ITU-APT Foundation of India

1. Introduction:

AWG-30 approved the creation of a new Task Group TG-WAS/RLAN on Wireless Access Systems including Radio Local Access Networks (WAS/RLAN) under WG-TER; with the following **Terms of Reference:**

- To develop AWG output documents on spectrum utilization and/or channel arrangements for WAS/RLAN.
- To develop various AWG output documents, which are specified in AWG Document Approval Procedure, for the following objectives:
    - to share information on status of spectrum usage, technical conditions, and national regulatory experiences in Asia-Pacific region for current and emerging WAS/RLAN technologies.
    - to perform studies of technical and operational scenarios (including system description, deployment, service requirements, and regulatory provisions etc.) of current and emerging WAS/RLAN technologies.
    - to share information on spectrum sharing between WAS/RLAN technologies
- To review and revise, as appropriate, any existing texts on WAS/RLAN, which may be included in APT Recommendations or Reports already developed in AWG.

At AWG-29 meeting, input contribution INP-77 proposed to develop of a new draft APT Report on Wi-Fi in lower and upper 6 GHz bands, The meeting encouraged members to submit new input contributions to further discuss the topic.

2. Proposal:

Working document submitted by IAFI in input 77 has been redrafted taking into account the comments and suggestions and a new proposed working document is enclosed here for consideration and approval of AWG.

PROPOSED WORKING DOCUMENT TOWARDS A DRAFT NEW APT REPORT ON STATUS OF 5925 -7125 MHZ SPECTRUM USAGE, TECHNICAL CONDITIONS AND CHANNEL ARRANGEMENTS FOR WAS/RLAN IN ASIA PACIFIC

Table of Contents

1. Introduction:

Wi-Fi has proved the most popular way of internet connectivity to multiple devices without cables and wiring, in home and business networks, making it a most popular choice. Wi-Fi-enabled devices such as smartphones, tablets, laptops, and smart home devices can be connected to the internet easily without the need for any physical connection, to a Wi-Fi modem or router. Wi-Fi also allows multiple devices to connect to the internet simultaneously, making it a convenient and cost-effective way to provide internet access in homes, offices, and public spaces. Even large proportion of the mobile data traffic is now delivered to the end user through Wi-Fi devices. Therefore, the demand devices capable to access internet wireless broadband though Wi-Fi, is growing at a phenomenal pace. Presently, there are almost 25 billion Wi-Fi connected devices in the world and almost 3 mobile device every person.

So, the wireless highways through which Wi-Fi traffic moves are congested and will continue to get more crowded. Main reasons are:

(a) Every house is installed with one Wi-Fi modem and even few having more than one.

(b) Many communities are served with public Wi-Fi.

(c) Increased in demand of speed of internet requires wider channel.

(d) Cellular operators are dumping traffic into the Wi-Fi spectrum, onto the unlicensed spectrum used by Wi-Fi.

So, Wi-Fi became a victim due to its own success and now it is the appropriate time for administrations to take action to improve things.

Presently, only two unlicensed frequency bands have been allocated for Wi-Fi.

(a) 2.4 GHz band – from 2400.00 to 2483.50 MHz = 83.50 MHz, having 3 channels of 20 MHz or 1 channel of 40 MHz.

(b) 5.0 GHz band –Parts of 5150-5925 MHz (*5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 850 MHz)* having 25 channels of 20 MHz or12 channels of 40 MHz or 6 channels of 80 MHz or 2 channels of 160 MHz.

So, only 883.50 MHz spectrum in 2.4 GHz and 5.0 GHz band has been allocated for unlicensed band for Wi-Fi. Studies have shown that there is a need of at least 2 GHz spectrum to meet the increased need to respond to increased home working, particularly in high human density countries such as India. Currently unlicensed Wi-Fi spectrum is inadequate to meet out the growing demand.

So, to meet out the growing demand of Wi-Fi spectrum, it is proposed to harmonize the 1200 megahertz of spectrum available in the 6 gigahertz (GHz) band from 5.925 GHz to 7.125 GHz, to be assigned as unlicensed band for Wi-Fi devices. Unlicensed devices will share this spectrum with incumbent licensed services under rules that are carefully crafted to protect those licensed services and to enable both unlicensed and licensed operations to thrive throughout the band. More than 32 countries in the world including developed economies like USA, Canada, Australia, Japan and EU have already allotted the 5925-7125 MHz band for the use of unlicensed Wi-Fi.

The 6 GHz Wi-Fi spectrum is 1200 MHz wide (more than double the total size of the 2.4 GHz and 5 GHz spectrums) and supports up to 59 channels of 20 MHz or 29 channels of 40 MHz or 14 channels of 80 MHz or 7 channels of 160 MHz channels and 3 channels of 320 MHz. These channels are only accessible to new Wi-Fi 6E devices and enable gigabit Wi-Fi speeds and allow operations free from legacy Wi-Fi interference.

So, 6 GHz frequency band is uniquely suited to meet growing demand for Wi-Fi connectivity, as there is no alternative spectrum now or in the future.

IAFI through this draft new report would like to bring the issue for the consideration of the APT member countries and to support the issue in the upcoming AWG/WRC-23 to globally harmonization the 6 GHz frequency band from 5925 -7125 MHz, total 1200 MHz spectrum, as unlicensed frequency band for Wi-Fi.

2. Background:

The demand for wireless broadband is increasing at a phenomenal pace, as citizens and businesses groups are increasingly relying on Internet connectivity. To meet this demand, the various administrations are continuously evaluating the use of the spectrum available for the use of Wi-Fi in more efficient usage using a variety of methods, including unlicensed operations.

The 6 GHz band is comprised of allocations for Fixed Services, Fixed Satellite Services (FSS) and Mobile Services across sub-bands. Fixed microwave service licensees, specifically those operating point-to-point microwave links for supporting variety of critical services commercial, private entities, and public safety agencies, are the largest user group in the 6 GHz band.

The Fixed Satellite Service (FSS) (Earth-to-space) is allocated in all sub-bands of 6 GHz, except for the 7.075-7.125 GHz portion. FSS operations are heaviest in the 6 GHz band, which is paired with the 3.7-4.2 GHz, space-to-Earth frequency band. Predominant FSS uses of these frequencies include content distribution to television and radio broadcasters, including transportable antennas to cover live news and sports events, cable television and small master antenna systems, and backhaul of telephone and data traffic.

Considering the existing and anticipated congestion, many administrations decided to provide additional spectrum to complement spectrum where Wi-Fi is presently deployed, to ease any congestion so that businesses and consumers can take advantage of new data intensive applications. By making this spectrum available for unlicensed use, cable companies and wireless carriers started expanding their Wi-Fi hotspot networks to provide customers' access to even higher speed data connections, than they experience today and expand their networks in areas where they need additional capacity.

Many administrations allocated entire 6 GHz from 5925 – 7125 MHz, as unlicensed 3rd frequency band for Wi-Fi. So, a contiguous 1200-megahertz block of spectrum is now available n many countries for the development of new and innovative high-speed, short range Wi-Fi devices.

3. Abbreviations and acronyms:

Wi-Fi - Wireless Fidelity, most popular way of developing wireless local area network in home, office or any public place.

FSS - Fixed Satellite Service

IMT - International Mobile Telecommunications

WRC - World Radiocommunication Conference

LTE - Long Term Evolution

RLAN - Radio Local Area Network, also known as WLAN or Wi-Fi

WAS - Wireless Access System, use today for implementing wireless access include cellular, cordless and wireless local area network systems.

4. Usage of the 5925 – 7125 MHz spectrum:

As per the Radio Regulation, 2020, 6 GHz has been allocated for the following services

S. No.	Frequency Band	Allocated on Primary basis	Region
1	5925 – 6700 MHz	FIXED, FIXED SATELLITE (Earth to space), MOBILE	Globally
2	6700 – 7075 MHz	FIXED, FIXED SATELLITE (Earth to space), MOBILE	Globally
3.	7075 – 7125 MHz	FIXED, MOBILE	Globally

Some administrations were regularly pursuing in various ITU meeting for allocation of mid band spectrum (6 GHz) for IMT

China, Russia and the African Telecommunications Union (ATU) were the main proponents at WRC-19 for the inclusion of Agenda item for WRC-23, for allocation of additional 6 GHz spectrum or IMT.

As per the decision taken in WRC-19 vide Agenda Item 1.2, ITU-R was requested to consider identification of the frequency bands 3 300-3 400 MHz, 3 600-3 800 MHz, 6 425-7 025 MHz, 7 025-7 125 MHz and 10.0-10.5 GHz for International Mobile Telecommunications (IMT), including possible additional allocations to the mobile service on a primary basis.

Six frequency bands were addressed under this agenda item: Band 1 (3 300-3 400 MHz (Region-1)), Band 2 (3 300-3 400 MHz (Region 2)), Band 3 (3 600-3 800 MHz (Region 2)), Band 4 (6 425-7 025 MHz (Region 1)), Band 5 (7 025-7 125 MHz (Globally)) and Band 6 (10.0-10.5 GHz (Region 2)).

Now, following 6 GHz bands are under consideration in the upcoming meeting of WRC-23 likely to be held in Nov, 2023, to consider

Band -4 (6 425 – 7 025 MHz) for Region-1 (Europe, Russia, Africa, Middle East) and

Band-5 (7 025 -7 125 MHz) for the use of IMT.

5. Technical Conditions regarding use Wi-Fi in 6 GHz band:

Initially Wi-Fi networks operates in the unlicensed 2.4 GHz and later unlicensed 5 GHz bands was also open for Wi-Fi. The 2.4-GHz band works the best for indoor Wi-Fi use, as easily penetrates through walls and furniture, and signals generally travel farther at the same power level as they do in the 5-GHz band.

In the 2.4 GHz band, roughly 80 MHz frequency band is available for the Wi-Fi use. The channels are 20 or 22 MHz wide, so normally three nonoverlapping channels are existing. The situation is slightly different in Europe, where 13 channels are allowed, but still just three nonoverlapping channels, In Japan, there are 14 channels with four nonoverlapping channels.

Signals in the 5-GHz band have a shorter range in the home, mostly because of the walls and furniture, but the band extends from 5.125 to 5.925 GHz (800 MHz), so 24 non-overlapping channel of 20MHz-wide each or 12 channels of 40 MHz wide or 6 channels of 80 MHz or 2 channels of 160 MHz wide channels can work.

In the Wi-Fi world, when two conversations collide, all the devices go quiet and then try to talk again a little while later. The amount of time they wait is determined by an exponentially increasing time delay, known as a backoff. With more collisions, the backoff increases, and the Wi-Fi becomes slower and less reliable. Today, congestion has increased so much in many regions making 2.4 GHz band unusable for transferring data at high rates.

Wi-Fi congestion may go even worse, as the mobile-phone carriers are planning to use the technology called as LTE-Unlicensed (LTE-U) or Licensed Assisted Access (LAA). It uses 4G LTE radios and routers to send and receive data via the same 5 GHz frequencies as used by unlicensed Wi-Fi.

So, to overcome the problem, many administrations allowed entire 6 GHz band from 5925 -7125 MHz band for the use of unlicensed Wi-Fi, with two types of operation.

(a) Authorizing unlicensed standard-power access points in the band 5925-6875 MHz, through use of an AFC system. The AFC is designed to protect devices with fixed locations.
(b) Opening the entire 6 GHz band for unlicensed indoor low power access points. By authorizing use of the entire 6 GHz band for indoor use, so 59 channels of 20 MHz or 29 channels of 40 MHz or 14 channels of 80 MHz or 7 channels of 160 MHz channels or 3 channels of 320 MHz are possible to expand capacity and performance capabilities.

So, the 6 GHz Wi-Fi or Wi-Fi 6E extends the same Wi-Fi capabilities into the 6 GHz band to allow greater efficiency, higher throughput, and increased security. 6 GHz Wi-Fi is specifically designed for gigabit broadband and immersive wireless applications. Considering the vast

capabilities Wi-Fi 6E, many countries around the World have already delicensed 6 GHz band for Wi-Fi.

6. Channel Arrangements for RLAN:

RLAN (Radio Local Area Network) is a type of wireless communication technology that allows devices to communicate with each other over a local area network (LAN) using radio frequency (RF) signals. RLANs are also commonly referred to as WLANs (Wireless Local Area Networks) or Wi-Fi networks.

The basic operation of RLAN involves a wireless access point (AP) or router that acts as a central hub for wireless devices to connect to the network. The AP is connected to the wired LAN and serves as a bridge between the wired and wireless networks.

When a wireless device, such as a laptop or smart phone, wants to connect to the RLAN, it sends a request to the AP to join the network. The AP authenticates the device and assigns it an IP address. Once the device is connected, it can communicate with other devices on the network and access the Internet.

The RLAN network are secured as using various encryption and authentication protocols, such as WPA2 (Wi-Fi Protected Access II) and 802.1x. These protocols provide protection against unauthorized access and ensure the confidentiality and integrity of the data transmitted over the network.

Radio local area networks (RLANs) systems are quickly emerging as a preferred access technology. RLAN uses different frequency bands for communication, such as the 2.4 GHz and 5 GHz bands. RLAN consortium proposes to introduce unlicensed Wireless point to point and point to multipoint devices into the 5.925 to 7.125 GHz band.

In wireless communication systems, channel assignment refers to a process of allocating radio frequency channels to different users or devices in order to optimize the use of the available spectrum and minimize interference.

There are several approaches to channel assignment in RLANs, including: -

(a) Fixed channel assignment: In this approach, each AP is assigned a fixed channel that is pre-determined based on factors such as signal strength, interference level, and available bandwidth.
(b) Dynamic channel assignment: In this approach, the channel assignment is dynamically adjusted based on the current network conditions, such as the number of active users and the level of interference.
(c) Channel hopping: In this approach, the APs or wireless devices periodically switch channels in order to avoid interference and improve overall network performance.

7. Channel Arrangements for WAS:

Wireless Access Systems (WAS) are defined as end-user radio connections to public or private core networks. Technologies in use today for implementing wireless access include cellular, cordless telecommunication, and wireless local area network systems.

WAS typically uses cellular radio frequencies and protocols such as GSM, CDMA or LTE to provide wireless connectivity to devices, and it is often used in mobile phones, tablets, and other mobile devices.

Wireless Access Systems (WAS) are defined as end-user radio connections to public or private core networks. Technologies in use today for implementing wireless access include cellular, cordless telecommunication, and wireless local area network systems.

The basic operation of WAS involves a network of base stations, or cell sites, that are strategically located to provide coverage over a particular area. Each cell site is equipped with one or more antennas that transmit and receive wireless signals to and from mobile devices within the coverage area.

When a mobile device wants to connect to the cellular network, it searches for an available cell site and sends a signal requesting access. The cell site authenticates the device and assigns it a unique identifier, such as a mobile phone number or subscriber identity module (SIM) card. Once the device is connected, it can communicate with other devices on the network and access the Internet or other network services. The wireless signals are encoded and modulated using various techniques to ensure reliable and secure communication.

The WAS network can be secured using various encryption and authentication protocols, such as Advanced Encryption Standard (AES) and Transport Layer Security (TLS). These protocols provide protection against unauthorized access and ensure the confidentiality and integrity of the data transmitted over the network.

WAS uses different wireless protocols and frequencies, depending on the technology used by the cellular network operator. For example, in case of GSM (Global System for Mobile Communications) standard, it uses a combination of time division multiple access (TDMA) and frequency division multiple access (FDMA) to divide the wireless spectrum into channels that can be shared by multiple users.

Overall, WAS provides a convenient and reliable way for mobile devices to connect and communicate over a wireless network, and it is widely used in cellular networks around the world.

Channel assignment in WAS (Wireless Access System) is the process of assigning frequencies or channels to different base stations, or cell sites, in a cellular network to avoid interference and ensure efficient use of the available wireless spectrum. The goal of channel assignment is to minimize the number of channels used while ensuring that each cell site has sufficient channels to serve its users. This is because the wireless spectrum is a limited resource, and it must be shared among all the cell sites in the network.

There are different channel assignment strategies that can be used in WAS, depending on the technology used by the cellular network operator. One common approach is the fixed channel allocation (FCA) strategy, where a fixed set of channels is assigned to each cell site, and the channels are reused across the network.
Another approach is the dynamic channel allocation (DCA) strategy, where channels are dynamically allocated to cell sites based on the traffic load and channel availability. This approach can help to optimize the use of the available spectrum and improve network efficiency.

In WAS, channel assignment can also be influenced by other factors such as the physical environment, the distance between cell sites, and the number of users in a particular area. In urban areas with high user density, for example, smaller cell sites may be used to provide better coverage and capacity, and more channels may be assigned to these sites to accommodate the higher traffic.

Overall, channel assignment is a critical aspect of WAS network design and optimization, and it requires careful planning and management to ensure optimal network performance and user experience.

8. Summary

Wi-Fi is optimized for high performance indoor, and therefore delivers the bulk of the world's data traffic, including most data traffic on mobile devices. Demand for Wi-Fi will continue to grow with increased fiber deployments and cellular generations.

Wi-Fi 6E is a resounding success and by 2024, there will be billions of devices installed globally able to operate from 5.925 to 7.125 GHz. Only countries that allow Wi-Fi access to the entire 6 GHz spectrum range will be most benefited.

Wi-Fi 7 and Wi-Fi 8 will depend on 6GHz access, and 320 MHz channels will be optimized for demanding emerging use cases.

6 GHz frequency band from 5925 – 7125 MHz is perfectly suited for Wi-Fi to continue to deliver the connectivity users need, there is no alternative spectrum for Wi-Fi, and 6 GHz is unsuitable for IMT.

As many countries in all regions are deploying Wi-Fi in 6 GHz, so 5G networks are not feasible in 6 GHz. Therefore, frequency harmonization for IMT/5G cannot be achieved in 6 GHz, even no interoperability. Market fragmentation precludes economies of scale, which is necessary for a viable 5G ecosystem in 6 GHz, as massive investments are needed to design and produce cellular chipsets for 6 GHz, to integrate chipsets into devices and bring them to market, to deploy IMT technology network and to operate IMT network. At present, no ecosystem is available for the IMT in 6 GHz band nor likely to come in near future.

IAFI through this new report would like to bring the issue for the consideration of the APT member countries to support the issue in the upcoming AWG/WRC-23 to globally harmonization the 6 GHz frequency band from 5925 -7125 MHz, total 1200 MHz spectrum, as unlicensed frequency band for Wi-Fi.

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5 GHz (802.11a/h/j/n/ac/ax

Channel	Center Freq	Frequency Range	10	20	40	80	160 MHz	Australia	Japan	India	Singapore	China	Korea	New Zealand	Vietnam	Indonesia
	(MHz)	(MHz)	MHz													
7	5035	5030–5040	10					No	No	No	No	No	No	No	No	No
8	5040	5030–5050		20												
9	5045	5040–5050	10													
11	5055	5050–5060	10													
12	5060	5050–5070		20												
16	5080	5070–5090		20												
32	5160	5150–5170		20				Indoors	Indoors	Yes	Yes	Indoors	Indoors	Indoors	Indoors	Indoors
34	5170	5150–5190			40											
36	5180	5170–5190		20												
38	5190	5170–5210			40											
40	5200	5190–5210		20												
42	5210	5170–5250				80										
44	5220	5210–5230		20												
46	5230	5210–5250			40											
48	5240	5230–5250		20												
50	5250	5170–5330					160	Indoors/DFS/TPC							No	
52	5260	5250–5270		20				Indoors								
54	5270	5250–5290			40											
56	5280	5270–5290		20												
58	5290	5250–5330				80										
60	5300	5290–5310		20												
62	5310	5290–5330			40											
64	5320	5310–5330		20												
68	5340	5330–5350		20				Un-known								
96	5480	5470–5490		20				DFS/TPC				No	DFS/TPC			No
100	5500	5490–5510		20				Yes								
102	5510	5490–5530			40											

104	5520	5510–5530		20												
106	5530	5490–5570				80										
108	5540	5530–5550		20												
110	5550	5530–5570			40											
112	5560	5550–5570		20												
114	5570	5490–5650					160	No								
116	5580	5570–5590		20												
118	5590	5570–5610			40			No								
120	5600	5590–5610		20												
122	5610	5570–5650				80										
124	5620	5610–5630		20												
126	5630	5610–5650			40											
128	5640	5630–5650		20												
132	5660	5650–5670		20				DFC/ TPC								
134	5670	5650–5690			40											
136	5680	5670–5690		20												
138	5690	5650–5730				80		No								
140	5700	5690–5710		20				Indoors								
142	5710	5690–5730			40			No								
144	5720	5710–5730		20												
149	5745	5735–5755		20				Yes	Indoors	Yes	Indoors	Yes	Yes			
151	5755	5735–5775			40											
153	5765	5755–5775		20												
155	5775	5735–5815				80										
157	5785	5775–5795		20												
159	5795	5775–5815			40											
161	5805	5795–5815		20												
163	5815	5735–5895					160	No	No	No	No	No	No			
165	5825	5815–5835		20				Yes	Indoors	Yes	Indoors	Yes	Yes			
167	5835	5815–5855			40			No	No	No	No	No	No			

169	5845	5835–5855		20													
171	5855	5815–5895				80											
173	5865	5855–5875		20													
175	5875	5855–5895			40			No									
177	5885	5875–5895		20													
180	5900	5895–5905	10														
182	5910	5905–5915	10					No	Regd req		No	No	No	No	No	No	No
183	5915	5905–5925		20													
Channel	**Center Freq**	**Frequency Range**	**10**	**20**	**40**	**80**	**160**	**Australia**	**Japan**	**India**	**Singapore**	**China**	**Korea**	**New Zealand**	**Vietnam**	**Indonesia**
	(MHz)	**(MHz)**														