

RECOMMENDATION ITU-R F.1498-1

**Deployment characteristics of fixed service systems
in the band 37-40 GHz for use in sharing studies**

(Question ITU-R 107/9)

(2000-2002)

The ITU Radiocommunication Assembly,

considering

- a) that the band 37-40 GHz is allocated to the fixed service (FS) on a primary basis;
- b) that the telecommunication deregulation trend increases demand for competitive local access alternatives;
- c) that point-to-point (P-P) FS systems are deployed on a large scale and their use is growing in the band 37-40 GHz;
- d) that mobile network and competitive access infrastructures represent the major FS applications in this band;
- e) that an increasing number of P-P and point-to-multipoint (P-MP) FS stations are deployed or being planned for local access use in the band 37-40 GHz;
- f) that the high concentrations of service users in urban, suburban and industrial areas require high-density deployment of user terminals in these areas;
- g) that propagation conditions in this band are predominantly controlled by rain attenuation;
- h) that technological progress in system implementation and deployment are continually improving competitive local access service provisioning in this band;
- j) that emerging applications in the high density fixed service (HDFS) systems such as broadband wireless access (BWA) may require availability objectives of at least 99.999% at 1×10^{-6} bit error rate (BER) threshold and nominal BERs of 1×10^{-11} under clear-sky conditions;
- k) that in order to achieve such performance, link budgets may require coding gain such as forward error correction (FEC) coding gain;
- l) that the band 37.5-40 GHz is also allocated on a primary basis to the fixed-satellite service (FSS) (space-to-Earth) and that an increasing number of FSS systems are being planned for this band;
- m) that *noting* c) of Resolution 84 (WRC-2000) refers to Recommendation ITU-R F.1498;
- n) that the studies under *invites* ITU-R 1 and 6 of Resolution 84 (WRC-2000) require updated information on fixed service deployment in the bands 37.5-42.5 GHz,

recognizing

- a) that fixed systems in the band 37-40 GHz include ubiquitous deployment of P-P and P-MP systems over specific service areas;

b) that administrations may authorize P-P and P-MP systems using discrete channelling or frequency block assignments; within a frequency block, it is common practice to permit a range of technologies, carrier frequency bandwidths and access techniques,

recommends

1 that efficient spectrum utilization and performance and availability, based on the applicable ITU-T and ITU-R Recommendations, be primary considerations for high-density deployment of systems in the FS in the band 37-40 GHz (see Note 1);

2 that the propagation conditions in this band be advantageously used in path engineering to achieve extensive frequency reuse;

3 that Annex 1 can be referred to for FS system deployment guidance in the band 37-40 GHz for use in sharing studies.

NOTE 1 – Relevant Recommendations are, *inter alia*:

ITU-T Recommendations

ITU-T Recommendation G.821 – Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network.

ITU-T Recommendation G.826 – Error performance parameters and objectives for international constant bit rate digital paths at or above the primary rate.

ITU-T Recommendation G.827 – Availability parameters and objectives for path elements of international constant bit rate digital paths at or above the primary rate.

ITU-T Recommendation G.828 – Error performance parameters and objectives for international, constant bit rate synchronous digital paths.

ITU-R Recommendations

Recommendation ITU-R F.697 – Error performance and availability objectives for the local-grade portion at each end of an ISDN connection at a bit rate below the primary rate utilizing digital radio-relay systems.

Recommendation ITU-R F.1491 – Error performance objectives for real digital radio links used in the national portion of a 27 500 km hypothetical reference path at or above the primary rate.

Recommendation ITU-R F.1398 – Performance degradation due to interference from other services sharing the same frequency bands on a primary basis with digital radio-relay systems operating at or above the primary rate and which may form part of the national portion of a 27 500 km hypothetical reference path.

Recommendation ITU-R SM.1046 – Definition of spectrum use and efficiency of a radio system.

Recommendation ITU-R SM.1271 – Efficient spectrum utilization using probabilistic methods.

Recommendation ITU-R F.755 – Point-to-multipoint systems used in the fixed service.

Recommendation ITU-R F.758 – Considerations in the development of criteria for sharing between the terrestrial fixed service and other services.

Recommendation ITU-R F.1102 – Characteristics of fixed wireless systems operating in frequency bands above about 17 GHz.

ANNEX 1

**Fixed service deployment characteristics in the frequency band
37-40 GHz considered for use in sharing studies****1 Introduction**

The progressing deployment of FS stations or FSS earth stations may affect the future expansion of either service in the same frequency band. Accordingly, the FS station deployment patterns and the FSS earth station deployment patterns required for the introduction and growth of viable services have a major impact on band sharing.

A combination of different propagation and service development conditions results in substantial FS deployment differences in the bands below 14 GHz where sharing between FS and GSO FSS systems is currently practised, and in the bands above 17 GHz which are being considered for additional sharing with space services, e.g. the FSS. Propagation conditions result in usable FS hop lengths that are inversely proportional to frequency. The bands below 8 GHz are therefore best suited for long-distance transmission, whereas the much shorter usable hops at frequencies above 17 GHz are particularly well suited for cellular infrastructures and local access applications which are rapidly growing in urban, suburban and industrial areas.

In the bands below 14 GHz, the predominant deployment patterns of both services facilitate sharing, because FS deployment along major communications routes results in branching network configurations that leave large geographical areas free for FSS gateway deployment. This facilitates realizing the interservice separation distances that are needed to limit interference to tolerable levels.

In the band 37-40 GHz, however, the predominant FS deployment pattern is characterized by mobile network infrastructures and direct subscriber access in local areas of high population density, concentrated industrial activity or campus settings, and FSS deployment patterns could include these areas as well. FSS earth station deployment outside areas of dense FS deployment should present few coordination problems. The same is not necessarily true with respect to the deployment of FSS earth stations within and adjacent to the FS deployment and area-wide FS licence areas, and vice versa.

The information on FS deployment, presented in this Annex, is intended to be used in the assessment of FS/FSS earth station sharing in the 38 GHz band.

**2 Basic differentiation between conventional fixed wireless systems and
BWA applications in the FS**

FS deployment in the 38 GHz band started with conventional applications migrating upwards from lower frequency bands that are approaching saturation due to increasing deployment or new, more restrictive regulatory measures. The 38 GHz band was particularly attractive for the fast growing mobile infrastructure applications which account for the majority of conventional FS applications in

this band. A favourable regulatory environment in many countries and progress in telecommunications deregulation stimulated a new type of deployment in this band, direct-to-user BWA, which substitutes for and competes with optical fibre access.

Although BWA deployment started by using the commercially available systems that have been developed for conventional P-P FS applications, the BWA deployment patterns and link designs are substantially different in several aspects. The fundamental difference is due to the different service needs. The deployment of conventional FS systems in the 38 GHz band instead of in a lower frequency band with more favourable propagation conditions became necessarily more restricted in usable link length, but fit very well to the requirements of GSM900/1800 systems in urban areas. Commercially available transmitters and receivers are designed for such applications based on trade-offs between high system gain, on the one hand, and low cost, low power consumption, low weight and small size, on the other. This makes it possible for conventional FS applications to satisfy, in a technically and economically viable manner, the substantial percentage of deployment requirements near the upper limit of usable link lengths in the 38 GHz band, which makes large fade margins more practical.

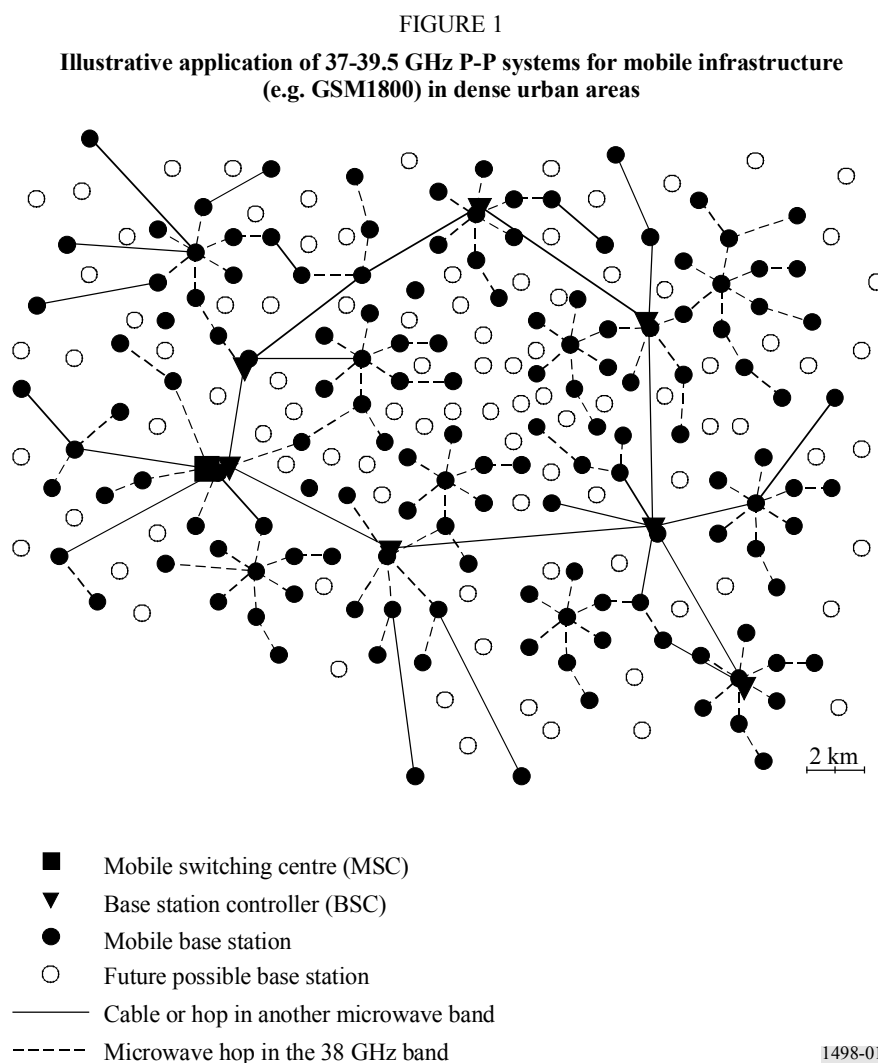
BWA deployment, by comparison, uses substantially smaller link lengths, and would be better served by P-P systems with substantially lower system gain. In fact, the transmitter power in most P-P BWA links is routinely set to or near the lowest adjustable level, which is necessitated by the stringent frequency reuse requirements in high-density cellular deployment. This requires operation with the lowest fade margins that assure the desired link availability. This applies also to the more recently introduced P-MP BWA systems that usually complement P-P deployment by providing service to the users that are closest to the cell hub. Nevertheless, P-MP system may not be able to serve those subscribers within their area of coverage that require higher data rates which can be provided with P-P systems. The shorter links and higher deployment densities of BWA systems result also in substantially higher elevation angles. These two distinctive characteristics of BWA systems make them more susceptible to interference from FSS systems than is the case with conventional FS systems. The net result is that, as far as band sharing capability is concerned, cellular BWA systems display great similarity to cellular mobile systems, due to the high densities and unpredictable locations of subscribers.

3 Representative examples of 38 GHz HDFS deployment

The initial large-scale deployment of P-P systems in the band 37-40 GHz was in mobile networks with a concentration mainly in and around urban and industrial areas. A more recent large-scale FS application in this band represents a new variety of fixed wireless access (FWA) using P-P links that terminate directly on subscriber premises.

3.1 Development of 38 GHz HDFS systems for mobile infrastructure applications

Figure 1 illustrates an example of the current primary application within a mobile network for 38 GHz deployment in urban areas where deployment densities have progressed into the range of 1 to 10 stations per km². The links are designed to satisfy availability criteria between 99.99% and 99.999%.



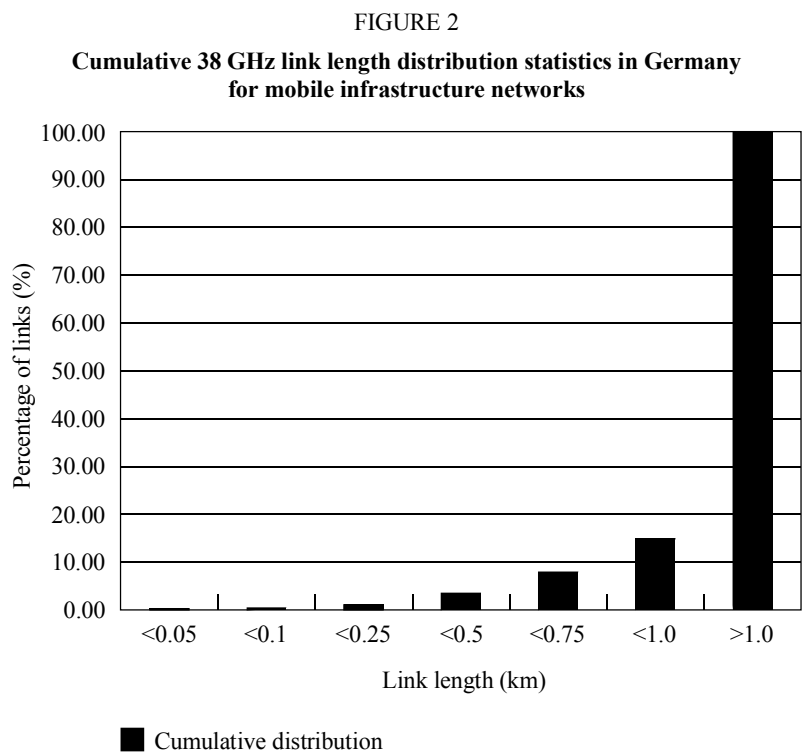
A large number of links in the 38 GHz band are deployed in several countries in Region 1. In Germany, for example, a total of some 11 200 P-P links had been deployed by the end of 2000. In Table 1 the development of the deployment is indicated.

TABLE 1

Development of link deployments in the 38 GHz band in Germany

End of year	1994	1996	1998	2000
No. of links	243	1 867	6 346	11 174

It is anticipated that this number will increase significantly during the next years, with increasing FWA applications. It can also be noted that 80% of the links are concentrated in 15% of the total area (see Fig. 8). The other links are distributed over the remaining area, but there are also numerous areas with no or neglectable 38 GHz applications.



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The corresponding distribution of elevation angles is presented in Fig. 3. Only 10 links are currently deployed with elevation angles higher than 25°. The following specific facts may be the main reasons that the elevation angle distribution will be significantly different compared to subscriber based HDFS networks in the United States of America in § 3.2:

- the major number of links is above 1 km (in the range of 1-4 km);
- terminal heights in mobile infrastructure networks are more commonly distributed;
- and possibly architectonic differences in metropolitan areas in Germany and the United States of America.