TELECOMUNICATION SYSTEMS AND SERVICES

PRACTICE 5:

Budget Link

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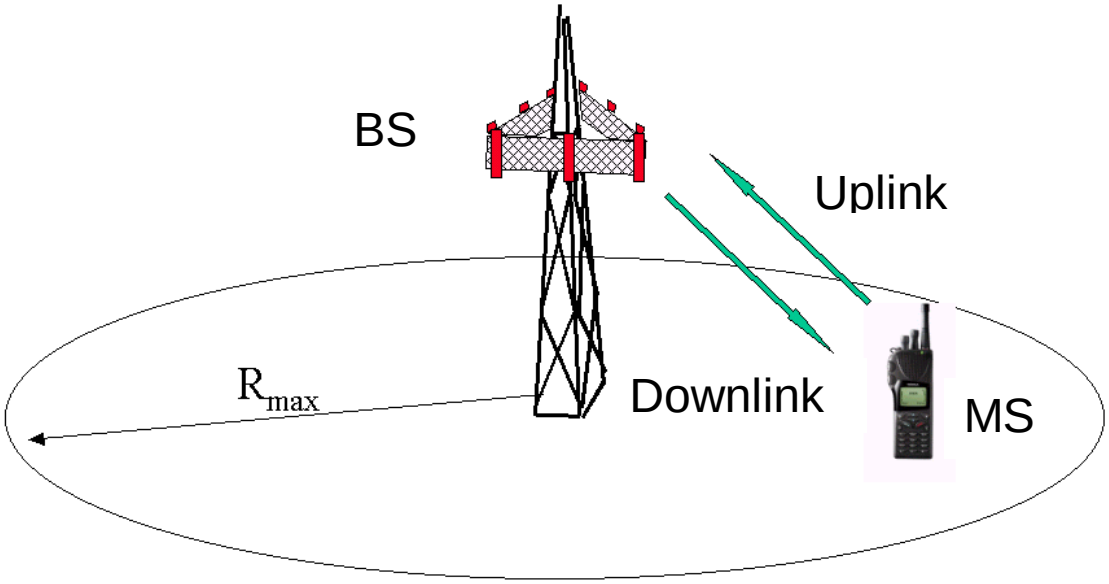
1. Introduction.

Nowadays, there exist many cellular systems, as for example the mobile telephone systems. In the planning task of the mentioned mobile systems it is important to properly evaluate the coverage area of each one of the base stations that form the network, that is to say, the region where the connection between the network and the mobile station is possible. The analysis of the budget link between the base and mobile stations is needed to calculate the coverage areas. The theoretical cell radius is the maximum distance (R_{max}) at which the received power, both in the mobile and the base station, is larger than a certain threshold called sensitivity.



We can find nowadays different mobile communication systems as GSM, DCS, UMTS, TETRA, etc.; among all these systems we will carry out the budget link of a TETRA system. This system belongs to the trunked networks group and it is very similar to the very well know GSM system. In the Appendix the characteristics of the equipment used in this system (transmitters, receivers, antennas,é) are shown.

2. Theory.

2.1 Budget Link Parameters

To carry out a power budget link of a Wireless system is necessary firstly to find the parameters corresponding to the base station and the mobile and terminal (portable) stations. There are many parameters that must be considered; inn our analysis we have considered only the parameters shown in the next table. Please note that some of the values have been substituted by a symbol ¿? ; these values must be found in the Appendix.

		Units	**Base Station**		**Mobile Station**		**Terminal Station (Portable Station)**	
	Transmitter							
A	**Frequency band**	MHz	390	395	380	385	380	385
B	**Tx power**	W	¿?		¿?		¿?	
C	**Type of combiner**		Hybrid Union		-		-	
D	**Insetion losses for 2 TX**	dB	4					
E	**Insetion losses for 3/4 TX**	dB	7,5					
F	**Type of antennaõs feeder cable**		CELLFLEX 1/2"		RG58		-	
G	**Antennaõs feeder attenuation**	dB/100m	5		35		0	
H	**Antennaõs feeder length**	m	20		1,5		0	
I	**Radiant System (antenna)**		Collinear antenna		Rod antenna		Helical antenna	
J	**Antenna gain**	dBd	¿?		0		0	
K	**Other losses**	dB	0		2		8	
		Units	**Base Station**		**Mobile Station**		**Terminal Station**	
	Receiver							
L	**Frequency Band**	MHz	380	385	390	395	390	395
M	**Static Sensitivity**	dBm	-115		¿?		¿?	
Ñ	**Dynamic Sensitivity**	dBm	¿?		¿?		¿?	
O	**Multi-coupler gain**	dB	2		0		0	
P	**Type of antennaõs feeder cable**		Cellflex 1/2"		RG58		-	
Q	**Antennaõs feeder attenuation**	dB/100m	5		35		0	
R	**Antennaõs feeder length**	m	20		1,5		0	
S	**Radiant System (antenna)**		Collinear antenna		Rod antenna		Helical antenna	
T	**Antenna gain**	dBd	¿?		0		0	
U	**Other losses**	dB	0		2		8	

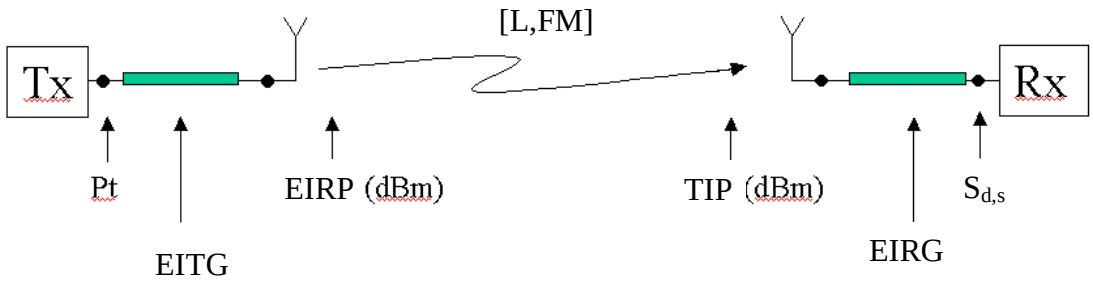
2.2 Budget Link.

Next, an example of how a budget link could be evaluated is presented. The equations used to evaluate each parameter are collected in the column ñRelationò, the letters associated to each equation are shown in the previous Table.

TETRA-ERM System Budget Link in an Outdoor environment

				Mobile		Portable	
		Units	Relation	Base to Mobile	Mobile to Base	Base to Portable	Portable to Base
Pt	Tx Power	dBm	10Log(B)+30				
EITG	Equivalent Isotropic Transmitter Gain	dBi	J+2,15-D-K-G*H/100				
EIRP	Equivalent Isotropic Radiated Power	dBm	Ptx + EITG				
	Static Reception						
S_s	Static Sensitivity	dBm	M				
EIRG_s	Static Equivalent Isotropic Receiver Gain	dBi	O+T+2,15-U-Q*R/100				
TIP_s	Static threshold Isotropic Power	dBm	S_s-EIRG_s				
Lbmax_e	Maximum static propagation losses	dB	EIRP-TIP_s				
	Dynamic Reception						
S_d	Dynamic Sensitivity	dBm	Ñ				
EIRG_d	Dynamic Equivalent Isotropic Receiver Gain	dBi	O+T+2,15-U-Q*R/100				
TIP_d	Dynamic threshold Isotropic Power	dBm	S_d-EIRG_d				
Lbmax_d	Maximum dynamic propagation losses	dB	EIRP-TIP_d				

Once the budget link table has been filled out, the maximum allowed losses can be identified. We have different maximum allowed losses depending on the type of receiver (mobile or portable) and depending on the type of reception (static or dynamic); therefore we have four different cases corresponding to the combinations of the mentioned types of reception and stations. The next figure presents the main elements of a budget link in a schematic way. The maximum allowed losses are evaluated applying the operation EIRP- Threshold Isotropic Power.



Pt = Tx Power
EITG = Equivalent Isotropic Transmitter Gain
EIRP = Equivalent Isotropic Radiated Power (EIRP = Pt + EITG)
S = Sensitivity
EIRG = Equivalent Isotropic Receiver Gain
TIP = Threshold Isotropic Power (PIU = S ï EIRG)
L = Propagation losses

3. Laboratory.

Using the Excel program and the data of the Appendix calculate the budget link. This budget link must take into account the use of the mobile and portable stations, and the uplink and downlink in each case. Two different Excel worksheets must be used, one for the equipment parameters and another one for the budget link. The student must identify the worst case in both uplink and downlink for the case of static portable and dynamic mobile.