

Calculation of interference: *Broadcasting, satellite earth station*



István Bozsóki
Head of Division
BDT/IEE/SBD

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Propagation models

- Several well-known propagation models (including ITU-R “classics”, such as those specified in regulatory agreements) have been implemented in SMS4DC.
- Two main types of model for predicting propagation are required: those for point-to-point systems (e.g. fixed services) and those for point to area systems (e.g. land mobile or broadcasting services). Some models can be used for both types.
- All propagation models are designed to enable different values of parameters to be used to take account of differences in the particular path or area under examination and SMS4DC includes various pop-up menu boxes to enable the engineer to enter the appropriate values.
- Of course, the engineer must have the necessary training and experience of propagation modeling to understand how to use the SMS4DC tools to obtain valid results.

Analysis types

Propagation Models	Analysis type					Network Processor	
	Line	Polyline	Area	Link	Contour	Max Field Strength	Best Server
Free Space	Y	Y	Y	N	N	Y	Y
Line of Sight	Y	Y	Y	N	N	N	N
<i>ITU-R P.370</i>	Y	Y	Y	Y	Y	Y	Y
ITU-R P.1546	Y	Y	Y	Y	Y	Y	Y
Okumura-Hata	N	N	Y	N	N	Y	Y
ITU-R P.526 (by diffraction)	N	N	N	Y	N	N	N
ITU-R P.526 (Smooth Earth)	N	N	N	Y	N	N	N
ITU-R P.452	N	N	N	Y	N	N	N
ITU-R P.530	N	N	N	Y	N	N	N

Calculations

- ***Lines, Polylines or an Area*** may be defined (drawn) on the Digital Elevation Map using the DEM toolbar functions.
- ***Propagation Tools:*** further analysis in accordance with Table above (valid combinations are marked Y). Depending on the analysis type and model, the output could be, for example, a graph of field strength along a line or polyline, or a window containing a colour-scale field strength value map from a selected transmitter in a defined area. Such maps may be overlaid (with variable transparency) on the Digital Elevation Map.
- ***Link*** analysis enables a complete analysis of the link budget between selected stations in a point-to-point link, including the path profile and Fresnel zones, in a comprehensive graphical display. Various parameters may be adjusted and the link budget is automatically recalculated to determine the effect.

Calculations

- **Contour analysis** determines field strength values along each radial at 1 degree intervals around the selected transmitter and draws a contour through all locations where the field strength is equal to a specified value. For example using P.1546 as the model, within this contour, the field strength at L% of locations and T% of time should be greater than the specified field strength (values for L and T may be specified in accordance with P.1546).
- **The Network Processor analysis** enables comparison of the service areas (or interference areas) from two or more transmitters to be determined and displayed in different colours on the Digital Elevation Map.

Broadcasting service co-ordination

- **Broadcasting service** co-ordination includes interference analysis and frequency co-ordination tools between Broadcasting Services and between Broadcasting Services and some of the other services (Fixed and Land Mobile only) sharing the frequency bands in the ST61, GE84, GE89, and GE06 Agreements.
- Interference analysis methods are in conformity with the relevant requirements of the Agreements.

ST 61 Coordination

ST61 Assignment Plan

Plan for television and sound broadcasting in the European broadcasting area, Stockholm, 1961 Rev.2006 (ST61).

For the few remaining frequency bands still subject to ST61 co-ordination, [BC,BT]²[BC,BT] calculates the co-ordination distance of a wanted VHF sound or TV broadcasting station to the nearest point on the border of neighboring countries which are in ST61 plan, Rev.2006

GE89 Co-ordination

Plan for VHF/UHF television broadcasting in the African Broadcasting Area and neighboring countries, Geneva, 1989 Rev. 2006 (GE89).

For the few remaining frequency bands still subject to GE89 co-ordination, there are several tools to identify stations in neighboring countries that maybe affected by a wanted TV (BT) station:

- Television (*BT2BT co-ordination distance*);
- Fixed (*BT2FX field strength*);
- Land Mobile (*BT2LM field strength*).
- Also Fixed and Land Mobile stations that may affect a TV station (*[FX,LM]2BT field strength*).

GE84 Co-ordination

Plan for use of the band 87.5-108 MHz for FM sound broadcasting in Region 1 and part of Region 3, Geneva, 1984 (GE84).

There are several tools to co-ordinate FM sound broadcasting station with stations in the broadcasting, fixed and land mobile radiocommunication services, in accordance with the GE84 plan:

- Sound broadcasting stations (*BC2BC coordination distance*);
- ST61 TV stations (*BC2BT ST61 coordination distance*);
- Fixed (*BC2FX field strength*); Land Mobile (*BC2LM field strength*).

There are additional tools to calculate aggregate interference and nuisance field strengths to and from sound broadcasting stations to other sound broadcasting stations.

GE06 Co-ordination

Plans for VHF/UHF analogue and digital broadcasting in parts of Regions 1 and 3, in the frequency bands 174-230 MHz and 470-862 MHz, Geneva 2006 (GE06)

- *BCBT2BCBT (Affected Admin)*: identifies Administrations whose Sound or TV Broadcast services might be affected by a Sound or TV broadcast transmitter of another Administration.
- *BCBT2FXLM (Affected Admin)*: identifies Administrations whose Fixed or Land Mobile services might be affected by a Sound or TV broadcast transmitter of another Administration.

GE06

- *FXLM2BCBT (Affected Admin)*: identifies Administrations whose Sound or TV broadcast services might be affected by a Fixed or Land Mobile transmitter of another Administration.
- *FXLM2BCBT (Affected Admin)/TX FXLM*: identifies by a coordination contour (defined in the GE06 Plan) Administrations whose broadcasting service might be affected by a Fixed or Land Mobile transmitter of another Administration.
- *FXLM2BCBT (Affected Admin)/RX FXLM*: identifies by a coordination contour (defined in the GE06 Plan) Administrations whose broadcasting service might be affected by a Fixed or Land Mobile receiver of another Administration.

GE06

- *Coverage Area*: calculates the noise-limited and interference-limited coverage areas for a wanted broadcasting assignment. These may be displayed on the DEM.
- *Service Area*: calculates the service area test points for a wanted broadcasting assignment. These may be displayed on the DEM.
- *Interference To* and *Interference From*: different scenarios are implemented to calculate interference between the broadcasting assignments/allotments and between the broadcasting assignments/allotments and stations in the fixed and land mobile services included in the GE06 Plan. These scenarios include interference to and from Digital Sound/TV, Analogue TV, Fixed and Land Mobile services

GE06 modification and coordination procedure

When an administration proposes to make a modification to the digital Plan or the analogue Plan, i.e. in cases where an administration needs:

- a) to change the characteristics of an allotment, or of an assignment to a broadcasting station, appearing in the *Plans*; or
- b) to add to the *Plans* an allotment, or an assignment to a broadcasting station; or
- c) to add to the digital Plan an assignment stemming from an allotment in the digital Plan; or
- d) to cancel from the *Plans* an allotment, or an assignment to a broadcasting station,

GE06 modification and coordination procedure

- Any administration proposing to change the characteristics of an assignment/allotment appearing in the *Plans*, or to add a new assignment/allotment to the *Plans*, shall seek the agreement of any other administration whose broadcasting service and/or *other primary terrestrial services* are considered to be affected.
- An administration is considered to be affected in respect of its *other primary terrestrial services* when the limits given in Section I of Annex 4 are exceeded for any of the *existing assignments to other primary terrestrial services*

Field-strength prediction

- Recommendation ITU-R P.1546-2 forms the basis of a field-strength prediction method applicable for the broadcasting, land mobile, maritime mobile and certain fixed services (e.g. those using point-to-multipoint systems). The complete description of the prediction method is provided in Appendix 2.1 to the Chapter 2 to Annex 2. The method can be applied using either graphical or automated (computer) procedures.

Satellite earth station – RR Appendix 7

Procedure for effecting coordination of earth stations with respect to terrestrial stations as well as other earth stations

Coordination of earth stations with respect to terrestrial stations or earth stations is based on the concept of a coordination area. The procedure for effecting coordination of earth stations involves:

- collection of coordination data using SpaceCap program (see RR Appendix 4 Annex 2), preparing the coordination contour using GIBC/AP7 program (see RR Appendix 7) and providing coordination information by Administration A to any concerned Administration B;
- action taken by Administration B receiving the coordination information;
- consultation between Administrations A and B as required, and
- conclusion of coordination agreement or disagreement between administrations.

The procedure is mainly based on the provisions of Article 9, Appendix 5 and Appendix 7 of the Radio Regulations.

Coordination area

- Appendix 7 of Radio Regulations explains the concept and the detailed methods for the determination of the coordination area around an earth station in the frequency bands between 100 MHz and 105 GHz.
- The *coordination area* is defined as “the area surrounding an *earth station* sharing the same frequency band with *terrestrial stations*, or surrounding a transmitting *earth station* sharing the same bidirectionally allocated frequency band with receiving *earth stations*, beyond which the level of *permissible interference* will not be exceeded and coordination is therefore not required” (No. **1.171**).
- It is important to note that, although the determination of the coordination area is based on technical criteria, it represents a regulatory concept. Its purpose is to identify the area within which detailed evaluations of the interference potential need to be performed in order to determine whether the coordinating earth station or any of the terrestrial stations, or in the case of a bidirectional allocation, any of the receiving earth stations that are sharing the same frequency band will experience unacceptable levels of interference

Interference calculation

ITU-R Recommendation P.452 by consideration of antenna pattern

- Interference caused or received by a selected Earth station, operating with geostationary satellites, on or from other Earth stations located inside a circular area around the selected earth station
- “Interference to” and “Interference from”, to calculate the interference caused by a wanted transmitting Earth station to victim receiving Earth stations or the interference caused by other Earth stations to a wanted receiving Earth station, respectively.
- Interference caused by a selected earth station, operating with geostationary satellites, on terrestrial stations in the fixed service, above 1GHz, located inside a circular area around the selected earth station

The background features a large, light blue watermark of the ITU logo, which consists of a globe with a lightning bolt striking it, and the letters 'ITU' in a bold, sans-serif font.

Thank you !

István Bozsóki
Head of Division
BDT/IEE/SBD
Istvan.bozsoki@itu.int