APPENDIX J

1. Reference planning configurations (RPC)

Reference frequency:

- 650 MHz (UHF).

The reference planning configurations for DVB-T that shall be used are summarized in Table 1.

Table 1

RPCs for DVB-T

RPC	RPC 1	RPC 2	RPC 3
Reference location probability	95%	95%	95%
Reference C/N (dB)	21	19	17
Reference (Emed)ref (dB(μV/m)) at fr = 650 MHz	56	78	88

(Emed)ref: Reference value for minimum median field strength

RPC 1: RPC for fixed reception

RPC 2: RPC for portable outdoor reception or lower coverage quality portable indoor reception or mobile reception

RPC 3: RPC for higher coverage quality for portable indoor reception

For other frequencies, the reference field-strength values in Table 1 shall be adjusted by adding the correction factor defined according to the following rule:

- $(E_{med})ref(f) = (E_{med})ref(fr) + Corr$;
- for fixed reception, Corr = 20 log10 (f/fr), where f is the actual frequency and fr the reference frequency of the relevant band quoted in Table 1;
- for portable reception and mobile reception, Corr = 30 log10 (f/fr) where f is the actual frequency and fr the reference frequency of the relevant band quoted in Table 1

The reference parameters of the RPC that are given in Table 1 (location probability, C/N, minimum median field strength) are not associated with a particular DVB-T system variant or a real DVB-T network implementation; rather, they stand for a large number of different real implementations. For instance, a DVB-T service for mobile reception might use as real implementation parameters a location probability of 99% and a rugged DVB-T variant with a C/N of 14 dB. Nevertheless, this service will be represented by RPC 2 with a reference location probability of 95% and a reference C/N of 19 dB without restricting the possibilities for the implementation of the "real" service for mobile DVB-T reception.

The standard deviation used for the calculation of the location correction factor of each RPC shall be as follows:

- for RPC 1 and RPC 2: 5.5 dB,
- for RPC 3: 7.8 dB.

2. Reference networks

For the determination of the power budget of the reference networks, antenna heights and powers are adjusted in such a way that the desired coverage probability is achieved at each location of the service area.

The method of adjusting the power budget of the network uses a noise-limited basis, which is known to be not very frequency-efficient. To overcome this drawback, the powers of the transmitters in the reference networks are increased by a value of 3 dB.
For the effective antenna heights of the transmitter in the reference networks, 150 m shall be used as an average value.

An open network structure has been chosen for the reference networks, since it is assumed that real network implementations will normally resemble this network type. The service area is defined as a hexagon about 15% larger than the hexagon formed by the peripheral transmitters. However, in order to allow for network implementations with very low interference potentials, a reference network with a semi-closed network structure is also introduced.

In some cases, the interference potentials of reference networks significantly overestimate the interference potential of real network implementations, for example, where the standard geometry of a reference network differs considerably from the particular shape of the real service area. In these cases, administrations may adopt an appropriate method, agreed on bilateral basis, to better model the interference potential of the reference network.

2.1 Reference network 1 (large service-area SFN)

The network consists of seven transmitters situated at the centre and at the vertices of a hexagonal lattice. An open network type has been chosen, i.e. the transmitters have non-directional antenna patterns and the service area is assumed to exceed the transmitter hexagon by about 15%. The geometry of the network is given in Fig. 2.1.

This reference network (RN 1) is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for Bands IV/V.

RN 1 is intended for large service area SFN coverage. It is assumed that main transmitter sites with an appropriate effective antenna height are used as a backbone for this type of network. For portable and mobile reception, the size of the real service areas for this type of SFN coverage is restricted to 150 to 200 km in diameter because of self-interference degradation, unless very rugged DVB-T system variants are used or the concept of dense networks is employed.

Figure 2.1

RN 1 (large service area SFN)

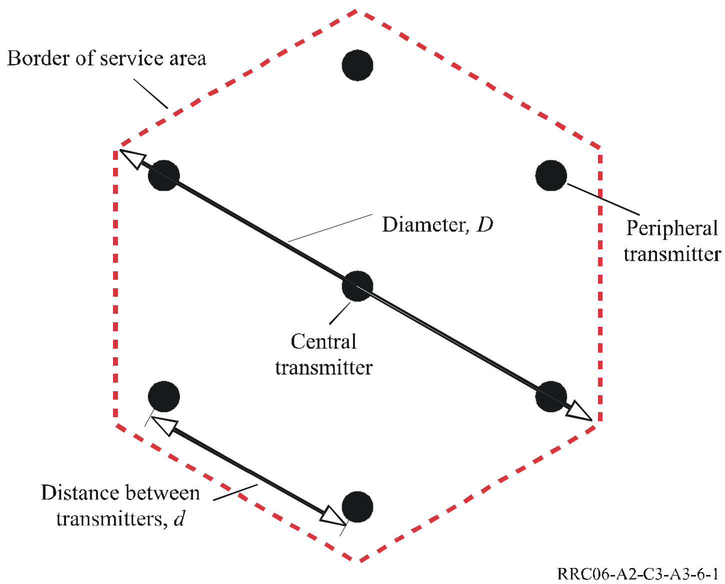


Table 2.1

Parameters of RN 1 (large service area SFN)

RPC and reception type		RPC 1 Fixed antenna	RPC 2 Portable outdoor and mobile	RPC 3 Portable indoor
Type of network		Open	Open	Open
Geometry of service area		Hexagon	Hexagon	Hexagon
Number of transmitters		7	7	7
Geometry of transmitter lattice		Hexagon	Hexagon	Hexagon
Distance between transmitters d (km)		70	50	40
Service area diameter *D* (km)		161	115	92
Tx effective antenna height (m)		150	150	150
Tx antenna pattern		Non-directional	Non-directional	Non-directional
e.r.p.* (dBW)	Bands IV/V	42.8	49.7	52.4

The e.r.p. is given for 650 MHz in Bands IV/V; for other frequencies (*f* in MHz) the frequency correction factor to be added is: 20 $\log_{10}$ (*f*/650) for RPC 1 and 30 $\log_{10}$ (*f*/650) for RPC 2 and RPC 3.

* The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.

For the guard interval length, the maximum value 1/4 Tu of the 8k FFT mode is assumed. The distance between transmitters in an SFN should not significantly exceed the distance equivalent to the guard interval duration. In this case, the guard interval duration is 224 μs, which corresponds to a distance of 67 km. The distance between transmitters for RPC 1 is taken as 70 km. For RPC 2 and RPC 3, 70 km is too large a distance from a power budget point of view. Therefore, smaller values for the distance between transmitters have been selected, 50 km for RPC 2 and 40 km for RPC 3.

The parameters and the power budgets of RN 1 given in Table 2.1 shall be used.

2.2 Reference network 2 (small service area SFN, dense SFN)

The network consists of three transmitters situated at the vertices of an equilateral triangle. An open network type has been chosen, i.e. the transmitters have non-directional antenna patterns. The service area is assumed to be hexagonal, as indicated in Fig. 2.2

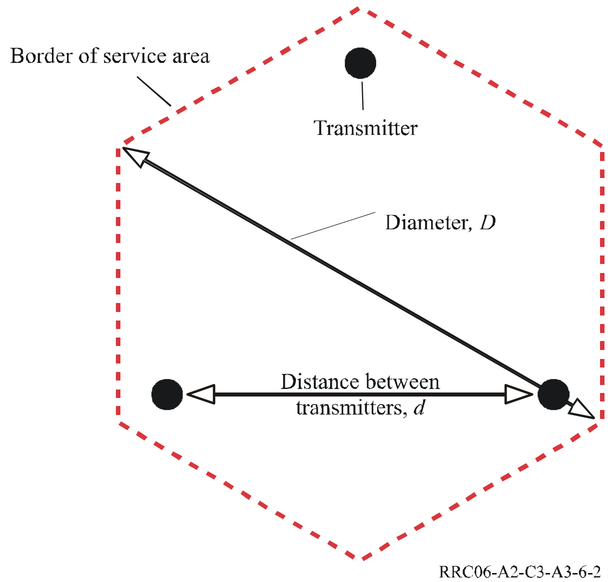
This reference network (RN 2) is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for both Bands IV and V.

RN 2 is intended for small service area SFN coverage. Transmitter sites with appropriate effective antenna heights are assumed to be available for this type of network and self-interference restrictions are expected to be small. Typical service area diameters may be from 30 to 50 km.

It is also possible to cover large service areas with this kind of dense SFN. However, a very large number of transmitters is then necessary. It therefore seems reasonable to have large service areas being represented by RN 1, even if a dense network structure is envisaged.

Figure 2.2

RN 2 (small service area SFN)



In RN 2 the inter-transmitter distance is 25 km in the case of RPCs 2 and 3. It is therefore possible to use a value of 1/8 Tu (8k FFT) for the guard interval, which would increase the available data capacity as compared to the use of a guard interval of 1/4 Tu. The same guard interval value might also be feasible for RPC 1, with its greater distance between transmitters of 40 km, since fixed roof-level reception is less sensitive to self-interference because of the directional properties of the receiving antenna.

The parameters and the power budgets of the RN 2 given in Table 2.2 shall be used.

TABLE 2.2

Parameters of RN 2 (small service area SFN)

RPC and reception type	RPC 1 Fixed antenna	RPC 2 Portable outdoor and mobile	RPC 3 Portable indoor
Type of network	Open	Open	Open
Geometry of service area	Hexagon	Hexagon	Hexagon
Number of transmitters	3	3	3
Geometry of transmitter lattice	Triangle	Triangle	Triangle
Distance between transmitters d (km)	40	25	25
Service area diameter D (km)	53	33	33
Tx effective antenna height (m)	150	150	150
Tx antenna pattern	Non-directional	Non-directional	Non-directional

e.r.p.* (dBW)	Bands IV/V	31.8	39.0	46.3

The e.r.p. is given for 650 MHz in Bands IV/V; for other frequencies (f in MHz) the frequency correction factor to be added is: 20 log10 (f/650) for RPC 1 and 30 log10 (f/650) for RPC 2 and RPC 3.

* The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.

2.3 Reference network 3 (small service area SFN for urban environment)

The geometry of the transmitter lattice of reference network 3 (RN 3) and the service area are identical to those of RN 2. (See Fig. 2.3.)

RN 3 is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for both Bands IV and V.

RN 3 is intended for small service area SFN coverage in an urban environment. It is identical to RN 2, apart from the fact that urban-type height loss figures are used. This increases the required power of the SFN transmitters by about 5 dB for RPC 2 and RPC 3.

The parameters and the power budgets of the RN 3 given in Table 2.3 shall be used.

TABLE 2.3

Parameters of RN 3 (small service area SFN for urban environment)

RPC and reception type		RPC 1 Fixed antenna	RPC 2 Portable outdoor and mobile	RPC 3 Portable indoor
Type of network		Open	Open	Open
Geometry of service area		Hexagon	Hexagon	hexagon
Number of transmitters		3	3	3
Geometry of transmitter lattice		Triangle	Triangle	Triangle
Distance d (km)		40	25	25
Service area diameter D (km)		53	33	33
Tx effective antenna height (m)		150	150	150
Tx antenna pattern		Non-directional	Non-directional	Non-directional
e.r.p.* (dBW)	Bands IV/V	31.8	44.9	52.2

The e.r.p. is given for 650 MHz in Bands IV/V; for other frequencies (f in MHz) the frequency correction factor to be added is: 20 log10 (f/650) for RPC 1 and 30 log10 (f/650) for RPC 2 and RPC 3.

* The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.

2.4 Reference network 4 (semi-closed small service area SFN)

This reference network (RN 4) is intended for cases in which increased implementation efforts regarding transmitter locations and antenna patterns are undertaken in order to reduce the outgoing interference of the network.

The geometry for RN 4 is identical to that for RN 2, except for the antenna patterns of the transmitters, which have a reduction of the outgoing field strength of 6 dB over 240 degrees (i.e. it is a semi-closed RN). The service area of this RN is shown in Fig. 2.4. A sharp transition from 0 dB to 6 dB reduction is assumed at the indicated bearings.

RN 4 is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception for Bands IV/V.

Figure 2.4

RN4 (semi-closed small service area SFN)

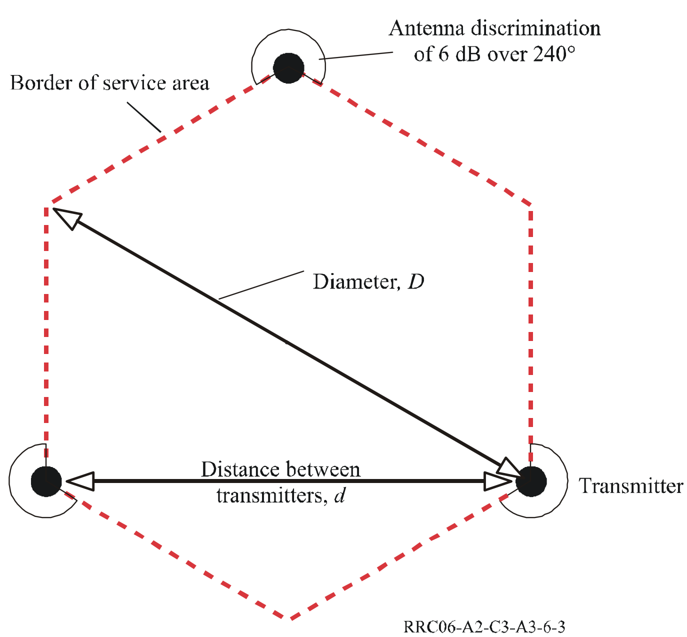


TABLE 2.4

Parameters of RN 4 (semi-closed small service area SFN)

RPC	RPC 1	RPC 2	RPC 3
Type of networkand reception type	Semi-closed Fixed antenna	Semi-closed Portable outdoor and mobile	Semi-closed Portable indoor
Geometry of service area	Hexagon	Hexagon	Hexagon

Number of transmitters		3	3	3
Geometry of transmitter lattice		Triangle	Triangle	Triangle
Distance between transmitters d (km)		40	25	25
Service area diameter D (km)		46	29	29
Tx effective antenna height (m)		150	150	150
Tx antenna pattern		Directional 6 dB reduction over 240°	Directional 6 dB reduction over 240°	Directional 6 dB reduction over 240°
e.r.p.* (dBW)	Bands IV/V	29.4	37.2	44.8

The e.r.p. is given for 650 MHz in Bands IV/V; for other frequencies (f in MHz) the frequency correction factor to be added is: 20 log10 (f/650) for RPC 1 and 30 log10 (f/650) for RPC 2 and RPC 3.

* The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.

The difference between RN 4 and RN 2 is the outgoing interference (interference potential). RN 4 has a lower interference potential as compared to that of RN 2. Because of this, the distance at which the same frequency can be reused is smaller when two allotments are both planned with RN 4.

There is a trade-off between this lower interference potential and the increased implementation costs to achieve the directional antennas. This should be kept in mind when choosing this RN for planning. There is also a reduction in the diameters of the service areas compared to those for RN 2.

The parameters and the power budgets of the RN 4 given in Table 2.4 shall be used.