

1.1 Progress of IEC technical committees



IEC working group documents of interest, circulated in Mar/Apr are noted below. Copies for WG use are available for the purpose of contribution to their content. The list is provided to increase awareness of international IEC standardisation work.

More information is available at <http://www.iec.ch/dyn/www/f?p=103:63:5696885606248##ref=menu>

Dependable systems for all sectors http://www.iec.ch/etech/2015/etech_0315/tech-5.htm

IEC systems committee for smart energy http://www.iec.ch/etech/2015/etech_0115/tc-1.htm

The great potential of wearables http://www.iec.ch/etech/2015/etech_0115/tech-7.htm

- **SyCAAL – Active assisted living**
 - SyCAAL/11/MTG Presentations from SyCAAL meeting on 3-4 Mar, Frankfurt....Presentations
- **TC7 – Overhead electrical conductors**
 - 7/638/FDIS Method for fatigue testing of conductors.....IEC 62568
 - 7/639/CD Aluminium wires for concentric lay stranded conductorsIEC 62641
- **TC9 – Electrical equipment and systems for railways**
 - 9/2017/CDV DC switchgear – Indoor DC disconnectors and earthing.....IEC 61992-3
 - 9/2018/CDV DC switchgear – Outdoor DC disconnectors and earthing.....IEC 61992-4
 - 9/2023/FDIS Software for railway control and protection systems.....IEC 62279
 - 9/2028/CD Energy measurement on board trains, generalIEC 62888-1
 - 9/2029/FDIS Train communication network profile (TCN)IEC 61375-2-3
- **TC13 – Electrical energy measurement and control**
 - 13/1605/CDV Local data transmission profiles for local networks.....IEC 62056-7-5
- **TC14 – Power transformers**
 - 14/812/CDV Liquid immersed phase-shifting transformersIEC 60076-57-1202
 - 14/816/CD Power transformers for wind turbine applications.....IEC/IEEE 60076-16
- **TC15 – Solid electrical insulating materials**
 - 15/751/FDIS Resin based reactive compounds for electrical insulation.....IEC 60455-2
 - 15/752/CD Heat shrinkable polyolefin moulded shapes for LVIEC 62677-3-101
 - 15/753/CD Heat shrinkable polyolefin anti-tracking moulded shapesIEC 62677-3-102
- **TC17 – Switchgear and controlgear**
 - 17A/1085/CD Common specification for AC switchgear and controlgear.....IEC 62271-1
 - 17A/1090/CD Guide to IEC stds on HV AC circuit breakersIEC 62271-306
 - 17A/1092/CD Inductive load switchingIEC 62271-110
 - 17A/1093/CD Alternating current circuit breakers.....IEC 62271-100
 - 17C/622/CDV Compact equipment assemblies for distribution substation ...IEC 62271-212
 - 17C/625/DTR Guide for extension of type test validity above 1kVIEC 62271-307
- **TC21 – Secondary cells and batteries**
 - 21/852/CDV Safety reqs of nickel-metal hydride cells and modules.....IEC 61982-4
 - 21/855/CDV Safety reqs of secondary lithium-ion cells for EV'sIEC 62660-3
 - 21A/575/CDV Vented nickel-cadmium prismatic rechargeable cellsIEC 60623
- **TC22 – Power electronic systems and equipment**
 - 22F/378/DTR HVDC, guide to design of AC filters, overviewIEC 62001-1
 - 22F/379/DTR HVDC, guide to design of AC filters, equipmentIEC 62001-4
 - 22G/293/CDV Adjustable speed drive systems, functional safety reqsIEC 61800-5-2
 - 22G/295A/CD Adjustable speed drive systems, elec & thermal safety reqs ..IEC 61800-5-1
 - 22G/303/FDIS Adjustable speed drive systems, general requirementsIEC 61800-2
 - 22H/192/CD UPS – product category rules for life cycle declarations.....IEC 62040-4-1
- **TC23 – Electrical accessories**
 - 23E/887/CDV Circuit breakers for ac and dc operation.....IEC 60898-2
 - 23E/902/NP Req's for auto-reclosing devices (ARDs) for circuit breakersNew proposal

- 23G/345/FDIS Appliance couplers, general requirementsIEC 60320-1
- 23H/325/CD Reqs for plugs, socket-outlets, ship connectors (LVSC)IEC 60309-5
- 23J/390/CDV Switches for appliances, general requirementsIEC 61058-1
- 23J/391/CDV Switches for appliances, reqs for mechanical switchesIEC 61058-1-1
- 23J/392/CDV Switches for appliances, reqs for electronic switchesIEC 61058-1-2
- **TC26 – Electric welding**
 - 26/564/CD Human exposure to EMF from resistance welding processes .IEC 62822-3
- **TC31 – Equipment for explosive atmospheres**
 - 31/1173/CDV Performance reqs of detectors for flammable gases.....IEC 60079-29-1
 - 31/1191/FDIS Electrical resistance trace heating, general and test reqs... IEC/IEEE 60079-30-1
 - 31/1192/CD Performance reqs of detectors for toxic gasesIEC 62990-1
- **TC33 – Power capacitors and their application**
 - 33/578/FDIS Series capacitors for power systems, general.....IEC 60143-1
- **TC34 – Lamps and related equipment**
 - 34A/1847/CD Reliability testing for LED light sources and LED luminairesIEC/TS 62861
 - 34B/1738/FDIS Lamp capsIEC 60061-1
 - 34B/1775/CDV Lampholders for double-capped linear LED-lampsIEC 60838-2-3
 - 34B/1784-5/CDV Lampholders, gaugesIEC 60061-2/3
 - 34C/1155/FDIS Safety reqs of capacitors for use in tubular fluorescentsIEC 61048
- **TC37 – Surge arrestors**
 - 37A/273/FDIS SPD selection and application principlesIEC 61643-22
 - 37B/135/CDV Reqs and tests for lightning isolation transformers (LIT)IEC 61643-351
- **TC40 – Capacitors and resistors for electronic equipment**
 - 40/2361/CDV Fixed aluminium electrolytic cap’s with MnO₂ electrolyteIEC 60384-4
 - 40/2381/FDIS Metallized polyphenylene sulphide film SMD DC cap’sIEC 60384-20
 - 40/2832/FDIS Tantalum electrolytic SMD cap’s with conductive polymer.....IEC 60384-24
 - 40/2383/FDIS Aluminium electrolytic SMD cap’s with conductive polymer ..IEC 60384-25
- **TC45 – Nuclear instrumentation**
 - 45/787/CD Electron linear acceleratorIEC 62976
 - 45A/1014/CD Requirements for coordinating safety and cybersecurity.....IEC 62859
 - 45A/1008A/FDIS Optical time domain reflectometryIEC/IEEE 62582-5
 - 45A/1016/CD Centralised systems for continuous monitoringIEC 61504
 - 45A/1018/CD Categorization of functions and systemsIEC 61226
 - 45A/1003/CDV Supplementary control room for reactor shutdownIEC 60965
- **TC46 – Cables, wires, waveguides, RF connectors**
 - 46/551/FDIS Screening attenuation measurement by reverb chamberIEC 61726
 - 46A/1256/FDIS Sectional specification for radiating cables.....IEC 61196-4
 - 46C/1009/CDV Cables for channels up to 2 GHzIEC 61156-9
 - 46C/1010/CDV Cables for cords for use up to 2 GHz.....IEC 61156-10
- **TC47 – Semiconductor devices**
 - 47/2226/CDV Neutron beam irradiated SEE test methodIEC 60749-44
 - 47/2227/CDV Human body comm, functional type & operational condn’s...IEC 62779-3
 - 47/2229/CDV Thermo power based thermoelectric energy harvestingIEC 62830-2
 - 47E/499/CDV Microwave diodes and transistors.....IEC 60747-4
 - 47E/500/CDV Microwave integrated circuits – amplifiersIEC 60747-16-1
 - 47F/220/CDV Vibration driven MEMS electret energy harvesting devices....IEC 62047-28
- **TC48 – Electrical connectors and mechanical structures**
 - 48B/2432/NP Rectangular connectors, unshielded, free & fixed 10 wayIEC 61076-3-119
 - 48D/585A/CD Aisle containment for IT cabinets – dimensionsIEC 62966-1
 - 48D/586/CD tests of security aspects for indoor cabinetsIEC 61587-6
- **TC49 – Piezoelectric, dielectric and electrostatic devices**
 - 49/1126/CDV Test fixture for surface mounted quartz crystal unitsIEC 60444-8
 - 49/1141/CD Outline drawings of SMD devices, general rulesIEC 61240
 - 49/1143/FDIS SAW and BAW duplexers – generic specificationIEC 62604-1
 - 49/1145/NP Chemical sensor devices using piezoelectric vibrations.....New proposal

- **TC56 – Dependability**
 - 56/1617/CD Open systems dependability.....IEC 62853
- **TC57 – Power systems management and associated information exchange**
 - 57/1533/CDV Precision time protocol for power utility automationIEC 61850-9-3
 - 57/1565/CD Cyber security key management for power systemsIEC 62351-9
 - 57/1566/FDIS Interfaces for maintenance and constructionIEC 61968-6
- **TC59 – Performance of household and similar electrical appliances**
 - 59F/279/NP High pressure cleaners and steam cleaners.....IEC 62885-x
 - 59K/263A/CDV Ranges, ovens, steam ovens and grills, performanceIEC 60350-1
- **TC61 – Safety of household and similar electrical appliances**
 - 61D/297-9/CDV Reqs for electrical heat pumps, air-con’s and dehumidifiers ..IEC 60335-2-40
 - 61J/614/CD Reqs for vacuum cleaners and dust extractors.....IEC 62784
- **TC62 – Electrical equipment in medical practice**
 - 62D/1246/CD Reqs for haemodialysis and haemodiafiltration equipment....IEC 60601-2-16
 - 62D/1247/CD Reqs for peritoneal dialysis equipmentIEC 60601-2-39
 - 62D/1248/CDV Reqs for respiratory humidifying equipment.....ISO 80601-2-74
- **TC65 – Industrial process measurement, control and automation**
 - 65/594/CD Particular reqs for control equipmentIEC 61010-2-201
 - 65B/971-3/CDV Industrial and process measurement transmitters.....IEC 62828-1/2/3
 - 65B/978/CDV Industrial process control valves, inspection and testingIEC 60534-4
 - 65B/991/NP Industrial inspecting thermal imagersNew proposal
 - 65B/992/CD List of properties of valve/actuator accessoriesIEC 61987-24-2
 - 65B/993/CD List of properties of flow modification accessoriesIEC 61987-24-3
 - 65B/996-9/FDIS List of properties of automated valves for data exchangeIEC 61987-21to24
 - 65C/813/CD Wireless communication network (WIA-FA).....IEC 62948
- **TC66 – Safety of measuring, control and laboratory equipment**
 - 66/562A/CDV Particular safety reqs for machinery.....IEC 61010-2-120
 - 66/570/FDIS Particular reqs for sterilizers and washer-disinfectorsIEC 61010-2-40
- **TC76 – Optical radiation safety and laser equipment**
 - 76/519/FDIS Photobiological safety of lamps and lamp systemsIEC 62471-5
- **TC77 – Electromagnetic compatibility**
 - 77A/884/CD Limitation of voltage changes, fluctuation and flickerIEC 61000-3-3
 - 77A/887/CD Limitation of voltage changes, fluctuation and flickerIEC 61000-3-11
 - 77B/726/CDV AC mains ports broadband conducted immunity testIEC 61000-4-31
 - 77B/728/CDV Pulse magnetic field immunity test.....IEC 61000-4-9
 - 77B/730/CDV Damped oscillatory magnetic field immunity testIEC 61000-4-10
- **TC79 – Alarm and electronic security systems**
 - 79/502/CDV Building intercom systems – general requirementsIEC 62820-1-1
- **TC82 – Solar photovoltaic energy systems**
 - 82/962/FDIS Transportation and shipping of PV module stacksIEC 62759-1
- **TC86 – Fibre optics**
 - 86A/1645/CDV Optical fibres, general product specificationsIEC 60793-2
 - 86A/1651/CDV Optical fibre cables, generic specification, generalIEC 60794-1-1
 - 86A/1653/CDV Optical cables, outdoor optical fibre for rapid deploymentIEC 60794-3-70
 - 86A/1661/FDIS Optical fibres, category A3 multimode fibresIEC 60793-2-30
 - 86B/3879/CDV Fibre optic interconnecting devices, thermal shocks.....IEC 61300-2-47
 - 86B/3901/CD Fibre optic interconnecting devices, bending test for cords....IEC 61300-2-52
 - 86C/1302/CDV Reliability, Laser modules used for telecommunicationIEC 62572-3
 - 86C/1304/CDV Dynamic modules, 1x9 wavelength selective switchIEC 62343-4-1
 - 86C/1315/FDIS Tuneable chromatic dispersion compensatorIEC 62343-1-2
- **TC87 – Ultrasonics**
 - 87/568/MTG Presentation from TC87 meeting on 9-13 Mar, Teddington....Presentations
- **TC91 – Electronics assembly technology**
 - 91/1257/PAS Device embedded substrate, guidelines, data formatIEC 62878-2-5
 - 91/1241/CDV Documentation and guidance on test T: solderingIEC 60068-3-13

- **TC94 – All-or-nothing electrical relays**
 - 94/387/CD Electromechanical elementary relays, reliabilityIEC 61810-2
- **TC100 – Audio, video and multimedia systems and components**
 - 100/2457A/CDV Colour management, extended gamut YCC colour spaceIEC 61966-2-4
- **TC104 – Environmental conditions, classification and methods of test**
 - 104/655/FDIS Test Ke: flowing mixed gas corrosion testIEC 60068-2-60
- **TC110 – Electronic display devices**
 - 110/661/FDIS LCD cells – blank detail specificationIEC 62906-1-2
 - 110/662/CD Flexible display devices, optical performanceIEC 62715-5-1
 - 110/658/CD Electronic paper displays, environmental test methodIEC 62679-4-2
 - 110/659/CD OLED displays, measuring methods transparent properties ...IEC 62341-6-4
 - 110/645/CDV Optical measuring methods of speckle contrastIEC 62906-5-2
- **TC112 – Electrical insulation systems**
 - 112/324/CD Dielectric & resistive properties, frequencies 0.1 to 10MHz ...IEC 62631-2-1
 - 112/325/CD Thermal evaluation of hermetic motor-compressorsIEC 62332-3
- **TC113 – Nanotechnology standardization**
 - 113/259/CD Quantum phenomena in nanotechnologyISO 80004-12
- **TC116 – Safety of motor-operated electric tools**
 - 116/217/CDV Safety reqs of transportable threading machinesIEC 62841-3-12
 - 116/222/FDIS Safety reqs of hand-held planersIEC 62841-2-14
 - 116/223/NP Safety reqs of hedge trimmersIEC 62841-4-2
- **CISPR – International special committee on radio interference**
 - CIS/F/663/CD Measurement of radio disturbance of electrical lightingCISPR 15

1.2 Progress of CENELEC (EU) technical committees



CENELEC working group documents of interest, circulated in Mar/Apr are noted below. Copies for WG use are available for the purpose of contribution to their content. The list is provided to increase awareness of European standardisation work.

More info at http://www.cenelec.eu/dyn/www/f?p=104:78:249705853254301:::FSP_LANG_ID:25

- **CLC/TC 9X – Electrical and electronic applications for railways**
 - Railway applications – EMC – General EN 50121-1
 - Railway applications – EMC – Emission of the whole system to the world EN 50121-2
 - Railway applications – EMC – Rolling stock – Train and complete vehicle EN 50121-3-1
 - Railway applications – EMC – Rolling stock – Apparatus EN 50121-3-2
 - Railway applications – EMC – Signalling and telecommunication apparatus EN 50121-4
 - Railway applications – EMC – Power supply installations and apparatus EN 50121-5
- **CLC/TC13 – Electricity metering data exchange**
 - PRIME PLC communication profile for neighbourhood networks CLC 52056-8-4
 - G3-PLC communication profile for neighbourhood networks CLC 52056-8-5
 - AMC-SS PLC communication profile for neighbourhood networks CLC 52056-8-7
- **CLC/TC 210 – Electromagnetic compatibility (EMC)**
 - Immunity – Product family standard EN 55014-2
 - Supplement for grid connected power converters (GCPC) CISPR 11
 - Radio disturbance characteristics – Limits and methods of measurement EN 55013
 - Radiated disturbance measurement EN 55016-2-3
- **CLC/TC 215 – Electrotechnical aspects of telecommunication equipment**
 - Telecommunications cabling infrastructure EN 50600-2-4
 - Cabling installation - Remote powering CLC 50174-99-1

1.3 Progress of ETSI (EU) technical committees



3GPP specification group documents of interest, are recorded on the 3GPP website. Copies can be downloaded for free from [current status list \(warning: large file!\)](#).



ETSI working group documents of interest, **excluding** 3GPP, published in Mar/Apr are noted below. Copies can be downloaded from <http://portal.etsi.org/>

ETSI launches Quantum Safe Cryptography WG <http://www.etsi.org/news-events/news/947-2015-03-news-etsi-launches-quantum-safe-cryptography-specification-group>

DG Energy discussion of standards for smart energy grids <http://www.etsi.org/news-events/news/889-2015-02-press-standardization-experts-discuss-next-steps-in-development-of-standards-for-smart-energy-grids>

Fourth ETSI workshop on Smart Appliances, 1 April, Brussels
http://docbox.etsi.org/Workshop/2015/201504_SMARTAPPLIANCES4/

- **ERM – Electromagnetic compatibility and radio spectrum matters**
 - [Guide to the impact of the RED \(2014/53/EU\)](#).....EG 201 399 v3.1.1
 - VHF air-ground digital link (VDL) mode 2.....EN 301 841-3 v1.2.1
 - Test spec for the RFID interoperability test event in Brazil May 2013.....TS 103 302 v1.1.1
- **SCP – Smart cards**
 - UICC-terminal interface - physical, electrical and logical specification.....TS 102 230 v10.2.0
 - UICC-terminal interface – Card application toolkit conformance spec.....TS 102 384 v10.2.0
 - Test specification for single wire protocol – Terminal features.....TS 102 694-1 v10.2.0
 - Test specification for single wire protocol – UICC featuresTS 102 694-2 v10.3.0
 - Test specification for the host controller – Terminal features.....TS 102 695-1 v10.1.0
 - Test specification for the host controller – UICC featuresTS 102 695-2 v10.0.1
 - Test specification for the UICC API for Java CardTS 102 268 v7.0.0
 - Test specification for the UICC API for Java Card contactless application . TS 103 115 v9.4.0
- **OneM2M – Machine to machine communication**
 - [Analysis of the architectures proposed for consideration by oneM2M](#)TR 118 502 v1.0.0
 - [Study for the merging of architectures by oneM2M](#)TR 118 503 v1.0.0
- **TTR – Terrestrial trunked radio**
 - Conformance test specification – Radio.....EN 300 394-1 v3.3.1
- **NTECH – Network technologies**
 - E2 interface based on DIAMETER protocolES 283 035 v3.1.1
- **SES – Satellite earth stations and systems**
 - Hybrid FSS satellite/terrestrial network architectureTR 103 272 v1.1.1
- **BRAN – Broadband radio access networks**
 - 5GHz high performance RLAN.....EN 301 893 v1.8.1
- **DECT – Digital enhanced cordless telecommunications**
 - Common interface – OverviewEN 300 175-1 v2.5.4
 - Common interface – Physical layer (PHL)EN 300 175-2 v2.5.6
 - Common interface – Medium access control (MAC)EN 300 175-3 v2.5.8
 - Common interface – Data link control layer(DLC).....EN 300 175-4 v2.5.9
 - Common interface – Network layer (NWK)EN 300 175-5 v2.5.8
 - Common interface – Identities and addressingEN 300 175-6 v2.5.4
 - Common interface – Security featuresEN 300 175-7 v2.5.7
 - Common interface – Speech and audio coding and transmissionEN 300 175-8 v2.5.4
 - DECT packet radio service (DPRS)EN 301 649 v2.3.1
 - [Ultra low energy M2M communications – Home automation network](#)....TS 102 939-1 v1.2.1
 - [Ultra low energy M2M communications – Home automation network](#)....TS 102 939-2 v1.1.1

- **AERO – Aeronautics**
 - VDL mode 4 radio equipment – EN foreground equipment EN 301 842-1 v1.4.1
 - VDL mode 4 radio equipment – Data link layer EN 301 842-2 v1.7.1
 - VDL mode 4 radio equipment – Additional broadcast aspects EN 301 842-3 v1.4.1
 - VDL mode 4 radio equipment – Point-to-point functions EN 301 842-4 v1.3.1
- **CABLE – Integrated broadband cable telecommunication networks**
 - Cabinet DOCSIS system specification ES 203 312 v1.1.1
 - Specific requirements – Cable access networks ES 205 200-2-4 v1.1.1.1
- **DVB – Digital video broadcasting**
 - Coding specification based on MPEG-2 transport stream TS 101 154 v2.1.1
 - Object-based audio immersive sound metadata and bitstream TS 103 223 v1.1.1
- **STQ – Speech and multimedia transmission quality**
 - Speech samples and their use for QoS testing TR 103 138 v1.3.1
 - QoS aspects of voice communication in an LTE environment TR 103 219 v1.1.1
 - Background noise simulation technique and noise database ES 202 396-1 v1.6.1
- **MTS – Methods for testing and specification**
 - Security testing – Basic terminology TR 101 583 v1.1.1
 - TTCN-3 test suite for use of XML schema – Conformance statement TS 103 253 v1.1.1
 - TTCN-3 test suite for use of XML schema – eXtra information for testing TS 103 255 v1.1.1
 - TTCN-3 core language ES 201 873-1 v4.7.1
 - TTCN-3 runtime interface (TRI) ES 201 873-5 v4.7.1
 - TTCN-3 control interface (TCI) ES 201 873-6 v4.7.1
 - The IDL to TTCN-3 mapping ES 201 873-8 v4.6.1
 - Using XML schema with TTCN-3 ES 201 873-9 v4.6.1
 - TTCN-3 language extensions – Configuration and deployment support ... ES 202 781 v1.4.1
 - TTCN-3 language extensions – Performance and real time testing ES 202 782 v1.3.1
 - TTCN-3 language extensions – Advanced parameterization ES 202 784 v1.5.1
 - TTCN-3 language extensions – Behaviour types ES 202 785 v1.4.1
 - TTCN-3 language extensions – Interfaces with continuous signals ES 202 786 v1.3.1
 - TTCN-3 language extensions – Extended TRI ES 202 789 v1.4.1
 - Test description language (TDL) – Abstract syntax and semantics ES 203 119-1 v1.2.0
 - Test description language (TDL) – Graphical syntax ES 203 119-2 v1.1.0
 - Test description language (TDL) – Exchange format ES 203 119-3 v1.1.0
 - Test description language (TDL) – Structured test objective spec ES 203 119-4 v1.1.0
- **EE – Environmental engineering**
 - Assessment of mobile network energy efficiency ES 203 228 v1.1.1
 - Limits for power consumption in broadband networks EN 303 215 v1.3.1
 - ICT equipment power, energy and environmental parameters ES 202 336-12 v1.0.0

1.4 Progress of BSI (UK) technical committees

bsi. BSI working group documents of interest, circulated in Mar/Apr are noted below. Copies for WG use are available for the purpose of contribution to their content. The list is provided to increase awareness of European and UK standardisation work.

<http://www.bsigroup.com/en-GB/about-bsi/uk-national-standards-body/UK-National-Standards-Body/>

- **PEL/13 – Electrical energy measurement and control**
 - PEL_13_15_0037 Presentations from CLC13 plenary held 16-17 Apr Presentations
- **PEL/894 – Remote meter reading**
 - PEL_894_15_0100 Local bus EN 13757-6
- **DS/1 – Dependability**
 - DS_1_15_0056 Maintenance – guideline on preparation of contracts.... BS EN 13269
 - DS_1_15_0058 Open systems dependability IEC 62853
 - TDW_4_7_15_0017 Through-life engineering services Report

IoT Key Enabling Wireless Technologies Summary

Standards	Freq(s)	Max BW	Data rate	Mod	Range	Network	Applications
LTE-M Category 0/1 (LTE Rel12/13)	LTE band	1.4 MHz	200 kbps ~ 1 Mbps	OFDM	1000 m	WMAN	lower speed and power versions of the LTE standard defined in Rel12/13
802.11ah (IEEE 802.11)	Sub GHz	1 to 16 MHz	150 kbps to 78 Mbps	OFDM	1000 m	WLAN	Target for IoT, wearable devices or extend range
802.11p (IEEE 802.11)	5.8~5.9 GHz	5/10/20 MHz	1.5 Mbps to 54 Mbps	OFDM	1000 m	WLAN	Wireless access in vehicle environment (WAVE)
Bluetooth Low Energy	2.4 GHz	2 MHz	1 Mbps	GFSK	50 m	WPAN	automotive, healthcare, security, home entertainment
Z-Wave (ITU G.9959)	868.42 MHz 908.42 MHz	200 kHz	9.6 kbps ~100 kbps	BFSK GFSK	100 m	WPAN	Remote controls, smoke alarm, security sensors Owned by Denmark Zensys
ZigBee (802.15.4)	ISM < 2.4 GHz	5 MHz	40 kbps to 250 kbps	BPSK OQPSK	10 m	WPAN	Home automation, smart grid, remote control
Thread (802.15.4)	ISM < 2.4 GHz	5 MHz	40 kbps to 250 kbps	BPSK, FSK OQPSK	10 m	WPAN	Mesh network for home and support 6LoWPAN
Wi-Sun (802.15.4g)	ISM < 2.4 GHz	200 kHz to 1.2 MHz	50 kbps to 1 Mbps	FSK ,OFDM, OQPSK	1000 m	WNAN	FAN and HAN Smart Utility Networks, Smart Grid, Smart Metering
NFC (ISO/IEC18092)	13.56 MHz	1 MHz	848 kbps	FSK, ASK	20 cm	P2P	Contactless payment, easy other connection (Wi-Fi, BT), identity and access

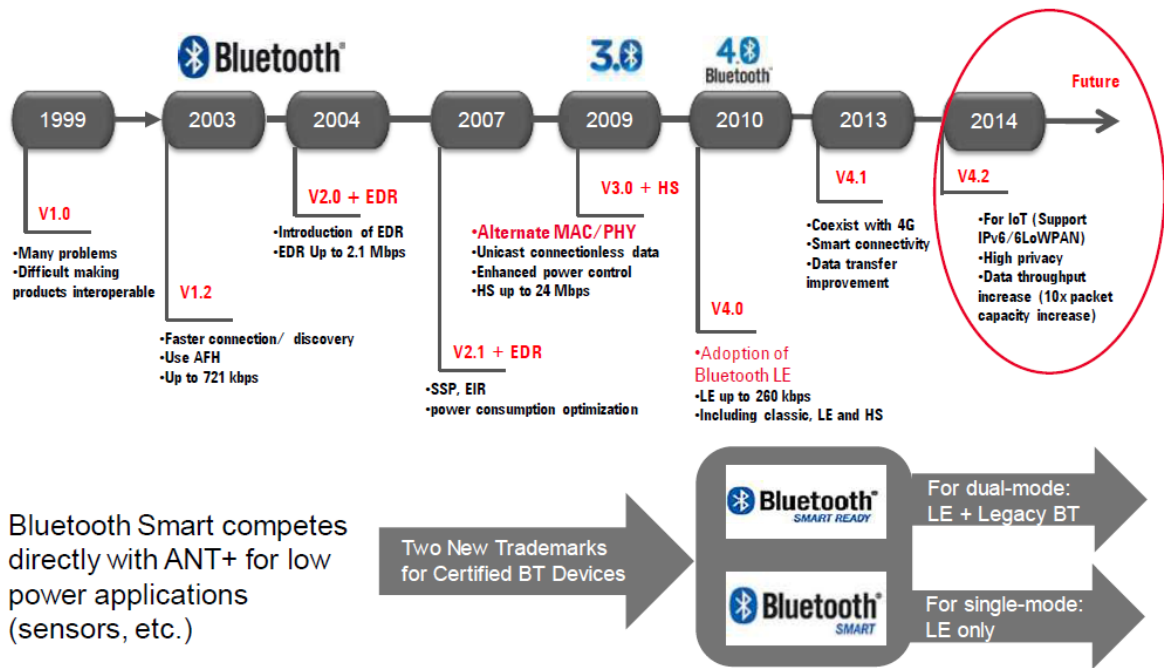


PHY Differences between 802.11ac and 802.11ah

Feature	802.11ac	802.11ah
Channel bandwidth	20/40/80/160 MHz	1/2/4/8/16 MHz
FFT size	64/128/256/512	32/64/128/256/512
Data subcarriers /	52/108/234/468	24/52/108/234/468
Pilot Sub-carriers	4/6/8/16	2/4/6/8/16
Pilot Type	Fixed pilot	Fixed pilot or traveling pilot
Subcarrier spacing	312.5 kHz	31.25 kHz
OFDM symbol duration	4.0/3.6 us	40/36 us
Guard interval (short/normal/long)	0.4/0.8/1.6 us	4/8/16 us
Preamble duration	16 us	320 us(1M BW)/160 us
Modulation types	BPSK/QPSK/16QAM/64QAM/256QAM	BPSK/QPSK/16QAM/64QAM/256QAM
Coding rates	1/2, 2/3, 3/4, 5/6	1/2 rep2, 1/2, 2/3, 3/4, 5/6
MCS	0-9	MCS0-9, 10
Transmission Mode	VHT mode, non-HT duplicate mode	Normal mode S1G, 1 MHz duplicate mode, 2 MHz duplicate mode
Duplicated PPDU	Non-HT PPDU	S1G_DUP_1M, S1G_DUP_2M
MIMO	Up to 8	Up to 4
Multi-user	Up to 4	Up to 4, only available in S1G_LONG PPDU
Beamforming	Support	Support



Bluetooth® Standard Evolution



ZigBee (IEEE 802.15.4) Physical Layer Specification

PHY (MHz)	Frequency band (MHz)	Spreading parameters		Data parameters		Channel Spacing (MHz)
		Chip rate (kcps)	Modulation	Bit rate (kbps)	Symbol rate (ksps)	
868*/915*	868 (Europe)	300/400/400	BPSK/ASK/O-QPSK	20/250/100	20/12.5/25	--
	915 (North America)	600/1600/1000	BPSK/ASK/O-QPSK	40/250/250	40/50/62.5	2
2450 DSSS	2400-2483.5 (World)	2000	O-QPSK	250	62.5	5

* optional

- Range: 10 – 75 meters (depending on the environment)
- Radio Power Requirements: 1 mW – 100 mW
- Transmit Center Frequency Tolerance: ± 40 ppm
- Receiver Sensitivity (PER < 1%): - 85 dBm @ 2.4 GHz band; -92 dBm @ 868/915 MHz band
- Modulation and channel access: DSSS and CSMA/CA