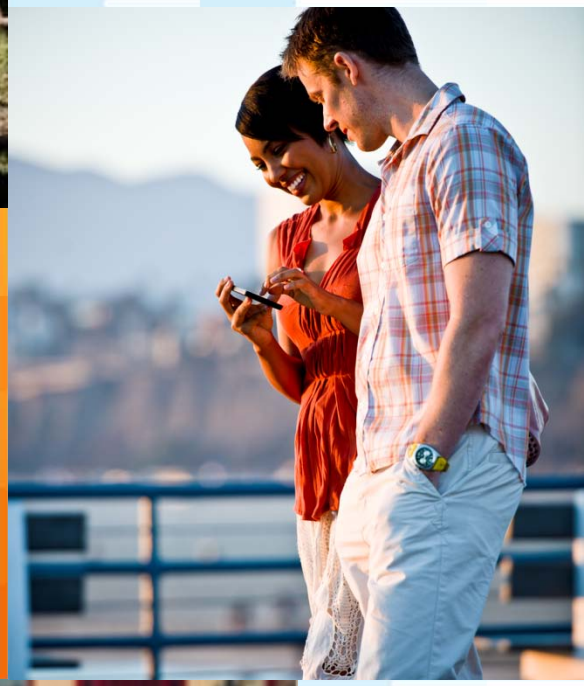


What is next for CDMA?

October 2011

What is next for CDMA?

CDMA&EV-DO

Rev. B is Commercial
Growing momentum with many operator and vendor commitments

1X Advanced—4x Voice Capacity
Continuing industry's voice performance leadership

DO Advanced—Maximizing Performance of EV-DO
Further increasing capacity and user experience where and when needed using existing assets

LTE to Complement 3G
Operators with access to new and wider spectrum plan to augment their networks with LTE —relying on 1X for voice services and EV-DO for ubiquitous data coverage

Expanding EV-DO Ecosystem

>534M
CDMA 2000 SUBSCRIPTIONS

~ 209 Million	~ 88 Million
EV-DO	Rev. A

>325
CDMA OPERATORS

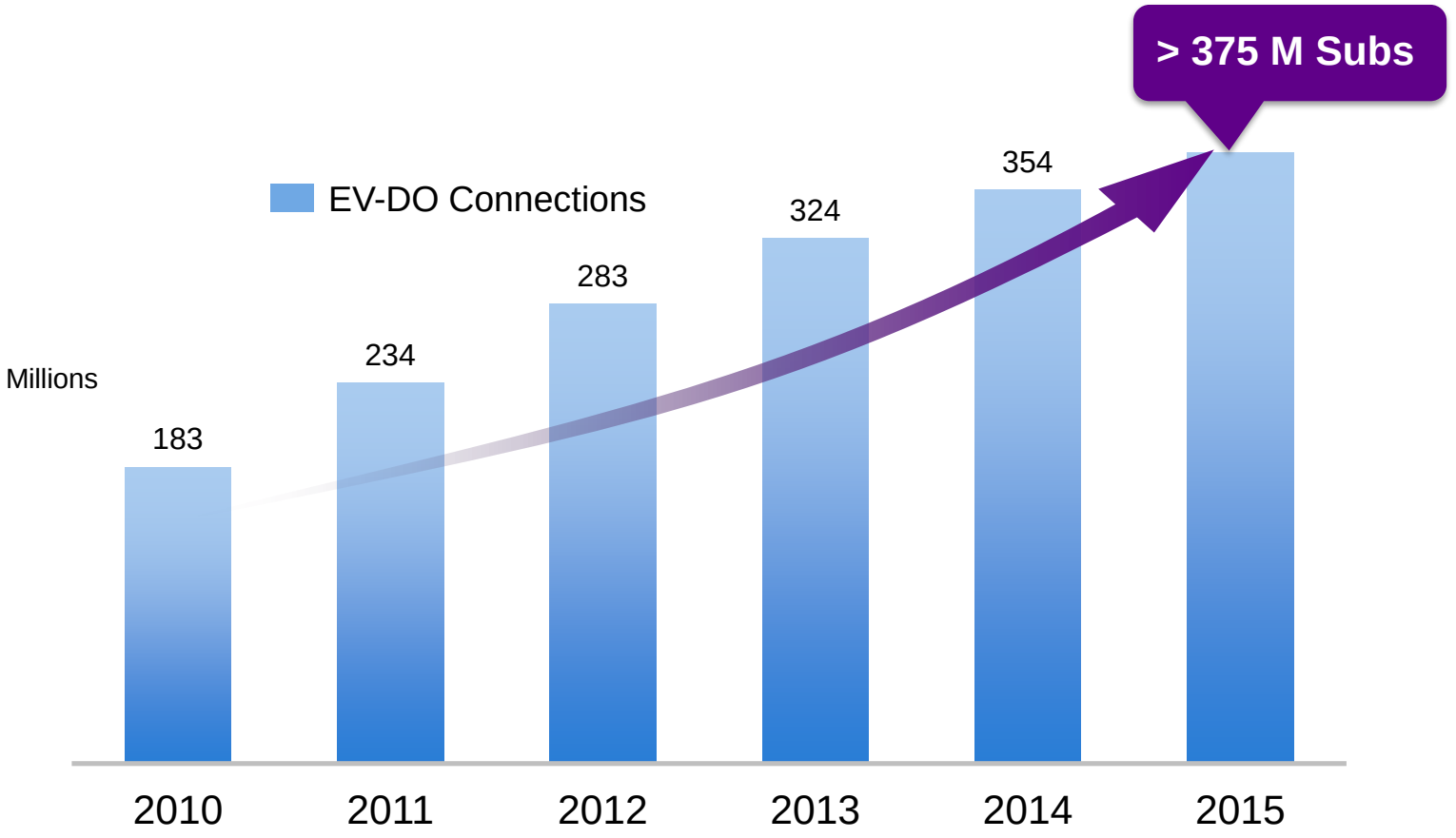
~ 121	~123	7
EV-DO	Rev. A	Rev. B

>2,733
CDMA 2000 DEVICES

~ 612	~423
EV-DO	Rev. A

Sources: Subscriber Information : Wireless Intelligence estimates as of Jul 18th, 2011 for quarter ending Jun 30th , 2011, not including WLL; Operators, devices, vendors related information : CDG. Jul 2011

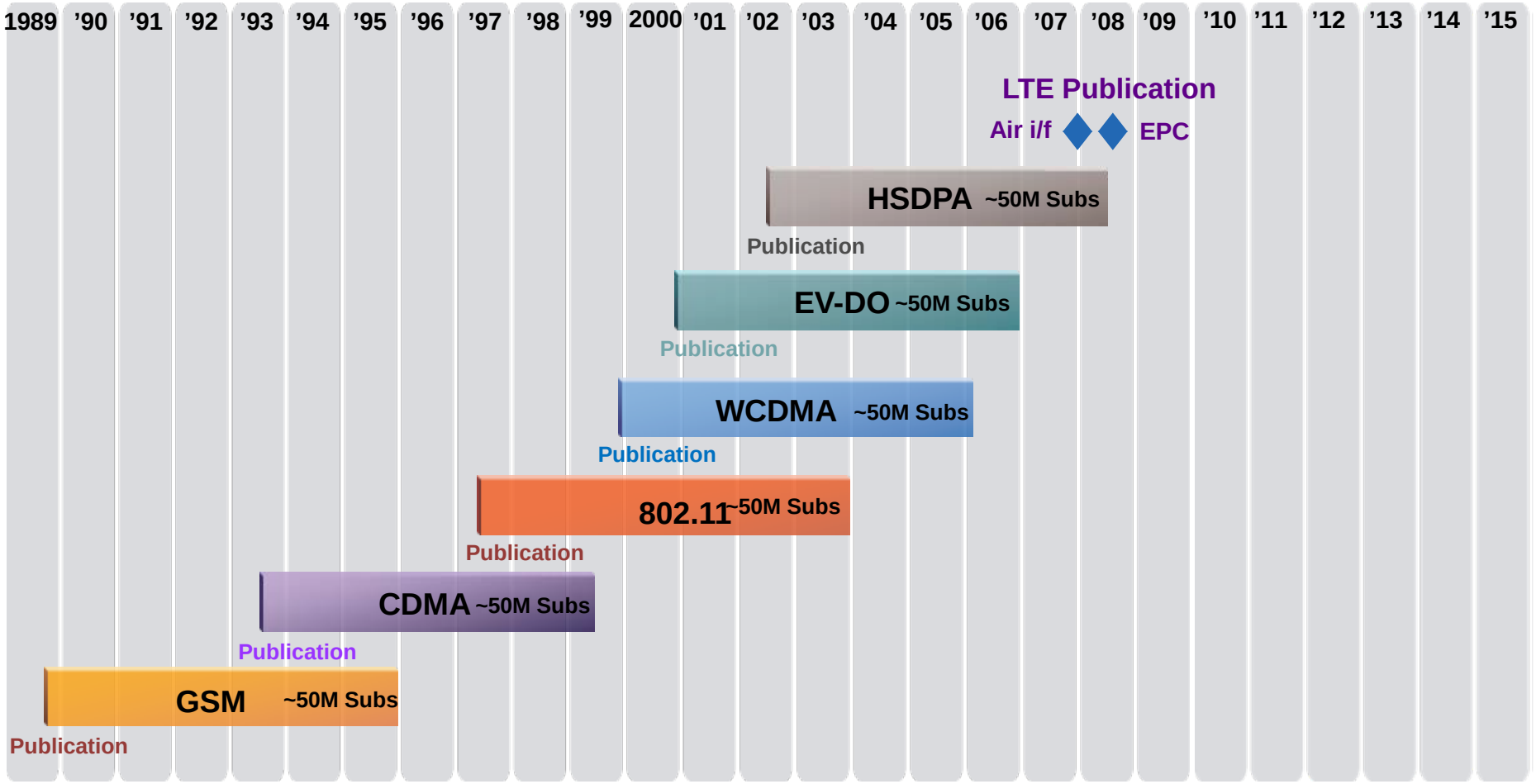
EV-DO's Strong Growth Continues



Source: Wireless Intelligence estimates as of July 18, 2011 for the quarter ending June 30, 2011 ; not including WLL connections

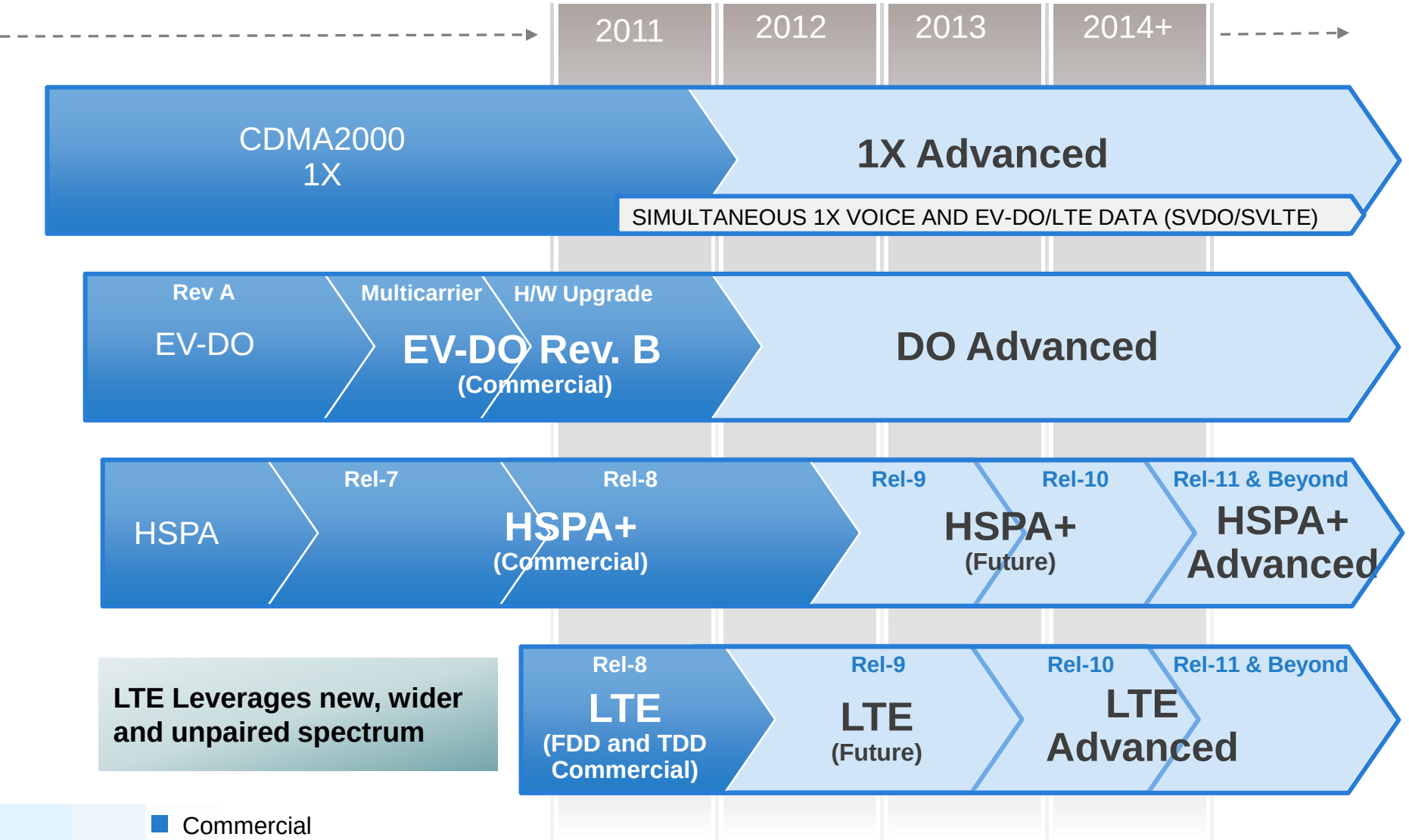
~6-7 Years to Reach 50M Subscribers

for Successful Wireless Standards



Sources: CDG, Qualcomm, Ericsson, IEEE, 3GPP2 and GSMA. The "first reference publication" date used is the earliest publication date where Qualcomm feels that a set of reasonably complete and consistent specifications were available. Note that the LTE air interface publication date shown is 12/2007, but the core network (EPC) was published mid 2008. A stable ASN.1 code is required for commercial implementation of the standard (LTE R8 ASN.1 was frozen in March 2009).

The 3G and 4G Evolution, But What is 4G?



Note: Estimated commercial dates.

Created 09/19/2011

EV-DO Rev. B is Growing

GROWING OPERATOR COMMITMENT

10 LAUNCHES

10 COMMITMENTS

DEVICES ACROSS ALL SEGMENTS

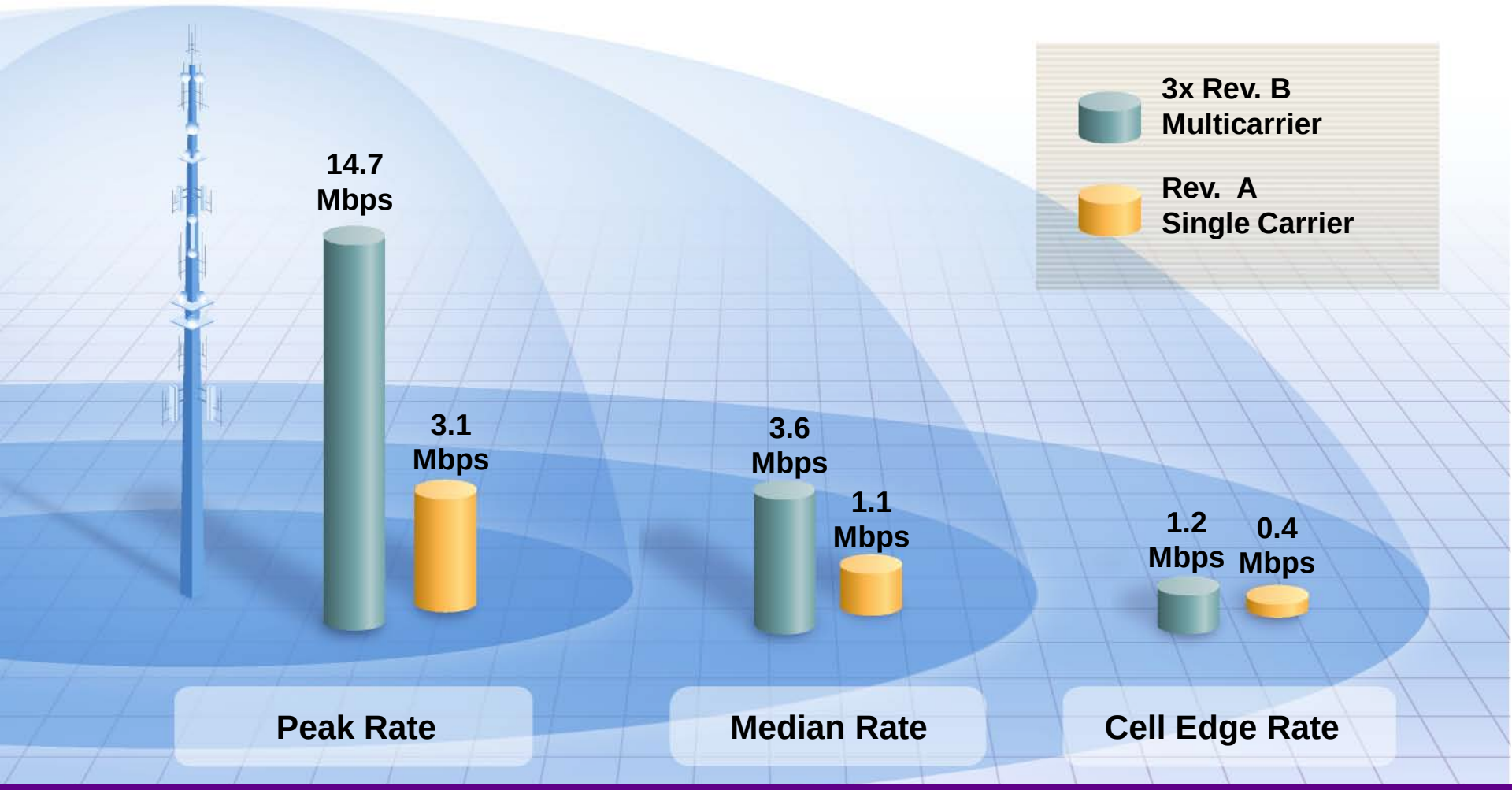
~30 DEVICES

~15 VENDORS

ALL MAJOR EV-DO INFRA VENDORS SUPPORT REV. B

Source: CDG, Oct 2011

Rev. B's Multicarrier Enhances Broadband Experience—Triples Data Rates to All Users

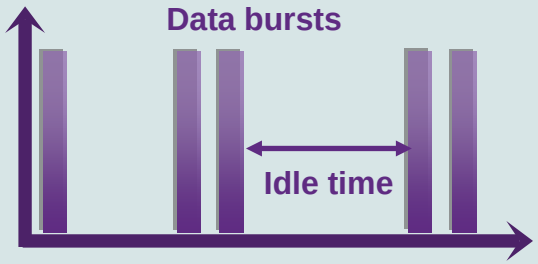


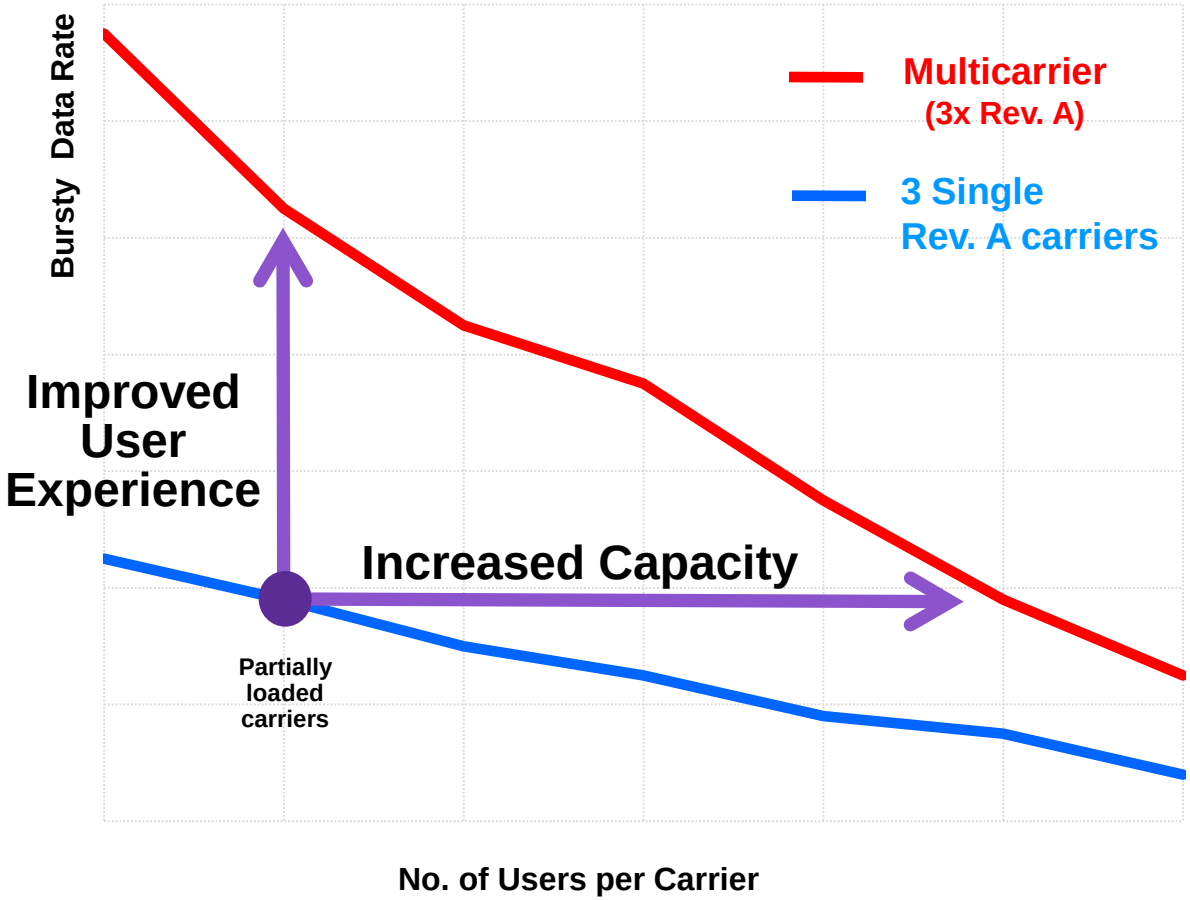
Cost-effective software upgrade to multicarrier

Source: Peak rates are as defined in standards. The median and cell edge rates are based on Qualcomm simulations, using mixed channel model with Rev. B Phase-II devices supporting 64 QAM

Rev. B's Multicarrier More Than Doubles Capacity for Bursty Applications

Bursty Data Application (e.g. browsing)

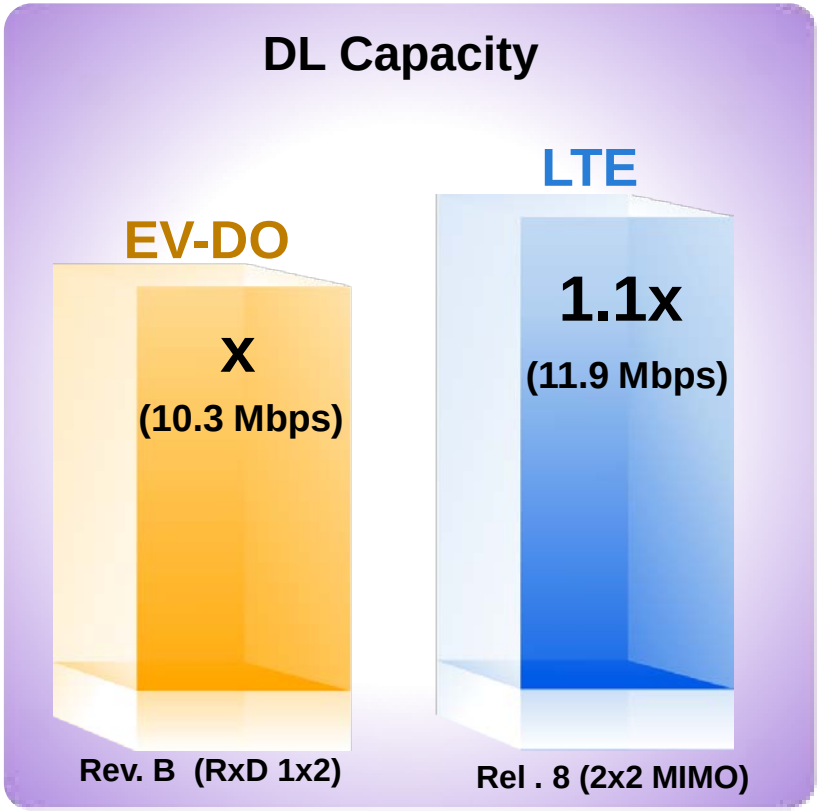


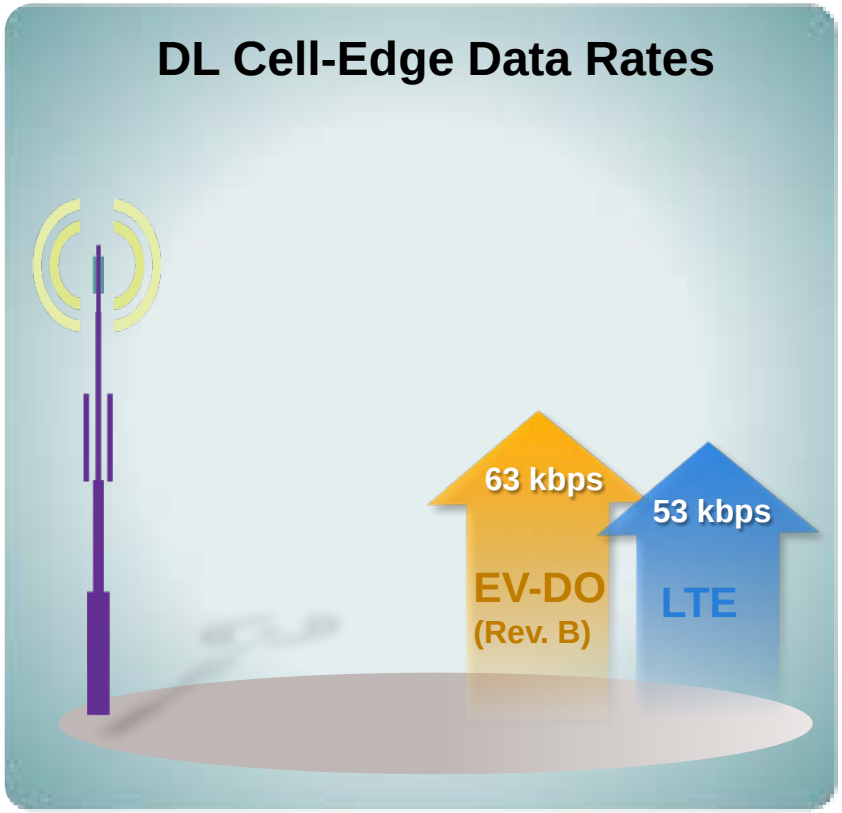


Note: Based on lab measurements using realistic traffic models from the web. The average burst download time (over the air) is reduced ~ 66%. The capacity gain depends on the sector load which in this case is typical for a EV-DO Rev. A system.

Similar Rev. B and LTE Cell Edge Performance using Fair Comparison

When using same amount of spectrum

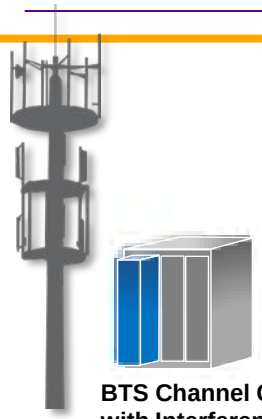




Cell edge performance can be traded for even higher cell capacity at the expense of fairness

Source: Qualcomm Simulations for 10 MHz FDD: 3GPP2 methodology - 2km site-to-site dist., embedded sector, mixed channel, full buffer traffic, proportional-fair scheduler; 7 carrier considered for Rev. B . Cell-edge rates are the worst 5 percentile of the over all data rate distribution in the cell, 64 QAM not considered for Rev. B

Even Higher Capacity and Data Rates with CSM6850 Upgrade



BTS Channel Card upgrade with Interference Cancellation.

No device impact

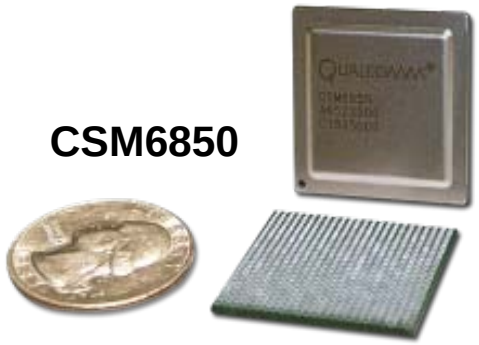
Up to 14.7 Mbps forward link peak data rates[1]

~ 65% higher uplink data capacity[2]

~ 45% higher VoIP capacity[3]

- Cost-Effective – Supports 4 carriers on a single card
- Provides gains for multicarrier or single carrier Rev. A/B networks
- First commercial chipset to support total interference cancellation[2]
  - Traffic, Overhead and Pilot IC

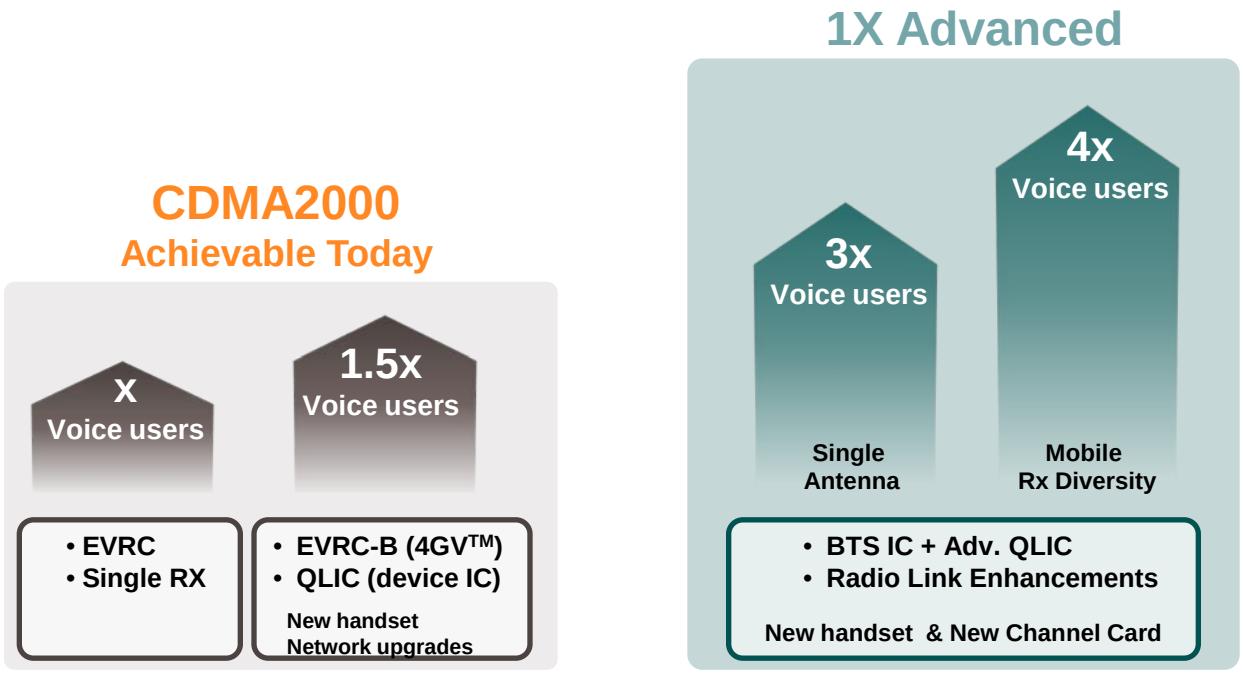
CSM6850



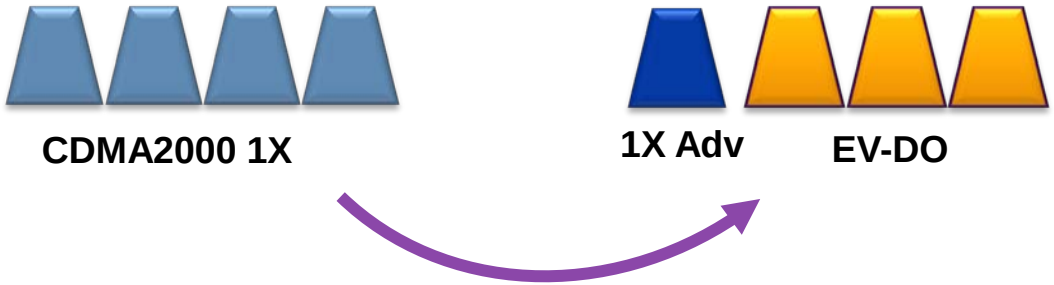
CSM6850 is Commercial

[1]Peak rate increased through Higher order modulation (64QAM). [2]Through total Interference Cancellation, also benefits existing devices, CSM6800 with Pilot IC is already commercial [2,3] Gain compared to CSM6800 without IC.

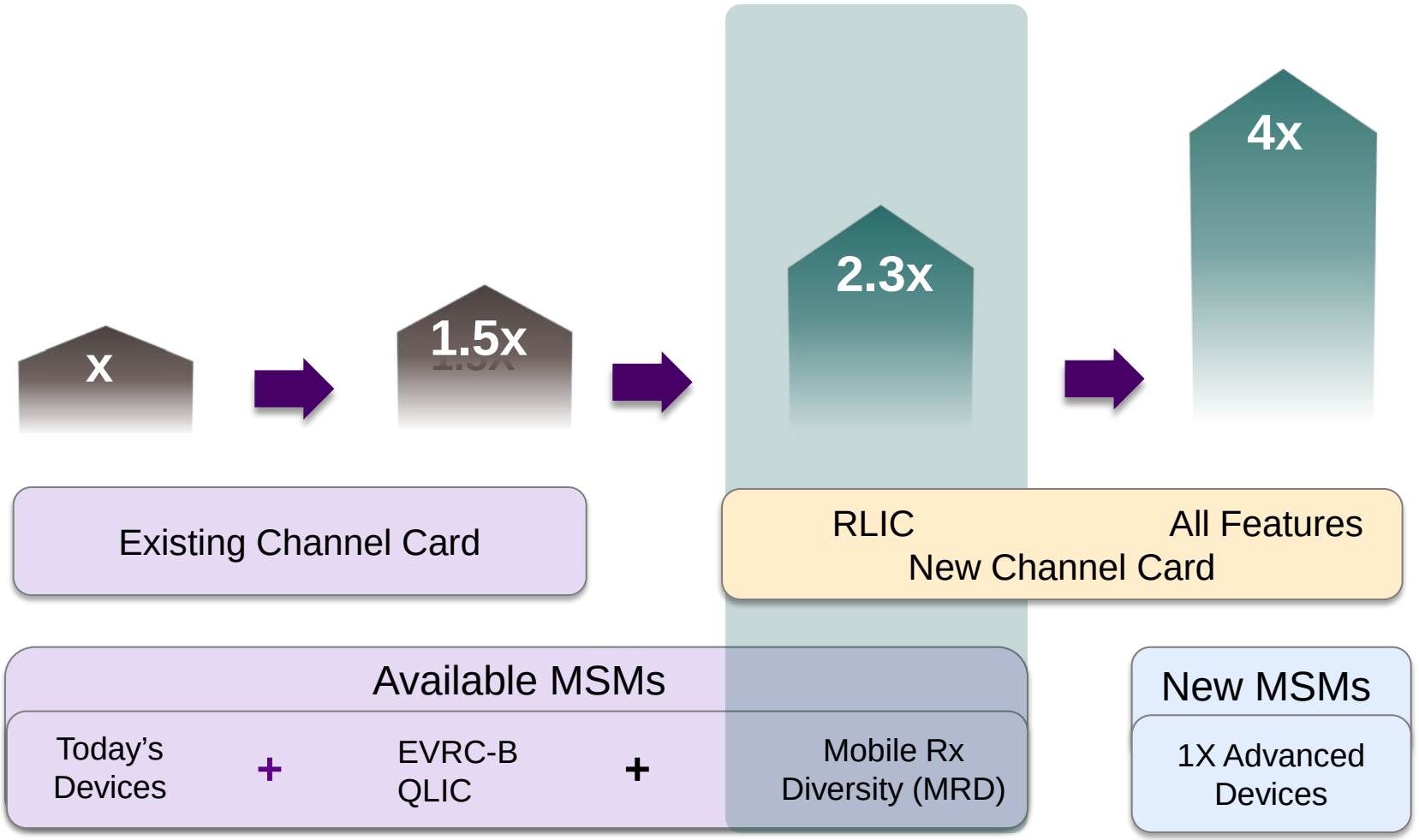
1X Advanced: Up to 4x Increase Compared to CDMA2000's Excellent Capacity



- Freed-up spectrum can be used for EV-DO data



1X Advanced: Early Time-to-Market by Leveraging Available MSMs with MRD



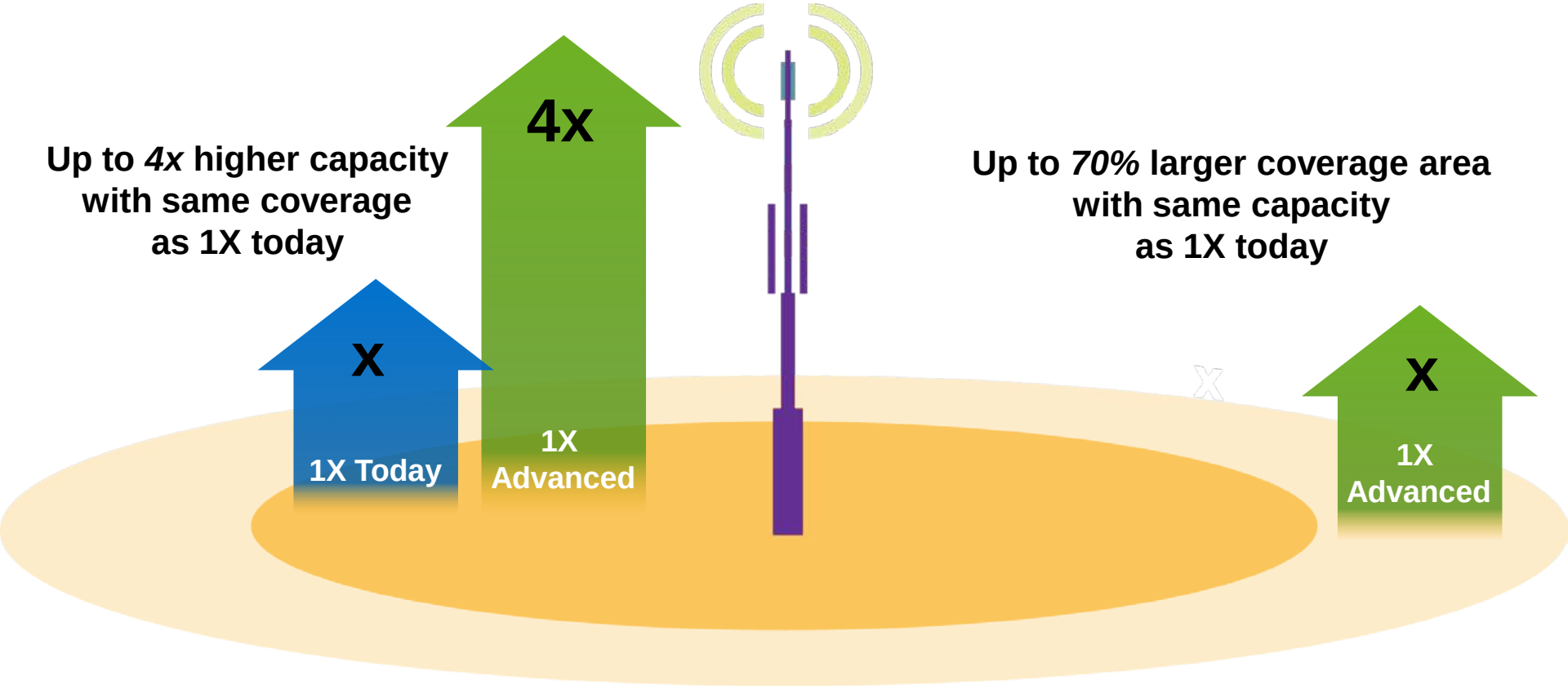
Relative capacity/sector (1.25 MHz)
RLIC – Reverse Link Interference Cancellation

1X Advanced: Simple and Cost-Effective Channel Card Upgrade

- Leverages existing assets
- Simple channel card upgrade
- Standards published in June 2009

- Interference Cancellation
- Radio Link Enhancements
- Mobile Receive Diversity

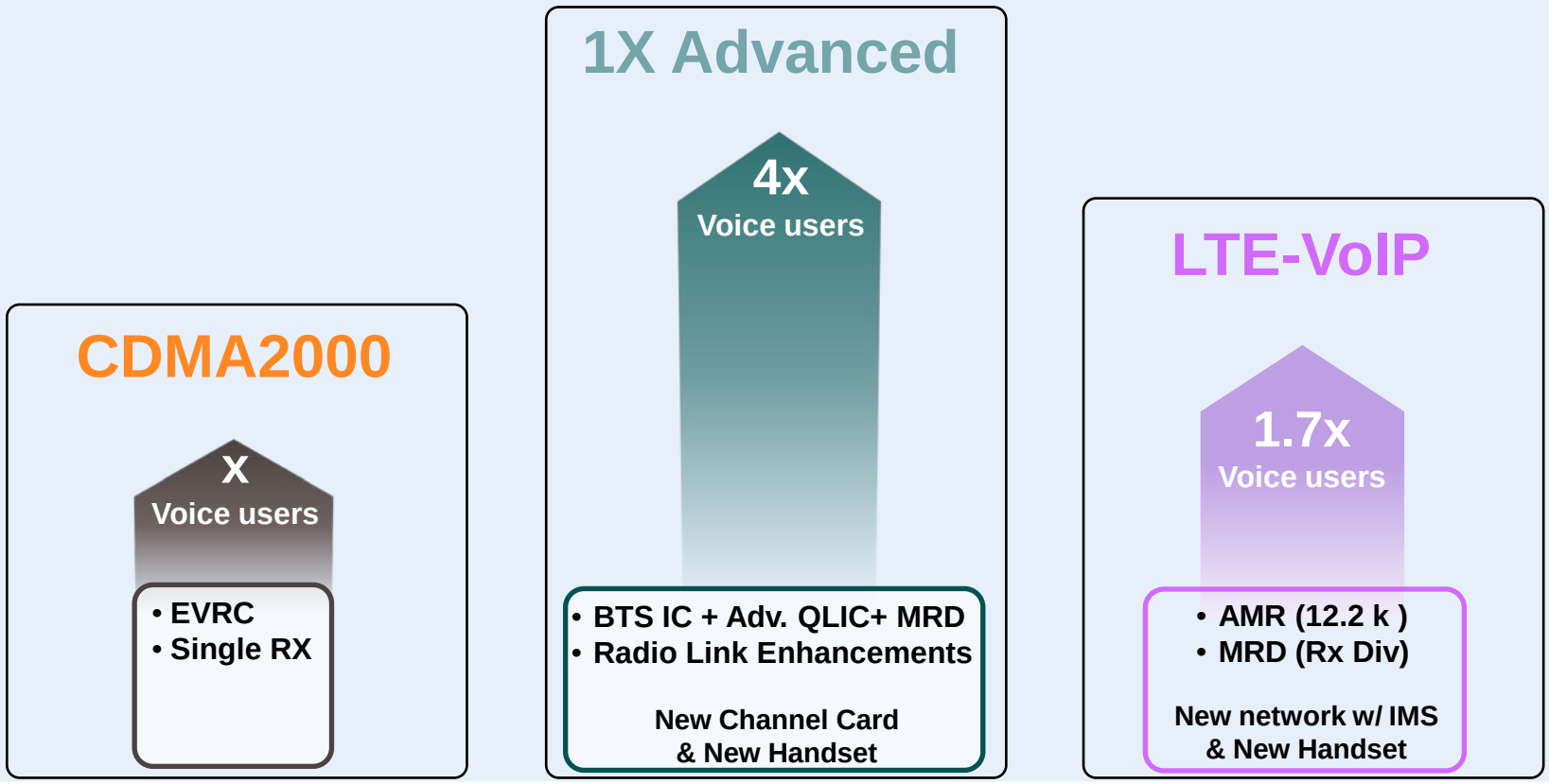
1X Advanced: Up to 70% Coverage Increase



Capacity and coverage tradeoff

Notes: Based on Qualcomm simulations, coverage is defined as the maximum area with less than 1% of the users in outage; Assumptions : 3GPP2 simulation frame work, embedded sector, with all the 1X Advanced features considered including MRD, FL and RL Interference Cancellation, new RC

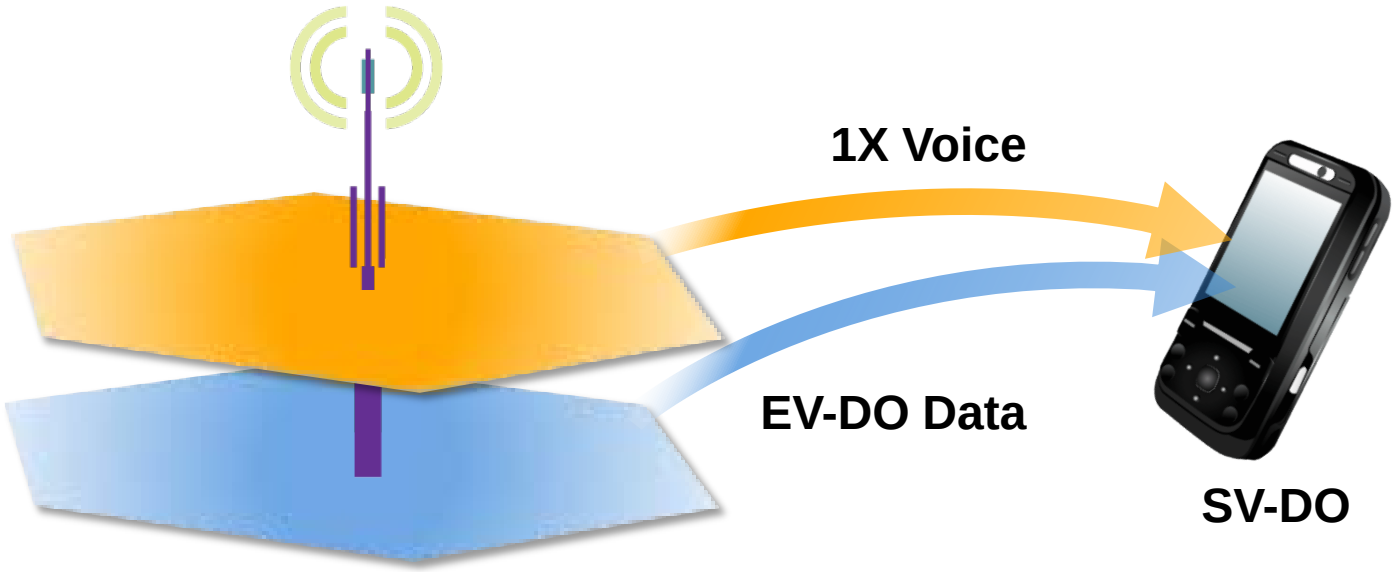
1X Advanced: Continuing the Voice Capacity Leadership



- Larger1X Advanced UL coverage because of soft-handoff and continuous UL

Notes: Source – Qualcomm Simulations. The capacity comparison is based on 10 MHz spectrum using 3GPP2 simulation framework with embedded sectors, 7 carriers considered for 1X and 1X Advanced .

Simultaneous 1X Voice and EV-DO Data



- Handset feature with no network impact
- Independent of the air link standard
  - Voice using 1X or 1X Advanced
  - EV-DO Rev. A or Rev. B
- Commercial in 2011

1X Advanced and Rev. B: Strong Chipset Support

SMARTPHONES/ TABLETS

- MSM 8660 — Rev. B/1X Adv HSPA+
- MSM 8960 — Rev. B/1X Adv LTE/DC-HSPA+
- QSD 8650 — Rev. B/HSPA

FEATURE PHONES

- QSC 6695 — Rev. B/1XAdv HSPA+
- QSC 6195 — Rev. B/ 1X Adv

MODEMS AND DATA CARDS/DONGELS/ HOTSPOTS

- MDM 6600 — Rev. B/ HSPA+
- MDM 9615 — Rev. B/ LTE/DC-HSPA+

IMPROVING PERFORMANCE OF EXISTING INFRASTRUCTURE

Macro BTS

- CSM 6850 Rev. B
- CSM 6800 Rev. B

DO Advanced (S/W Upgrade)

- CSM 8700 1X Advanced

1X Advanced

ENABLING FEMTO SOLUTIONS

Incorporating UltraSON™ Interference Management Techniques

- FSM 98xx Baseband

Pico/Femto

DO Advanced: New Dimension of Enhancements

Software Upgrade

Increased network capacity and data rates by exploiting uneven network loading

(Network Load Balancing, Distributed Network Scheduler, Adaptive Frequency Reuse, Single Carrier Multi-Link, Smart Carrier Management)

Software Upgrade

Increased connection-capacity by more efficient use of existing resources

(Parameter Optimization, Implementation Enhancements)

Infra/Standards Independent

Enhanced Equalizer
- Improved performance for uneven and bursty traffic

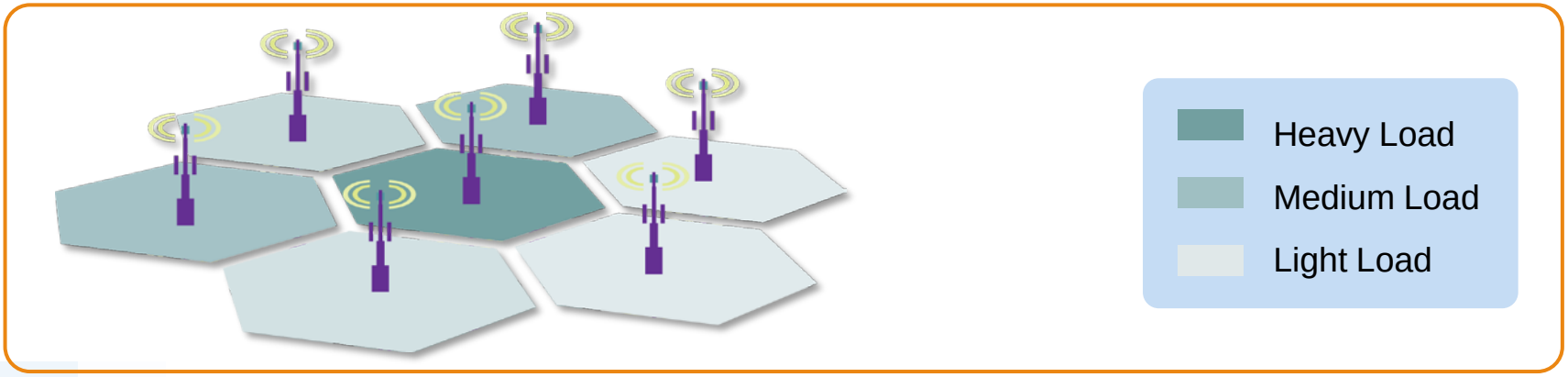
Mobile Tx Diversity
- Higher UL capacity and data rates

Software upgrade that benefits existing and new devices

Smart Networks Exploit Typically Unevenly Loaded Networks

Network loading continuously changes with time and location

Fully loaded sectors are usually surrounded by lightly loaded neighbors

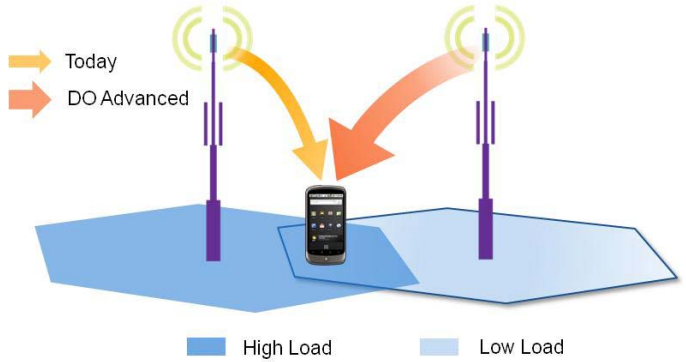


Smart Networks Increase Network Capacity and User Experience, Where & When Needed

Can double network capacity and cell-edge data rates

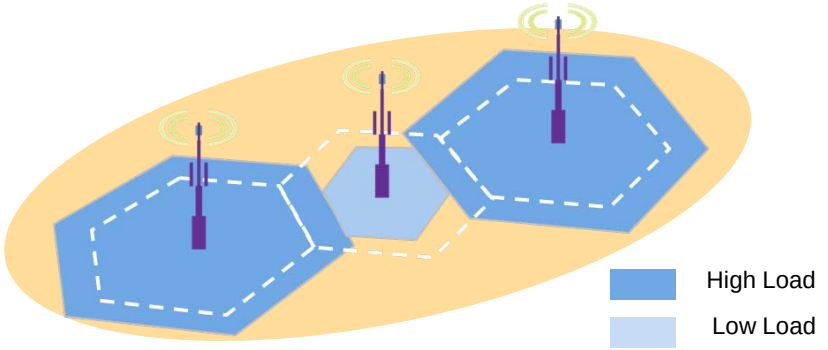
Network Load Balancing

Utilizing unused capacity of lightly loaded neighbors



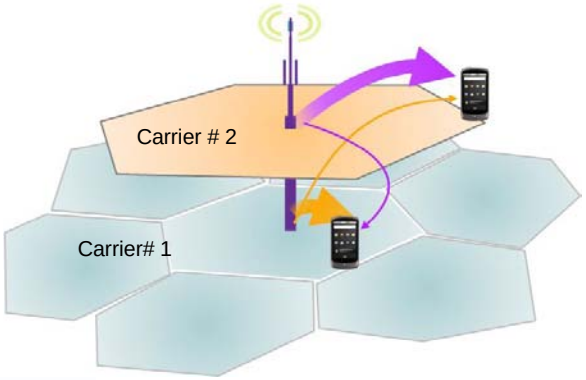
Adaptive Frequency Reuse*

Reducing interference by lowering tx power to match load



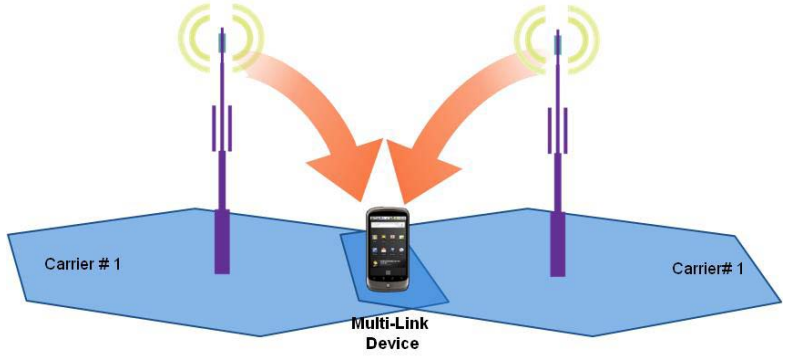
Distributed Network Scheduler

Users preferentially served by carriers that maximize capacity



Single Carrier Multi-Link

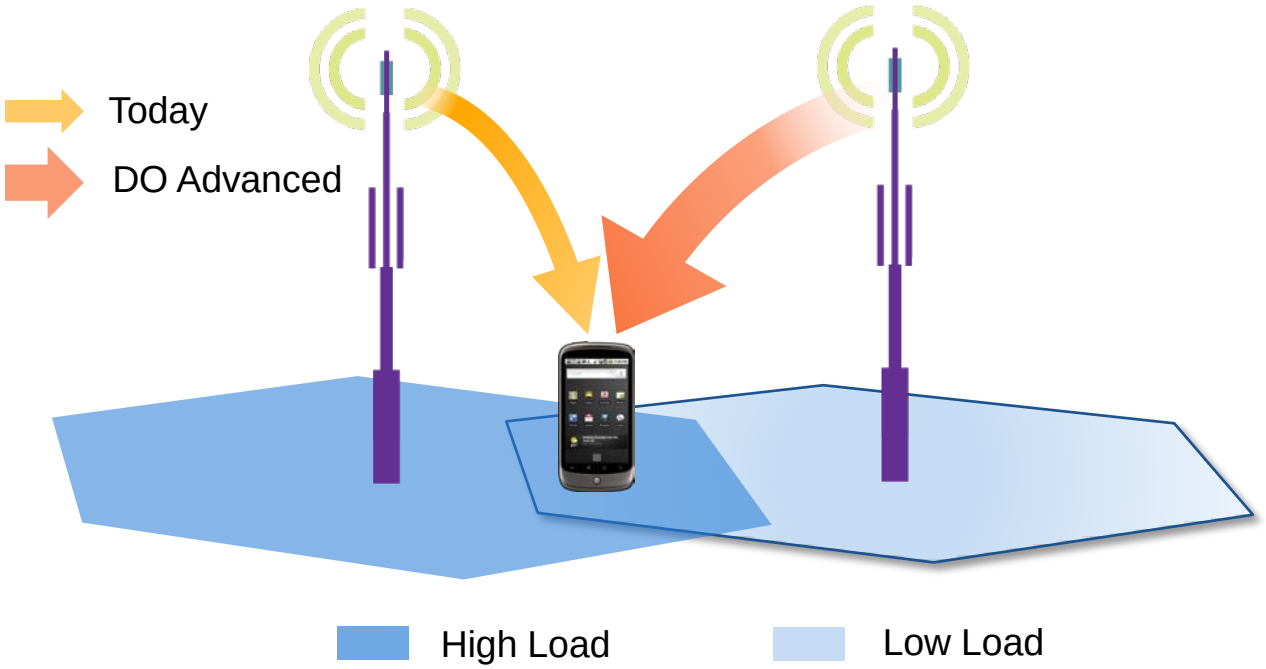
Leveraging multicarrier devices in single-carrier networks



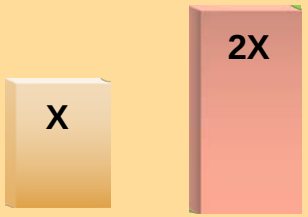
Improvement depends on deployment, demand distribution and implementation. Apart from the above, Smart Carrier Management is also another Smart Network technique; *Also known as *Demand Matched Configuration*

Network Load Balancing Utilizes Unused Capacity of Lightly Loaded Neighbors

Users in highly loaded cells offloaded to neighbors, when needed



Example:
User data rate



Today
(Connected to loaded cell)

DO Advanced
(Offloaded to neighbor cell)

Loading assumed:
Loaded cell- 80%; Neighbor cell- 20%

Improved data rates for both offloaded users and users in loaded cell

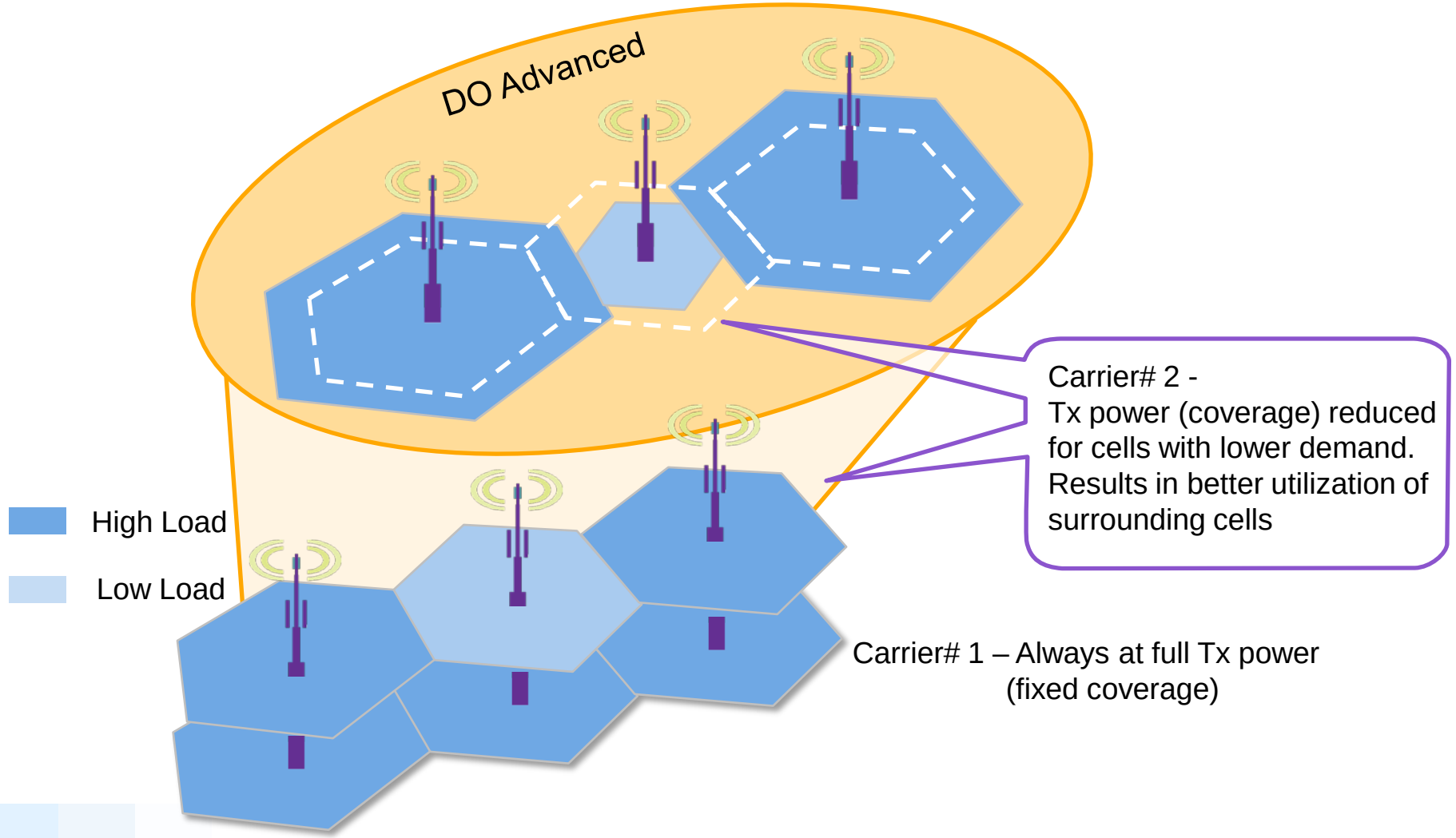
Higher overall network capacity

Reduced backhaul bottle-necks

Note: Performance improvement depends on deployment, demand distribution and implementation.

Adaptive Frequency Reuse Reduces Interference to Increase Capacity

By adjusting transmit power of lightly loaded cells



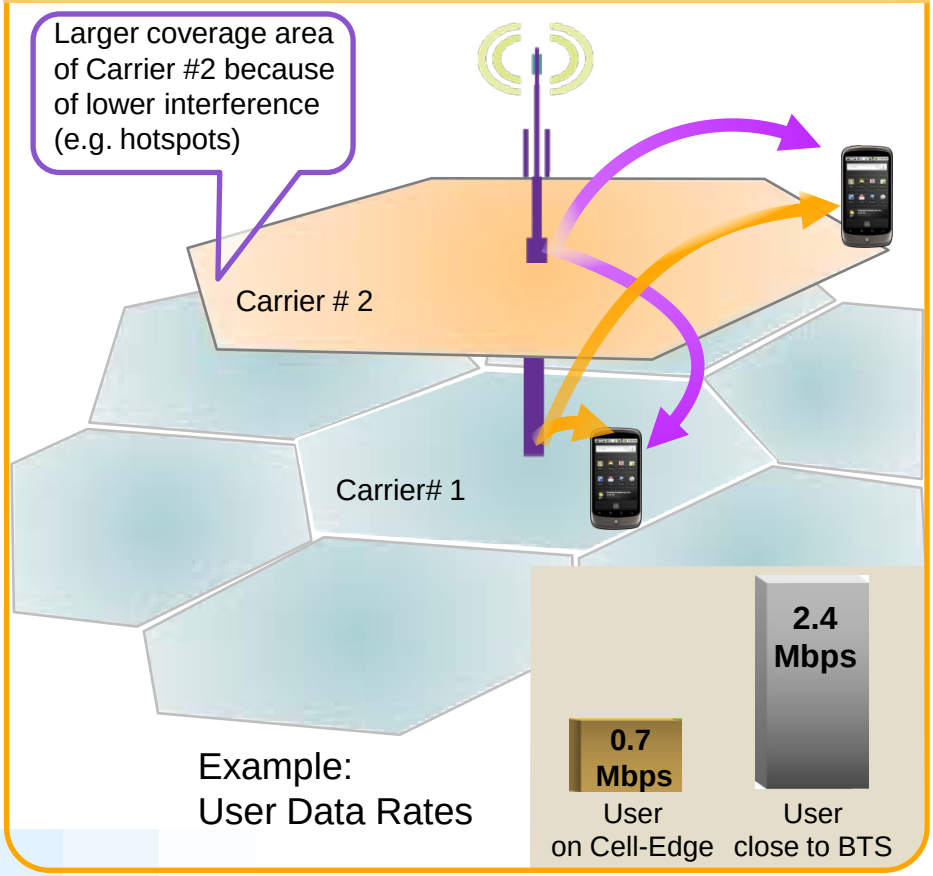
Note: This feature is also known as *Demand Matched Configuration*

Distributed Network Scheduler Maximizes Capacity by Prioritizing Carriers

Increased overall capacity and cell-edge data rates, especially in hotspots

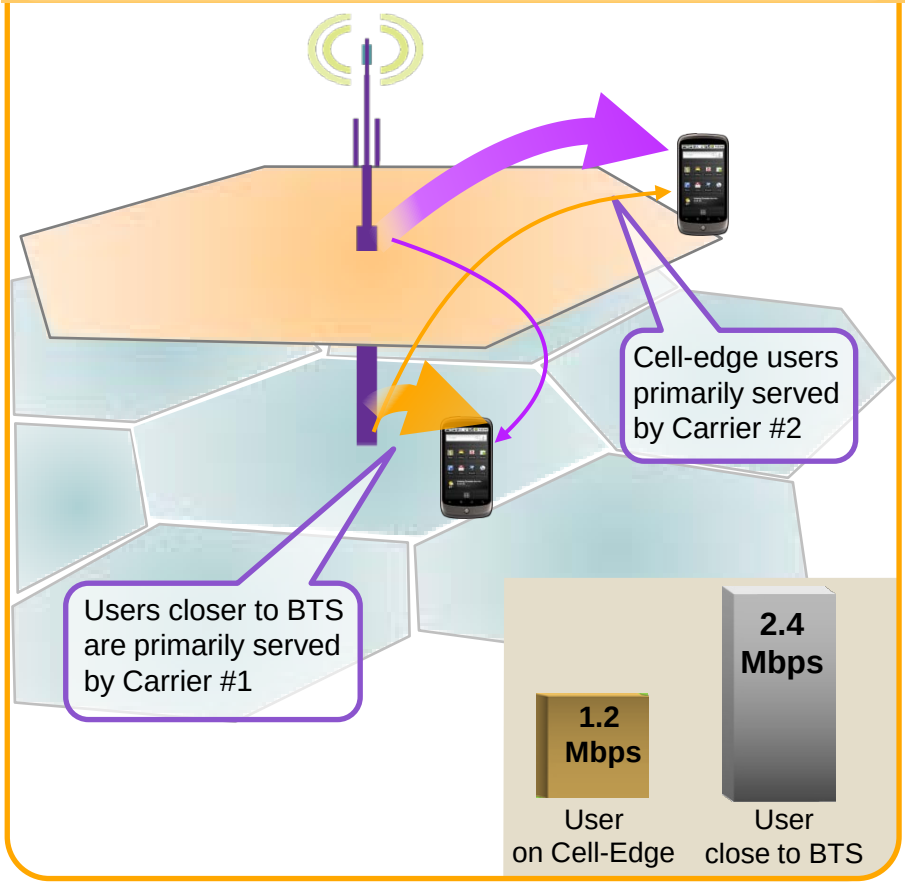
Today's Networks

All users served by all carriers



DO Advanced

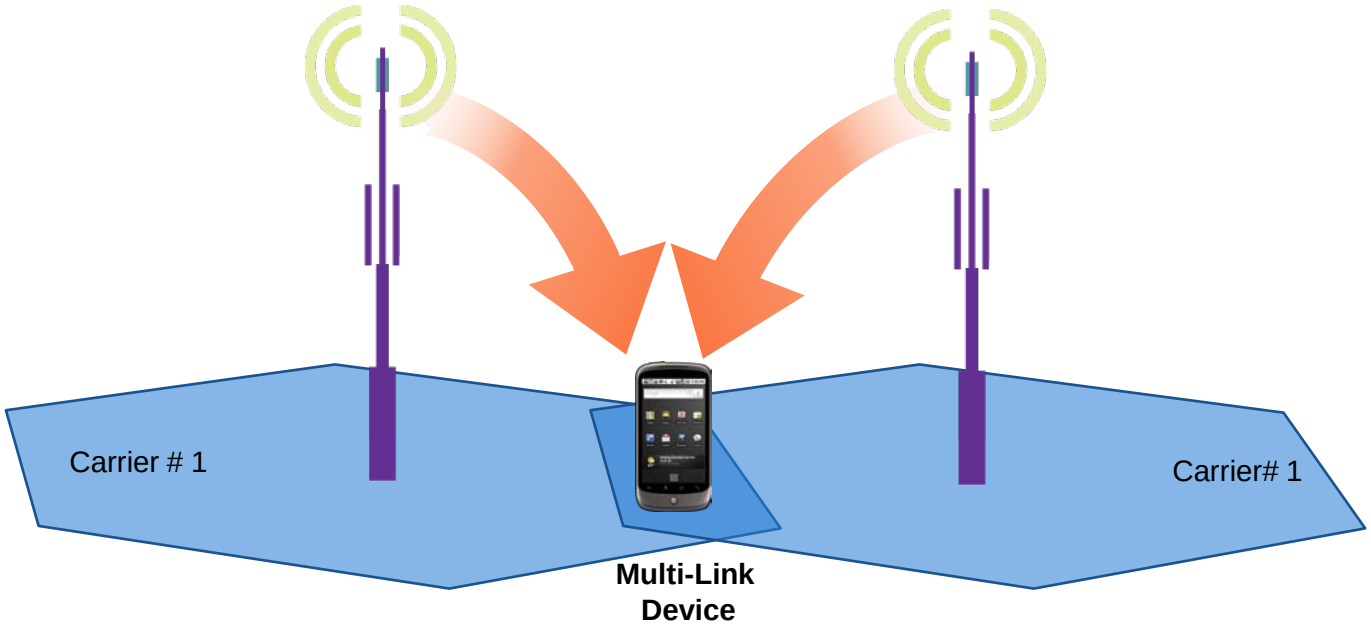
User served by most suitable carrier/s



Note: Performance improvement depends on deployment, demand distribution and implementation

Leveraging Multi-Link Devices in Single-Carrier Networks

Single Carrier Multi-Link enables connection to two single-carrier cells



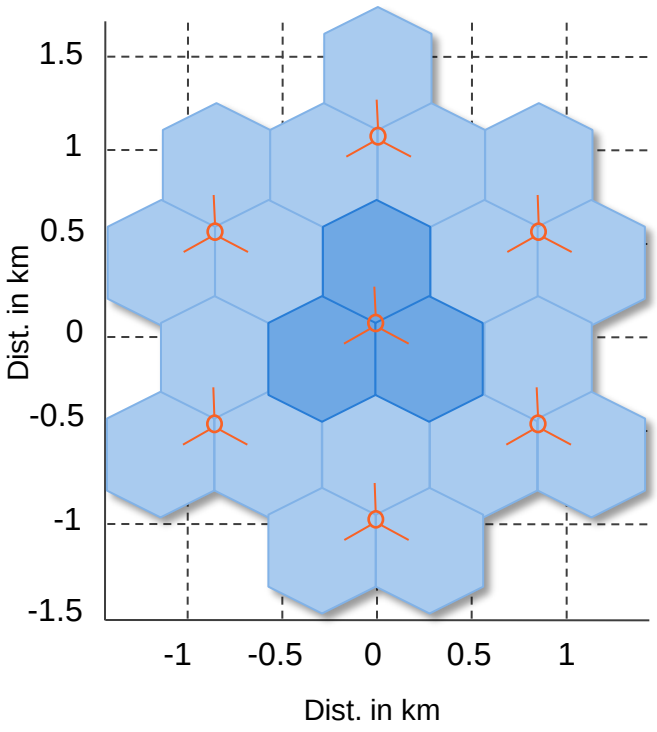
Higher cell-edge data rates, especially for multicarrier devices

Even better network load balancing

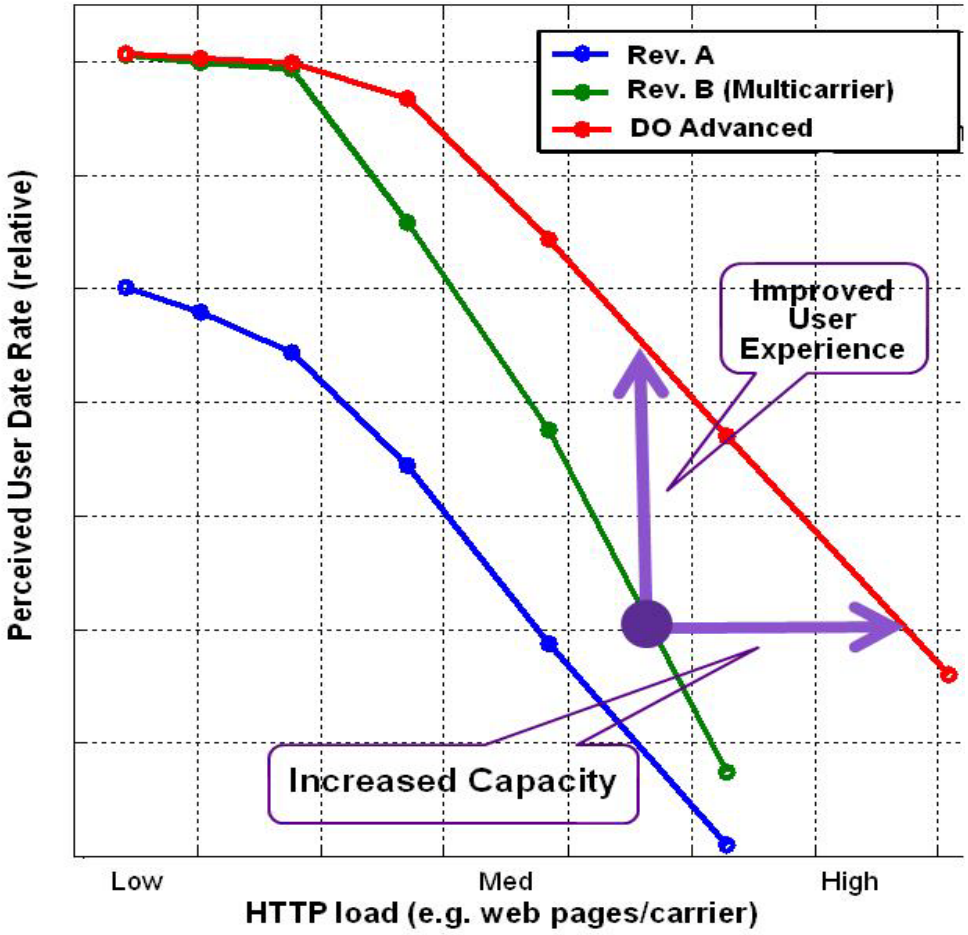
Higher overall network capacity

DO Advanced Performance Improvement - Example

Sample Cluster with Uneven Load



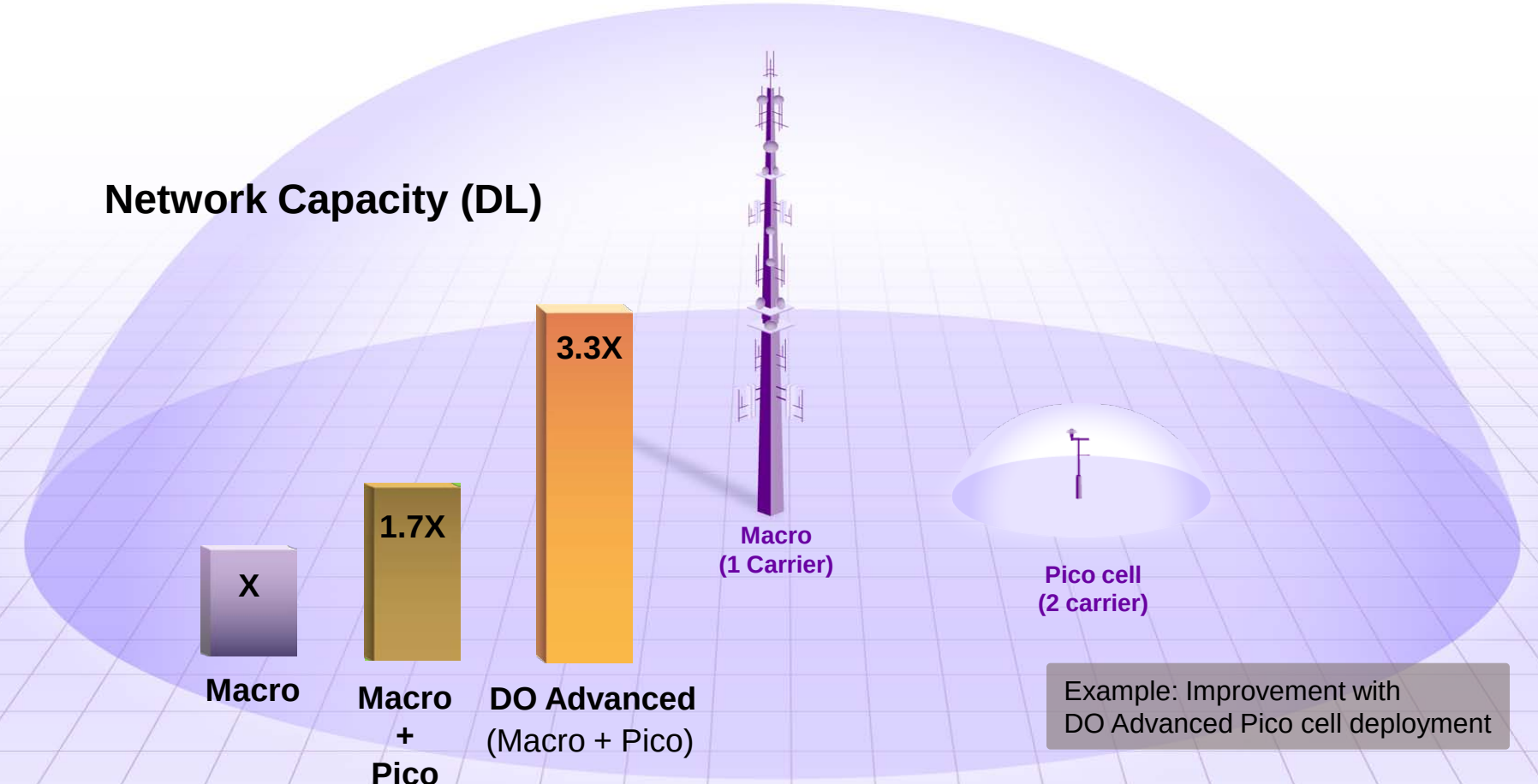
Improved Performance During Loaded Conditions



Note: The performance shown is for users in the central cells (with 2x load) . The increase depends on deployment, demand distribution and implementation

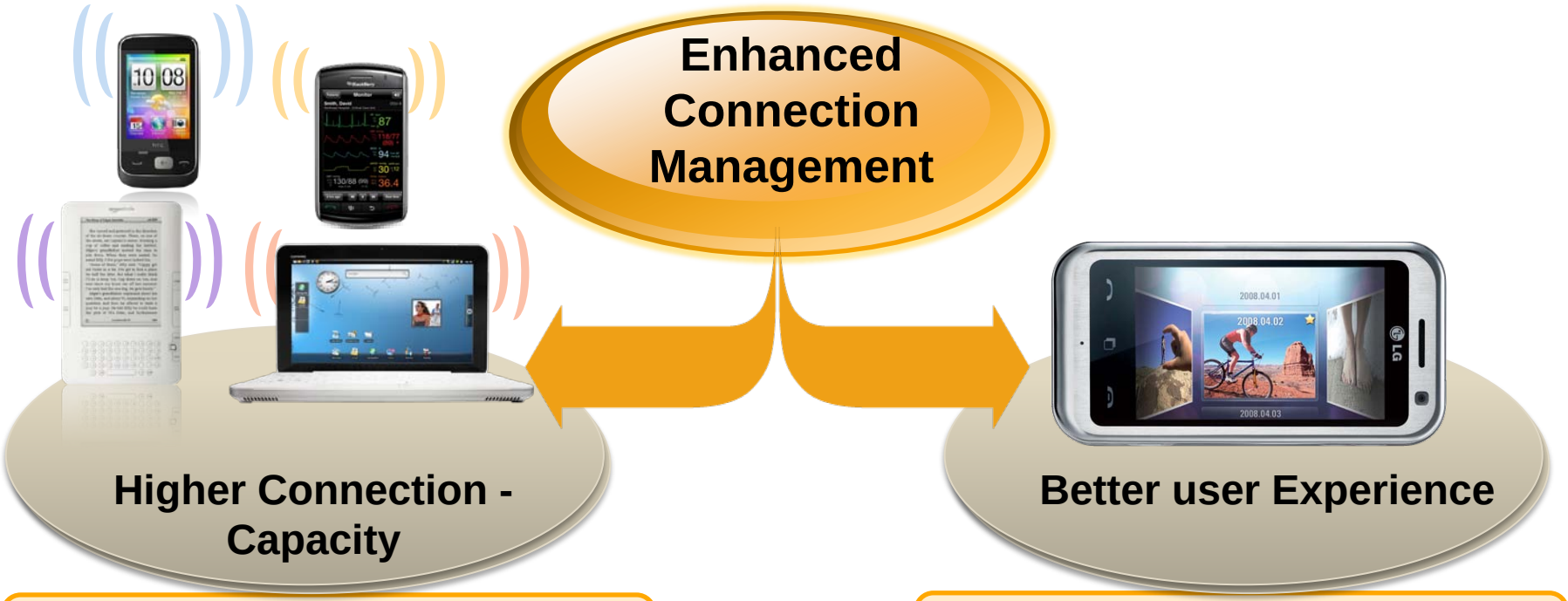
DO Advanced Optimizes Performance of Heterogeneous Networks

- DO Advanced techniques applied to networks with microcells, picocells, etc.



Source: Qualcomm simulations. assumes 1 single carrier macro, with 2 double carrier picocells. Pico-cells are randomly placed in the network. The data loading ratio of 4:1 between high-demand and low-demand areas

Enhanced Connection Management: Improved Connection-Capacity and User Experience



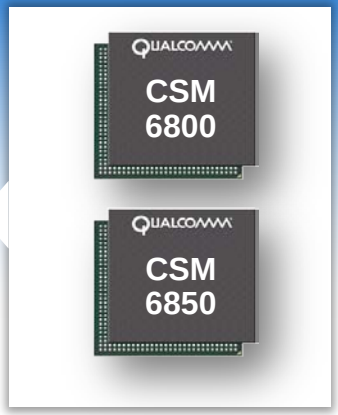
- Supports more interactive users such as “push-pull” mobile email
- Efficient use of paging and access channels
- Better traffic congestion management

- Improved “Always ON” experience
- Improved battery life
- Better user experience even during congestion

Upgrade Software Released; Standards Published

Firmware Released
in 2010

- Provides all the Smart Networks features
  - Network Load Balancing
  - Smart Carrier Management
  - Distributed Network Scheduler
  - Single-Carrier Multi-Link
  - Adaptive Frequency Reuse
- Supports both CSM6800 and CSM 6850



Standard Published
in April 2010

3G 3RD GENERATION PARTNERSHIP PROJECT 2 "3GPP2"

- 3GPP2' s EV-DO Rev.C released in April 2010 contains ***all*** the core DO Advanced features
- Active participation and contributions from many 3GPP2 ecosystem stakeholders

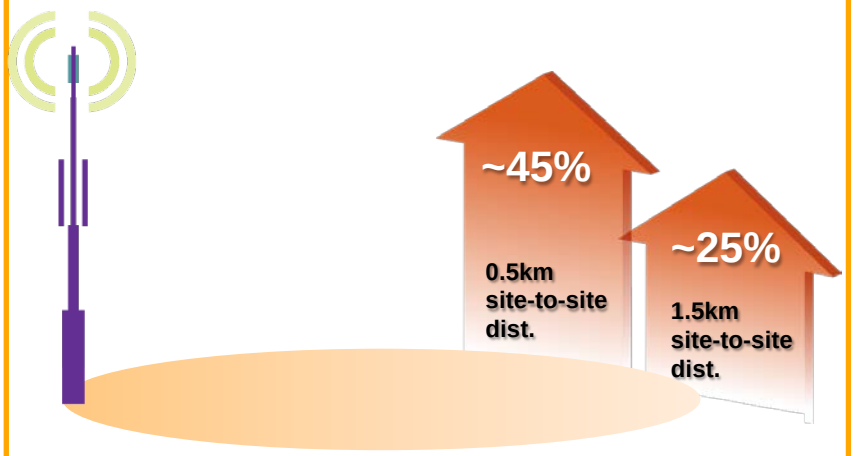
Paving the way for DO Advanced commercial deployments

Note 3GPP2 EV-DO Rev.C standard contains many more features that are not included in DO Advanced.

Advanced Devices Improve Performance without Standards or Infrastructure Impact

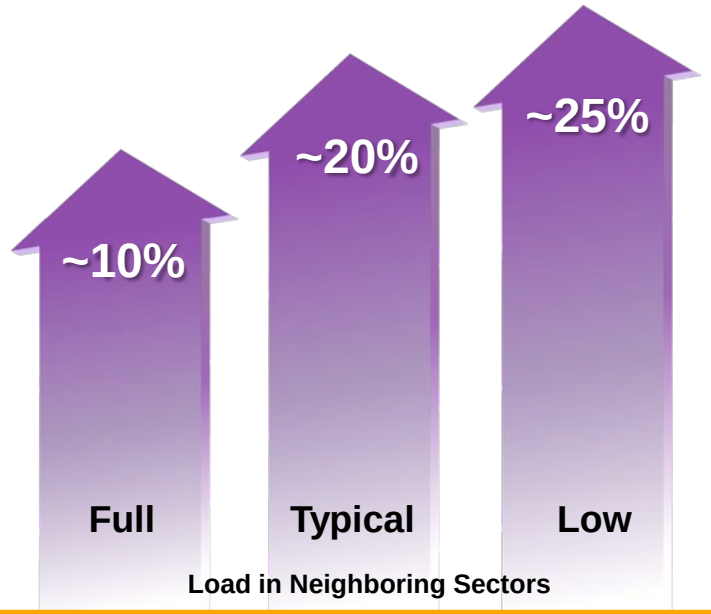
- Enhanced Equalizer exploits uneven loading and bursty traffic

Higher DL Cell-Edge Data Rates[1]



Higher gains for Dense Urban Sites (short site-to-site distance)

Higher DL Sector Capacity

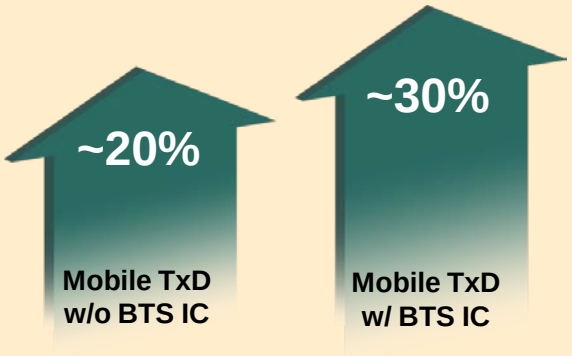


Higher gains for lower loading in neighboring sectors[2]

[1] Assumes ~50% loading , the worst 10 percentile considered as cell-edge users; [2] Represents neighbor transmit probability, Full – 100%, Typical 25%, Low 5% ; Other simulation assumptions - 3GPP2 methodology and channel mix, RoT/Effective RoT = 6dB, realistic Tx antenna modeling (handheld device model, laptop model) EV-DO Rev.A/B packet formats.

Mobile Tx Diversity Improves both Uplink and Downlink Performance

Higher UL Sector Capacity



Higher UL Cell-Edge Rates

Increase in UL data rates improves DL performance for bursty apps (web browsing)

BTS IC further improves the gains of Mobile Tx Diversity

Closed loop tx diversity will need infrastructure upgrade and a new standard, but open loop does not; [1] the worst 10 perentile considered as cell-edge users; ; Other simulation assumptions - 3GPP2 methodology and channel mix, RoT/Effective RoT = 6dB, realistic Tx antenna modeling (handheld device model, laptop model) EV-DO Rev.A/B packet formats, ant. model with 0% correlation between two pairs of ant. and 50% correlation within each pair (for tx diversity simulations).

LTE Augments Data Capacity in Urban Areas Leveraging New Wider Spectrum

Similar LTE & Rev. B performance
(Lower LTE performance because of higher overhead)

1.4 MHz 3 MHz 5 MHz

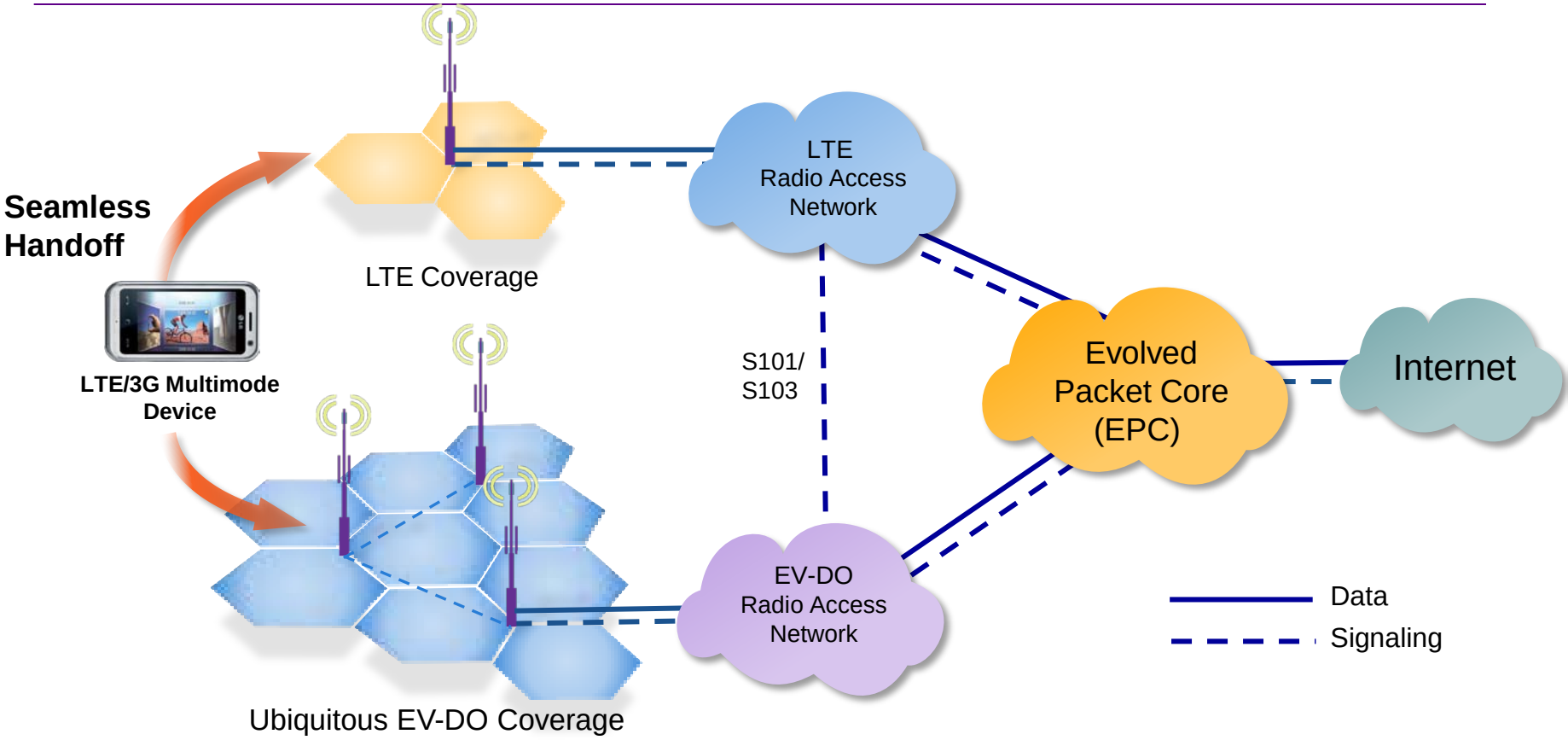
Best suited to leverage new and wider bandwidths

10 MHz 15 MHz 20 MHz

Rev. B and 1X ***(every where)***
Rev. B ensures similar user experience outside LTE coverage and 1X provides voice services everywhere

LTE relative performance decreases with bandwidth due to higher overhead; 40% overhead in 1.4 MHz vs. 25% in 20 MHz results in 25% better relative performance in 20 MHz vs. 1.4 MHz.

LTE Seamless Interoperability with EV-DO from Day One



Seamless handoff through eHRPD

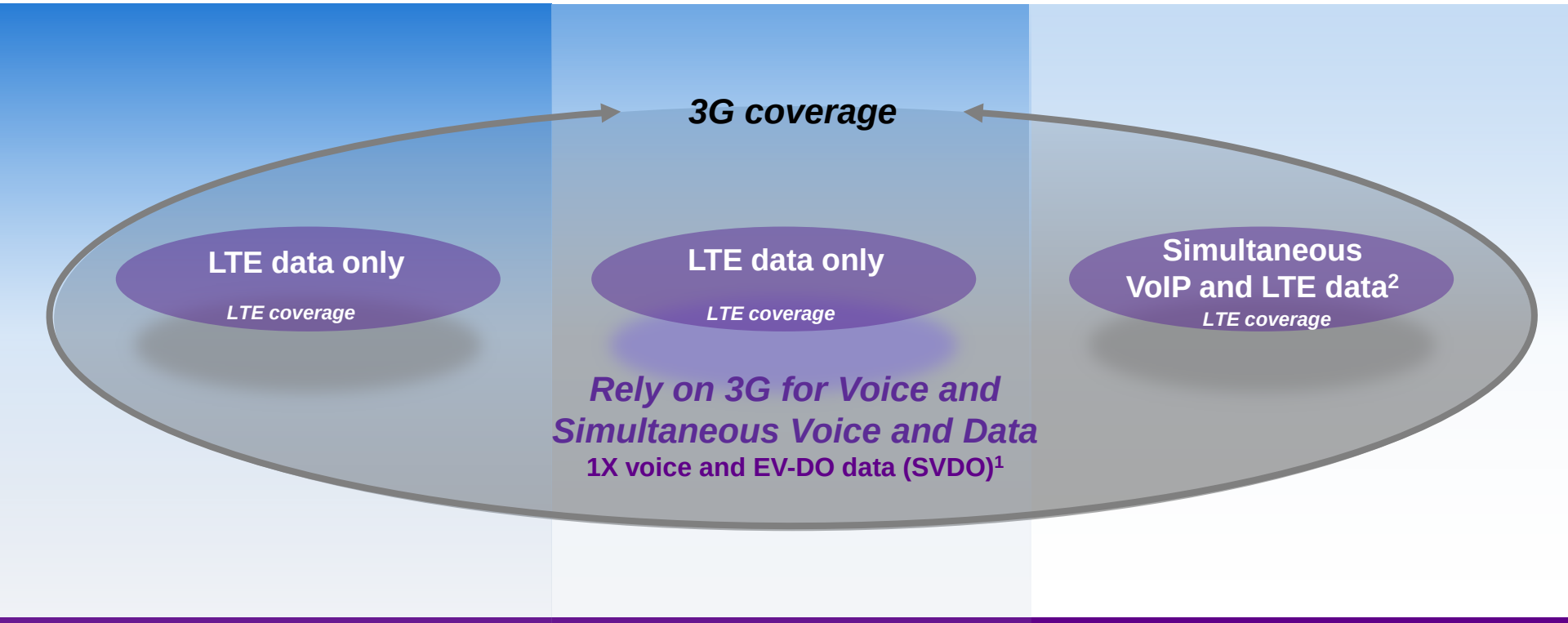
Single EPC core network simplifies introduction of new services

Minimal changes to EV-DO Radio Access Network and no change to EV-DO core

eHRPD (evolved High Rate Packet Data) is the standard that defines interoperability between LTE and EV-DO networks

LTE Voice Through Fallback to 3G, Long Term Solution is VoIP using IMS

Initial Launches	Initial Voice Solution	Long Term Voice Solution
Data Cards	**LTE Data Handsets**	**LTE VoIP Handsets**



LTE focused on data while leveraging 3G for voice[3]

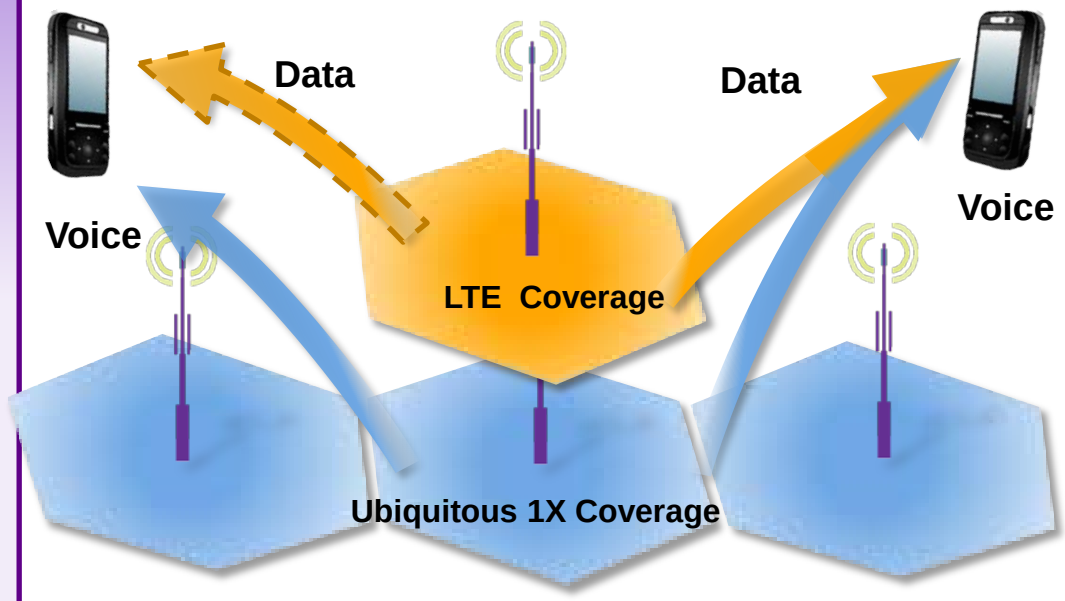
[1]Simultaneous 1X Voice and DO (SVDO) planned across future Qualcomm DO chipsets. Simultaneous Voice and data also through VoIP over EV-DO. [2]Requires VCC for service continuity

Two Voice Fallback Options

CS Fallback

- Fall back to 1X circuit switched voice
- Single radio in the device
- Simultaneous voice and data possible with SVDO
- Standardized solution (CSFB)

Or



SV-LTE

- Simultaneous 1X Voice and LTE data
  - Two radios for voice and data
- Handset feature without network impact
  - Works with 1X and 1X Advanced
- Enhanced user experience

Leveraging 1X and 1X Advanced for voice services all across the network

Common LTE FDD & TDD Chipset Platform

Modems & Data Cards

QUALCOMM
MDM 9600
LTE
DC-HSPA+/DOrB
EDGE
gobi
by Qualcomm

- 50+ designs by 25+ OEMs
- Commercial 4Q 2010
- 100 Mbps DL/50 Mbps UL

Smartphones & Tablets

QUALCOMM
MSM 8960
LTE
DC-HSPA+/DOrB
EDGE
snapdragon
Qualcomm

- Dual-Core CPU (28nm)
- Superior graphics & multimedia
- Integrated connectivity (WLAN, GPS, Bluetooth, FM)

- MSM8960 launches in 2012
- Handset & tablet launches in 2011 based on (MDM9x00+MSM)

Industry's First LTE/3G Multimode Chipsets

EV-DO Rev. B and DO Advanced—Natural Next Steps for EV-DO

EV DO Rev B	Multicarrier Enhances Broadband Experience
	Multicarrier Doubles Capacity for Bursty Applications
	Cost-Effective Software Upgrade to Multicarrier
	Even Higher Capacity & Data Rates with CSM6850 Upgrade
DO Advanced	Higher Network Capacity and Improved User Experience
	Benefits Existing Devices
	Cost-Effective Software Upgrade
	Improved Performance for All Network Topologies

Rev. B Multicarrier is Commercial

Up to 4x Voice Capacity With 1X Advanced —Improving Industry's Best Voice Capacity

1X Advanced

- **Up to 4x Voice Capacity**
- **Frees Up Spectrum for EV-DO Data**
- **Simple and Cost-Effective Channel Card Upgrade**
- **Up to 70% Coverage Increase**

- Interference Cancellation
- Radio Link Enhancements
- Mobile Receive Diversity

LTE Complements EV-DO

LTE

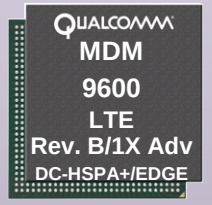
Boosts Data Capacity in Dense Urban Areas
Seamless Interoperability with 3G from day one

Leverages New, Wider and TDD Spectrum
Best suited in 10 MHz and beyond

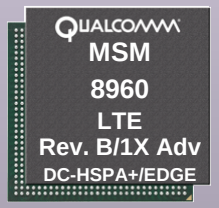
A Parallel Evolution Path to 3G
Similar performance with same bandwidth

Qualcomm: Industry's First LTE/3G Multimode Chipsets

Industry's first LTE and EV-DO Rev. A/B multimode solutions



Data Optimized



Handset Optimized

Common FDD and TDD platform

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