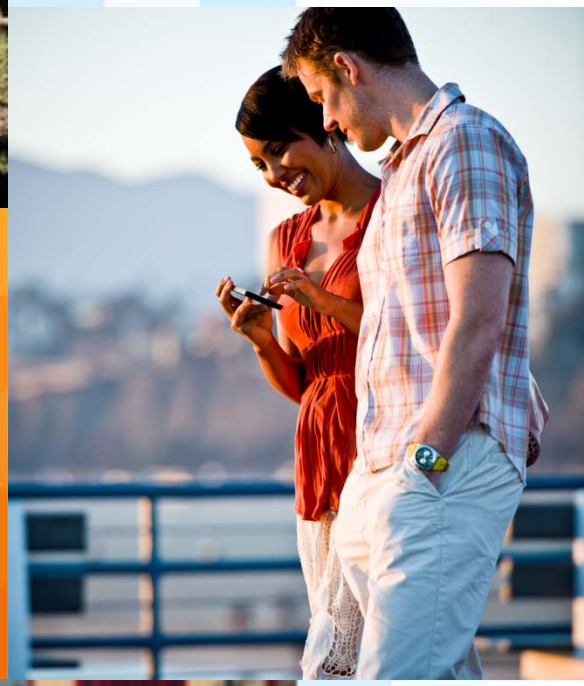


DO Advanced

October 2011

Maximizing the Performance of EV-DO

DO Advanced

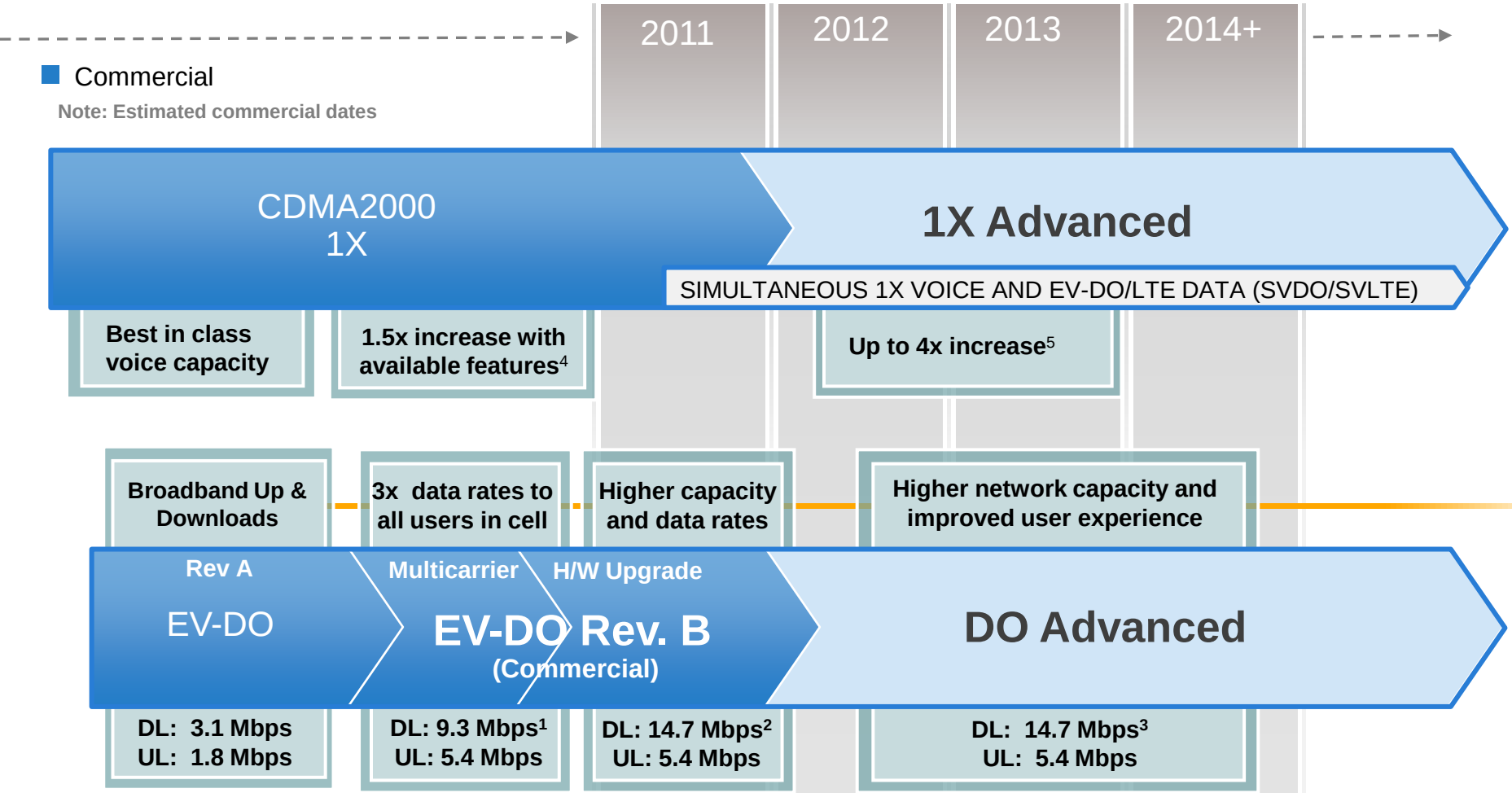
Higher Network Capacity and Improved User Experience
Where and when needed

Benefits Existing Devices
Even better performance for new devices

Cost-Effective Software Upgrade

Software Released; Standards Published
CSM Firmware released and standard published in 2010

1X and EV-DO Have Strong Evolution Paths



[1]Peak rate for 3 EV-DO carriers supported by initial implementation.
[2]Peak rate for 3 EV-DO carriers with 64QAM in the DL. Rev. B standard supports up to 15 aggregated Rev. A carriers.
[3] Same peak rates as Rev. B, but with new dimension of enhancements
[4]Capacity increase possible with new codec (EVRC-B) and handset interference cancellation (QLIC). [5]4x increase with receive diversity; 3x without

Created 06/20/2011

EV-DO Rev. B is Growing

GROWING OPERATOR COMMITMENT

10 LAUNCHES

10 COMMITMENTS

DEVICES ACROSS ALL SEGMENTS

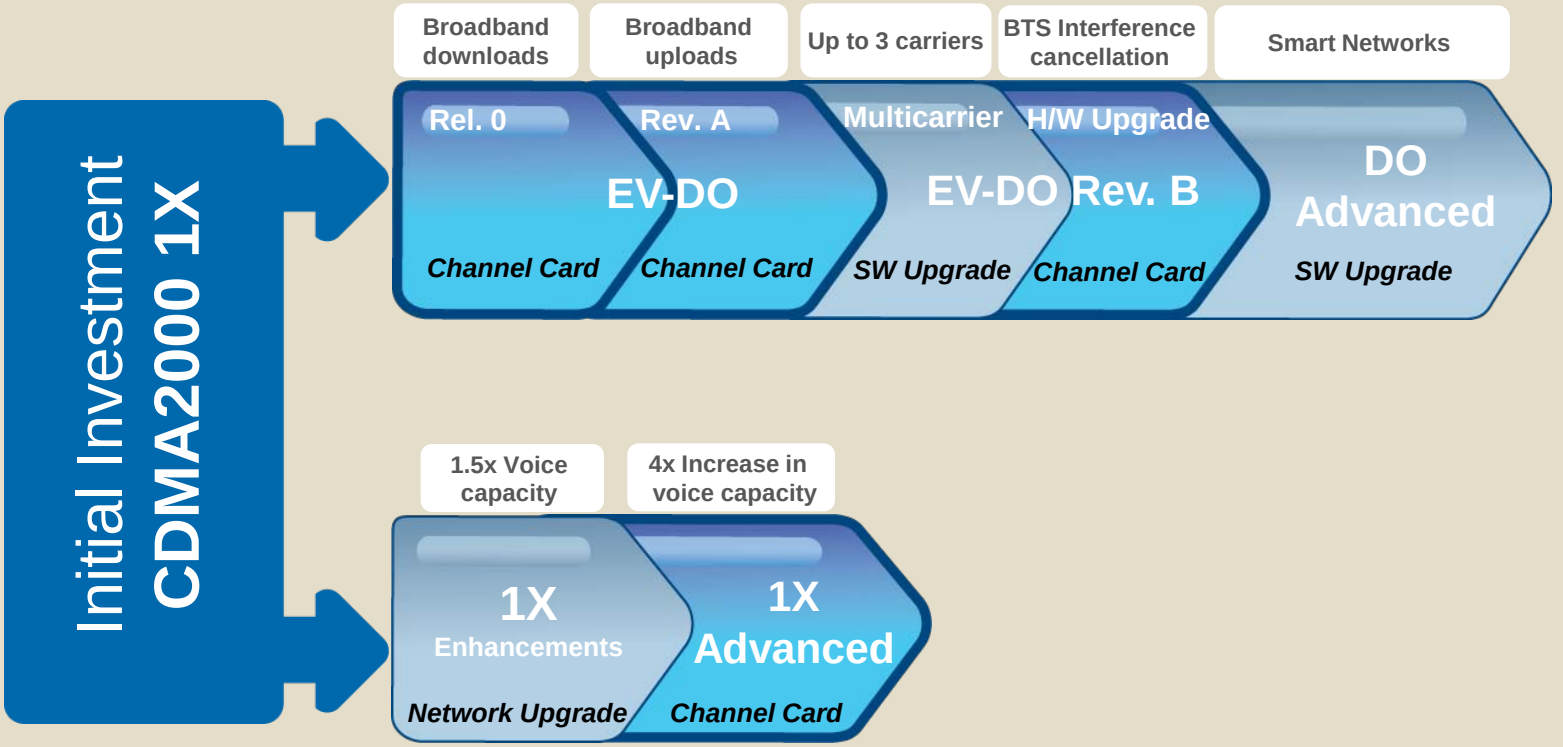
~30 DEVICES

~15 VENDORS

ALL MAJOR EV-DO INFRA VENDORS SUPPORT REV. B

Source: CDG, Oct 2011

Incremental and Cost-Effective Upgrades



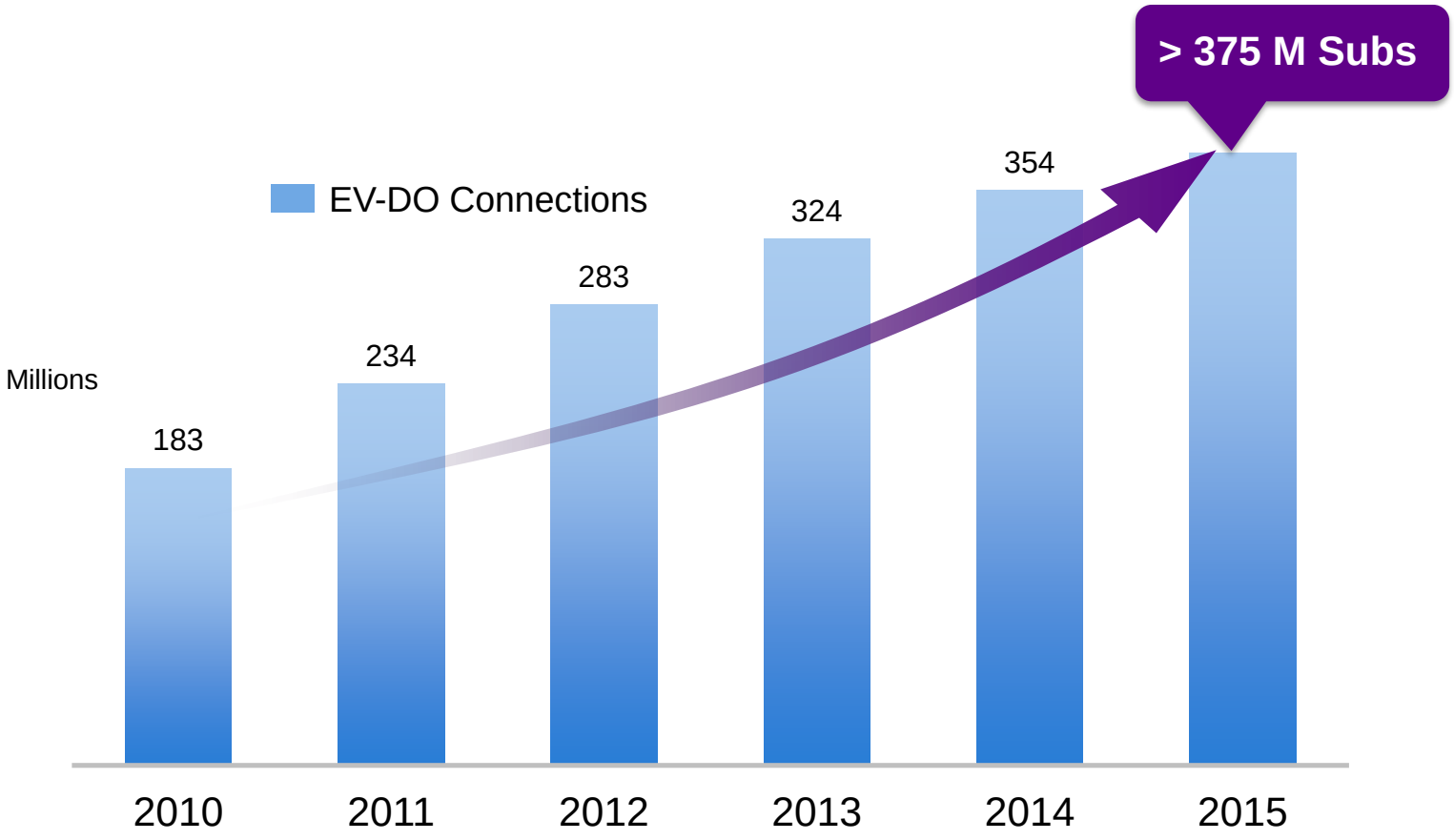
An evolution path that leverages current investments

Expanding EV-DO Ecosystem

>534M CDMA 2000 SUBSCRIPTIONS	**~ 209 Million** EV-DO	**~ 88 Million** Rev. A	
>325 CDMA OPERATORS	**~ 121** EV-DO	**~123** Rev. A	**7** Rev. B
>2,733 CDMA 2000 DEVICES	**~ 612** EV-DO	**~423** 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

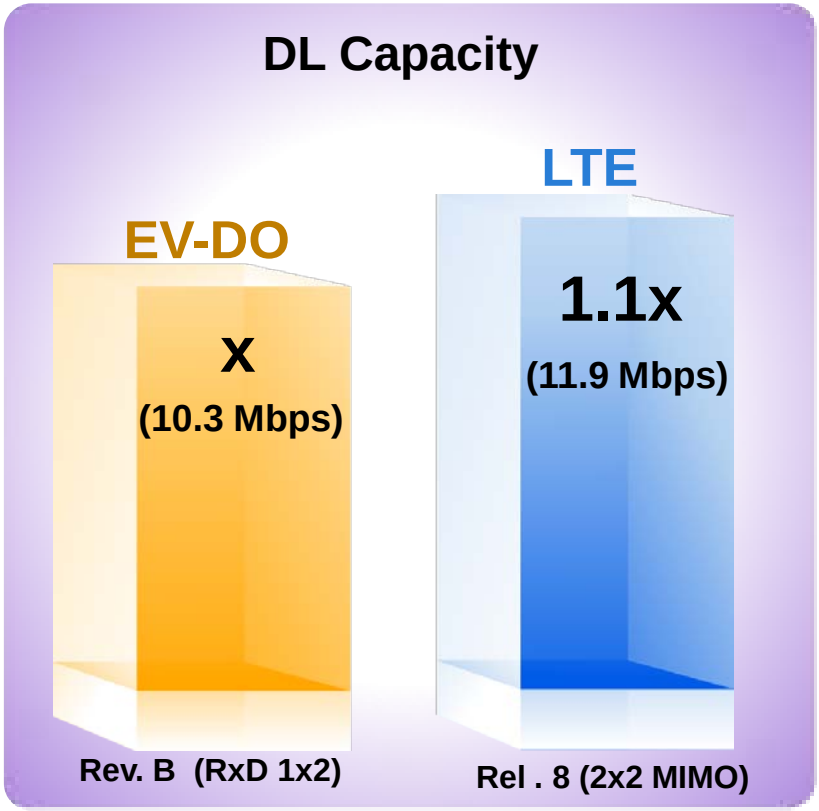
EV-DO's Strong Growth Continues

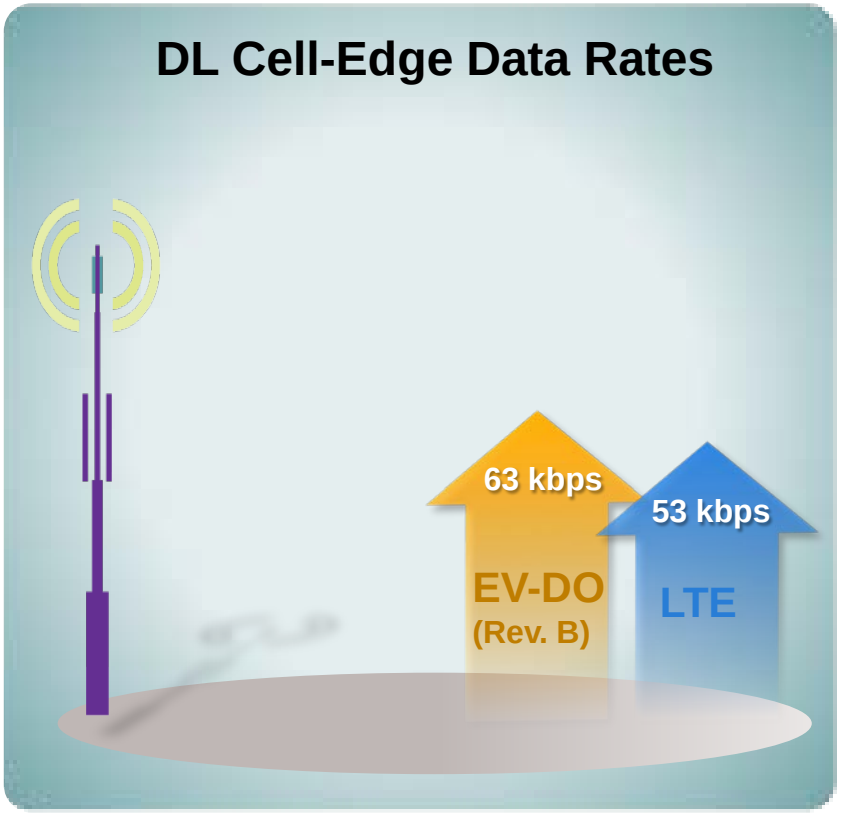


Source: Wireless Intelligence estimates as of July 18, 2011 for the quarter ending June 30, 2011 ; not including WLL connections

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

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

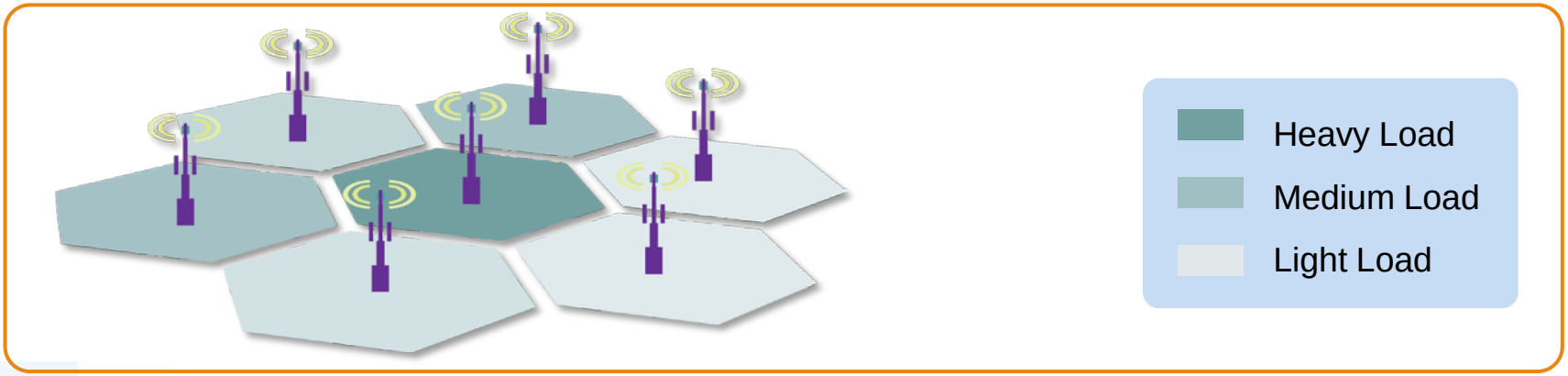
Mobile Tx Diversity
- Higher UL capacity and data rates

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

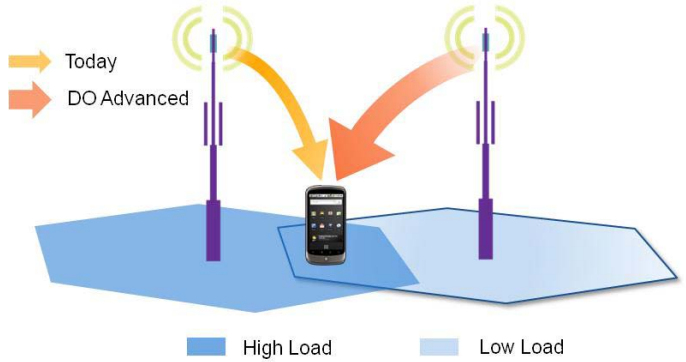


Smart Networks Increase Network Capacity and User Experience, Where & When Needed

Can double network capacity and cell-edge data rates

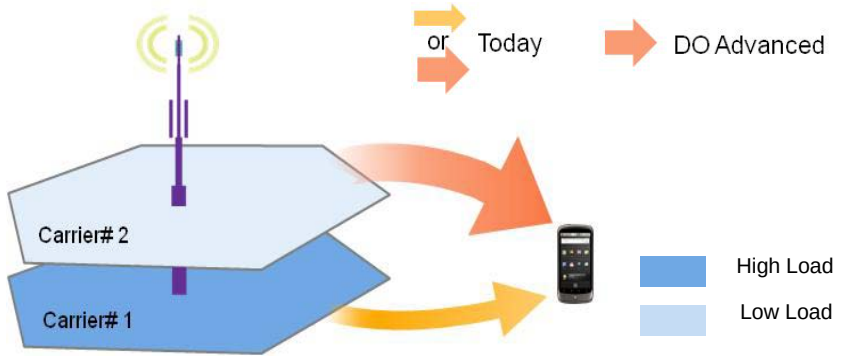
Network Load Balancing

Utilizing unused capacity of lightly loaded neighbors



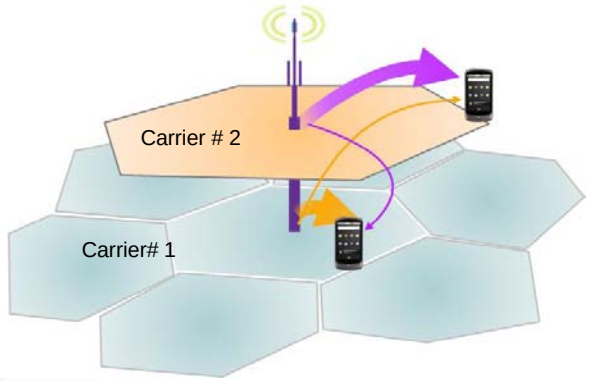
Smart Carrier Management

Assigning carriers based on accurate load and location



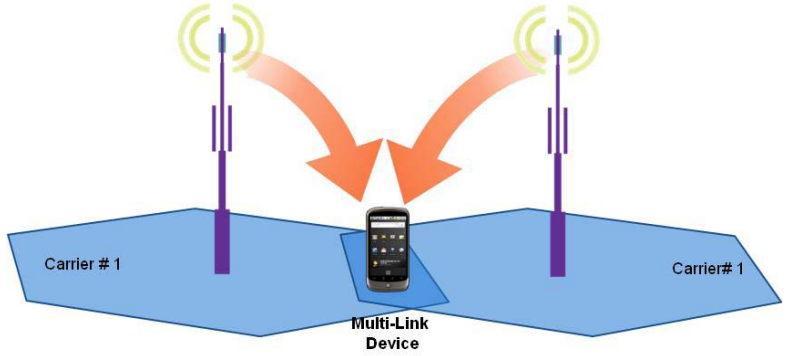
Distributed Network Scheduler

Users preferentially served by carriers that maximize capacity



Single Carrier Multi-Link

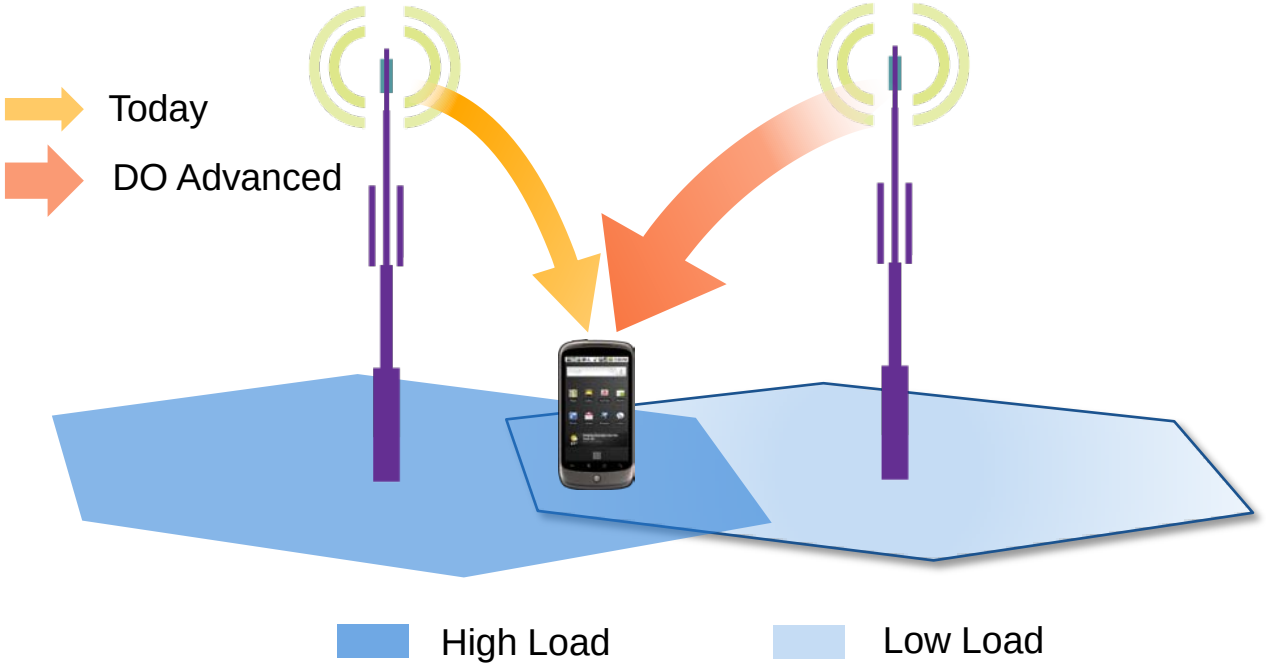
Leveraging multicarrier devices in single-carrier networks



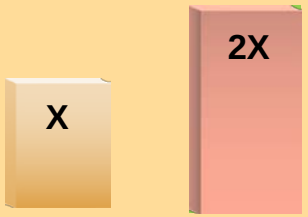
Improvement depends on deployment, demand distribution and implementation. Apart from the above, Adaptive Frequency Reuse (aka Demand Matched Configuration) is also another Smart Network technique.

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

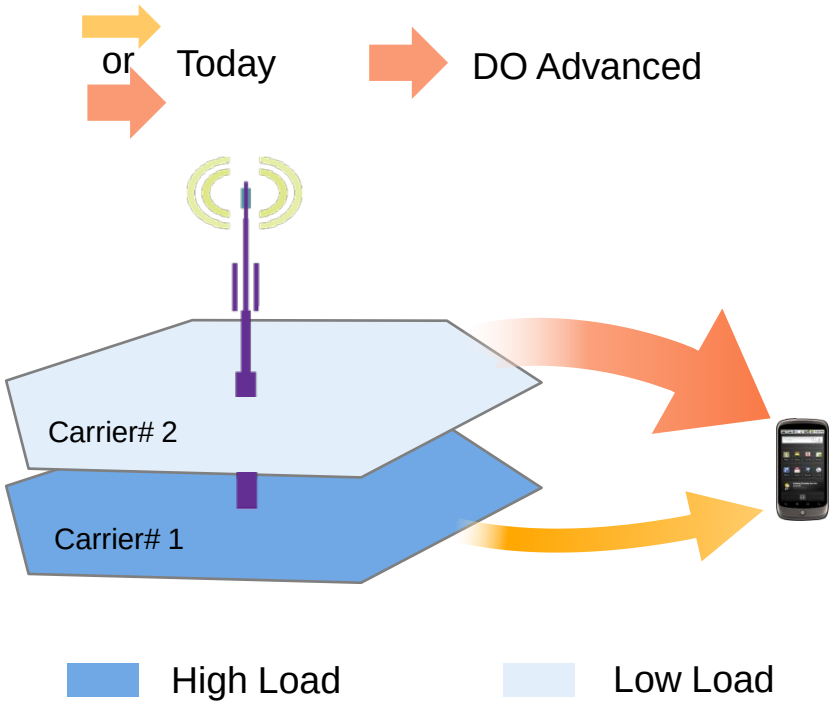
Reduced backhaul bottle-necks

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

Smart Carrier Management: Assignment based on Load and Location

Better Utilization

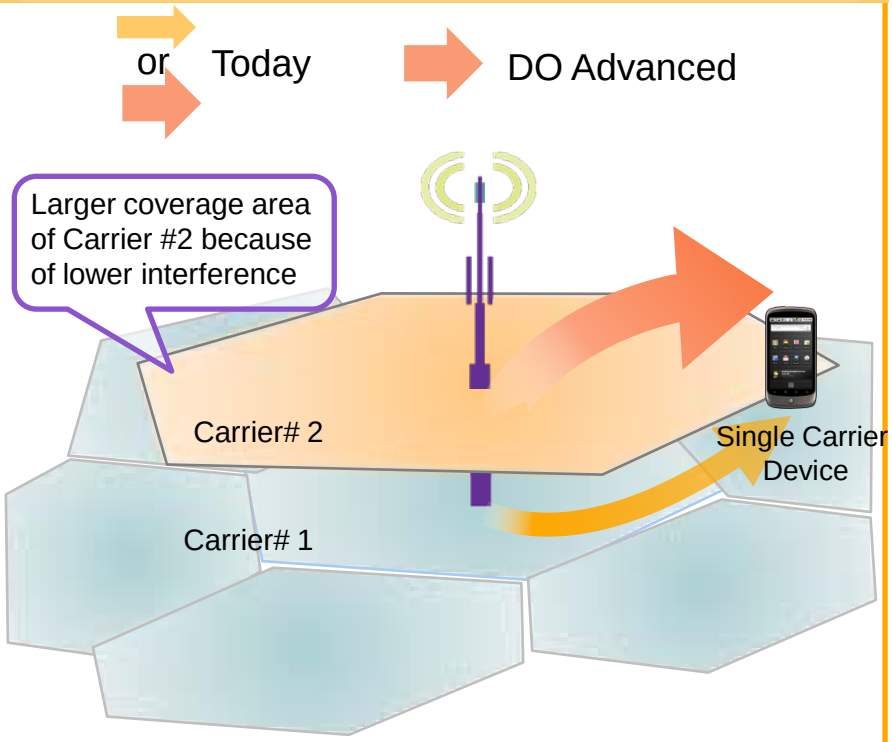
Assignment based on accurate loading



Benefits both single and multicarrier devices

Improved Cell-Edge Data Rates

Assignment based on location



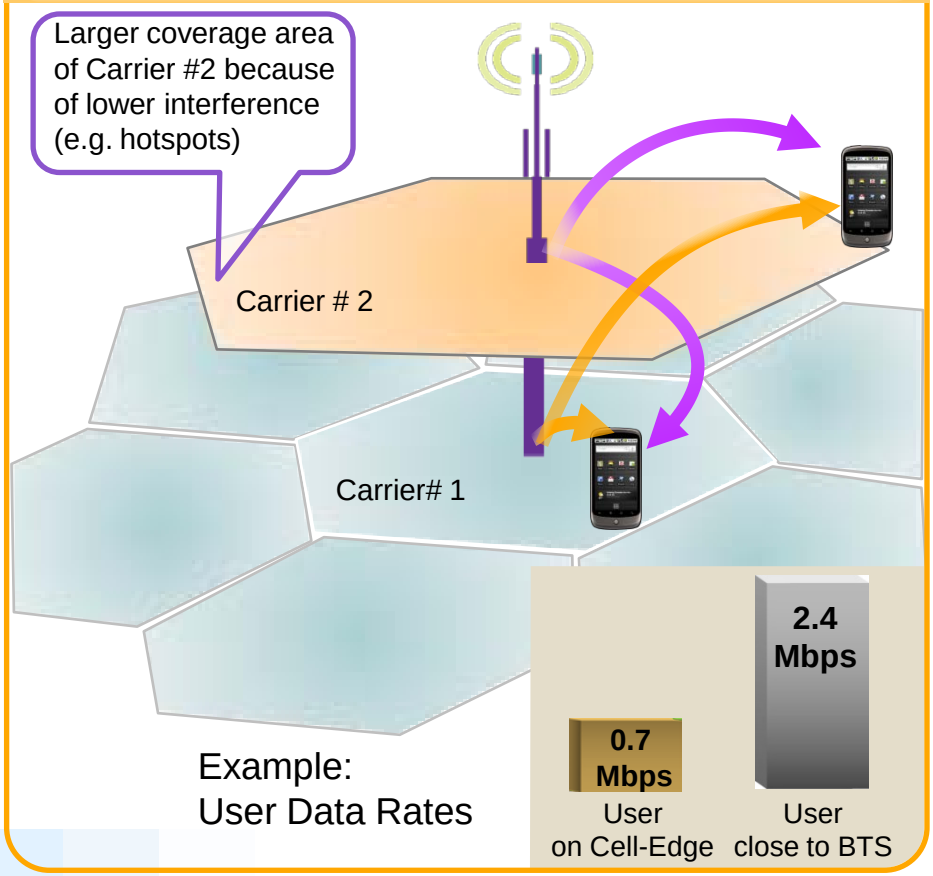
Allows single carrier devices to benefit from hotspot carriers

Distributed Network Scheduler Maximizes Capacity by Prioritizing Carriers

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

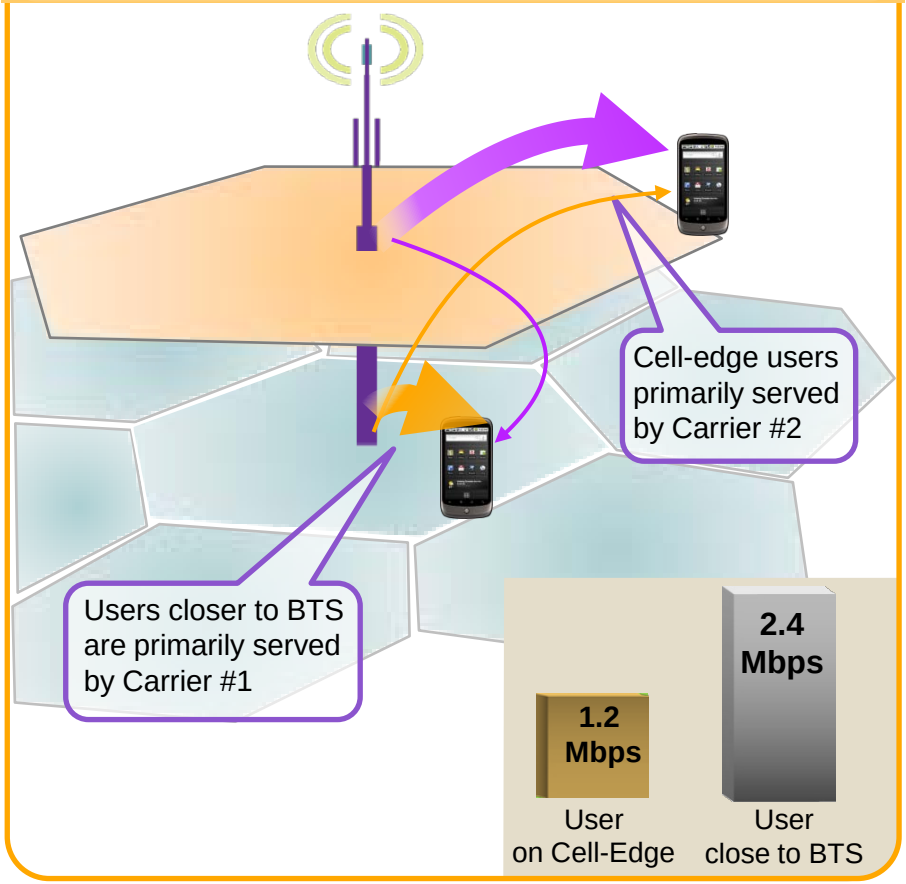
Today's Networks

All users served by all assigned carriers



DO Advanced

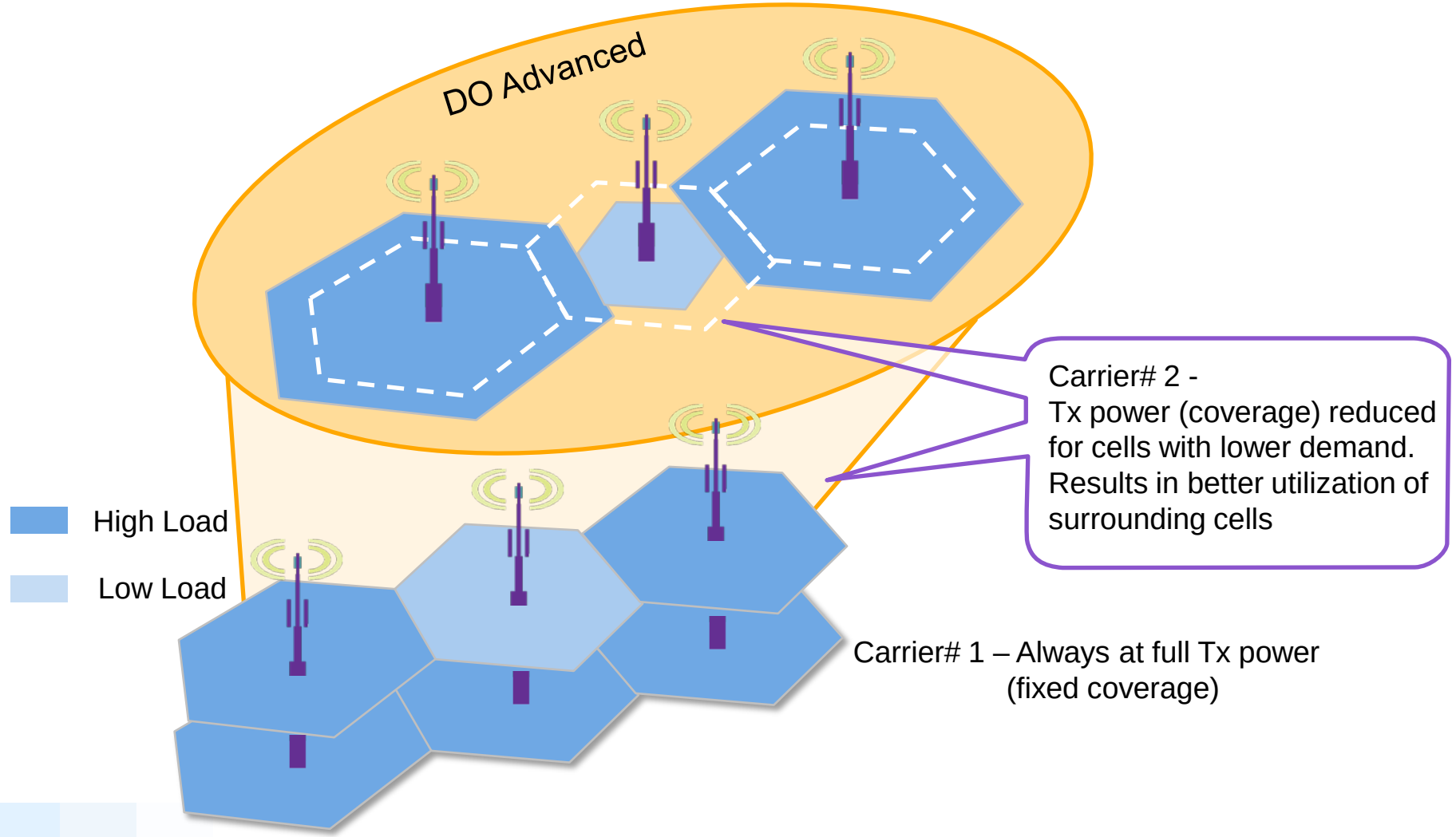
User served by most suitable carrier/s



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

Adaptive Frequency Reuse Reduces Interference to Increase Capacity

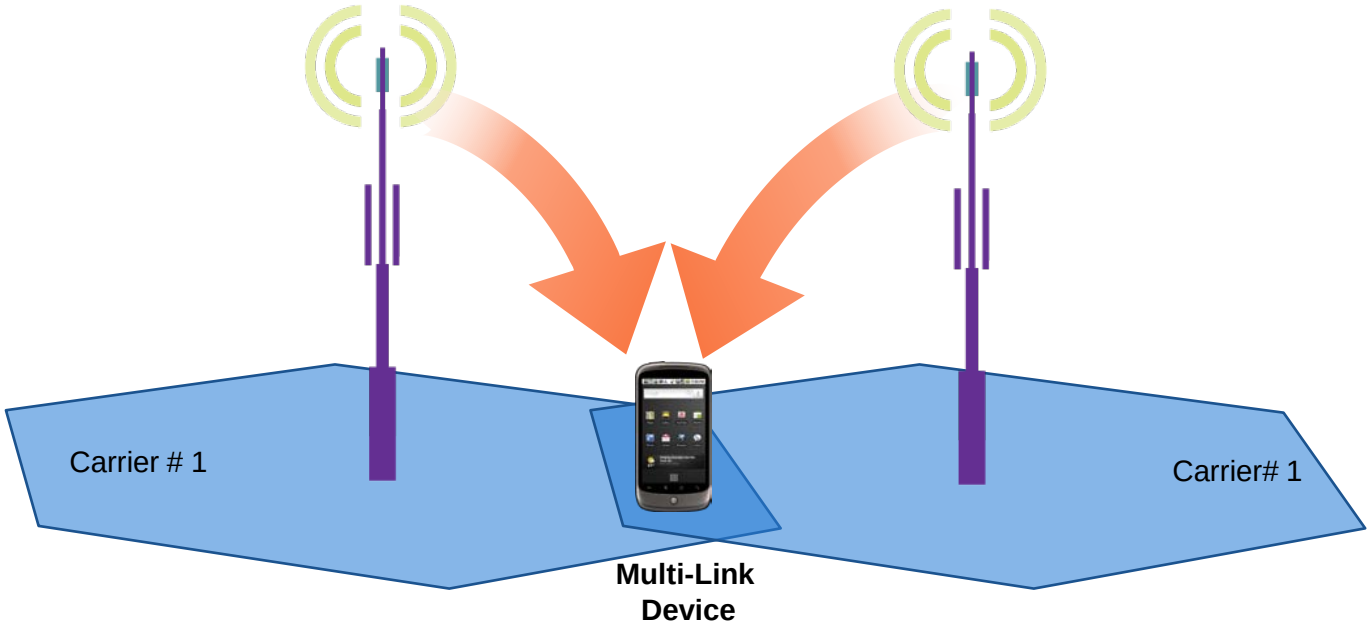
By adjusting transmit power of lightly loaded cells



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

Leveraging Multi-Link Devices in Single-Carrier Networks

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



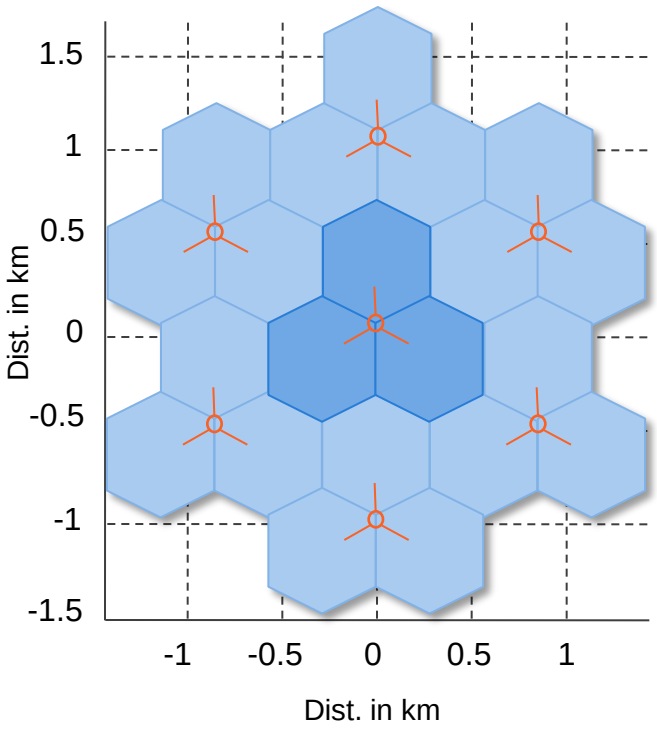
Higher cell-edge data rates, especially for multicarrier devices

Even better network load balancing

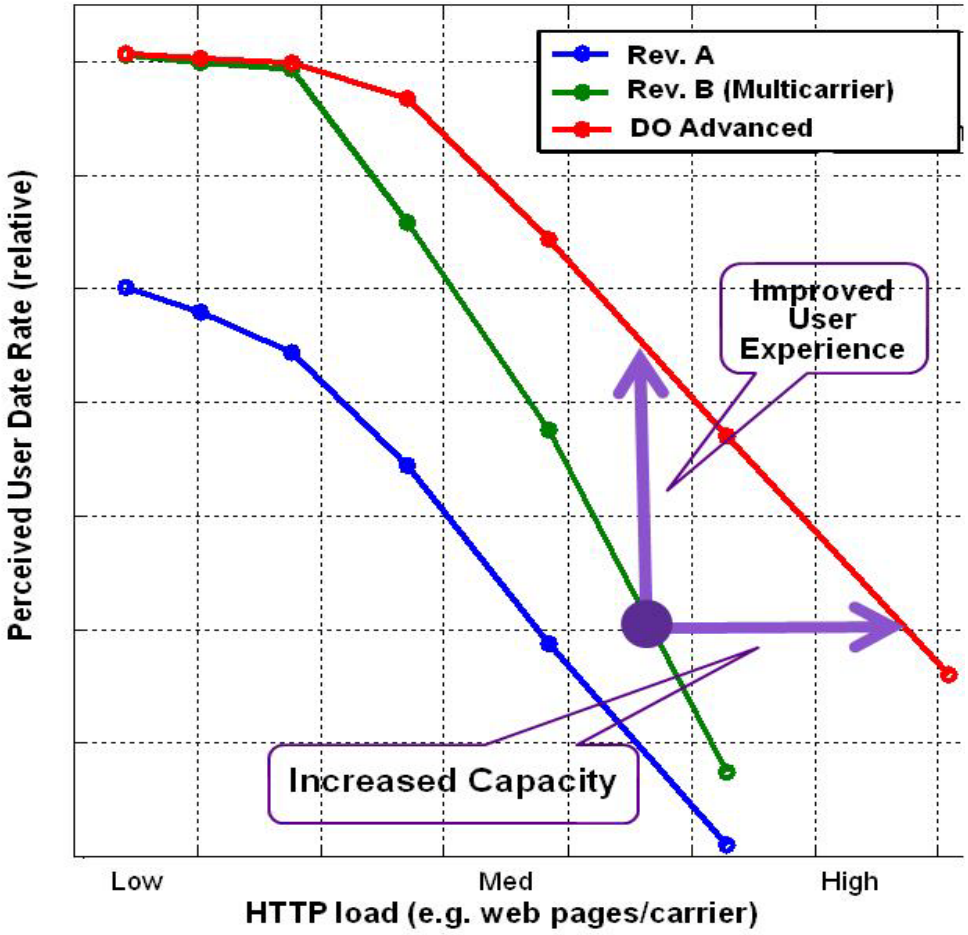
Higher overall network capacity

DO Advanced Performance Improvement - Example

Sample Cluster with Uneven Load



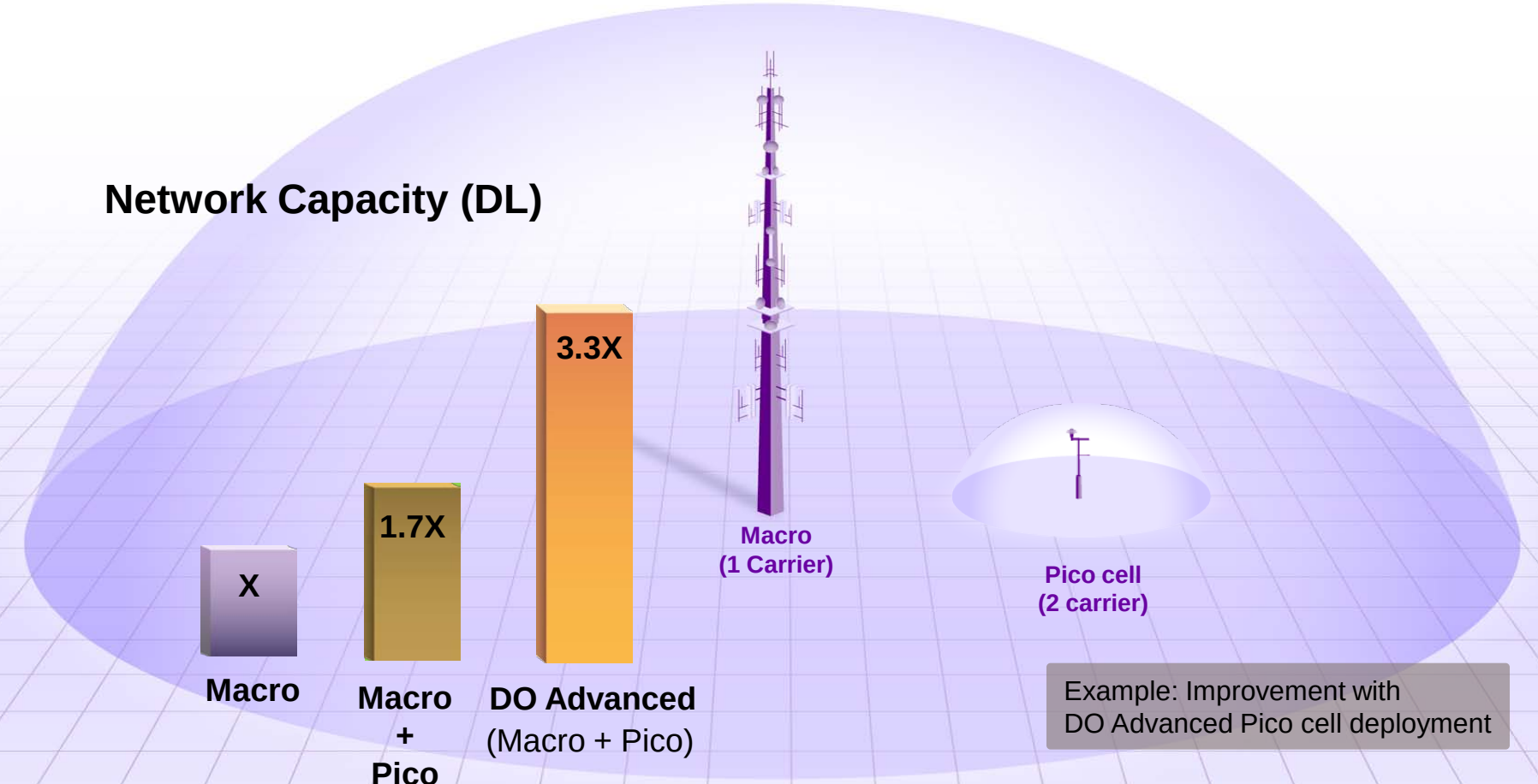
Improved Performance During Loaded Conditions



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

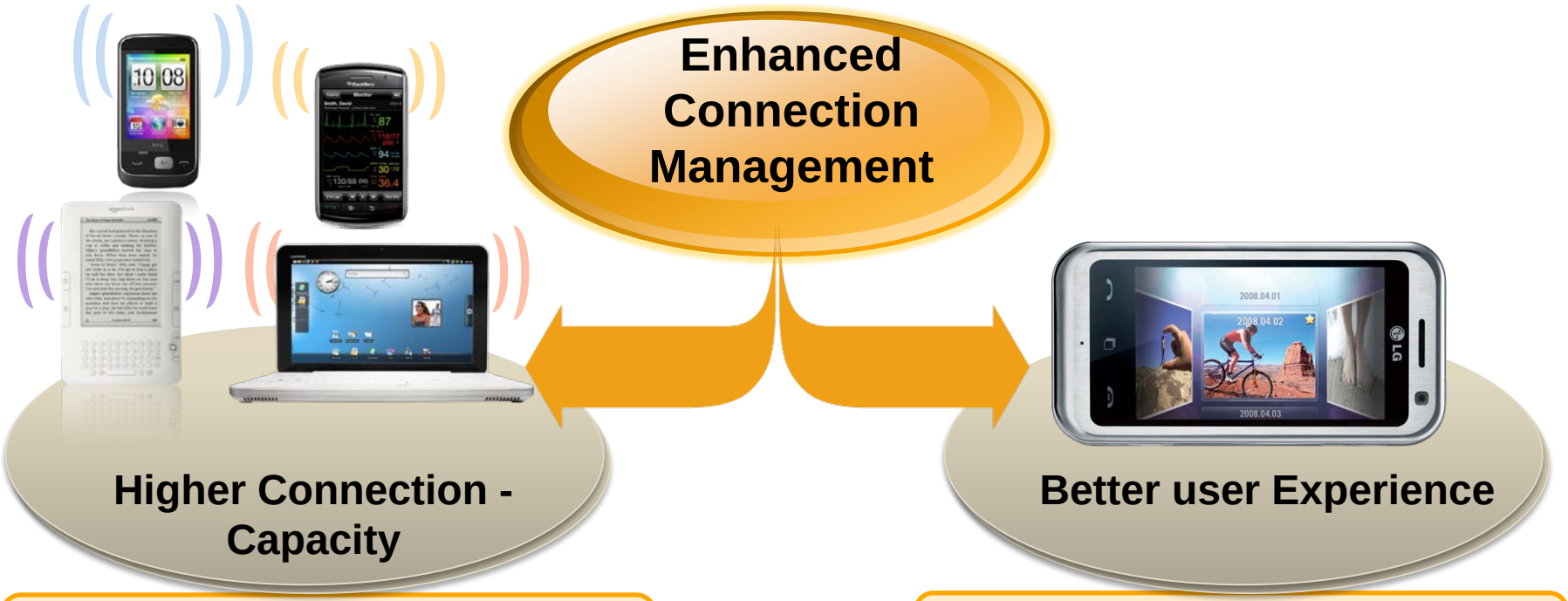
DO Advanced Optimizes Performance of Heterogeneous Networks

- 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



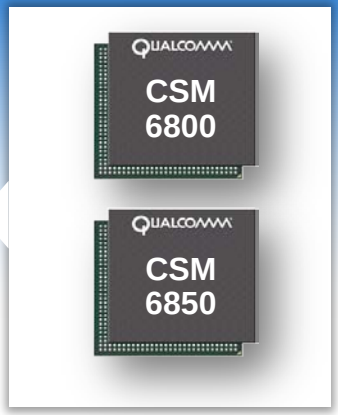
- Supports more interactive users such as “push-pull” mobile email
- Efficient use of paging and access channels
- Better traffic congestion management

- 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

3GPP2 – 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

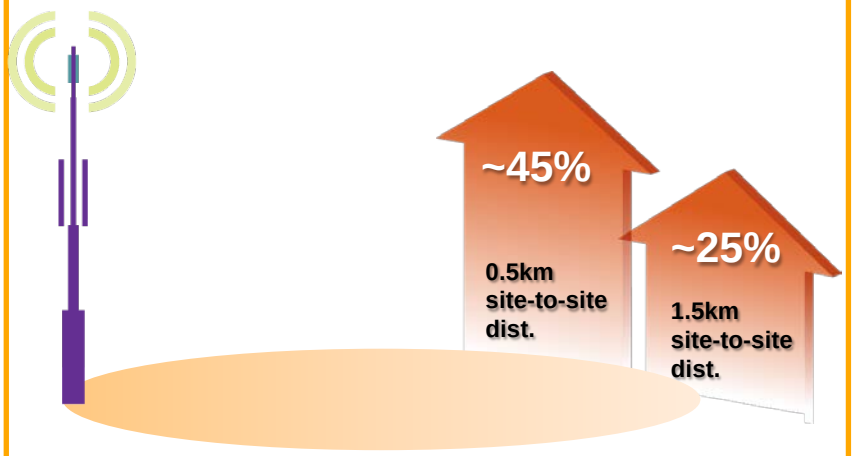
Paving the way for DO Advanced commercial deployments

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

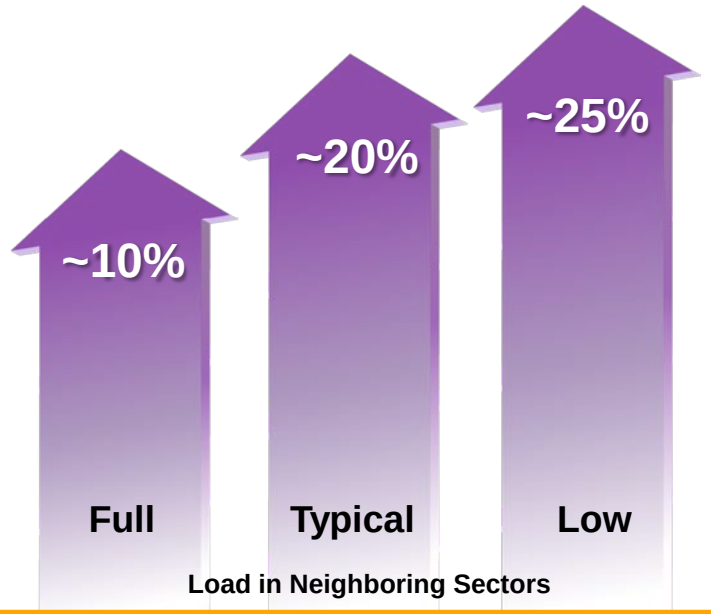
- Enhanced Equalizer exploits uneven loading and bursty traffic

Higher DL Cell-Edge Data Rates[1]



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

Higher DL Sector Capacity

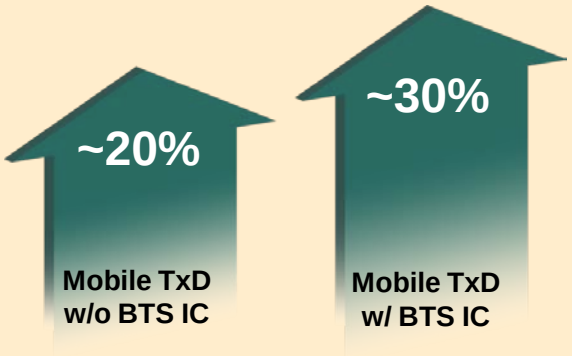


Higher gains for lower loading in neighboring sectors[2]

[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).

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