Nokia Siemens Networks
TD-LTE whitepaper

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1 Executive summary

The demand for Mobile Broadband is growing rapidly in both mature and emerging markets. Nokia Siemens Networks expects 5 billion people to be connected to the Internet along with a 100-fold traffic increase in networks by 2015. Nokia Siemens Networks' Mobile Broadband Study 2010 reported a 40% increase in average monthly expenditure on Mobile Broadband in comparison to 2009.

Fig 1 indicates that the mobile internet traffic will increase to 23 Exabytes by 2015, which implies that 6.3 billion people will be downloading a digital book every day.

The increasing demand is driving mobile operators to invest significantly in additional frequency spectrum. The operators are increasingly seeing unpaired spectrum as a viable complement to the paired spectrum. The catalyst behind all this is Long Term Evolution (LTE), which was designed to harmonize networks for unpaired as well as paired spectrum. LTE is designed for efficiency, constituting of flat, all-IP architecture with OFDMA (Orthogonal Frequency Division Multiplexing) air interface. LTE and System Architecture Evolution (SAE) are standardized by 3GPP. LTE is the radio part and SAE is the network architecture part specifying the Evolved Packet Core, of the LTE/SAE.

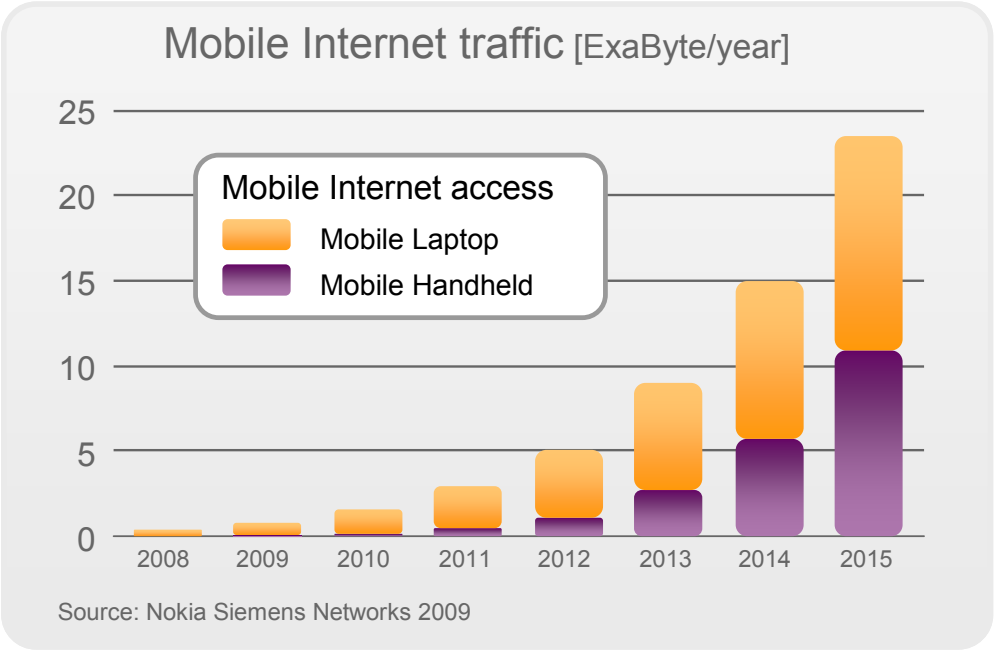

Figure 1 indicates that the mobile internet traffic will increase to 23 Exabytes by 2015, which implies that 6.3 billion people will be downloading a digital book every day.

The LTE standard supports both the Frequency Division Duplex (for paired spectrum) and the Time Division Duplex (for unpaired spectrum) mode of operation.

TDD LTE also known as TD-LTE enables global roaming in an otherwise fragmented spectrum landscape. Until recently, TD-LTE was often seen as a technology for China, India and a few other countries. However, due to nearly 90% commonality between LTE FDD and TD-LTE coupled with the light-speed development of the unpaired spectrum LTE standard, new possibilities are opening up for LTE to attain a truly global reach. Strong commonalities suggest that TD-LTE can have similar economies of scale like FDD- LTE and become an integral part of LTE ecosystem.

2010 will be etched in history as the year, when TD-LTE became a reality and initiated a change in the major paradigms of the Mobile Broadband world. Another characteristic of the 2010 Mobile Broadband market was its worldwide convergence around the 3GPP ecosystem, which resulted in LTE specified for frequency bands to fit into the band plans of all regions. In particular, the unpaired spectrum allocations, which have been widely unused or used with WiMAX or TD-SCDMA, were addressed with TD-LTE.

Pioneering and spearheading LTE development, Nokia Siemens Networks has made a long-term commitment to both the Frequency Division Duplex (FDD) and the Time Division Duplex (TDD) mode of operations.

2 Gaining global momentum

Historically, the world's mobile industry has not favored TDD technologies due to the voice centric nature of the networks and ample availability of FDD spectrum.

TD-LTE is an evolution path for TD-SCDMA, which is China's 3G standard. China Mobile was the first operator to drive TD-LTE and now the technology has gained a global momentum with strong traction towards TDD spectrum. Interest shown by major markets such as India, Russia, Japan, and USA has put TD-LTE on every operator's plan.

Europe's major operators have typically deployed FDD networks but recent trends indicate that operators are increasingly becoming interested in TDD bands. TD-LTE makes those bands an attractive asset with a more realistic pricing and the ability to deliver similar performance and coverage to the FDD version.

TD-LTE is a future proof technology with strong industry support from NGMN (Next Generation Mobile Networks), LSTI (LTE SAE Trial Initiative) and Terminal, Chipset and infrastructure vendors.TD-SCDMA and TD-LTE are the global 3G and LTE standards while the combination of TD-LTE and LTE FDD serves to be the basic foundation for the internationalization of TDD.

Nokia Siemens Networks spearheads LTE development and commercialization with its I-HSPA flat architecture innovation enabling a smooth migration path for operators to LTE.

3 Spectrum

The frequency bands in the world that are likely candidates for LTE deployments are the Cellular, PCS, AWS and Digital Dividend bands. FDD paired spectrum bands are expected to be the most common spectrum blocks. There are spectrum blocks available that could be used in an unpaired approach since TD-LTE is a committed 3GPP standard. Today, TDD spectrum bands allocated in most parts of the world are part of a technology agnostic approach.

Many countries throughout the world have large chunks of unpaired unused spectrum. History also suggests that unpaired spectrum will trade at a much lower price per MHz/population than its FDD equivalent. Key TDD bands are 2.3GHz and 2.6GHz respectively.

3GPP has defined 9 TDD bands for LTE operation (status Oct 2010). Bands 38, 40 and 41 are becoming major global bands. Band 41 is new and has been proposed by Clearwire. It was approved by 3GPP in September 2010 and is to be included in 3GPP Rel.10 (March 2011).

TD LTE has been standardized in 3GPP Release 8, which was completed at the end of 2008. 3GPP Rel9, which was completed in March 2010, provided some minor feature enhancements to the LTE standard. LTE evolves with 3GPP Rel10 to LTE-Advanced (LTE-A) in 3GPP Rel10.

Like FDD LTE, TD-LTE also supports a scalable bandwidth from 1.4, 3, 5, 10, 15 and 20 MHz. Higher bandwidths will be required to achieve optimum performance with the expected data traffic growth.

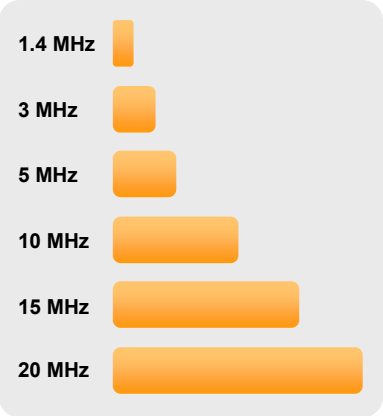

Figure 3 Flexible Bandwidth

Band	MHz	Uplink MHz	Downlink MHz		Region
33	1x20	1900-1920	1900-1920	TDD	UMTS core TDD
34	1x15	2010-2025	2010-2025	TDD	UMTS core TDD
35	1x60	1850-1910	1850-1910	TDD	US (TDD alternative to FDD)
36	1x60	1930-1990	1930-1990	TDD	US (TDD alternative to FDD)
37	1x20	1910-1930	1910-1930	TDD	US
38	1x50	2570-2620	2570-2620	TDD	2600 TDD part
39	1x40	1880-1920	1880-1920	TDD	China UMTS TDD
40	1x100	2300-2400	2300-2400	TDD	China TDD
41	1x194	2496-2690	2496-2690	TDD	US TDD

Figure 2 TDD LTE Bandwidth allocation

4 Positioning

LTE is the next evolution for mobile networks like GSM/EDGE, WCDMA/HSPA, CDMA/EVDO and WiMAX to future networks and services. 'Evolution' in mobile networks always needs to be understood as a longer phase of co-existence of technologies, which eventually ends with a refarming of spectrum bands from one technology to another. LTE is best suited to 3GPP as well as 3GPP2 operators, which makes it a truly global roaming technology.

TD-LTE is an evolutionary path for TD-SCDMA, WiMAX networks and for operators, who have available unpaired spectrum. It also takes care of issues like interworking, co-existence and roaming between different technologies. TD-LTE also helps WiMAX operators in availing an excellent opportunity to join the large 3GPP ecosystem, and leverage benefits of highest economies of scale, roaming and network sharing. The shift from TD-SCDMA and WiMAX to TD-LTE will be a gradual process, thereby, making it important for the two technologies to co-exist with each other.

The global potential and the initial definition of higher-frequency bands also made TD-LTE the ideal capacity option for Communication service providers with LTE FDD deployments. This additional capacity is sought mostly in urban areas, where several base station sites exist. Reuse of sites and equipment on large TD-LTE frequency allocations allow cost-efficient provision of excellent end-user data rates. Moreover, it relieves the threat of congestion on the FDD band. The System Architecture Evolution (SAE) is required in the core network architecture (defined by 3GPP) in order to realize the full benefit of LTE. SAE provides a flat, fully IP based network architecture, consisting of only one node in the user plane of the Core network, thus guaranteeing optimal scalability and reduced cost per bit. Since a circuit switched network is not available anymore, the voice services will be supported as VoIP.

Nokia Siemens Networks is committed towards providing a smooth evolutionary path to every operator's installed base networks. (Please refer to figure 5)

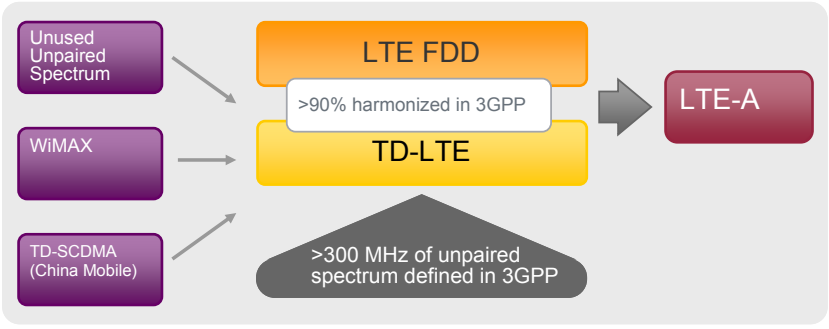

Figure 4 Harmonization of LTE FDD and TD-LTE

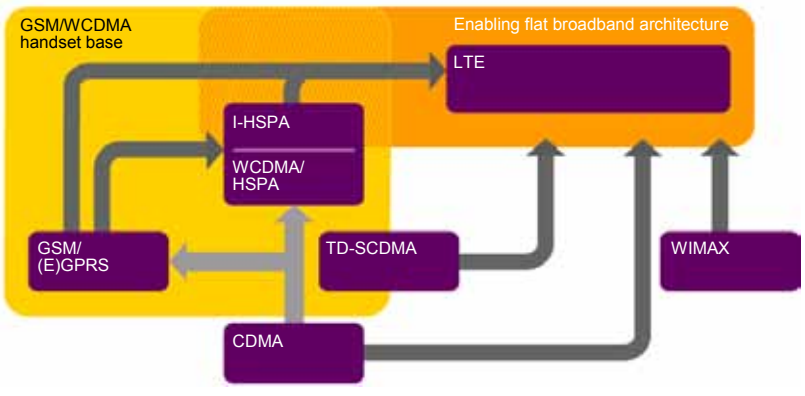

Figure 5 The Evolution of existing networks to LTE

5 Terminal ecosystem

Several leading vendors are actively developing terminals with TD-LTE capabilities. There have also been several announcements from chipset and platform vendors about the upcoming availability of multi-mode LTE (FDD and TDD) offerings. Commercial-scale shipments of such devices are expected to be in sync with operators' commercial service roll-out requirements. Nokia Siemens Networks has recently started the ‘TD-LTE Open Labs’ facilities in Hangzhou to foster and accelerate these developments. The vendors can participate in an end-to-end testing in these open labs and validate their solutions before providing them to the operators.

6 Conclusion

With large amount of globally available unpaired spectrum and growing capacity demands, TD-LTE has gained a lot of traction worldwide coupled with strong commitment from leading operators.

Nokia Siemens Networks is a clear leader in making TD-LTE a part of the commercial Mobile Broadband reality and helping operators around the globe to address new Mobile Broadband opportunities even on an unpaired spectrum. With our unique holistic approach, we are leveraging our global Mobile Broadband presence and rich experience to enable a widespread ecosystem for LTE. We address the network transformation challenges and opportunities most efficiently by offering common platforms and leading all-IP capabilities. Nokia Siemens Networks' Single RAN platform has set a new standard for the next generation mobile networks.

Nokia Siemens Networks being fully committed has made significant contributions to the development of TD-LTE and will continue to lead the industry.

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