# Fixed Service Unit – Fixed Link Licence Fee Algorithm in force from 2nd June 2005

**FWILF circulation**

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Section 1

# Introduction

The FWS spectrum pricing algorithm is contained within the new Statutory Instrument 2005 Wireless Telegraphy Licence Fees Regulations expected to come into force on 2 June 2005.

The algorithm is summarised in Section 2 and is composed of five main factors and two conditional modifiers. Section 3 provides details on the behaviour of each of the five main factors.

Section 2

# Formula for calculating fixed link fees

The formula is based on a number of factors –

***As = Sp x Bwf x Bf x Plf x Avf (x CCDP x Directional)***

Where –

'***As***' means the sum to be calculated

***'SP'*** is the spectrum price, being a sum set at £88 per 2 x 1 MHz for each bi-directional link.

'***Bwf***' means the value of actual system bandwidth (MHz)

'***Bf'*** means the band factor which is determined by the actual frequency band.

***'Plf'*** is the path length factor which is determined from the actual path length (Pl) and the minimum path length (Mpl) which is specified in Interface Regulation IR 2000 version 5.

'***Avf***' means the availability factor which is determined from the required system availability.

Shown in brackets are the conditional discount modifiers to fee –

For parallel use where any additional link is co-ordinated on a bi-directional basis and where links are operating co-channel and cross-polar along the same path, then the additional links are charged at 50 percent of the prescribed sum. The conditions for meeting the CCDP discount are

- Identical customer ids;
- Dissimilar RAREF link ids;
- Identical (and very local) NGRs at both sites;
- Identical hi and low transmit frequencies with channel numbers. It is assumed that receive frequencies operate on the duplex frequency for bi-directional links but this is not a conditional check;

- Identical bandwidths;
- Identical availabilities; and
- Orthogonal polarisations;

For each uni-directional fixed link then 75 per cent of the prescribed sum specified is applied.

For analogue links the concept of an 'equivalent bit rate' is used to determine the appropriate minimum path length. For FILSM analogue link service codes the value of the equivalent bit rate is equal to the value if the equivalent bandwidth.

Section 3

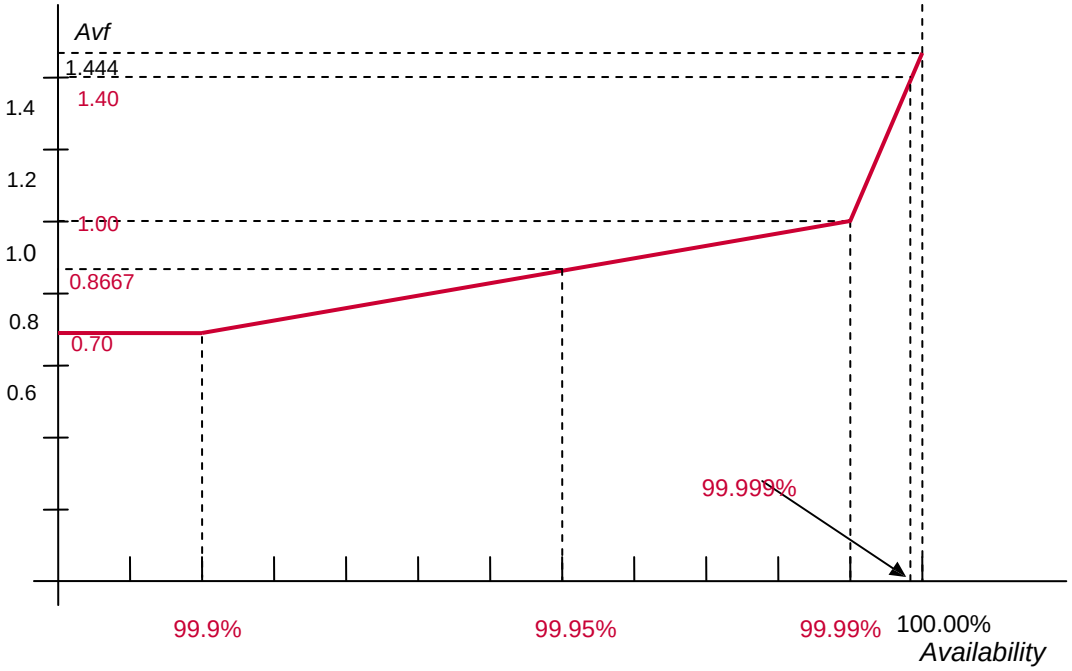
# The Factors

The following table sets out the possible limits for each factor.

| **Element** | **Range** |
|---|---|
| *Spectrum Price* | Set at **£88** per 2 x 1 MHz |
| *Bandwidth Factor* | Minimum = **1 MHz** but any **actual value** above this with an observed maximum of 135 MHz. |
| *Band Factor* | Any value between **0.00** and **1.00** is possible. However the current active range is 1.0 to 0.17 (decreasing with frequency band). See later. |
| *Path Length Factor* | **1** or the minimum between √**(Minimum Path Length / Actual Link Path)** and **4.** See later. |
| *Availability Factor* | Between **0.7** and **1.45.** See later. |
| *CCDP Discount* | For 2nd link operating co-channel cross-polar to the 1st link along a common path the value is **0.5** otherwise it equals **1**. |
| *Directional Discount* | For uni-directional links the value is **0.75** otherwise it equals **1**. |

### Availability factor (Avf)

The Availability factor (Avf) is related to the planned system availability (per cent) in accordance with the graph below.




There are three key parts to the curve and the availability value will fall into one of these parts.

Each part is associated with a different relationship between the unknown Availability Factor (Avf) and the known Availability value.

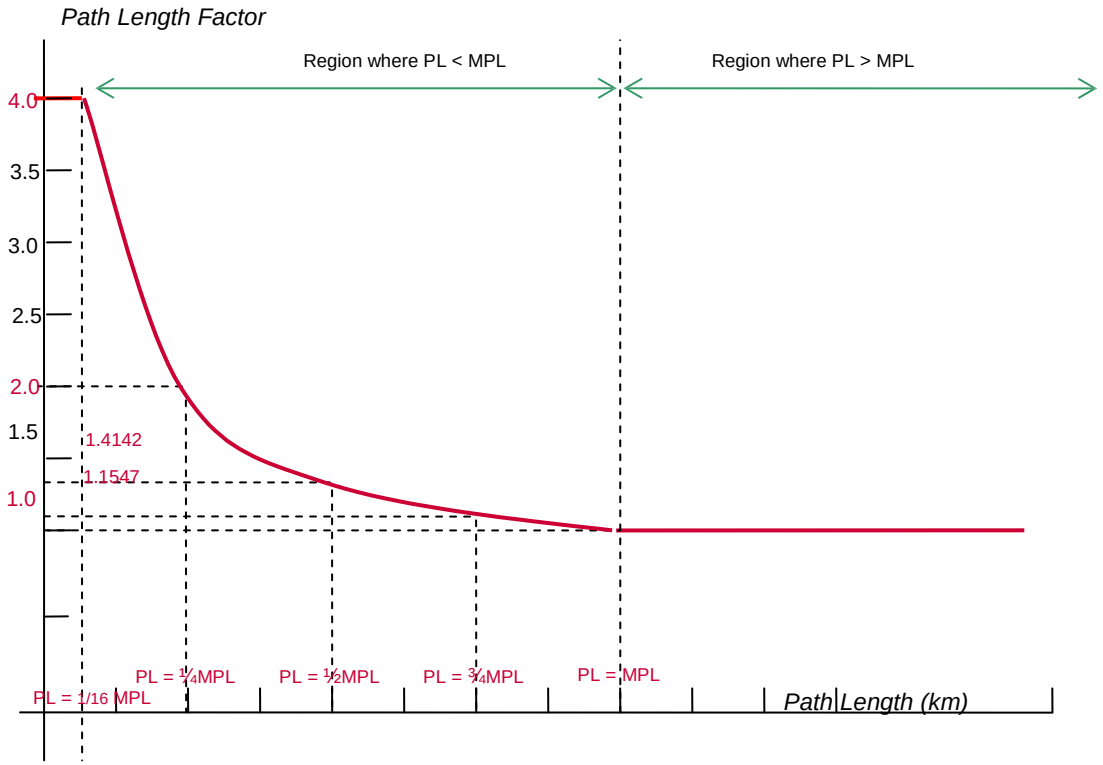
| **The possibilities are:** | |
|---|---|
| Availability ≤ 99.9% then | **Avf = *0.7*** |
| 99.9% < Availability ≤ 99.99% then | **Avf = *0.7 + (Availability - 99.9) x (0.3/0.09)*** |
| Availability > 99.99% then | **Avf = *1.0 + (Availability - 99.99) x (0.4/0.009)*** |

| **Availability** | **Avf** | **Availability (%)** | **Avf** |
|---|---|---|---|
| < 99.8% | 0.700 | 99.991% | 1.044 |
| 99.90% | 0.700 | 99.992% | 1.089 |
| 99.91% | 0.733 | 99.993% | 1.133 |
| 99.92% | 0.767 | 99.994% | 1.178 |
| 99.93% | 0.800 | 99.995% | 1.222 |
| 99.94% | 0.833 | 99.996% | 1.267 |
| 99.95% | 0.867 | 99.997% | 1.311 |
| 99.96% | 0.900 | 99.998% | 1.356 |
| 99.97% | 0.933 | 99.999% | 1.400 |
| 99.98% | 0.967 | | |
| 99.99% | 1.000 | | |

## Path Length Factor (Plf)

The Path Length Factor is determined by the square root of the result of dividing the Minimum Path Length (MPL) by the Actual Link Path Length (PL).

The relationship between Path Length Factor and PL is shown graphically below.

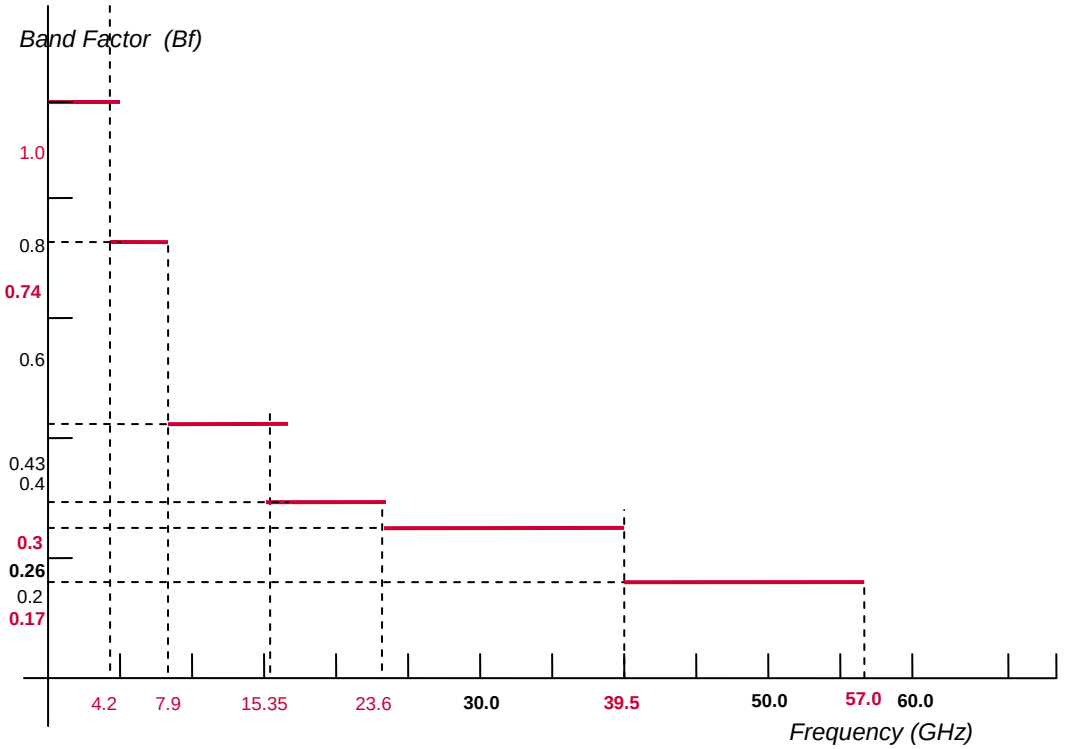



**Path Length Factor is calculated from** **Plf = √(MPL/PL)**

If the Path Length Factor ≤ 1 then it always equals unity. When Path Length Factor > 1 then it takes the value of the minimum between the calculated value and 4.

## Band Factor (Bf)

The principle of the band factor is nothing new to the latest algorithm and simply reflects the value of the spectrum in terms of how popular or busy the bands are. It was implicitly applied in the old fee algorithm except that some of the actual values might be different. Through the public consultation Ofcom also decided to rationalise the number of values hence providing more flexibility in the deployment of links. Graphically this is shown below.




In table form the values are for the frequency range set out in Column 1 the associated band factor is the number in Column 2:

| *Column 1: Range of frequency band (GHz)* | *Column 2: Band Factor* |
|---|---|
| 1.350-1.517 | 1.0 |
| 1.450-1.530 | 1.0 |
| 1.672-1.690 | 1.0 |
| 1.900-2.690 | 1.0 |
| 3.600-4.200 | 1.0 |
| 5.925-6.425 | 0.74 |
| 6.425-7.125 | 0.74 |
| 7.425-7.900 | 0.74 |
| 10.700-11.700 | 0.43 |
| 12.750-13.250 | 0.43 |
| 14.250-14.499 | 0.43 |
| 14.500-15.350 | 0.43 |
| 17.300-17.699 | 0.30 |
| 17.700-19.700 | 0.30 |
| 21.200-21.999 | 0.30 |
| 22.000-23.600 | 0.30 |
| 24.500-26.500 | 0.26 |
| 27.828-29.060 | 0.26 |
| 31.000-31.799 | 0.26 |
| 31.800-33.400 | 0.26 |
| 37.000-39.500 | 0.26 |
| 49.200-50.200 | 0.17 |
| 51.400-52.600 | 0.17 |
| 55.780-57.000 | 0.17 |

### Bandwidth factor (Bwf)

The relationship between the Bandwidth Factor (Bwf) and the actual system bandwidth is linear. The system bandwidth is equivalent to the actual channel spacing. However the value is normalised to 1MHz for the calculation for system bandwidths below 1MHz. Graphically the relationship is shown:


Section 4

## Minimum path length values

The minimum path length (Mpl) corresponds to the applicable data rate columns 2 and 3 for the frequency range set out in column 1 that can be transmitted over the path. The minimum path length values are:

| *Column 1: Range of frequency band (GHz)* | *Column 2: MPL (km) where the data rate < 2 Mbit/s* | *Column 3: MPL (km) where the data rate ≥ 2 Mbit/s* |
|---|---|---|
| 1.350-1.517 | 0 [1] | 30 |
| 1.450-1.530 | 0 [1] | 30 |
| 1.672-1.690 | 0 [1] | 30 |
| 1.900-2.690 | 0 [1] | 30 |

| *Column 1: Range of frequency band (GHz)* | *Column 2: MPL (km) where the data rate < 140 Mbit/s* | *Column 3: MPL (km) where the data rate ≥ 140 Mbit/s* |
|---|---|---|
| 3.600-4.200 | 24.5 | 16 |
| 5.925-6.425 | 24.5 | 16 |
| 6.425-7.125 | 24.5 | 16 |
| 7.425-7.900 | 15.5 | 9.5 |
| 10.700-11.700 | 10 | 6 |
| 12.750-13.250 | 9.5 | 5.5 |
| 14.250-14.499 | 9.5 | 5.5 |
| 14.500-15.350 | 9.5 | 5.5 |
| 17.300-17.699 | 4 | 2.5 |
| 17.700-19.700 | 4 | 2.5 |
| 21.200-21.999 | 4 | 2 |
| 22.000-23.600 | 4 | 2 |
| 24.500-26.500 | 3 | 2 |
| 27.828-29.060 | 3 | 2 |
| 31.000-31.799 | 0 [2] | 0 [2] |
| 31.800-33.400 | 2 | 1.5 |
| 37.000-39.500 | 0[3] | 0[3] |
| 49.200-50.200 | 0 | 0 |
| 51.400-52.600 | 0 | 0 |
| 55.780-57.000 | 0 | 0 |

Note [1]: No ‘Mpl’ specified for 1.4 GHz for bit rates below 2 MBit/s
Note [2]: No ‘Mpl’ is specified for the 31 GHz video surveillance band
Note [3]: The ‘Mpl’ for 38 GHz is actually 1 km. However, Ofcom has temporarily relaxed the ‘Mpl’ policy until equipment in the higher bands becomes available. When equipment in higher bands is available then the 38 GHz MPLs will be reinstated in a future release of the WT (Licence Charges) fee regulations.

Section 5

# Sample fee calculations

| Example | Description | Sp | BWf | Bf | Plf | Avf | AS |
|---|---|---|---|---|---|---|---|
| 1 | 1.4 GHz link, 99.99%, path length = 30km, bandwidth = 2MHz and data rate = 2Mbit/s kHz | £88 | 2.0 | 1.0 | 1.0 | 1.0 | £176.00 |
| 2 | 1.4 GHz link, 99.999%, path length = 30km, bandwidth = 2MHz and data rate = 2Mbit/s | £88 | 2.0 | 1.0 | 1.0 | 1.4 | £246.40 |
| 3 | 1.4 GHz link, 99.99%, path length | £88 | 2.0 | 1.0 | 1.414 | 1.0 | £248.86 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | = 15km, bandwidth = 2MHz and data rate = 2Mbit/s | | | | | | |
| 4 | 1.4 GHz link, 99.99%, path length = 15km, bandwidth = 250 kHz and data rate = 256 kbit/s | £88 | 1.0 | 1.0 | 1 | 1 | £88.00 |
| 5 | 1.4 GHz link, 99.9%, path length = 15km, bandwidth = 250 kHz and data rate = 256 kbit/s | £88 | 1.0 | 1.0 | 1.0 | 0.7 | £61.60 |
| 6 | 7.5 GHz link, 99.99%, path length = 16km, bandwidth = 7.0 MHz and data rate = 8 Mbit/s | £88 | 7.0 | 0.74 | 1.0 | 1.0 | £455.84 |
| 7 | 7.5 GHz link, 99.99%, path length = 7.75km, bandwidth = 7.0 MHz and data rate = 8 Mbit/s | £88 | 7.0 | 0.74 | 1.414 | 1.0 | £644.56 |
| 8 | 7.5 GHz link, 99.99%, path length = 0.5km, bandwidth = 7.0 MHz and data rate = 8 Mbit/s | £88 | 7.0 | 0.74 | 4.0 | 1.0 | £1,823.36 |
| 9 | 23 GHz link, 99.99%, path length = 2.0km, bandwidth = 28.0 MHz and data rate = 2x34 Mbit/s | £88 | 28.0 | 0.30 | 1.414 | 1.0 | £1,045.22 |
| 10 | 28 GHz link, 99.99%, path length = 2.0km, bandwidth = 28.0 MHz and data rate = STM(1) or 155 Mbit/s | £88 | 28.0 | 0.30 | 1.0 | 1.0 | £739.20 |
| 11 | 38 GHz link, 99.99%, path length = 0.75km, bandwidth = 28.0 MHz and data rate = 2x34 Mbit/s | £88 | 28.0 | 0.26 | 1.0 | 1.0 | £640.64 |
| 12 | 38 GHz link, 99.99%, path length = 0.75km, bandwidth = 28.0 MHz and data rate = STM(1) or 155 MBit/s | £88 | 28.0 | 0.26 | 1.0 | 1.0 | £640.64 |
| 13 | 7.5 GHz analogue (300 Channels) link bandwidth = 7MHz, 99.9%. Path length = 46.1km | £88 | 7.0 | 0.74 | 1.0 | 0.7 | £319.09 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14 | 1.4 GHz (Band ENB) Analogue telephony 8 channel link. Path length = 8km and availability = 99.9% Bandwidth = 200 kHz | £88 | 1 | 1 | 1 | 0.7 | £61.60 |
| 15 | 22 GHz Analogue Low Def. Surveillance link, 99.9%, path length = 1.5km, bandwidth = 28 MHz | £88 | 28.0 | 0.30 | 1.6333 | 0.7 | £844.98 |