Enabling LTE-Advanced

FDD Bands

EUTRA Band #	Uplink (UL) MHz BS receive	Downlink (DL) MHz BS transmit	BW MHz
1	1920 – 1980	2110 – 2170	60
2	1850 – 1910	1930 – 1990	60
3	1710 – 1785	1805 – 1880	75
4	1710 – 1755	2110 – 2155	45
5	824 – 849	869 – 894	25
6	830 – 840	875 – 885	10
7	2500 – 2570	2620 – 2690	70
8	880 – 915	925 – 960	35
9	1749.9 – 1784.9	1844.9 – 1879.9	35
10	1710 – 1770	2110 – 2170	60
11	1427.9 – 1447.9	1475.9 – 1495.9	20
12	699 – 716	729 – 746	17
13	777 – 787	746 – 756	10
14	788 – 798	758 – 768	10
15	Reserved	Reserved	
16	Reserved	Reserved	
17	704 – 716	734 – 746	12
18	815 – 830	860 – 875	15
19	830 – 845	875 – 890	15
20	832 – 862	791 – 821	30
21	1447.9 – 1462.9	1495.9 – 1510.9	15
22	3410 – 3490	3510 – 3590	80
23	2000 – 2020	2180 – 2200	20
24	1626.5 – 1660.5	1525 – 1559	34
25	1850 – 1915	1930 – 1995	65
26	814 – 849	859 – 894	35
27	807 – 824	852 – 869	17
28	703 – 748	758 – 803	45
29	N/A – N/A	717 – 728	11
30	2305 – 2315	2350 – 2360	10
31	452.5 – 457.5	462.5 – 467.5	5
32	N/A – N/A	1452 – 1496	44

TDD Bands

EUTRA Band #	Uplink (UL) MHz BS receive	Downlink (DL) MHz BS transmit	BW MHz
33	1900 – 1920	1900 – 1920	20
34	2010 – 2025	2010 – 2025	15
35	1850 – 1910	1850 – 1910	60
36	1930 – 1990	1930 – 1990	60
37	1910 – 1930	1910 – 1930	20
38	2570 – 2620	2570 – 2620	50
39	1880 – 1920	1880 – 1920	40
40	2300 – 2400	2300 – 2400	100
41	2496 – 2690	2496 – 2690	194
42	3400 – 3600	3400 – 3600	200
43	3600 – 3800	3600 – 3800	200
44	703 – 803	703 – 803	100

Release 12 Features

- FDD-TDD Carrier Aggregation
- 256 QAM for increased DL data rates
- Dual connectivity for increased DL and UL data rates
- Cat 0 UE for machine type communications
- LTE-U, LTE CA in the unlicensed spectrum (ie 5 GHz WiFi band) can be used in China, Korea, India and US
- Proximity-based services (ProSe)

Release 13 Features

- LAA, License-Assisted Access enabling use of 5 GHz WiFi band for LTE CA in all regions
- LWA, LTE-WiFi Aggregation, a variation of dual connectivity
- Cat M low complexity UE (1.4 MHz bandwidth only) for machine type communications with extended battery life
- Public Safety LTE
- Inter-eNB CoMP

LTE User Equipment Categories

3GPP Release	UE Category	Max L1 DL data rate Mbps	Max L1 UL data rate Mbps	Channel features	Max DL Transport Block size (bits/TTI)	Max UL Transport Block size (bits/TTI)
Rel-12	Category 0	1	1	SISO	1000	1000
Rel-8	Category 1	10.3	5.2	SISO	10296	5160
Rel-8	Category 2	51	25.5	2x2 MIMO DL	51024	25456
Rel-8	Category 3	102	51	2x2 MIMO DL	102048	51024
Rel-8	Category 4	150.8	51	2x2 MIMO DL	150752	51024
Rel-8	Category 5	299.6	75.4	4x4 MIMO DL, 64QAM UL	299552	75376
Rel-10	Category 6	301.5	51	CA (2CC) DL, 16QAM UL	301504	51024
Rel-10	Category 7	301.5	102	CA DL & UL (2CC), 16QAM UL	301504	102048
Rel-10	Category 8	2998.6	1497.8	8x8 MIMO DL, CA (5CC), 64QAM UL	2998560	1497760
Rel-11	Category 9	452.2	51	CA (3CC) DL	452256	51024
Rel-11	Category 10	452.2	102	CA (3CC) & UL (2CC)	452256	102048
Rel-12	Category 11	603	51	CA (3CC) & 256QAM DL	603008	51024
Rel-12	Category 12	603	102	CA (3CC) & 256QAM DL, 2CC UL	603008	102048
Rel-12	Category 13	391.6	150.7	CA (2CC) & 256QAM	391632	150752
Rel-12	Category 14	3916.6	1497.8	256QAM, 8x8 MIMO, CA (5CC)	3916560	1497760
Rel-12	Category 15	798.8	150.7	256QAM, CA (4CC)	798800	150752
Rel-12	Category 16	1051.4	150.7	256QAM, CA (5CC)	1051360	150752

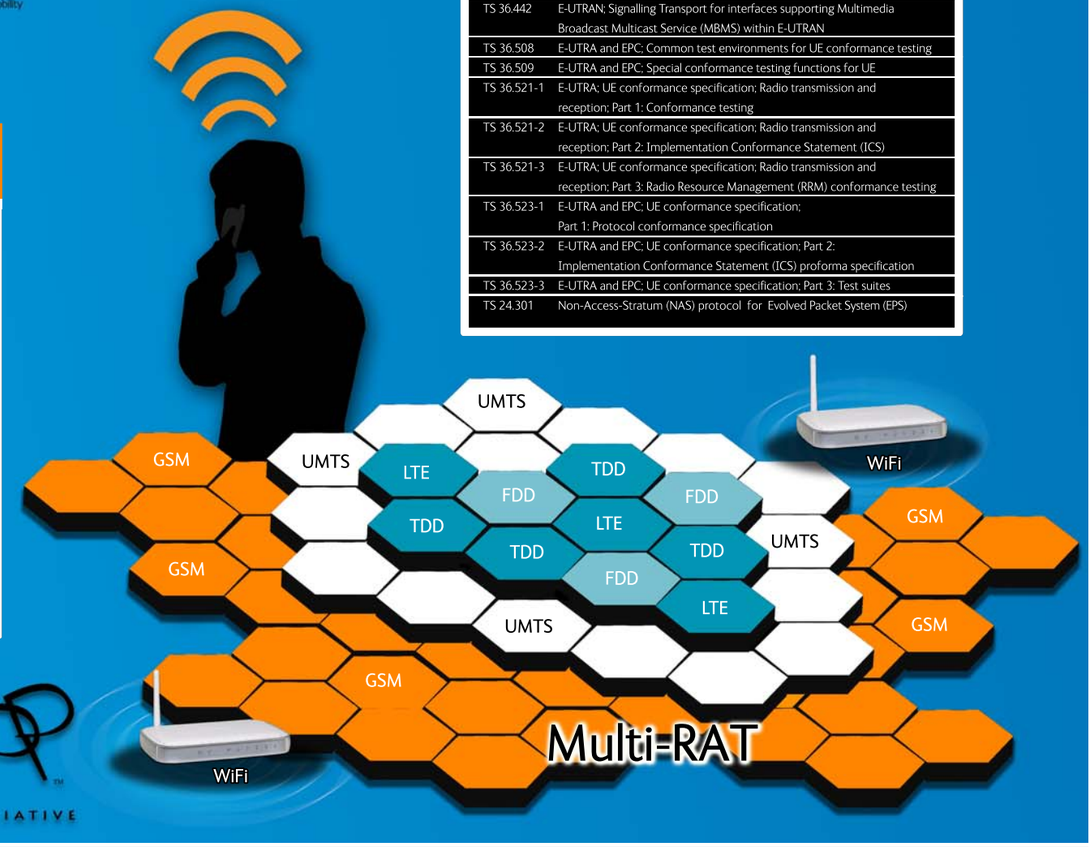
TDD Frame Structure

Uplink-downlink Configuration	Downlink to uplink switch periodicity	Subframe Number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	D	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	10 ms	D	S	U	U	U	D	S	U	U	D

LTE-A and IMT Advanced Comparison

		Release 8 LTE	LTE-Advanced	IMT-Advanced Target
Peak Data Rate	Downlink	300 Mbps	1 Gbps	1 Gbps*
	Uplink	75 Mbps	500 Gbps	
Peak Spectrum Efficiency [bps/Hz]	Downlink	15 (4x4 MIMO)	30 (8x8 MIMO)	15 (4x4 MIMO)
	Uplink	3.75 (64QAM SISO)	15 (up to 4X4 MIMO)	6.75 (2x4 MIMO)

*100 Mbps for high mobility and 1 Gbps for low mobility



3GPP Specifications

3GPP Specifications	
TS 36.101	E-UTRA; UE radio transmission and reception
TS 36.104	E-UTRA; BS radio transmission and reception
TS 36.133	E-UTRA; Requirements for support of radio resource management
TS 36.141	E-UTRA; BS conformance testing
TS 36.201	E-UTRA; LTE physical layer; General description
TS 36.211	E-UTRA; Physical channels and modulation
TS 36.212	E-UTRA; Multiplexing and channel coding
TS 36.213	E-UTRA; Physical layer procedures
TS 36.214	E-UTRA; Physical layer; Measurements
TS 36.216	E-UTRA; Physical layer for relaying operation
TS 36.300	E-UTRA and E-UTRAN; Overall description; Stage 2
TS 36.302	E-UTRA; Services provided by the physical layer
TS 36.304	E-UTRA; UE procedures in idle mode
TS 36.306	E-UTRA; UE radio access capabilities
TS 36.307	E-UTRA; Requirements on UEs supporting a release-independent frequency band
TS 36.314	E-UTRA; Layer 2 - Measurements
TS 36.321	E-UTRA; Medium Access Control (MAC) protocol specification
TS 36.322	E-UTRA; Radio Link Control (RLC) protocol specification
TS 36.323	E-UTRA; Packet Data Convergence Protocol (PDCP) specification
TS 36.331	E-UTRA; Radio Resource Control (RRC); Protocol specification
TS 36.401	E-UTRAN; Architecture description
TS 36.440	E-UTRAN; General aspects and principles for interfaces supporting Multimedia Broadcast Multicast Service (MBMS) within E-UTRAN
TS 36.441	E-UTRAN; Layer 1 for interfaces supporting Multimedia Broadcast Multicast Service (MBMS) within E-UTRAN
TS 36.442	E-UTRAN; Signalling Transport for interfaces supporting Multimedia Broadcast Multicast Service (MBMS) within E-UTRAN
TS 36.508	E-UTRA and EPC; Common test environments for UE conformance testing
TS 36.509	E-UTRA and EPC; Special conformance testing functions for UE
TS 36.521-1	E-UTRA; UE conformance specification; Radio transmission and reception; Part 1: Conformance testing
TS 36.521-2	E-UTRA; UE conformance specification; Radio transmission and reception; Part 2: Implementation Conformance Statement (ICS)
TS 36.521-3	E-UTRA; UE conformance specification; Radio transmission and reception; Part 3: Radio Resource Management (RRM) conformance testing
TS 36.523-1	E-UTRA and EPC; UE conformance specification; Part 1: Protocol conformance specification
TS 36.523-2	E-UTRA and EPC; UE conformance specification; Part 2: Implementation Conformance Statement (ICS) proforma specification
TS 36.523-3	E-UTRA and EPC; UE conformance specification; Part 3: Test suites
TS 24.301	Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS)

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