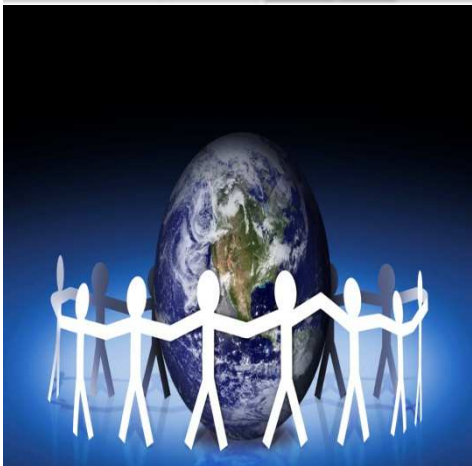




COORDINATION OF EARTH STATIONS

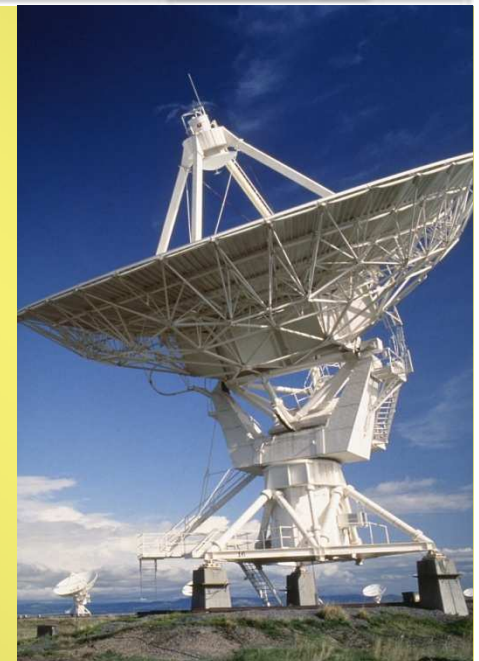
WITH RESPECT TO TERRESTRIAL STATIONS / OTHER EARTH STATIONS



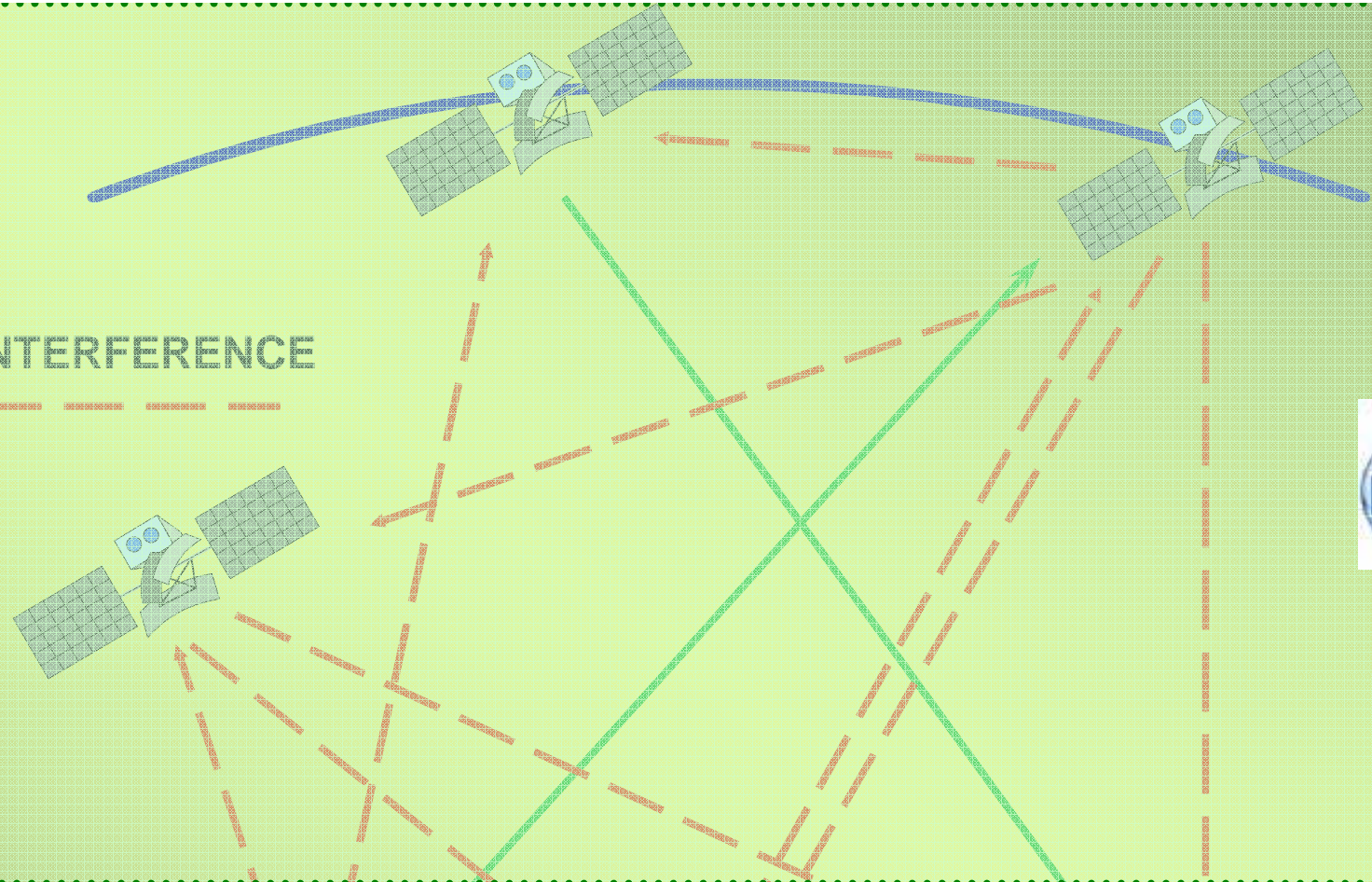
DongSik KIM
(Dong-sik.kim@itu.int)

Space Services Department

World Radiocommunication Seminar 2010 (Geneva, 10 Dec 2010)



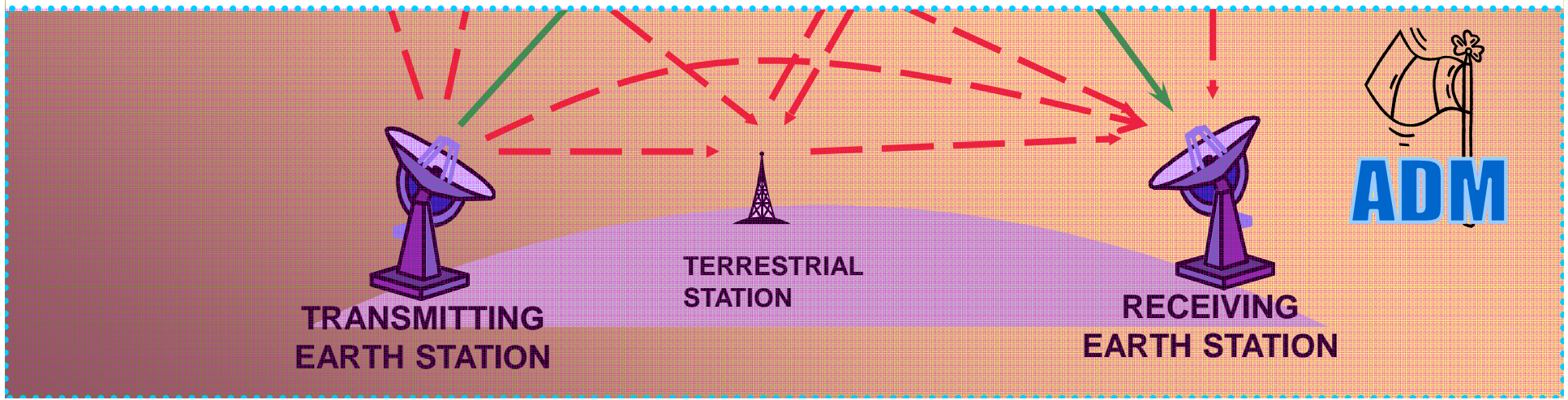
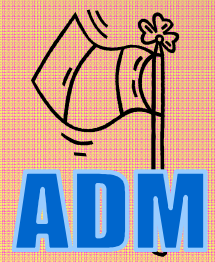
INTERFERENCE



TRANSMITTING
EARTH STATION

TERRESTRIAL
STATION

RECEIVING
EARTH STATION





Volume No.1
Article 5



Article 9



Volume No.2
Appendix 5



Appendix 4



(Vol. 1) Article 11

COORDINATION OF EARTH STATIONS

Region 1

5850 - 5925 MHz

FIXED

FIXED-SATELLITE

(Earth-to-space) ↑

MOBILE

All Regions

6700 - 7075 MHz

FIXED

FIXED-SATELLITE

(Earth-to-space) ↑

(space-to-Earth) ↓

MOBILE



Provisions : 9.6, 9.15, 9.17, 9.17A, 9.21



Coordination area : Appendix 7



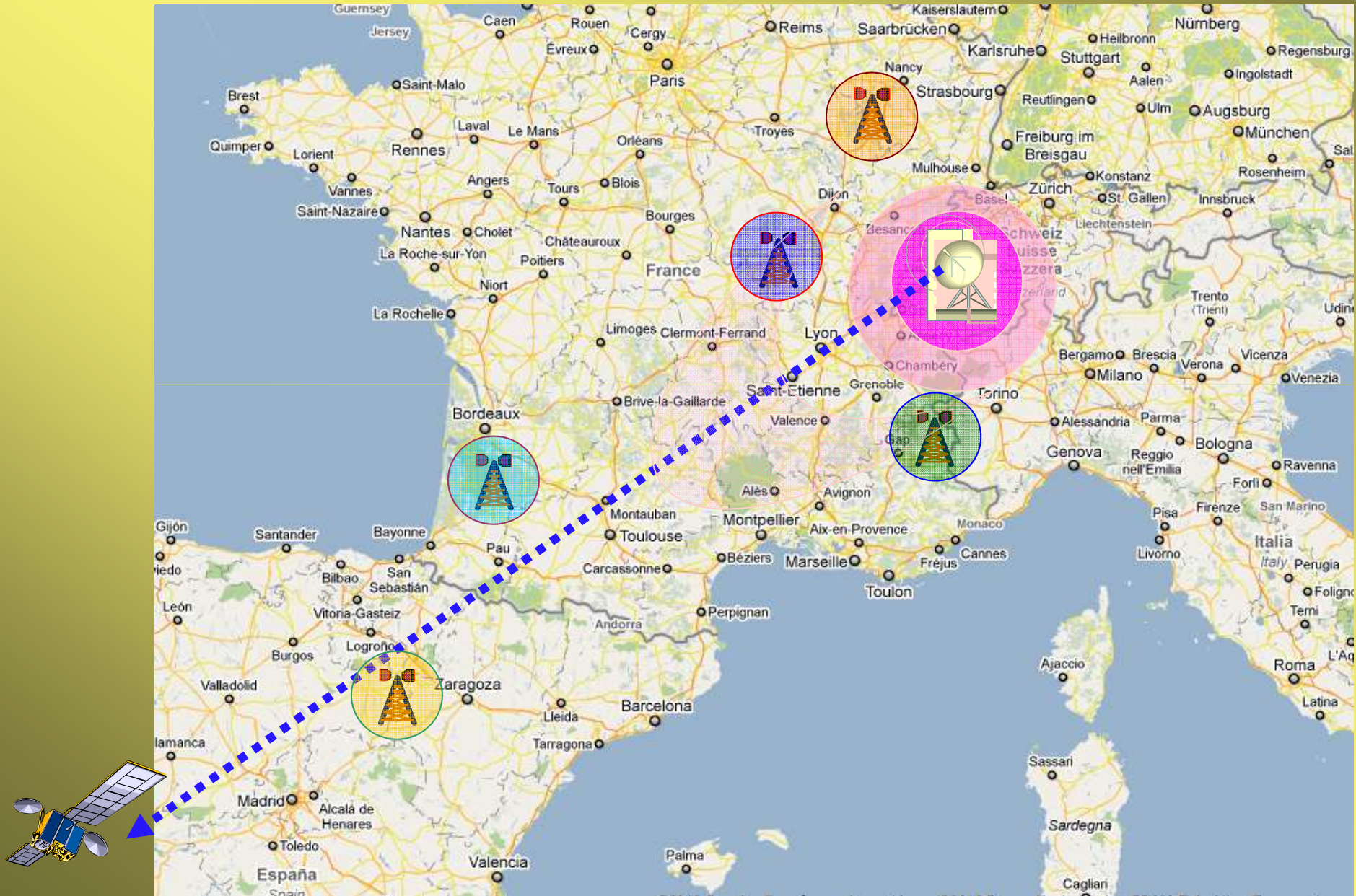
Coordination data to neighboring countries



Notification in Master Register

Who ?

Propagation do not care for Borders.



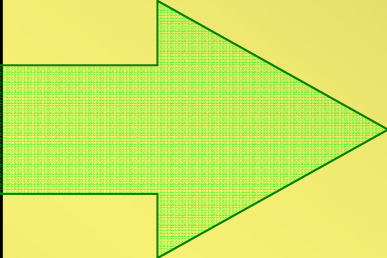
When ?

Volume No.1 → **Article 5**

Region 1

5850 - 5925 MHz

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

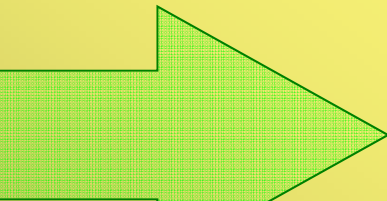


- **equal rights**
to **space** and
terrestrial services

All Regions

6700 - 7075 MHz

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



or

- operating in the
Opposite Direction of
Transmission (**ODT**)

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

PROVISIONS for effecting COORDINATION

Article 9

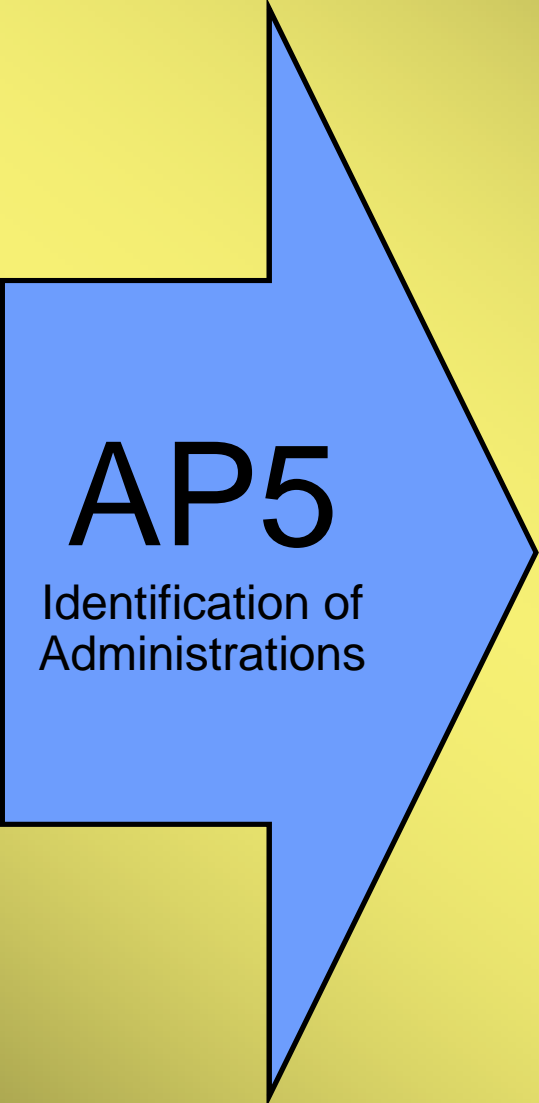


Space Service
under No. 9.21
agreement

(ex: footnote 5.461 – MSS)

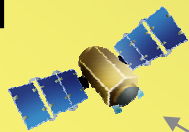
PROVISIONS for effecting COORDINATION

Article 9	9.15
	9.17
	9.17A
	9.21



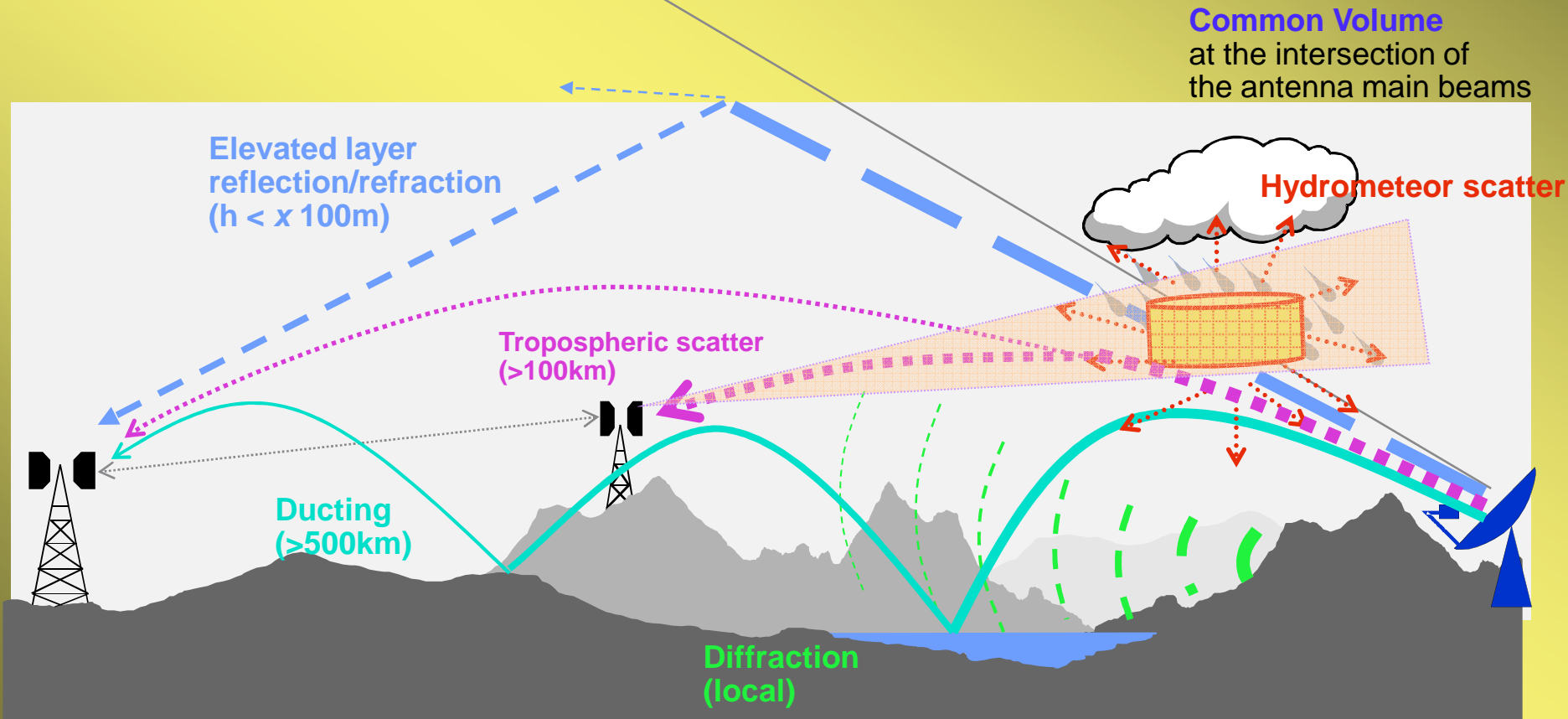
AP7
Determination of Coordination Area

Why ?



AP7 →

Anomalous (short-term) Interference Propagation mechanisms



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

+

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



Coordination Distance

How ?

Azimuth x°

Coordination Distance

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

$$L(\%) = P_t + G_e + G_x - P_r(\%)$$

ex: $G_x = 52$ dBi, $P_r(0.0025\%) = -98$ dBW/Hz for 12-14GHz

AP7 Table 7

$$L(\%) = P_t + G_x - P_r(\%)$$

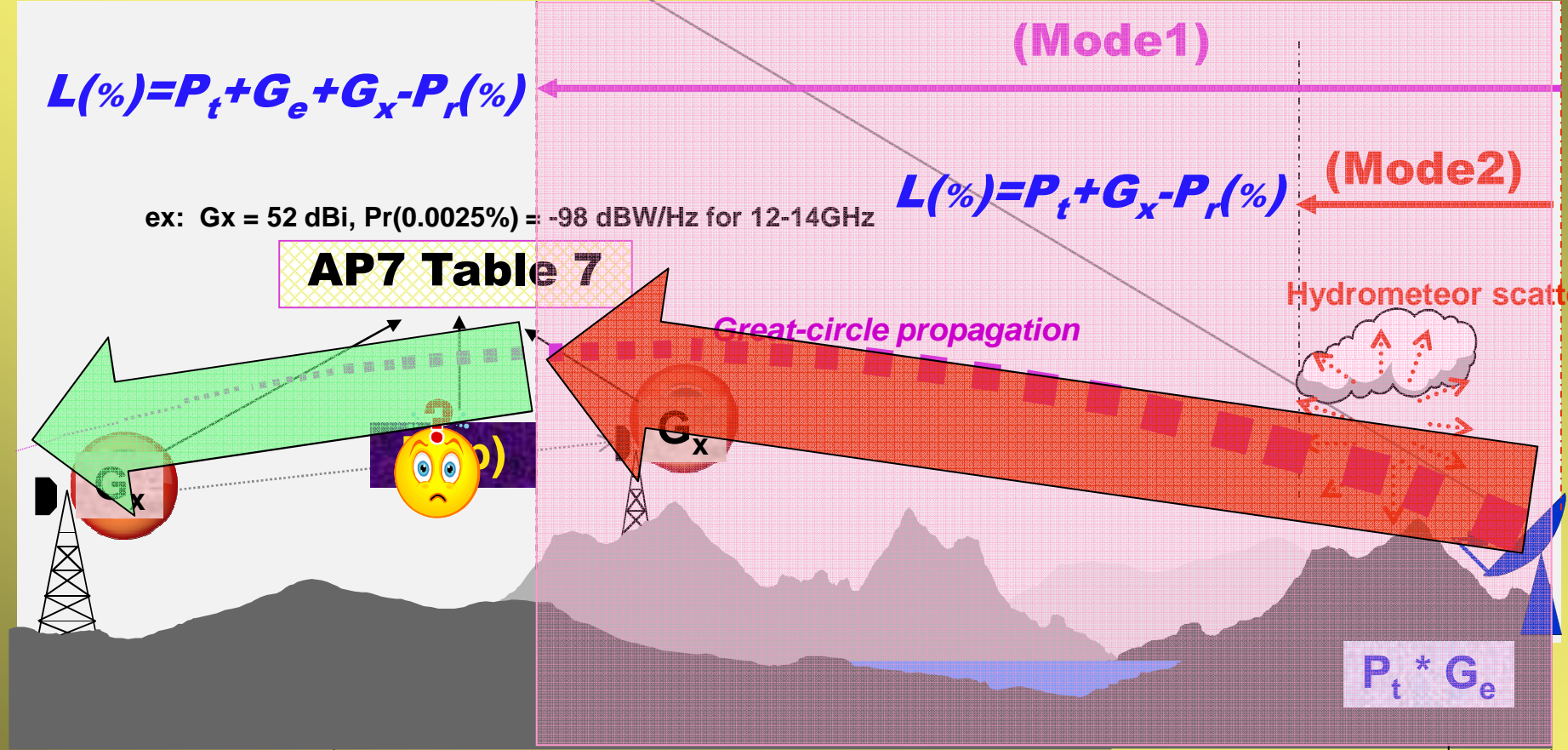
Hydrometeor scatter

Great-circle propagation

$P_t * G_e$

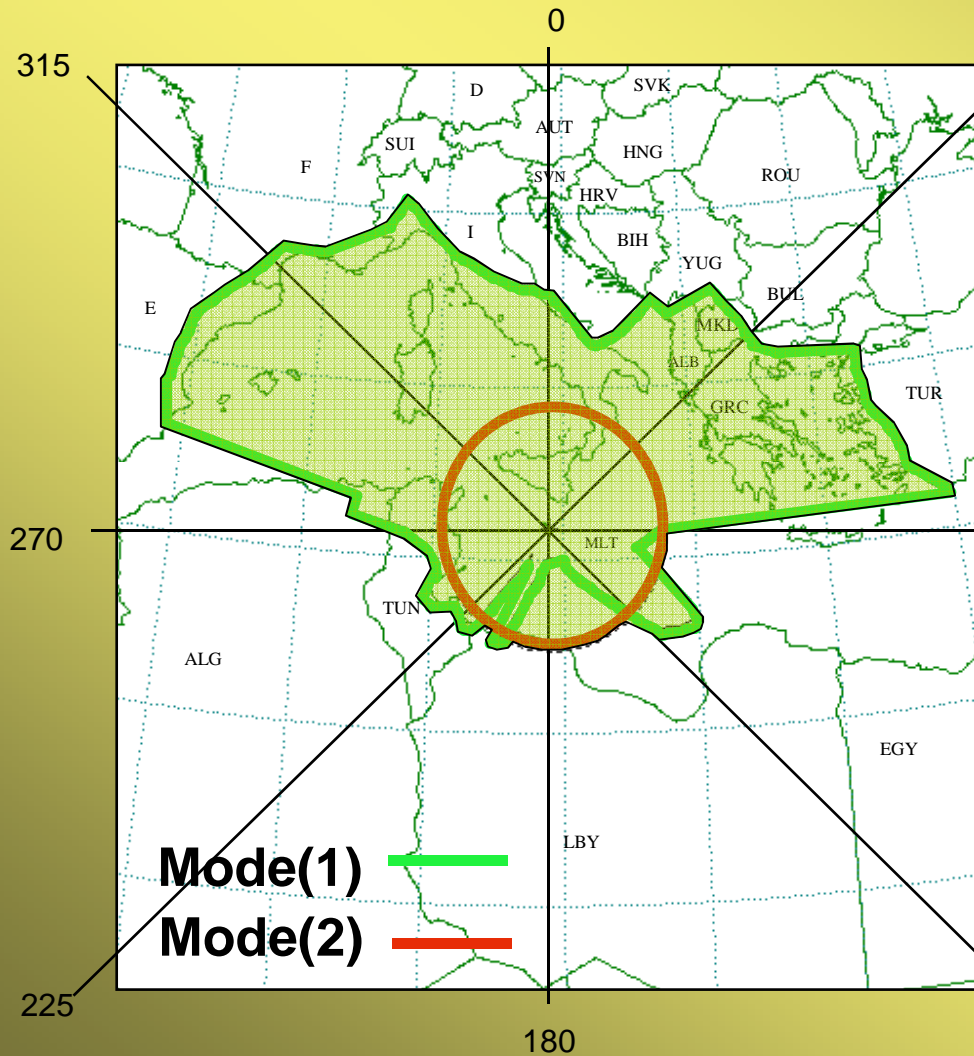
(10 to 123 Km/f) Minimum Coordination Distance

Maximum Calculation Distance (369/ Mode2 up to 1200 Km/ Mode1*Zone C)



APPENDIX 7

Methods for the Determination of the Coordination Area



Coordination contours with the greatest coordination distance

However

It represents a **regulatory concept** based on **unfavorable assumptions.**

i.e.

It's **not** a **exclusion zone.**


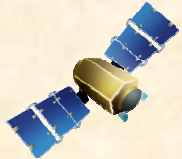
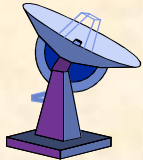

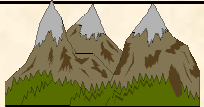
means

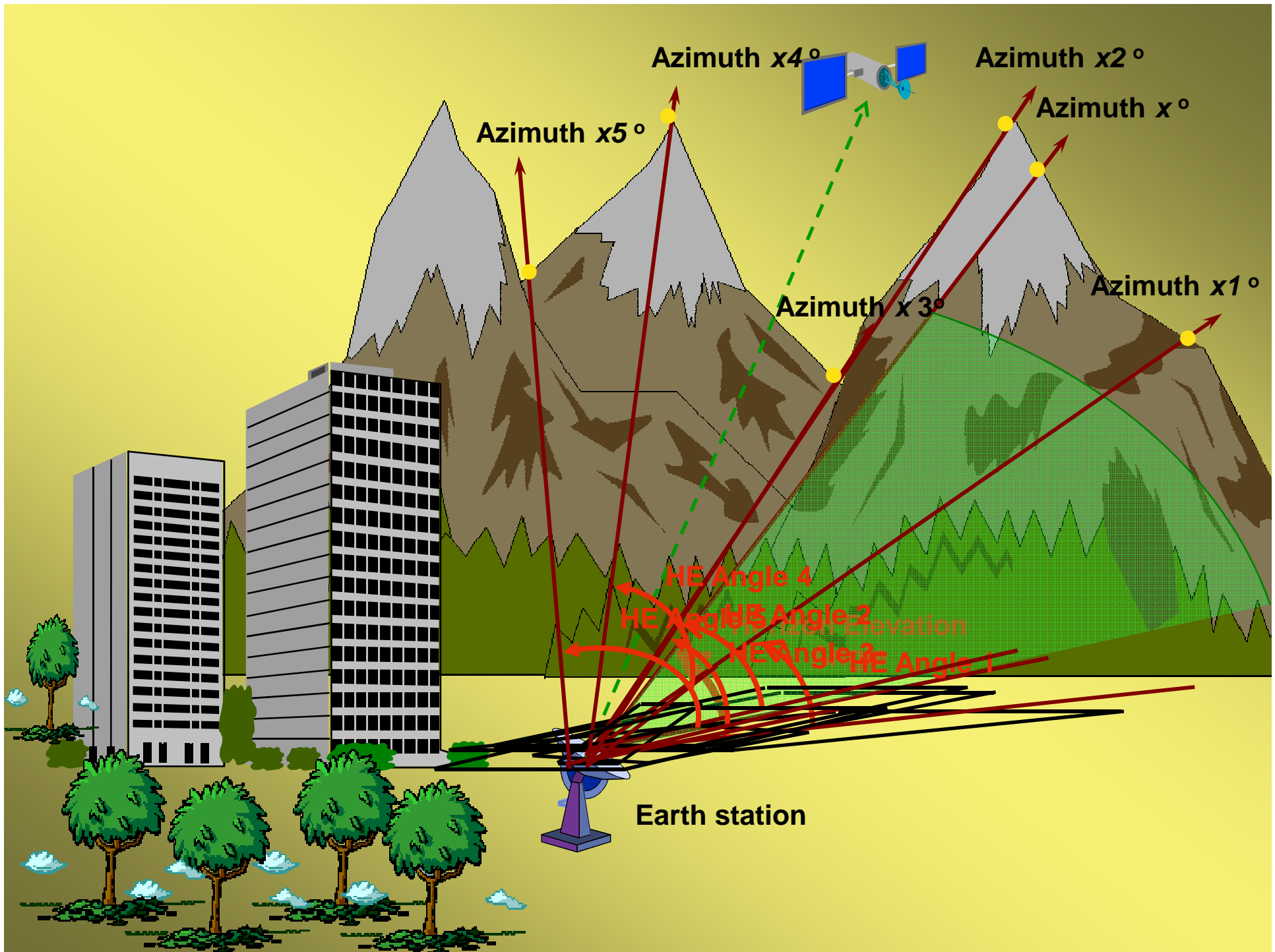
More detailed calculations and discussions need to be performed.

What ?

Coordination data

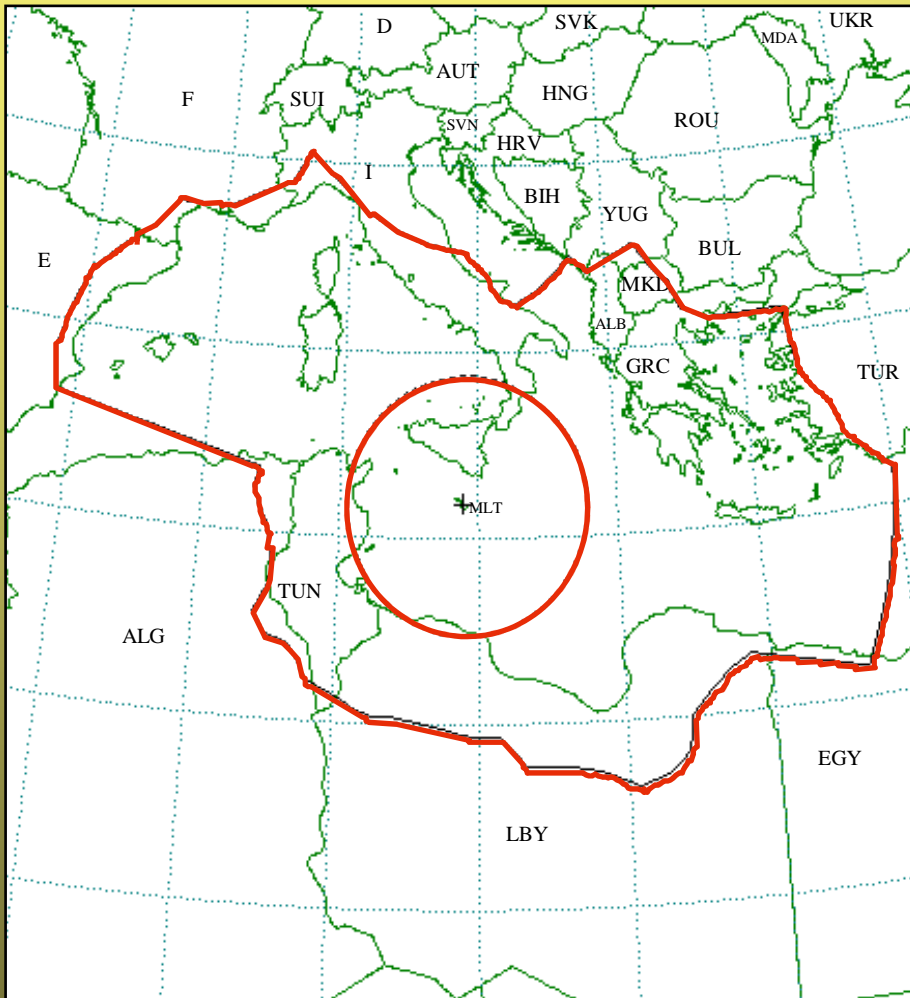
Appendix 4, Annex 2

	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

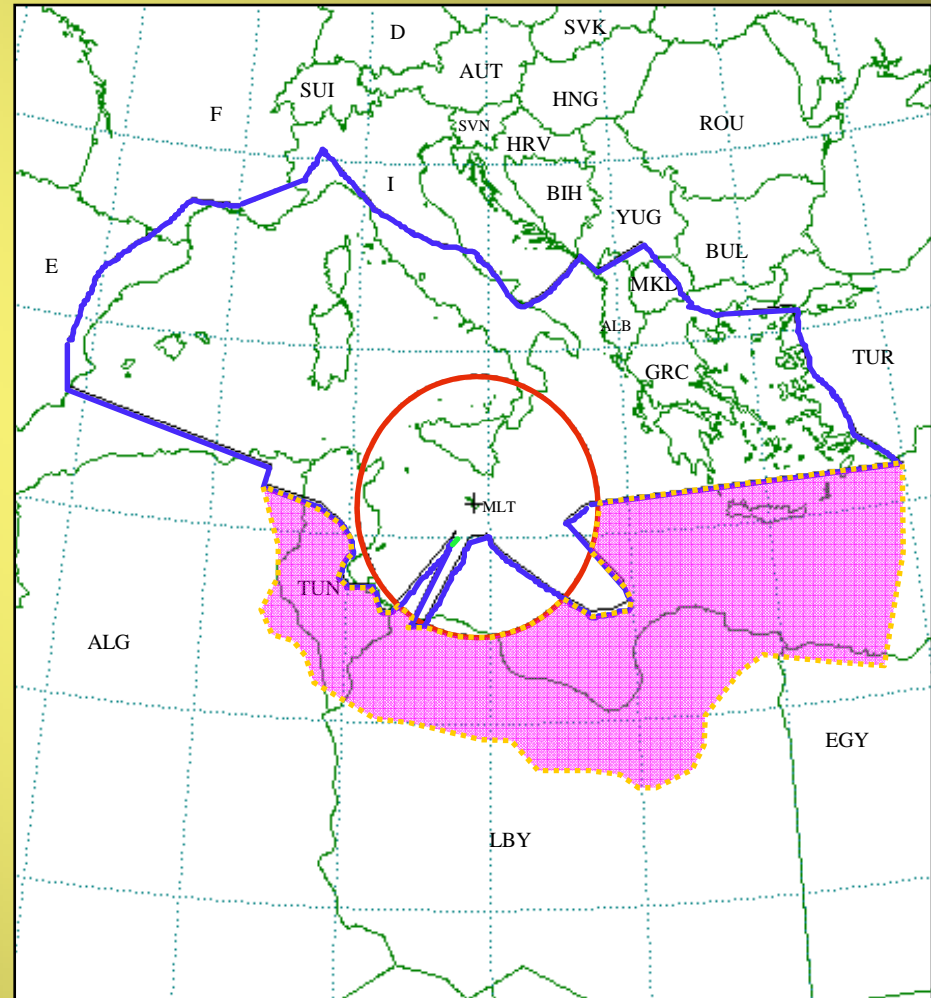


Effect of Horizon Elevation Angle

RECEIVING EARTH STATION COORDINATION AREAS
MAGHTAB MLT/MLT 014E2640 35N5556 4135.0 - 4135.0 MHZ



HORIZON ELEVATION ANGLE : 0°



HORIZON ELEVATION ANGLE: Actual Value

Which S/W?

Computer Program for Determination of Coordination Area

AP7 embedded in GIBC

Gibc - Graphical Interface for Batch ...

Appendix 8 | PFD (terrestrial serv.) | PFD (space serv.)
Appendix 7 | Appendix 30B | Tools / Options

Network ID:

Warning Error Progress

Message	Module	Code
---------	--------	------

Calculation Output

Out DB: C:\BR_TEX_RESULTS\APP7\ESCC.MDB

RTF Report Generation

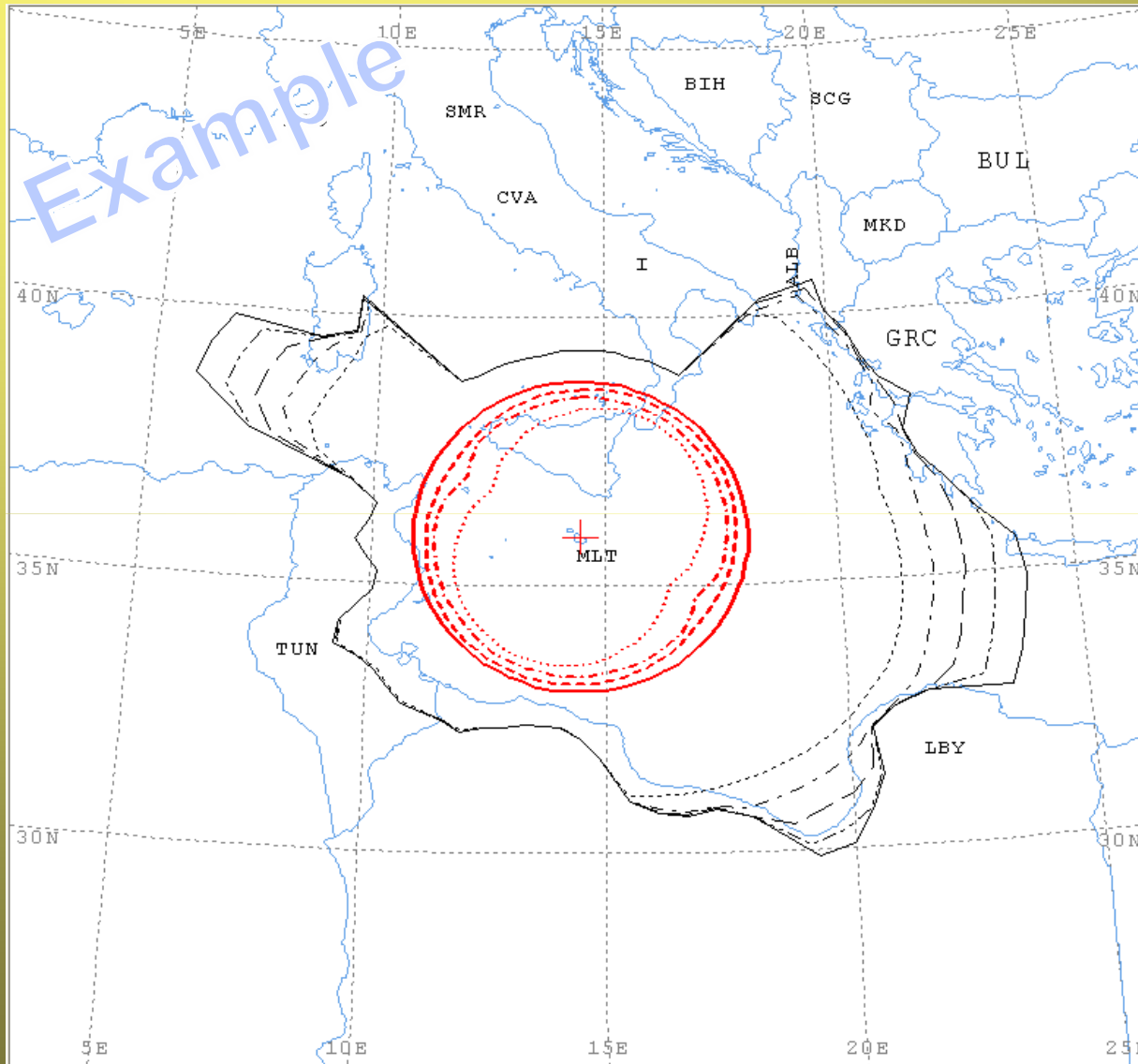
C:\BR_TEX_RESULTS\APP7\ESCC.MDB

Print Auxiliary Scale (km)

Version

1.5.0.7 Appendix 7

Coordination area of **Rcv GSO ES (FSS)** with respect to **Terrestrial Stations (FS or MS)**



	ES position		Aux. Model -5.0db		Aux. Mode2 2.0deg
	Main Model 0.0db		Aux. Model -10.0db		Aux. Mode2 3.0deg
	Main Mode2 0.0deg		Aux. Model -15.0db		Aux. Mode2 4.0deg
			Aux. Model -20.0db		Aux. Mode2 5.0deg

Freq: 3850-4200 GHz

Sat longitude : 1 W

Horizon Ele. Anagle : 0

Affected countries:

**ALB ALG E GRC
I LBY TUN**

**Automatic
indication
in AP7 report**

Which S/W?

Coordination Area with Auxiliary lines

AP7 embedded in GIBC

Gibc - Graphical Interface for Batch ...

Appendix 8 PFD (terrestrial serv.) PFD (space serv.)
Appendix 7 Appendix 30B Tools / Options

Network ID: Calculate Report

Warning Error Progress

Message	Module	Code
---------	--------	------

Calculation Output

Aux Contours

Out DB: C:\BR_TEX_RESULTS\APP7\ESCC.MDB

RTF Report Generation
C:\BR_TEX_RESULTS\APP7\ESCC.MDB

Print Auxiliary Scale (km)

Version
1.5.0.7 Appendix 7

EXIT Help

Auxiliary Contour

Extra coordination lines
inside main contour

Auxiliary Contours

Mode 1 (dB) Mode 2 (Deg)

Add dB Add Deg

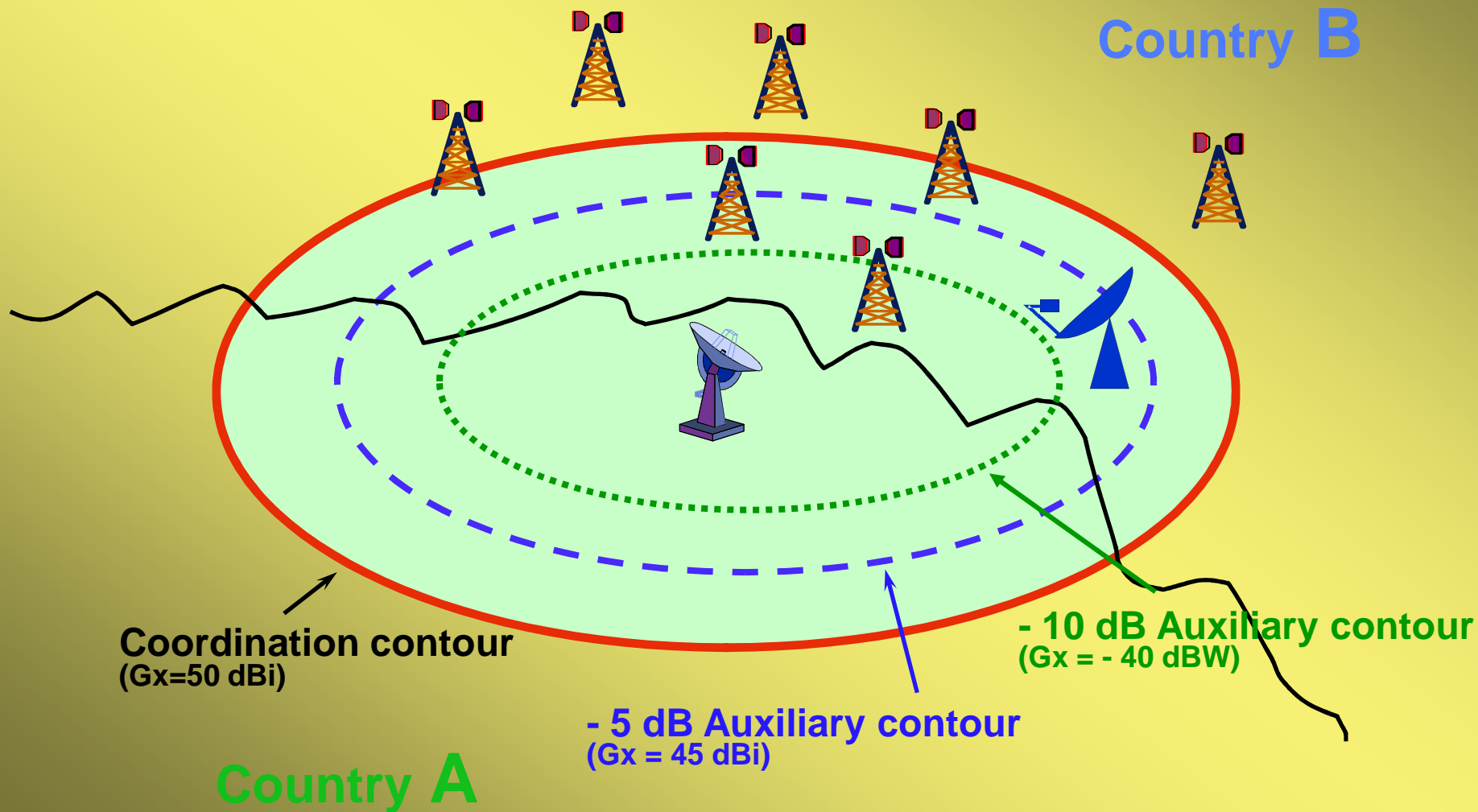
Clear All Clear All

OK Cancel

It's all
Complementary
information.

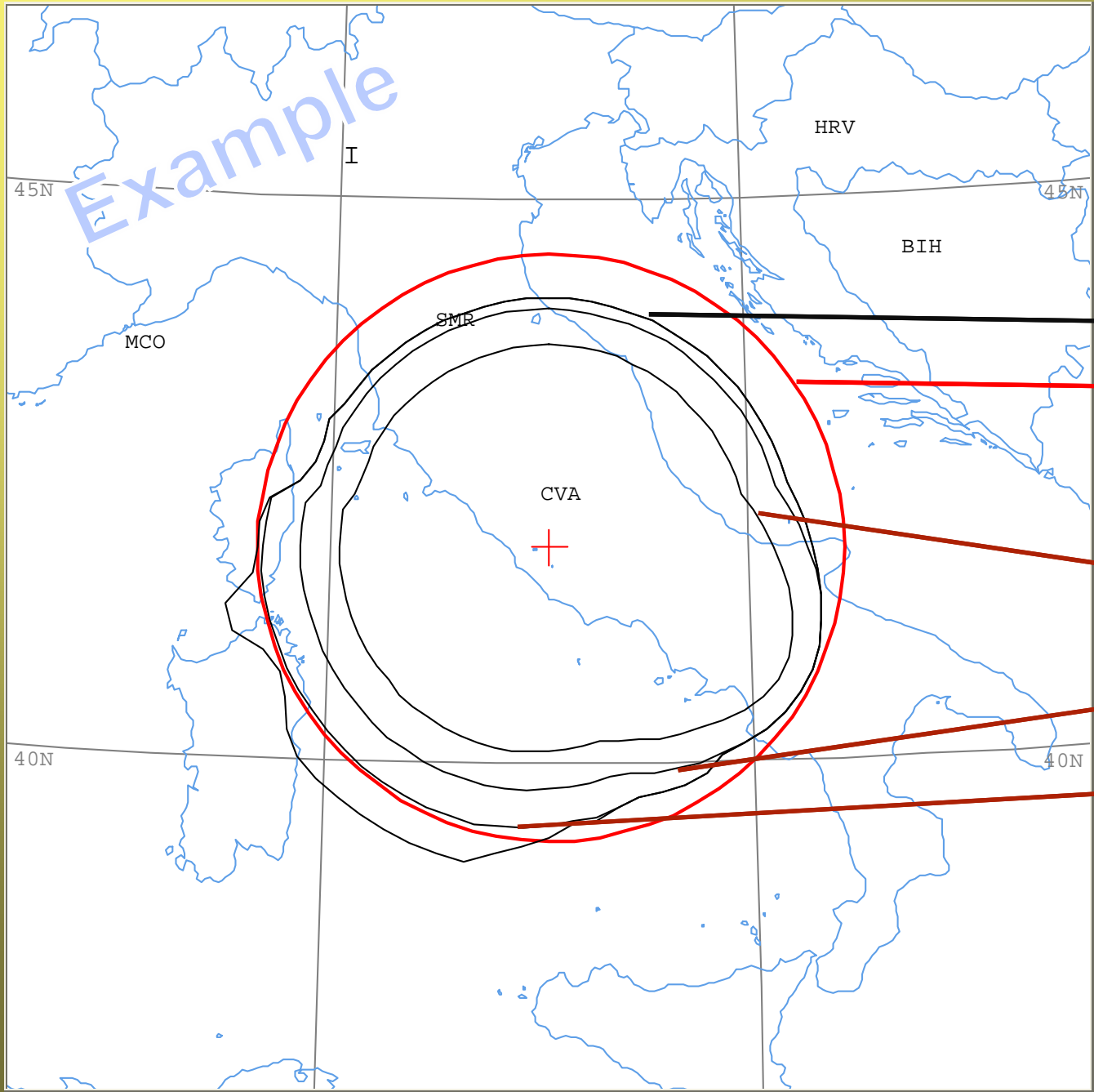
Auxiliary Contour - Mode 1 (& 2)

Appendix 7 - Annex 6



Auxiliary Contour - Mode 1

Example



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

→ **MODE 1**

→ **MODE 2**

Auxiliary Mode1

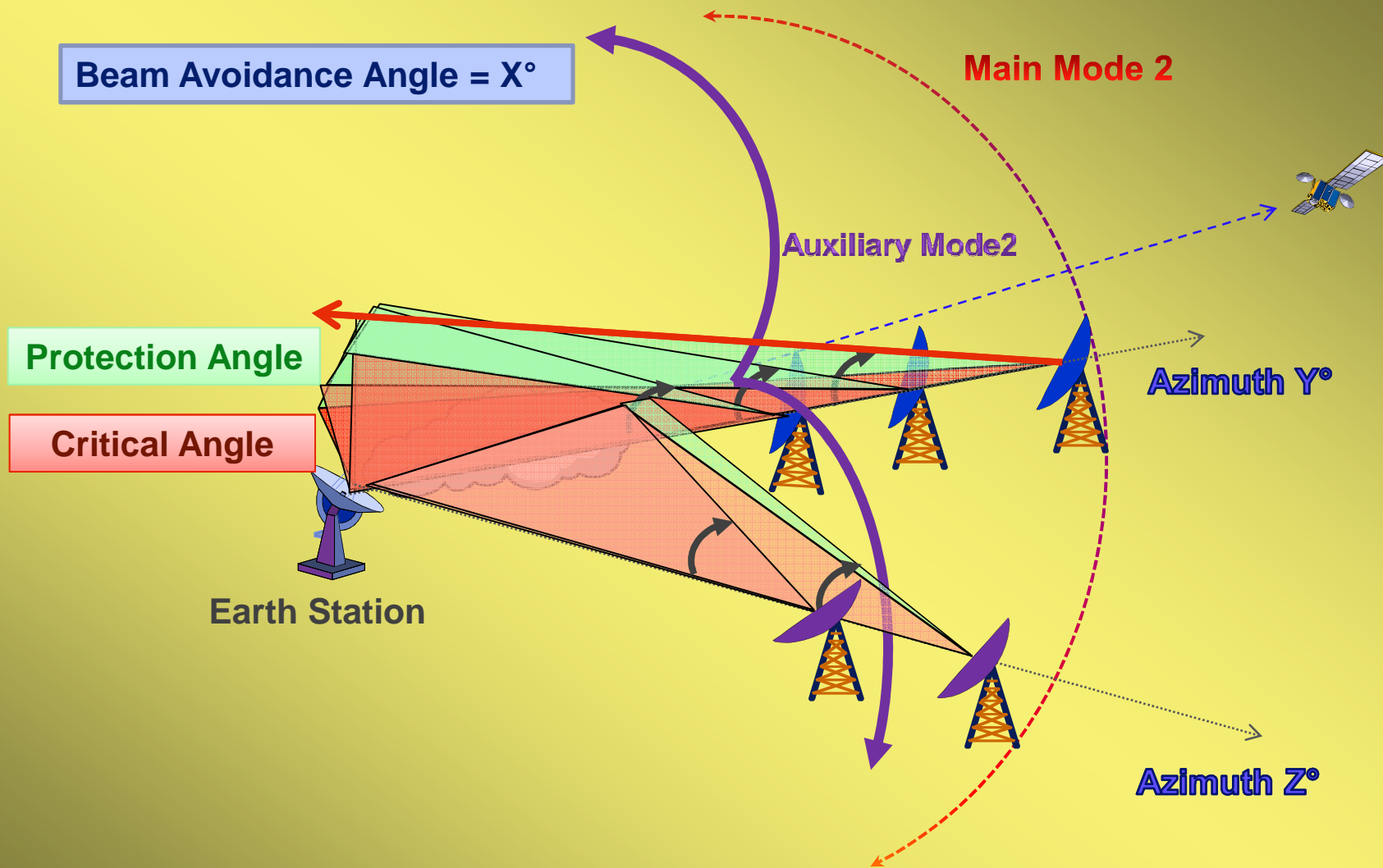
→ **- 15.0 dB**

→ **- 10.0 dB**

→ **- 5.0 dB**

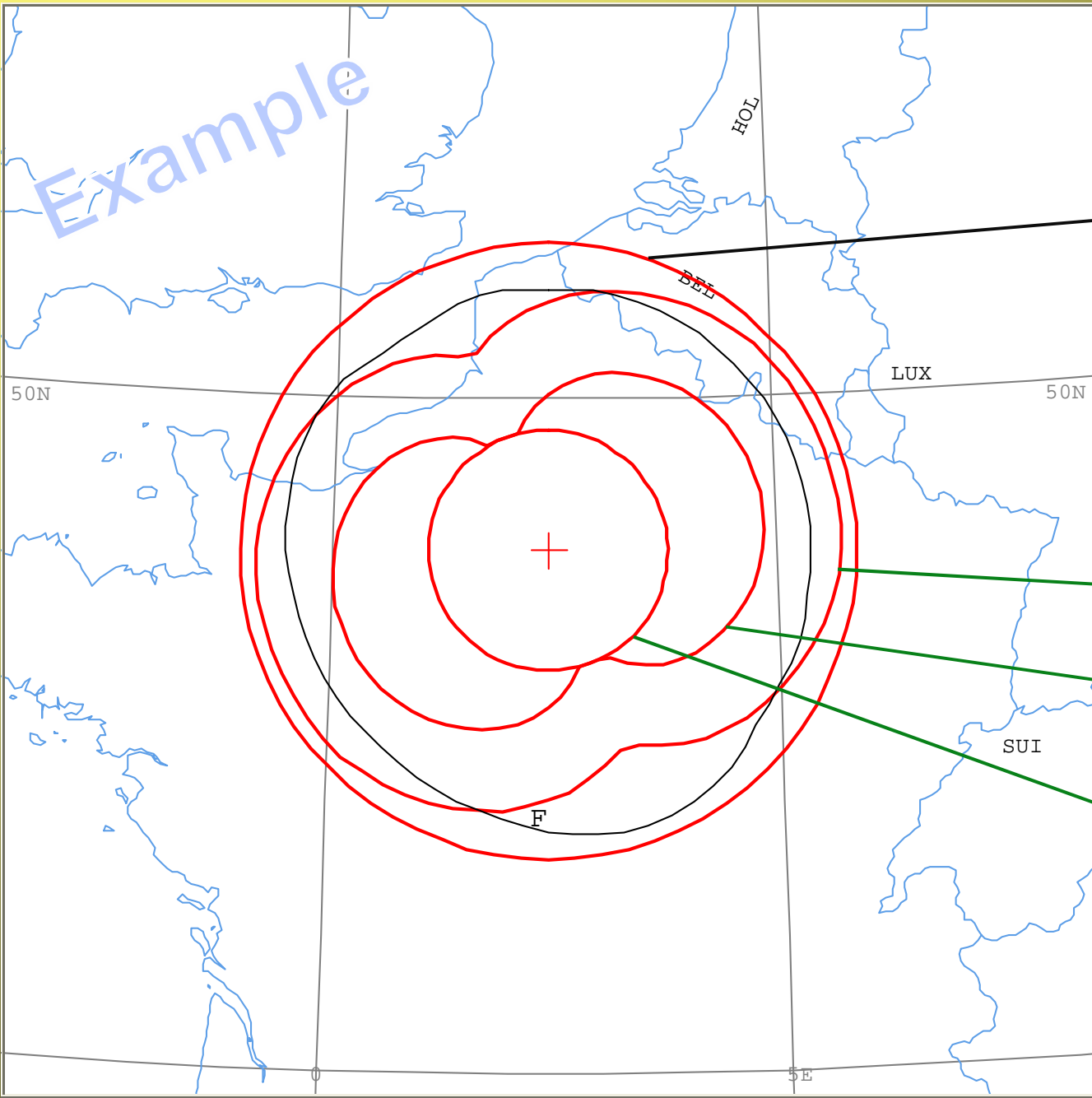
Auxiliary Contour - Mode 2

Appendix 7 - Annex 6 (from WRC-2000)



Auxiliary Contour - Mode 2

Example



Main Mode2

Auxiliary Mode2

Avoidance angle 2.0°

Avoidance angle 3.0°

Avoidance angle 5.0°

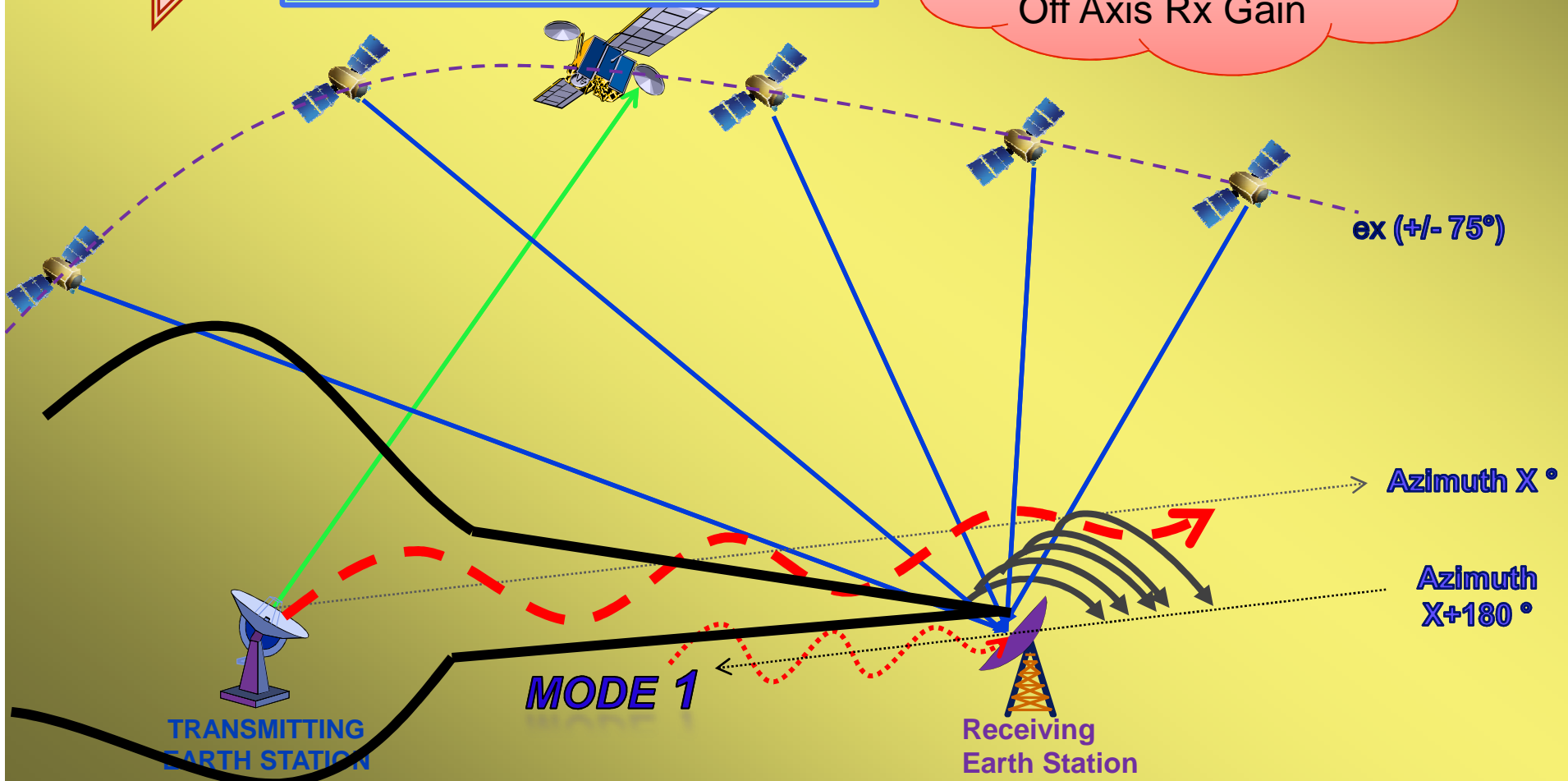
Contour of Opposite direction 1

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 ($> \epsilon_{\min}$)
- Same latitude with Tx E/S

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



Contour of Opposite direction 2

MODE 2

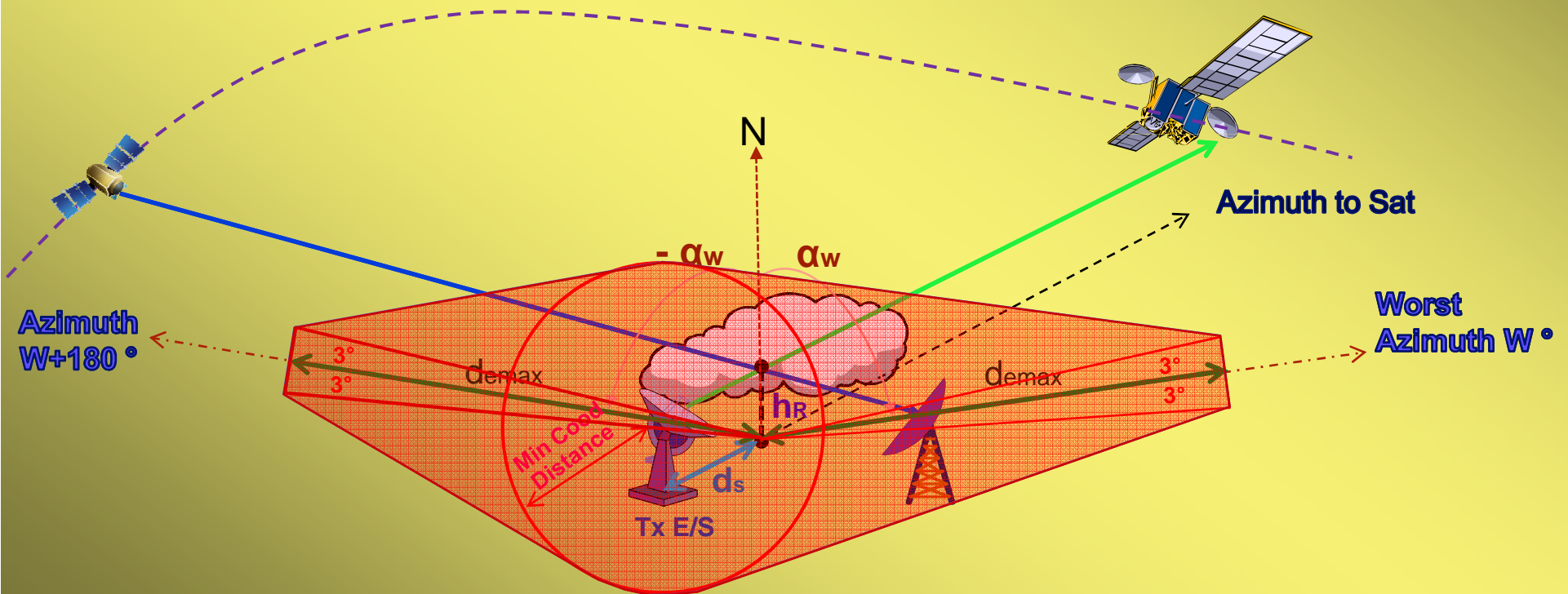
Appendix 7 - Annex 5 + Table 9

Worst Case Scenario + (as Mode1)

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

Apply Geometrical construction

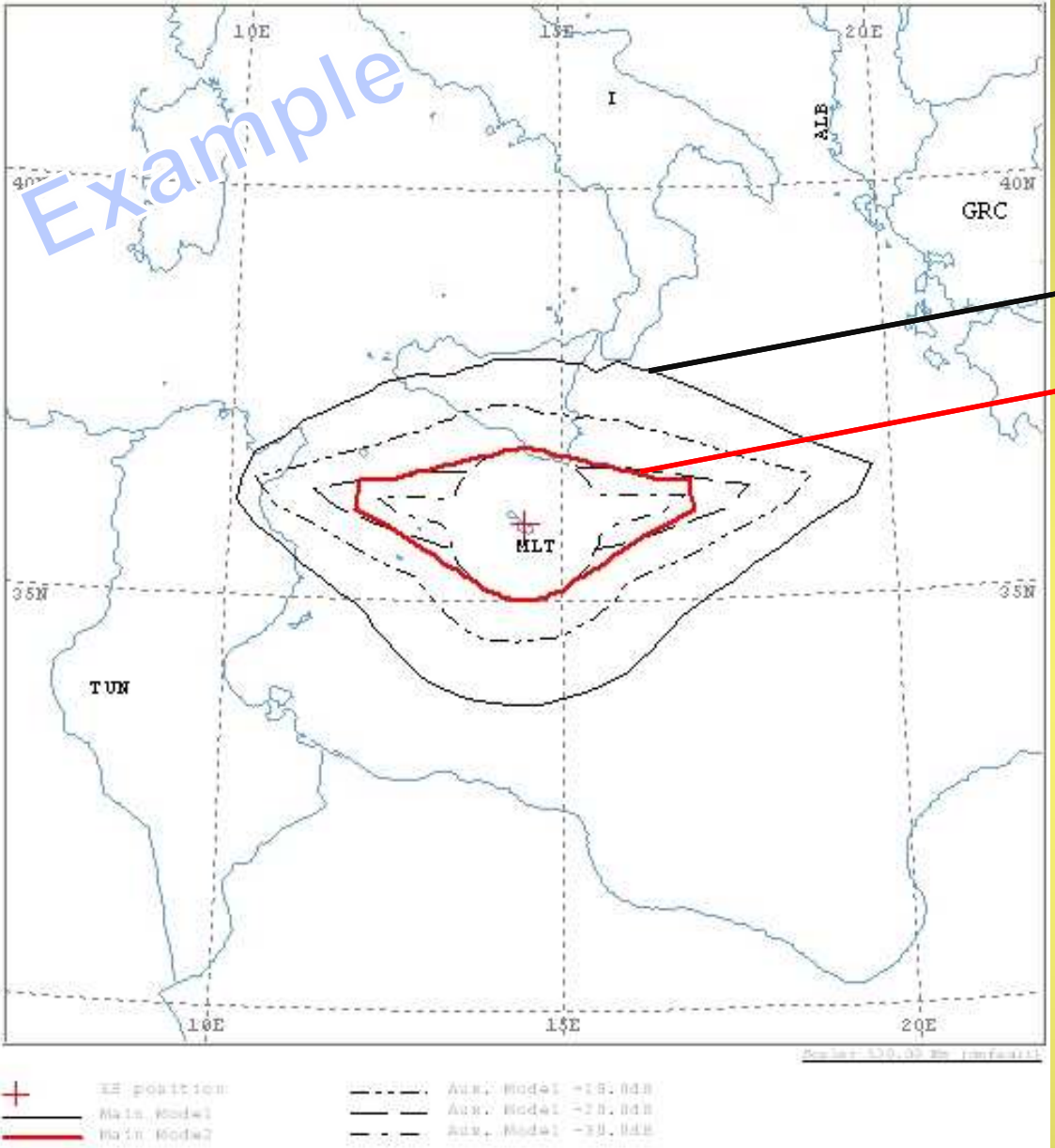
- Min. Coord. Distance (for some Azimuths)
 - two 6° sectors => worst-case distance
- No auxiliary contours (No calculation)



- h_R : rain height
- d_s : horizontal distance

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

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



MODE 1

MODE 2

Freq: 8025-8350 GHz

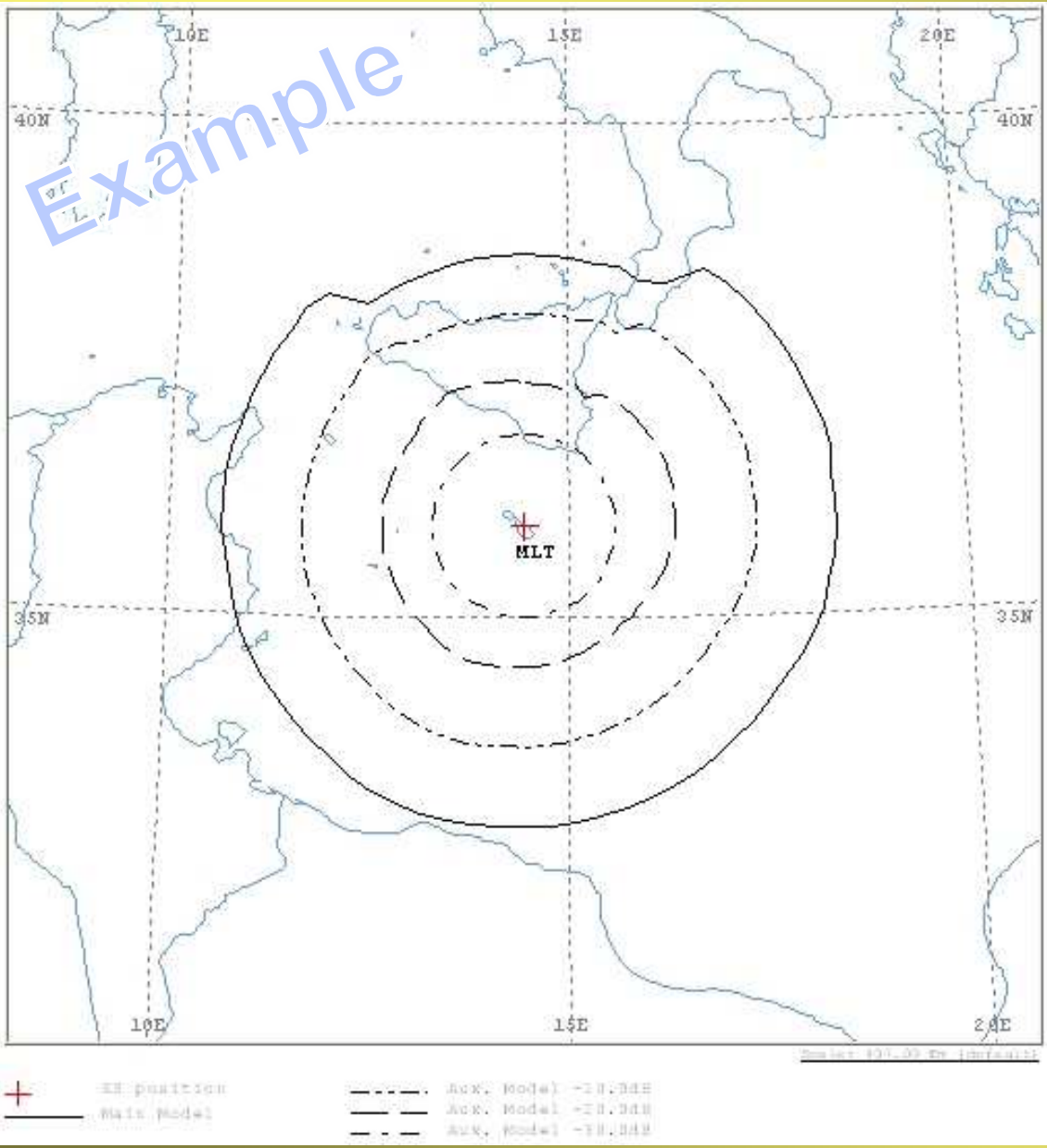
Sat longitude : 1 W

Horizon Ele. Anagle : 0

Affected countries:

I TUN

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



**NO
MODE 2**

**Tracking Antenna reduce
the probability of Mode2.**

Freq: 8025-8350 GHz

Sat longitude : 1 W

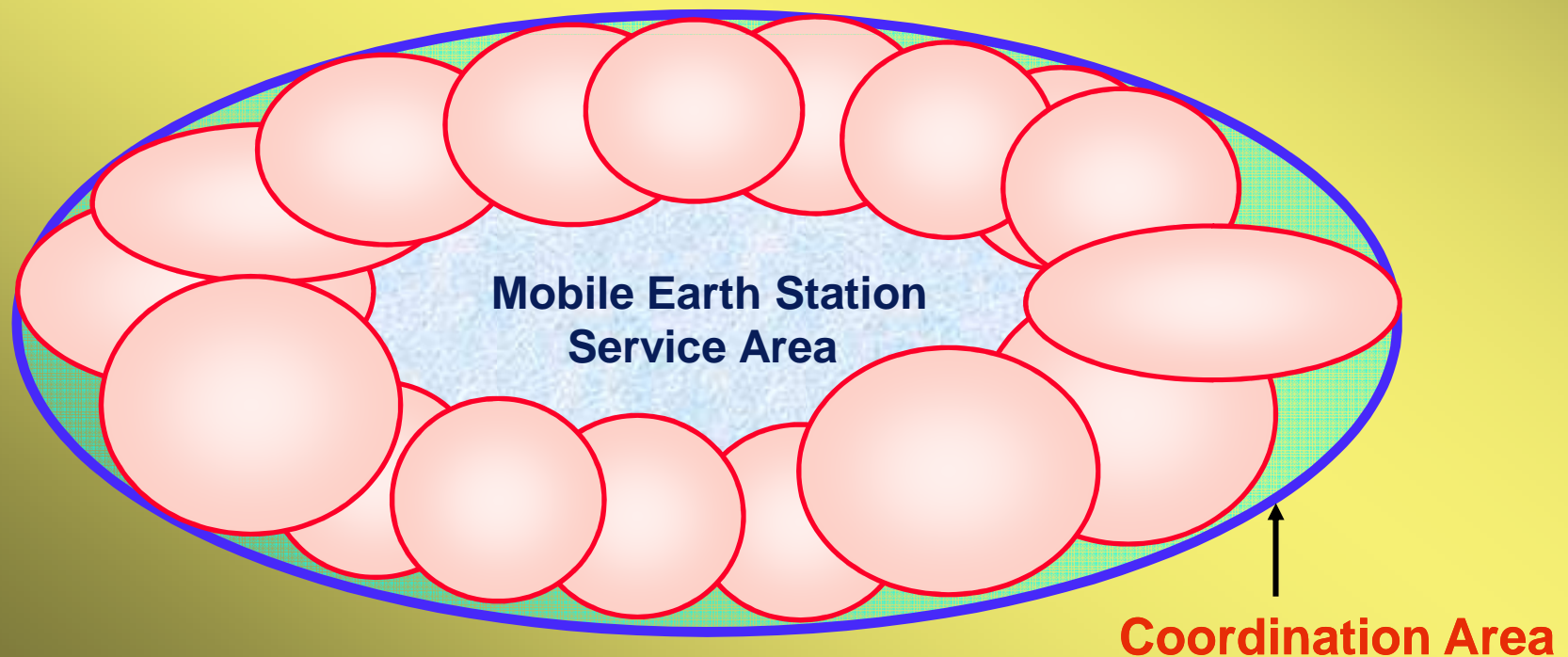
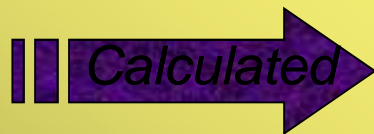
Horizon Ele. Angle : 0

Affected countries:

I TUN

Coordination Area of Mobile Earth Stations

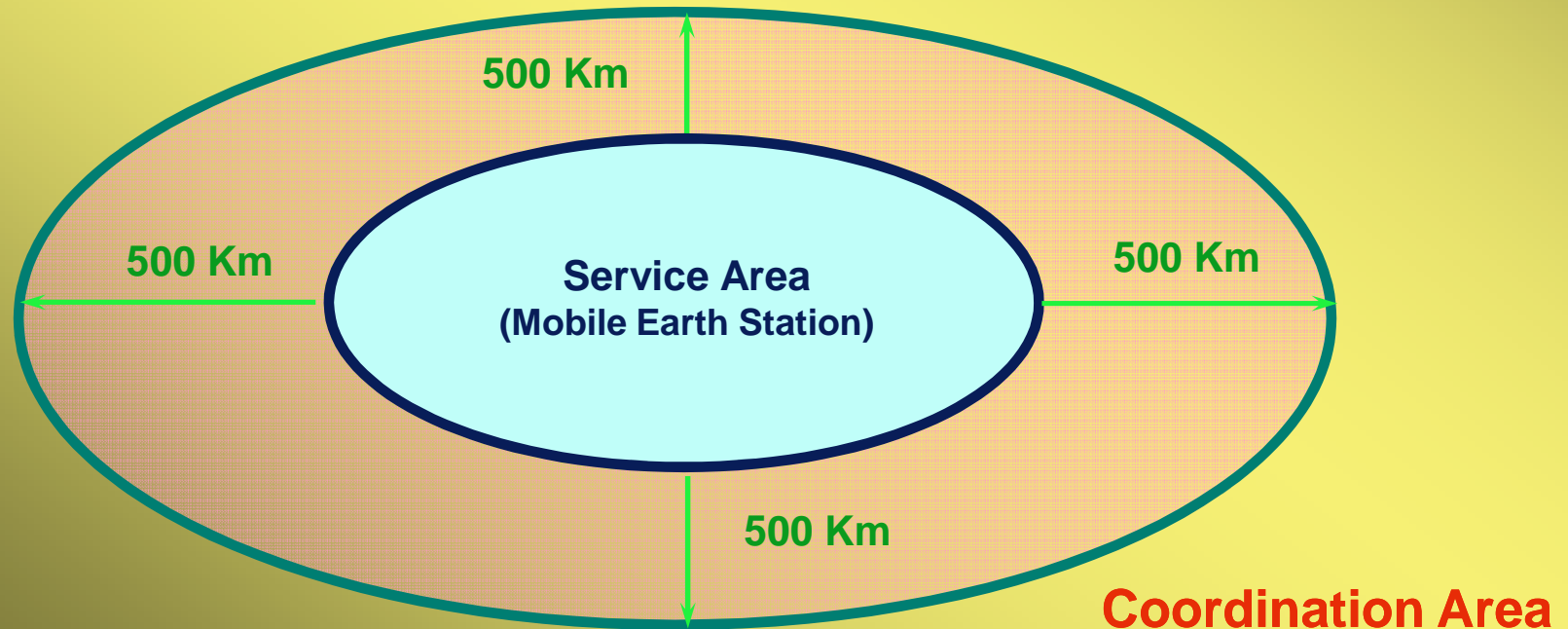
For a **mobile** earth station, the periphery of the service area is **extended by the coordination distance** (calculated or predetermined).



Predetermined Coordination distance

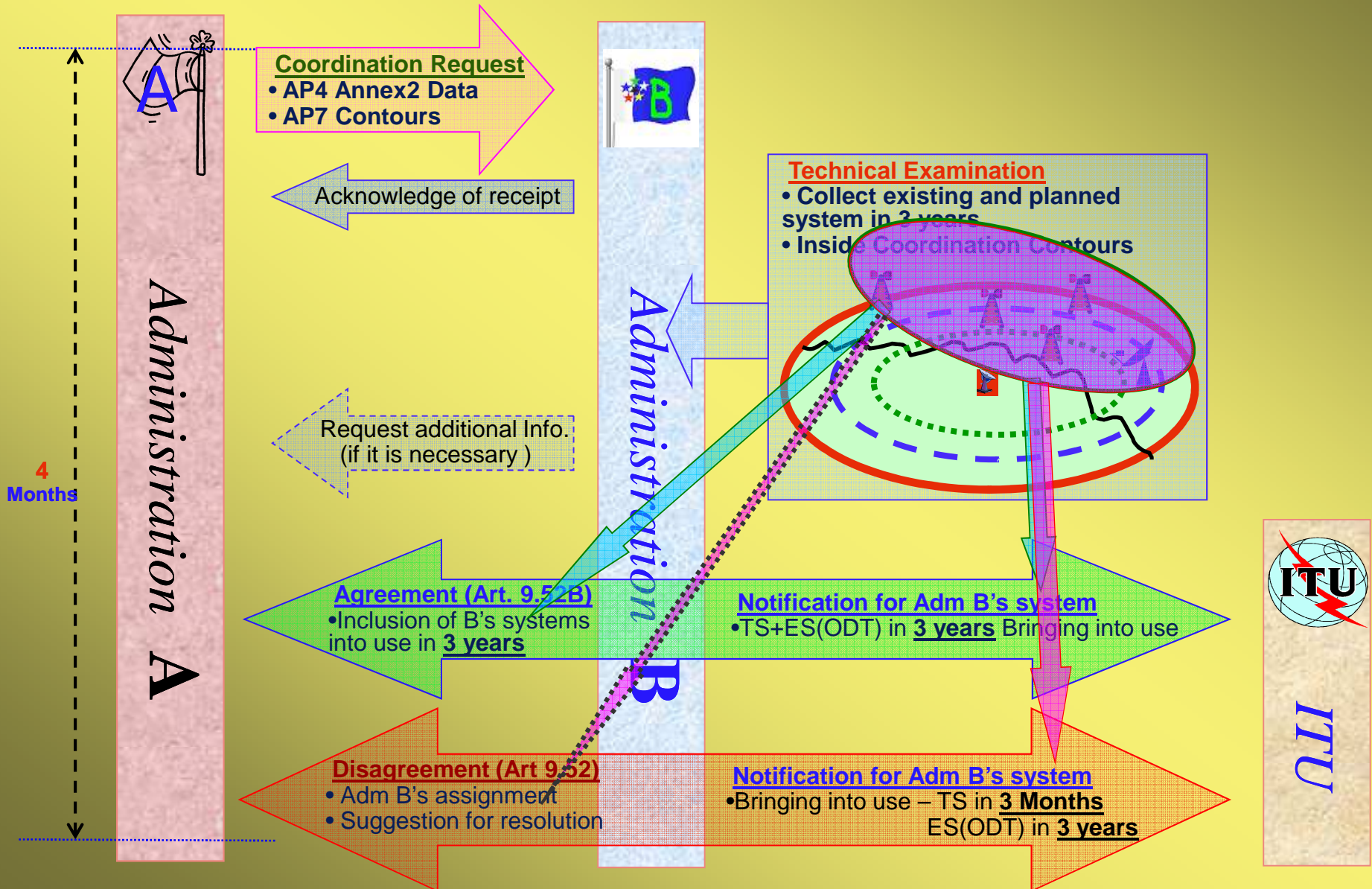
(Table 10 of Appendix 7)

ex: **Ground-based Mobile Earth Station** in respect of
Terrestrial Mobile (aircraft) in Band 1 - 3 GHz (9.11A/9.15)



Response by Administration B

(to Coordination Request from A)



SUMMARY

Coordination of Earth Stations

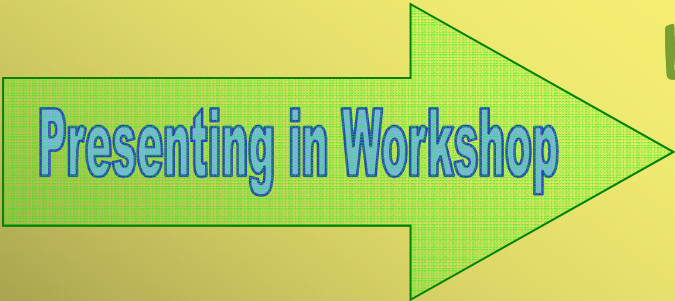
Procedures



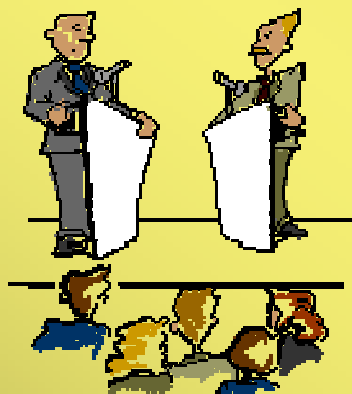
Technical Information

How to use?

GIBC/
AP7



Question ?



Answer !



if

