

Introduction

Computer-Based Software Frequency Planning Tools for Digital TV Broadcasting Service

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***Interregional Seminar on the Transition from SECAM
to Digital TV Broadcasting***

Kiev, November 14th, 2000

Frequency Planning Environment

Regulator

"Frequency Planning"

- ***National and International Coordination***
- ***Economic Assignment of Spectrum***

Emphasis on Avoiding Interference

Operator

"Network Planning"

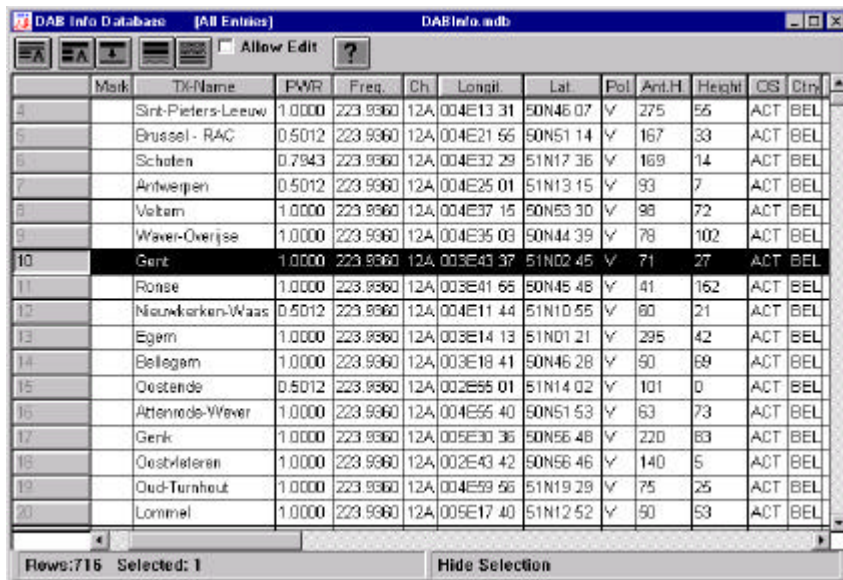
- ***Economic Coverage of Area/Population***

Emphasis on Coverage

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Frequency Planning Elements (1)

Transmitter Databases (Frequency "Plans") (International, Regional, National, Sub-National)



The screenshot shows a window titled "DAB Info Database [All Entries] DABInfo.mdb". It contains a table with the following columns: Mask, Df-Name, PWR, Freq., Ch, Longit., Lat, Pol, Ant.H, Height, OS, and Ctry. The table lists 20 entries for various locations in Belgium, including Sint-Pieters-Leeuw, Brussel - RAC, Schoten, Antwerpen, Vellem, Waver-Overijse, Gert, Ronse, Nieuwkerken-Waas, Eggen, Belleghem, Oostende, Atterode-Waver, Genk, Oostvleteren, Oud-Turnhout, and Lommel. The "Gert" entry is highlighted in black.

Mask	Df-Name	PWR	Freq.	Ch	Longit.	Lat	Pol	Ant.H	Height	OS	Ctry
	Sint-Pieters-Leeuw	1.0000	223.9360	12A,004E13 31	50N46 07	Y	275	55	ACT	BEL	
	Brussel - RAC	0.5012	223.9360	12A,004E21 55	50N51 14	Y	167	33	ACT	BEL	
	Schoten	0.7943	223.9360	12A,004E32 29	51N17 36	Y	169	14	ACT	BEL	
	Antwerpen	0.5012	223.9360	12A,004E25 01	51N13 15	Y	93	7	ACT	BEL	
	Vellem	1.0000	223.9360	12A,004E37 15	50N53 30	Y	98	72	ACT	BEL	
	Waver-Overijse	1.0000	223.9360	12A,004E35 03	50N44 39	Y	78	102	ACT	BEL	
	Gert	1.0000	223.9360	12A,003E43 37	51N02 45	Y	71	27	ACT	BEL	
	Ronse	1.0000	223.9360	12A,003E41 65	50N45 48	Y	41	152	ACT	BEL	
	Nieuwkerken-Waas	0.5012	223.9360	12A,004E11 44	51N10 55	Y	60	21	ACT	BEL	
	Eggen	1.0000	223.9360	12A,003E14 13	51N01 21	Y	295	42	ACT	BEL	
	Belleghem	1.0000	223.9360	12A,003E18 41	50N46 28	Y	50	69	ACT	BEL	
	Oostende	0.5012	223.9360	12A,002E55 01	51N14 02	Y	101	0	ACT	BEL	
	Atterode-Waver	1.0000	223.9360	12A,004E55 40	50N51 53	Y	63	73	ACT	BEL	
	Genk	1.0000	223.9360	12A,005E30 35	50N56 48	Y	220	83	ACT	BEL	
	Oostvleteren	1.0000	223.9360	12A,002E43 42	50N56 46	Y	140	5	ACT	BEL	
	Oud-Turnhout	1.0000	223.9360	12A,004E59 55	51N19 29	Y	75	25	ACT	BEL	
	Lommel	1.0000	223.9360	12A,009E17 40	51N12 52	Y	50	53	ACT	BEL	

- **Geographic Position**
- **Frequency**
- **Power**
- **Antenna Diagram**
- **Antenna Height plus Site Height Above Sea Level**
- **Transmission Mode**

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Frequency Planning Elements (2)

GIS - Geographic Information System

Raster Data

"Terrain Databases" (DTM - Digital Terrain Models)

- *Featuring raster size and geodetic datum and classifying into*
 - *Topography (elevation height)*
 - *Morphology (clutter classes, land use)*
 - *Conductivity maps for LF/MF use*
- *Population Data*
- *Topological Maps (Showing Cities, Roads, etc.)*

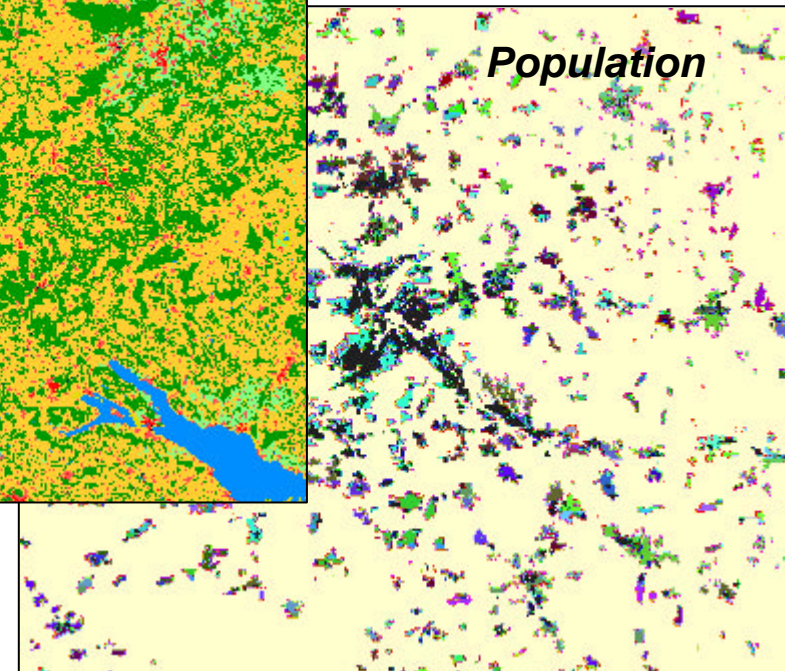
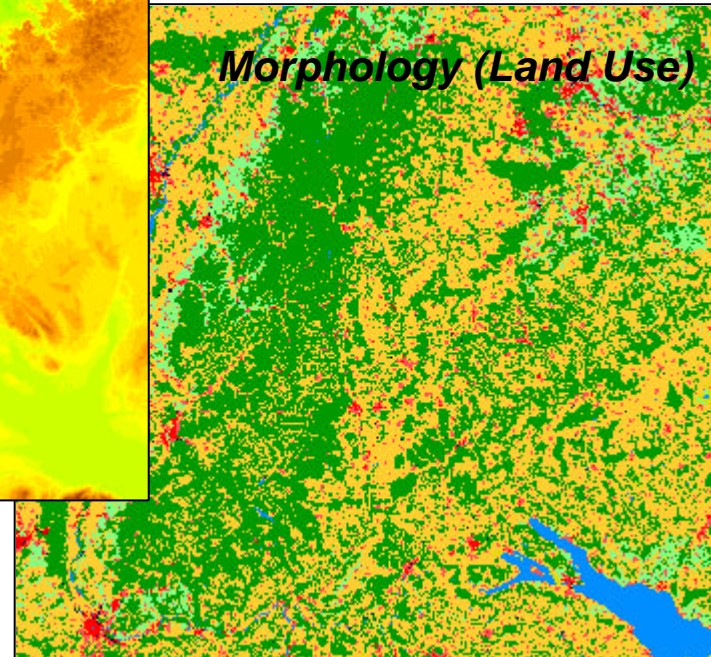
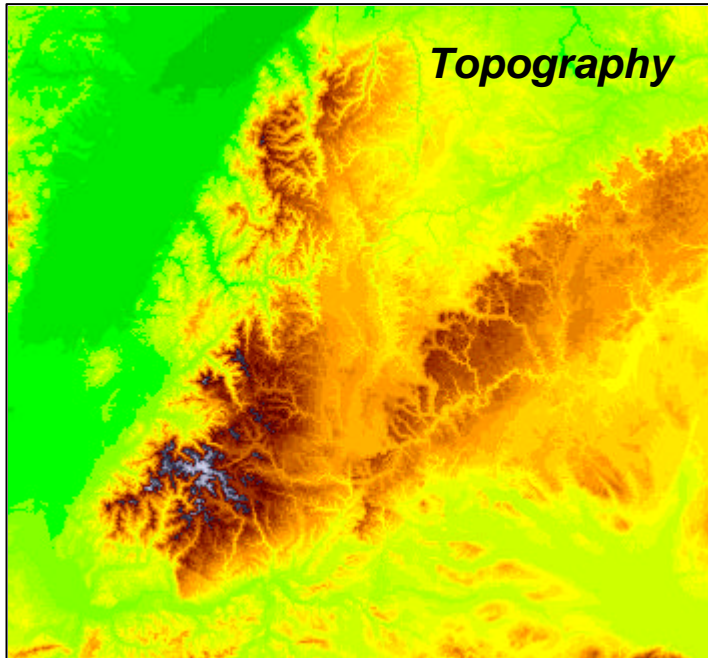
Vector Data

- *Vector format data such as country borders, field strength contours, test points*
(e.g. allotment database for DAB, maintained by ERO)

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Frequency Planning Elements (3)

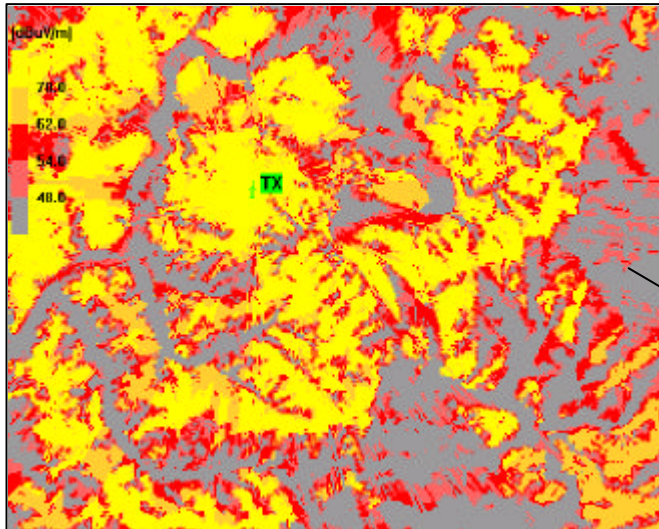
Raster Data



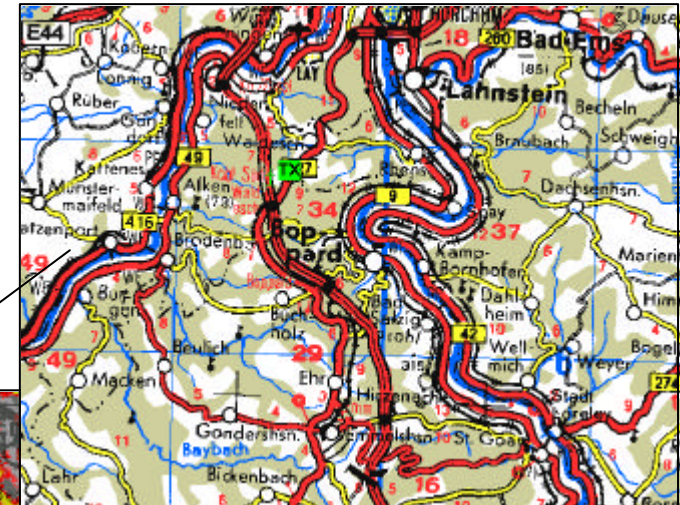
- Resolution
- Accuracy
- Availability
- Price

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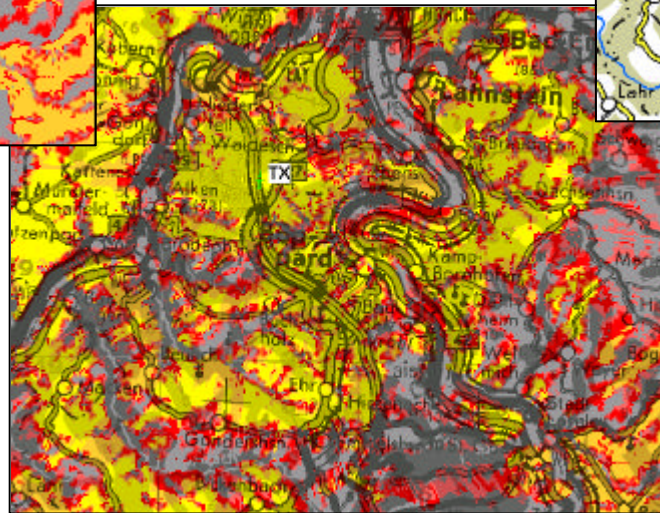
Frequency Planning Elements (4)



Field Strength Result



Topological Map



Overlay

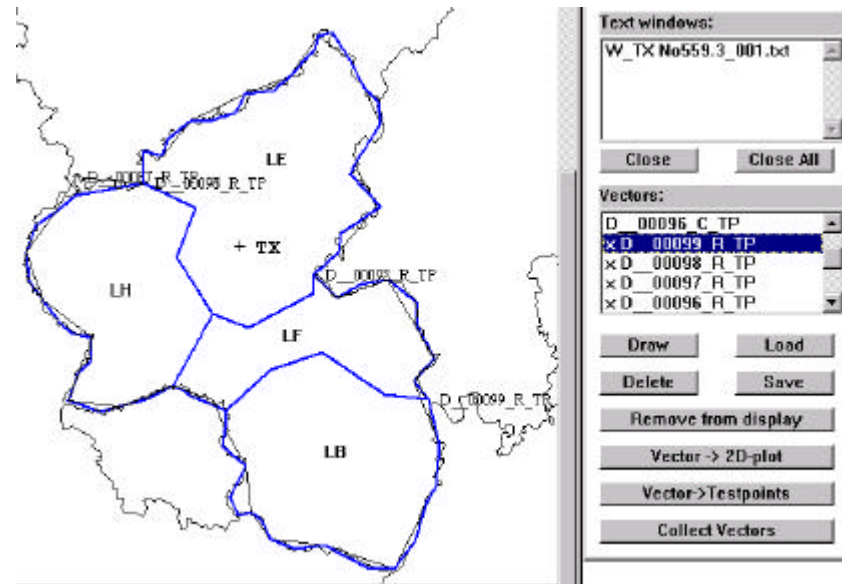
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Frequency Planning Elements (5)

Vector Data

Treatment as "vectors" is reasonable for:

- "Contours", such as field strength contours or coverage contours
- Country borders
- Arbitrarily placed test points
- Transmitter-related test points
- Allotment borders



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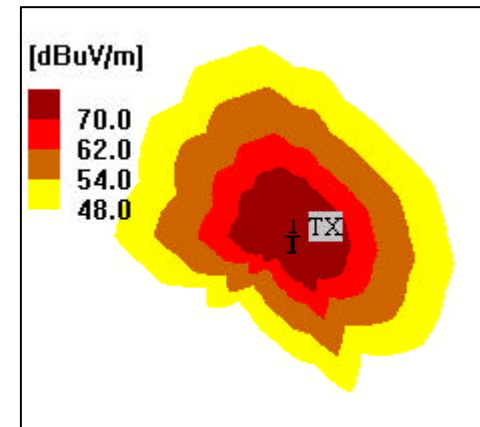
Frequency Planning Elements (7)

Field Strength Prediction Models

Non-Terrain Based

- Use of "effective antenna height"
- Monotonous decline of field strength with increasing distance to transmitter

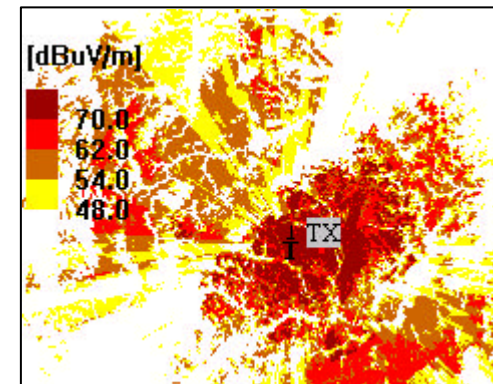
Example: ITU-R P. 370



DTM Based

- Diffraction, shading, reflection
- Terrain elevation and land use (morphology)
- 2D and 3D models

Examples: "Epstein-Peterson", "Longley&Rice", "Okumura-Hata"



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Frequency Planning Elements (8)

Coverage Prediction

Calculation if field strength supplied by one transmitter or transmitter ensemble is sufficient.

Interference Prediction

Combination of all interfering signals and protection ratios, and comparison to field strength of useful signals, giving the "C/I" ratio.

Both results require field strength calculation in advance

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Frequency Planning Elements (9)

Coordination

Implementation of internationally accepted rules of calculation.

Use of values in conformity with plans and recommendations, and use of appropriate formats and forms.

Notification

Reporting the parameters of own transmitters for inclusion into frequency plans.

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Frequency Planning Elements (10)

Presentation

- ***Ability to print out lists as well as graphical representations***
- ***Symbol and color handling***
- ***Ability to introduce thresholds***
- ***Data exchange with office programs***
- ***Use of approved forms in administration***

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Frequency Planning Elements (11)

Licensing

- ***Keeping track of all assignments made as a national plan***
- ***Supporting statistics/reporting***
- ***Administrative effort should be minimized***
- ***This may even include built-in forms for billing***

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The Digital Challenge in Broadcasting (1)

New Elements in Transmitter Database

New Transmission Modes

Identifying:

- *Modulation*
- *Different safeguard times*
- *Different code rates and thus protection requirements*

System Var.	B2: 16-QAM 2/3
Designator	D: 2k 1/4

Delay

To account for:

- *Delay resulting from the feeder link (satellite)*
- *Purposely shifted focus of network gain*
- *Delay before retransmission of repeater*

Time Del. / μ s	0.00
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SFN-ID

To identify transmitters belonging to the same single frequency network

SFN Id	00005
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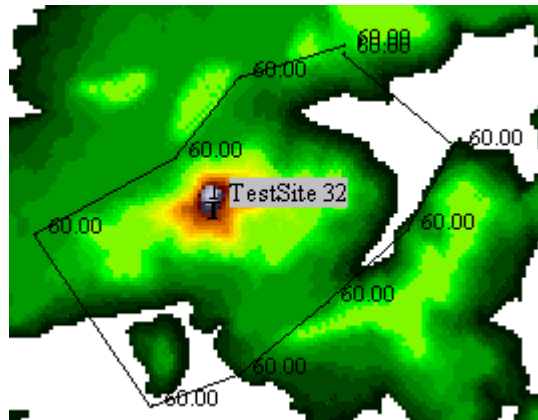
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The Digital Challenge in Broadcasting (2)

New Elements in Transmitter Database

Transmitter-Related Test Points

- Were introduced in Chester 1997 and are distributed with transmitter data



TestSite 559.250000 (32)

Transmitter Testpoints

ERO No. of TP's : 10

Adm. Unique ID:

Tuesday, 07. November 2000 14:58

	Longitude	Latitude	U1 FST	PR1 FST
1	114E11 14	22N28 33	60.00	0.00
2	114E08 11	22N27 45	60.00	0.00
3	114E06 16	22N25 37	60.00	0.00
4	114E02 09	22N23 38	60.00	0.00
5	114E05 25	22N18 55	60.00	0.00
6	114E08 00	22N19 44	60.00	0.00
7	114E10 36	22N21 38	60.00	0.00
8	114E12 58	22N23 32	60.00	0.00
9	114E14 25	22N25 47	60.00	0.00
10	114E11 13	22N28 20	60.00	0.00

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The Digital Challenge in Broadcasting (3)

New Planning and Coordination Methods

- ***Conversion Rules (Analog to Digital) for Transition Scenarios (Mixed / All Digital)***
- ***Single Frequency Networks (SFN's) in Addition to Conventional Multiple Frequency Networks***
- ***Allotment Planning (Area Related) in Addition to Conventional Assignment Planning (Site Related) Becomes Possible***

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The Digital Challenge in Broadcasting (4)

'Real' (Operator View) Network Planning

- ***Including Influence of Safeguard Interval (Self-Interference)***
- ***Including Network Gain***

'Cross Services' Compatibility Checks

- ***Analog Broadcasting*** « ***Digital Broadcasting***
- ***Digital Broadcasting*** « ***Other Services***

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The Digital Challenge in Broadcasting (5)

Statistical Aspects

Conventional analog frequency planning used to be for 50% of locations and 50% of time.

This was sufficient because of the "graceful degradation" of analog reception.

For digital services, the threshold for coverage is much sharper. This leads to a demand for higher location probabilities.

Digital services may benefit from reflections and other signals from the SFN.

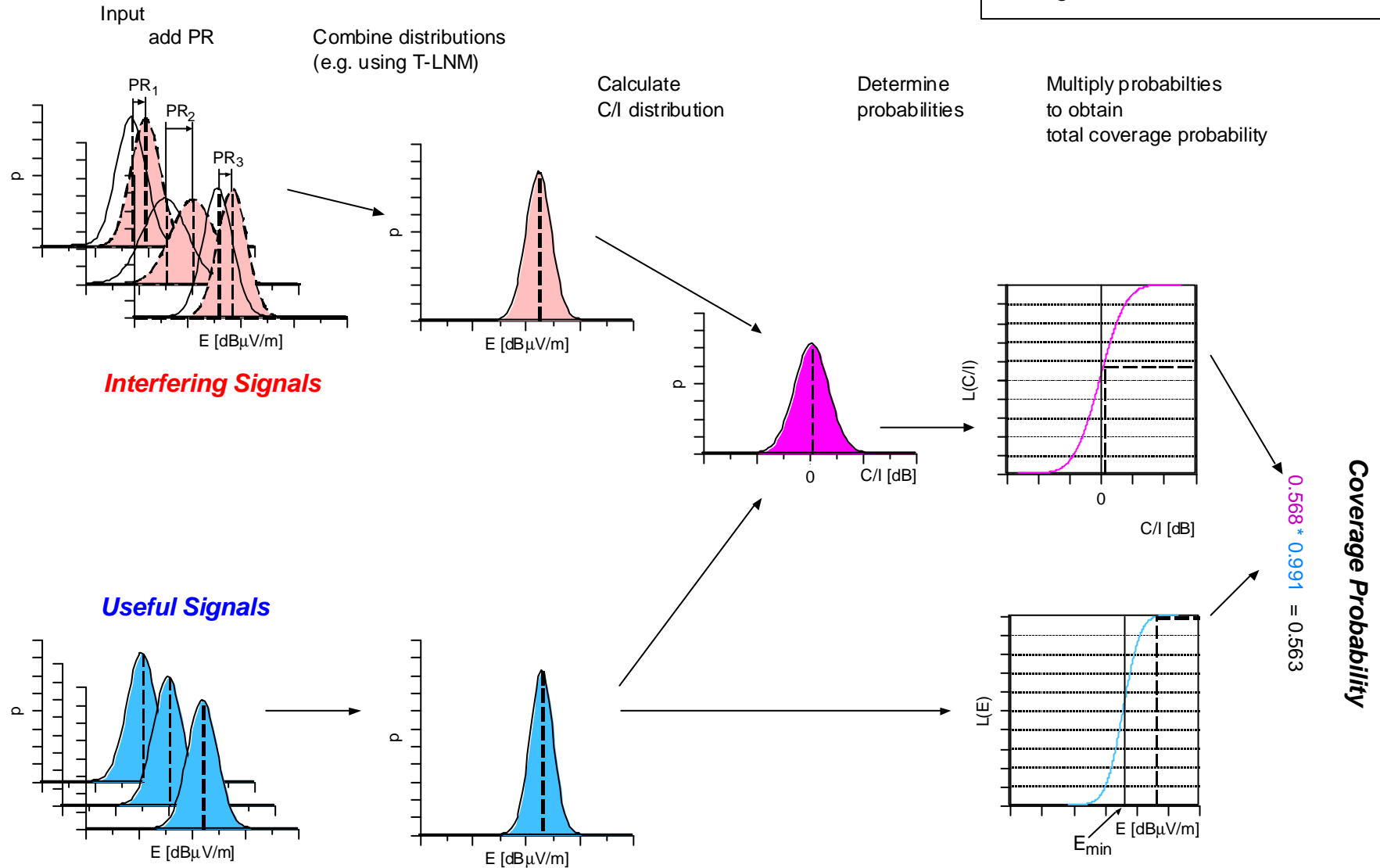
In combining signals, the signals have to be treated as being distributions characterized not only by a (median) field strength but also a deviation.

Real statistical combination methods such as "T-LNM" (assuming log-normal distributed levels) come into favor.

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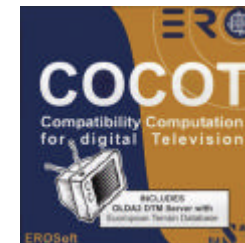
The Digital Challenge in Broadcasting (6)

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Requirements for a Computer-Based Frequency Planning Tool (1)

- *Include all necessary frequency planning elements mentioned above*
- *Interfacing (data import/export)*
- *Common hardware platform, desktop computer, interoperability with office type software (copy and paste), familiar user interface*
- *Multi-user environment*



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Requirements for a Computer-Based Frequency Planning Tool (2)

- **All-in-one solution (not several applications with difficult data exchange)**
- **Adaptable to national requirements and other customizations**

4.2.2 Lower adjacent channel (n - 1)

Table A1.19
Protection ratios (dB) for DVB-T interfered with by analogue television in the lower adjacent channel (n - 1)

Wanted signal		Interfering signal						
System	BW	Mode	PAL B	PAL G, B1, H	PAL I	PAL D,K	SECAM L	SECAM D,K
DVB-T	8 MHz	M1				-43		
		M2				-38		
		M3			-34	-34		
DVB-T	7 MHz	M1	-43					
		M2	-40					
		M3	-37					

Fill in parameters yet unknown

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Requirements for a Computer-Based Frequency Planning Tool (3)

- Integration of original forms for printout

The screenshot displays two overlapping windows from a software application. The background window, titled 'Page 2', shows a grid of input fields for antenna height at different azimuths, with values like '+200' and '+200'. The foreground window, titled 'Page 1', contains a detailed form for site and emission characteristics.

SITE CHARACTERISTICS

1401 Transmitter antenna name: DELAND

11 Geographic area: S

10 Coordinates: Longitude: 016 30 00 E, Latitude: 56 42 00 N

15 Altitude of site above sea level, m: +0

EMISSION CHARACTERISTICS

1 Frequency: 621.25 MHz

2 Modulation: N

3 Polarisation: V

4 Effective isotropic cover, dB

5 Horizontal: -7

6 Vertical: +30.0

7 Power ratio, dB: 0

ANTENNA CHARACTERISTICS

8 Directivity of antenna: ND

9 Height of antenna above ground level, m: 40

10 Maximum effective antenna height, m: +200

ARTICLE 11

12A Operating agency: 12B Address code: 40

13B Regular hours of operation: From (UTC): To (UTC):

14 Date of bringing into use:

Buttons: Cancel, OK

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Requirements for a Computer-Based Frequency Planning Tool (4)

- ***Expandable to more general spectrum management tasks***
 - ***Services other than broadcast***
 - ***Licensing***
 - ***Reminders and deadline management***
 - ***Reporting***
 - ***Billing and bookkeeping***
 - ***Link to radio monitoring stations***

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Excerpt of References (Literature)

- ***The Chester 1997 Multilateral Coordination Agreement, Relating to Technical Criteria, Coordination Principles and Procedures for the Introduction of Terrestrial Digital Video Broadcasting, DVB-T, Chester, Great Britain, 1997***
- ***ERO COCOT CD-ROM, European Radiocommunications Office, Copenhagen, Denmark***
- ***Final Acts of the CEPT T-DAB Planning Meeting, Wiesbaden, Germany, 1995***
- ***ERO DACAN CD-ROM, European Radiocommunications Office, Copenhagen, Denmark***
- ***ETSI 300744 (DVB-T), European Telecommunications Standards Institute, Sophia Antipolis, France***
- ***ETSI 300401 (DAB), European Telecommunications Standards Institute, Sophia Antipolis, France***
- ***M. Takada / M. Sasaki / T. Ikeda: "Draft Standard for Digital Terrestrial Sound Broadcasting in Japan", Proceedings of the NAB 1999***
- ***ITU-R P.370, International Telecommunications Union, Geneva, Switzerland***

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