

Exhibit 1010



WIRELESS BLOG

The **Wireless Blog** from Unwired Insight discusses the latest developments in wireless networks and services, including the new technologies and architectures of LTE-Advanced and 5G. For expert advice on 2G, 3G, 4G and 5G mobile systems and standards, including GSM, UMTS, LTE, LTE-Advanced and 5G-NR, please **contact us**.

Summary of 3GPP Standards Releases for LTE



Working in the UK, where commercial LTE services are still not available, it is easy to forget that standardisation of LTE has been underway for many years. The first 3GPP standards were frozen way back in 2008, in 3GPP Release 8, and no fewer than five 3GPP releases containing LTE aspects have now received attention in the 3GPP standards arena.

Here I provide a short summary of the 3GPP releases relevant to LTE, including brief highlights of their contents.

3GPP Release 8 – Freeze Date 2008

Release 8 introduced LTE for the first time, with a completely new radio interface and core network, enabling substantially improved data performance compared with previous systems. Highlights included:

- up to 300Mbit/s downlink and 75Mbit/s uplink
- latency down to 10ms
- implementation in bandwidths of 1.4, 3, 5, 10, 15 or 20MHz, to allow for different deployment scenarios
- orthogonal frequency domain multiple access (OFDMA) downlink
- single-carrier frequency domain multiple access (SC-FDMA) uplink
- multiple input multiple output (MIMO) antennas
- flat radio network architecture, with no equivalent to the GSM BSC or UMTS RNC, and functionality distributed among the base stations (eNodeBs)
- all IP core network, the System Architecture Evolution (SAE).

3GPP Release 9 – Freeze Date 2009

Release 9 brought a number of refinements to features introduced in Release 8, along with new developments to the network architecture and new service features. These included:

- introduction of LTE femtocells in the form of the Home eNodeB (HeNB)
- self organising network (SON) features, such as optimisation of the random access channel

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- evolved multimedia broadcast and multicast service (eMBMS) for the efficient delivery of the same multimedia content to multiple destinations
- location services (LCS) to pinpoint the location of a mobile device.

3GPP Release 10 – Freeze Date 2011

Release 10 provided a substantial uplift to the capacity and throughput of the LTE system and also took steps to improve the system performance for mobile devices located at some distance from a base station. Notable features included:

- up to 3Gbit/s downlink and 1.5Gbit/s uplink
- carrier aggregation (CA), allowing the combination of up to five separate carriers to enable bandwidths up to 100MHz
- higher order MIMO antenna configurations up to 8×8 downlink and 4×4 uplink
- relay nodes to support Heterogeneous Networks (“HetNets”) containing a wide variety of cell sizes
- enhanced inter-cell interference coordination (eICIC) to improve performance towards the edge of cells.

3GPP Release 11 – Freeze Date 2013

Release 11 will build on the platform of Release 10 with a number of refinements to existing capabilities, including:

- enhancements to Carrier Aggregation, MIMO, relay nodes and eICIC
- introduction of new frequency bands
- coordinated multipoint transmission and reception to enable simultaneous communication with multiple cells
- advanced receivers.

3GPP Release 12 – Freeze Date 2014

Potential features for Release 12 were discussed at a 3GPP workshop in Slovenia in June 2012. A strong requirement was the need to support the rapid increase in mobile data usage, but other items included the efficient support of diverse applications while ensuring a high quality user experience. Some of the candidates for Release 12 included:

- enhanced small cells for LTE, introducing a number of features to improve the support of HetNets
- inter-site carrier aggregation, to mix and match the capabilities and backhaul of adjacent cells
- new antenna techniques and advanced receivers to maximise the potential of large cells
- interworking between LTE and WiFi or HSPDA
- further developments of previous technologies.

Dr Alastair Brydon has worked in digital radio communications for over 25 years. He provides expert advice on 2G, 3G and 4G mobile systems and standards including GSM, UMTS and LTE. He has written over 40 reports on the development of wireless technologies and services and has acted as an expert witness in major patent disputes.

Tagged with: 3GPP Standards, eICIC, HetNets, Location Services, LTE Carrier Aggregation, MIMO, OFDMA, Relay Nodes, SAE, SC-FDMA, Small Cells

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LTE-Advanced taps into unlicensed spectrum with Licensed Assisted Access

In the quest for substantial increases to the capacity and throughput of mobile networks, unlicensed radio spectrum is expected to have an important role in 5G systems from 2020. However, work is already underway in 3GPP to allow 4G LTE-Advanced networks to take advantage of unlicensed spectrum much sooner. The Licensed Assisted Access (LAA) feature will... [Read more](#)

5G mobile network features

Since my first post on fifth generation (5G) mobile networks, in August 2013, there has been a dramatic upsurge in activity and publicity on the topic. Leading organisations in the mobile industry have become increasingly vocal, in white papers, conferences and press releases, about the benefits of 5G, the technologies they expect to feature and the... [Read more](#)

HSPA+ goes from strength to strength

With all the focus on LTE, LTE-Advanced and now 5G, it is easy to forget that High Speed Packet Access (HSPA/HSPA+), based on 3G WCDMA, is still the dominant mobile broadband technology worldwide. In February 2014, the Global mobile Suppliers Association (GSA) reported that all WCDMA operators had launched HSPA, with 547 networks providing access to... [Read more](#)

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