Technical Notes on

Application of 60 GHz MMW In Wireless LAN/ WiFi Systems

IEEE 802.11 ad Standard (WiGig)

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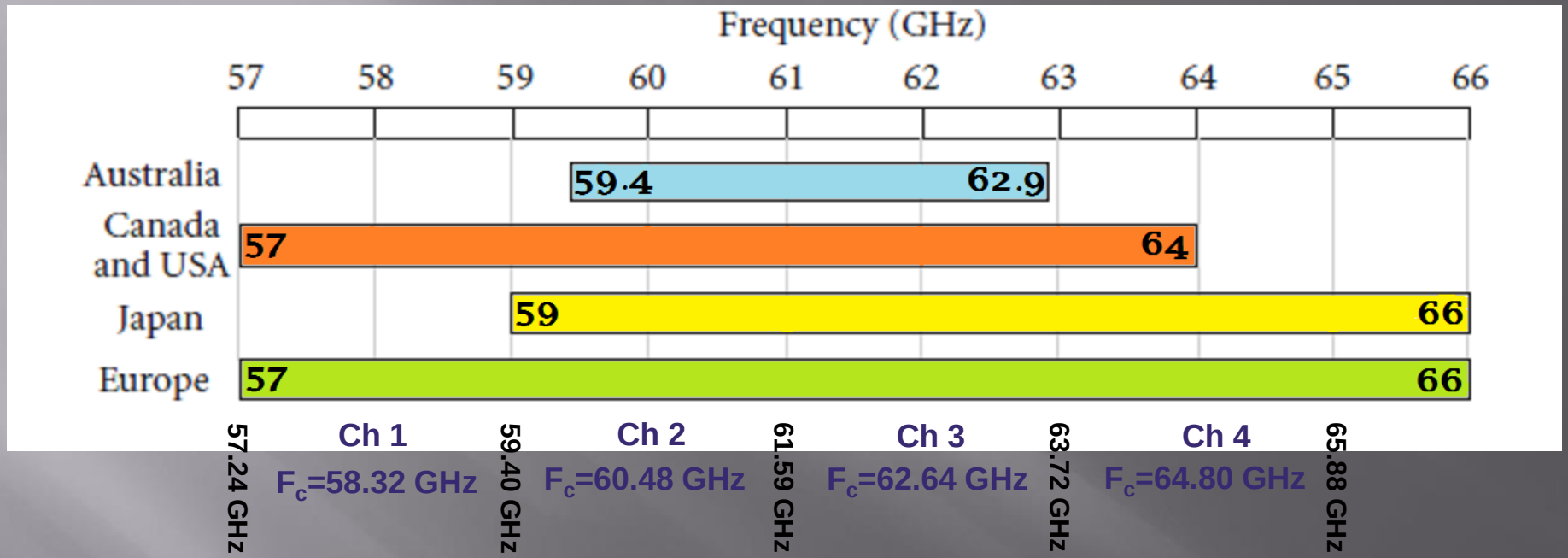
MMW 60 GHz Transmission Systems

Broadband MMW 60 GHz transmission systems are the most promising technology to respond to the demanding requirements of increased data rate and wide bandwidth of future indoor communication systems.

MMW frequencies can support wireless multi-gigabit bandwidths. This brings a huge commercial potential, for 60 GHz enabled devices in the next few years. Possible applications for 60 GHz includes indoor fast data/audio/video distributions such as inside planes, trains, cars, offices, etc.

Why 60 GHz Transmission Systems?

1- Available unlicensed spectrum around the world



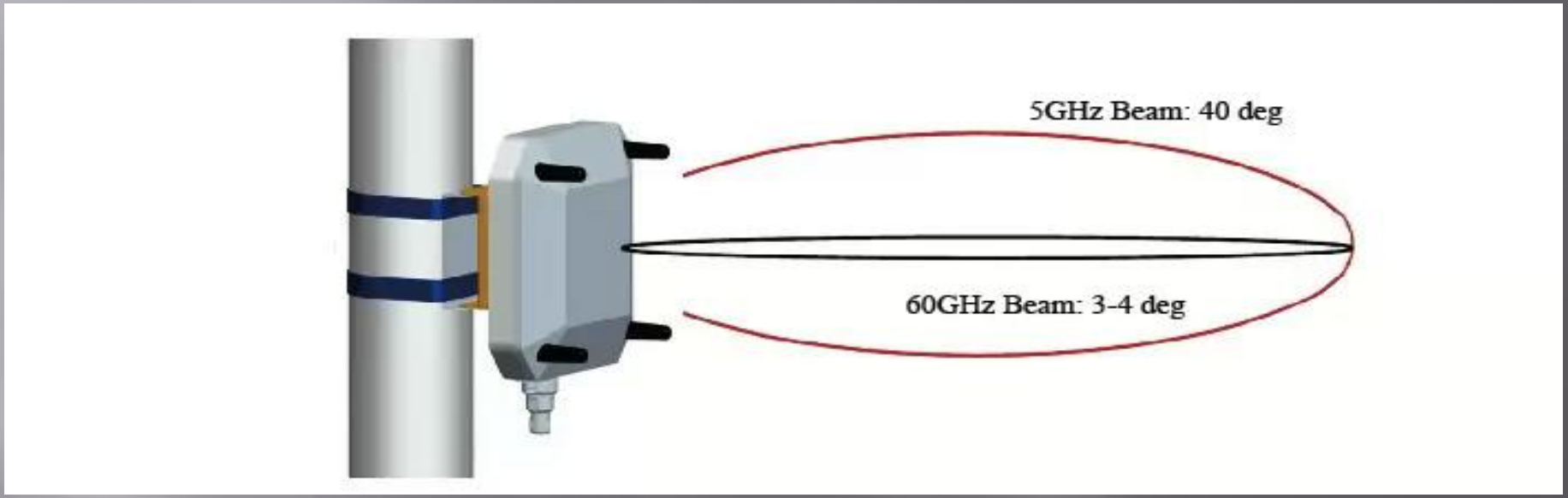
The unsilenced frequency allocations at around 60 GHz in each region gives a substantial overlap of 3.5 GHz of continues spectrum.

Unlike the 2.4 GHz and 5 GHz unlicensed bands, the 60 GHz area is also relatively uncongested

The ITU-R recommends channelization comprising four channels, each 2.16 GHz wide, centred as shown above. Channel 2 is globally available and is therefore the default channel for equipment operating in this frequencies.

Why 60 GHz Transmission Systems?

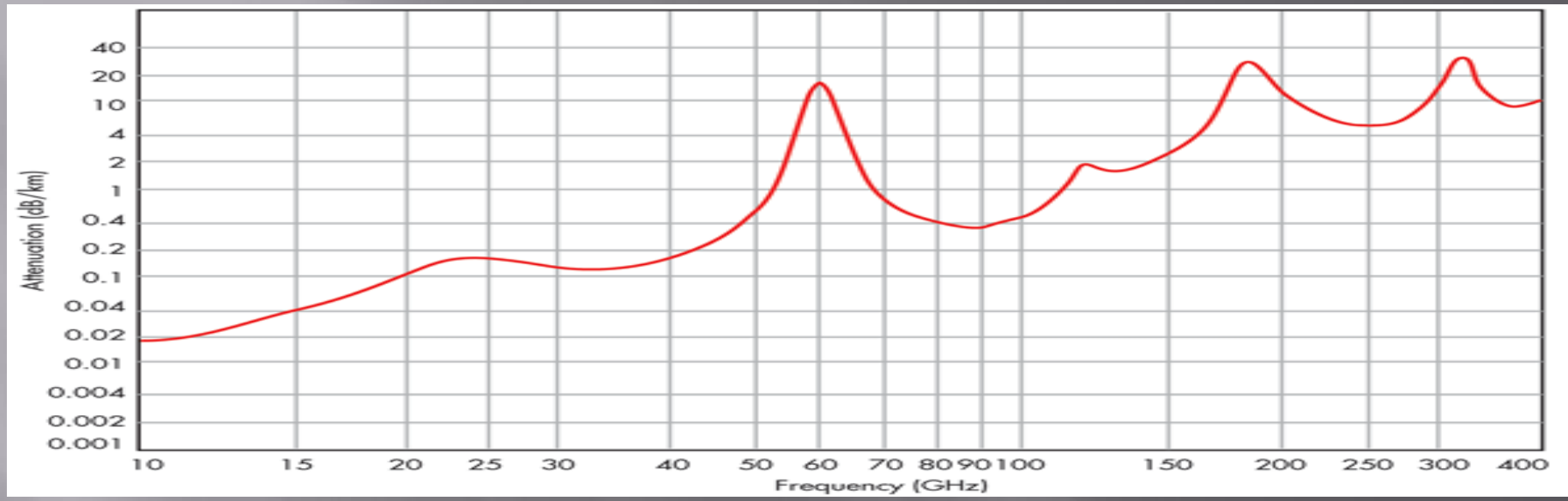
2- Narrow beam operation



Narrow beam operation enables multiple radio transmissions under the same roof and/or using the same frequencies. Multiple antenna configurations using beam-steering can be employed to circumnavigate minor obstacles like people moving around a room or anything blocking line-of-sight transmission.

Why 60 GHz Transmission Systems ?

3- Significant signal absorption by Oxygen around 60 GHz



Transmission at 60 GHz covers less distance for a given power, mainly due to space path loss (68db in 1m) , however this absorption effect only starts to become significant at short ranges,

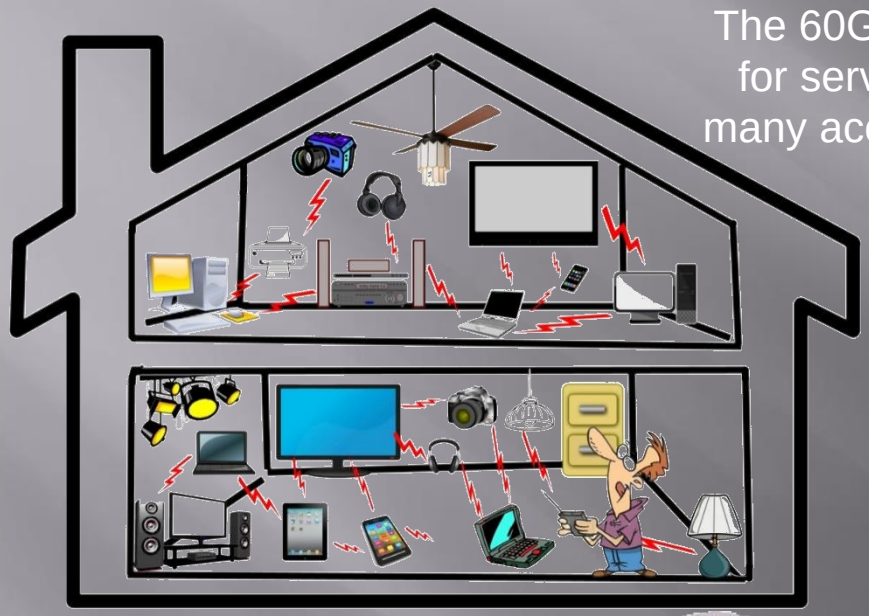
For low power transmission which will not propagate very far, this is considered as an advantage , as it reduces the likelihood of co-channel interference and increase the possible frequency re-use density. Also reduces opportunity for “theft” of protected content by eavesdropping on nearby transmissions

In fact 60GHz was first proposed for battlefield communications just for this reason.

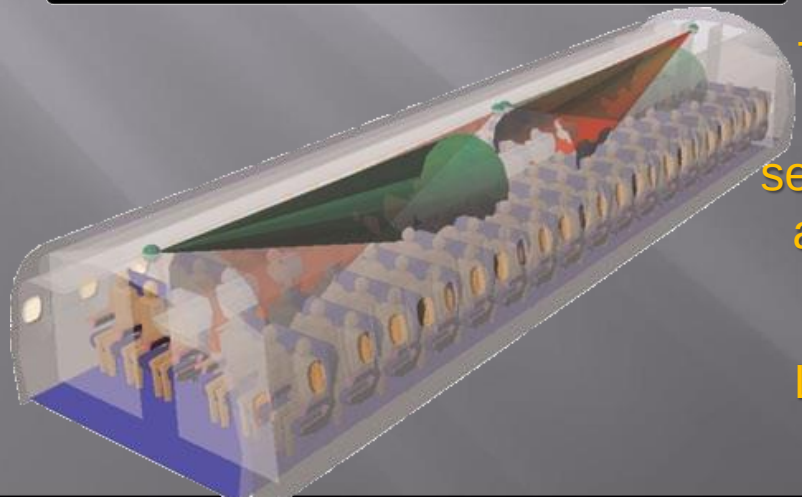
Applications of 60 GHz Transmission Systems

MMW frequencies support “Gigabits Bandwidths”

Bluetooth→ WiFi → WiMax → WiGig



The 60GHz wireless LANs won't be designed for going through walls but for serving small, focused areas. On an office floor filled with cubicles, many access points could be deployed, each delivering a large amount of capacity to a portion of the users



The large bandwidth allocated for the 60GHz frequency band could be used to transfer tens of gigabytes of data in few seconds. Short range indoor applications like broadband internet access and high speed point-to-point wireless communication could utilize this capability

Little interference with other radio systems, allows multiple 60 GHz transmission Systems to work in a common space.

Instant Wireless Sync
· IP-based P2P applications
· Using I/O PAL

Wireless Display
· HD streams over HDMI or DP using A/V PAL
· CE, PE and HH usages

Cordless Computing
· Combination of Wireless display using A/V PAL, sync and I/O using I/O PAL

Internet Access
· Using native Wi-Fi, 802.11ad support

Technology Requirement

Both Cellular and Wi-Fi networks are feeling the pinch as they look for ways to push more data to more and more customers, Possible solutions/requirements are as follows:

- Adding more towers/access points to a network
- Free up bandwidth by better balancing multiple user requests on a node
- Speed up the network

The telecom giant companies are exploring so-called “fifth generation” (5G) wireless technologies for this.

The 60 GHz band spectrum (from 57-66 GHz) is unlicensed band worldwide. International wireless standards for Wireless LAN and WiFi systems are developed and ratified by the IEEE for the application of 60GHz in Wireless applications.

Wireless LAN at 60 GHz

The first popular standards for Wireless LAN (IEEE 802.11 a & b) were designed primarily to serve the needs of laptops in home and office and later to allow mobile connectivity in hotels, airport, shopping malls , etc. That has been followed with other standards to meet the requirements of higher bandwidths at higher frequencies.

802.11 a : 54 Mb/s Bandwidth @ 5 GHz

802.11 b : 11 Mb/s Bandwidth @ 2.4 GHz

802.11 g : 54 Mb/s Bandwidth @ 2.4 GHz

802.11 n : 100-250Mb/s Bandwidth @ 2.4 & 5 GHz

802.11 ac : 500 Mb/s Bandwidth @ 5 GHz

802.11 ad : 7 Gb/s Bandwidth @ 60 GHz (short range)

It can be thought of as a cable replacement

7Gb/s for 802.11 ad is a start , utilizing a mix of modulation technologies (both Single Carrier and OFDM) and the use of active directional antenna (i.e. MIMO), targets Multi-Ten Gb/s achievable.

Latest Technologies

WiGig specialists work with leading manufacturers such as Cisco to integrate the technology with Wi-Fi into enterprise infrastructure that can run on three radio bands (2.4GHz, 5GHz, and 60GHz bands). The tri-band networks will include WiGig in addition to the mainstream Wi-Fi systems that use the 2.4GHz and 5GHz spectrum bands.

Initial expectations for market availability of WiGig devices was 2015, however at present is still rumours and whispers and it will probably be many years until we see any full matured 802.11ad product. Considering that 802.11ac has only been on the market for a short amount of time

Samsung is the only manufacturer (so far) who announced that they finished a 802.11ad access point solution (which is still not a industry product), Cisco is more focused on investigating the technology as a wireless USB to replace connecting devices at desks.

In general it seems we are at least 2-3 years away from any commercial implementation on 802.11 ad products.

(i.e. when it is natively supported in both network and user devices)

Strategic Views & Concerns

Enterprises will eventually turn to 802.11 ad networks for more bandwidth to handle growth in users and time-critical traffic. However nowadays many enterprises are just exploring how to implement 802.11ac to supplement their existing networks. Adding 60GHz to the mix will take even more work.

Considering that 802.11ac already offers such high throughput, this would be a question in the near future that do they really need 802.11ad? Is throughput on the order of 7 Gb/s or more necessary and enough?

It would be wrong to think in term of throughout alone because capacity is just as important. Capacity refers to the ability of networks to meet the ever growing traffic requirements of certain users. Technologies based on the 802.11 ad standard can supplement existing wireless networks , giving ability to offload heavy demands. The basic proposition is that the faster any given user gets bits reliably on and off the air, the more capacity is left for everyone else.

Therefore as a strategic approach, increasing enterprise network capacity would be the first stage in the preparation process for implementing WiGig products.