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MULTI GIGABIT WIRELESS SYSTEMS (MGWS) AROUND 60 GHz

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Abstract: Following a request from the European Telecommunications Standards Institute (ETSI), the European Conference of Post and Telecommunications (CEPT) is considering the possible introduction of Multi Gigabyte Wireless Systems (MGWS) around 60 GHz. To address this issue, the following items are considered:

- Compatibility between MGWS and the other possible users of this part of the spectrum (Earth Exploration Satellite Service, the Inter Satellite Service, the Fixed Service...
- Existing regulation and its possible impact on MGWS systems

This paper provides updated information on the results of compatibility studies undertaken within CEPT in view of possible introduction of MGWS.

Keywords: Compatibility, Fixed Service, Fixed Wireless System, MGWS, Regulation.

1. INTRODUCTION

ETSI has developed a Technical Report dealing with a new wireless system so-called Multi Gigabit Wireless Systems (MGWS) (ETSI, 2007). These applications are expected to provide short-range information exchange for communication, building to building LAN extension, computing, and consumer electronics at very high data rates. These applications could potentially be used not only by "fixed" user but also for nomadic and mobile applications.

CEPT may need to review the existing allocations of spectrum at 60 GHz (as given in ERC Report 25 CEPT, 2004) in order to consider a possible identification of spectrum for these new systems around 60 GHz. It has to be noted that MGWS may not be entitled to operate under the existing Fixed Service identifications of spectrum due to the possible mobile and nomadic applications.

Initially, the frequency range considered for MGWS extended from 59 GHz up to 66 GHz. It has been agreed in January 2007 to consider also the frequency range 57 to 59 GHz since it is already identified within CEPT for High Density Fixed Service (HDFS) and therefore, it may also be appropriate for MGWS deployment.

As a consequence CEPT may need to conduct compatibility analyses to assess:

- the impact of MGWS on the existing users of the frequency range and
- the possible impact of others users operating in this frequency range on MGWS.

2. MULTI GIGABIT WIRELESS SYSTEMS

MGWS is a new wireless system capable to operate around 60 GHz which is subdivided into 3 main applications:

- 2 nomadic applications: Wireless Local Area Network and Wireless Personal Area Network
- and one fixed application (Fixed Local Area Network Extension) (R. Premierlani, 2005).

Wireless Local Area Network (WLAN); radiocommunications used in short range, non-line-of-sight circumstances. Total range and performance will vary depending on the environment, but full WLAN performance is typically expected at ranges of 10 to 100 meters. The access point is mounted indoor covering an office space.

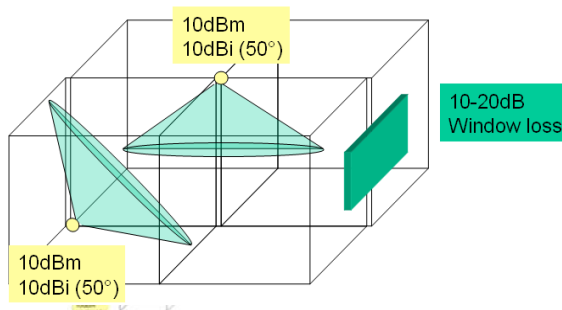


Fig. 1. MGWS - WLAN

Wireless Personal Area Network (WPAN); radiocommunications used in line-of-sight or near-line-of-sight circumstances. Total range and performance will vary depending on the environment, but full WPAN performance is typically expected at ranges of less than 10 meters or within a single room in an indoor environment. Typical application is equipment to equipment. (Laptop – Projector).

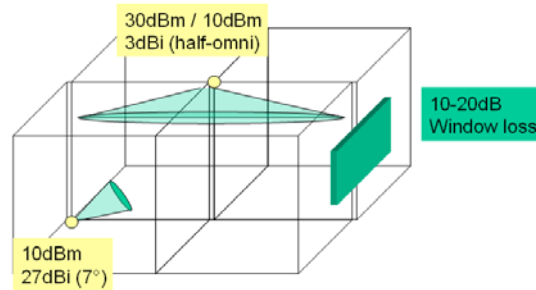


Fig. 2. MGWS – WPAN

Fixed Local Area Network Extension (FLANE); radiocommunications used in line-of-sight circumstances. Total range and performance will vary depending on the environment, but full FLANE performance is typically expected at ranges of 10-800 meters. The typical application is LAN extension where cable is not appropriate. Environment is between buildings on a campus outdoor situation.

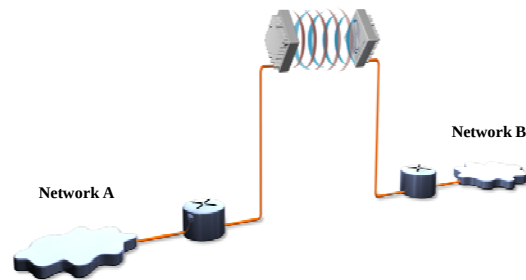


Fig. 3: MGWS – FLANE

Due to the propagation loss at 60 GHz (in particular the high oxygen absorption, ITU, 2005) and to the fact that MGWS are expected to use large bandwidth (up to 2.5 GHz ETSI, 2007), the length of the links between FLANE will be limited and is unlikely to exceed 1000 m.

The following picture provides an overview of the MGWS architecture in a given area.

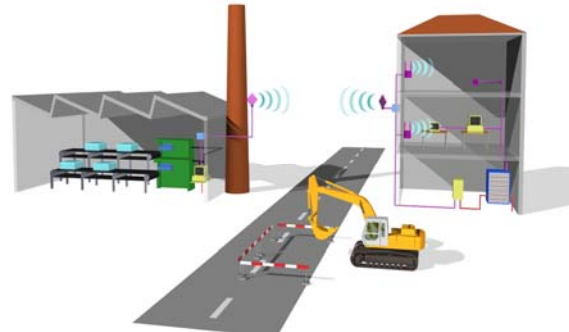


Fig. 4. MGWS Overview

The Technical Report TR 102 555 (ETSI, 2007) provides further details on the characteristics of MGWS systems.

3. COMPATIBILITY ISSUES

MGWS are expected to be developed around 60 GHz and to provide indoor and outdoor wireless links. CEPT is discussing a possible frequency range from 57 or 59 GHz till 66 GHz. The following Table provides the current identification of spectrum within CEPT (see <http://www.efis.dk>).

Table 1 CEPT identification of spectrum from 57 GHz to 66 GHz

FREQUENCY BAND	ALLOCATIONS	APPLICATIONS
57.0 - 58.2 GHz	EARTH EXPLORATION-SATELLITE (passive) FIXED INTER-SATELLITE MOBILE SPACE RESEARCH (passive)	Passive sensors (satellite) (52.6 - 59.3 GHz) Fixed links (55.78 - 59.0 GHz)
58.2 - 59.0 GHz	EESS (passive) FIXED RADIO ASTRONOMY SPACE RESEARCH (passive)	Passive sensors (satellite) (52.6 - 59.3 GHz) Fixed links (55.78 - 59.0 GHz)
59.0 - 59.3 GHz	EESS (passive) FIXED INTER-SATELLITE MOBILE RADIOLOCATION SPACE RESEARCH (passive)	Passive sensors (satellite) (52.6 - 59.3 GHz) Defence systems (59.0 - 61.0 GHz)
59.3 - 62.0 GHz	FIXED INTER-SATELLITE MOBILE RADIOLOCATION	Defence systems (59.0 - 61.0 GHz) Fixed links ISM Non-specific SRDs Radio LANs
62.0 - 63.0 GHz	INTER-SATELLITE MOBILE RADIOLOCATION	Land mobile Radiolocation (military) (62.0 - 64.0 GHz)
63.0 - 64.0 GHz	INTER-SATELLITE MOBILE RADIOLOCATION	Radiolocation (military) (62.0 - 64.0 GHz) RTTT
64.0 - 65.0 GHz	FIXED INTER-SATELLITE MOBILE except aeronautical mobile	Fixed links (64.0 - 66.0 GHz)
65.0 - 66.0 GHz	EESS (passive) FIXED INTER-SATELLITE MOBILE except aeronautical mobile SPACE RESEARCH	Fixed links (64.0 - 66.0 GHz) Land mobile

A number of compatibility issues may need to be considered:

- FLANE may be considered as a Fixed Service (FS) system. Therefore, it has to be checked that they are effectively in conformity with the regulation applicable to FS (57-62 GHz and 64 GHz - 66 GHz) and that they meet the corresponding technical requirements (CEPT, 2002 or ETSI, 2006)
- The bands 62-63 GHz and 63-64 GHz are not identified for Fixed Service, therefore the compatibility with MGWS and other systems (Radiolocation systems, Mobile Service, Inter-Satellite Service (ISS)) in this frequency range should be considered for all parts of MGWS.
- Finally there is a need to investigate the impact of WLAN and WPAN in the bands already identified for Fixed Services on all the other systems including other Fixed Service systems.

Compatibility issues relating to MGWS are discussed within CEPT in the framework of WG SE, and in two of its Project Teams:

- SE 24 is responsible for the compatibility issues between Intelligent Transport System (ITS) relating and other systems, including MGWS, in the 63-64 GHz band.
- SE19 is responsible for all the remaining compatibility issues from 57 GHz to 66 GHz relating to MGWS.

The following section provides the initial results achieved within SE 24 (December 2006) and within SE 19 (January 2007).

4. PRELIMINARY RESULTS

4.1 Compatibility with Space Services

Several parts of the considered frequency range are used by space services (ISS, the Earth Exploration Satellite Service (EESS) and Space Research Service (passive)).

Inter Satellite Service (ISS); SE 24 already considered the compatibility between ISS and ITS at 63-64 GHz, it was preliminarily concluded that no problem is expected due to "isolation" resulting from the gaseous absorption in the zenith direction (about 50dB at 63-64 GHz - see Figure 5). SE 19 may need to further consider the protection of ISS in the bands where the isolation will be lower, in particular in the frequency range 64-66 GHz.

Earth Exploration Satellite Service (EESS); SE19 initiated the compatibility studies between MGWS and EESS in the frequency range 57-59 GHz. Again, due to the isolation resulting from the gaseous absorption (more than 90dB – see Figure 5), the preliminary conclusion is that the two systems are compatible and that MGWS will not interfere the EESS operations.

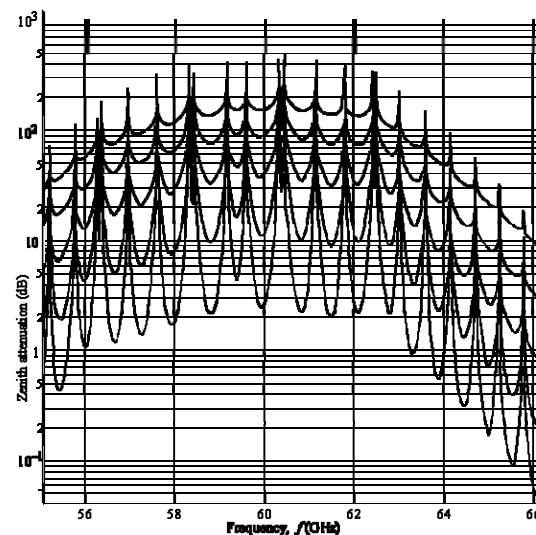


Fig. 5. Gaseous absorption in the zenith direction (ITU, 2005)

Space Research Service (passive); since the characteristics of Space Research systems are similar to EESS systems, it is expected that the conclusions achieved for EESS will also be valid for compatibility between MGWS and the Space Research Services.

4.2 Compatibility with Military Applications

No radiolocation system utilisation has been reported to NATO at 63-64 GHz. However, some countries are using radar systems in this frequency range and may need to take the appropriate measure on a national basis.

The utilisation of radiolocation systems and other military applications (fixed and mobile systems) in other bands may need to be confirmed in the other frequency ranges.

4.3 Compatibility between ITS and MGWS

ITS; Intelligent Transport Systems at 63GHz are expected to provide Vehicle to Vehicle (V2V) communications and Roadside to Vehicles (R2V) communications.

ITS are expected to cover a large variety of services including:

Parking Payment	Probe data collection
Access control (car and truck)	Toll collection
Transit vehicle data transfer	Repair-service record
Rental car processing	Fuel payment
Electronic licence plate	Signal priority
Traffic information	In-vehicle signing
Work zone safety warning	Fast food payment
Intersection collision avoidance ...	

Figure 6 provides an example of applications where a car is located in a dangerous area and is sending a warning to the neighbouring cars (only those

equipped with the ITS technology -in dark grey- will receive the warning).

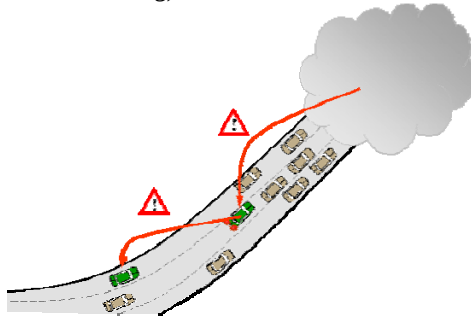


Fig. 6. Car to Car Communications

The following figure provide an overview of a possible ITS network architecture where the ITS infrastructure may use Fixed links at 64-66 GHz (ITU, WP8A, 2006).

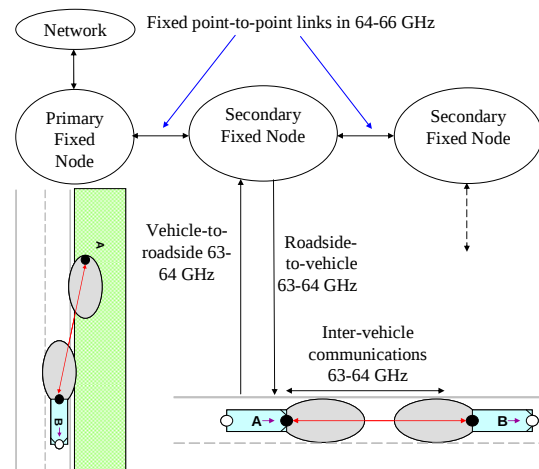


Fig. 7. Possible ITS Network Overview

Preliminary results of compatibility between ITS and MGWS. A number of possible cases of interference may need to be considered due to the complexity of the two considered systems:

- impact of ITS/V2V transmission on MGWS/FLANE receiver;
- impact of MGWS/FLANE transmission on ITS/C2C receiver;
- impact of MGWS/FLANE transmission on ITS/Roadside Unit receiver (see Figure 8);
- ...

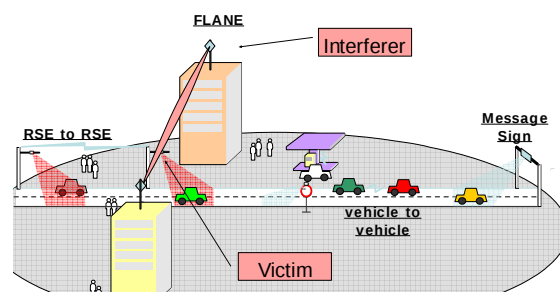


Fig. 8. Possible Case Study for the Impact of MGWS on ITS

Among all these possible cases it has been found that the impact of ITS on MGWS is likely to be quite limited due to the fact that:

- for typical outdoor of MGWS (FLANE), the antennas are quite directive and the antenna are not pointing to each other.
- for WLAN/WPAN, the attenuation resulting from building losses (about 15 dB) help reducing the possible cases of interference.

For the other direction (impact of MGWS on ITS), it was found that the most sensitive case will occur when a WLAN user is located outside a building and in particular in a car. Then, it may interfere with a V2V receiver located in another car. In such case, the required separation distance may be up to around 1.5 km.

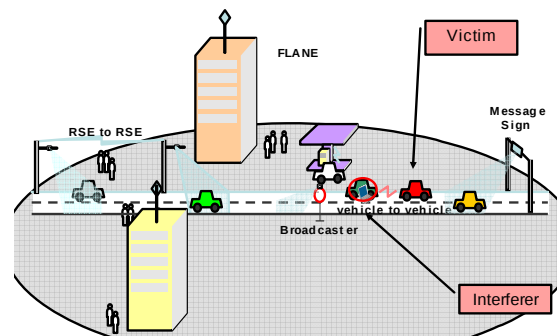


Fig. 9. Worst Case Study – For the Impact of MGWS on ITS

Therefore the preliminary conclusions from SE24 are as follows:

- WLAN equipment: these systems could be limited to indoor use for this frequency band.
- FLANE: coordination between FLANE and ITS Roadside Unit may be needed to ensure compatibility between these systems (to avoid that the antennas are pointing to each other).

4.4 Compatibility between FS and MGWS

FLANE systems do not need specific calculations if there are considered as system belonging to the Fixed Service. Potential interference could be predicted and avoided if the respective locations of FLANE and Point to Point systems are known in advance.

However, for WLAN/WPAN, their possible impact may need to be further addressed. Figure 10 an example of scenario to be considered.

In this direction, due to the low power used by MGWS and the loss resulting from the wall/windows (about 15dB), the separation distances found by SE19 to protect FS systems are quite low: about 200m.

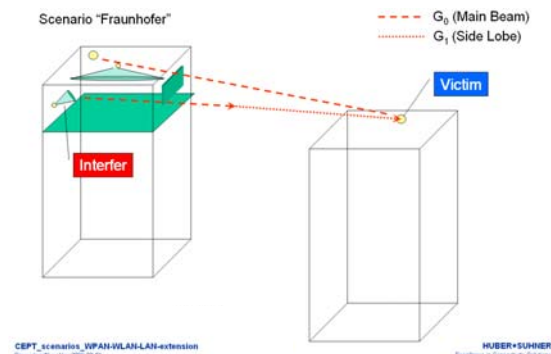


Fig. 10. Possible Case Study for the Impact of MGWS on FS R. (Premarlani, 2005)

In the other direction (impact of FS on MGWS), the situation is quite similar except than the power radiated by FS system may be larger than for MGWS (65dBm for FS and 40dBm for MGWS). This leads to larger separation distances, i.e. up to 2.5 km at 66 GHz. However, the probability of such event (less than 0.1%) would have to be considered when developing conclusions of the possible sharing.

5. OTHER ISSUES RELATING TO THE IDENTIFICATION OF SPECTRUM FOR MGWS SYSTEMS

In addition to the compatibility issues listed in section 4, CEPT may need to address some additional issues relating to MGWS.

5.1 Status of MGWS Systems

When addressing the impact of MGWS on other systems, there will be a need to consider the possible status of the different MGWS systems with regard to the existing allocations of spectrum.

If FLANE systems could be considered as belonging to the Fixed Service, then there will be a need to consider the existing allocations with regard to the spectrum requirement for FLANE.

WLAN and WPAN could be considered as belonging to the Mobile Service, identically, there will be a need to consider the existing Mobile Service allocations with regard to the existing spectrum

5.2 Licensing Regime

The high frequency re-use achievable in the oxygen-absorption band reduces the requirement for sophisticated frequency planning techniques and offers the possibility of a pan-European deregulated telecommunications environment for various low-power, low cost, short-range applications.

Therefore, portions of the 60 GHz have been allocated on both light licensing (64-66 GHz) and license-exempt (57-59 GHz) basis for a variety of fixed, mobile, and satellite applications.

The licensing regime for MGWS over the frequency range 57-66 GHz may need to be carefully investigated taking into account the possible Nomadic aspect of LAN components.

5.3 Status of ITS within CEPT at 63-64 GHz

There are some on going discussions within CEPT on the status of ITS systems/applications at 63-64 GHz. Some of the applications to be developed on ITS systems are expected to decrease the number of casualties and to improve the security of the driver. This may mean that some of these applications could be considered as "safety of life" applications. Such regulatory status will imply a high degree of protection that may impose severe constraints on MGWS in this part of the spectrum and make unpractical their deployment.

6. CONCLUSIONS

In the band 63-64 GHz, the initial conclusions from SE24 are as follows:

- WLAN equipment: possible limitation of these systems to indoor use for this frequency band.
- FLANE: coordination between FLANE and ITS Roadside Unit may be needed to ensure compatibility between these systems

In the frequency range 57-59, the SE 19 preliminary concluded that impact on EESS is exaceptable. Conclusions relating to the other parts of the spectrum will be updated depending on the results of the forthcoming CEPT meetings.

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BIOGRAPHY



Marc Le Dévendec received the Engineering Degree in Telecommunication from the Ecole Nationale Supérieure des Télécommunications de Bretagne (France) in 1998.

From 1998 to 2004, he was working for the Agence Nationale des

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