RECOMMENDATION ITU-R F.1518*

Spectrum requirement methodology for fixed wireless access and mobile wireless access networks using the same type of equipment, when coexisting in the same frequency band

(Questions ITU-R 215/8 and ITU-R 140/9)

(2001)

The ITU Radiocommunication Assembly,

considering

a) that use of wireless access systems is expanding for both fixed and mobile applications;

b) that, for easy implementation, some wireless access systems use dynamic RF channel assignment;

c) that fixed and mobile wireless access (FWA and MWA) systems operated in the same band may use the same type of equipment;

d) that shared use of a limited spectrum by different access systems may reduce the traffic handling capability of each system;

e) that the traffic handling capacity of a wireless system is a basic parameter of the engineering of the radio network;

f) that a methodology to assess the traffic handling capability of a FWA system in a frequency band shared with other wireless access systems, fixed and/or mobile, is necessary,

recommends

1 that the methodology to be followed to assess the traffic capability should consider:

– the cell deployment schemes of the different systems;

– the access methods of the systems;

– the transmission of the interfering signal towards the victim system;

– the relative level of wanted and unwanted signals;

– the statistical distribution of activity of the systems involved;

– the interference mitigation techniques developed by the victim system;

2 that the calculation methodology in Annex 1 could be used to assess frequency spectrum requirement and traffic handling capability for coexisting MWA system and FWA system using the same type of equipment.

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* This Recommendation was jointly developed by Radiocommunication Study Groups 8 (WP 8A) and 9 (WP 9B) and any further revision should be undertaken jointly.

ANNEX 1

A methodology to assess frequency spectrum requirements and traffic handling capability for coexisting of MWA system and FWA system in the same band using the same type of equipment, based on time division multiple access (TDMA) and/or frequency division multiple access (FDMA) technology

1 Introduction

Recommendation ITU-R F.1402 presents the frequency sharing between a MWA system and a FWA system on condition that the interference to each other should be less than a certain level. The basic idea behind the sharing is that the FWA system and MWA system have different service areas and the examination was done to find the separation distance between both systems.

In the practical operation, however, the service areas for the FWA system and MWA system sometimes overlap and there arises a need to coexist in part of their areas. Such coexistence is possible for the system in which the radio resource assignment is done autonomously, each equipment avoiding on-going interference.

Particularly, in some cases, the MWA system and FWA system have basically different service areas and share the same frequency band only in a small portion at the edge of each area, where the traffic for each system is rather small. In this situation, it is advisable in respect of the efficient use of frequencies, that the MWA system and FWA system use the same frequency band and coexist only in a small part where the service area overlaps, instead of each system using a different frequency band.

Considering the above, this Annex describes the technical conditions concerning the MWA system and FWA system using the same equipment as the MWA system and accessing the same frequency band at the same area.

2 Scope

In this methodology, the MWA system and the FWA system use the same type of equipment based on TDMA and/or FDMA technology, where the equipment chooses autonomously an unused radio channel within the frequency band. Coexistence conditions for such MWA and FWA systems when they use the same frequency band at the same area are examined.

The method described in this Annex can be applied to a wide range of frequency bands by applying a propagation formula suitable for the target frequency.

3 References

Recommendation ITU-R F.1399 – Vocabulary of terms for wireless access.

Recommendation ITU-R F.1402 – Frequency sharing criteria between a land mobile wireless access system and a fixed wireless access system using the same equipment as the mobile wireless access system.

Recommendation ITU-R M.1390 – Methodology for the calculation of IMT-2000 terrestrial spectrum requirements.

4 Analysis of frequency spectrum requirement

4.1 Assumed system

In this methodology, both the MWA and FWA systems are assumed to use the same TDMA/FDMA technology and in these systems the radio channel resource assignment is not controlled by the system as a whole, but each radio base station (MWA system) or cell station (FWA system) chooses the available resource autonomously from the candidate channels within the frequency band. It is possible that the channel being used receives interference, and in this case the system activates the interference avoidance process. It is assumed that the two systems have the same functions.

When the service areas of the MWA system and FWA system overlap, they can coexist in the same frequency band because the frequency assignments are done autonomously at call set up.

On the other hand, when one system uses a radio channel, the other system cannot use the channel, and in order to maintain the same call loss probability, it is necessary to assign additional frequency bandwidth.

If the systems employ an autonomous frequency control method, it may be possible that different types of systems can coexist. However, the interference conditions are much more complicated in this case.

4.2 Calculation of required frequency bandwidth when using the same frequency in the same service area

Generally speaking, when considering the introduction of a MWA or FWA system, the frequency bandwidth necessary for the system is calculated, assuming a traffic model and arrangement of base stations or cell stations for the serving area.

When considering the coexistence of a MWA system with a FWA system, the frequency bandwidth necessary to maintain the call loss probability is calculated in the same manner, and the possibility of coexistence is judged. The method for such an examination is shown in Appendix 1 to this Annex.

A calculation example about the coexistence of mobile PHS and PHS-FWA systems in rural areas is shown in Appendix 2 to this Annex.

4.3 Techniques for the efficient frequency use

It is possible to minimize the increase in the required bandwidth and extend the possibility of coexistence by employing the techniques given below.

4.3.1 Use of directional antenna

It is possible to reduce the interference by using a directional antenna, not only for base stations or cell stations but also for terminal stations in the FWA applications. Several types of directional antenna, such as tilt antenna, sector antenna, array antenna, can be used. By using directional antennas, the cluster shape and size explained in Appendix 1 to this Annex will be improved.

4.3.2 Frame synchronization of radio signals

Two steps of synchronization are possible for the radio signal frame synchronization for coexistence conditions. They are explained in the following paragraphs.

4.3.2.1 Frame synchronization within a system

By using frame synchronization within the MWA system or within the FWA system, communication on one time slot generates interference within the system during that time slot only. Therefore, the frequency bandwidth necessary for one communication channel will be improved in non-coexistence areas when compared with the unsynchronized case.

Moreover, in a TDD system, by achieving synchronization within a system, the possibility for interference is limited to the same conditions as for the FDD system (see Recommendation ITU-R F.1402). This means that the interference between base stations, which is the most problematic, is eliminated and the coexistence conditions are much improved. In the calculation method described in Appendix 1 to this Annex, the cluster size and spectrum requirement will become smaller than in an unsynchronized system.

4.3.2.2 Mutual frame synchronization among the systems

Without mutual frame synchronization, significant interference may occur between unsynchronized systems, especially if base stations or cell stations are in line-of-sight of one another. In general, mutual frame synchronization will be very difficult if different technologies are used for MWA and FWA systems.

By achieving mutual frame synchronization between a MWA system and a FWA system, communication on one time slot creates interference to primarily only that time slot, though it depends on how precise synchronization is achieved. Therefore, the frequency bandwidth necessary for one communication channel will be improved in all cases compared to the unsynchronized case.

Moreover, in the TDD system, by achieving synchronization among the systems, the possibilities for interference are limited to the same conditions as for the FDD system (see Recommendation ITU-R F.1402). In the calculation method described in Appendix 1 to this Annex, the cluster size and spectrum requirement will become smaller in all cases.

5 Traffic handling capability

The simulation process in Appendix 3 assesses the traffic handling capability for coexistence of the MWA system and FWA system using the same DECT type of equipment in an allocated frequency band.

6 Acronyms

DCA dynamic channel allocation

DECT digital enhanced cordless telecommunications

FDD frequency division duplex

FDMA frequency division multiple access

FWA fixed wireless access

MWA mobile wireless access

PHS personal handy-phone system

PSTN public switched telephone network

TDD time division duplex

TDMA time division multiple access

APPENDIX 1

TO ANNEX 1

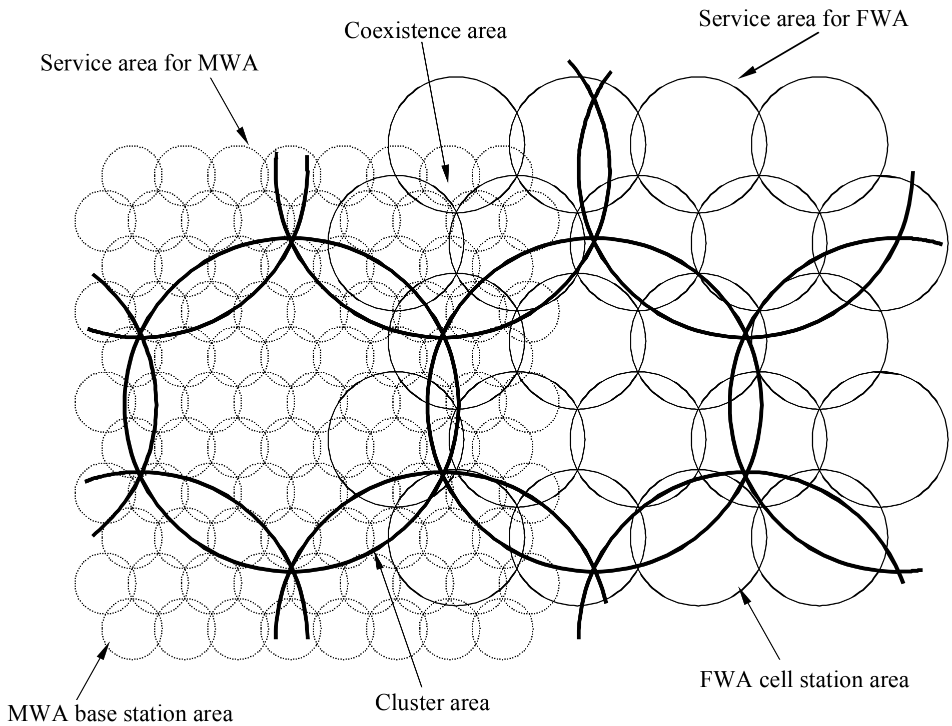
Calculation method

1 Coexistence model

In calculating the necessary frequency bandwidth, the coexistence model shown in Fig. 1 is assumed.

FIGURE 1

Coexistence model



Note 1 – The service areas for the two systems may be identical.
Note 2 – Cluster radius for the two systems may be different.

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1.1 Radio base station model and cluster area

1.1.1 Radio base station model

In this model, MWA base stations and FWA cell stations are deployed in the same service area and use the same frequency band. The two systems are based on the same system and use the same carrier assignment and the same access method. When a system uses a radio channel, the other system cannot use the radio channel and may experience interference on the immediately adjacent channels.

The FWA cell station covers a circle area with radius r_f, and the MWA base station covers a circle area with radius r_m. Each base station is scattered uniformly in the service area.

Each base station can use any unused radio channel in the frequency band, without any other restrictions.

1.1.2 Idea of cluster area

To calculate the frequency reuse conditions in such a case, a virtual "cluster area" is assumed. This cluster area is assumed to exist uniformly within the service area and it is assumed that the same frequency/time slot combination cannot be reused in the same cluster area, but can be reused in a different cluster area.

1.1.3 Calculation of cluster area radius

We assume that there are two circle areas A and B which have the same radius, r, and border on point P as in Fig. 2. Area A is assumed to be the interfered area and area B is assumed to be the interfering area. Among the interfered base/cell station areas in area A, we pick up the worst base/cell station area C that borders on point P.

Base/cell stations and subscriber stations are scattered at various points in area B. So, the received power from an interfering radio station in area B at point P is not uniform. But if we use an average value, the received power is about the same level as when the interfering radio station is at the centre of area B. In addition, in order to simplify the problem and to assume the worst-case scenario, we assume that the subscriber or base/cell station has the maximum antenna gain toward point P.

Similarly, subscriber stations are scattered at various points in base/cell station area C. But if we use an average value, the received power at point P is about the same level as when transmitting radio station is at the centre of area C.

Considering this way, it is reasonable to suppose that at point P, the D/U is given by the following equation:

$$D/U = P_{rC}/P_{rB}(r) \qquad (1)$$

where:

D : desired signal level

U : undesired or interfering signal level

P_{rC} : received power at point P from transmitting radio station at the centre of area C

$P_{rB}(r)$: received power at point P from interfering radio station at the centre of area B

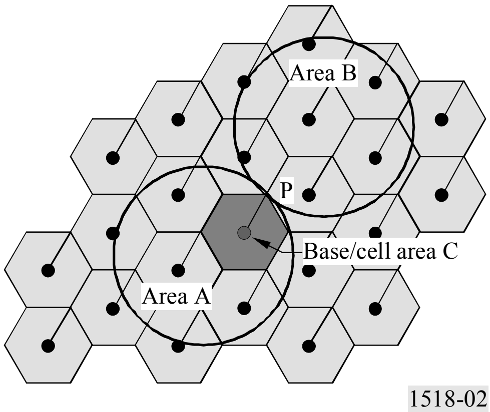
r : radius of areas A and B.

Therefore, the cluster area radius, r_c, limited by the following equation:

$$\text{Required } D/U \leq P_{rC}/P_{rB}(r_c) \qquad (2)$$

FIGURE 2

Calculation of cluster area radius



1.2 Traffic model

It is assumed that subscribers are scattered uniformly in the service area, the subscriber density of the MWA system is u_m, and that of the FWA system is u_f, the traffic per subscriber for each system is a_m, a_f respectively, and that the required loss probability is b_m, b_f respectively. In the following calculations of the required frequency bandwidth, only ordinary speech telephone calls are considered.

2 Calculation target area

In calculating the required frequency band, the area for calculation target, which is called calculation target area, is determined first.

FWA systems are often used as a complement system for wired access system. In this case, the FWA service area is a closed area, for example an area of several-kilometre radius, where the houses are located. The different service areas are independent in terms of radio propagation because they are widely separated, or there are some geographical conditions that prevent the radio propagation. Such closed area is called closed service area. Taking this into account, the calculation target area is expressed as follows:

$$\text{Calculation target area size, } s_c = min.\ (closed\ service\ area\ size,\ cluster\ area\ size) \qquad (3)$$

where *min.* (a, b): the smaller value of a and b.

In ordinary cases, the MWA service area may be the same as the FWA service area when the area is closed service area.

In the following calculations, it is assumed that the calculation target areas for the MWA system and FWA system are the same (see Note 1).

NOTE 1 – Calculation when the calculation target areas for the MWA system and FWA system are not the same is for further study.

3 Simplified calculation of required frequency bandwidth

This calculation assumes only that a single MWA system and a single FWA system coexist, but could be extended to include multiple systems.

When the calculation target area is decided, the required frequency band is estimated by calculating the number of radio channels, which correspond to the traffic in the area.

Firstly, the traffic density per unit area size in the service area for the MWA system and FWA system, respectively, is given by:

$$u_m \cdot a_m \text{ and } u_f \cdot a_f$$

So, assuming perfect synchronization of all cells in both the MWA and FWA systems, the total traffic in the calculation target area is given by the following:

$$s_c \cdot (u_m \cdot a_m + u_f \cdot a_f)$$

Therefore, the required frequency bandwidth, f_c, is given by the following equation:

$$f_c = w \cdot n_c \tag{4}$$

where n_c is the minimum integer that satisfies:

$$b_c > B\,(s_c \cdot (u_m \cdot a_m + u_f \cdot a_f), n_c) \tag{5}$$

$$b_c = min.\,(b_m, b_f) \tag{6}$$

$B\,(a, n)$: indicates an Erlang B formula

$B\,(a, n)$: loss probability for n outgoing channels with traffic volume a

w: required equivalent frequency bandwidth per one communication slot.

On the other hand, the required frequency bandwidth f_m, f_f when the MWA system and FWA system do not coexist in the same area but use a different frequency band or use the same frequency while being applied with sufficient separation is given by the following equation:

$$f_m = w \cdot n_m \qquad \text{for the MWA system} \tag{7}$$

where n_m is the minimum integer that satisfies:

$$b_m > B\,(s_m \cdot u_m \cdot a_m, n_m) \tag{8}$$

$$f_f = w \cdot n_f \qquad \text{for the FWA system} \tag{9}$$

where n_f is the minimum integer that satisfies:

$$b_f > B\,(s_f \cdot u_f \cdot a_f, n_f) \tag{10}$$

When the system uses a separate control channel other than the traffic channel, the frequency for such separate control channels should be added besides the above calculated frequency bandwidth.

The frequency requirements must be rounded up to the channel modularity of the technology used.

If more precise frequency bandwidth calculations are required, the approach in Recommendation ITU-R M.1390 could be used.

APPENDIX 2

TO ANNEX 1

Example of calculation of required frequency bandwidth for PHS system in a rural environment

1 Introduction

In the following calculation example, it is assumed that the systems are applied in a rural area and the MWA system and FWA system coexist in the closed service area in the same frequency band.

2 Calculation example

The calculation is done using the characteristics of mobile PHS (MWA) and PHS-FWA (FWA).

As an example, the case where the two are deployed in a rural area is examined. A similar calculation can be done for urban deployment.

2.1 Traffic model

The following traffic parameters are assumed for the calculation. The calculation model is produced referring to a typical rural area in Japan. Only the PSTN traffic is considered in this calculation.

MWA: 0.04 E/subscriber, call loss probability = 1.0%

FWA: 0.05 E/subscriber, call loss probability = 0.1%.

The subscriber densities are assumed as follows:

MWA: 1 subscriber/km^2

FWA: 5 subscribers/km^2.

The population density of the area is assumed to be 33 per km^2. Assuming that 10% of the residential population is mobile and that the mobile service penetration is 30% of the mobile population, MWA has one subscriber per km^2.

Five subscribers/km^2 is a typical PSTN subscriber density for an area where FWA is suitable.

It is assumed that MWA and FWA coexist in an area of 140 km^2, which indicates the maximum area size where FWA is suitable.

2.2 Calculation target area

Assuming that the desired signal field strength of the system (PHS-FWA) at the edge of the cell area is 40 dB(μV/m) (with the transmit power of 13 dBm and antenna gain of 10 dBi, see Recommendation ITU-R F.1402), and that the required *D*/*U* ratio is 15 dB, permissible undesired signal strength at the same point should be 25 dB(μV/m).

It is assumed that the distance which corresponds to the undesired signal field strength of 25 dB(μV/m) is 5.3 km using the line-of-sight propagation condition. Then, the cluster area, i.e. calculation target area, becomes 88.2 km^2 with a radius of 5.3 km.

2.3 Necessary traffic channels

Applying the traffic model to the calculation target area, the traffic in the area is calculated as follows:

Traffic from MWA: 0.04 × 1 × 88.2 = 3.53 E

Traffic from FWA: 0.05 × 5 × 88.2 = 22.1 E

Total traffic = 25.63 E.

2.4 Necessary traffic bandwidth

The next step is to find the number of channels needed to handle the above traffic with the respective call loss probability using an Erlang B formula.

It is calculated that 9 channels are needed to handle 3.53 E with a call loss probability of 1.0%, that 38 channels are needed to handle 22.1 E with a call loss probability of 0.1%, and that 42 channels are needed to handle 25.63 E with a call loss probability of 0.1%. When preparing frequency for coexistence conditions, it is necessary to calculate with the smaller call loss probability to achieve the quality of services for both MWA and FWA.

The necessary frequency bandwidth per one traffic channel is supposed to be 100 kHz. The PHS system uses 300 kHz carrier spacing and employs TDMA/TDD with four time slots. So, ideally, 75 kHz is necessary for one traffic channel on average. Considering the interference to adjacent channels, 100 kHz would be necessary for one traffic.

In addition the PHS needs one control carrier for each system.

Considering these things, the following frequencies are necessary:

MWA: 9 channels × 100 kHz + 300 kHz = 1.2 MHz

FWA: 38 channels × 100 kHz + 300 kHz = 4.1 MHz → 4.2 MHz

MWA and FWA without coexistence: 1.2 + 4.2 = 5.4 MHz

MWA and FWA with coexistence: (42 channels × 100 kHz) + (300 kHz × 2) = 4.8 MHz.

2.5 Summary of the calculation

The above calculations are summarized in Table 1.

TABLE 1

Summary of the calculation

	MWA system	FWA system	Combined MWA/FWA systems
Traffic per subscriver (a_f, a_m) (E/subscriber)	0.04	0.05	
Subscriber density (u_f, u_m) (subscriber/km^2)	1.0	5.0	
Closed service area size (km^2)	140.00	140.00	
Cluster area size (km^2)	88.2	88.2	
Calculation target area size (s_c, s_c) (km^2)	88.2	88.2	
Traffic in the calculation target area (E)	3.53	22.1	25.63
Call loss probability (b_f, b_m) (%)	1.00	0.10	0.10
Number of necessary traffic channels	9	38	42
Necessary frequency bandwidth per one traffic channel (w)(1) (kHz)	100	100	100
Necessary frequency bandwidth (calculated) (MHz)	0.9	3.8	4.2
Necessary frequency bandwidth (in operation)(2) (MHz)	1.2	4.2	4.8
Total necessary frequency bandwidth when separated bands (MHz)	5.4		–

(1) Considering the interference to adjacent channel.

(2) Considering the carrier spacing of 300 kHz and adding a control channel (one carrier per system).

NOTE 1 – The shaded parameters are the assumption of the calculation.

NOTE 2 – Subscript *m* indicates the notation for the MWA system and subscript *f* indicates the notation for the FWA system.

3 Consideration on coexistence

The result shows that if separate channels are assigned for the MWA and FWA, 5.4 MHz is necessary in total. If the two systems coexist in a spectrum efficient manner in the same frequency, 4.8 MHz is sufficient.

When calculating the necessary bandwidth for the coexistence area in this example, the design traffic of each system or in other words, the highest traffic for each system, is considered to be applied to the coexistence area as well. However, in cases where the MWA and FWA systems have different suitable service areas, and they share the same frequency band only in a small section at the edge of each service area, the traffic for each system is considered to be small. In this situation, the necessary frequency bandwidth, when they coexist, will be smaller than the above result and it would be even smaller than 4.2 MHz, the frequency band for the FWA system only. This means that MWA and FWA can coexist in the same frequency without any additional frequency bands.

This calculation example deals with the case of rural area deployment. On the other hand, as is often the case, MWA and FWA are deployed in more urban areas. In such cases, traffic volume is much bigger and greater frequency reduction will be expected owing to the greater trunking efficiency of traffic, when MWA and FWA coexist in a spectrum efficient manner in the same frequency band.

APPENDIX 3

TO ANNEX 1

Assessment of traffic handling capability for coexistence of MWA and FWA DECT systems in an assigned frequency band

1 Introduction

Some FWA systems are using a technology which has been developed for MWA applications and are operated in the same frequency band which has to be shared between the two applications. In the areas where the two systems are deployed at the same time, the consequence for the traffic capability of the FWA system that coexists with MWA shall be assessed in order to check that the required grade of service of FWA is achieved.

2 FWA application

It should be noted that effective radio ranges achieved in the FWA application with subscriber terminals will be considerably greater than when the same system is used in the mobile mode (MWA). The signal path is more consistent, it is generally line-of-sight (subscriber terminal antennas are often installed on roofs) and base/subscriber stations may use high gain antennas, whose directionality also reduces the occurrence of multipath signals.

The worst case to analyse is the coexistence of public pedestrian application with FWA application in an urban environment. In these circumstances FWA application will be interference limited (C/I limited), due to the density of subscribers.

Typical urban scenarios for FWA are either the extension of the fixed network to a new housing area near an existing town/a new town or a new operator in an urban area. The connection density ranges from 500 (villa area) to 2 000 (blocks of flats, 2-4 stories) connections per km^2. Each connection being supposed with a traffic in E of 70 mE, the total traffic in the area ranges from 35 to 140 E/km^2.

For a built up city the highest residential traffic is 140 to 280 E/km^2 for blocks of flats with 4-8 stories which is not typical for new housing areas.

It may be concluded that a traffic capacity of 100 to 300 E/km^2 is required to support speech FWA applications.

These traffic densities are estimated to increase within a few years to 200 to 400 E/km^2 due to the development of data services.

The range of cell radii of FWA systems corresponding to this traffic is between 400 and 500 m.

The traffic estimation is based on the models agreed by many countries planning to deploy FWA systems of this type.

3 Public pedestrian application (MWA)

The public pedestrian application provides local mobility to subscribers in an urban or suburban area. There are two main types of areas, indoor public zones like shopping centres, railway stations or airports, and outdoor streets. For each mobile user, the traffic is assumed to be 30 mE. The indoor hot spots in public zones will not be considered as their contribution to interference is very low due to wall and floor shielding. Therefore, the highest level of interference between the two applications is met when FWA connections are implemented above rooftops while outdoor base stations for public pedestrian cordless access (MWA) are situated a few metres above ground level.

The street coverage is obtained by positioning the base stations at lamp post height along the streets. If it is assumed that a maximum penetration for this application could be 5% of the population, this means, for a city of 2 million inhabitants over 100 km^2, a traffic of 30 E/km^2, but people are not always in the streets.

Another way to estimate the traffic is to use an estimated density of pedestrians in a metropolitan centre, 10 000/km^2, 5% penetration leads to 15 E/km^2.

A large main street with a 5 m wide pavement on each side is considered, the base station has a range of 200 m to each side, so that its total coverage is 4 000 m^2 of pavement. In the streets there is one person every 10 m^2, in total 400 persons, 5% only with a handset. If for each user the traffic is 30 mE, the average total traffic at the base station will be 0.6 E, corresponding to 30 E/km^2, with streets separated by 100 m. Only a few main streets in a city centre have such a high load, therefore the mean traffic density will be 10 to 15 E/km^2 as estimated above. The average traffic per base station will be less than 1 E, but the limited radio path budget (small antennas for the handsets) imposes small cells.

4 Simulation of interference between public pedestrian MWA and FWA systems, based on DECT technology

As said above, the highest potential interference occurs between above rooftop FWA systems and a public pedestrian street MWA system below rooftop.

Such an interference scenario has been simulated, based on DECT technology, where each FWA base station site supports 6 sector cells. All the base stations are synchronized and the subscriber stations use DCA. The separation between FWA base stations is 1.7 km, and between public pedestrian base stations 300 m, both systems are installed in hexagon grid patterns. There are 33 public pedestrian base stations within the area of one FWA base station. Each base/subscriber station is controlled by a call simulator according to Poisson law. If the call attempt is not successful after 3 s (DECT standard) the call is considered as blocked.

4.1 Impact of FWA on MWA public pedestrian

The public pedestrian base stations are considered with an average traffic of 1 to 3 E. This means that the traffic is far from its trunk limitation but also that the traffic is not interference limited since the interference received from adjacent sites, is firstly very little since the traffic per base station is weak, and secondly, has a low level due to propagation characteristics, reflections and diffractions.

The dimensioning of the public pedestrian system is based on coverage issue more than traffic issue.

The FWA applications coexisting in the same area will interfere with the hand sets and base stations of the public pedestrian. For the configuration exposed above and for more important FWA cell radius, the impact of this interference remains negligible on the public pedestrian system and the traffic is not influenced. A small cell of the pedestrian application will receive only one part of the FWA connections, which are operated within a larger cell.

4.2 Impact of MWA public pedestrian on FWA applications

The FWA applications for urban environment are interference limited; the cell radius is traffic limited. The FWA interference comes from other synchronized system sites. If some interference is added to its own FWA interference, the traffic per base station may reduce, according to the importance of the interference introduced by the public pedestrian application.

A 1 E average traffic per public pedestrian cell does not affect the FWA system having its maximum average traffic per base station. Average traffic of 3 E per public pedestrian cell however reduces the FWA traffic (for the same grade of service) by about 10% to 30% per base station. Typical street public pedestrian systems with 1 E per cell, do not affect the FWA traffic.

The interference impact on both the uplink and the downlink transmission can be summed up as follows:

– *uplink*: the additional interference comes from the handset telephones communicating with their base stations; these signals interfere with the FWA base stations especially when the pedestrian is near the site. This interference may not become important with the numerous pedestrian cells included in one FWA cell, as only a few of them are near the FWA base station;

– *downlink*: the FWA subscriber stations are interfered by the MWA base station of the public pedestrian system. The low traffic level managed by the base station prevents the subscriber stations from being blocked.

These results demonstrate the positive impact of DCA on the way each radio equipment, either base station or subscriber station, is protected against interfering signals.