Commission for
Communications Regulation

Wideband Digital Mobile Data Services (WDMDS)

Response to request for licence amendment

Information Notice

Reference: ComReg 14/16

Date: 18 February 2014

1 Background

1. In 2005[1], the Commission for Communications Regulation ("ComReg") conducted an auction for the award of three national licences for the provision of Wideband Digital Mobile Data Services (WDMDS) in the frequency ranges 410 – 414 MHz paired with 420 – 424 MHz and 872 -876 MHz paired with 917 – 921 MHz. At the conclusion of the auction, the three licences were awarded to DigiWeb, Mobisof and Wirefree Communications ("Wirefree") in Block C (872 – 876 MHz paired with 917 – 921 MHz), Block B (412 – 414 MHz paired with 422 – 424 MHz) and Block A (410 – 412 MHz paired with 420 – 422 MHz) respectively.

2. Following the transfer of ownership of Mobisof to Wirefree in March 2009, Wirefree assumed the rights of use of the former Mobisof licences.

3. As of 2014, the current WDMDS licensees are Digiweb and Wirefree, with Wirefree holding Blocks A and B and Digiweb holding Block C.

[1] ComReg Document 05/80 – Information Memorandum: Process for the award of national licences for the provision of WDMDS – published 20 October 2005. Note: this document is not publicly available as it was only accessible through purchase. However, the majority of details in the Information Memorandum are covered at a high level in ComReg Document 05/79 – Information Notice: The awarding of national licences for the provision of WDMDS – published 20 October 2005.

2 Request for licence amendment

4. The three national licences were issued under the Wireless Telegraphy (Wideband Digital Mobile Data Services) Regulations, 2005 (S. I. No. 642 of 2005) for a maximum duration of 10 years. It was a technical condition of each licence that a mobile station and base station would operate in different paired frequencies such that licensees were required to use frequency-division duplexing (FDD) technology which adequately reflected the available technology at that time.

5. On 2 October 2013, ComReg received a request from Wirefree for an amendment to this technical condition to facilitate the use of time-division duplexing (TDD) technology as well as FDD in respect of each of its WDMDS licences (see Annex 1).

6. In support of its application, Wirefree submitted a technical report (see Annex 2) on the issue which, amongst other things, addressed any risks of interference and how to ensure any potential for interference between WDMDS and adjacent band users could be minimised in accordance with its licence obligations.

7. On 4 November 2013, ComReg sought additional clarifications in relation to certain aspects of Wirefree's technical report (see Annex 3). Wirefree responded to these additional queries on 12 November 2013 (see Annex 4).

8. After careful consideration of Wirefree's reasoned request for an amendment to its licences along with the documents submitted to support that request, ComReg notes that:

    - the licence amendment is minor in nature and both of Wirefree's licences expire in less than two years; and

    - the technical parameters presented in the Wirefree report are adequate to prevent harmful interference to both co-channel and adjacent channel FDD/PMR base stations and terminal devices.

9. ComReg, therefore, intends to amend Wirefree's WDMDS licences to facilitate the use of TDD technology.

Annex: 1

Commission for Communications Regulation
Att: Dr. Samuel Ritchie
Abbey Court
Irish Life Centre
Lower Abbey Street
Dublin 1

2nd October 2013

Dear Sir,

Following our meetings and discussions with Comreg, we would now like to proceed with installing the suggested TDD equipment in our licensed band. At the time of auction, the frequency band was awarded as technology neutral, but in the license documents, the terminal and BTS transmit bands are specified. ComReg have expressed fears of interference that we have sought to address.

We hereby seek ComReg's approval to change the license to allow both BTS and terminal transmit in both our frequency bands (i.e. 410-414 and 420-424 MHz) subject to our voluntary commitments and validation of our technical report on the issue and risks of interference.

We accept responsibility not to cause interference to the adjacent users when introducing this new technology, including taking corrective action if unacceptable interference would be detected.

As described in the attached report, the highest risk of interference is between TDD and FDD base stations if these are placed close to each other. To minimize the risk of interference we would therefore voluntarily accept the following restriction in our license:

- Avoid placing the TDD base station antennas facing PMR FDD base stations in adjacent bands with less than 330m distance. We will respect this distance requirement either by physical separation of the base stations of at least 330m, or by ensuring sufficient antenna isolation in some other way (like avoiding line of sight).

Yours Sincerely

Johan Jobér
Wirefree Communications Limited
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+46 735 151 000

cc. Ms. Tara Kavanagh, ComReg
Attachment: Interference scenario analysis

Annex: 2

WIREFREE COMMUNICATIONS LIMITED

Analysis of the Co-existence Interference and Isolation between TDD and PMR/FDD

2013/9/17

Analysis with respect to the requirements of the co-existence and isolation of 400M system

1. Overview

1.1 PMR/FDD System

In accordance with the technical standards of ETSI TS 102 361 and practical service conditions in Ireland, the spectrum allocation of FDD PMR systems is as follows:

- The range from 416MHz to 418.8625MHz is the transmit frequency of mobile terminals and receive frequency of base stations;
- The range from 426MHz to 428.8625MHz is the transmit frequency of base stations and receive frequency of terminals;

It also provides that the carrier bandwidth of these FDD systems are is 12.5kHz and can either be analogue or digital.

1.2 TDD System

The TDD system under study is the system described by ITU-R M.1801, Annex 7 and frequency license of ComReg in Ireland to Wirefree Communications Limited, the frequency currently in 410-414MHz and 420-424MHz (for both terminals and base stations). Carrier start frequency is adjustable with 250kHz resolution and the bandwidth of each carrier is 1MHz. As TDD 420-424MHz product works on the closest adjacent frequency with PMR/FDD, the analysis is to study potential interference between these two systems.

Table 1 Frequency allocation of TDD® and FDD

System	TDD	FDD
Uplink frequency(MHz)	420-424MHz	416-418.8625MHz
Downlink frequency(MHz)	420-424MHz	426-428.8625MHz

Bandwidth per sector	4MHz	12.5KHz
Duplex mode	TDD	FDD
Multi access mode	CS-OFDMA	FDMA/(TDMA)

1.3 Potential problems arising from systems co-existence

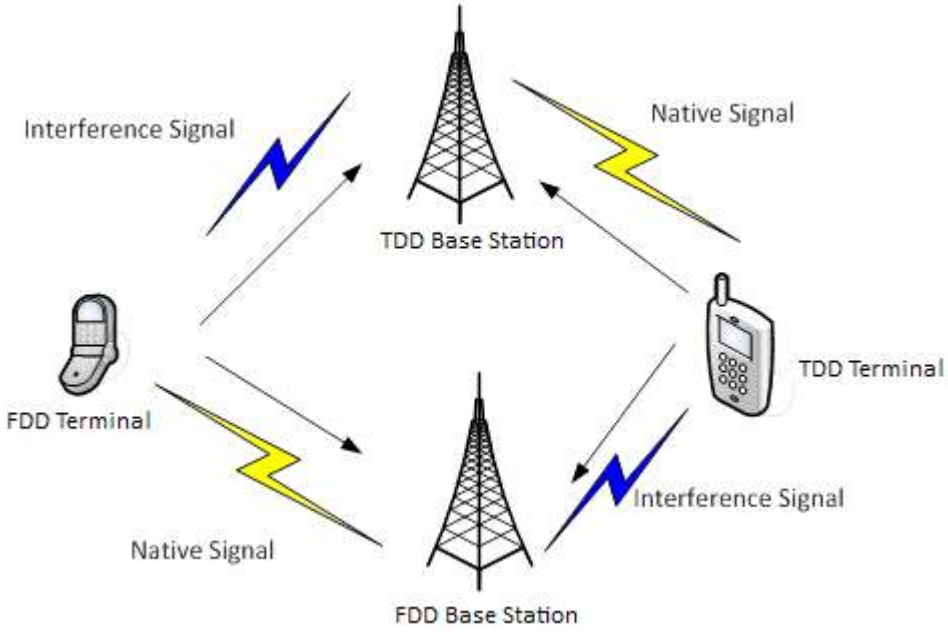


Fig.1 Typical scenario of systems co-existence

The typical scenario of systems co-existence as shown in Fig. 1 the possible interference among systems is the mutual interference between FDD and TDD. The actual interference between systems includes that from BTS's to BTS's, BTS's to terminals, terminals to BTS's and terminals to terminals. The interference from terminals to BTS's is negligible since the terminal transmit power is far below that of a BTS. Therefore, the interference between systems mainly falls under that among BTS's and from BTS's to terminals and terminals to terminals.

2. Analysis of the Interference from TDD to FDD System

2.1 TDD base station to FDD base station

2.1.1 Transmitter indicator of TDD base station

In accordance with the technical standard of TDD recommended by ITU-R M.1801, the transmitter mask of TDD base station is as follows:

- Transmitter spectrum mask

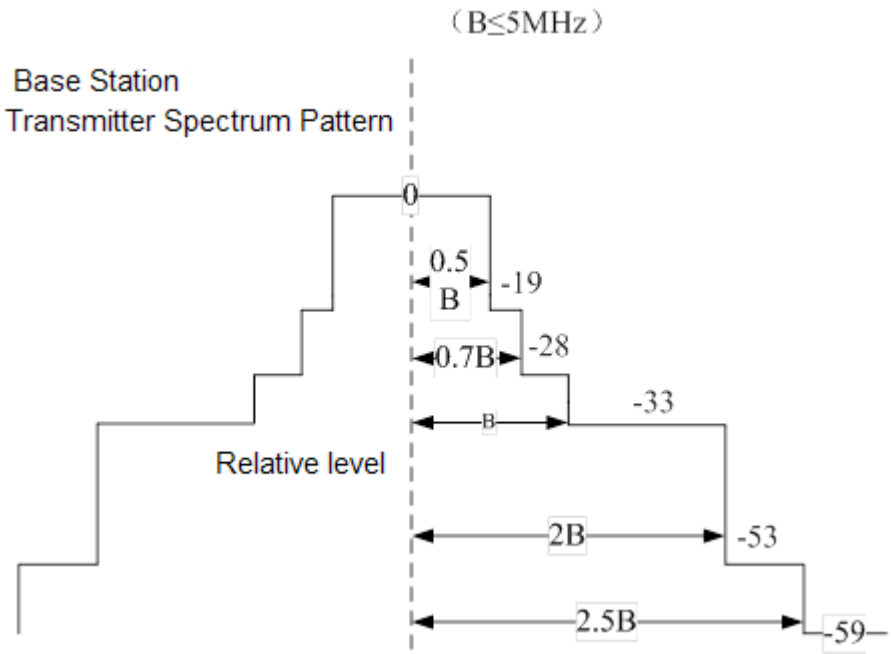


Fig.2 Transmitter Spectrum Mask

- Maximum output power of BTS shall not exceed (33dBm+/-2dB)/5MHz, while power tolerance is 2dB (based on rated power).

- Spurious emission of antenna ports

Frequency (MHz)	Limit (dBm)	RBW (kHz)
0.009—0.150	-36	1
0.150—30	-36	10
30—1 000[a]	-36	100

1 000—12 750	-30	1000

2.1.2 Spurious interference analysis

Spurious interference is defined as that from the out-of-band spurious signals of TDD transmitters to FDDPMRFDD base station receivers. Frequency allocation of PMR FDD base station receivers is 416-418.8625MHz. We can take that there is no significant effect on the receiver when the interferer signal strength equals to the receiver's floor noise. The noise figure of PMRFDD system is 4.

Floor Noise = -174+bandwidth+Noise Figure=-174+10*log10(12500)+4=-129dBm

THIS IS THE WORST CASE, i.e. this is on the coverage edge of the PMR system. They still get a good SIR when the the terminals are closer than the edge of range. This should ideally also be described that both these conditions need to be fulfilled in order to have problems.

When the two base stations are co-located and there is line of sight:

Spurious Interference				
No.	Description	Unit	Value	Note
1	Antenna output power (Ptr)	dBm	33	Output port
2	Transmit bandwidth (Btr)	MHz	4	
3	1st adjacent channel power ratio (ACPR)	dBc	33	First adjacent channel power ratio (1.1375MHz from frequency band edge)
4	Rejection of 2 notch filters (L_filter)	dB	60	Out-of-band rejection
5	Number of Antenna Elements (Nant)	/	8	TDD 8-antenna array
6	Receive bandwidth (Brec)	MHz	0.0125	DMR carrier frequency bandwidth
7	Interference power in the band of DMR	dBm	-76	Ptr-10log(Btr/Brec)-ACPR-L_filter+ 10*log10(Nant)
8	Maximum permissible interference power	dB	-129	KTB+noise figure
9	Need for additional isolation	dB	53	Ptr-10log(Btr/Brec)-ACPR -L_filter+10*log10(Nant)-Prec

10	Antenna gain (pointing)/Antenna gain (opposite)	dB	22/-10	DMR antenna gain=10dBi, TDD sectorized antenna gain (front facing) =12dBi, TDD sectorized antenna gain (back facing) = -10dBi.
11	Need for additional isolation	dB	75	If the TDD antenna faces the FDD BS
12	Physical distance when two antennas pointed at each other	m	330	
13	Need for additional isolation	dB	53	If the TDD antenna faces opposite against the FDD BTS antenna
14	Physical distance if the TDD sectorized antenn faces opposite to the DMR omni antenna	m	25	

2.2 TDD base station to FDD terminals

The interference from base stations to terminals mainly originates from spurious interference. Likewise, we can take that there is no significant effect on the receiver when the interferer signal strength be 7dB higher than the receiver's floor noise. The noise figure of PMR FDD system is 4.

Floor Noise=-174+bandwidth+noise factor=-174+10log10(12500)+4+7=-122dB

Spurious Interference				
No.	Description	Unit	Value	Note
1	Antenna output power (Ptr)	dBm	33	Output port
2	Transmit bandwidth (Btr)	MHz	4	
3	1st adjacent channel power ratio (ACPR)	dBc	33	First adjacent channel power ratio (1.1375MHz from frequency band edge)
4	Rejection of 2 notch filters (L_filter)	dB	60	Out-of-band rejection
5	Number of antenna elements (Nant)	/	8	TDD 8-element antenna array
6	Receive bandwidth (Brec)	MHz	0.0125	DMR carrier frequency bandwidth
7	Interference power in the band of DMR	dBm	-76	Ptr-10log(Btr/Brec)-ACPR-L_filter+ 10*log10(Nant)
8	Maximum permissible interference power	dB	-122	

9	Need for additional isolation	dB	46	Ptr-10log(Btr/Brec)-ACPR -L_filter+10*log10(Nant)-Prec
10	Antenna gain	dBi	12/0	TDD antenna faces the FDD terminal/Antenna gain of FDD
11	Need for additional isolation	dB	58	If the TDD antenna faces the FDD terminal
12	Free space isolation	M	50	$E_{\text{Free space}}=32.45+20\lg(f\cdot d)$
13	Simulated environmental isolation	M	<50	COS 231 model (45m antenna height, and 1.5m terminal height) :

The scenario is that FDD subscribes are located in the coverage area of TDD base station. Take free space model in LOS condition and COS231 model in NLOS condition for calculation isolation.

2.3 TDD terminal to FDD terminals

The interference from terminals to terminals mainly originates from spurious interference. Likewise, we can take that there is no significant effect on the receiver when the interferer signal strength equals to the receiver's floor noise. The noise factor of FDD system is 4.

Floor Noise=-174+bandwidth+noise factor=-174+10log10(12500)+4=-129dB

Spurious Interference				
No.	Description	Unit	Value	Note
1	Antenna output power (Ptr)	dBm	23	
2	Transmit bandwidth (Btr)	MHz	4	
3	1st adjacent channel power ratio (ACPR)	dBc	28	First adjacent channel power ratio (1.1375MHz from frequency band edge)
4	Notch filter reject L_filter	dB	23	Out-of-band rejection
5	Number of Antenna Elements (Nant)	/	1	
6	Receive bandwidth (Brec)	MHz	0.0125	FDD carrier frequency bandwidth
7	Interference power in the band of FDD	dBm	-53	Ptr-10log(Btr/Brec)-ACPR-L_filter+ 10*log10(Nant)
8	Maximum permissible interference power	dB	-129	

9	Need for additional isolation	dB	76	Ptr-10log(Btr/Brec)-ACPR -L_filter+10*log10(Nant)-Prec
10	Free space isolation	Km	0.36	$E_{\text{Free space}}=32.45+20\lg(f \cdot d)$
11	Simulated Environmental isolation	M	50	COS 231 model (1.5m terminal height) :

The scenario is that TDD subscribers and FDD subscribes are located in the coverage area of both TDD and FDD base stations. Take free space model in LOS condition and COS231 model in NLOS condition for calculation isolation.

3. Concluding Remarks

Base on the above analyses, we can find out that if we install the TDD base stations with some safe separation, they will not cause interference to the FDD/PMR base stations.

- Since FDD/PMR base stations are usually sparsely located, it is not difficult to find the sites for TDD base stations. In case we have to locate a TDD base station close to a FDD/PMR base station, we can always place the antenna panels back facing the FDD/PMR base station antennas.
- The FDD/PMR terminals are on the ground levels, as a result, they may not pick up too strong interference signals from the TDD base stations.
- Since the FDD/PMR system is uplink limited (due to very strong power for downlink), the interference to the FDD/PMR terminals from the TDD terminals is not significant.

Annex: 3

Commission for
Communications Regulation

4 November 2013

Wirefree Communications Limited

Ref: Request to changes from FDD to TDD use

Dear Mr Jobér

We are currently evaluating your request to change the technology of your licence from FDD to TDD. As part of this evaluation we seek clarification on the following items;

1. The equipment that Wirefree intends to install - can we have a copy of the manufacturers equipment specification sheets for the base station and terminals;

2. Section 1.2 of the analysis mentions that the TDD system under study is the system described by ITU-R M.1801 Annex 7 – it appears to me to be described in Annex 8;

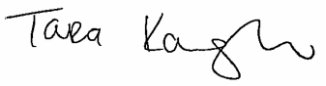
3. How many carriers do you intend to use within each 4 MHz block (or what is the band plan)?

4. Table on page 4 item no.1 specifies an Antenna output power of 33 dBm but the note refers to output port. It is not clear to me if this is 33 dBm EIRP or not as the text on page 3 states “max output power of BTS shall not exceed 33 dBm/ 5 MHz.

5. Following on from question 4 - what is the significance of item 5 of the same table – the number of antenna elements? It is summed into the power budget as if it was a proxy for antenna gain.

Please provide this information to us no later than 22 November 2013.

Yours sincerely



Tara Kavanagh
Licensing Operations Manager

Annex: 4

12 November 2013

Commission for Communications Regulation
Att: Ms. Tara Kavanagh, Licensing Operations Manager
Abbey Court
Irish Life Centre
Lower Abbey Street
Dublin 1

Ref: Request to changes from FDD to TDD use, clarifications

Dear Ms. Kavanagh,

In response to your letter dated 4 November 2013, we would like to make clarifications as follows:

1. The equipment that Wirefree intends to install - can we have a copy of the manufacturers equipment specification sheets for the base station and terminals;

Answer: Please refer to Attachments 1 and 2 for BTS and antenna examples.
<CONFIDENTIAL>

2. Section 1.2 of the analysis mentions that the TDD system under study is the system described by ITU-R M.1801 Annex 7 – it appears to me to be described in Annex 8;

Answer: You are correct. It should be ITU-R M.1801-2 Annex 8.
(it was Annex 7 in the now superseded version ITU-R M.1801-1, sorry)

3. How many carriers do you intend to use within each 4 MHz block (or what is the band plan)?

<CONFIDENTIAL>

4. Table on page 4 item no.1 specifies an Antenna output power of 33 dBm but the note refers to output port. It is not clear to me if this is 33 dBm EIRP or not as the text on page 3 states “max output power of BTS shall not exceed 33 dBm/ 5 MHz.

<CONFIDENTIAL>

5. Following on from question 4 - what is the significance of item 5 of the same table – the number of antenna elements? It is summed into the power budget as if it was a proxy for antenna gain.

<CONFIDENTIAL>

Please, do not hesitate to contact me would you need any further clarifications.

Yours Sincerely

Johan Jobér
Wirefree Communications Limited
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+46 735 151 000

cc. Samuel Ritchie
Zeeshan Nazneen

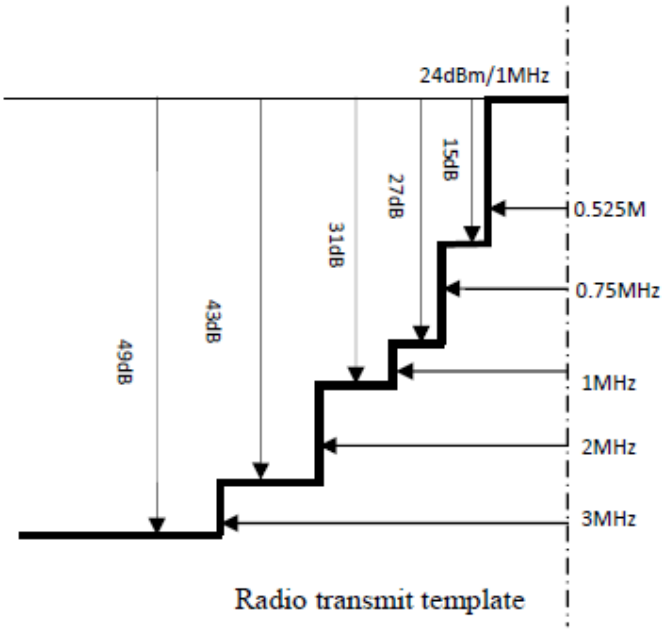
Attachment1: Example of base station specification sheets
Attachment2: Example of panel antenna specification sheet
Attachment3: Example of a terminal (data modem)

Attachment 1: Macro BTS example (CONFIDENTIAL)

Attachment 2: (Confidential)

Attachment 3 (Confidential)
Examples of data modem terminal
<Confidential part removed>

Channel Space	Frequency offset ΔF（MHz）	0.5B	0.525B	0.75B	B	2B	3B
B：1 MHz	ΔF/B	0.5	0.525	0.75	1	2	3
64QAM Modulation mode relative power level(dB)		0 dB	-15 dB	-27 dB	-31 dB	-43 dB	-49 dB



Radio transmit template