

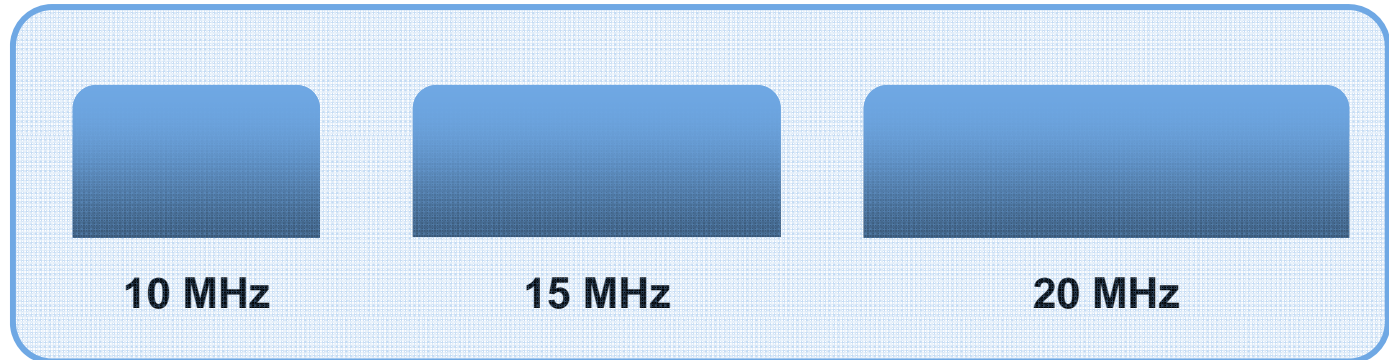
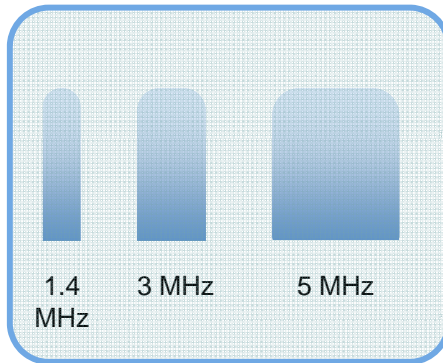
Long Term Evolution and Beyond

April, 2010

LTE Leverages New Wider Spectrum to Boost Data Capacity in Urban Area

Available in smaller bandwidths

Best suited to leverage new and wider bandwidths



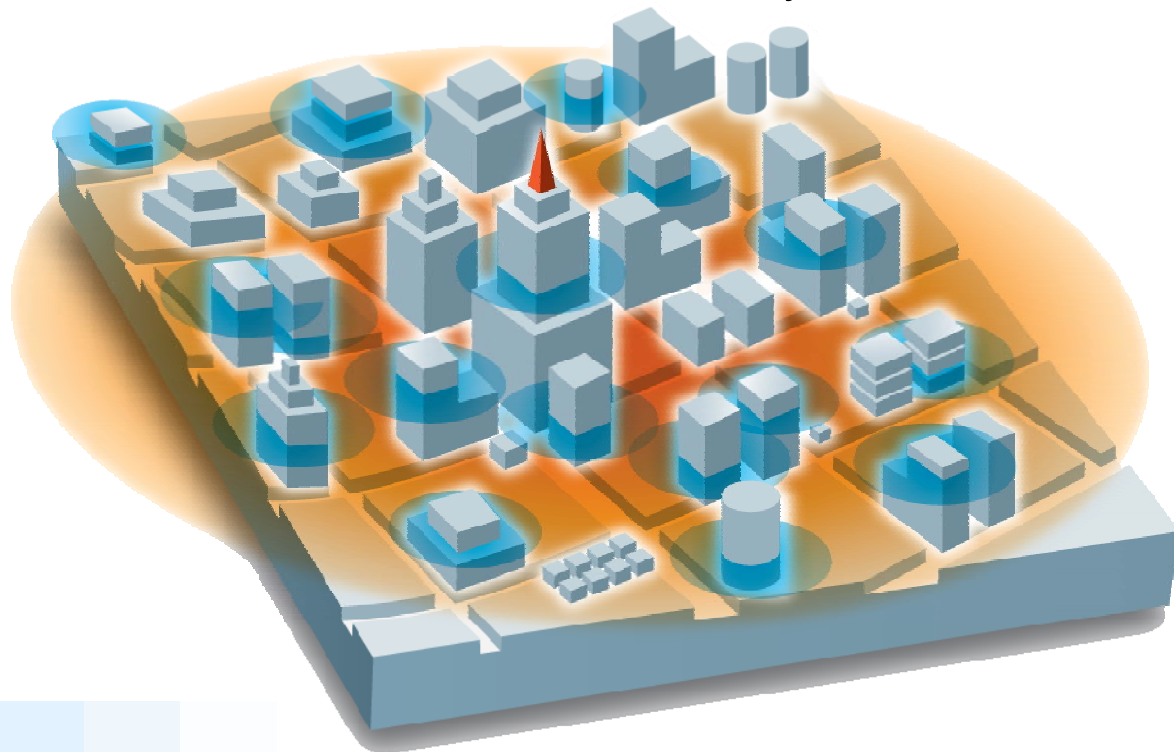
LTE relative performance decreases with bandwidth due to higher overhead; 40% overhead in 1.4 MHz vs. 25% in 20 MHz results in 25% better relative performance in 20 MHz vs. 1.4 MHz.



3G Coverage
Evolved 3G ensures similar user experience outside LTE coverage

LTE Complements 3G Networks

- LTE suitable for hot-spot capacity expansions
 - Utilize spectrum available at higher frequency bands
 - TDD has less coverage compared to FDD¹
 - Leverage lower cost TDD spectrum
- Seamless service continuity with 3G²



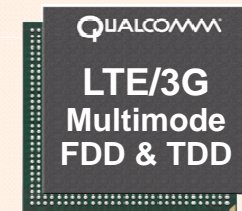
LTE Hot-spots
Micro, Pico and Femtocells
(e.g. 2.3 and 2.6 GHz)

3G Macro Coverage
HSPA+ and EV-DO Rev. B
(e.g. 800/900 MHz and 2.1 GHz)

TD-LTE is Global Solution for Unpaired Spectrum

- Strong TD-LTE industry support
 - All major infra vendors offering TD-LTE
 - China Mobile committed to TD-LTE
 - TD-LTE available in similar timeframe as FDD
 - 3G interworking addressed from day one
- WiMAX industry support declining
 - All major infra vendors supporting LTE

Common FDD and TDD chipset platform



TDD Spectrum

Examples of worldwide TDD Spectrum	Potential Spectrum
2.5/2.6 GHz ¹	50 MHz
2.3 GHz ²	100 MHz

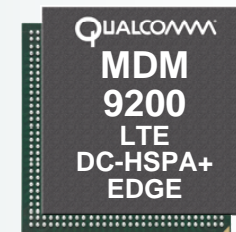
TD-LTE leverages large LTE FDD ecosystem

Industry's First LTE/3G Multimode Chipsets

Common FDD and TDD platform

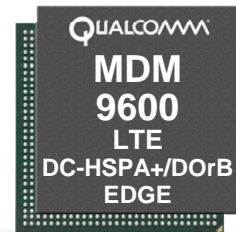
- **MDM9200™: LTE with HSPA+ R8**

- 100 Mbps downlink / 50 Mbps uplink
- Sampling to leading OEMs



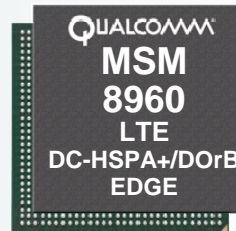
- **MDM9600™: LTE with HSPA+ R8, EV-DO Rev. B**

- 100 Mbps downlink / 50 Mbps uplink
- Sampling to leading OEMs



- **MSM8960™: LTE with HSPA+ R8, EV-DO Rev. B**

- 1GHz applications processor
- 1080p HD encode and decode
- Sampling 2011



Data
Optimized

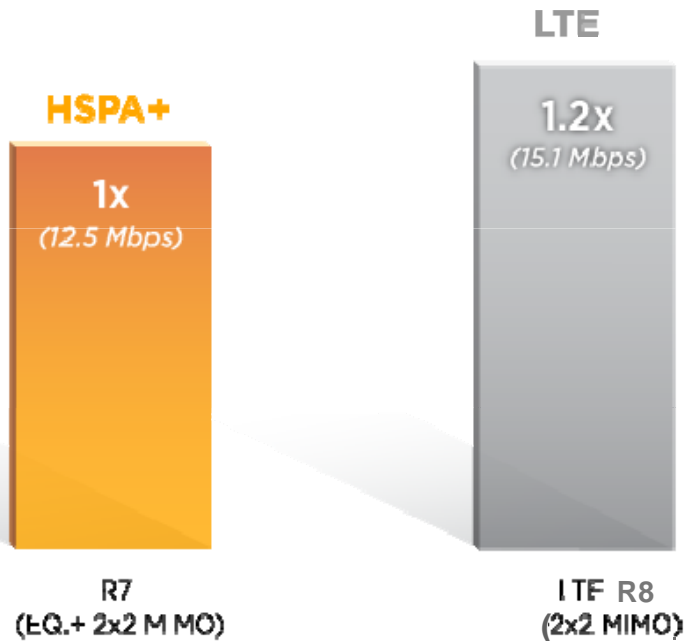
Handset
Optimized

Qualcomm is uniquely positioned to support first multimode LTE deployments

Similar HSPA+ and LTE Performance

Similar Spectral Efficiency

with same number of antennas and bandwidth
(Downlink sector capacity in 10 MHz FDD)



Note: Handset Interference Cancellation and HSPA+ multicarrier would further improve HSPA+ spectral efficiency.

Similar Peak Data Rates

with same bandwidth and number of antennas
(Downlink peak data rate)

Bandwidth	HSPA+	LTE
5 MHz	42 Mbps	37 Mbps
10 MHz	84 Mbps	73 Mbps
20 MHz	Beyond R9	150 Mbps

Note: Assuming 2x2 MIMO. LTE supports 4x4 MIMO but initial deployments will support 2x2 MIMO.

Similar RTT Latency

Transport NW key for low latency—can be same for LTE&HSPA+

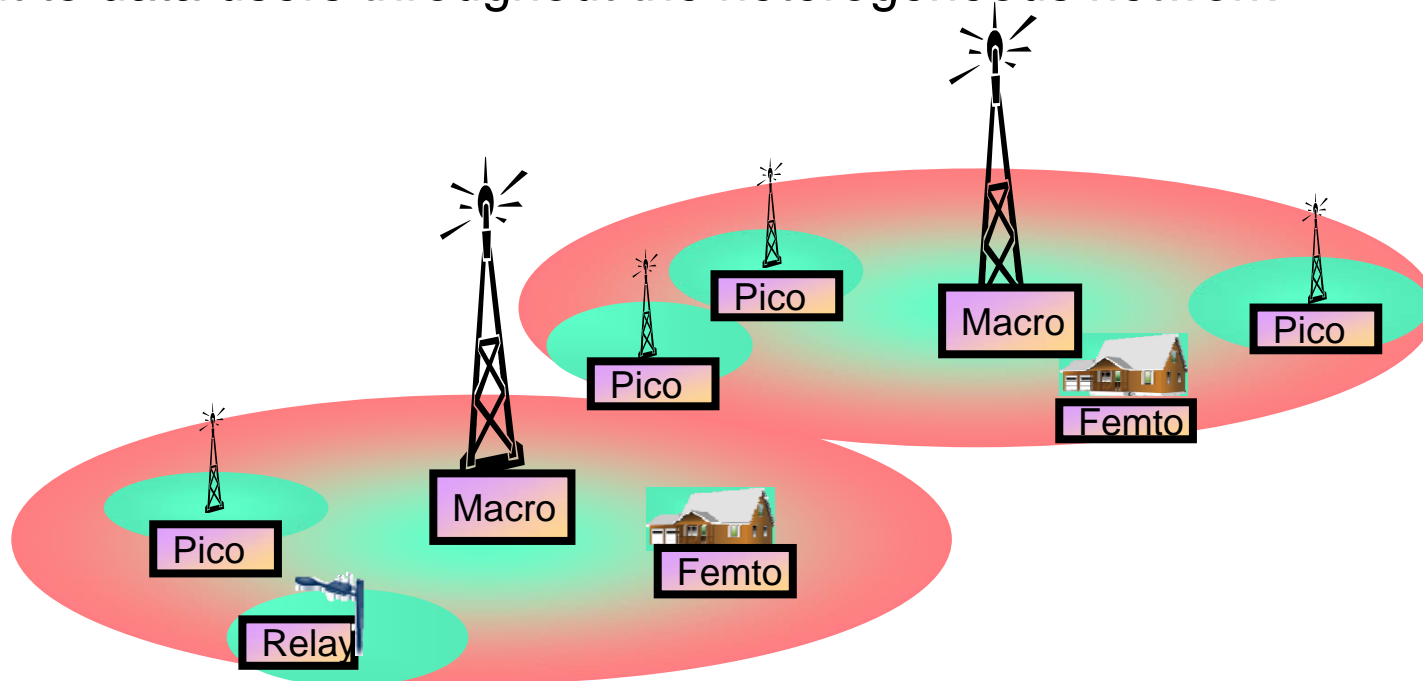
	HSPA+	LTE
RTT ²	28 ms + Transport network	22 ms + Transport network

¹ Source: Qualcomm Simulation, details in 3GPP R1-070674. NGMN 500m ISD, HSPA+ R7 results scaled up from 10 MHz. HSPA+: 16QAM not considered for the UL and UE IC not considered for the DL. HSPA+ multicarrier and DL Interference Cancellation not considered and would narrow the gap with LTE.

² Source: Qualcomm assuming similar operating points, processing delays, excludes transport network delay that is dependent on actual network used

LTE Advanced: Better Performance with Optimized Heterogeneous Networks and Hotspots

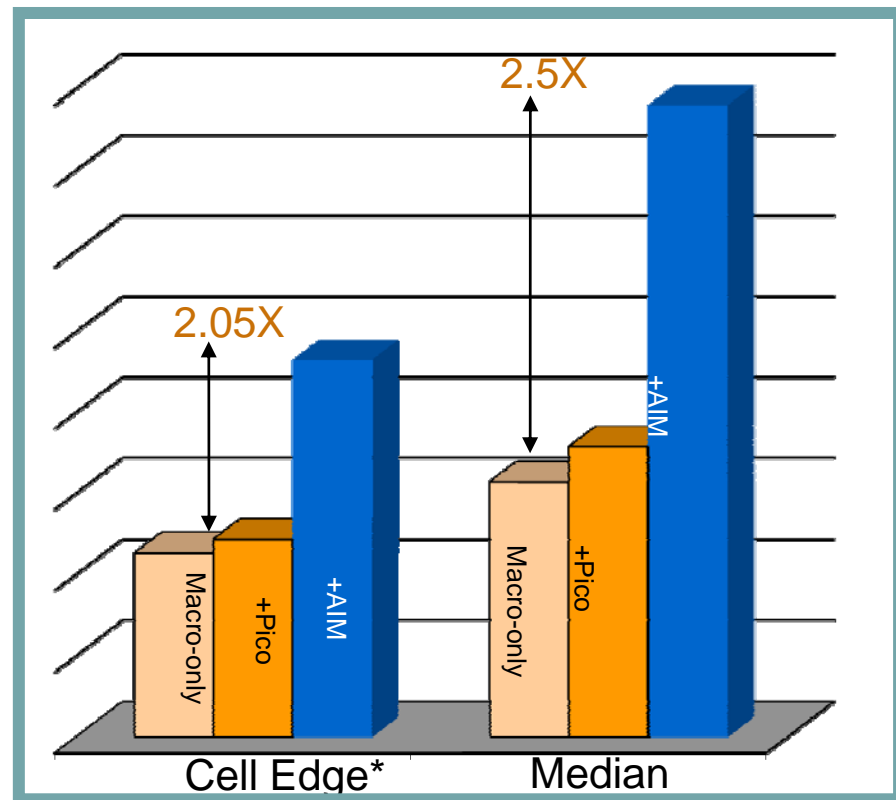
- Target coverage with Macro eNBs for initial deployments
- Pico/Home eNBs and Relay stations added for incremental capacity growth, richer user experience and in-building coverage
- Utilize Advanced Interference Management (AIM) to provide high throughput to data users throughout the heterogeneous network



Better User Experience via LTE-Advanced

- Advanced interference management (AIM)
- **Advanced receivers** so that the devices can detect cells more accurately
- Simple introduction of **Pico eNBs** in the macro environment is not sufficient capacity
 - AIM techniques improve user experience throughout the coverage

DL Throughput Improvements



* Cell edge user is defined as 5 percentile rate user.
Results from 3GPP R1-101509. Evaluation methodology R1-084026
10 MHz FDD, 2x2 MIMO UE, 4 Picos per Macro cell, uniform random layout

LTE: An Optimized OFDMA Solution

L
T
E

Boosts Data Capacity in Dense Urban Areas

Seamless Interoperability with 3G

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 Leading LTE/3G Multimode Chipset

3G multimode required for ubiquitous data coverage and voice services