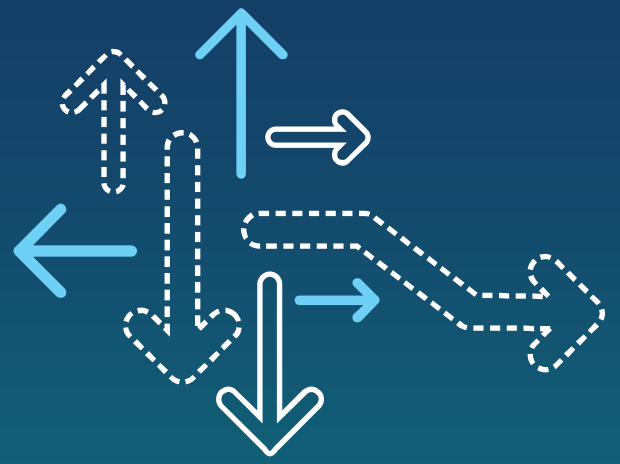
www.qualcomm.com/wcdma_plus

to learn more about the WCDMA/HSPA+ ev



Questions? - Connect with Us



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