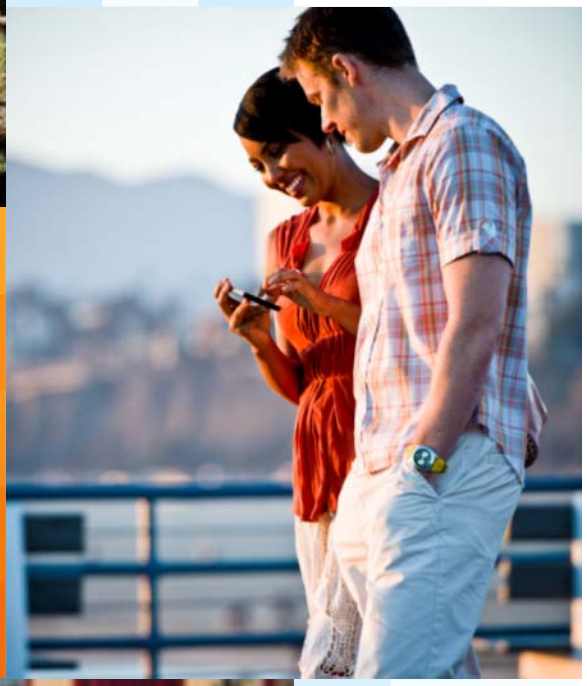
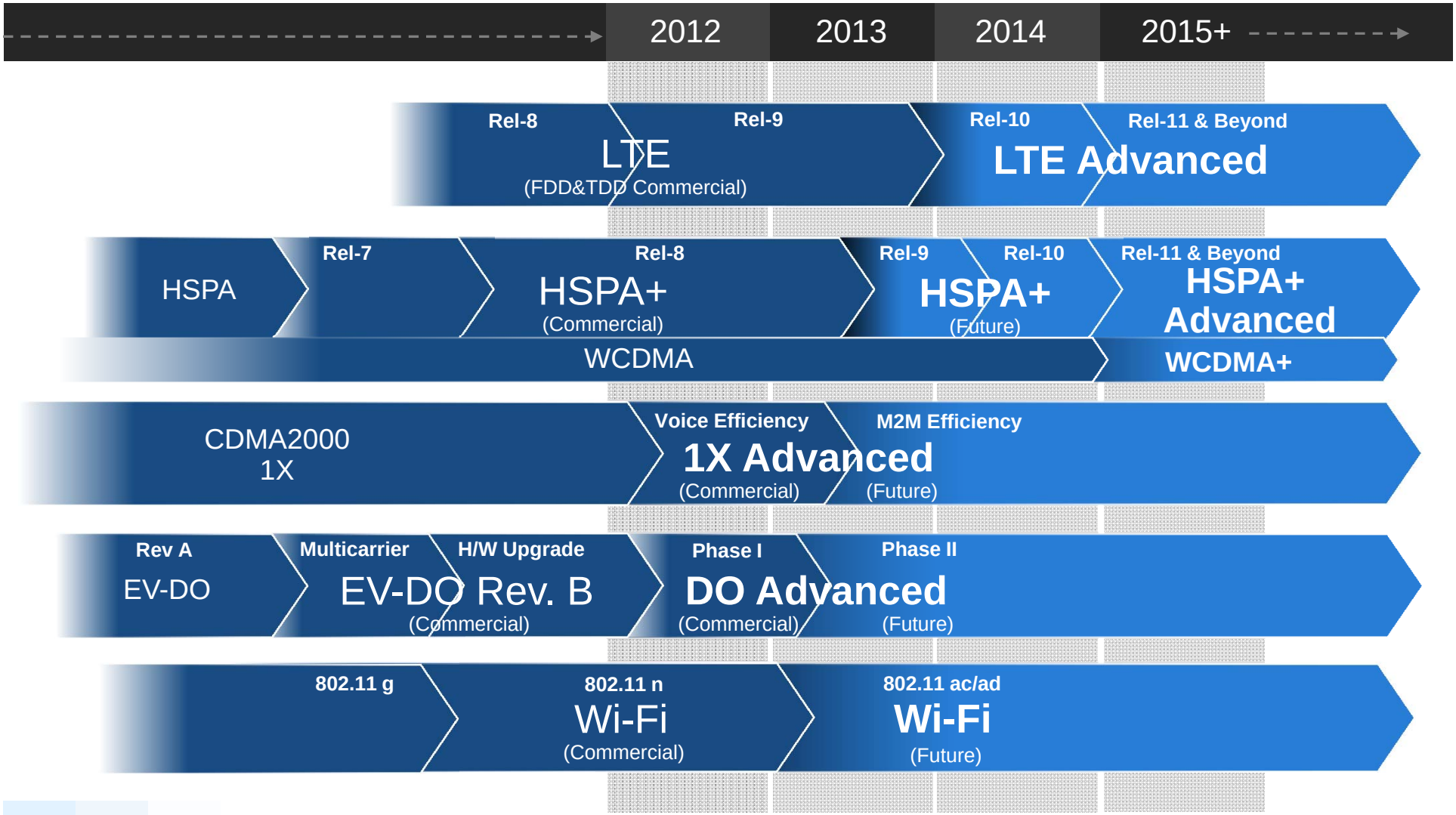


The Voice Evolution

VoLTE, VoHSPA+, WCDMA+ and Quality Evolution

April 2012

Qualcomm is a Leader in Wireless



Commercial

Note: Estimated commercial dates.

Created 04/18/2012

Evolving Voice for More Data, Better Quality, Richer Experience

- Qualcomm: Comprehensive Voice Evolution Leadership
  - 1X Advanced, WCDMA+, IMS VoIP over LTE, HSPA+, EV-DO, and seamless transitions
- 2G/3G Provides LTE Voice Today & Future VoLTE Fallback
  - CSFB widely deployed, future VoLTE needs SRVCC to ensure seamless voice
- VoLTE with VoHSPA+ Ensure Rich Voice Everywhere
  - Ensures a seamless and consistent *rich voice* user experience
- WCDMA+: More Efficient Voice to Support More Data
  - Triples WCDMA circuit switched voice spectral efficiency
- Qualcomm Enables The Best Voice Experience
  - Leading Voice Quality Technologies for 3G circuit switched voice, IMS VoIP and OTT VoIP (HDOn, Calliope Fluence..)

Circuit Voice Has A Long Life During The Transition to Richer, Carrier Grade VoIP

IMS VoIP: Rich Voice – Ubiquity vs. OTT VoIP

VoLTE Timing is Operator Specific
VoIP over HSPA+ Driven by VoLTE

2013

Fallback to 2G/3G voice (CSFB) used by most LTE operators while the VoLTE ecosystem is being developed and expanded

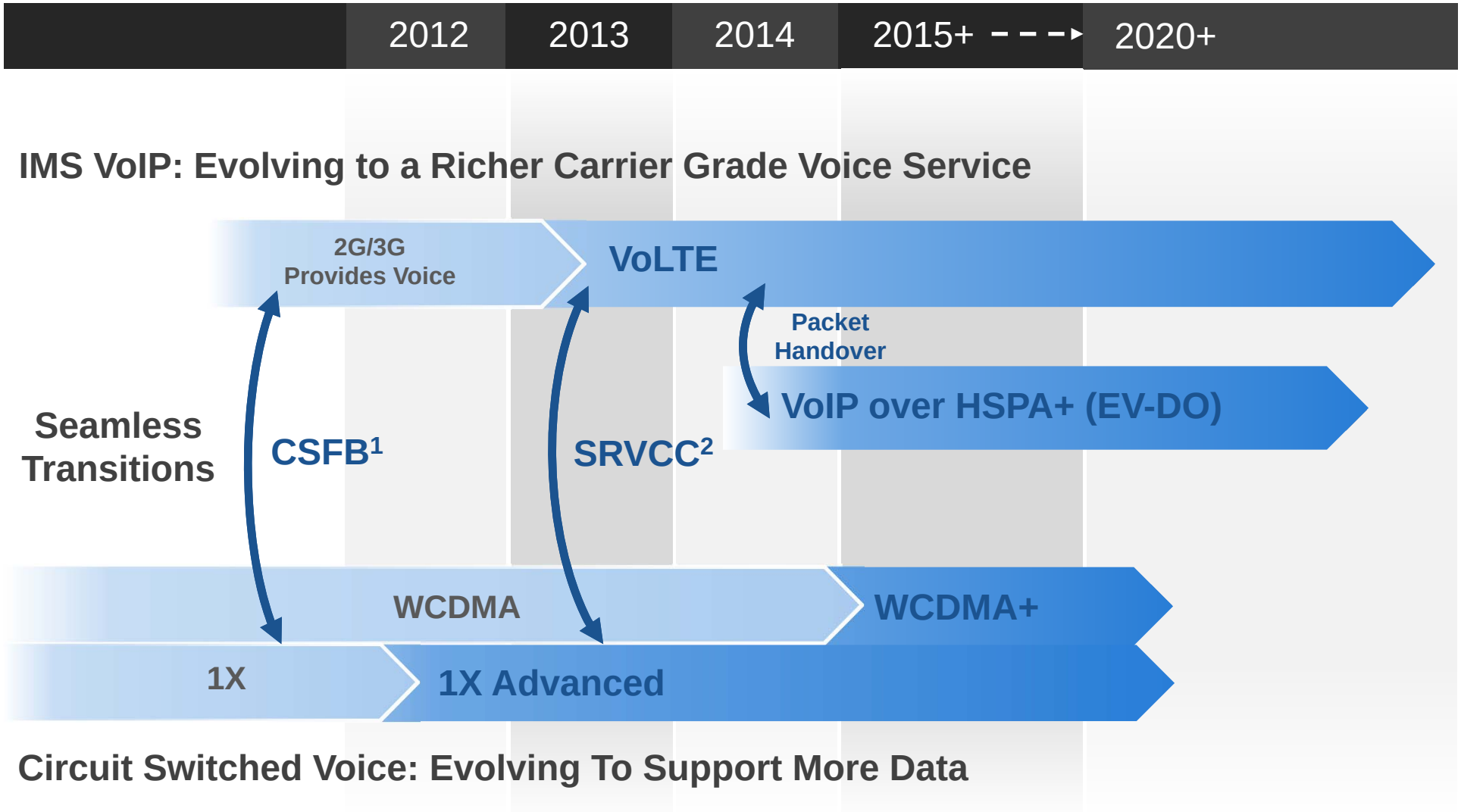
Proven Circuit Voice: High Quality, Reliable, Ubiquitous[1]

WCDMA+: Long life of HSPA+ means long life of WCDMA
1X Advanced Commercial (1H 2012)

2020+

[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

Qualcomm: Comprehensive Voice Evolution Leadership



Blue: Qualcomm Technology Leadership

[1]CSFB: Circuit Switched Fallback. [2]SRVCC: Single Radio Voice Call Continuity to enable handover to WCDMA/1X/GSM CS voice outside VoLTE coverage.

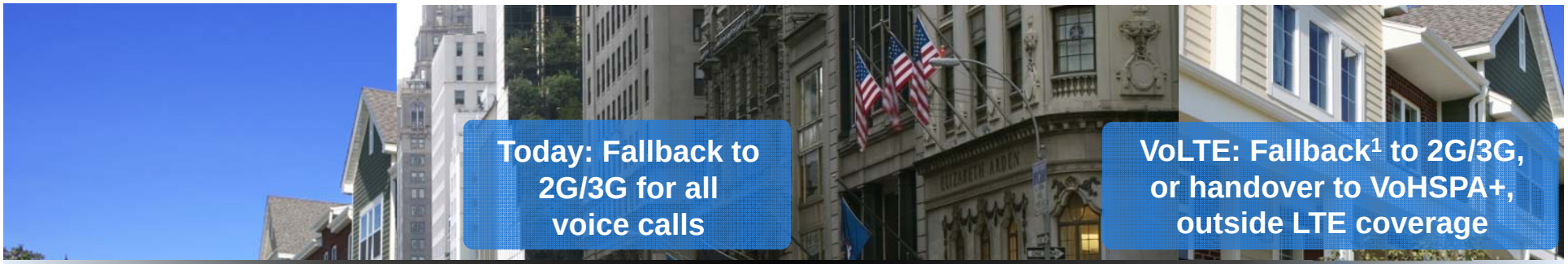
2G/3G Provides LTE Voice Today —And Future VoLTE Fallback

2G/3G Provides Voice

CSFB[1] to WCDMA, 1X or GSM voice is commercial since 2011.

VoLTE—IMS VoIP over LTE

Ccommercialization with SRVCC[1] starting in 2013, maturing in 2015



Today: Fallback to 2G/3G for all voice calls

VoLTE: Fallback[1] to 2G/3G, or handover to VoHSPA+, outside LTE coverage

LTE ***(FDD or TDD)***

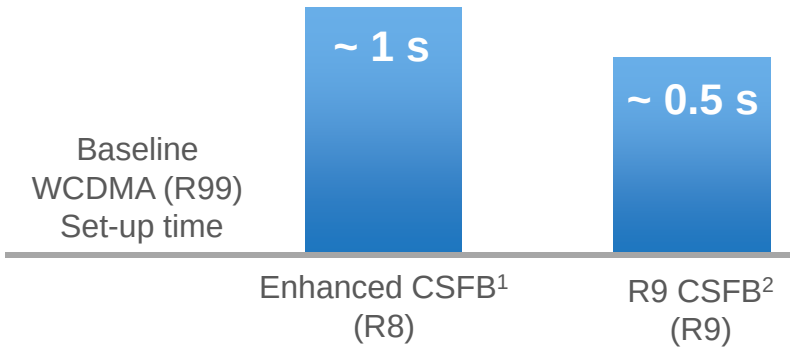
2G/3G Voice & EV-DO/HSPA+ Data

Voice Continuity and Global Roaming

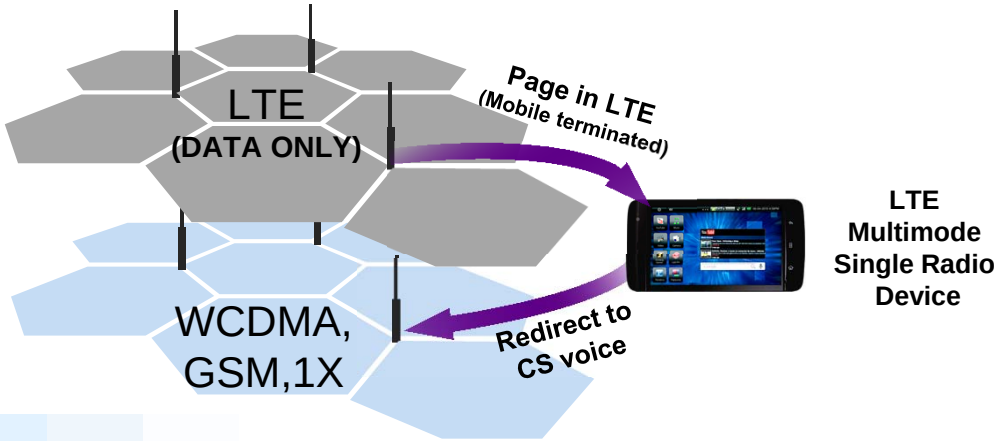
[1]SRVCC: Single Radio Voice Call Continuity. CSFB: Circuit Switched Fallback.

2G/3G Voice Fallback (CSFB)

Commercial Since 2011 and Widely Deployed



SIMILAR CALL
SET-UP TIME AS TODAY
(MOBILE ORIGINATED
OR TERMINATED CALL)

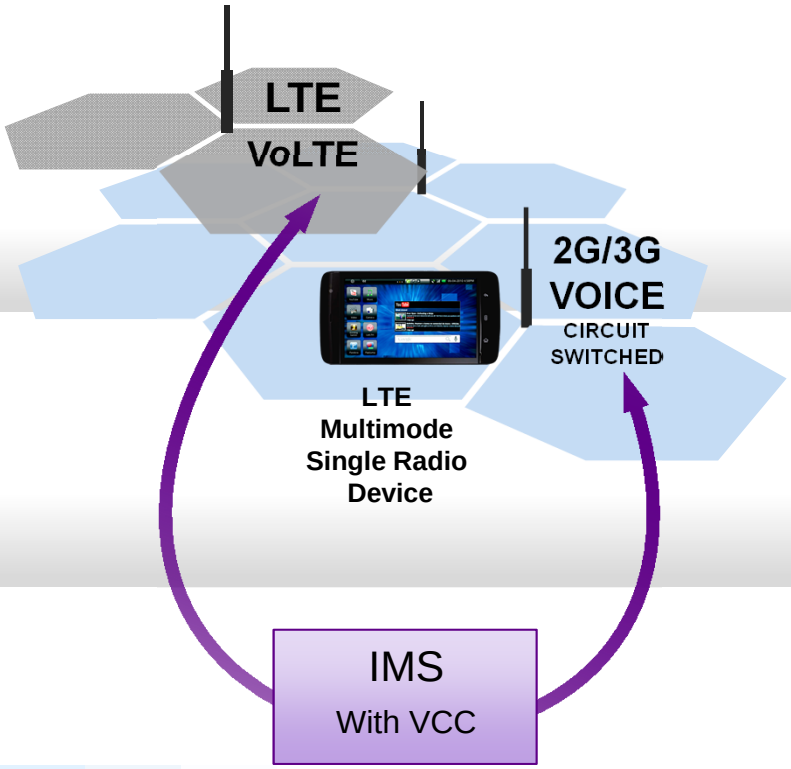


RELIABILITY ON PAR
WITH TODAY'S
NETWORKS

[1]Redirection without reading the non-mandatory system information blocks 'SIBs', 1xCSFB for 1X is also redirection based in R8.
[2]System information provided directly in a LTE redirection message to speed up the transition, aka 'SIB tunneling". Enhanced R9 1xCSFB is Handover based

SRVCC Ensures Seamless Voice Continuity

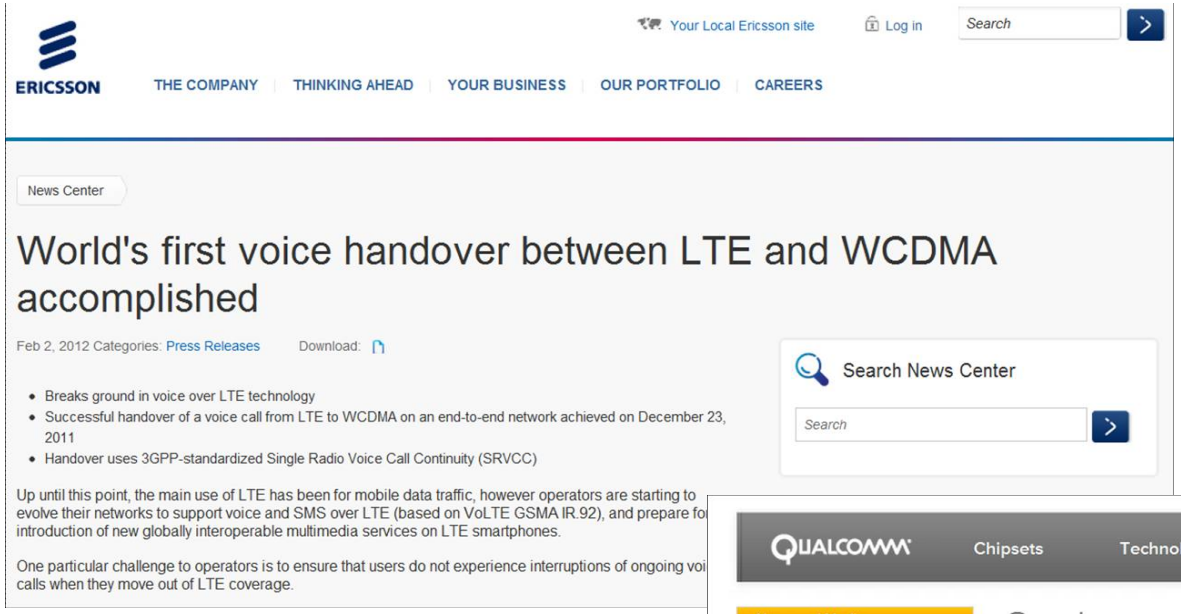
2012	2013	2014	2015+
VoLTE w/ SRVCC	VoLTE on par with CS Voice Quality	Mature Interoperable VoLTE	



- Single Radio Voice Call Continuity (SRVCC) enables handover to 2G/3G Voice Outside VoLTE coverage
- Multimode devices ensure global roaming from day one
- VoLTE IMS can expand to support other VoIP accesses (HSPA+, EV-DO etc.)

[1]SRVCC for VoLTE to 2G/3G circuit switched voice is defined in 3GPP Rel-9, with enhancements in Rel-10

World's First SRVCC Handover by Qualcomm and Ericsson (Feb 2012)



Different VoIP Models Will Co-Exist

OPERATOR PROVIDED SERVICE

3RD PARTY PROVIDED SERVICE

OVER-THE-TOP VOIP (BEST EFFORT)

IMS/RCS VoIP

Operator Client

3rd party Client

Opportunity To Offer Quality Of Service to OTT VoIP Provider

Interoperable, ubiquitous rich voice solution[1]

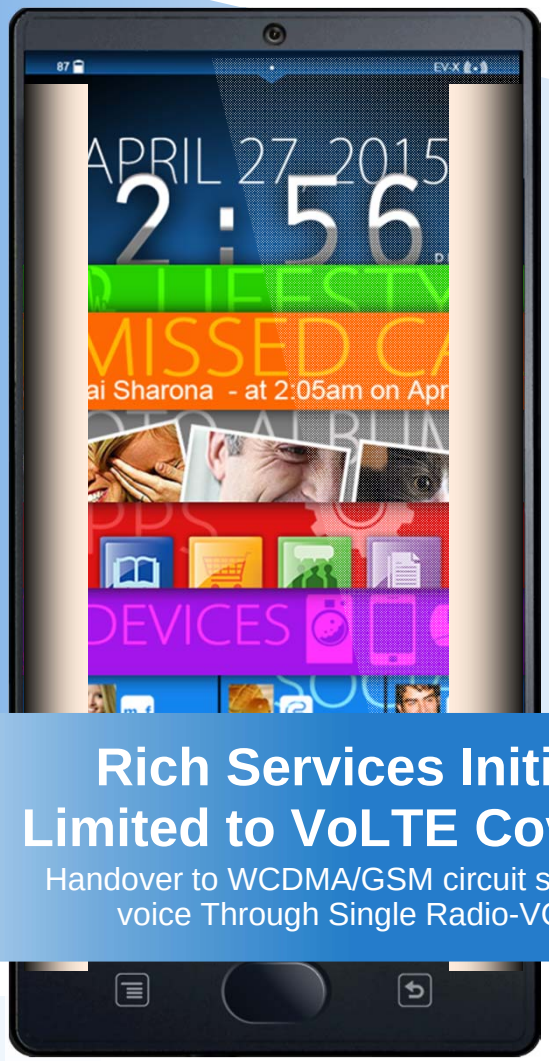
May not interoperate with other VoIP solutions

Carrier Grade Voice

Variable Quality, Dependent on Network Load

[1]IMS/RCS based VoIP is the industry solution for carrier grade voice, to enable a ubiquitous VoIP solutions .

VoLTE with VoHSPA+ Ensures Rich Voice Everywhere



Integrated Presence

Enhanced contacts with presence
Integrated messaging, chat, synch. etc

Enriched Voice/Push to Share

Share multimedia content during call,
such as video, pictures, files etc.

Video Telephony

With full interoperability

Rich Services Initially Limited to VoLTE Coverage

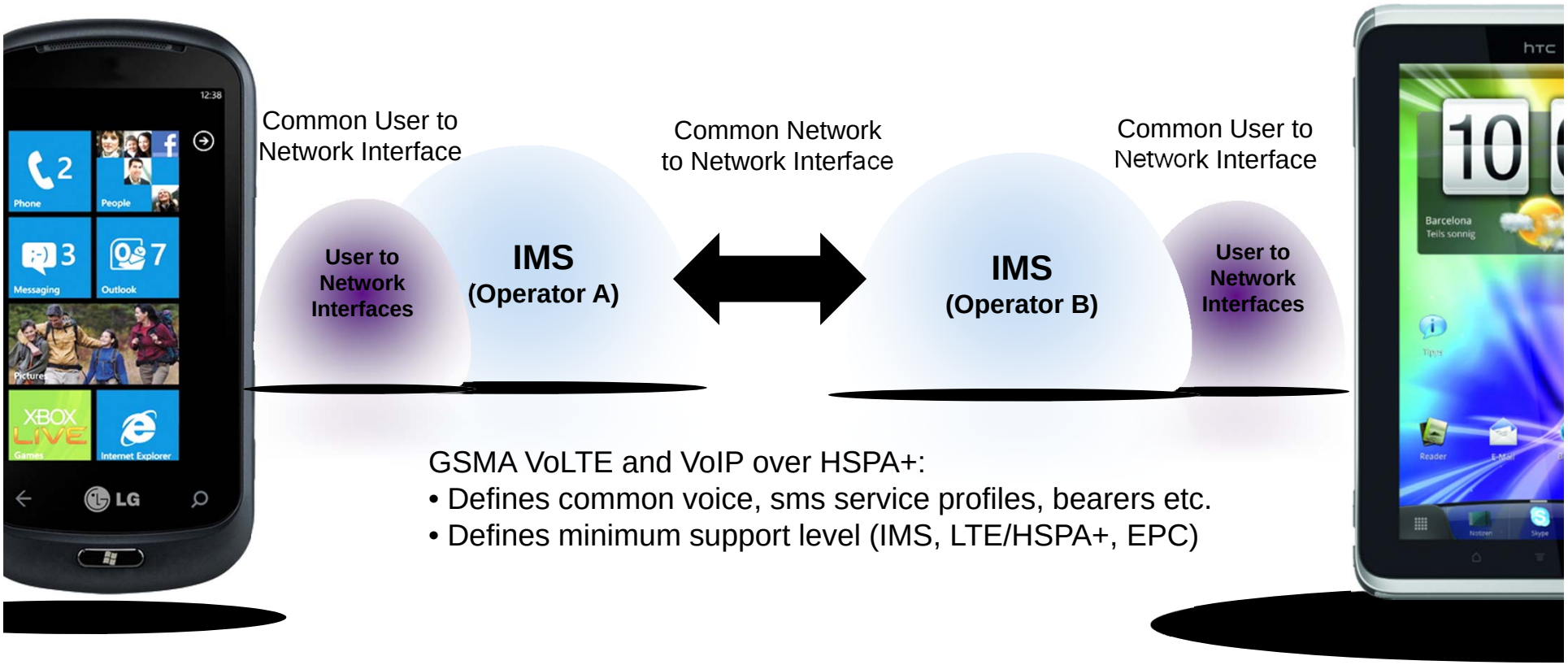
Handover to WCDMA/GSM circuit switched voice Through Single Radio-VCC

VoLTE with VoHSPA+ Ensures Consistent and Seamless Rich Voice Experience

Based on Rich Communication Suite (RCS), an industry effort leveraging IMS to providing mobile phone services.

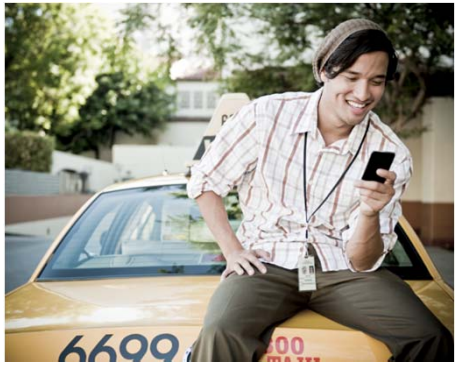
VoLTE and HSPA+ VoIP Profiles Defined

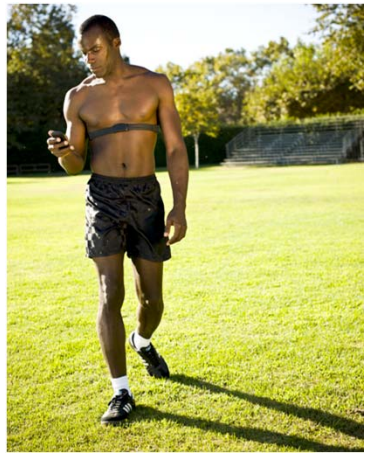
TO ENABLE INTEROPERABILITY, SCALE AND ROAMING



VoLTE ROAMING AND INTERCONNECT EXPECTED 2014 AND BEYOND

VoLTE: GSMA PRD IR.92 – “IMS Profile for Voice and SMS” completed in 2011, HSPA+ profile defined in IR.58 completed early 2012. Additional PRD on IMS roaming defined.



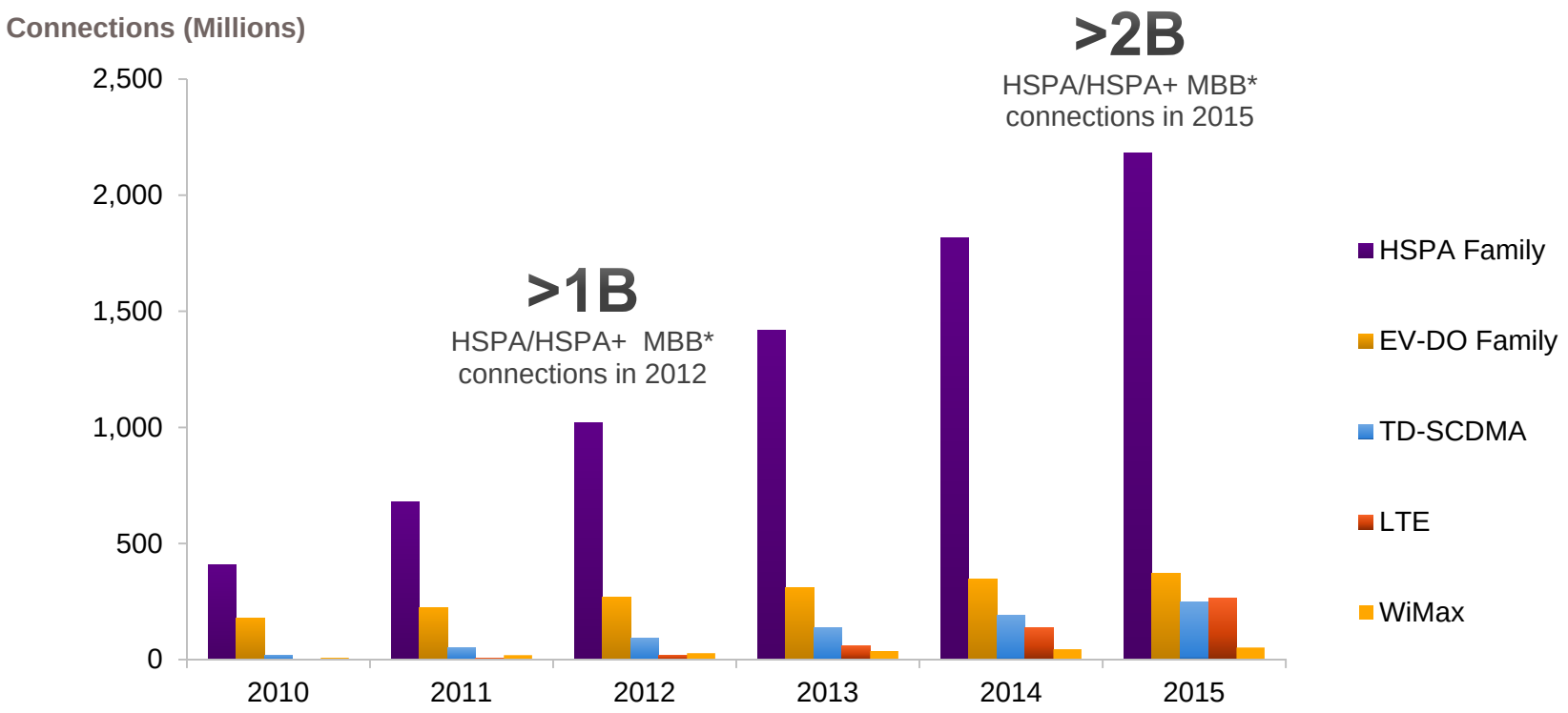


Circuit Switched Voice Evolution

Make Voice More Efficient to Support More Data

2 Billion HSPA/HSPA+ Subscribers in 2015 Will Be Using WCDMA voice

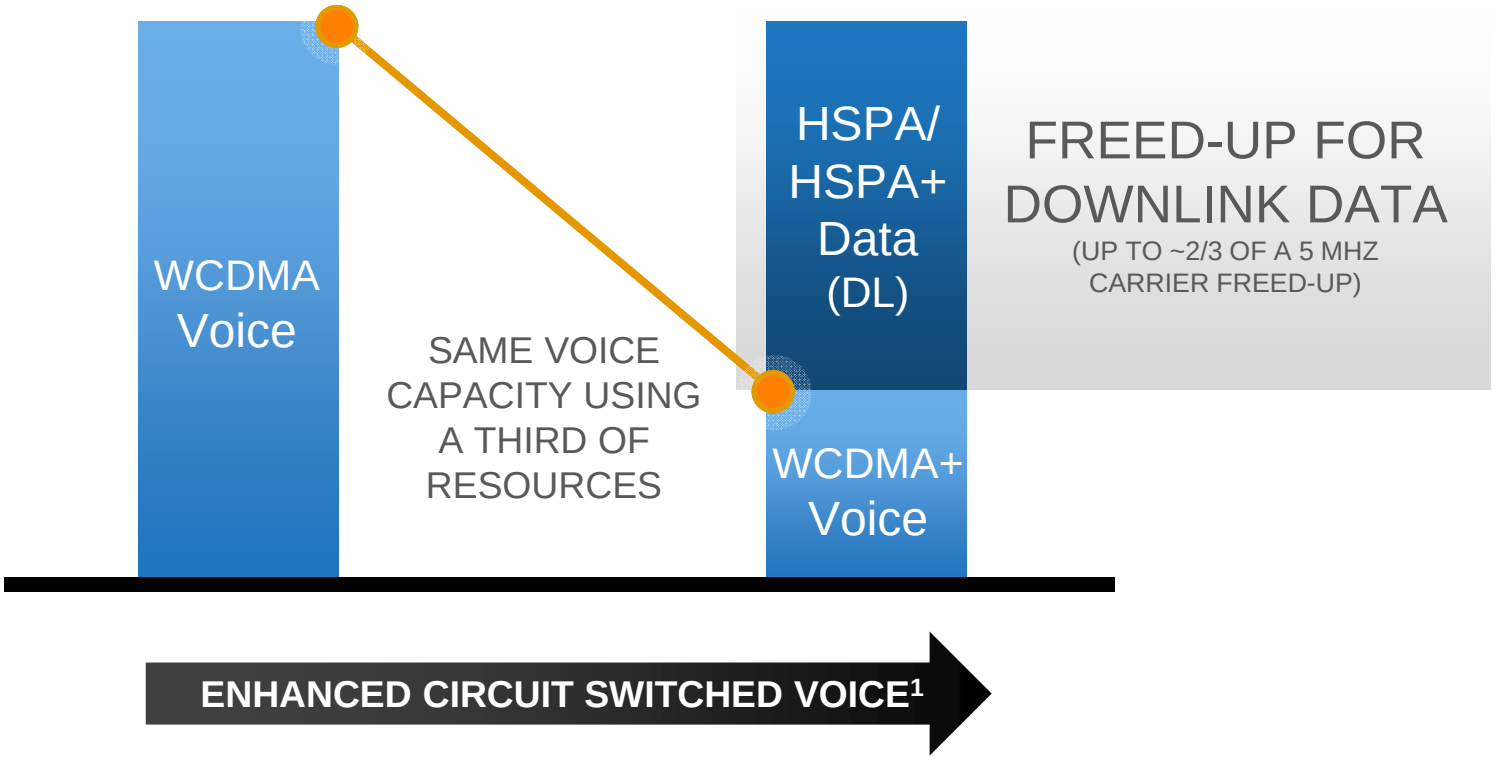
HSPA/HSPA+ relies on WCDMA for voice



Source: HSPA, EV-DO ,TD-SCDMA and LTE subs – Wireless Intelligence (Oct '11) and WiMax - ABI (Aug '11)

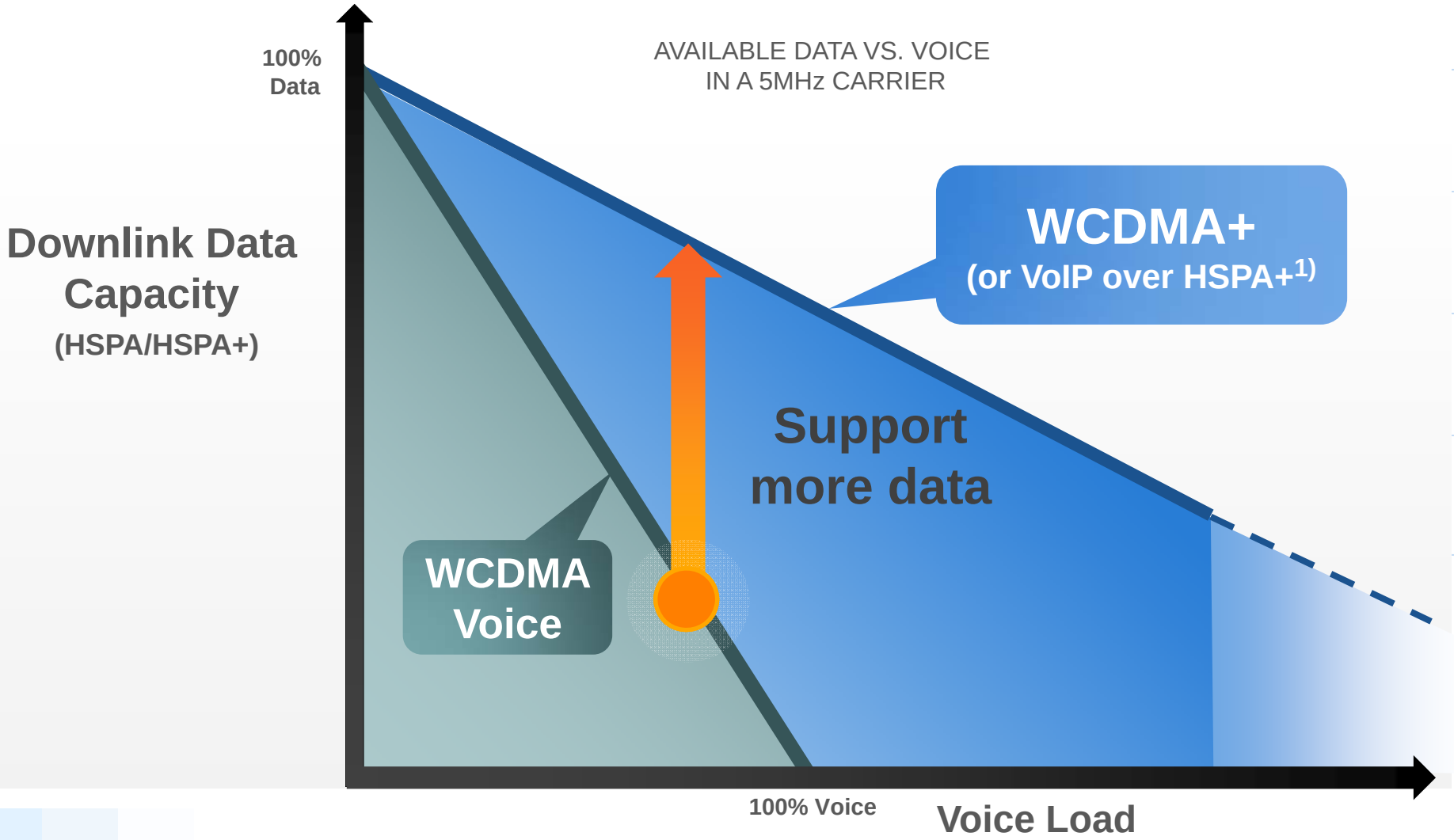
WCDMA+: More Efficient Voice to Support More Data

Triples Voice Spectral Efficiency to Free Up ~2/3 of a Carrier for Data



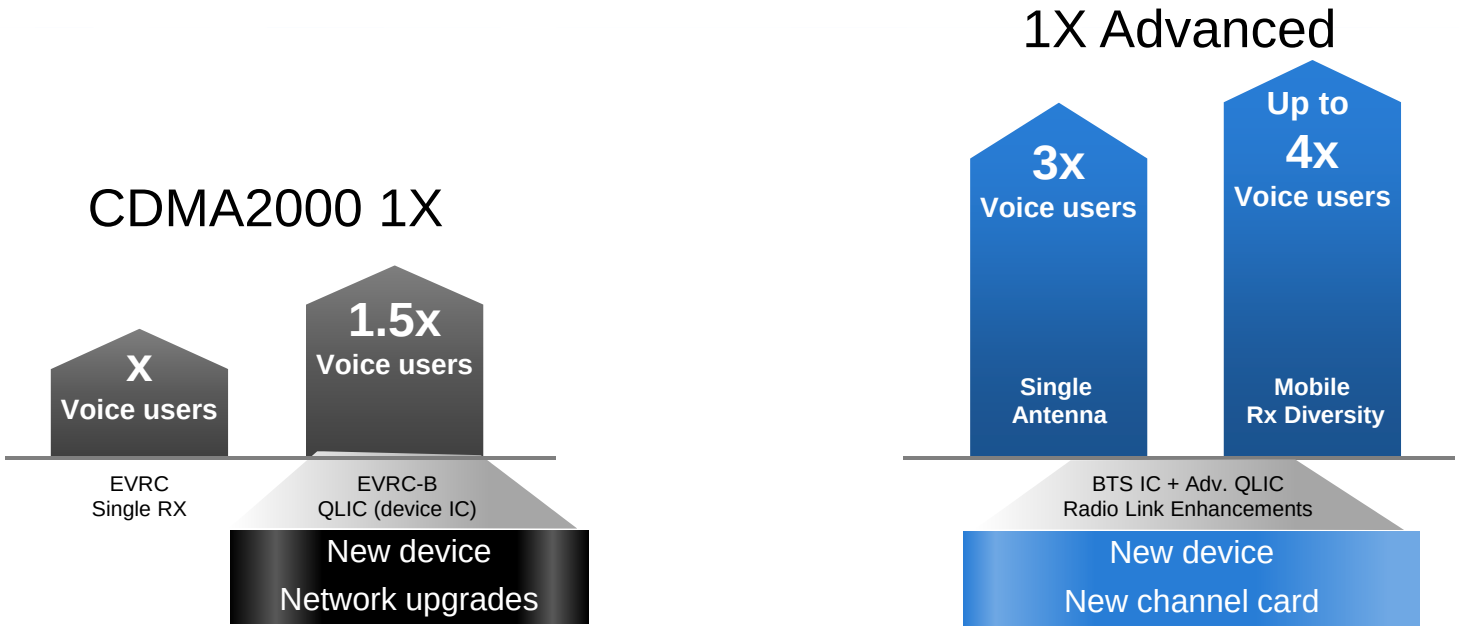
[1]Improvements such as overhead optimizations, early termination and new codec (EVS) 5.9kbps. Single receive antenna assumed. WCDMA+ enhancements targeted for 3GPP R12.

More Data Capacity at All Voice Loads

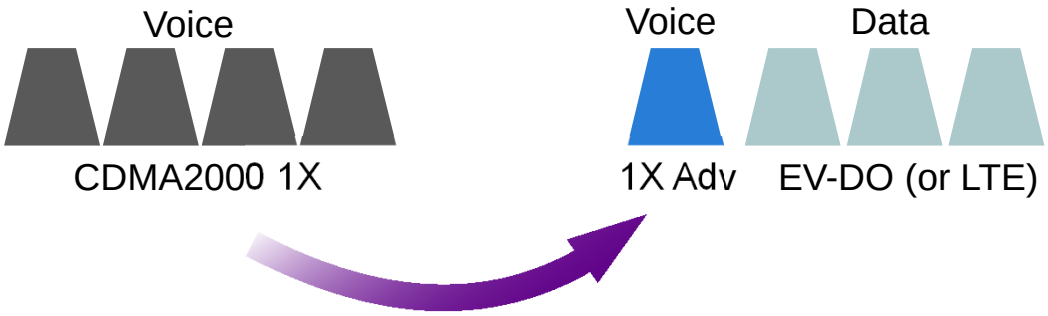


[1]For optimized VoIP over HSPA+ with features such as ROHC header compression, DTX, DRX and advanced receivers, over–the-top (OTT) VoIP less efficient than WCDMA voice

1X Advanced Frees Up Spectrum for Data



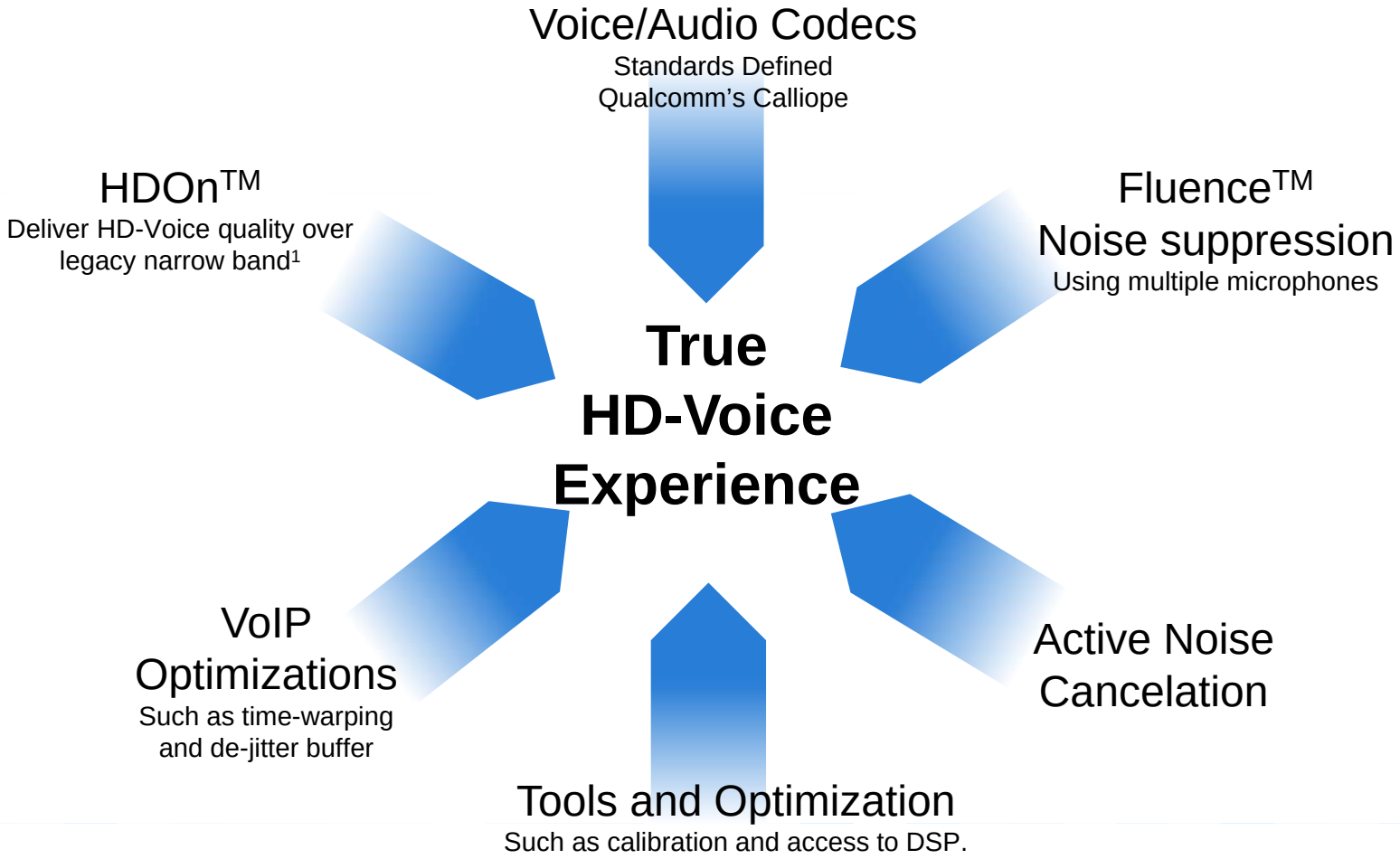
Same Voice Capacity in ~¼ of the Spectrum



Voice Quality Evolution

Qualcomm Provides Leading Voice Quality Technologies for 3G Circuit Switched Voice , IMS VoIP and OTT VoIP

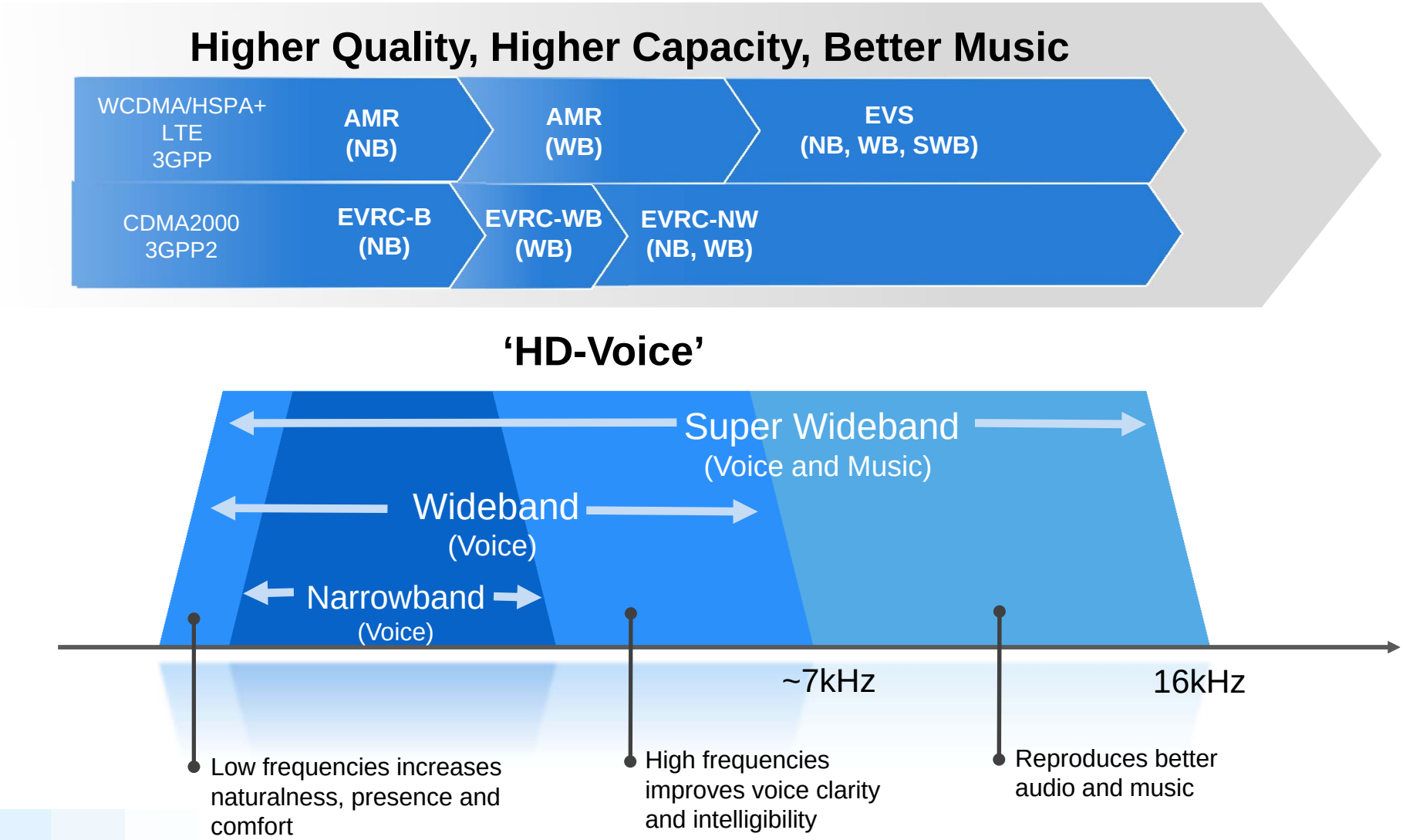
Qualcomm Enables The Best Voice Experience



HD-Voice Across 3G Voice, IMS VoIP or Over-The-Top VoIP

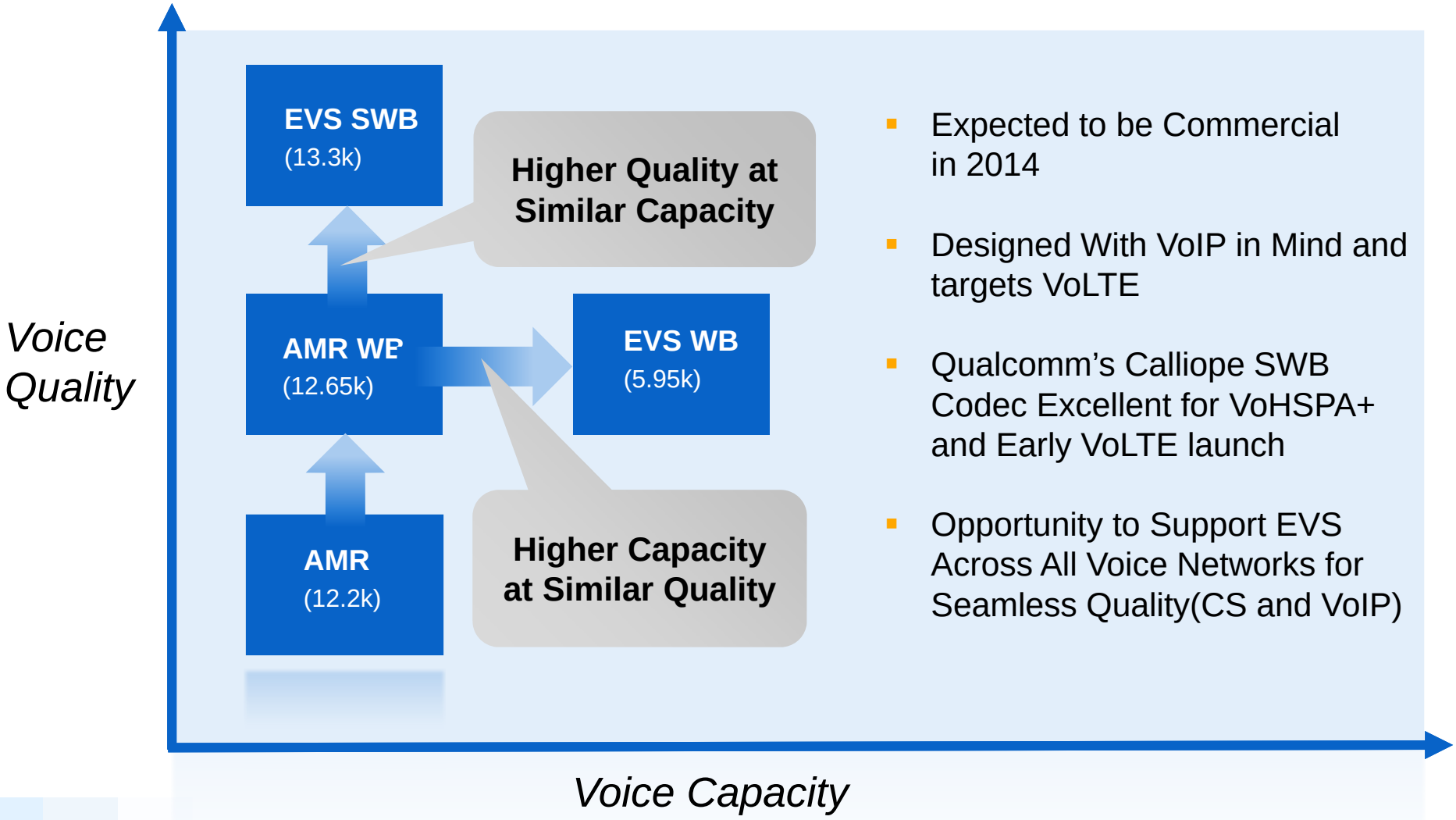
[1]Such as "HDOn-eAMR" which transmits true WB compressed voice quality over a NB channel. Qualcomm's 'Widevoice' can also artificially create WB voice quality at the handset

Continuously Enhanced Codecs to Improve Voice and Audio



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

Enhanced Voice Service (EVS) Codecs: Better Quality, Capacity or Both



- Expected to be Commercial in 2014
- Designed With VoIP in Mind and targets VoLTE
- Qualcomm's Calliope SWB Codec Excellent for VoHSPA+ and Early VoLTE launch
- 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. Calliope: 12kbps SWB VoIP optimized codec

Summary: Evolving Voice for More Data, Better Quality, Richer Experience

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