

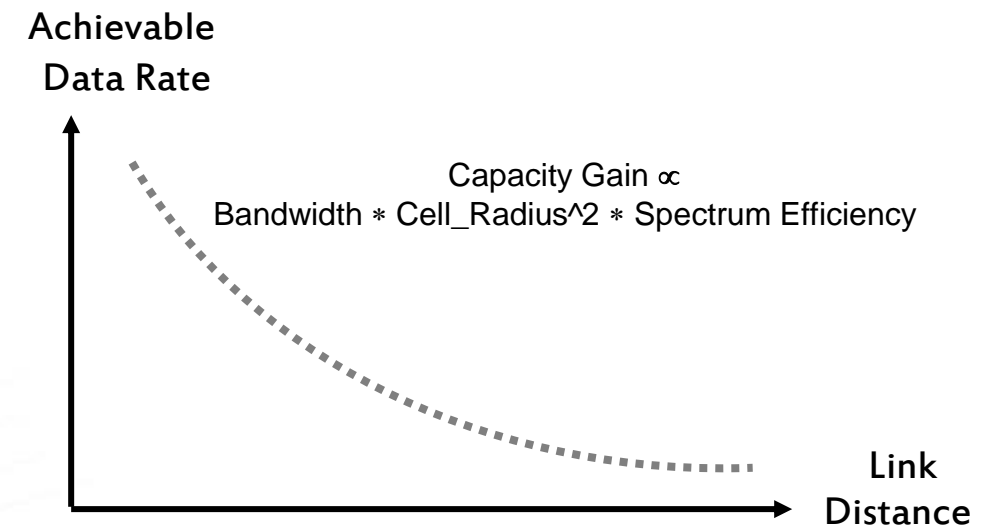
DISCUSSION ON LICENSED-ASSISTED LTE



Broadcom Corporation

- **There is a general need for global, unified and contiguous bandwidth for the use of Telecommunication services**
 - 3GPP has a tendency to specify more and more complex band combinations with Carrier Aggregation, aiming at 1Gbps peak data rates
 - Global unified spectrum usage is welcome – in addition, normal carrier/network planning is needed to serve multiple users instead of focusing just on single user peak data rates
 - Small Cell focus (network densification) targets nicely the goal of providing higher average data rates

Cell densification & more bandwidth:
Achievable end-user data rate improves



■ Proliferation of LTE Carrier Aggregation in 3GPP

- In Rel'11, new UE categories were introduced (e.g. Cat 9 & 10) to support up to 550Mbps (UL+DL)
- In Rel'12, new functions such as 4 component carriers, cross-type (FDD/TDD) Carrier Aggregation, and 256QAM DL modulation were introduced – all to increase the capacity and spectral efficiency

⇒ These are positive developments but they do not solve spectrum shortage

■ In 3GPP Rel'13, LTE-U will be one of the main work items to respond to the need of increased contiguous spectrum

1. Focus will be likely first on downlink (SDL)
 - Quite wide industry consensus in 3GPP
2. Furthermore, LTE-U with Uplink support has been proposed
 - Both TDD CA and DuCo variants have been discussed
 - Likely not enough time to be addressed in Rel'13

Major task in LTE-U is the necessary definition of coexistence mechanisms

Broadcom prefers standardized solutions

- **The power of 3GPP and IEEE comes from defining global solutions**
 - Economies of scale
 - Support for multivendor environment and enabling competition
 - Universal availability of the related technologies
 - Standards support for global interoperability
- **Regional and possible proprietary LTE-U technology means bad results for everybody**
 - Fragmentation and higher costs (no economies of scale)
 - Added work load on specifying regional technologies
 - Added implementation complexities for vendors
 - Uneven technology access for operators
 - Sporadic, incompatible deployments
 - Consumer confusion
 - Non-global LTE-U opens the door for other technology variations

LTE-U MUST address the global market
Same LTE-U technology must be usable in all regions

■ Operator deployed small cells

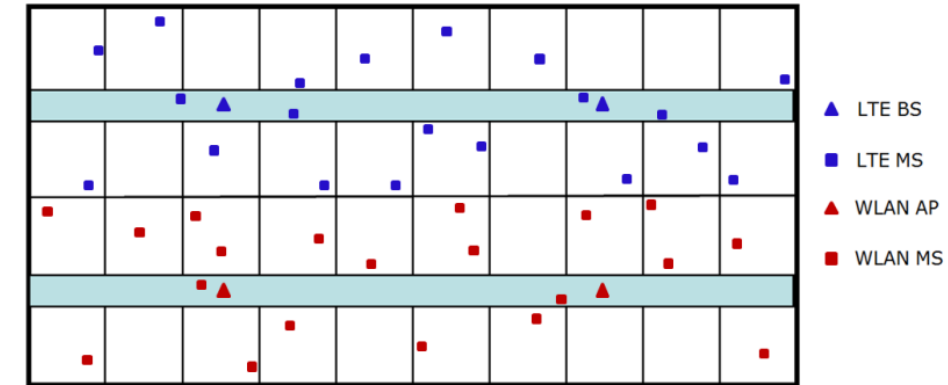
- Multi-floor/multi AP/multi-operator with coordination
- Uncoordinated Wi-Fi (both clients and AP's) included
- Limited number of high bandwidth best-effort users
- Both partially and fully loaded networks
- Hot Spots
- For indoors and outdoors

■ LTE-U supplementing LTE in licensed spectrum

- Forward compatibility of phased introduction of LTE-U needs to be considered
- Both TDD and FDD operations may be considered

■ We would consider additional residential use cases

- Scenarios could be reflected together with DL only and TDD (UL+DL)
- To ensure forward compatibility of e.g. coexistence concept
- ⇒ Bring dense eNB deployment and possibly CSG (uncoordinated deployment?)
- ⇒ Co-located Wi-Fi needs to be considered



**LTE-U study could identify forward-looking (TDD CA and DuCo)
LTE-U deployment scenarios as well**

Broadcom promotes unambiguous, global and standardized solutions

- LTE-U should be standardized if technical studies are promising and industry agreement can be reached
- Rel'13 LTE-U standardization focus on developing SDL

Identify forward-looking^{*)} LTE-U deployment scenarios, including presence of Wi-Fi

- Realistic dynamic traffic models including UL+DL
- Combined performance with UL+DL
- End-to-End performance (TCP)
- Take Small Cell scenarios as a starting point

Ensure efficient overall spectrum usage

- Solve the claimed issues with carrier Wi-Fi management
- Combined licensed + unlicensed bands (LTE-U + Wi-Fi)
- Unlicensed bands (LTE-U + Wi-Fi)
- LTE-U –only and Wi-Fi –only as reference cases
- Consider alternatives to get Wi-Fi reference scenarios/results: e.g. from IEEE 802.11 or WFA

Broadcom is in favor of 3GPP Rel'13 LTE-U standards work

Coexistence and Resource Sharing

- Thorough Robust Co-Existence Mechanism (RCM) studies needed
- Proper and global RCM to be standardized from the outset to avoid problems with legacy systems and to ensure forward compatibility (in LTE-U evolution)
- Mechanisms to give priority to primary Wi-Fi channels, and dynamic resource allocation both in time and frequency domains required for LTE-U
- Study the role of UE in RCM from the beginning, in addition to eNB coexistence functions
- Adaptation of Wi-Fi coexistence principles needs to be considered
- Both functionality and performance of legacy systems shall be secured

Normative 3GPP specification required for RCM in RAN1,2,4,5 groups



Thank You!