

# WiFi: Spectrum Bands and Evolution

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# ISM Bands

- ▶ The industrial, scientific and medical (ISM) radio bands are radio bands (portions of the radio spectrum) reserved internationally for the use of RF energy for industrial, scientific and medical purposes other than telecommunications;
- ▶ The ISM bands were first established at the International Telecommunications Conference of the ITU in Atlantic City, 1947
- ▶ The ISM bands are defined by the ITU Radio Regulations (RR, article 5) in footnotes 5.138 and 5.150;
- ▶ ***As per RR, ISM applications (of radio frequency energy):*** Operation of equipment or appliances designed to generate and use locally radio frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of *telecommunications*.
- ▶ The ISM bands were for applications, include radio-frequency process heating, microwave ovens, and medical diathermy machines etc.

# Unlicensing Spectrum Bands

- ▶ In the U.S., the FCC first made unlicensed spread spectrum available in the ISM bands in rules adopted on May 9, 1985: spread spectrum systems of higher power to operate in the 902-928, 2400-2483.5 and 5725-5875 MHz ISM bands;
- ▶ The FCC action was proposed by a FCC staff in 1980 and the subsequent regulatory action took five more years;
- ▶ Unlicensing of spectrum bands was part of a broader proposal to allow civil use of spread spectrum technology and was opposed at the time by mainstream equipment manufacturers and many radio system operators;
- ▶ Thereon, Many other countries developed similar unlicensed regulations, enabling use of ISM Bands;

# Wireless License Exempt frequency Bands In India

In India Exemption from Licensing Requirement Rules for Wireless Access (LAN/WAN), wherein No licence shall be required by any person to establish, maintain, work, possess or deal in any wireless equipment for the purpose of:

- ▶ 1st Rule for Exemption from Licensing Requirement for Indoor Use of Wireless LAN (W-LAN) Equipment using Bluetooth and IEEE 802.11b Standard in 2.4 GHz were **Notified in 2003**;
- ▶ This Rule of 2003 was superseded by more generic Rule Notified on **25Aug. 2004 for Indoor Use** of low power Equipment in the frequency band 2.4 GHz to 2.4835 GHz. This rule permitted **Maximum Radiated power output 100 mW (20dBm) in Spread of 10 MHz (Max Effective Radiated Power 26 dBm)**;
- ▶ The Rule of 2004 was superseded by Rule Notified on **28 Jan 2005 permitting outdoor Use** the frequency band permitted **Maximum Radiated power output 1W (30dBm) in Spread of 10 MHz (Max Effective Radiated Power 4 W; 36 dBm)**;

# Wireless License Exempt frequency Bands In India (2)

- ▶ On 28 Jan 2005 Rule Notified for Indoor Use of low power wireless equipment in the frequency band 5.150 to 5.350 GHz and 5.725 to 5.875 GHz) permitting Maximum ERP 200mW; power density of 10mW/MHz;
- ▶ On 19 Jan 2007, Rule Notified permitting outdoor Use of the frequency band 5.825 to 5.875 GHz permitting Maximum Radiated power output 1W (30dBm) in Spread of 10 MHz (Max EIRP 4 W; 36 dBm);
- ▶ In supersession of earlier Rules in 5Ghz band, Vide Notification dated 18 Oct 2018 the frequency band 5 150-5 250 MHz; 5 250-5 350 MHz; 5 470-5 725 MHz; and 5 725 - 5875 exempted from licensing requirements with detailed regulatory provisions;
- ▶ The 2.4 GHz, 5.1 GHz and 5.8 Ghz bands are the frequency bands being used for WiFi operations.

# WiFi Evolution

- ▶ In 1991, [NCR Corporation](#) with [AT&T Corporation](#) invented the predecessor to 802.11, intended for use in cashier systems. The first wireless products were under the name [WaveLAN](#);
- ▶ WiFi was invented and first released for consumers in 1997 with the 1<sup>st</sup> ver. of the 802.11 protocol in 2.4 GHz band, up to 2 Mbit/s link speeds;
- ▶ updated in 1999 with [802.11b](#) to permit 11 Mbit/s link speeds; For many years, 2.4Ghz was a popular choice for WiFi users sparked a development in prototype equipment (routers) to comply with IEEE802.11, and WiFi was introduced for home use.
- ▶ WiFi uses electromagnetic waves to communicate data that run at two main frequencies: 2.4Ghz (802.11b) and 5Ghz (802.11a);
- ▶ In 1999, the [Wi-Fi Alliance](#) formed as a trade association to hold the Wi-Fi trademark;

## WiFi Evolution (2)

- ▶ In 2003, faster speeds and distance coverage of the earlier WiFi versions combined to make the 802.11g standard;
- ▶ **2009 - The Arrival of 802.11n:** the final version of the 802.11n, which was even faster and more reliable than its predecessor; This increase in efficiency is attributed to 'Multiple input multiple output' data (MIMOs);
- ▶ The 2.4 GHz band overcrowded extended range meant that an increasing number of devices (from baby monitors to bluetooth) were using the same frequency, causing it to become overcrowded and slower. Consequently, 5Ghz became the more attractive;
- ▶ To solve this issue, dual-band routers were created;

# WiFi Evolution (3)

- ▶ In 2012 801.11ac aimed to make the 5Ghz range better, it had four times the speed of WiFi 801.11n, a greater width, and the ability to support more antennas; Also saw the birth of the Beamforming concept;

## WiFi Today and the Internet of Things

- ▶ WiFi performance continues to improve and it's one of the most ubiquitous wireless communications technologies in use today;
- ▶ It's easy to install, simple to use and economical too;
- ▶ WiFi Access Points are now set up at home and in public hotspots, giving convenient internet access to everything from laptops to smartphones.
- ▶ Encryption technologies make WiFi secure, keeping out unwanted intruders from these wireless communications

# WiFi (4)

- ▶ WiFi has also enabled a mind-blowing number of consumer electronics and computing devices to become interconnected and exchange information - a phenomenon known as Internet of Things (IoT);
- ▶ According to [Wi-Fi.org](http://Wi-Fi.org), the IoT is “one of the most exciting waves of innovation the world has witnessed” and that “its potential has only just begun to emerge.”
- ▶ It’s clear that WiFi is no longer a one-way street - it has become an essential part of our personal and professional day-to-day, and is constantly improving our efficiency, our communication, and is persistently encourages the technology industry to push the boundaries of what’s possible.

THANK YOU

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