COORDINATION of EARTH STATIONS

WITH RESPECT TO TERRESTRIAL STATIONS / OTHER EARTH STATIONS

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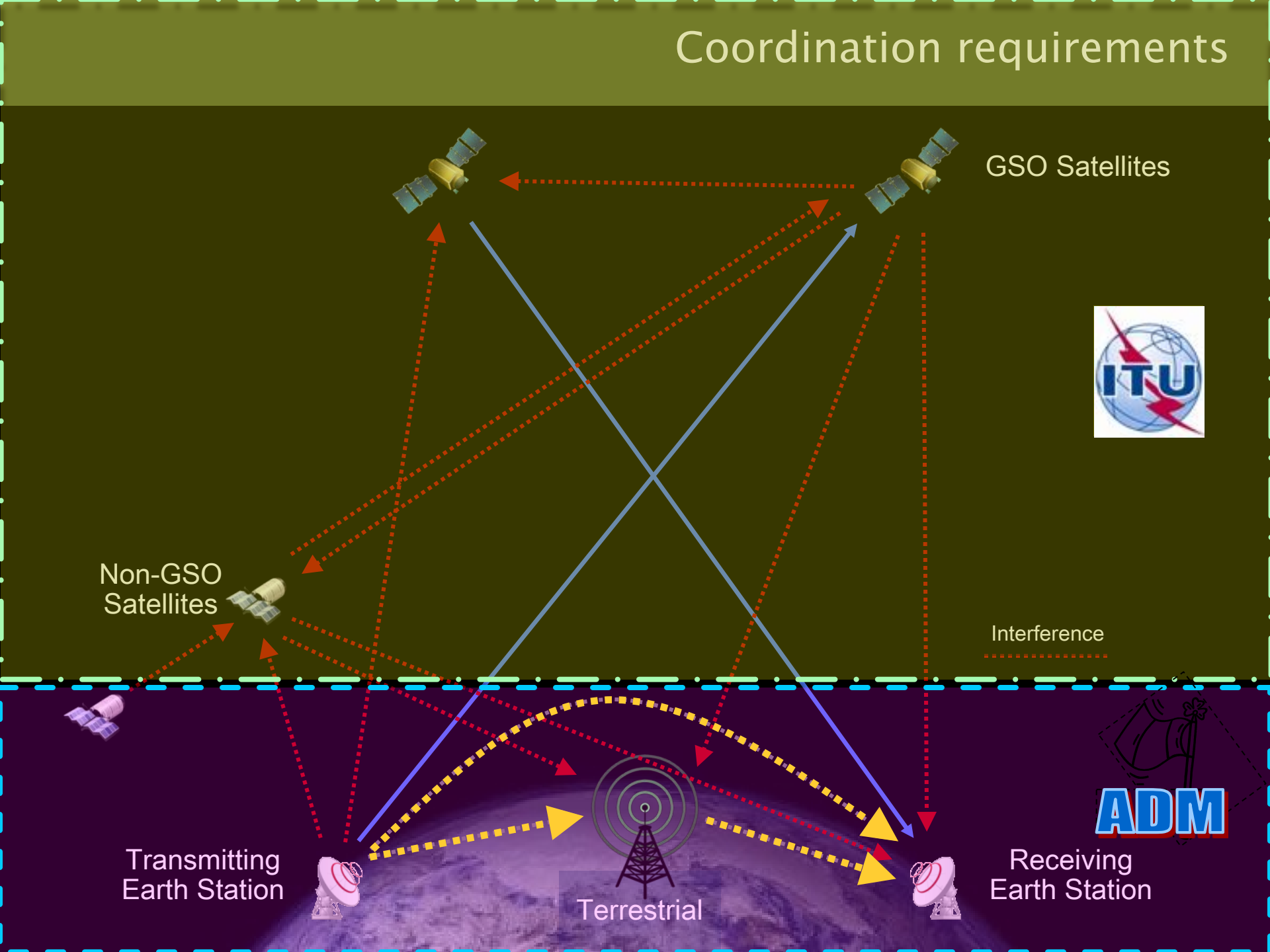
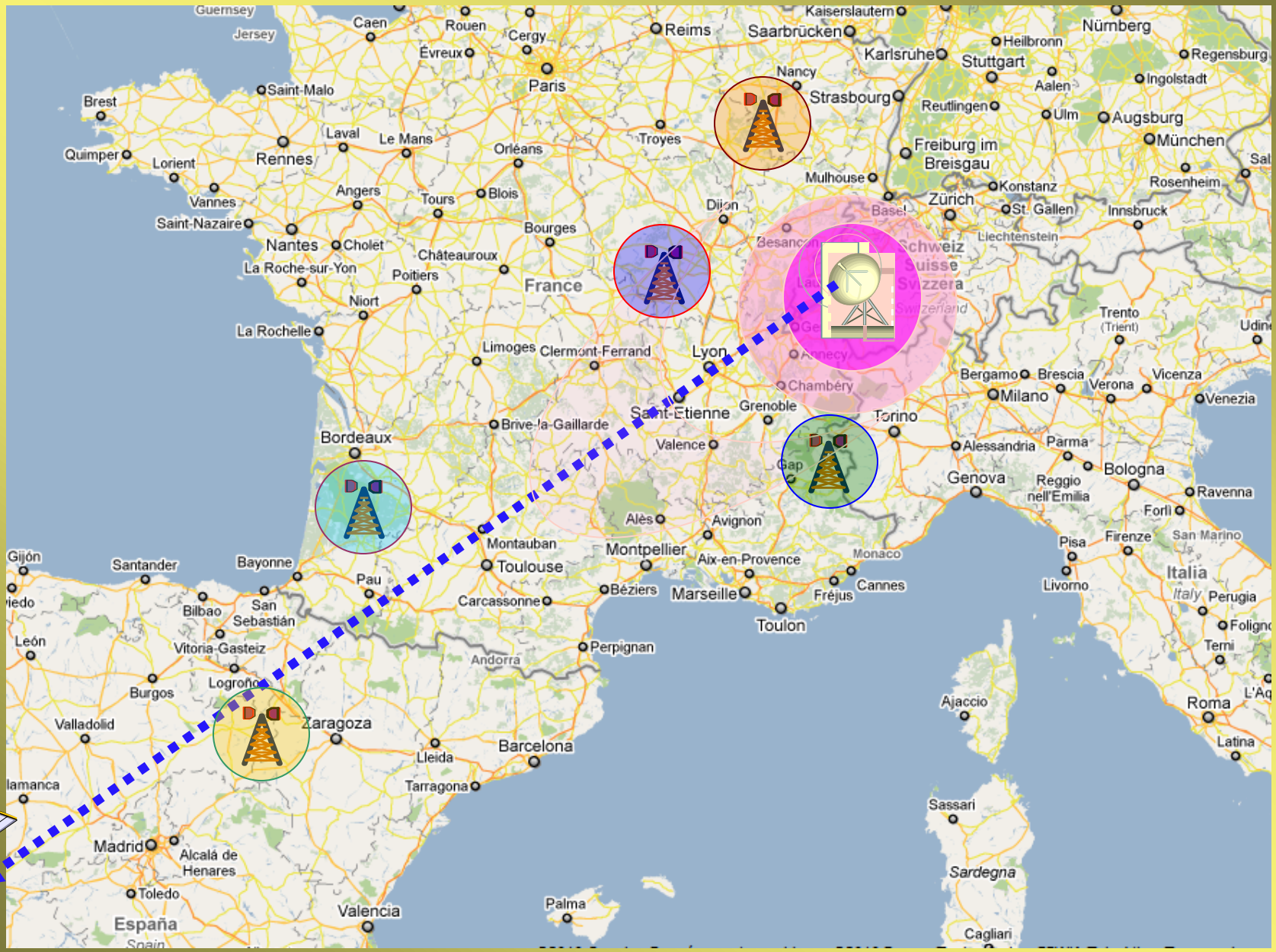
Coordination requirements



Why ?

Propagation do not care for Borders.



COORDINATION OF EARTH STATIONS

Volume No.1

Article 5

Region 1	All Regions
5850 - 5925 MHz	**6700 - 7075 MHz**
FIXED **FIXED-SATELLITE** *(Earth-to-space)* ↑ MOBILE	**FIXED** **FIXED-SATELLITE** ***(Earth-to-space)*** ↑ ***(space-to-Earth)*** ↓ MOBILE

Article 9 ⇨ Provisions : 9.6, 9.15, 9.17, 9.17A, 9.21

Volume No.2

Appendix 5 ⇨ Coordination area : Appendix 7

Appendix 4 ⇨ Coordination data to neighboring countries

(Vol. 1) Article 11 ⇨ *Notification in Master Register*

When ?

Volumn No.1 → Article **5**

Region 1

5850 - 5925 MHz

FIXED
FIXED-SATELLITE
(Earth-to-space) ↑

equal rights

Space = Terrestrial

All Regions

6700 - 7075 MHz

FIXED-SATELLITE
(Earth-to-space) ↑
(space-to-Earth) ↓

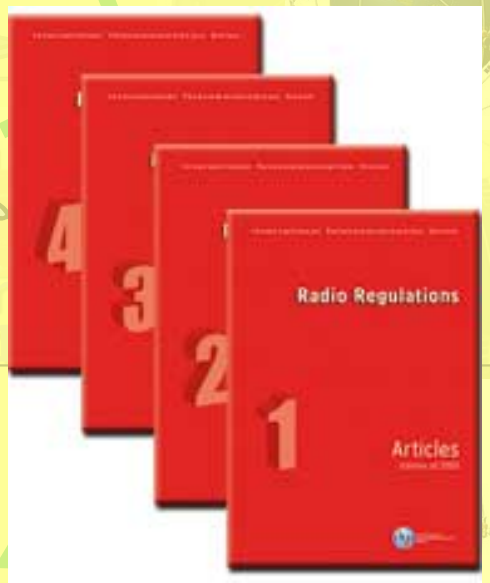
opposite direction

Uplink = Downlink

- **If** coordination area **includes the territory of another country**

PROVISIONS for effecting COORDINATION

Article 9



Space Service under No. 9.21 agreement

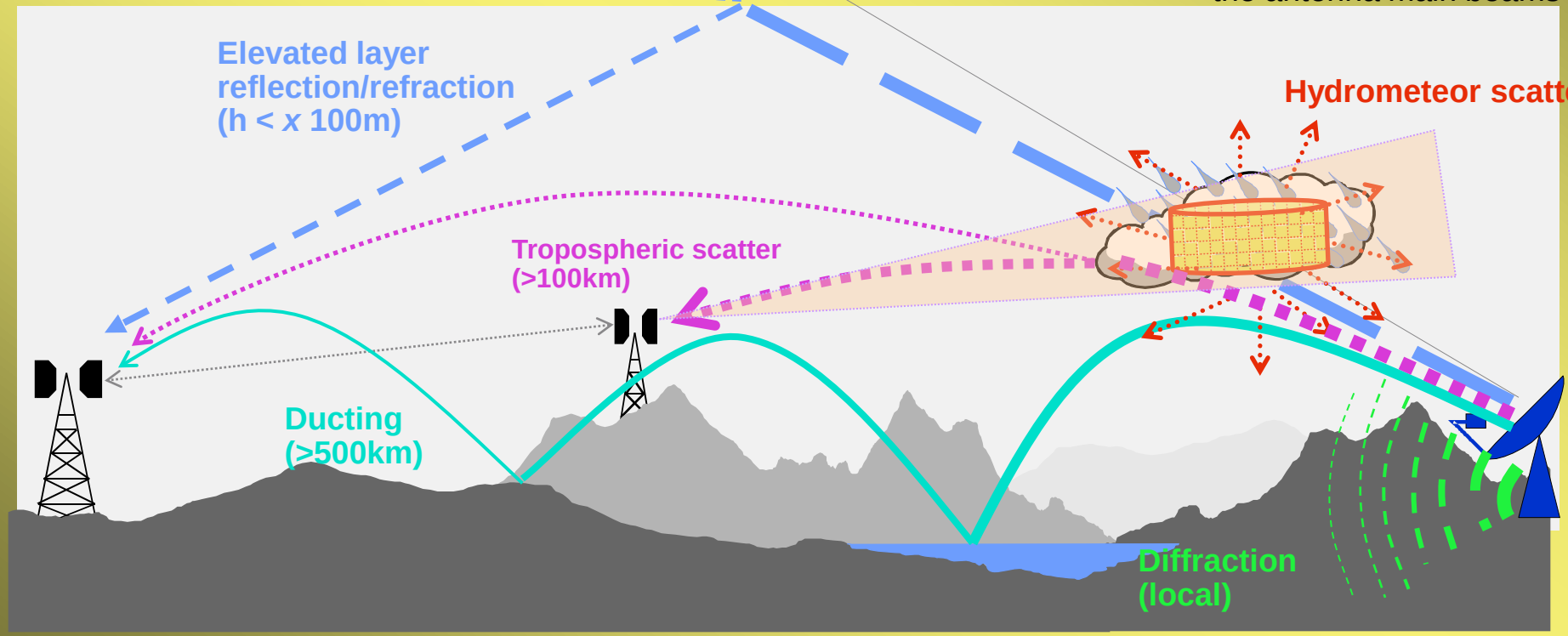
(ex: footnote 5.461 – MSS)

Why AP7?

AP7

Anomalous (short-term) Interference Propagation mechanisms

Common Volume
at the intersection of
the antenna main beams



Great-circle propagation (**Mode 1**) ***– 4 Radio-Clim. zone***

+

Hydrometeor scatter (**Mode 2**) ***– 15 Rain zone A-Q***

→ **Coordination Distance**

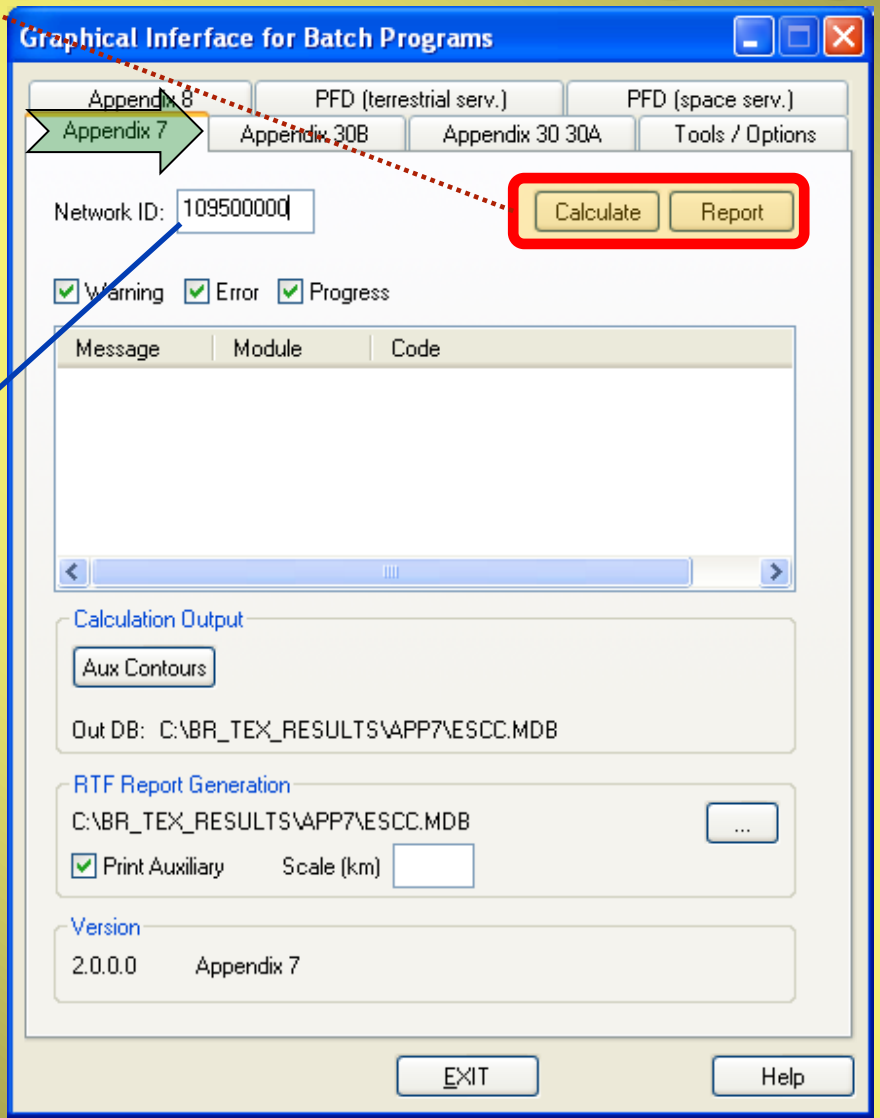
Simple button?

Computer Program for Determination of Coordination Area

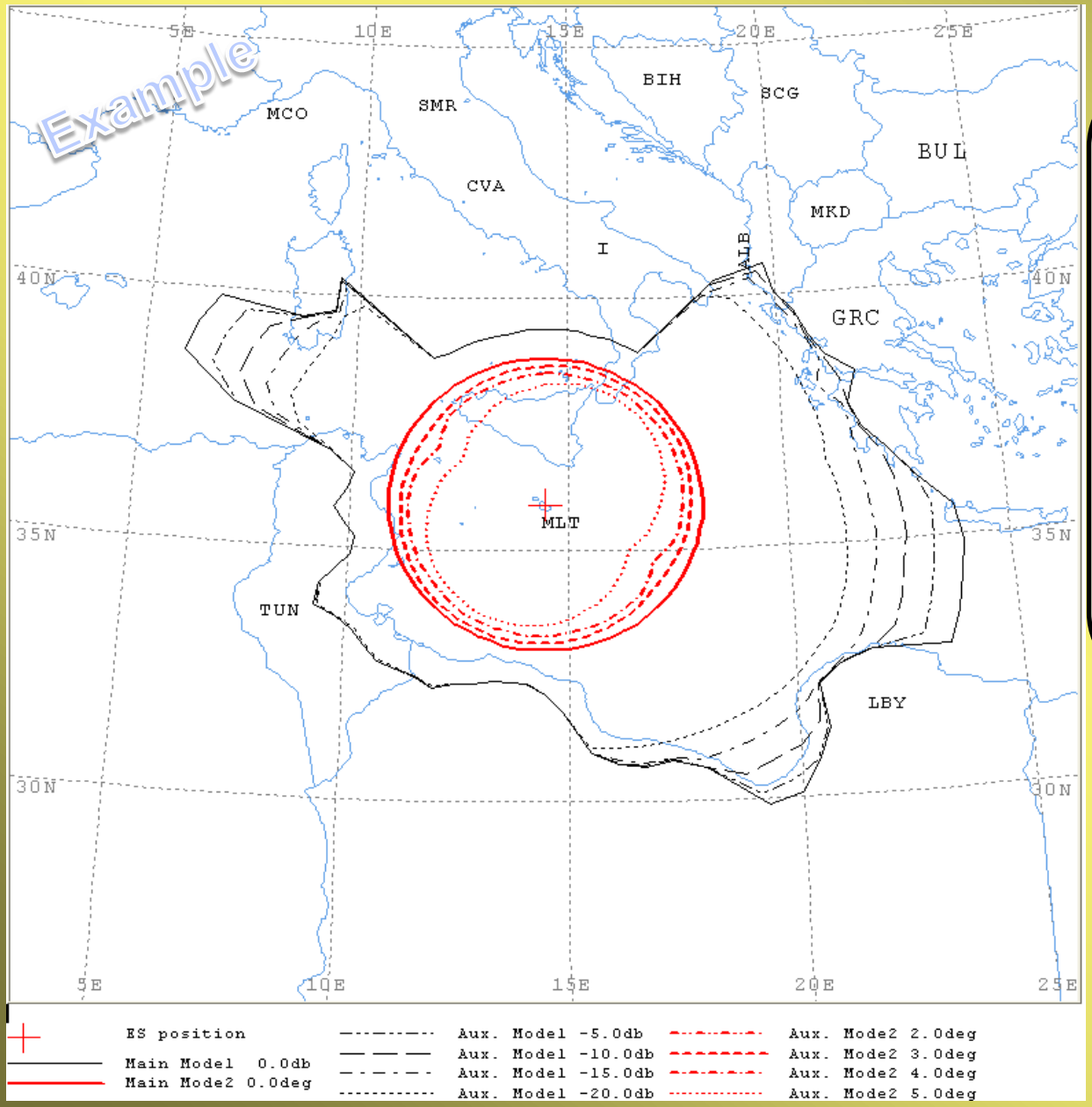
AP7 embedded in GIBC

C:\BR_SOFT\BATCH

Create your Input File



Report (p1) of AP7 (GIBC) program



Rcv GSO ES (FSS) w.r.t. Terrestrial St (TS, FS, MS)

Freq: 3850-4200 GHz
Sat longitude : 18 W
Horizon Ele. Anagle : 0

Affected countries:

Countries included in Coordination Distance/Area

Automatic indication in AP7 report

Report (p2) of AP7 (GIBC) program

Example

Diagram 4: 2.1_TABLE8. RECEIVING GSO ES in FIXED-SATELLITE SERVICE W.R.T. TRANSMITTING TERRESTRIAL STATIONS. TS in FS or MS

[illegible]IC. ID: 108500000   EARTH STATION NAME: BR SEMINAR ES1   EARTH STATION POSITION: 014E264035N5556   PHASE: N
A[illegible]/GEO_AREA: BEL/MLT   RAIN CLIMATICAL ZONE: K
SATELLITE NAME[illegible]   ITU BR TEST SAT   SATELLITE ORBITAL POSITION: -18.00 DEG
ANTENNA AZIMUT[illegible]: [illegible] DEG   ANTENNA ELEVATION: [illegible] DEG
FREQUENCY BAND[illegible]: [illegible] MHZ   [illegible] FREQUENCY: [illegible] MHZ   PERCENTAGE OF TIME: 0.0017 %
MAXIMUM ANTENNA GAIN: 59.3 DBI   MAXIMUM POWER DENSITY: - DBW/HZ   NOISE TEMPERATURE: 100.0 K
ANTENNA PATTER[illegible]: APERECO15V01
2.1_TABLE8 [illegible]el: PLM_DUCTING

Tech. parameters of the planning E/S

TRANSMISSION LOSS MODE 1: 204.9 DB (DOES NOT INCLUDE HOR. CORR. AND ANT. GAIN)
TRANSMISSION LOSS MODE 2: 162.9 DB

Calculated parameters by 5° Azimuth

Coordination distance by 5° Azimuth

AZIMUTH	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115
OFF-AXIS	[illegible]	126.7	130.0	133.1	135.9	138.4	140.5	142.1	143.3	143.8	143.8	143.2	142.0	140.3	138.2	135.7	132.8	129.7	126.4	122.9	119.3	115.6	111.7	107.8
HOR.ELEV.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-
HOR.CORR.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-	-	-	-	-	-	-
ANT.GAIN	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0
COORDINATION DISTANCE (KM)																								
MODE 1																								
0.0 DB	391	391	391	391	394	394	391	515	686	669	[illegible]	667	665	[illegible]	665	674	719	769	841	855	850	850	847	748
MODE 2																								
0.0 DEG	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	321	322	322	322	322

AZIMUTH	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215	220	225	230	235
OFF-AXIS	103.9	99.9	95.9	91.8	87.8	83.8	79.8	75.8	71.8	67.9	64.1	60.4	56.8	53.3	50.0	46.9	44.1	41.6	39.5	37.9	36.7	36.2	36.2	36.8
HOR.ELEV.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HOR.CORR.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANT.GAIN	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-9.8	-9.1	-8.5	-7.9	-7.5	-7.1	-7.0	-7.0	-7.1
COORDINATION DISTANCE (KM)																								
MODE 1																								
0.0 DB	703	691	765	801	820	808	674	626	618	595	561	465	425	[illegible]	[illegible]	408	[illegible]	[illegible]	[illegible]	470	477	491	488	485
MODE 2																								
0.0 DEG	322	322	323	323	323	323	323	323	324	324	324	324	324	324	325	325	325	325	325	325	325	325	325	325

(0 - 355°)

AZIMUTH	240	245	250	255	260	265	270	275	280	285	290	295	300	305	310	315	320	325	330	335	340	345	350	355
OFF-AXIS	38.0	39.7	41.8	44.3	47.2	50.3	53.6	57.1	60.7	64.4	68.3	72.2	76.1	80.1	84.1	88.1	92.2	96.2	100.2	104.2	108.2	112.1	115.9	119.6
HOR.ELEV.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HOR.CORR.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANT.GAIN	-7.5	-8.0	-8.5	-9.2	-9.8	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0	-10.0
COORDINATION DISTANCE (KM)																								
MODE 1																								
0.0 DB	498	525	497	416	400	415	434	409	401	456	697	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	391
-10.0 DB	498	525	497	416	400	415	434	409	401	456	649	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	391
MODE 2																								
0.0 DEG	325	325	325	325	325	325	324	324	324	324	324	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PROBABLY AFFECTED COUNTRIES: ALB GRC I LBY MLT TUN

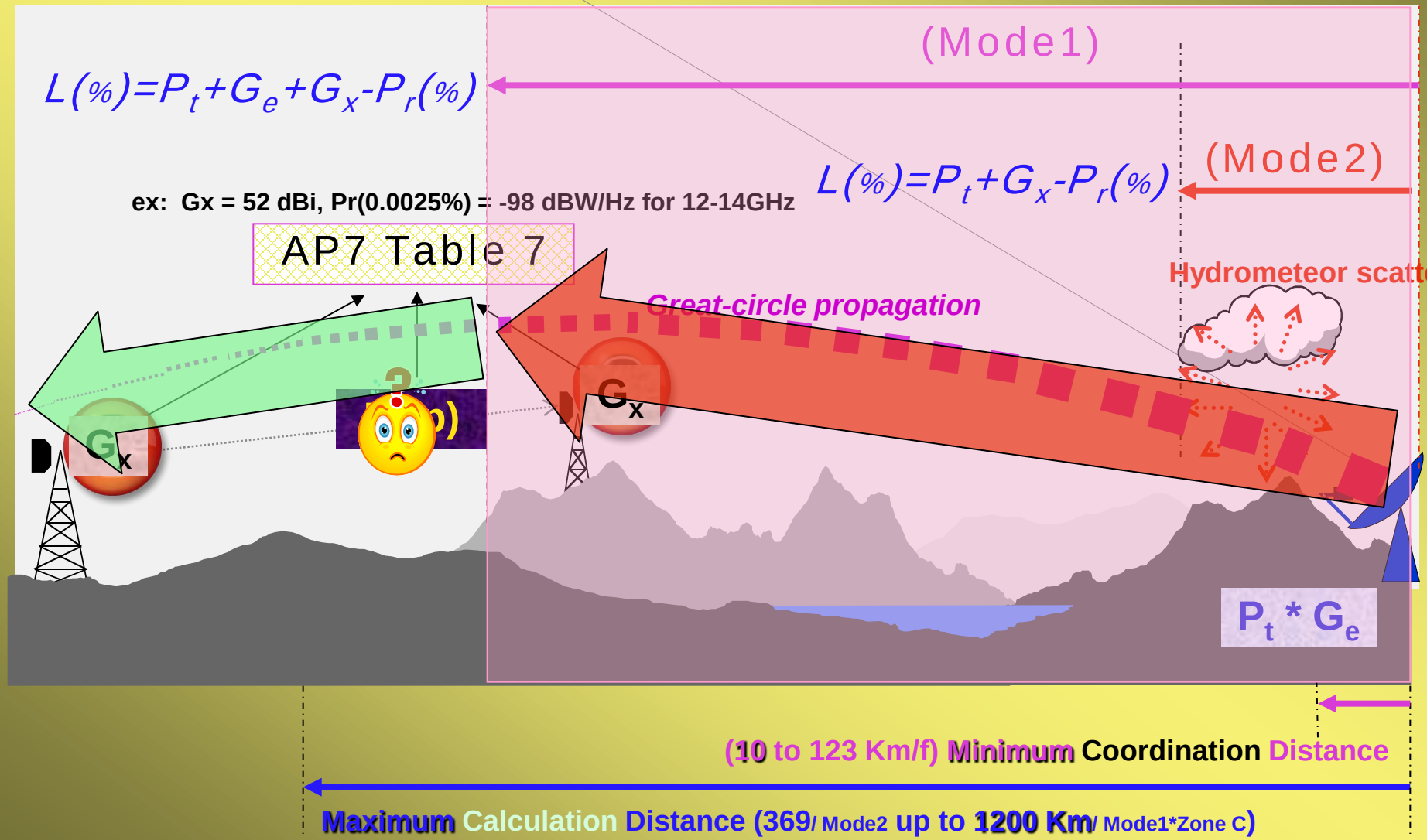
Probably Affected ADM in AP7 report

How (Tx E/S)?

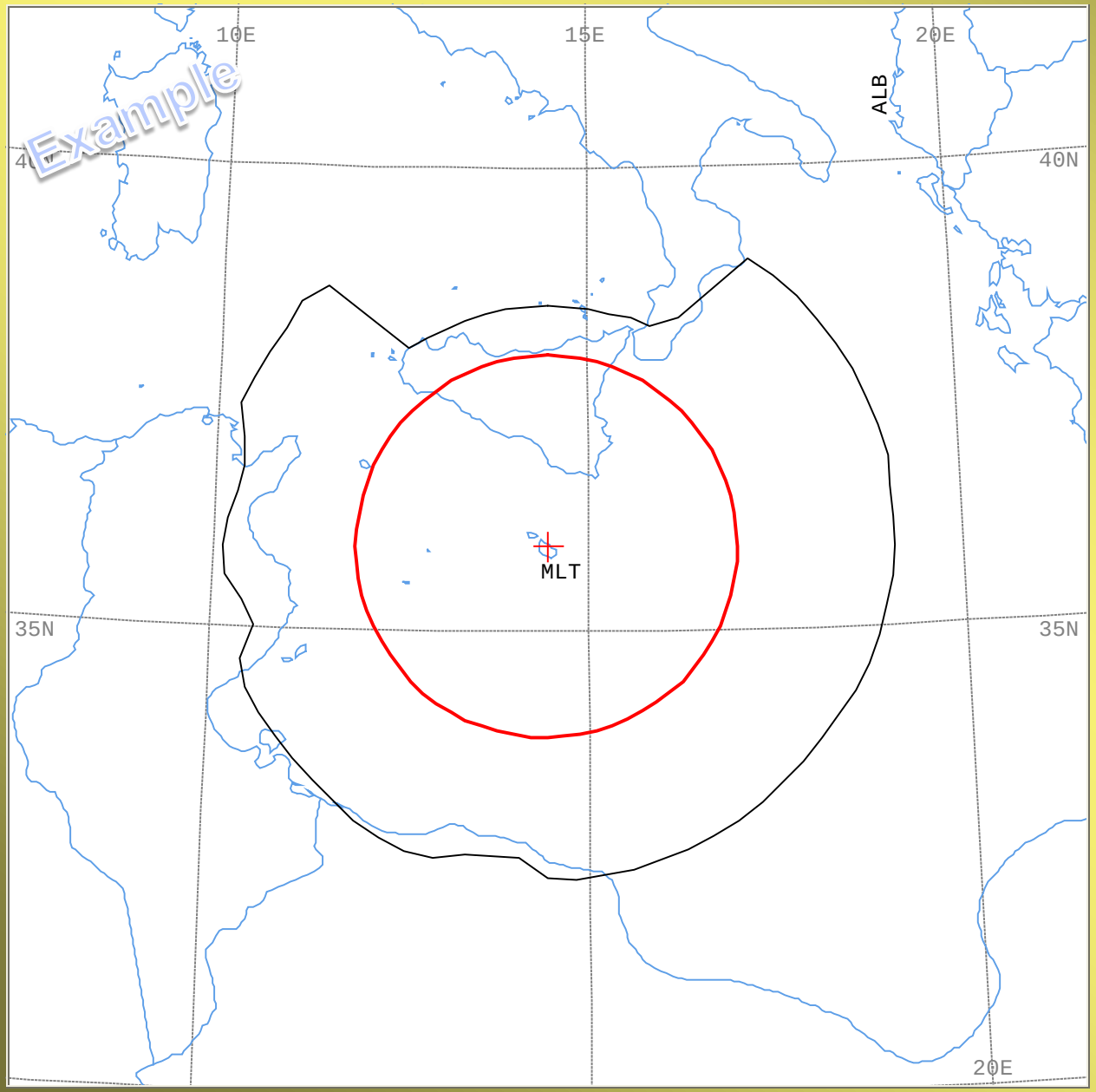
Azimuth x°

Coordination Distance

Max (Great-circle propagation (Mode 1) , Hydrometeor scatter (Mode 2))



Coordination area of Tx GSO E/S (FSS) with respect to Rcv Terrestrial stations (FS)



Freq: 5925 - 6425 GHz

Sat longitude : 1 W

Horizon Ele. Anagle : 0

Affected countries:

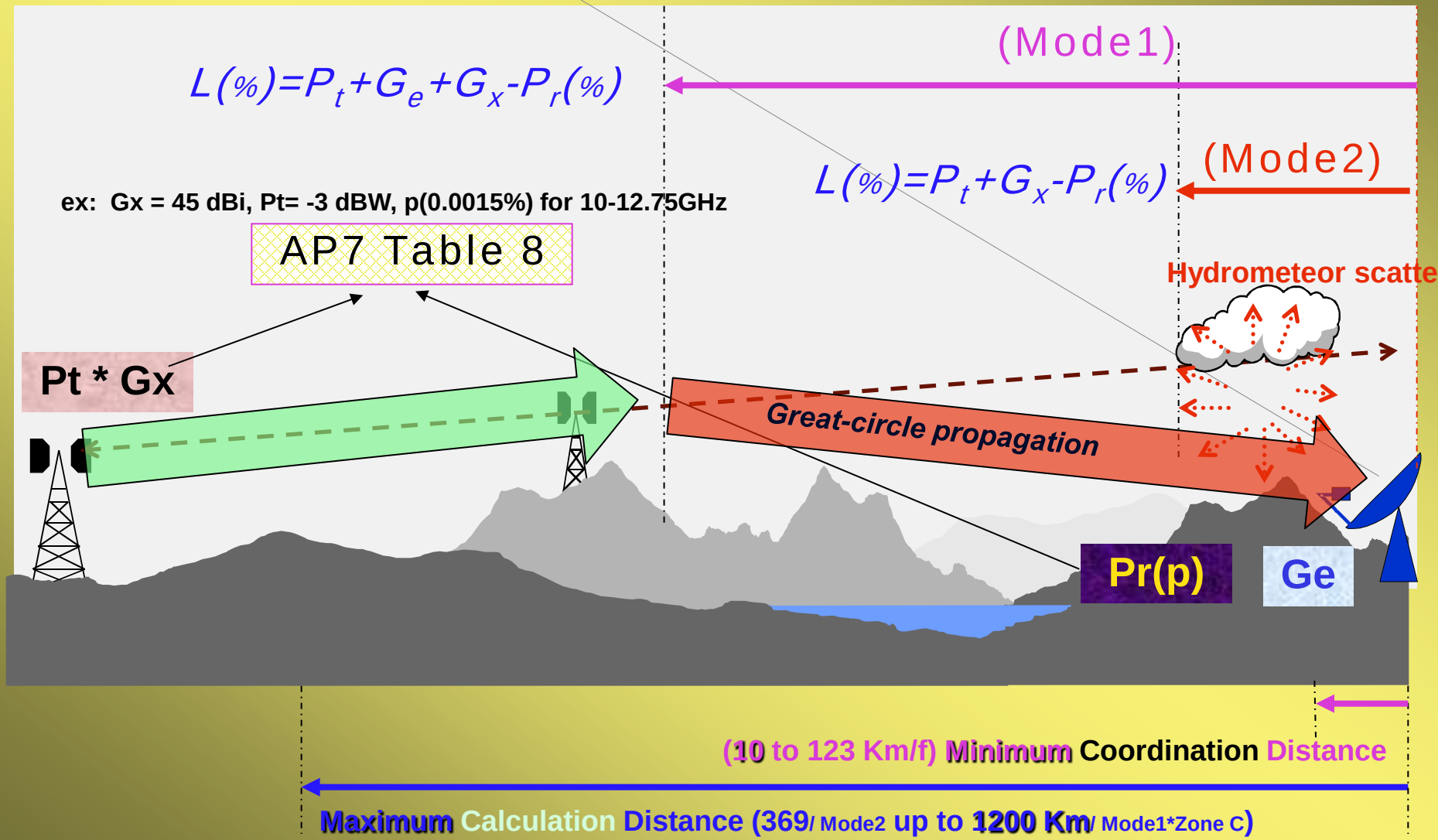
I LBY TUN

How (Rcv E/S)?

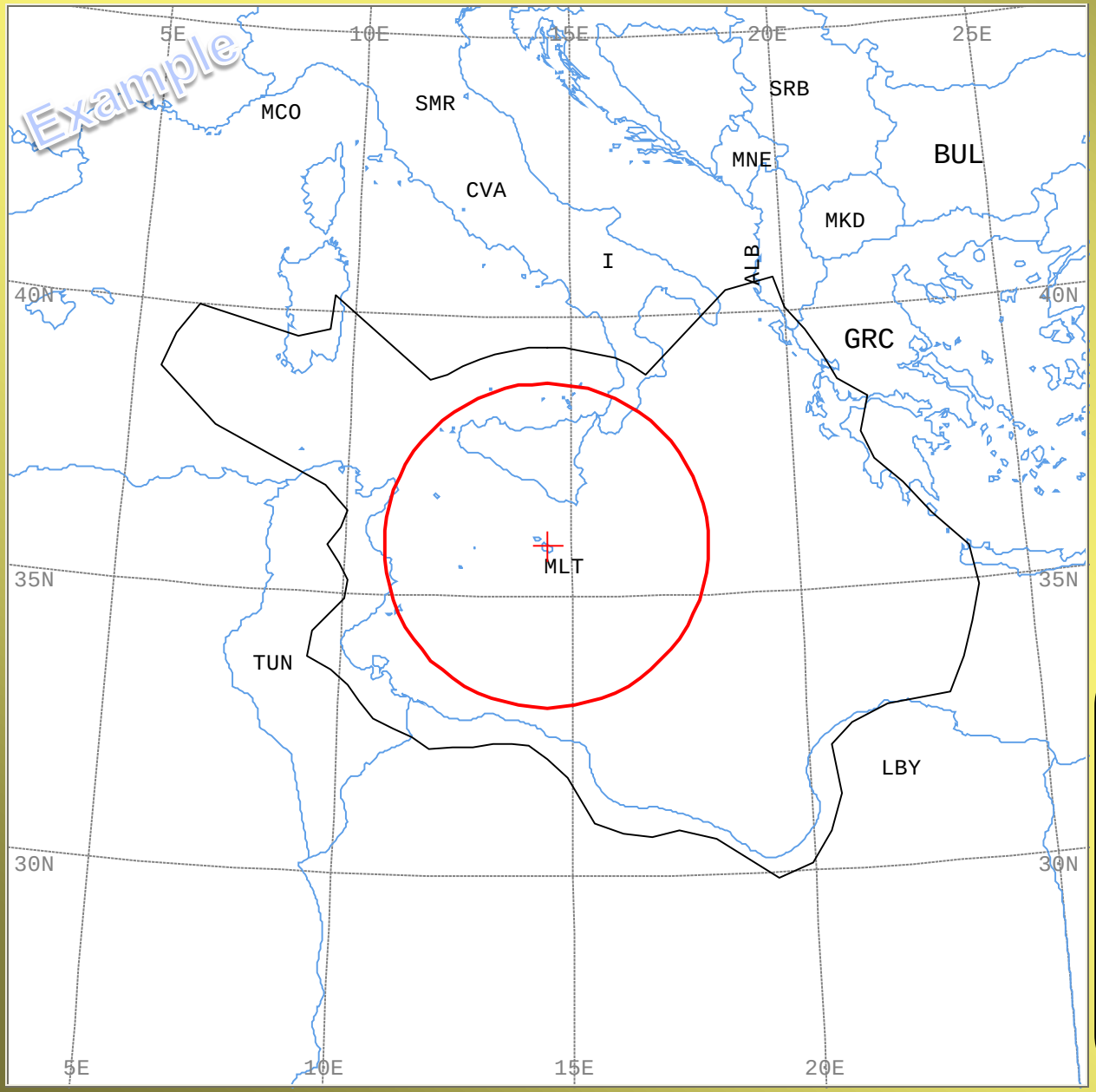
Azimuth x°

Coordination Distance

Max (Great-circle propagation (Mode 1) , Hydrometeor scatter (Mode 2))



Coordination area of Rcv GSO ES (FSS) with respect to Tx Terrestrial stations (FS)



Freq: 3700 - 4200 GHz

Sat longitude : 1 W

Horizon Ele. Anagle : 0

Affected countries:

ALB GRC I LBY TUN

Contour of Opposite direction 1

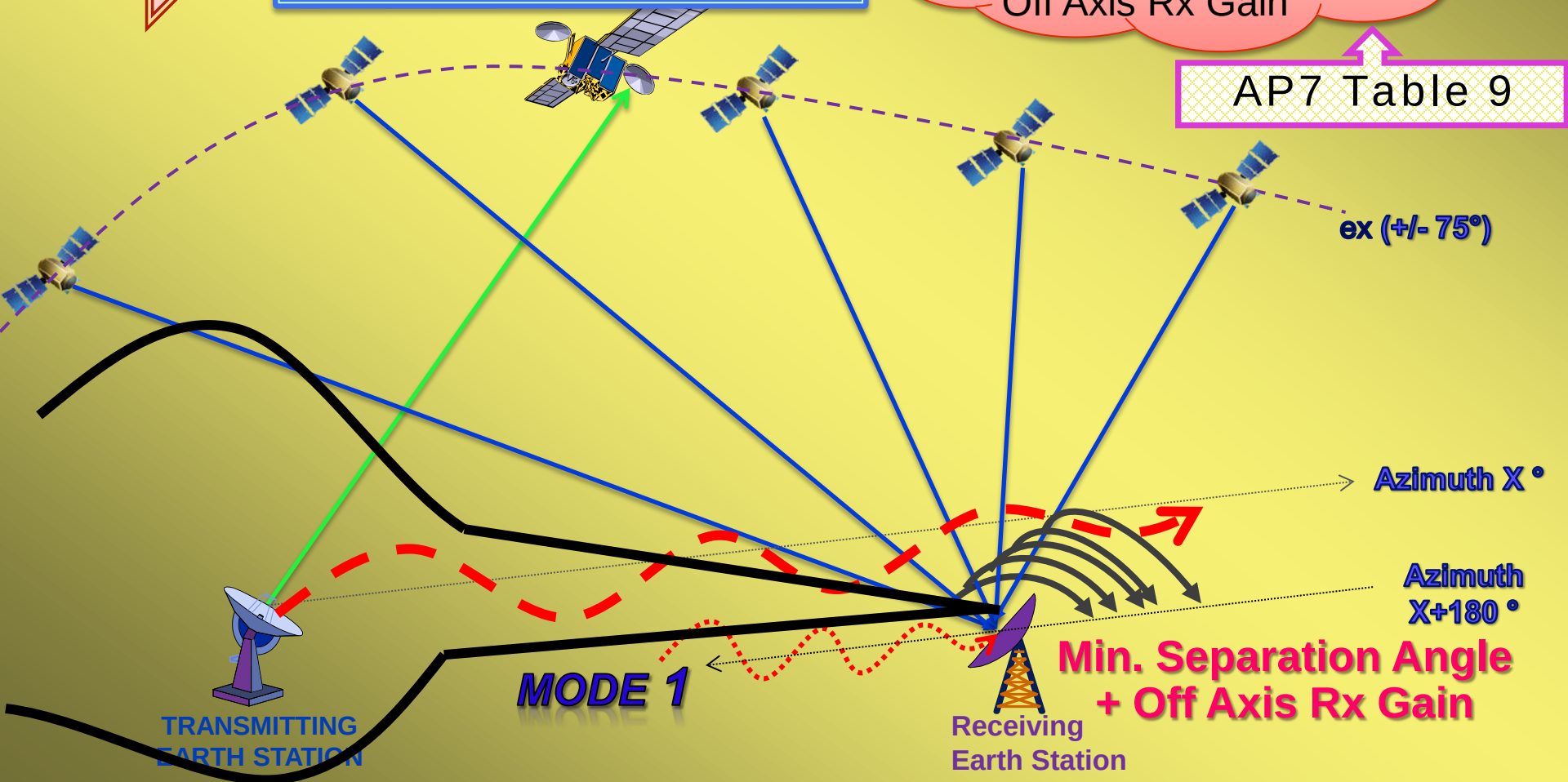
MODE 1 Appendix 7 - Annex 3 & 5 + Table 9

Worst Case Scenario (for Rx E/S)

- Horizon ele. angle (Rx E/S) = 0 °
- Orbit inclination = 0 °
- Anywhere in GSO orbit (> ε_{min})
- Same latitude with Tx E/S

- Find Min. separation Angle of Rx E/S (for Azimuths)
- Calculate Distance with Off Axis Rx Gain

AP7 Table 9



Contour of Opposite direction 2

MODE 2

Appendix 7 - Annex 5 + Table 9

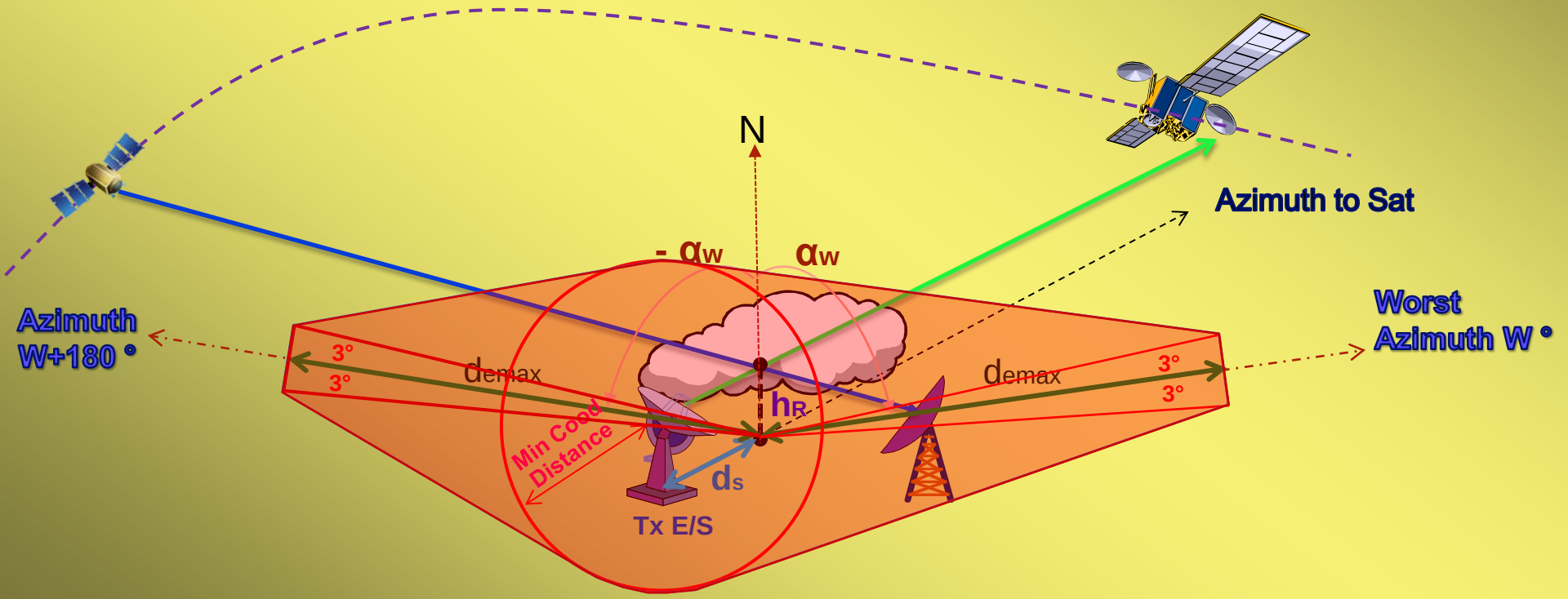
Worst Case Scenario (as Mode1) +

- Plane geometry approximation
- Rx E/S operates at Min. Ele. angle
- Beam intersection under Rain height

Apply Geometrical construction

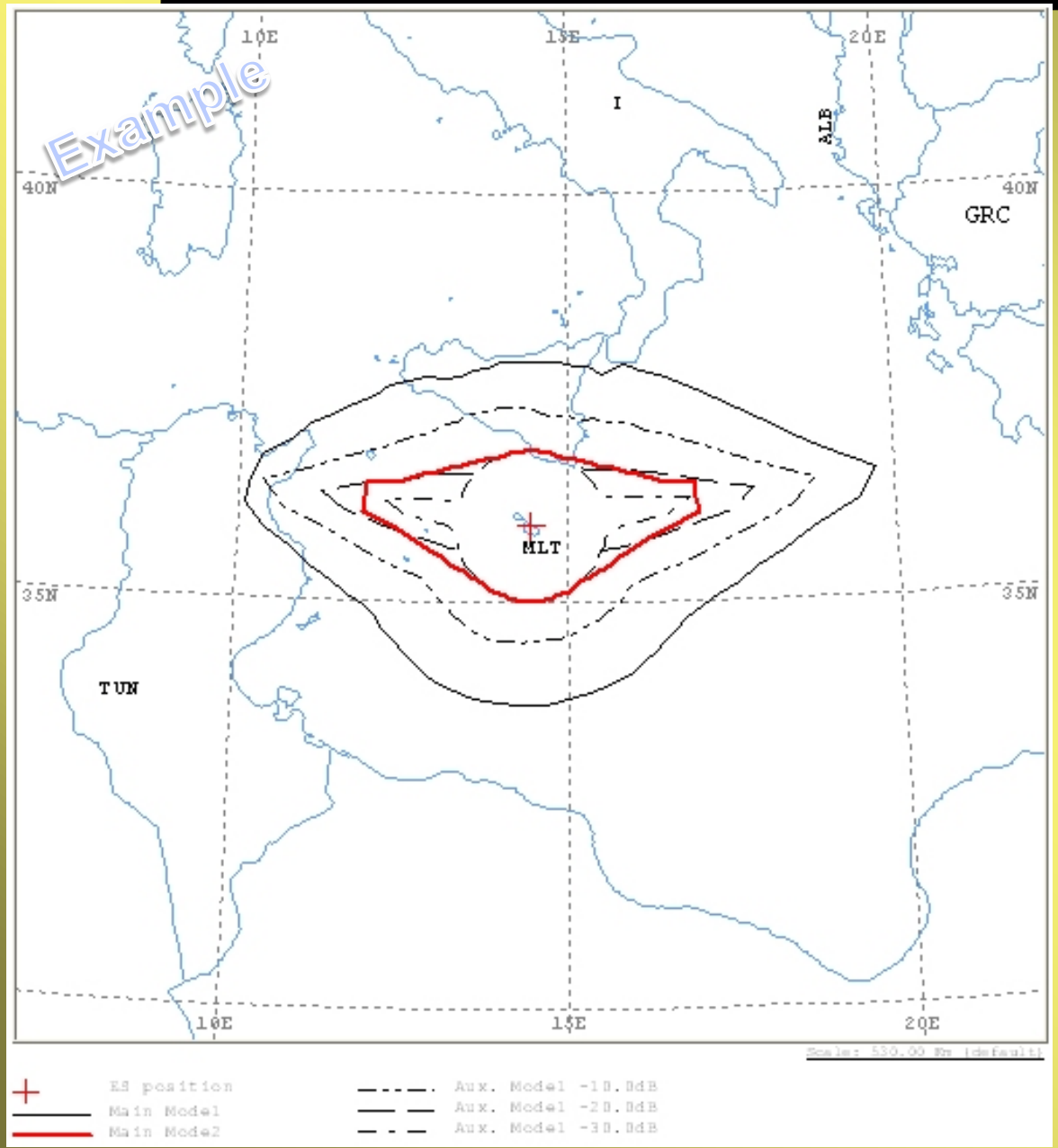
- Min. Coor. Distance (for some Azimuths)
- two 6° sectors => worst-case distance

No auxiliary contours (No calculation)



- h_R : rain height
- d_s : horizontal distance
- α_w : Azimuth to possible Rx E/S (by Latitudes, ε_{min})
- d_{emax} : Max calculation distance by h_R

Coordination area of Tx GSO ES (FSS) with respect to Rcv GSO ES (EESS)



Freq: 8025-8350 GHz

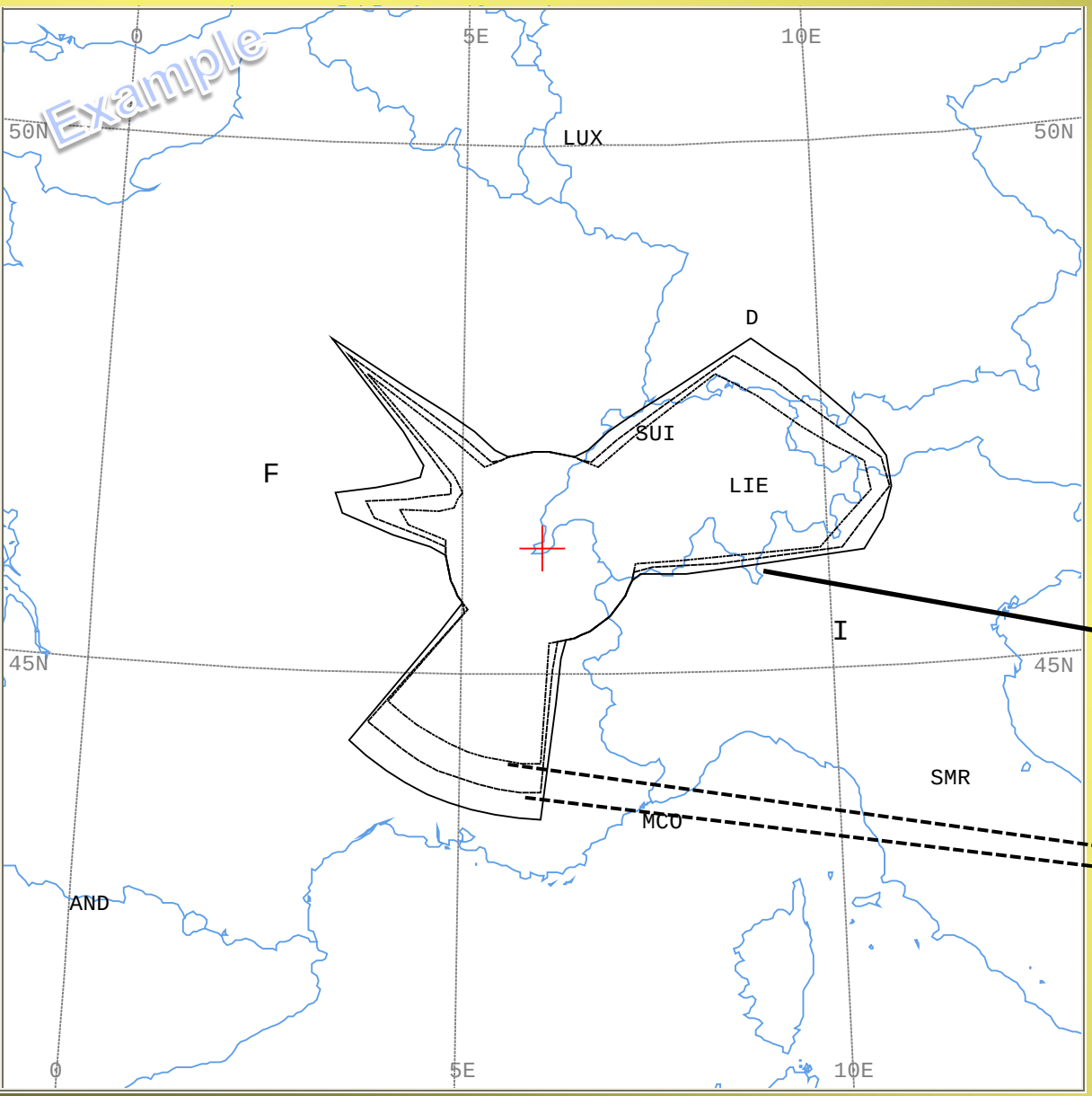
Sat longitude : 1 W

Horizon Ele. Anagle : 0

Affected countries:

I TUN

Coordination area of Tx NGSO ES (FSS) with respect to Rcv GSO ES (EESS)



Earth station (NGSO)

No Mode2 contours

Tracking Antenna reduce the probability of Mode2.

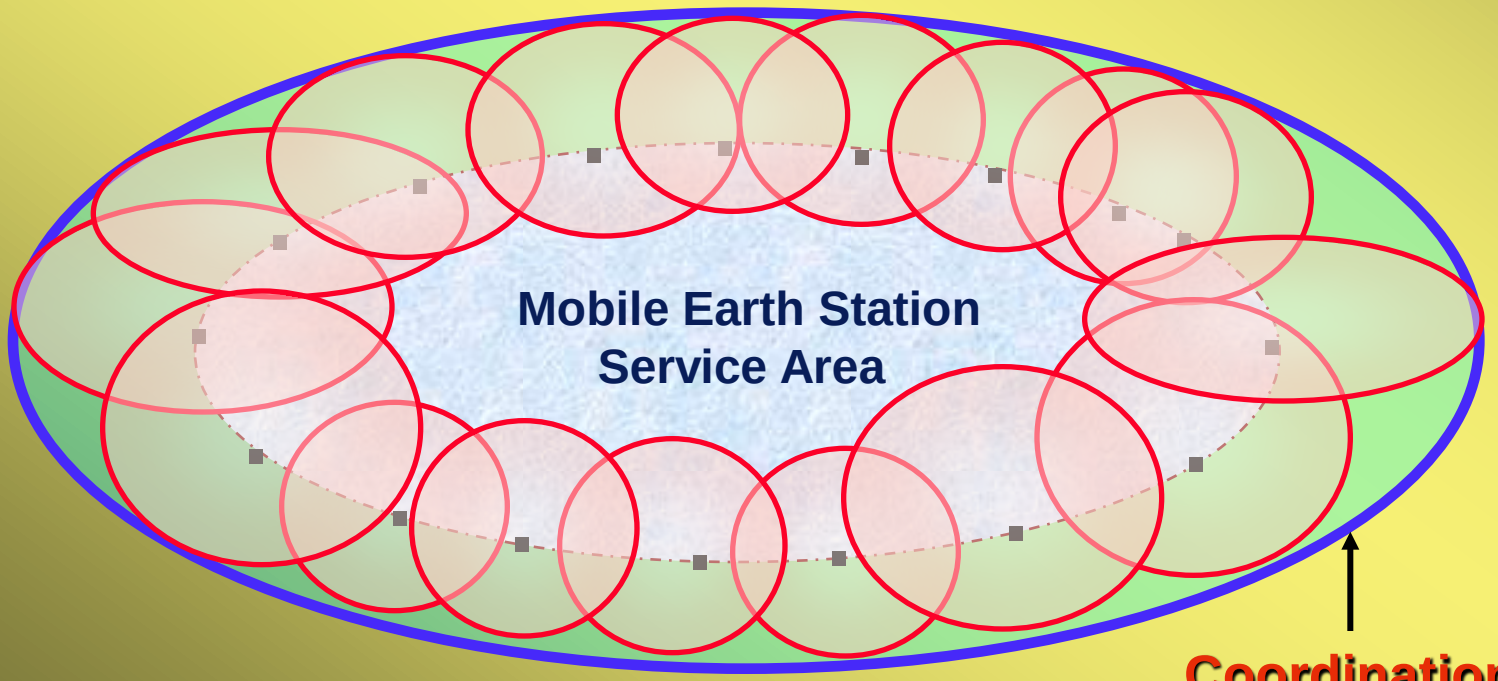
Main Mode 1

Aux. Mode 1

Coordination Area of Mobile Earth Stations

For a **mobile** earth station,
the periphery of the service area is **extended by the coordination distance** (calculated or predetermined).

Calculated



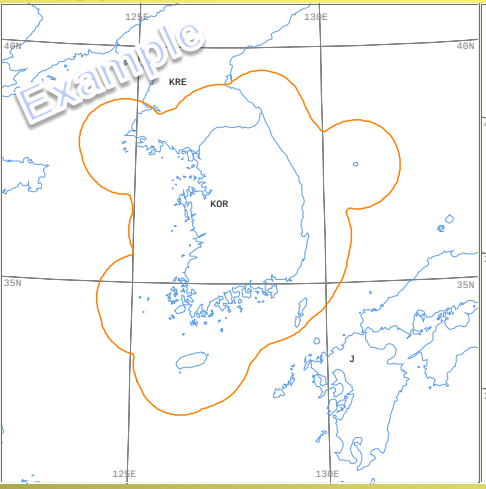
Predetermined Coordination distance

(Table 10 of Appendix 7)

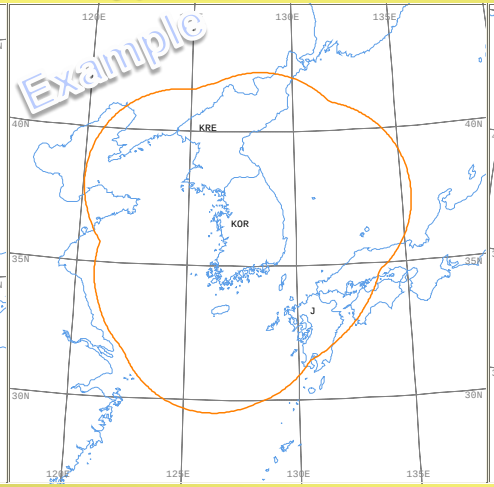
Predetermined → AP7 Table 10

(Example Adm: **KOR**)

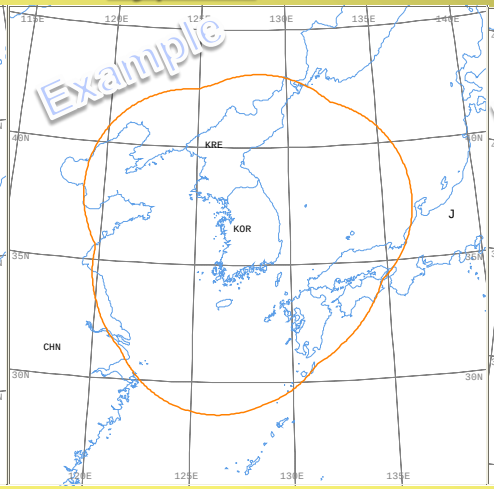
Typical, 100Km



Typical, 400Km



Typical, 500Km

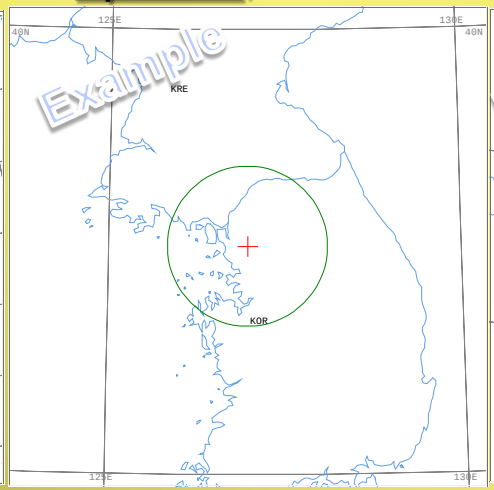


Typical, 580Km

Typical, 1000Km

Typical, 1080Km

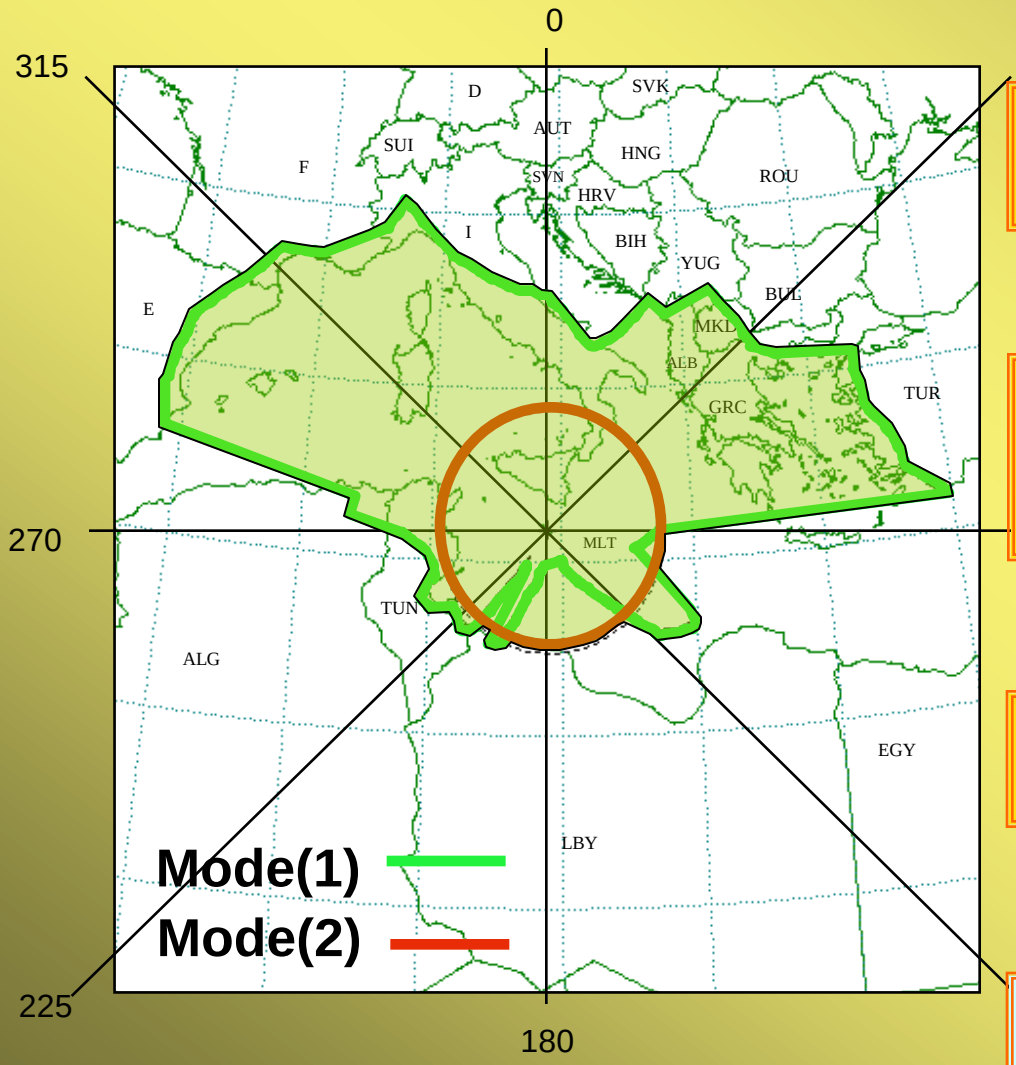
Specific, 100Km



Specific, 580Km

APPENDIX 7

Definition of the Coordination Area



Coordination contours with the greatest coordination distance

However

It represents a regulatory concept based on Worst Cases & Conservative Assumptions.

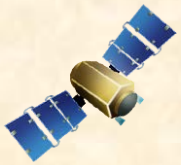
i.e.

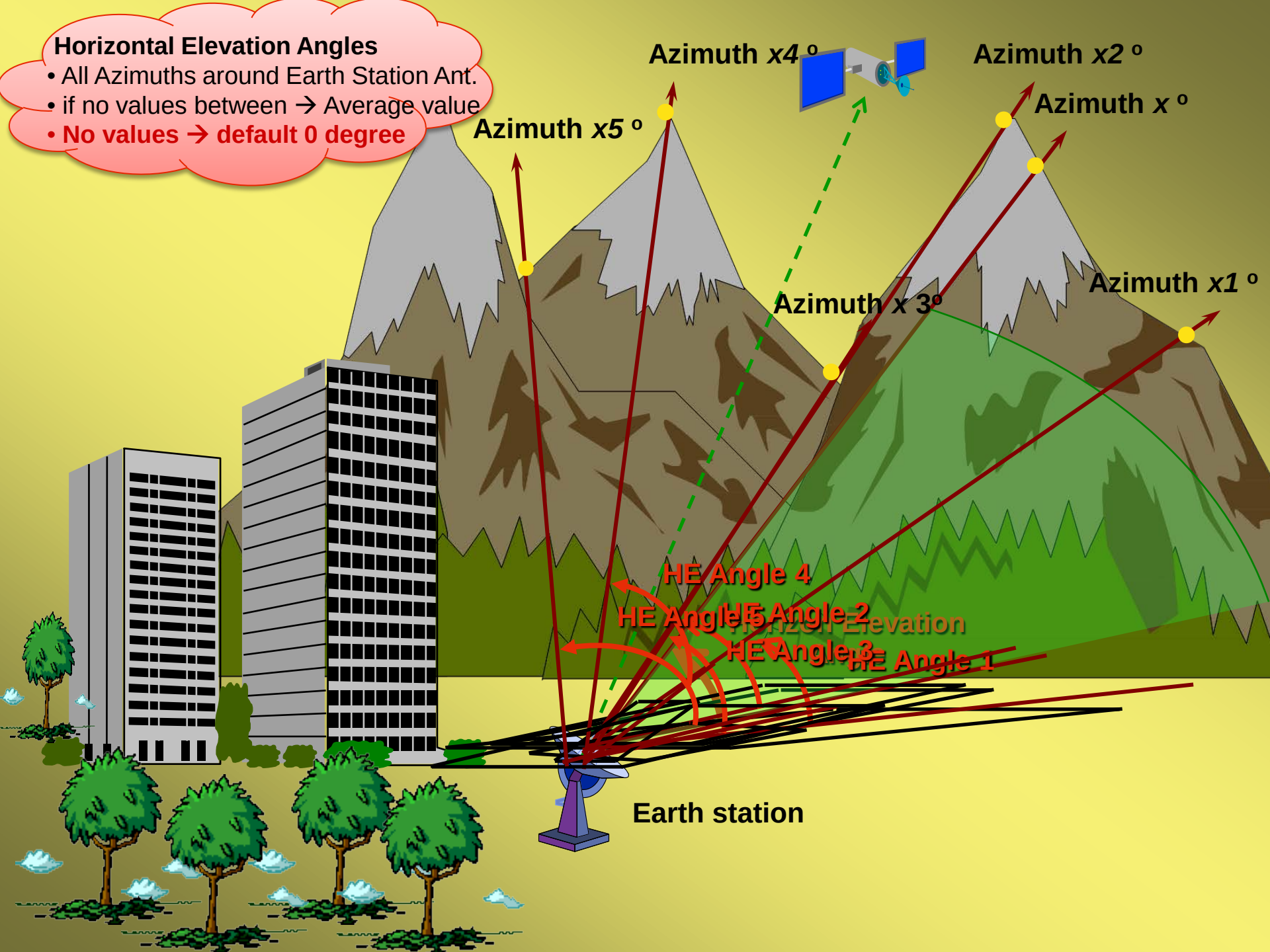
It's not a exclusion zone.

means

More detailed calculations and discussions need to be performed.

Coordination data (Appendix 4)

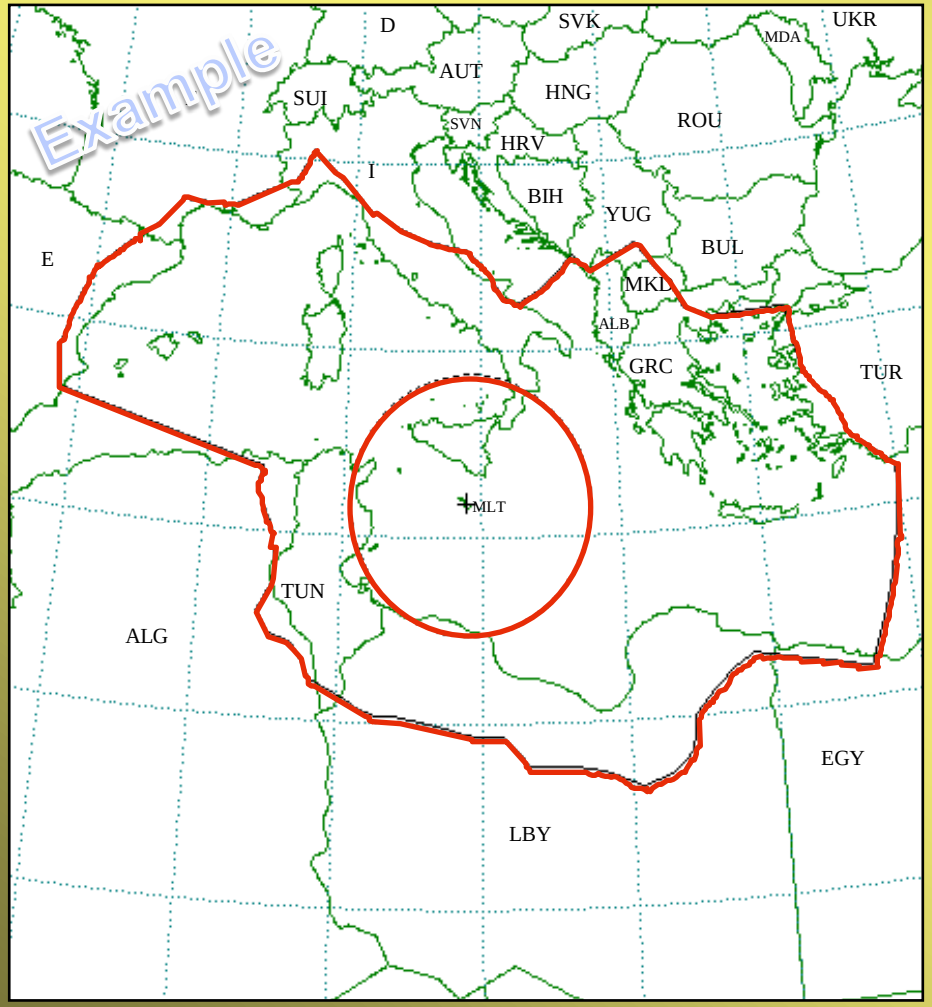
Annex 2		
	**GEOGRAPHICAL DATA**	(Earth station's) **Location, Altitude**
	**SATELLITE**	**Orbital Location,** **Identification (Geo, Non-Geo)**
	**ANTENNA**	**Maximum gain** **Radiation pattern**
	**SIGNAL CHARACTERISTICS**	**Power** **Maximum Power Density** **Frequencies** **Noise temperature** **Emission Type**
	**Others**	**Horizontal Elevation Angle**


Horizontal Elevation Angles
• All Azimuths around Earth Station Ant.
• if no values between → Average value
• No values → default 0 degree
Azimuth x4 º
Azimuth x2 º
Azimuth x º
Azimuth x5 º
Azimuth x 3º
Azimuth x1 º
HE Angle 4
HE Angle 5
HE Angle 2
HE Angle 3
HE Angle 1
Horizon Elevation
Earth station

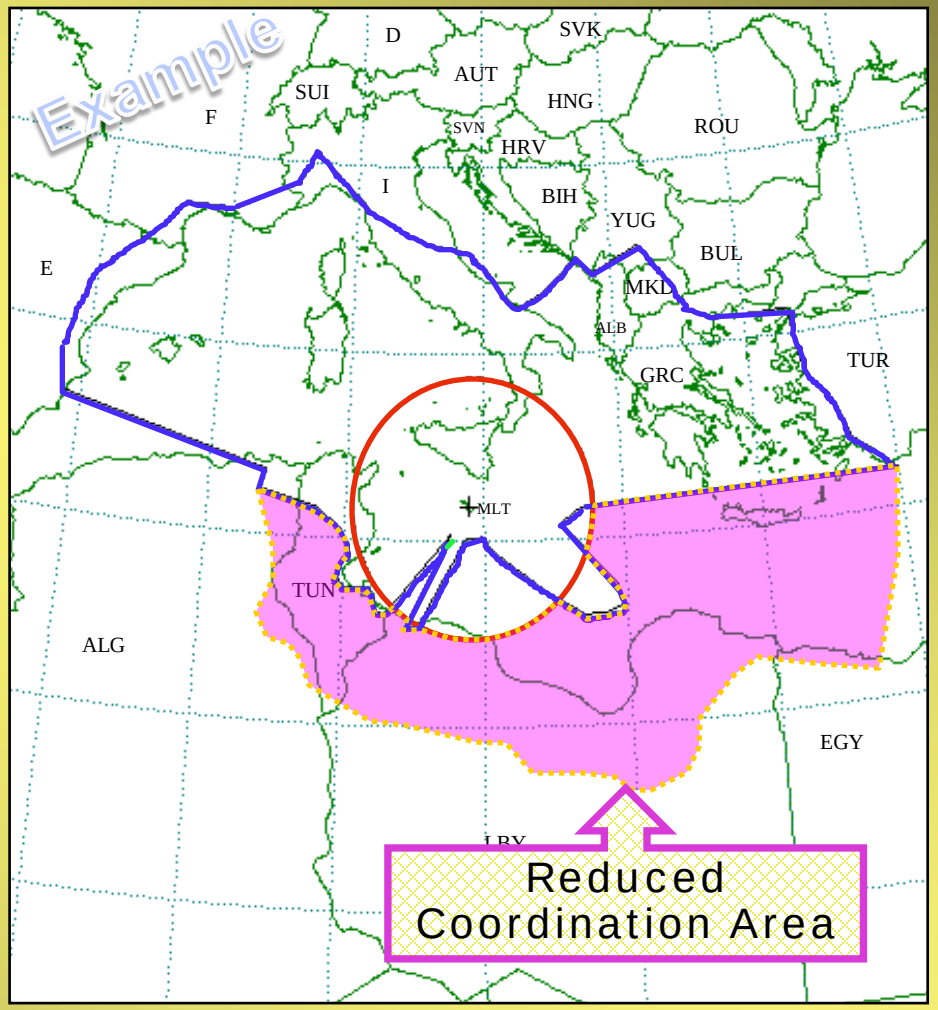
Effect of Horizon Elevation Angle

RECEIVING EARTH STATION COORDINATION AREAS

MAGHTAB MLT/MLT 014E2640 35N5556 4135.0 - 4135.0 MHZ



HORIZON ELEVATION ANGLE : 0°

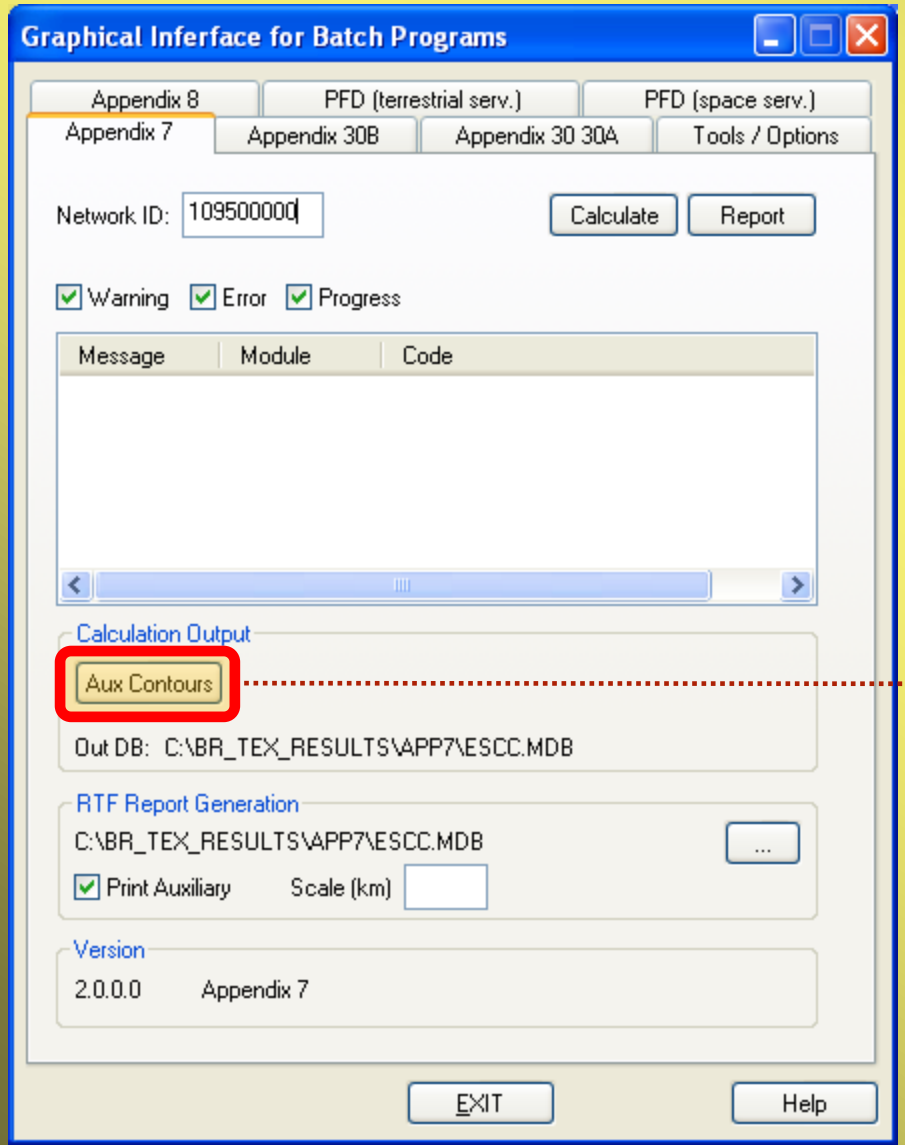


HORIZON ELEVATION ANGLE: Actual Value

Tips for Coordination ?

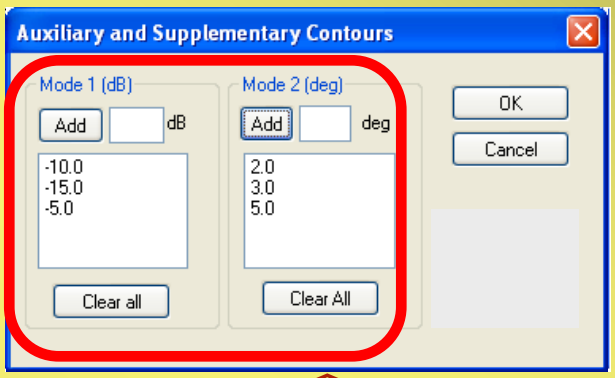
More practical consideration on the Coordination Area

AP7 embedded in GIBC



Auxiliary Contour

Extra coordination lines inside main contour

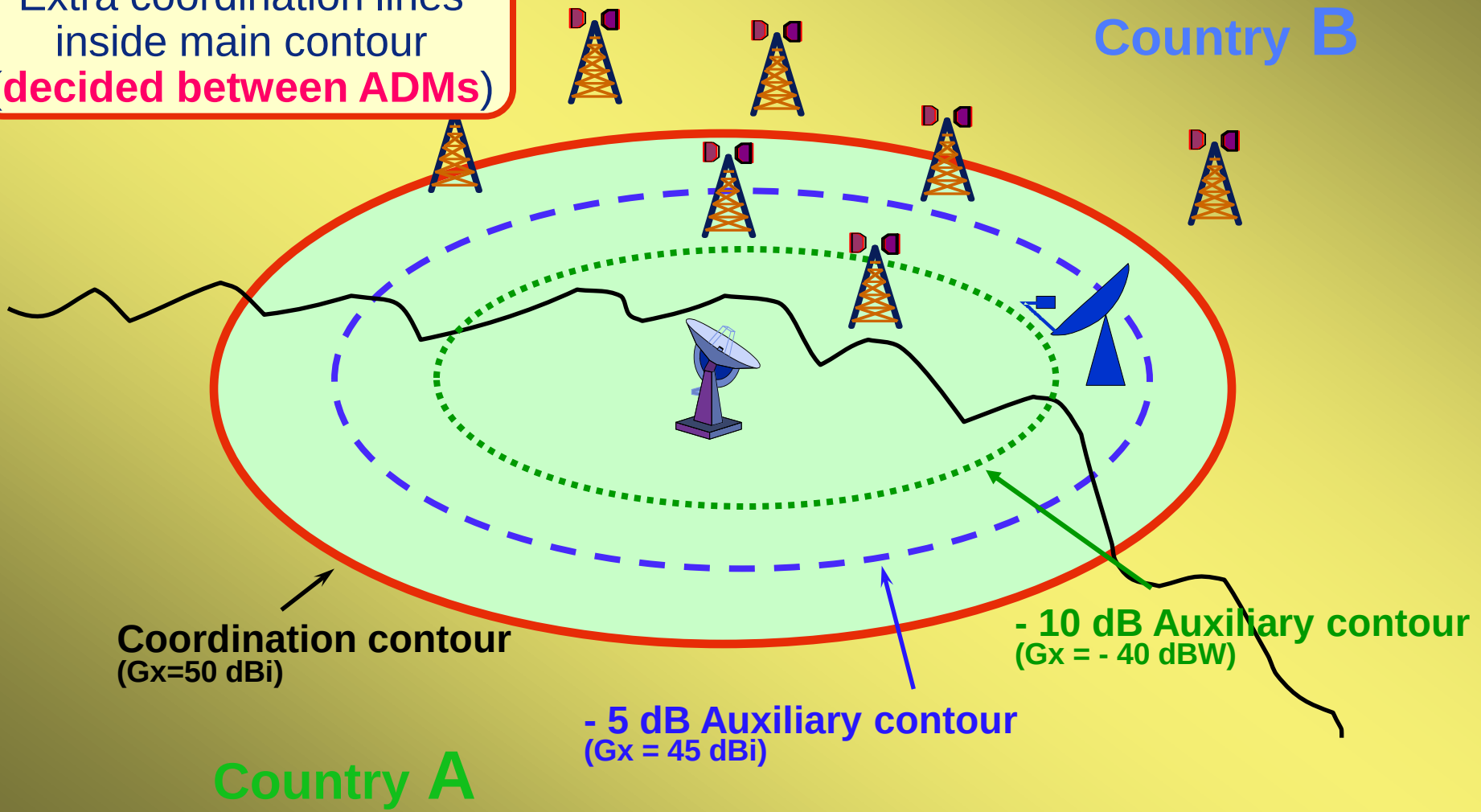


It's all **Complementary information**.

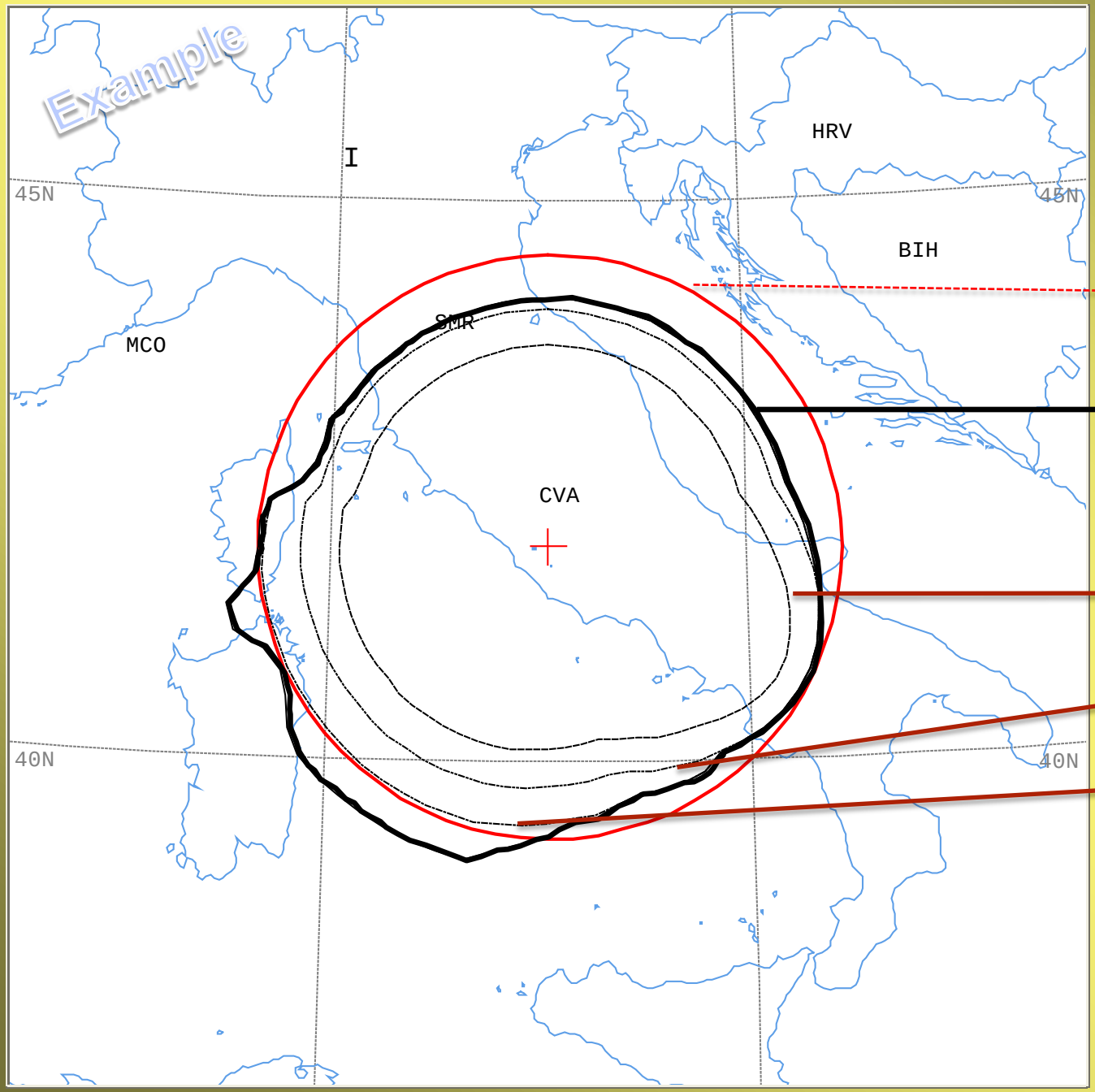
Auxiliary Contour - Mode 1 (& 2)

Appendix 7 - Annex 6

Extra coordination lines inside main contour (**decided between ADMs**)



Auxiliary Contour - Mode 1



Auxiliary Contour
(ex. -5,-10,-15 dB)

MODE 2

Mode 1

Auxiliary Mode1

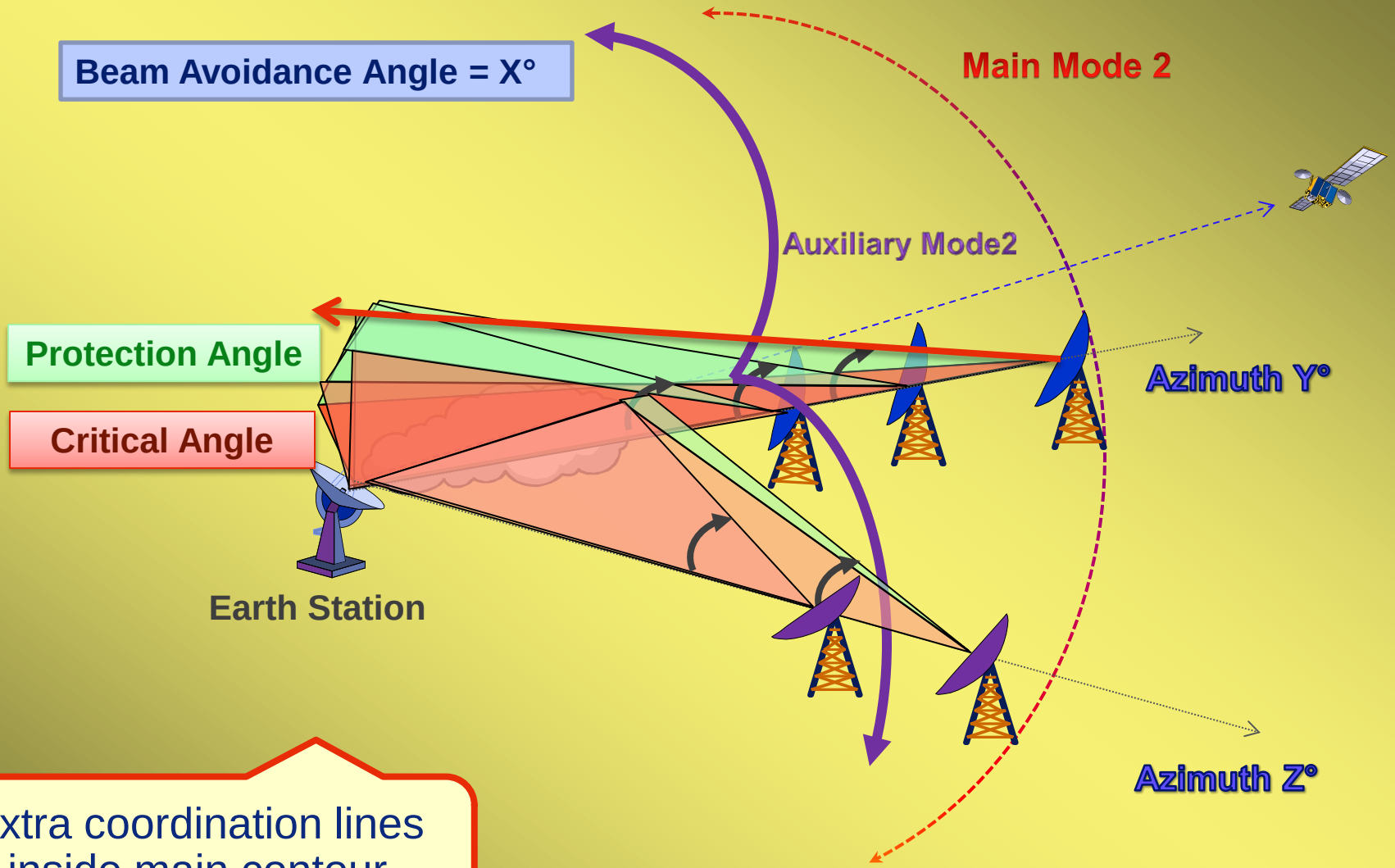
- 15.0 dB

- 10.0 dB

- 5.0 dB

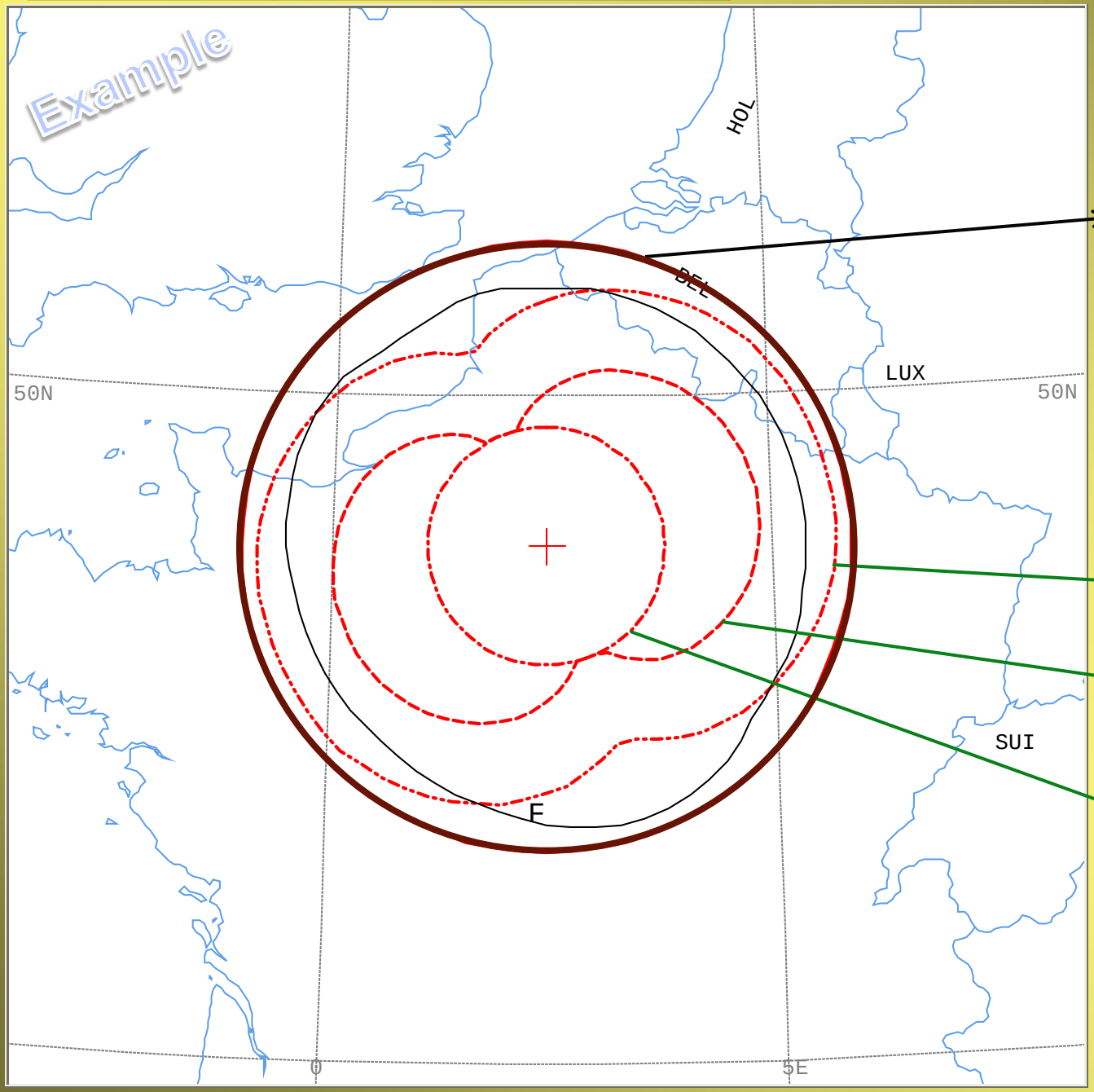
Auxiliary Contour - Mode 2

Appendix 7 - Annex 6 (from WRC-2000)



Extra coordination lines inside main contour (**decided between ADMs**)

Auxiliary Contour - Mode 2



Main Mode2

Auxiliary Mode2

Avoidance angle 2.0 °

Avoidance angle 3.0 °

Avoidance angle 5.0 °

Response by Administration B

(to Coordination Request from A)

Administration A

Administration B

ITU

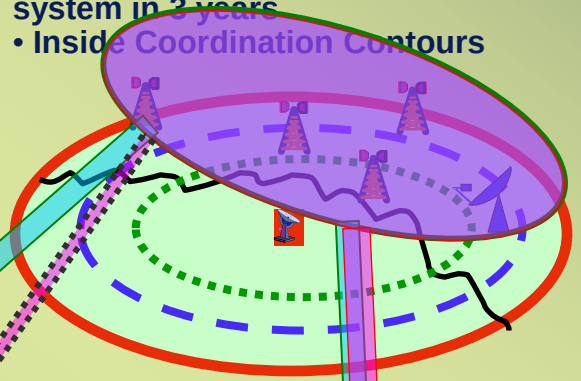
Coordination Request
- **AP4 Annex2 Data**
- **AP7 Contours**

Acknowledge of receipt

Request additional Info.
(if it is necessary)

4 Months

Technical Examination
- **Collect existing and planned system in 3 years**
- **Inside Coordination Contours**



Agreement (Art. 9.52B)
- Inclusion of B's systems into use in **3 years**

Notification for Adm B's system
- TS+ES(ODT) in **3 years** Bringing into use

Disagreement (Art 9.52)
- Adm B's assignment
- Suggestion for resolution

Notification for Adm B's system
- Bringing into use – TS in **3 Months**
  ES(ODT) in **3 years**

Result of WRC-12

No major change in AP7

- Some frequencies/services were deleted/added in Table 7 – 9.
- It’s consequential arrangement with regards to Art 5 & footnotes.

3 Things to Do
on **Coordination of Earth Stations**

1. Define Affected ADM (AP7)

2. Send Data (AP4 & AP7)

3. Do Coordination (with cooperation)

Question ?

Answer !

if