

RA 371

Information Sheet describing the Co-ordination Process
Between Point-to-MultiPoint Systems, Point-to-Point Links,
and Earth Stations in the Fixed Satellite Service,
Operating in the Band 3.6 to 4.2 GHz

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1. Introduction

The frequency band 3.6 to 4.2 GHz is allocated internationally to Fixed Service and the Fixed Satellite Services (space-to-Earth). From 1st July 2000, there will be wider use of Fixed Services within the UK outside of existing trunk routes. The number and density of new point-to-point (P-P) and new point-to-multipoint (P-MP) Fixed Service systems operating within the band is expected to increase significantly.

This document describes the co-ordination process and criteria developed by the RA to facilitate the co-existence of P-P, P-MP Fixed Services and satellite Earth Stations of the Fixed Satellite Service (space-to-Earth) within the UK.

Section 2 describes how the 3.6 to 4.2 GHz band is to be segmented after 1st July 2000 in order to facilitate the introduction of new P-MP systems within the UK.

Section 3 details the roles that the Agency will undertake to facilitate the co-ordination process.

Section 4 defines the technical characteristics of the P-MP systems that will be used during the co-ordination process.

Section 5 describes the methods and detailed procedures for effecting co-ordination.

The Annex provides diagrams that illustrate the process described in Section 5.

In general the Agency will not apply this co-ordination process to apparatus installed and used under a temporary Wireless Telegraphy Act licence or where the installation and use of apparatus has been exempted. The process may be applied to registered apparatus. See **RA 372**.

2. Use of the frequency band 3.6 to 4.2 GHz

In order to facilitate sharing, after 1st July 2000 the frequency band 3.6 to 4.2 GHz will be segmented within the UK as follows:

- the frequency ranges 3 605 MHz to 3 641 MHz and 3 925 MHz to 3 961 MHz (i.e. 2x36 MHz) will be allocated on a co-primary basis between the Fixed Satellite (space-to-Earth) and P-MP Fixed services only. The Agency does not intend to assign P-P stations of the Fixed Service in this frequency range. This frequency range is viewed as the "core" P-MP Fixed Service frequency allocation;
- the frequency ranges 3 641 MHz to 3 650 MHz and 3 961 MHz to 3 970 MHz (i.e. 2x9 MHz) will be an extension of the core band, and will be allocated to the Fixed Satellite (space-to-Earth) and P-MP Fixed services. P-MP Fixed Services, in these frequency ranges, will be assigned on a primary basis only by specific

agreement by the Agency on a case-by-case basis. In all other cases, the assignment will be on a non-interference, unprotected basis;

- the frequency ranges 3 650 MHz to 3 689 MHz and 3 970 MHz to 4 009 MHz (i.e. 2x39 MHz) will be an extension of the core band, and will be assigned to the P-P Fixed, Fixed Satellite (space-to-Earth) and P-MP Fixed Services. P-MP Fixed Services, in these frequency ranges, will be assigned on a primary basis only by specific agreement by the Agency on a case-by-case basis. In all other cases, the assignment will be on a non-interference, unprotected basis;
- the frequency ranges 3 689 MHz to 3 875 MHz and 4 009 MHz to 4 195 MHz will be allocated on a co-primary basis solely between P-P Fixed and Fixed Satellite Services (space-to-Earth).

The following frequency ranges will be guard bands and will not be allocated for terrestrial transmissions:

3 600 - 3 605 MHz
 3 875 - 3 925 MHz
 4 195 - 4 200 MHz

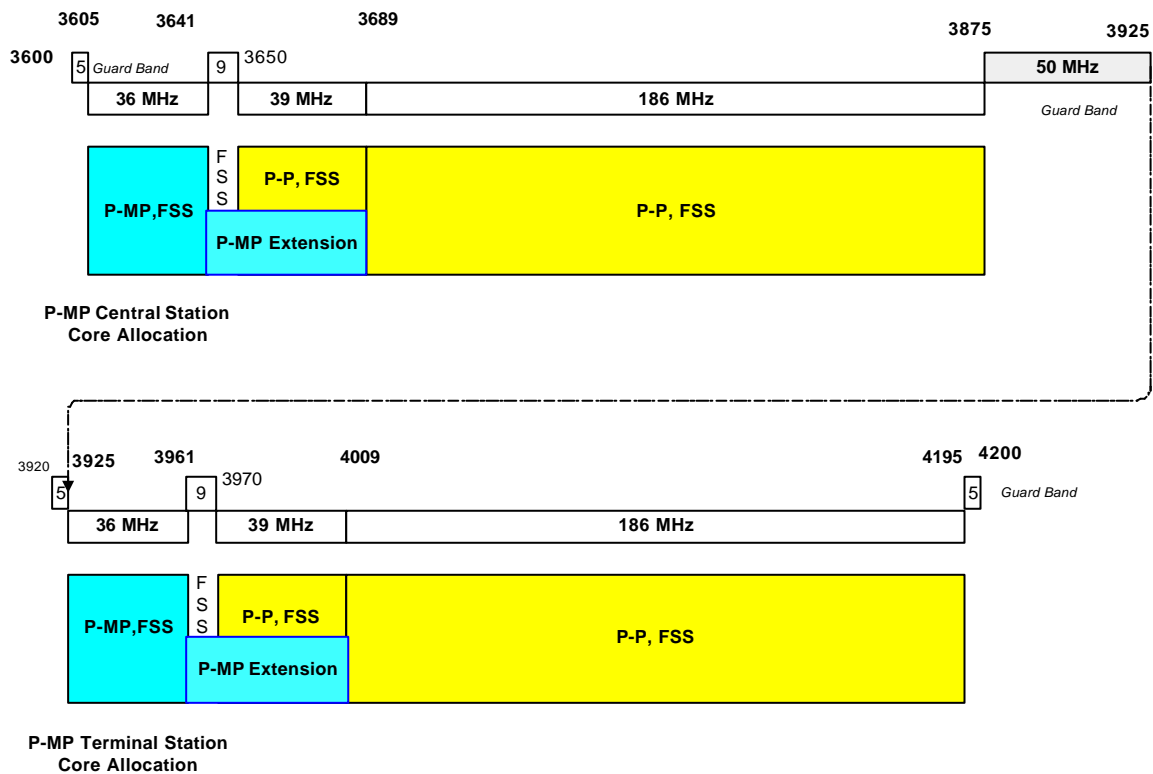


Figure 1: UK Frequency Allocations in the Frequency Range 3600 MHz to 4200 MHz (from 1st July 2000)

3. The Role of the Agency

3.1 General

To facilitate frequency sharing within the Band 3.6 to 4.2 GHz the Agency undertakes:

- to provide guidance and advice to licensees as to their obligations and responsibilities when they enter into co-ordination;
- to provide optional registration to Receive-Only Earth Stations;
- to operate the Point-to-Multipoint CO-ordination software tool (POMCO) to determine whether a proposed P-MP site is within the co-ordination area of any Earth Station, and to conduct detailed evaluation of interference into Earth Stations and P-P fixed services;
- to apply date priority where applicable to stations entering into co-ordination;
- to notify existing licensees or registered Receive-Only terminals that may be affected by the introduction of new services and to advise them accordingly;
- where appropriate, to monitor peak spectral density field strengths from P-P and P-MP transmissions at Earth Stations;
- upon request, to act as arbitrator to facilitate successful co-ordination between parties.

3.2 Registration of Receive Only Earth Stations

The Agency will operate an optional scheme for the registration of license exempt Receive-Only (space-to-Earth) equipment that is currently operating unknown to the Agency to allow them to be taken into account in the co-ordination process, provided that the details of such apparatus are registered under the registration scheme.

Receive-Only Earth Stations that have been operational prior to 1st July 2000 (and previously exempted by legislation SI 1989 No 123) may register with the Agency to be included within the planning of new services. (See **RA 372.**)

Receive-Only Earth Station registration applications may be submitted after 1st July 2000. However, in these cases the Agency will assume that Earth Station sites incorporate the necessary additional mitigation or screening protection within the P-MP core frequency allocation so as to allow them to share, and attain a minimum of 20dB additional protection over and above those parameters described in Appendix APS30B.

3.3 Notification

The requirement to initiate co-ordination uses the method of the Radio Regulations Appendix **APS7**. It is important to note that the minimum APS7 co-ordination distance of 100km does not define an exclusion zone.

When a new application for a P-MP site is received the details are checked and entered into POMCO. In the case of Earth Stations the tool will assess whether the new P-MP application lies outside of the APS7 co-ordination zones of the Earth Stations listed in its database.

If the proposed P-MP site is to be established within an APS7 co-ordination zone, the Agency will undertake to:

- inform the appropriate Earth Station operators that a P-MP system is being planned within their earth station co-ordination zone;
- notify the Earth Station operator of the technical parameters associated with that system;
- submit a detailed evaluation of interference into Earth Station based on Recommendation ITU-R P.452;
- if appropriate, recommend that both parties enter into bilateral co-ordination;
- respond to complaints.

If the P-MP site is to be established outside a co-ordination zone, the Agency will assume that the new P-MP site will not cause interference to that Earth Station.

In the case of P-P stations in the Fixed Service, the Agency makes the necessary assignments and notification is unnecessary.

3.4 Arbitration

Either party to bi-lateral negotiation may at any time request that the Agency arbitrate. The Agency will require that new P-MP stations take due regard of all fair and justifiable site-specific quality of service requirements of Earth Stations in any of the following cases:

- a) the Earth Station had been operating under a full Wireless Telegraph Act licence;
- b) the Earth Station had been licensed as a Receive-Only station or was operating prior to 1989. Receive-Only Earth Stations became exempt from licensing with the introduction of Statutory Instrument 1989 No. 123, which came into force on 27th February 1989;
- c) the Receive-Only Earth Station was operating at a location known to the Agency prior to 1st July 2000;
- d) the Receive-Only Earth Station was operating prior to 1st July 2000 at an unknown location and has formally registered the site;

- e) the Receive-Only Earth Station registration application is received after the 1st July 2000.

In cases a), b) c) and d) above, the Agency will require that the P-MP applicant bears the cost of implementing mitigation.

For Receive-Only Earth Stations described in d) above that apply for registration by 1st July 2000, the Agency may require that they co-ordinate on the basis of the default parameters defined in Appendix APS30B of the Radio Regulations, in which case the calculated interference at the antenna flange may not exceed -142 dBW/MHz for more than 0.05% of the time.

For registration applications received after 1st July 2000 described in e) above, the Agency will assume that the Earth Station site will have incorporated additional screening to attain a minimum of 20dB additional protection over and above those parameters described in Appendix APS30B.

4. Technical Criteria of Point to Multipoint Systems

Specific limits are applied to the installation and use of all apparatus under the Wireless Telegraphy Act 1949. Schedules to Wireless Telegraphy Act licences issued on behalf of the Secretary of State for Trade and Industry prescribe these limits. Table 1 gives the limits for P-MP stations.

Table 1: P-MP Technical Criteria.

Equipment Type	Central Station Maximum Power Spectral Density (dBm/MHz)	Central Station Maximum Antenna Gain (dBi)	Central Station Maximum E.I.R.P. Spectral Density (dBW/MHz)	Central Station Receiver Reference Level (dBm)	Terminal Station Maximum Power Spectral Density (dBm/MHz)	Terminal Station Maximum Antenna Gain (dBi)	Terminal Station Maximum E.I.R.P. Spectral Density (dBW/MHz)
Frequency Hopping (FH-CDMA)	27	16	13	-87	27	18	15
Direct Sequence (DS-CD/TDMA)	16.2	16	2.2	-87	16.2	13	-0.8

The designation for Direct Sequence equipment is 24M0G7DEW, and the channel spacing for direct sequence is nominally 12 MHz using alternate polarisation. The emission designation for the frequency hopping equipment is 2M00F1DEF and comprises of 18 x 2 MHz slots; each channel spacing is 2 MHz. Receiver signal threshold levels are given in ETSI EN301 253 and ETSI EN301 744. Additional technical criteria for P-MP apparatus are given in UK Radio Interface Requirement 2015.

The new P-MP services will be deployed as networks of remote Terminal Stations (TSs) that communicate with Central Stations (CSs), which use sectored antennas. The azimuthal limits and the maximum radius of operation of each sector of a CS will be specified by the Wireless Telegraphy Act licence issued to the P-MP licensee. Each sector, defined by its geographical limits, must be associated with the sectored antenna of the CS which serves it. A P-MP cell is defined as a CS and all the TSs

that it serves. These measures are considered necessary to take into account overlapping sectors between different CSs.

5. Methods and procedures for Co-ordination

5.1 Characterisation of P-MP Interference

For the calculation of co-ordination distance and the detailed evaluation of interference, for both earth stations and P-P fixed stations, the following methods will be used to calculate the potential for interference from a P-MP cell.

5.1.1 Central Stations

The interference from each sector of a CS antenna is calculated on the basis of the maximum EIRP spectral density, taking into account the actual antenna height, and the radiation pattern envelopes for each sector at the azimuthal and elevation directions of the interference path. The interfering signal levels from the CSs are combined by power summation, taking net frequency discriminations into account where the interfered-with station is P-P.

5.1.2 Terminal Stations

The unknown distribution of TSs within each sector will be simulated using an area-uniform distribution of hypothetical TSs covering the same area.

The calculation method is based on the following assumptions:

- each co-ordinated P-MP cell has a radius that does not exceed 10 km;
- the EIRP of each TS will be adjusted at installation to achieve not greater than +13dB above the receiver reference level at the CS based on free space path loss and maximum CS antenna gain;
- the maximum EIRP spectral density of each TS does not exceed the figure in Table 1;
- only one TS is transmitting in a given sector at any one time;
- each TS is 10 metres above ground level;
- It is assumed that each TS antenna is pointed directly towards the CS associated with that sector;
- each TS is not shadowed by buildings¹.

The interference from each hypothetical TS is calculated on the basis of the EIRP spectral density established at installation, taking into account the antenna gain and

¹ Further study is proceeding on the statistics of such shadowing, and it may be practicable to introduce a shadowing allowance at a later date.

the azimuthal and elevation directions of the interference path to the Earth Station or P-P station.

The interfering signal level from the hypothetical TS in each sector causing the highest interference level at each Earth Station and P-P station are combined by power summation, taking net frequency discriminations into account where the interfered-with station is P-P. This takes into account the effect of time and frequency division aspects of the P-MP radio interface.

5.2 Earth station Co-ordination.

5.2.1 Satellite Earth Station Technical parameters

The antenna and equipment parameters at any given Earth Station site will depend on many factors across a range of service requirements as determined by the Earth Station operator and individual satellite operators' requirements.

The operational technical parameters of individual Earth Stations are therefore specific to each particular site and generally require assessment on a case-by-case basis.

In the absence of agreed Earth Station parameters, the Agency may require that the Earth Station technical criteria described in Appendix APS30B are applied, since the plan was devised for a similar frequency band to be independent of the satellite modulation scheme being used

The relevant Earth Station technical parameters as listed in ITU Appendix APS30B.(1998) Annex 1 are:

- 7m diameter dish
- Antenna noise temperature 140 deg K
- Antenna efficiency 70%
- Off- axis response 32- 25 log theta
- Backlobe gain -10dBi
- Minimum elevation angle 10 degrees
- Interference Criteria min. C/I > 26dB
- C/N requirement > 16dB for 99.95% of the year

Example: at 52 degrees latitude:

Calculated Equivalent Earth Station parameters:

Boresight gain = 48 dBi

Equivalent APS7 Receiver Interference threshold = -142 dBW/MHz in a 1 MHz bandwidth

Maximum Effective Terrestrial lobe gain at 10 degree elevation = 7 dBi

Maximum % time allowable interference = 0.05% time.

5.2.2 Initial APS7 Assessment

The initial assessments made by the Agency will have determined, according to APS7, the Earth Station co-ordination distance in the direction of the P-MP CS. If the new P-MP station lies within this distance it will have triggered the requirement to notify the Earth Station operator.

5.2.3 Detailed Evaluation of Interference

The detailed evaluation will use the highest Earth Station antenna gain at the appropriate elevation angle of the radio horizon in the direction towards the P-MP site for all positions of the Earth Station antenna pointing to the GSO arc between specified eastern and western limits.

In the case of Receive-Only Earth Stations, the eastern and western limits for this assessment will normally correspond to a minimum elevation angle of ten degrees. More detailed information may be taken into account by the Agency.

In the case of licensed Earth Stations (e.g those using international telephony) the minimum elevation angle will correspond to the minimum elevation specified by the WT Act Licence.

The detailed evaluation of interference will use the method of Recommendation ITU-R P.452 using a percentage time consistent with the appropriate quality of service conditions. The interference threshold will include a multiple entry allowance.

The ITU-R P.452 calculation will use only the clear air part of the model (i.e. no hydrometeor scatter) and will not use the local site-shielding model.

The assessment tool POMCO will use data on UK terrain heights that have been sampled on a 50m basis.

5.2.4 Bi-lateral Co-ordination

Once the initial assessments conducted by the Agency have indicated that co-ordination is required, the Agency will notify the P-MP license applicant and all affected licensees or registration holders of the requirement to effect co-ordination.

The parties involved in the detailed co-ordination process will need to agree on:

- i) the named officials that represent the parties for the purposes of the agreement;
- ii) the appropriate co-ordination methodology;
 - a) the locations and operating frequencies used by the P-MP stations;
 - b) the maximum spectral density level of the relevant P-MP stations;
 - c) the percentage of time that interference may be allowed to exceed the agreed threshold, as dictated by the nature and quality of operational service requirements;
 - d) the suitability of using frequency avoidance^{2/} and mitigation techniques;
 - e) specific Earth Station parameters such as antenna gain, off axis response, noise temperature;

² Dependant on required Carrier/Noise ratios, a variety of possible mitigation techniques are available to operators which may include combinations of EIRP reduction, frequency band selection, frequency hop omission, sector omission, site screening, pre co-ordination, active antenna cancellation.

- f) where appropriate, the working longitudes of satellites positioned along the geostationary arc, the minimum operational elevation angles to which the antenna site can work effectively, and the derived antenna gain in the direction of the interference path;
 - g) the screening available at operational frequencies at the site;
 - h) the interference margins and thresholds required by the Earth Station;
 - i) additional screening requirements or filtering;
 - j) the required propagation loss and the percentage of time over which it must not be exceeded;
 - k) where applicable, exclusion distances from the Earth Station over relevant azimuths;
 - l) the suitability of easing the co-ordination process by use of pre co-ordination methods, or application of worse case analysis, or statistical processing methods;
- iii) the procedure and contact points for purposes of notification of cases of interference;
 - iv) the need for periodic review;
 - v) the need or otherwise for periodic monitoring by the Agency.

When co-ordination has finally been agreed, the P-MP station applicant must submit the final agreement to the Radiocommunications Agency.

5.3 Point-to-Point Fixed Link station Co-ordination:

5.3.1 P-P Fixed Technical Criteria

Co-ordination between P-MP and P-P Fixed Links will be based on standardised parameters described by a future revision of the Fixed Links Frequency Assignment Criteria Document, **RA 353**.

5.3.2 Assignment

The Agency is responsible for assigning Fixed Links and will conduct assignments based on the detailed evaluation of theoretical unwanted signal levels received from a CS or hypothetical distributions of TSs into a P-P fixed station.

5.3.3 Detailed Evaluation of Interference.

The detailed evaluation of interference will use the method of Recommendation ITU-R P.452 using a percentage time consistent with the required P-P Fixed Link propagation availability. The P-P Fixed Link station antenna gain at the elevation angle of the radio horizon in the direction of the P-MP CS will be calculated using the co-polar or cross polar radiation pattern provided for the station as appropriate.

The ITU-R P.452 calculation will use only the clear air part of the model (i.e. no hydrometeor scatter) and will not use the local site-shielding model.

The assessment tool POMCO will include tables describing the permitted Wanted/Unwanted ratio for each combination of equipment as a function of frequency separation. The maximum acceptable level of interference at a P-P Fixed Link station will be obtained explicitly from the technical characteristics of each station.

The calculated interference signal level will then be compared against the limit for the Wanted/Unwanted ratios applicable to the appropriate equipment types operating in the band. This will include a multiple entry allowance (see **RA353**).

If the calculated interference level is less than the limit then the proposed systems will be considered as successfully co-ordinated against the P-P Fixed station. Otherwise, the P-MP cell will have failed co-ordination.

Bibliography

EN 302 085 "Fixed Radio Systems: Point to Multipoint Antennas; Antennas for point to multipoint fixed radio systems in the 3 GHz to 11 GHz band." ETSI

EN 301 253 "Transmission and Multiplexing(TM); Digital Radio Relay Systems (DRRS) Frequency hopping Code Division Multiple Access (FH-CDMA) Point to Multipoint systems operating in the frequency bands in the range 3 GHz to 11 GHz." ETSI.

EN 301 744 "Transmission and Multiplexing(TM); Digital Radio Relay Systems (DRRS) Direct Sequence Code Division/ Time Division Multiple Access(DS-CD TDMA) Point to Multipoint systems operating in the frequency bands in the range 3 GHz to 11 GHz." ETSI.

UK Radio Interface Requirement 2000: "(Point to Point) Radio relay systems operating in all frequency bands Administered by the Radiocommunications Agency."

UK Radio Interface Requirement 2015: "Multipoint Radio relay systems operating within the 1 to 11 GHz Fixed Wireless Access Bands. "

RA 353 : "Frequency Assignment Criteria for Fixed Point to Point radio services with digital modulation operating in the frequency range 3.6 to 4.2 GHz". November 1999.

Rec. ITU-R P.530 "Propagation and Prediction methods required for the design of Terrestrial line-of-sight systems" (1997).

Rec. ITU-R SF.1006: "Determination of the Interference potential between Earth stations of the Fixed Satellite Service and stations in the Fixed Service."(1993).

Rec. ITU-R-P 452 "Prediction procedure for the evaluation of microwave interference between stations on the surface of the earth at frequencies above 0.7 GHz" ITU-R P series Part 2 (P-H Frequency sharing, interference signal prediction and co-ordination).(1997)

Rec. ITU-R IS.847 "Determination of the co-ordination Area of an Earth Station operating with a Geostationary Space Station and using the same frequency band as

a system in the terrestrial service.” Radio Regulations 4, ITU Recommendations incorporated by Reference, (1998).

Appendix APS7 “ Method for the determination of the co-ordination area around an earth station in frequency bands between 1GHz and 40 GHz shared between space and terrestrial radiocommunication services” Radio Regulations 2, Appendices, (1998).

Appendix APS30B “Provisions and associated Plan for the fixed satellite services in the frequency bands 4500-4800 MHz, 6725- 7025 MHz, 10.07- 10.95 GHz, 11.2- 11.45 GHz and 12.75 –13.25 GHz” Radio Regulations 2, Appendices,(1998).

RA 372: “ Guidance Notes for the National Registration and Licensing of Receive Only Terminals.”

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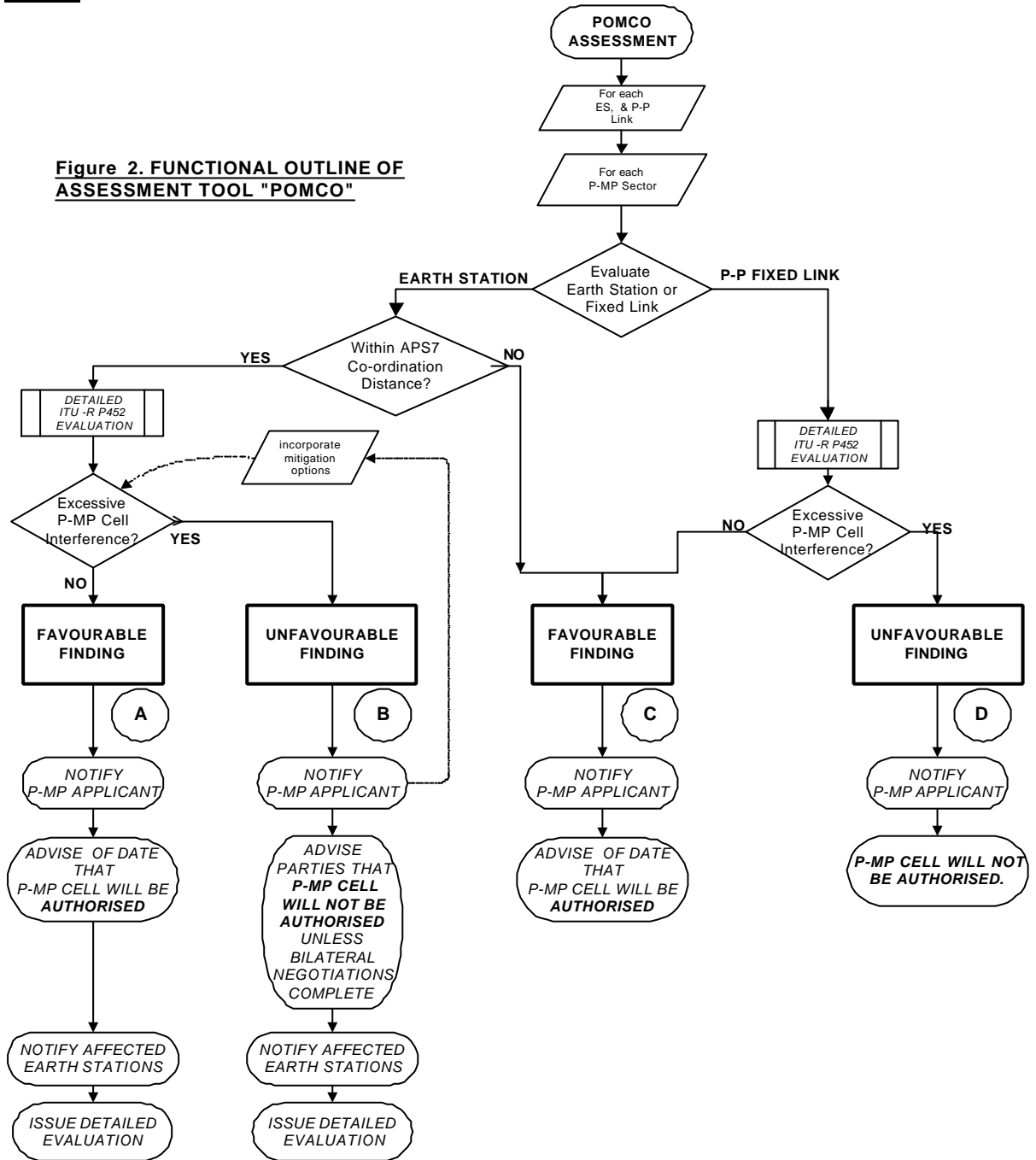
DTI Press Notice 89/80 “DTI removes need for satellite dish licences”. 3^d February 1989.

Glossary.

C/I	Carrier/Interference Ratio
C/N	Carrier/Noise Ratio
CDMA	Code Division Multiple Access
CS	Central (Radio) Station
EIRP	Effective Isotropic Radiated Power
ES	Earth Station
ETSI	European Telecommunications Standardisation Institute
FS	Fixed Service
FSS	Fixed Satellite Service
GSO	Geo-Stationary Orbit
ITU	International Telecommunications Union
ITU- RR	ITU Radio Regulations
P-MP	Point to Multipoint
POMCO	POint to Multipoint Co-Ordination Tool
P-P	Point to Point
TS	Terminal Station
WT	Wireless Telegraphy

Annex

Figure 2. FUNCTIONAL OUTLINE OF ASSESSMENT TOOL "POMCO"



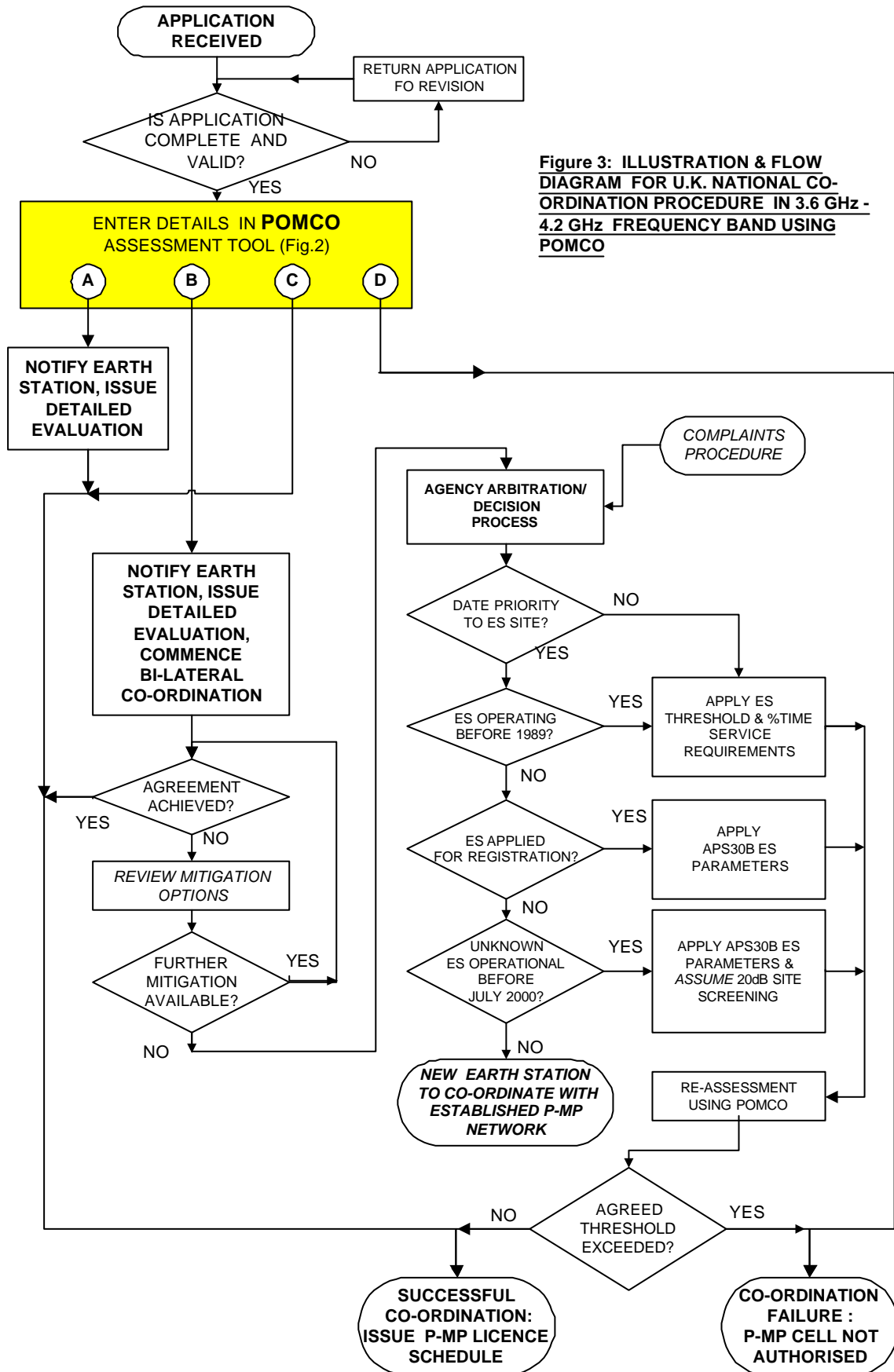


Figure 3: ILLUSTRATION & FLOW DIAGRAM FOR U.K. NATIONAL CO-ORDINATION PROCEDURE IN 3.6 GHz - 4.2 GHz FREQUENCY BAND USING POMCO