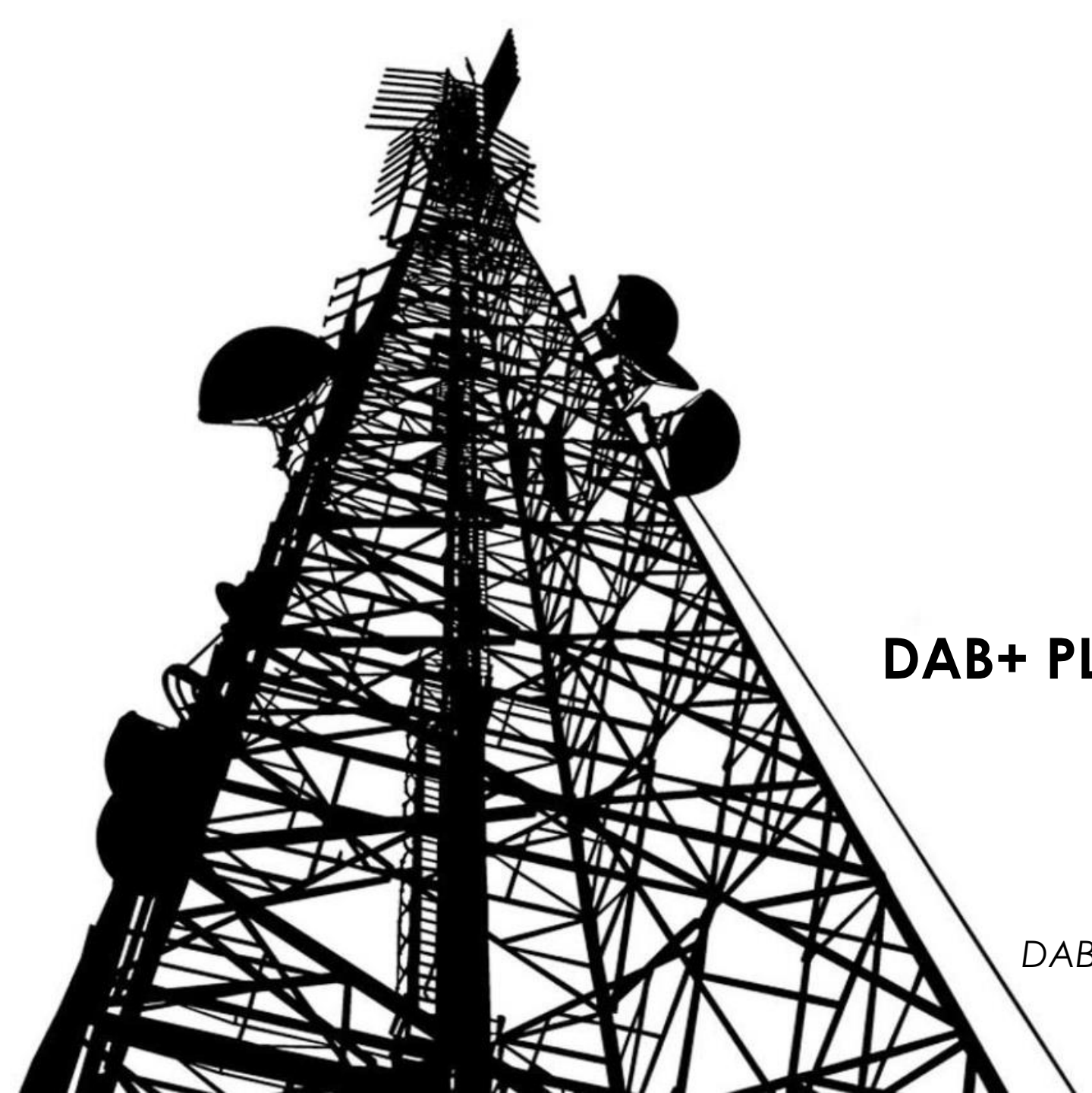


DAB+ PLANNING vs MEASUREMENT

CARLO PEROTTA – *ALDENA*

SEMINAR
DAB+ Planning Measurement and Monitoring
20 March 2024 EBU, Geneva

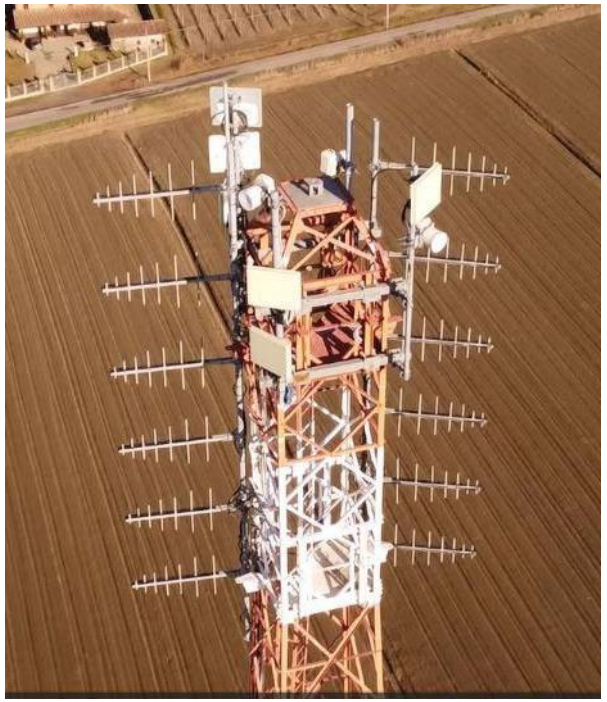
1979 • 2024 45 YEARS OF RELIABLE ANTENNAS

ANTENNAS and RF SOLUTIONS

in tunes with the future

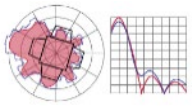
Alden The Reliable Antennas

FM RADIO • DAB+ RADIO • DIGITAL TV • MISSION CRITIAL • MONITORING • CONTROL

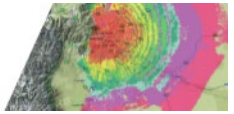


EMLAB RF SOFTWARE

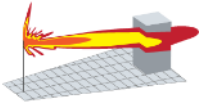
ANTENNA PATTERN DESIGN



COVERAGE NETWORK PLANNING



EM HEALTH SAFETY



PLANNING PROCESS

DAB+ Digital Radio

Services Providers

Content Providers

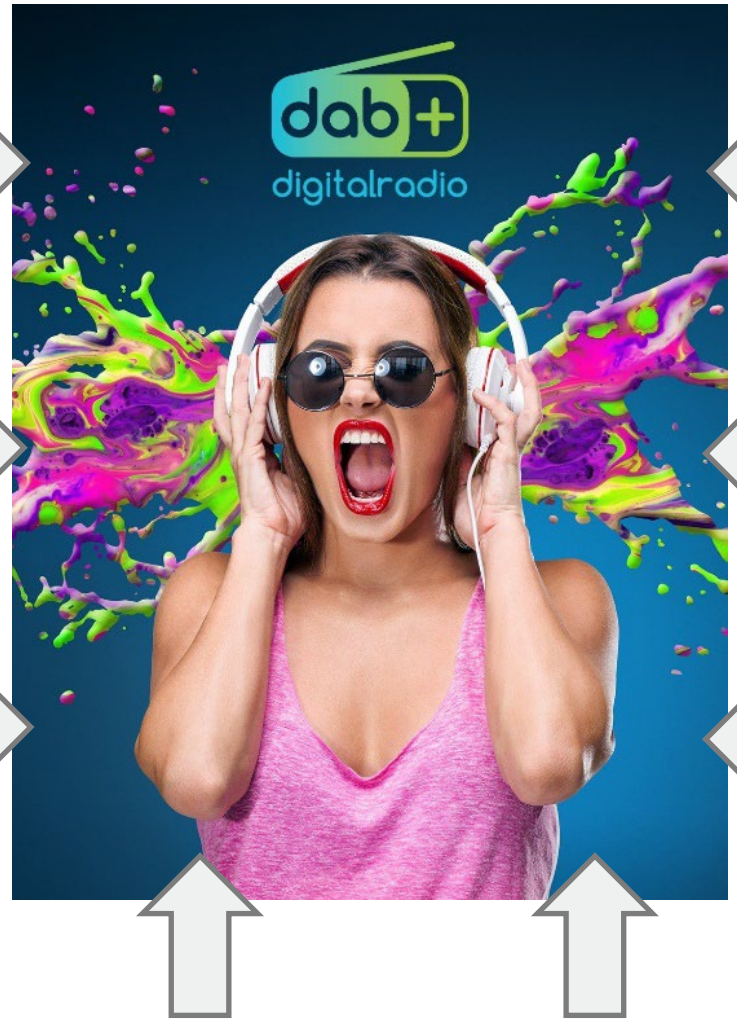
Network equipment suppliers

Broadcasters

Regulators Goverments

RX Manufacture

Automotive



Marketing

Commercial

Engineering

Costs of transmission

Licence Fulfilling

International Coordination

Quality of Services

National Coordination

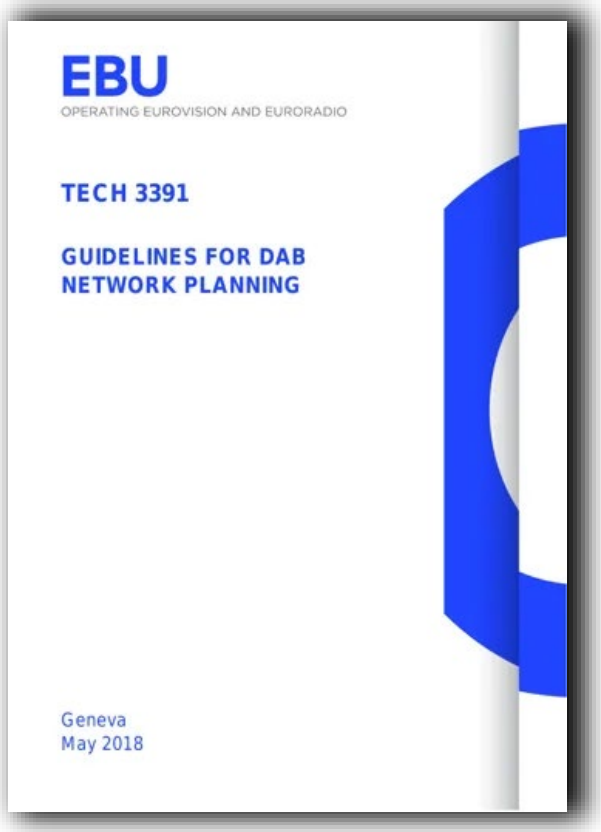
Strategy HPHT / LPLT

SFN Self interference

NETWORK PLANNING
DAB+ Digital Radio

EBU Tech 3391

This strategic report provides guidance on key elements necessary to plan and design a DAB network.



Mimimum Field Strength Reference Levels for different Reception Modes (target)

MO Mobile reception RURAL	PO Portable Outdoor SUBURBAN	PI Portable Indoor URBAN	…
42.84 dBµV/m	42.98 dBµV/m	65.68 dBµV/m	

RX = 1.5 mt

Wanted Signal 50% locations, 50% time
Unwanted Signal 50% locations, 1% time

Minimum C/N

Height Loss

Man Made Noise

Location variation

Vehicle antenna info
Antenna gain

Building Entry Loss

RX performance
Noise Figure

NETWORK PLANNING
DAB+ Digital Radio

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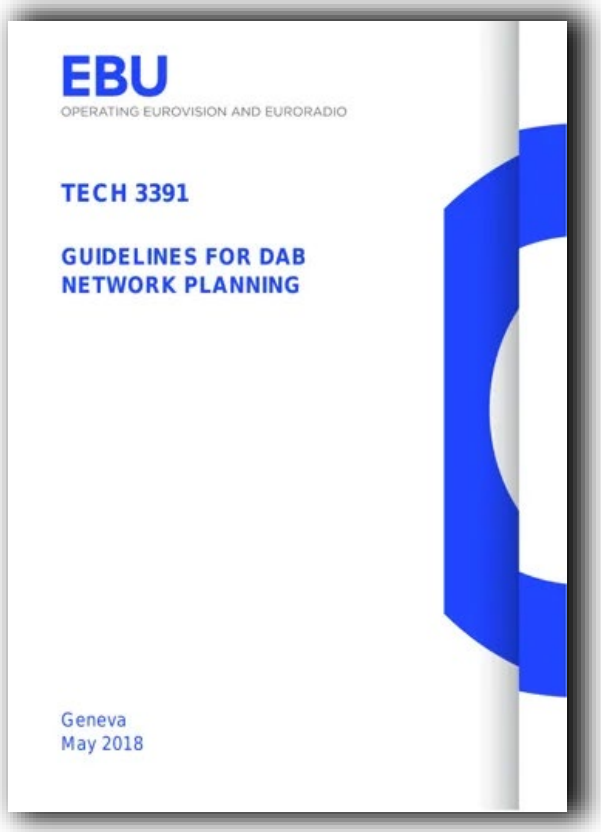
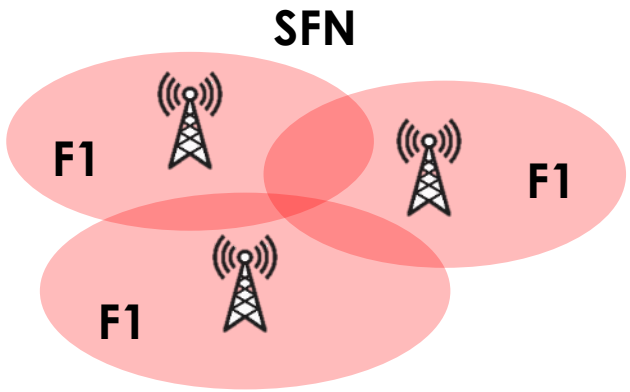
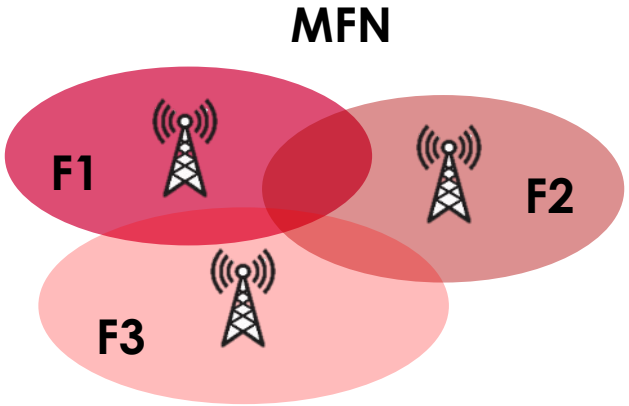




Same services -> Same Multiplex



Different services -> Different multiplex

SFN distance limit ≈ 74 km

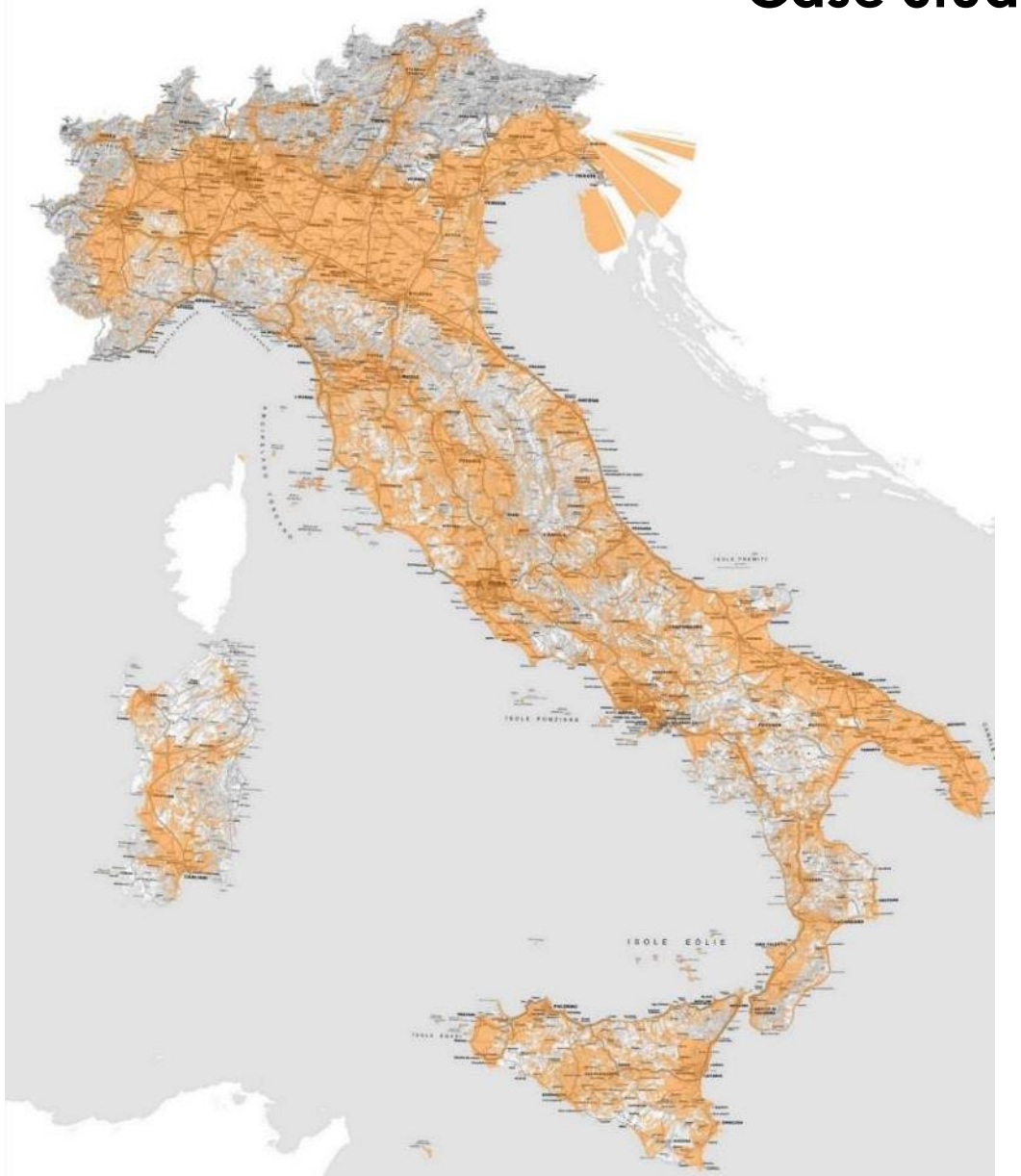
SFN self interference can be simulated!
(Make adjustment – reduction – move it!)

Useful vs Interferring component

Required protection ratio ζ	Relative delay
0 (i.e. not required)	0 ≤ t ≤ 246 µs (i.e. inside the guard interval)
5 dB	246 < t ≤ 350 µs
13.5 dB	t > 350 µs

NETWORK ROLL-OUT

Case Study – EURODAB ITALY



National Operator 6-SFN networks

9 Simulcast FM programmes
11 programmes exclusively on DAB+

Population: 87 % Terrain: 61 %

Number of sites: 177

ERP ≥ 10KW	ERP <10 KW ERP >2 KW	ERP ≤ 2KW
16	23	138

(data up to 04-03-2024)

Which is the BEST ANTENNA?

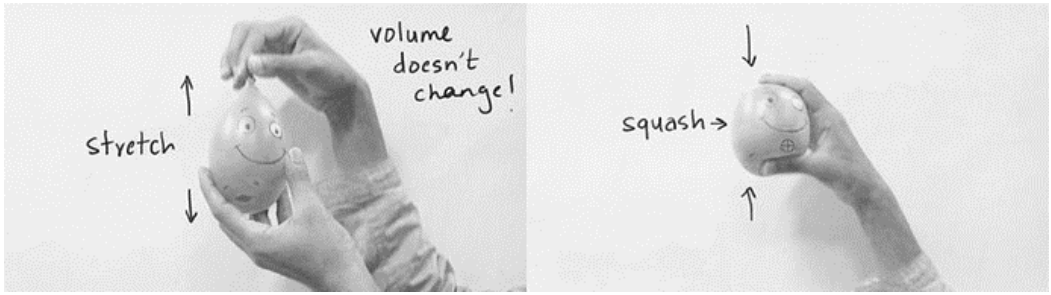
Transmission Design

ERP = Effective Radiated Power

$$P_{ERP} = P_{Input\text{-}Losses} \times G_{Antenna}$$

TRADE OFF

Gain - Efficiency



Antenna System Design → **HRP / VRP Pattern** → **Final Array GAIN**



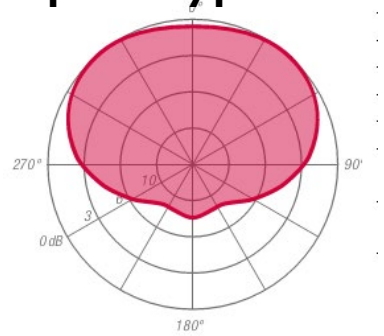


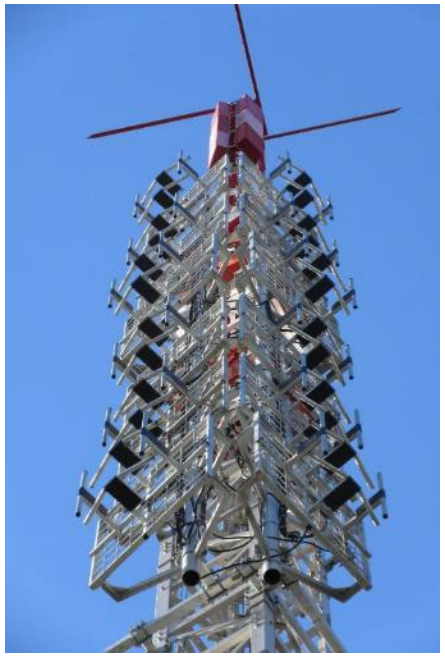


Horizontal Radiation Pattern

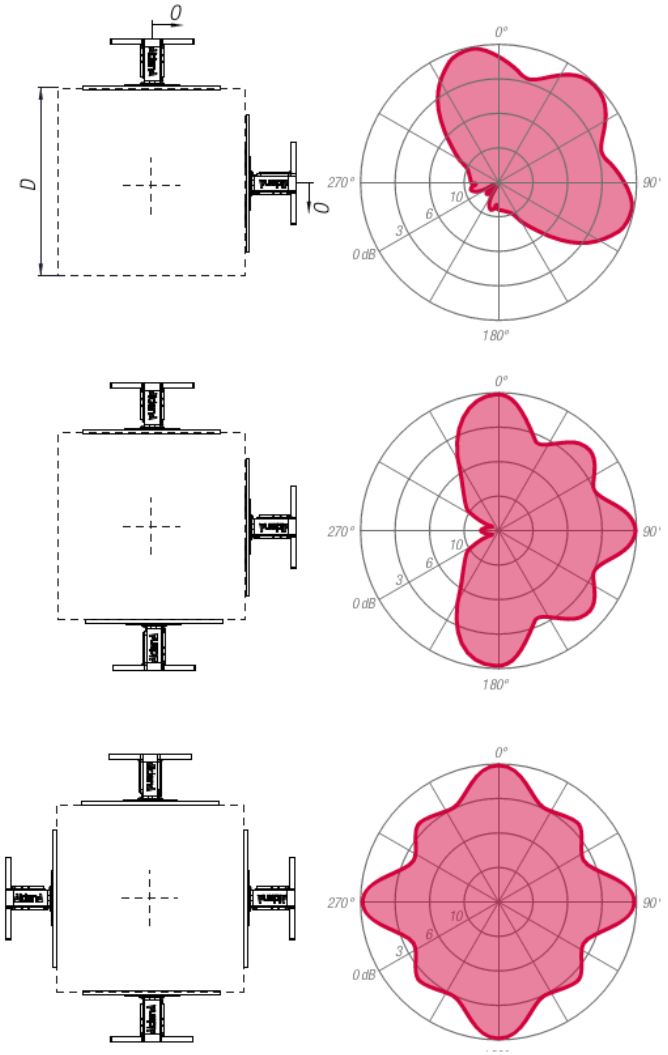
Antenna Design

Dipole Typical HRP

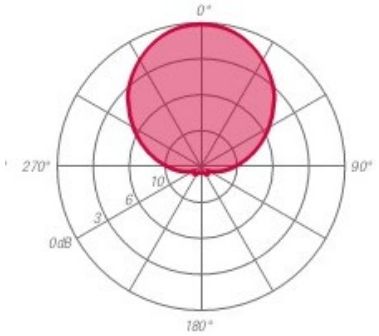




Panel Typical HRP



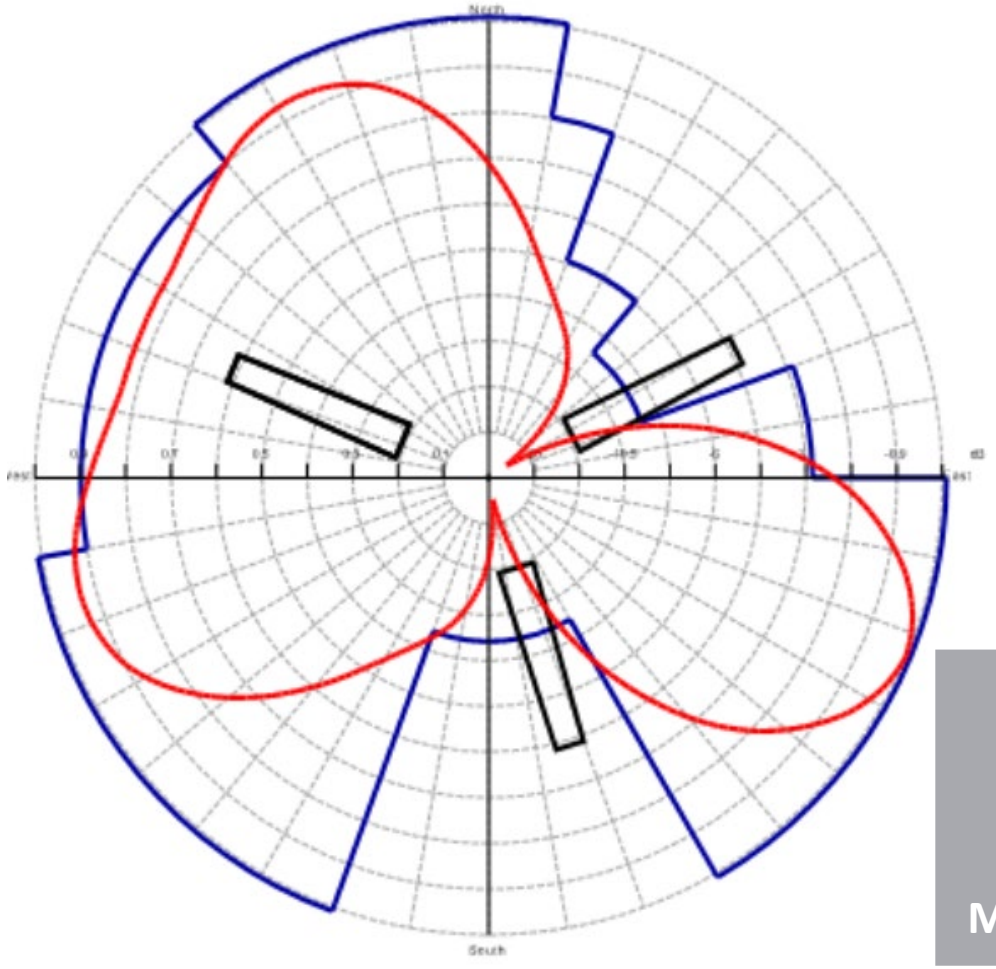
Log Periodic/Yagi Typical HRP

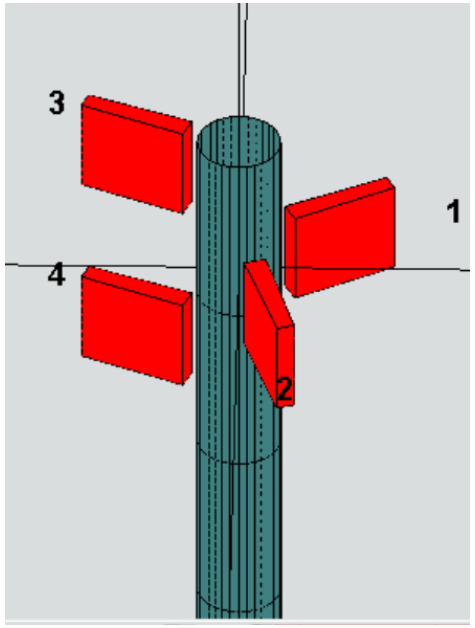


Horizontal Radiation Pattern

Antenna Design

HRP with ERP Limitation





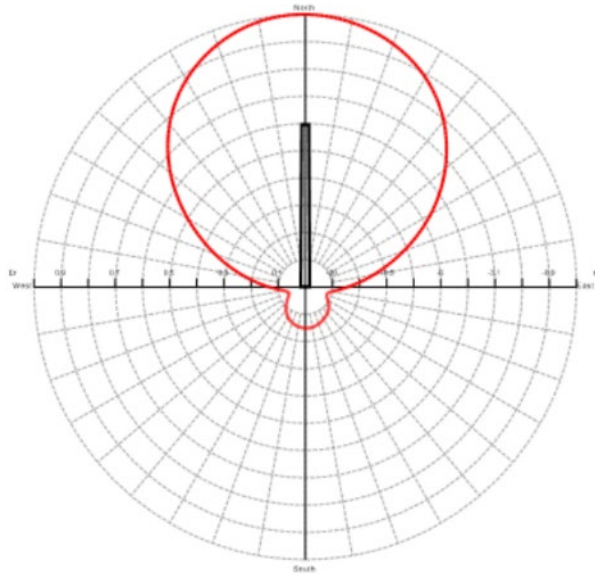
How-To

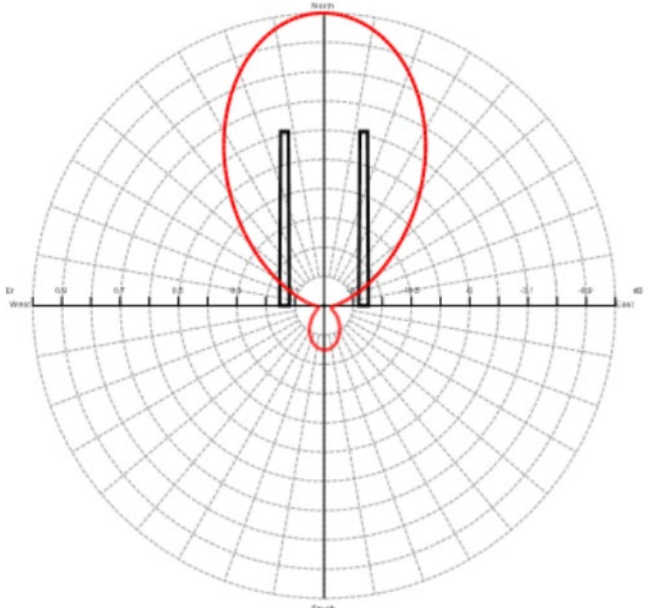
Antenna Type
Power (%)
Phase (°)
Azimuth (°/N)
Mutual Distance between elements

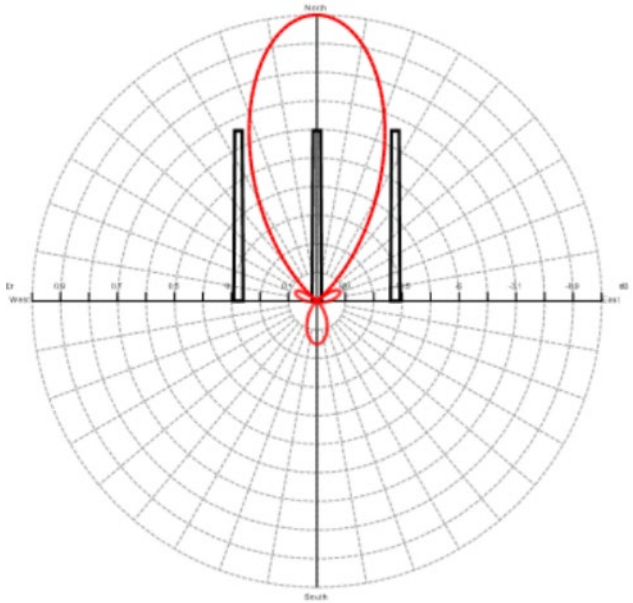
Horizontal Radiation Pattern

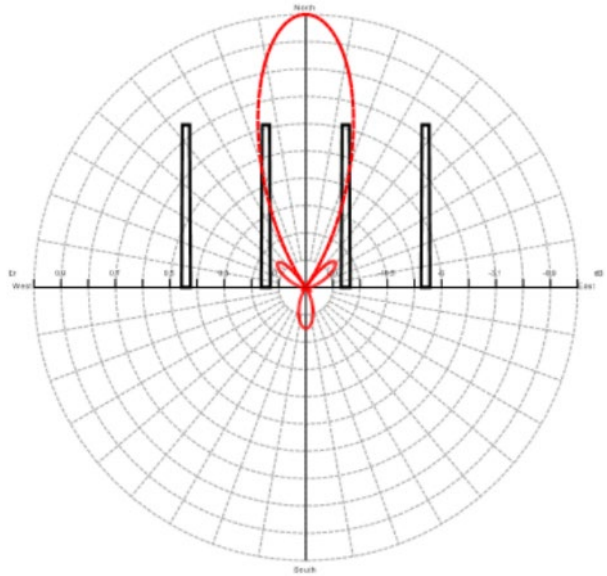
Antenna Design

“Broad-side” Configuration







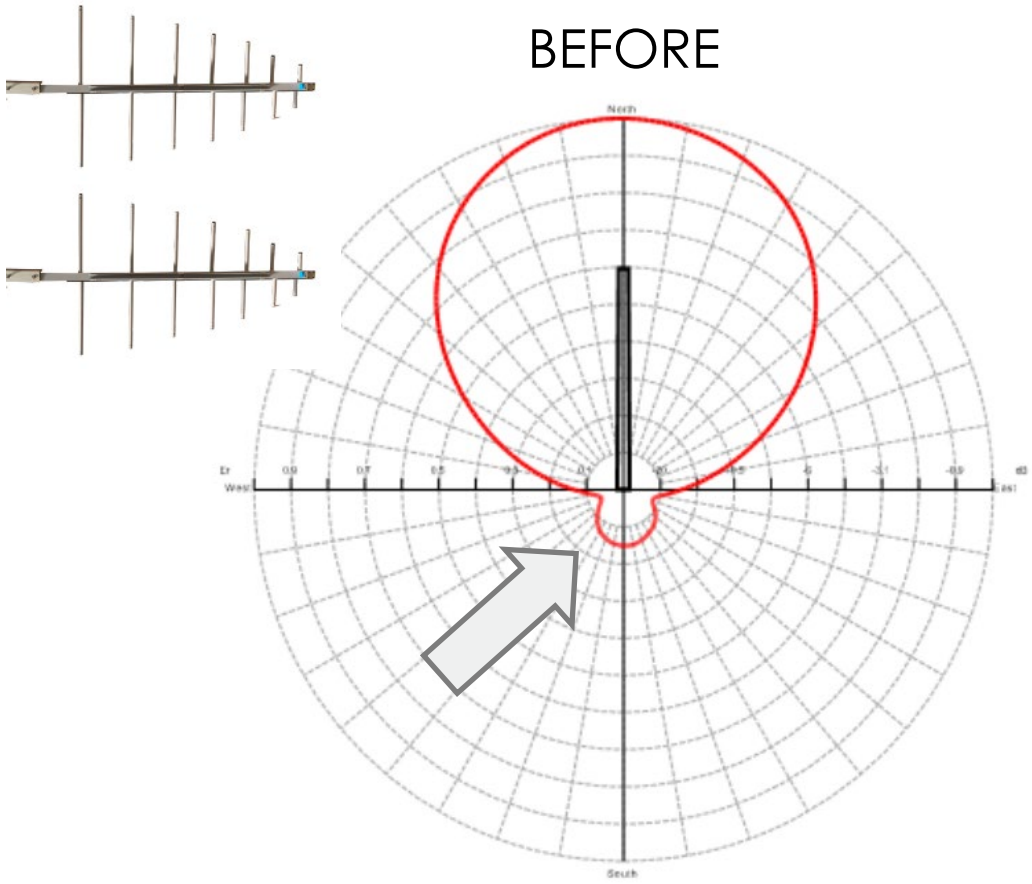


Horizontal Radiation Pattern

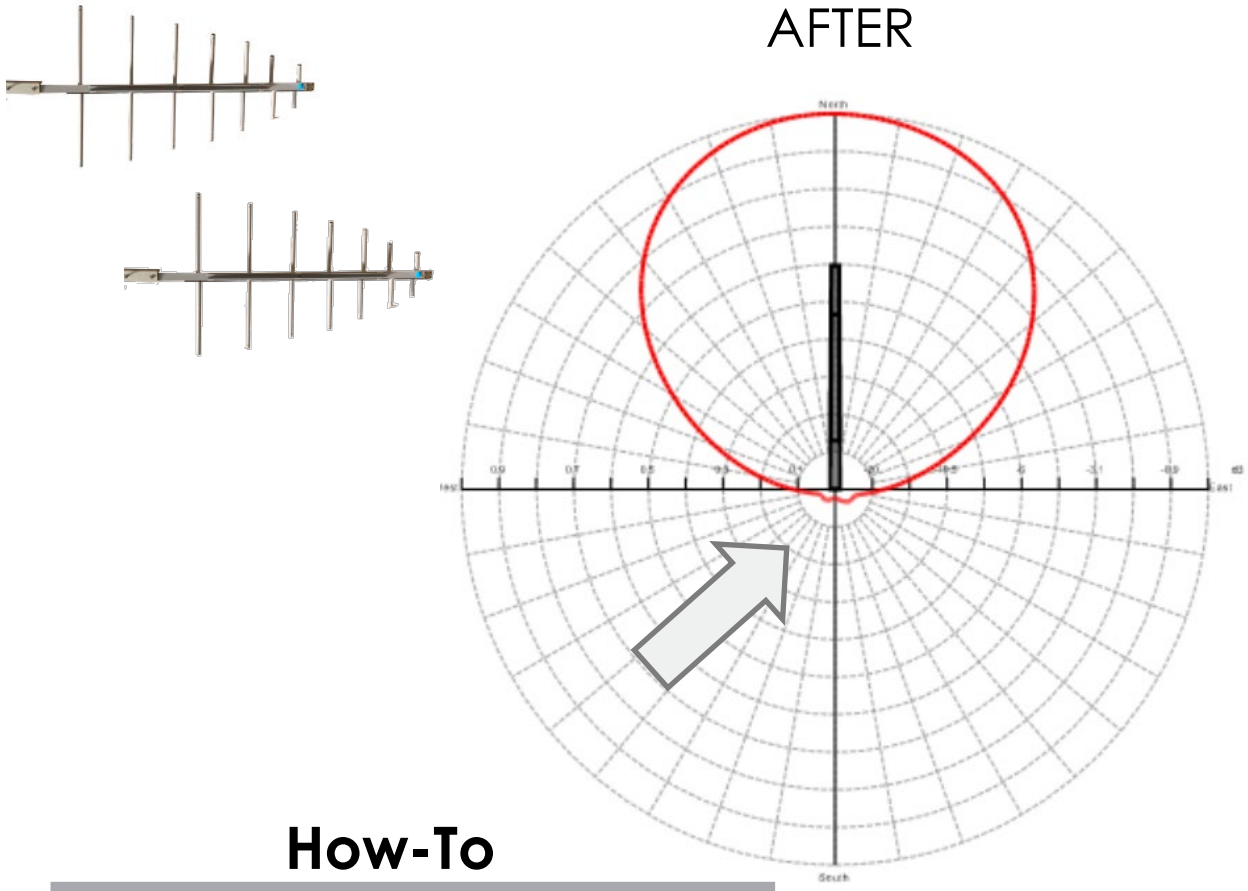
Antenna Design

Front-to-Back ERP Reduction (HELPFUL for Cross-Border coordination/protection)

BEFORE



AFTER



How-To

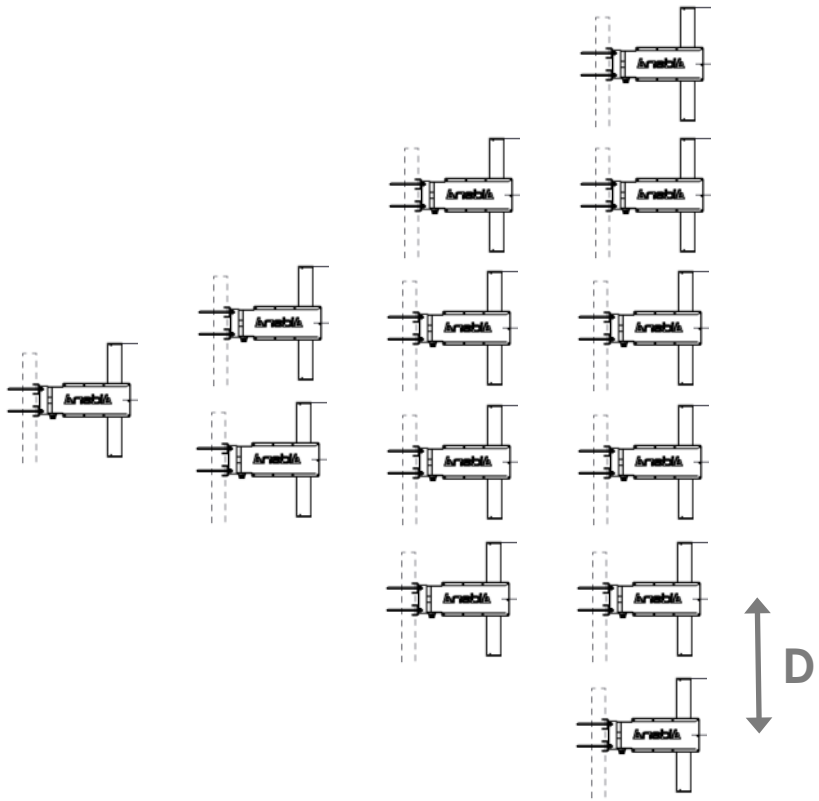
Lower antenna shifted forward and phase compensated

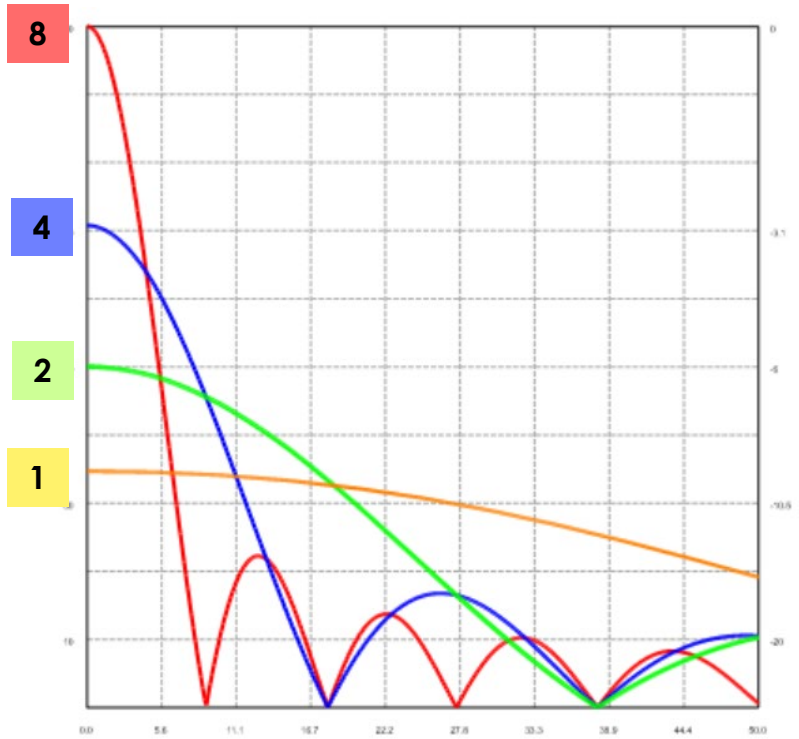
Vertical Radiation Pattern

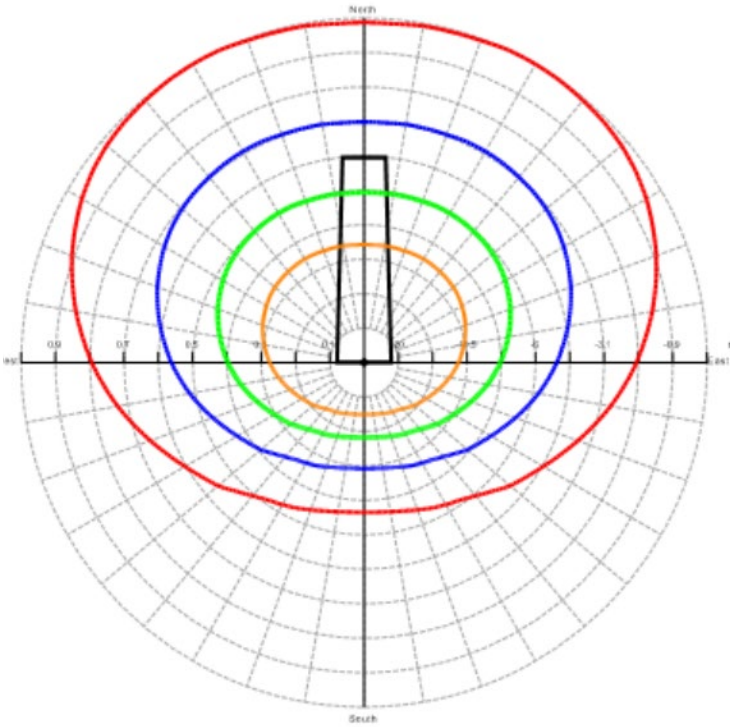
Antenna Design

*General Reference**

1 Antenna	2 Antennas	4 Antennas	8 Antennas
Base GAIN	Base Gain +3dB	Base Gain +6dB	Base Gain +9dB







* D = Vertical Distance, about 0.9λ or 1.4 meter (VHF Band III)

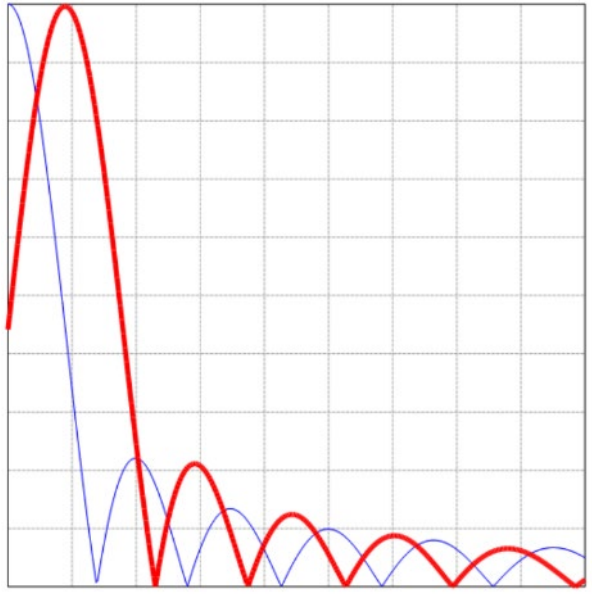
Vertical Radiation Pattern

Antenna Design

VRP DESIGN

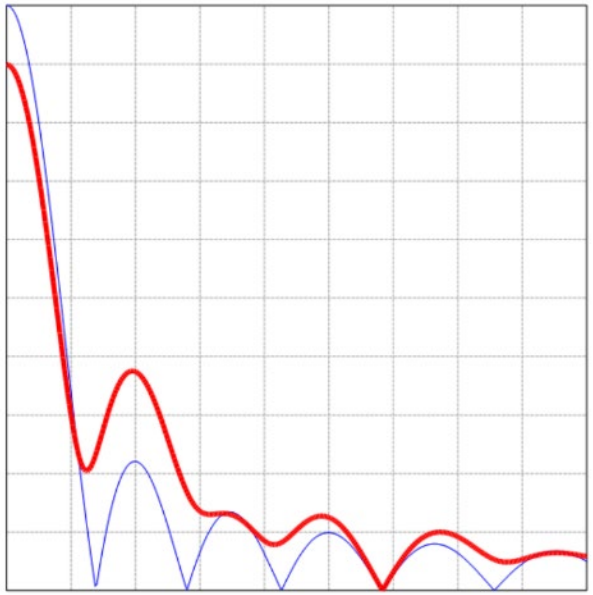
A
Electrical TILT

MORE SERVICE



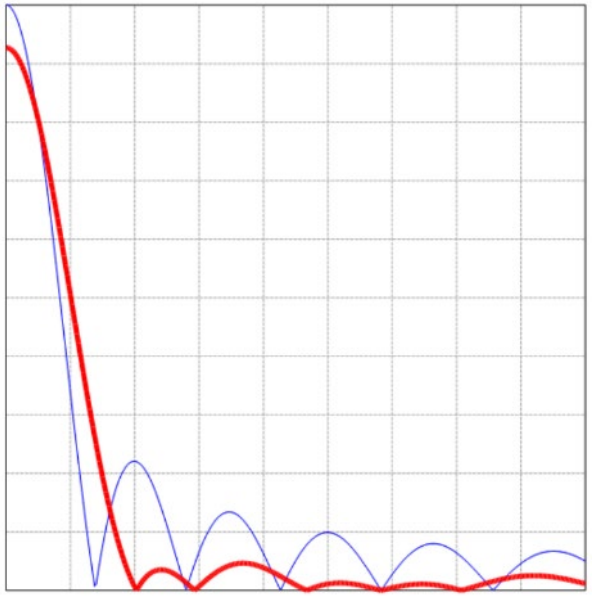
B
Null filling

MORE SERVICE

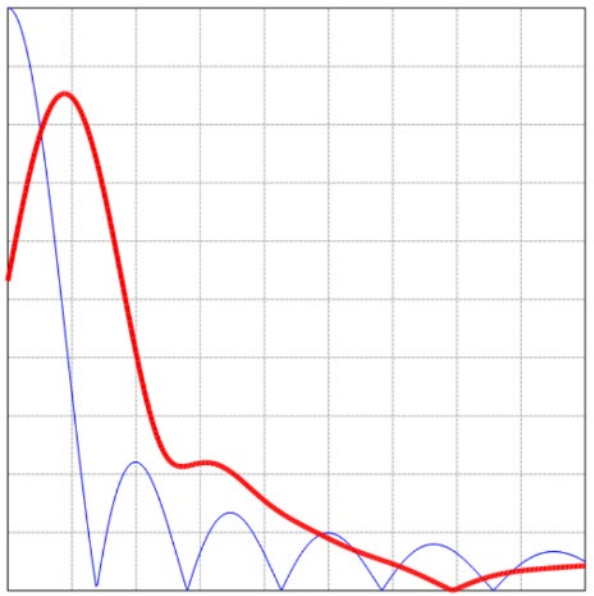


C
Lobes Reduction

LESS EMF RADIATION

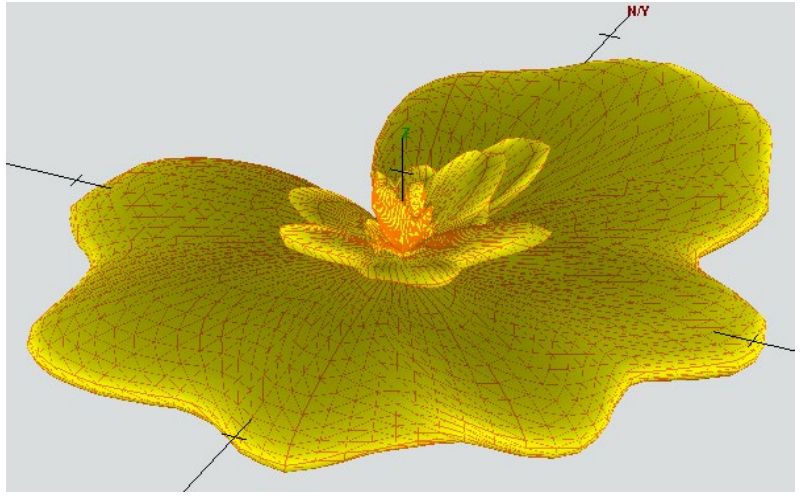


A + B + C

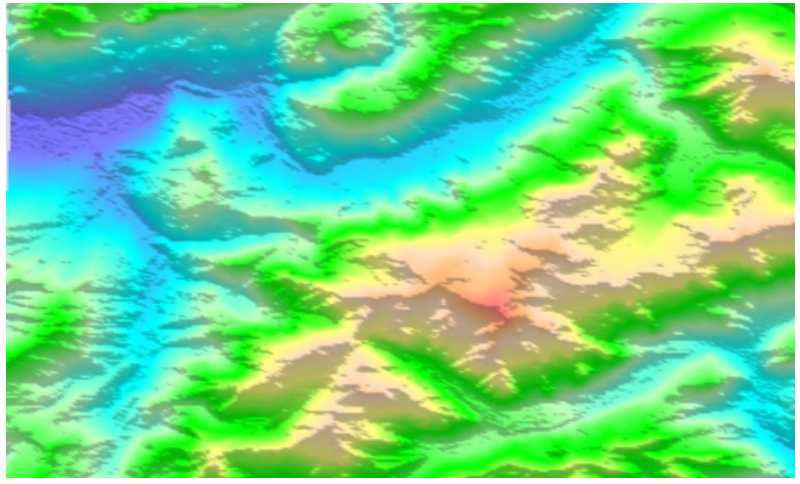


COVERAGE
DAB+ Digital Radio

RELIABLE 3D ANTENNA PATTERN



3D Terrain

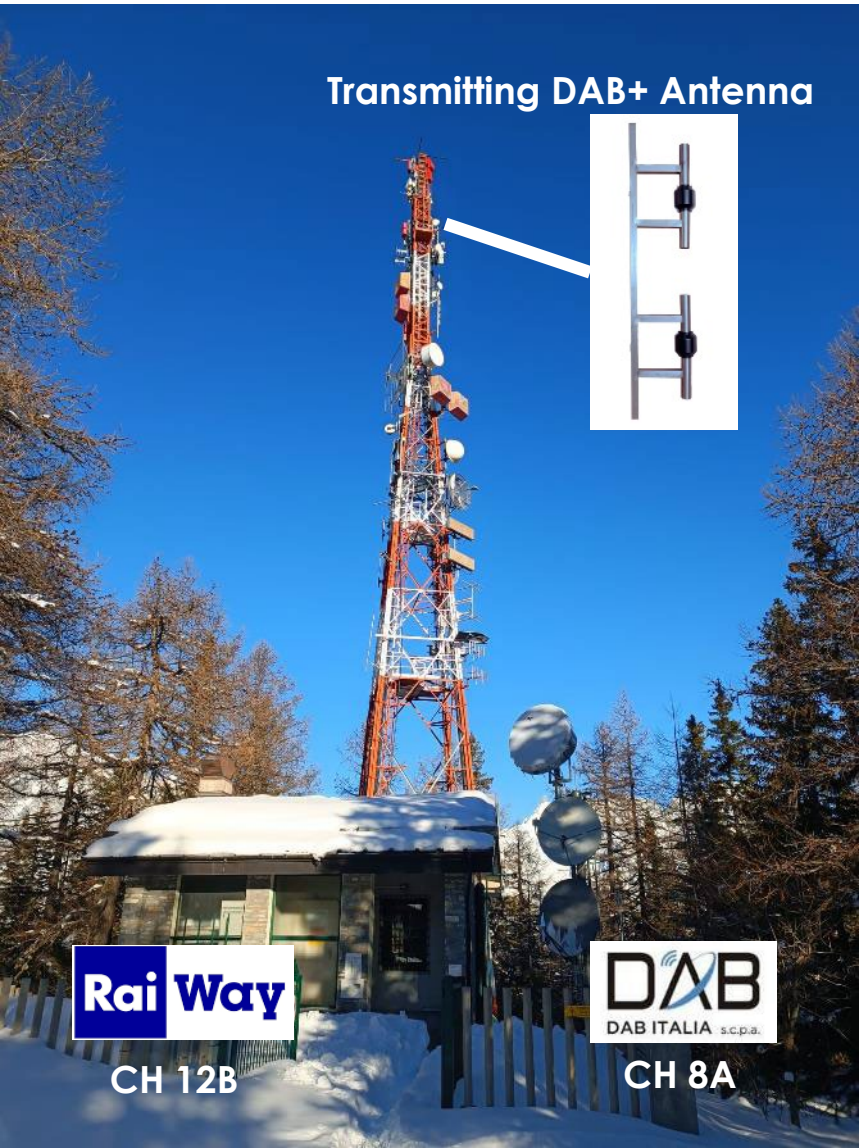


PROPAGATION MODELS FOR BROADCASTING
- Most Used -

	ITU-R P. 1812-7	ITU-R P. 1546-6
Type	Deterministic	Empirical
Path Profile	Uses complete terrain profile (Specific Path)	Uses Effective Antenna height (General Path)
Main	30 MHz -3GHz 0.25km -3000km 1% < time < 50% 1% < locations < 99% Rx/Tx hgt agl<= 3km	30 MHz -4GHz 1 km -1000km 1% < time < 50% 1% < locations < 99% Rx/Tx hgt agl<= 3km
	coverage planning	interference analysis

COVERAGE & MEASUREMENTS

Case Study : ITALY – Valle D'Aosta Region



COVERAGE & MEASUREMENTS

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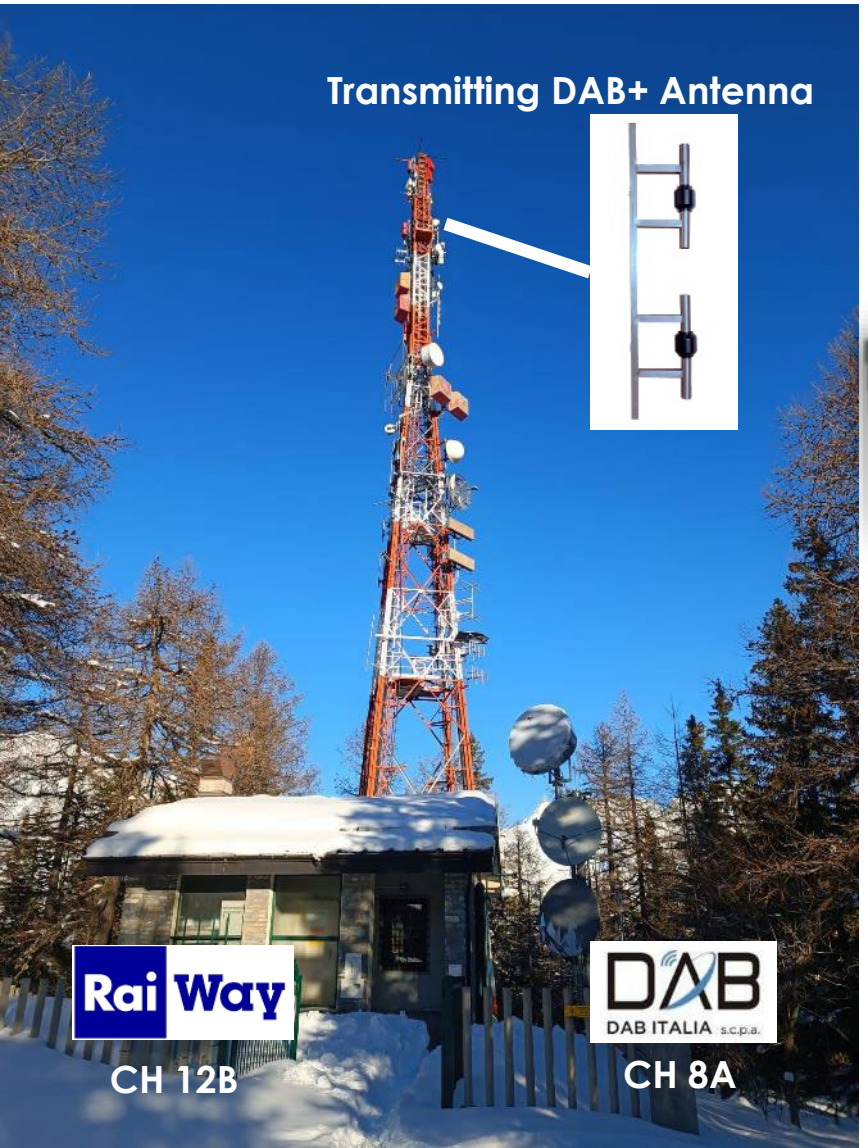
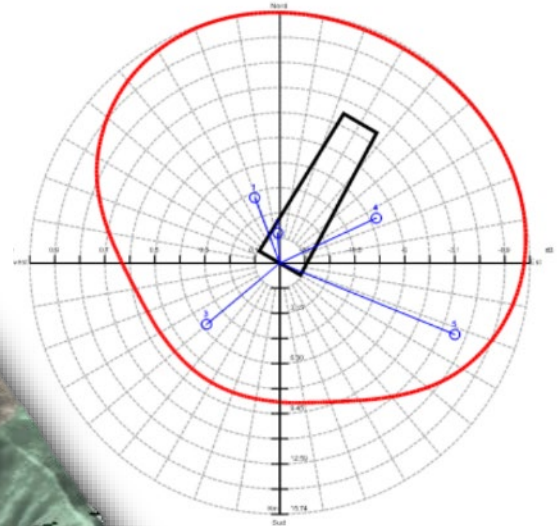
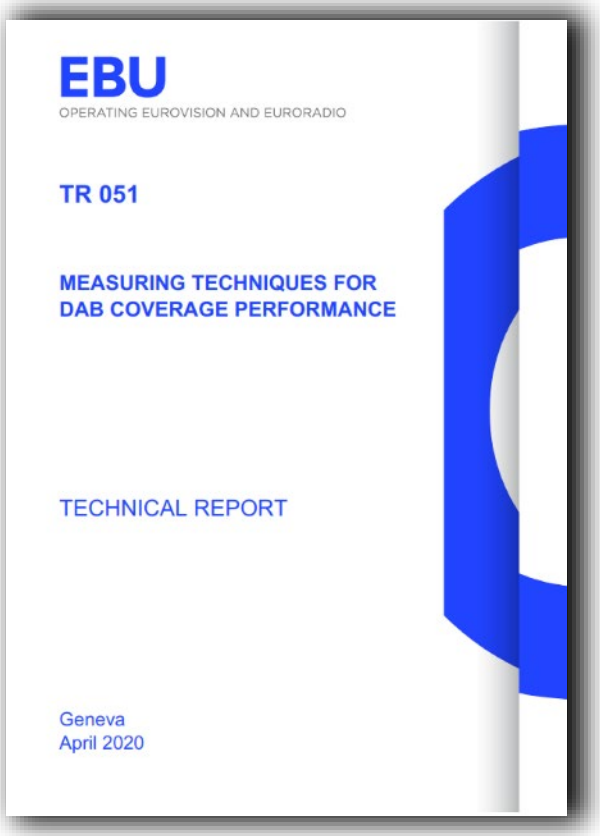




ERP ≈ 0.3 KW

MEASUREMENTS
DAB+ Digital Radio

Tech Report 051
Various use cases for measuring DAB network coverage are presented



➢ **SERVICE QUALITY**

Example: Verifying outdoor coverage for mobile reception quality in car (DRIVE TEST)

Tech Report 051 Quality Scale suggested

No service: E <35 dBµV/m or E ≥35 dBµV/m and MSC not detected (no audio - FIC could be detected)

Adequate service: E ≥35 dBµV/m; MSC detected and MSC BER ≤ $5*10^{-2}$

Good/excellent service: E ≥ 35 dBµV/m; MSC detected and MSC BER ≤ $2*10^{-2}$

No Service

Adequate

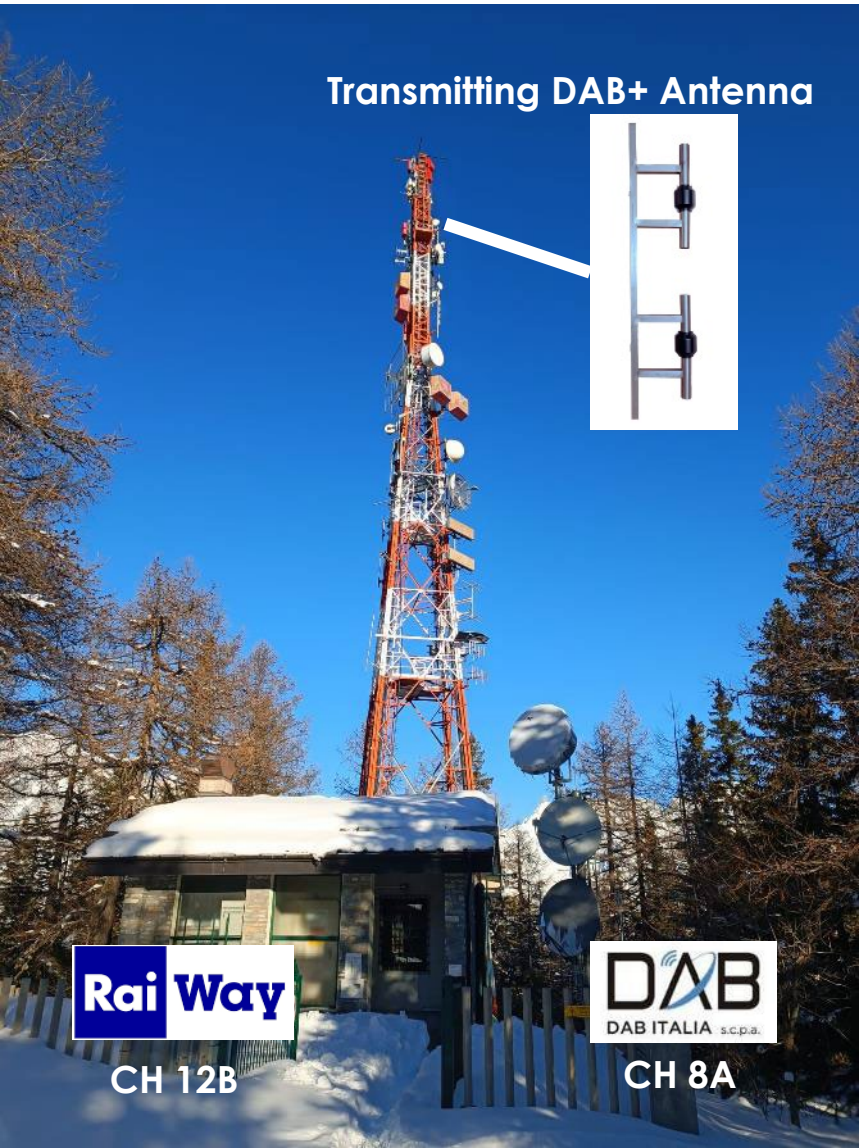
Excellent

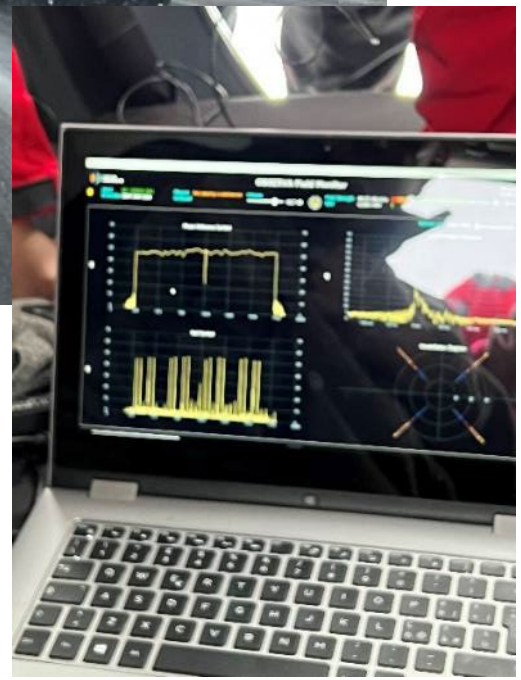
Equipments:
- A roof mounted antenna, (typically a centrally mounted ¼ λ whip antenna)
- Gps ANTENNA/RECEIVER
- Dab RECEIVER analyzer
- Dedicated tool
- ….

Example kit
Observa (Factum Radioscape)

COVERAGE & MEASUREMENTS

Case Study : ITALY – Valle D'Aosta Region





COVERAGE & MEASUREMENTS

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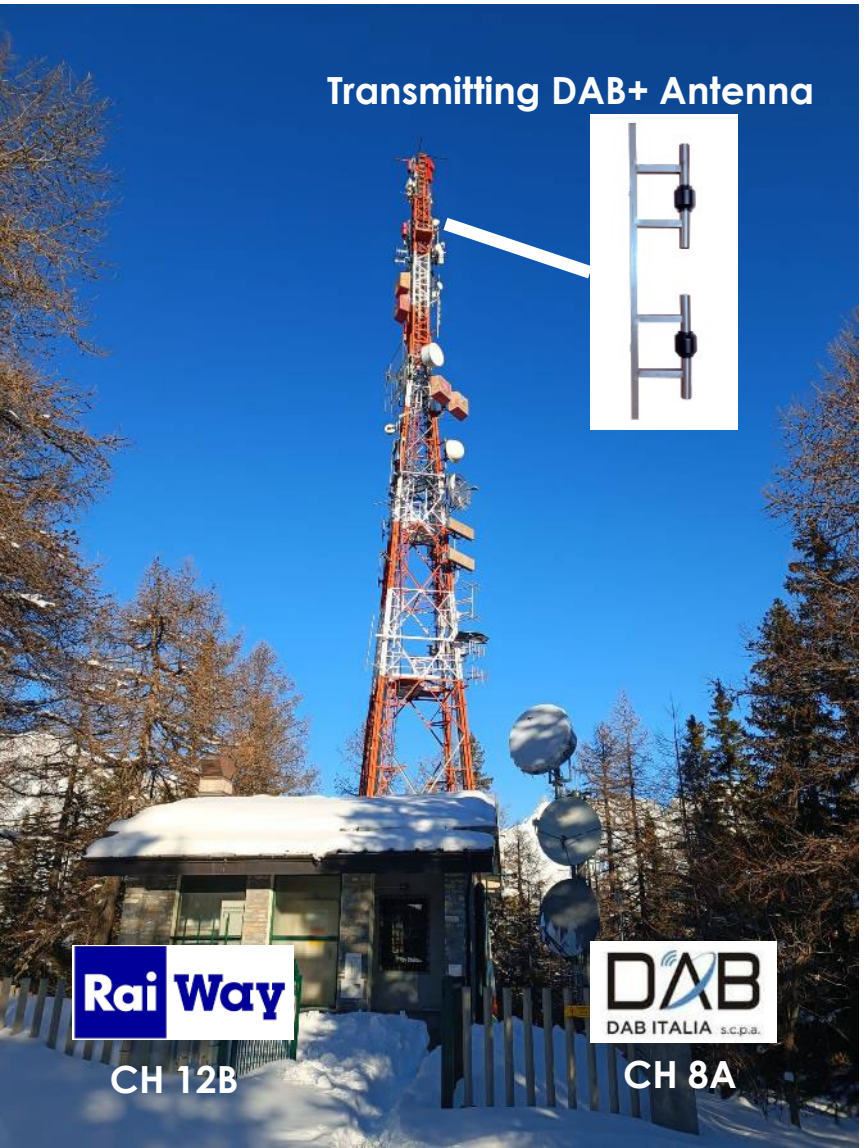
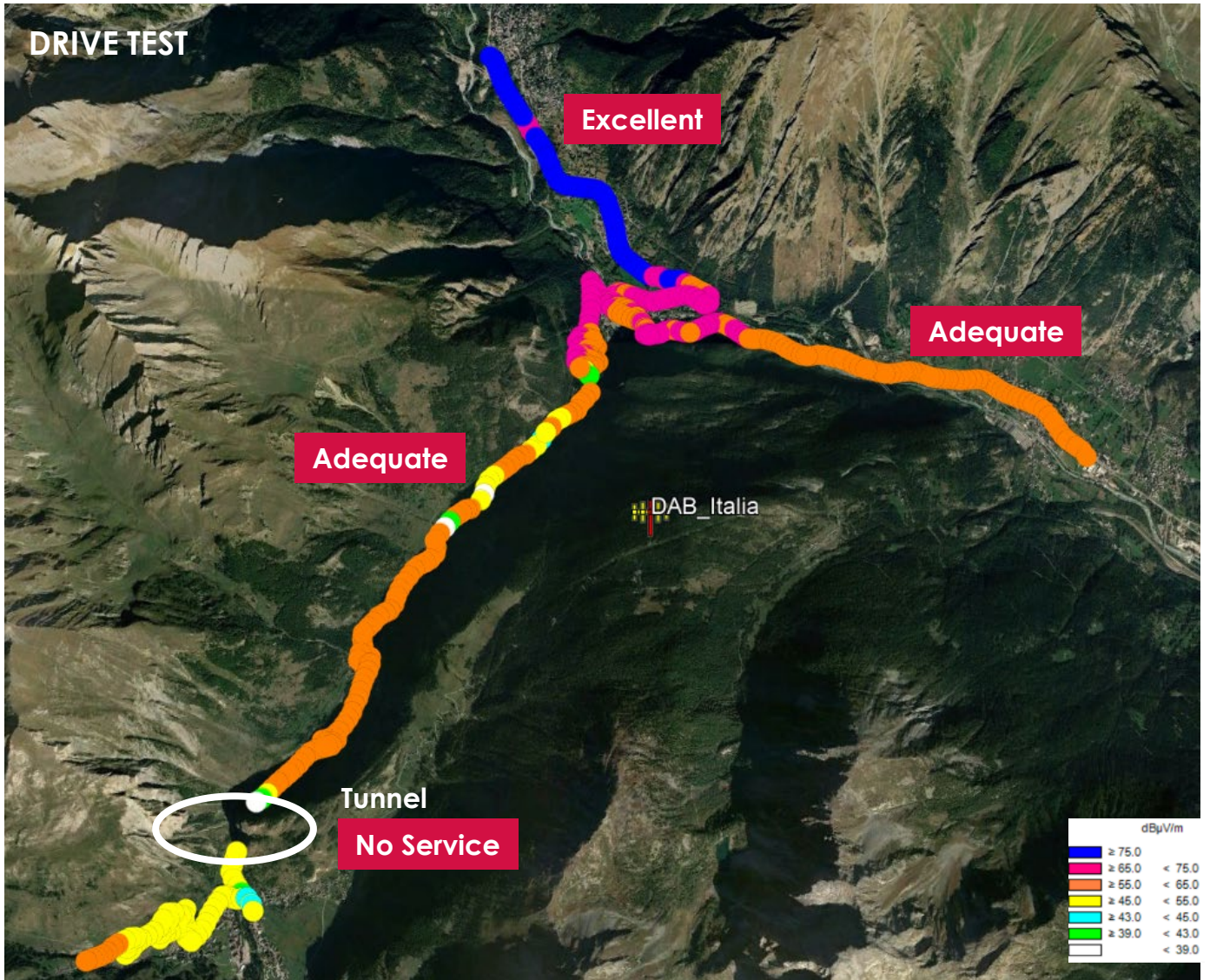
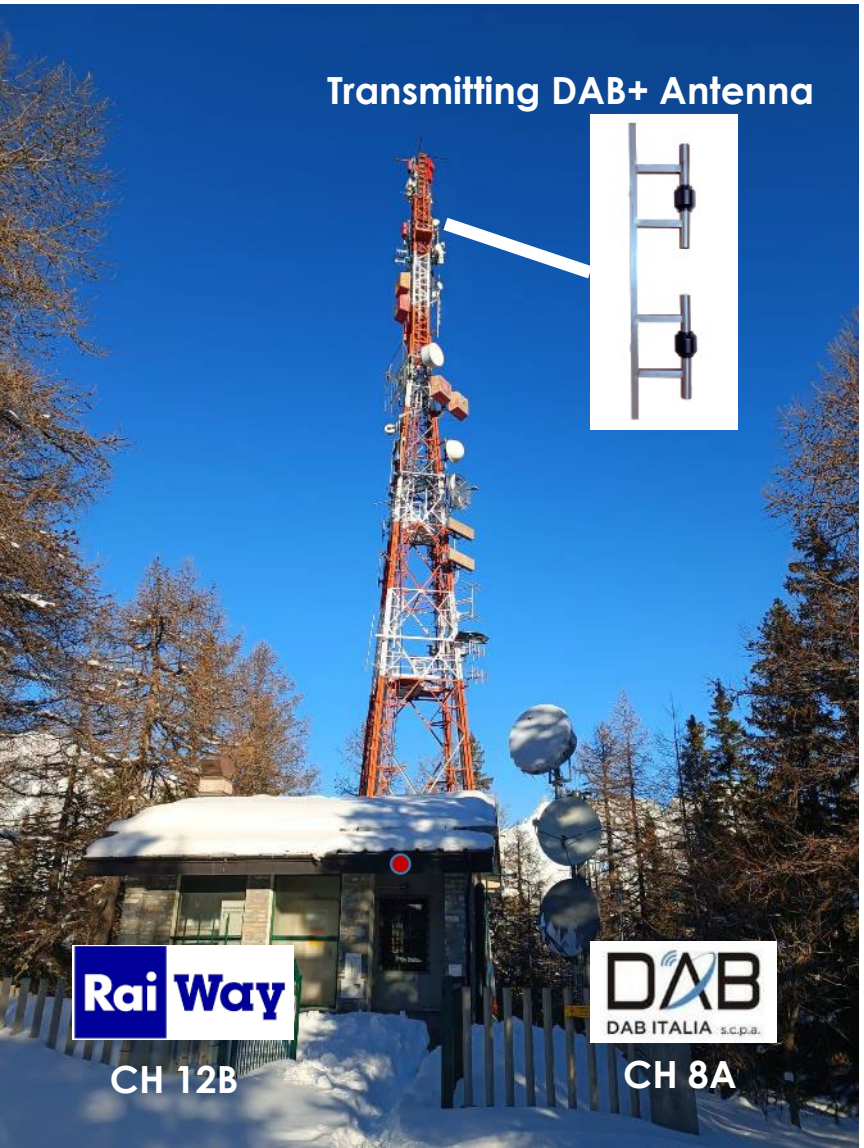
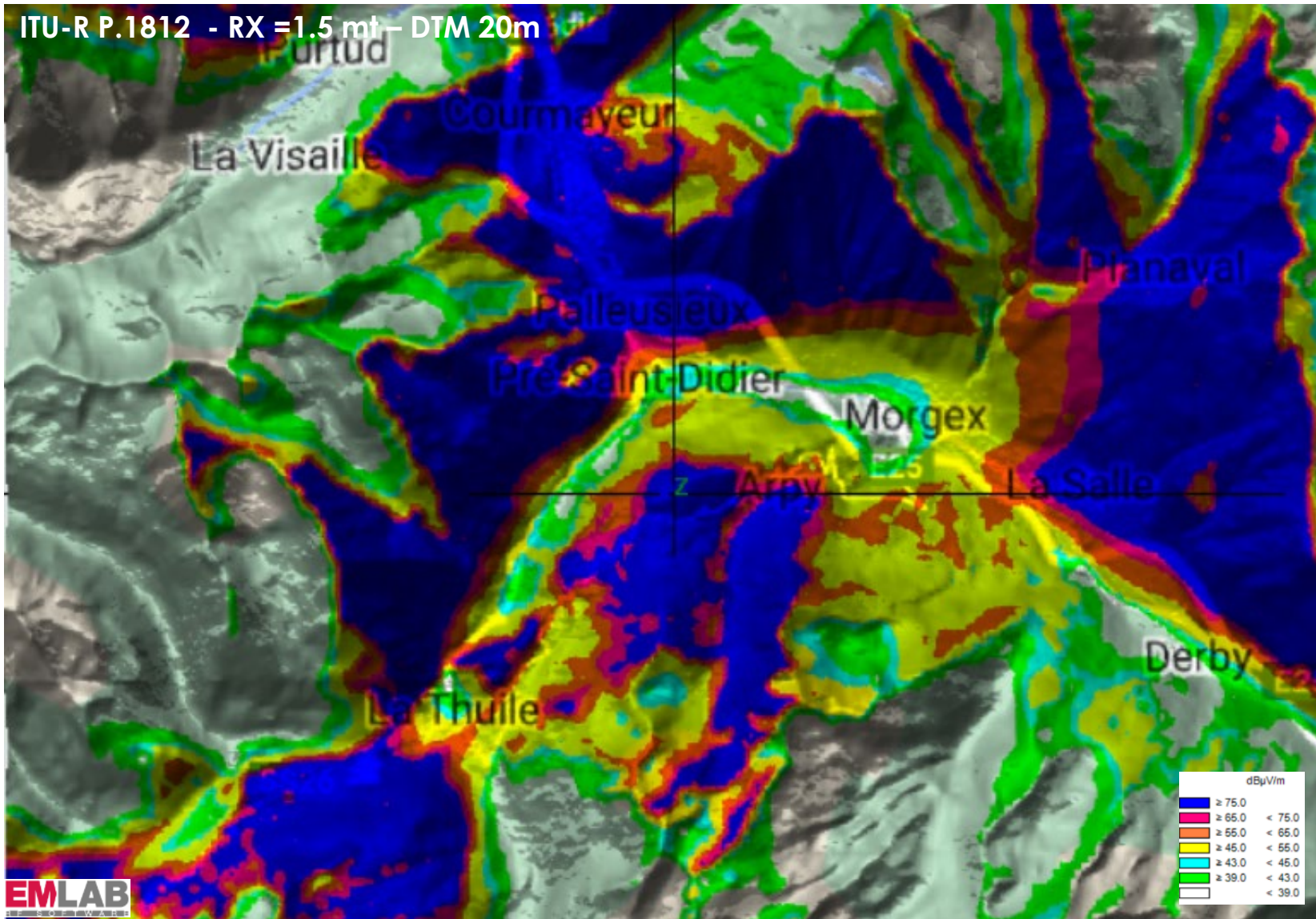




COVERAGE & MEASUREMENTS

Case Study : ITALY – Valle D'Aosta Region





COVERAGE & MEASUREMENTS

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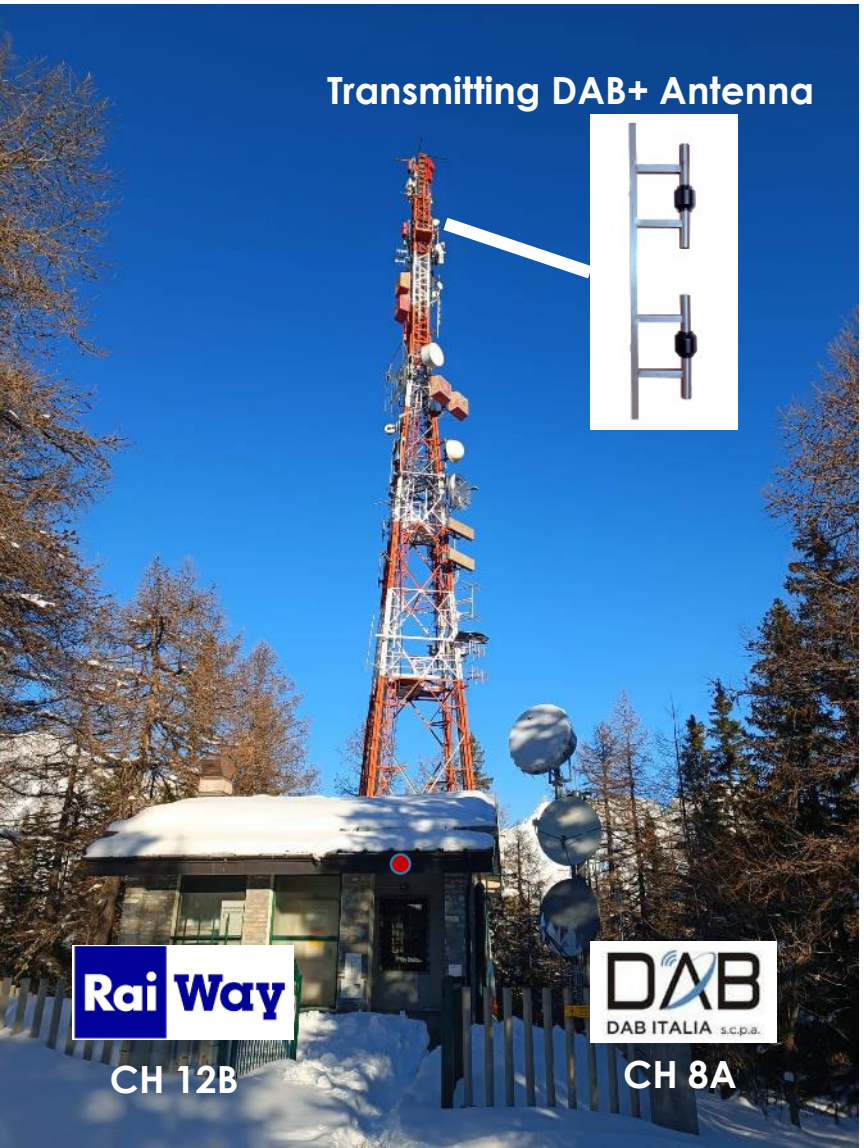

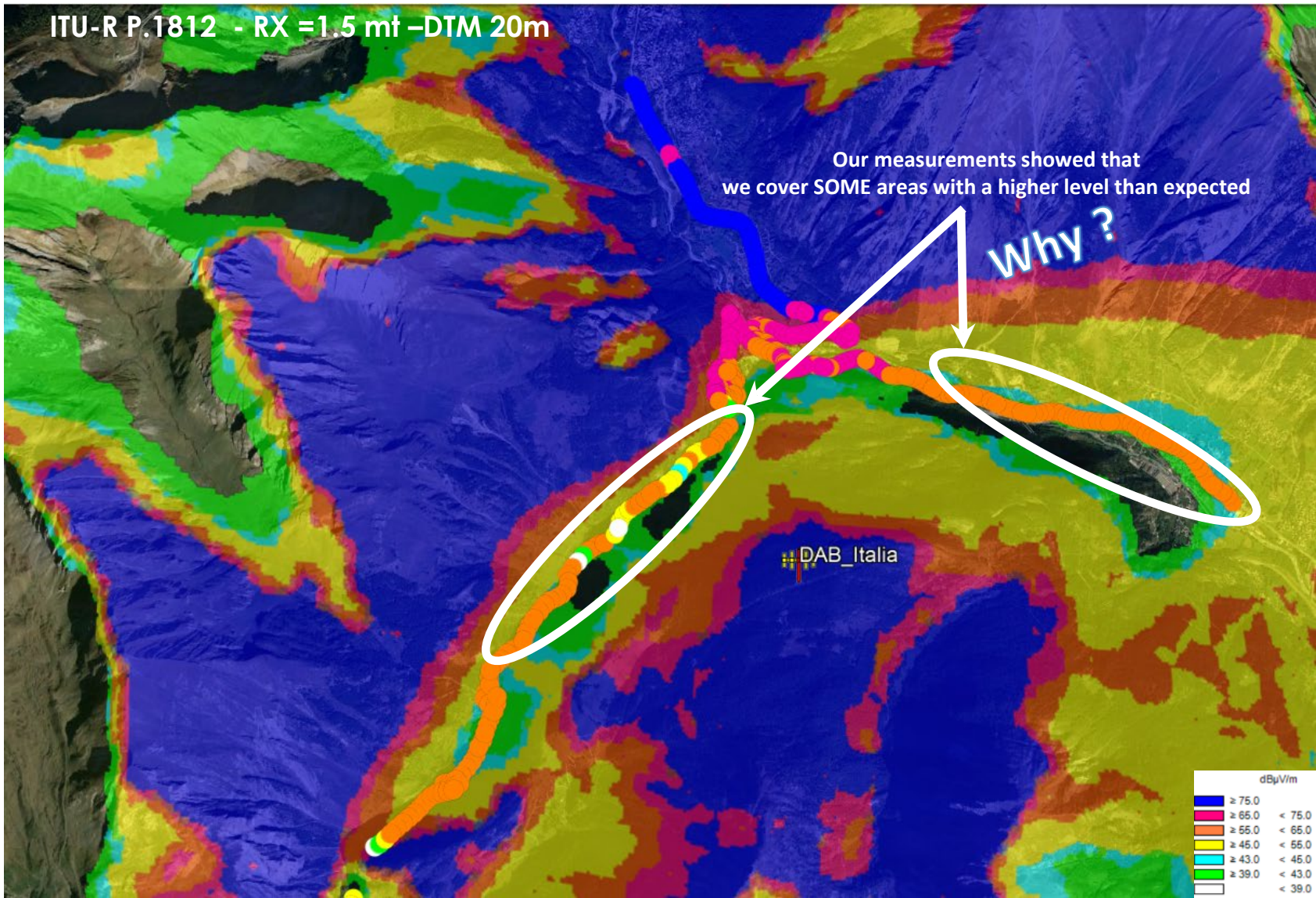

MEASUREMENTS
DAB+ Digital Radio

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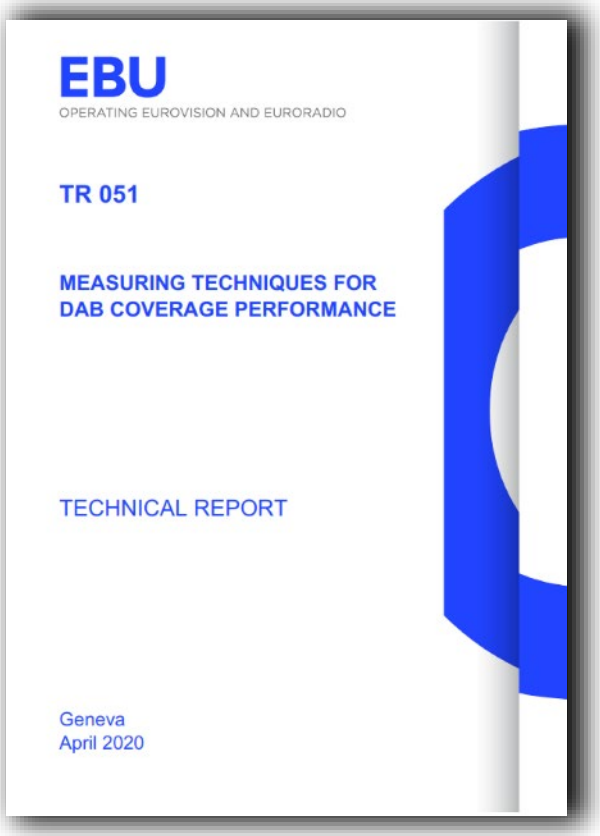


➢ **NETWORK QUALITY**

Example: Verifying planning prediction with reality (Ground-Based measurements)

Tech Report 051 check point selection criteria suggestion

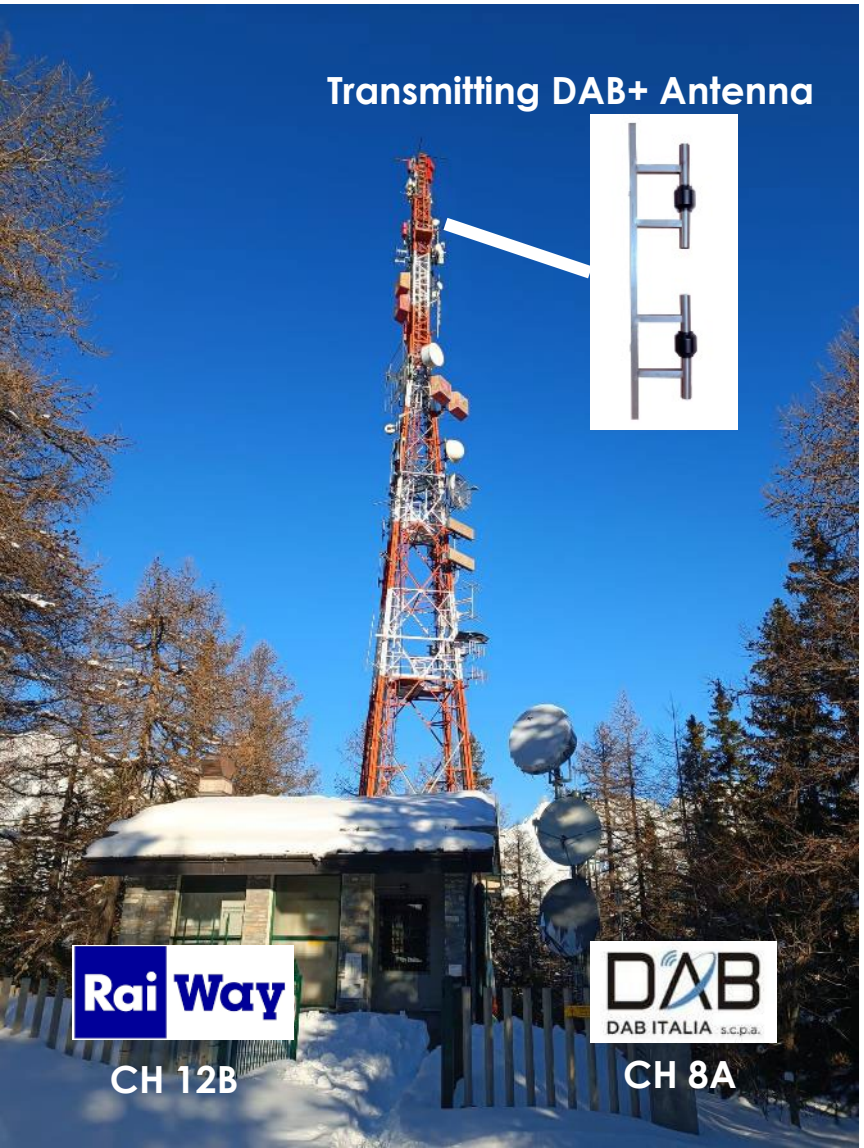
- Knowing the wanted antenna pattern (vertical and horizontal)
- Line of sight from the selected location to the transmitter is mandatory

… for accurate measurement results,
one should measure the field strength
within the direction of the main beam of the vertical diagram
with max -1 dB attenuation ….

Equipments:
- A rotable fixed antenna (omnidirectional or directional log periodic antenna)
- Field Strenght measured between 3.5 – 10 Meters
- Gps ANTENNA/RECEIVER
- Dab RECEIVER analyzer
- Dedicated tool
- ….

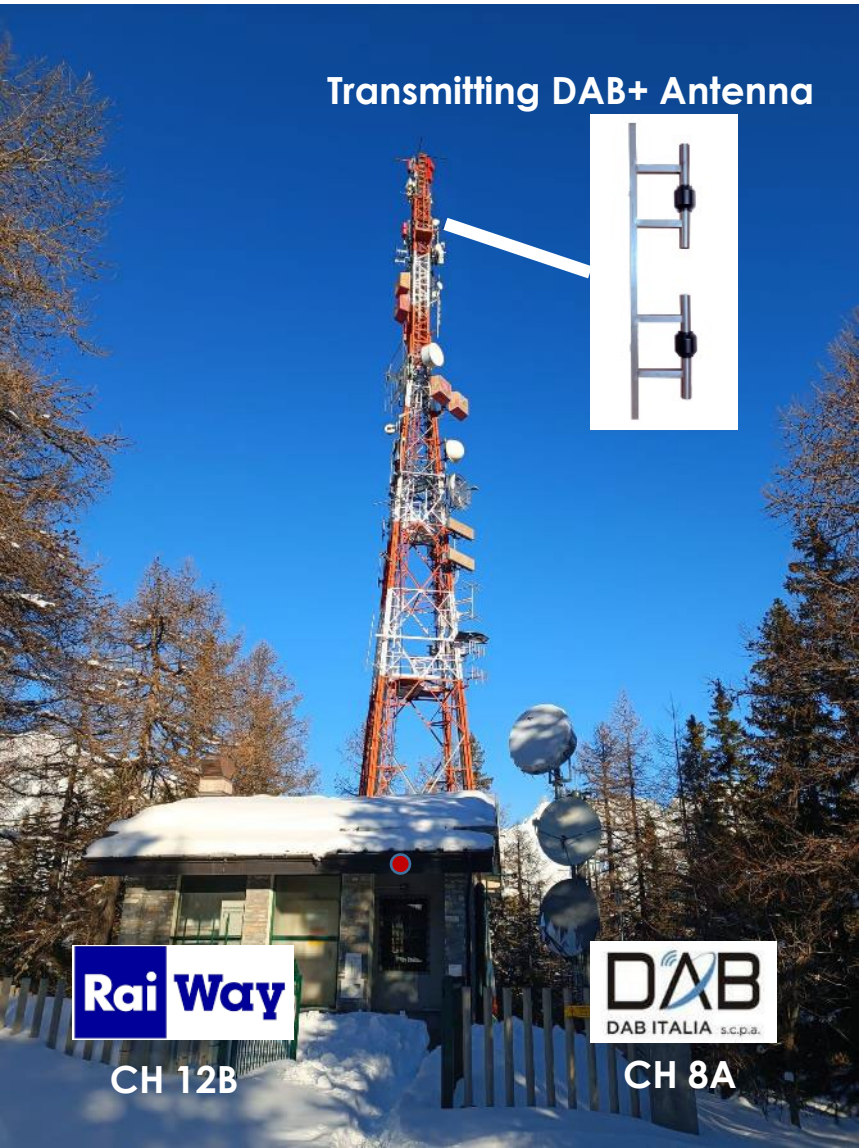
COVERAGE & MEASUREMENTS

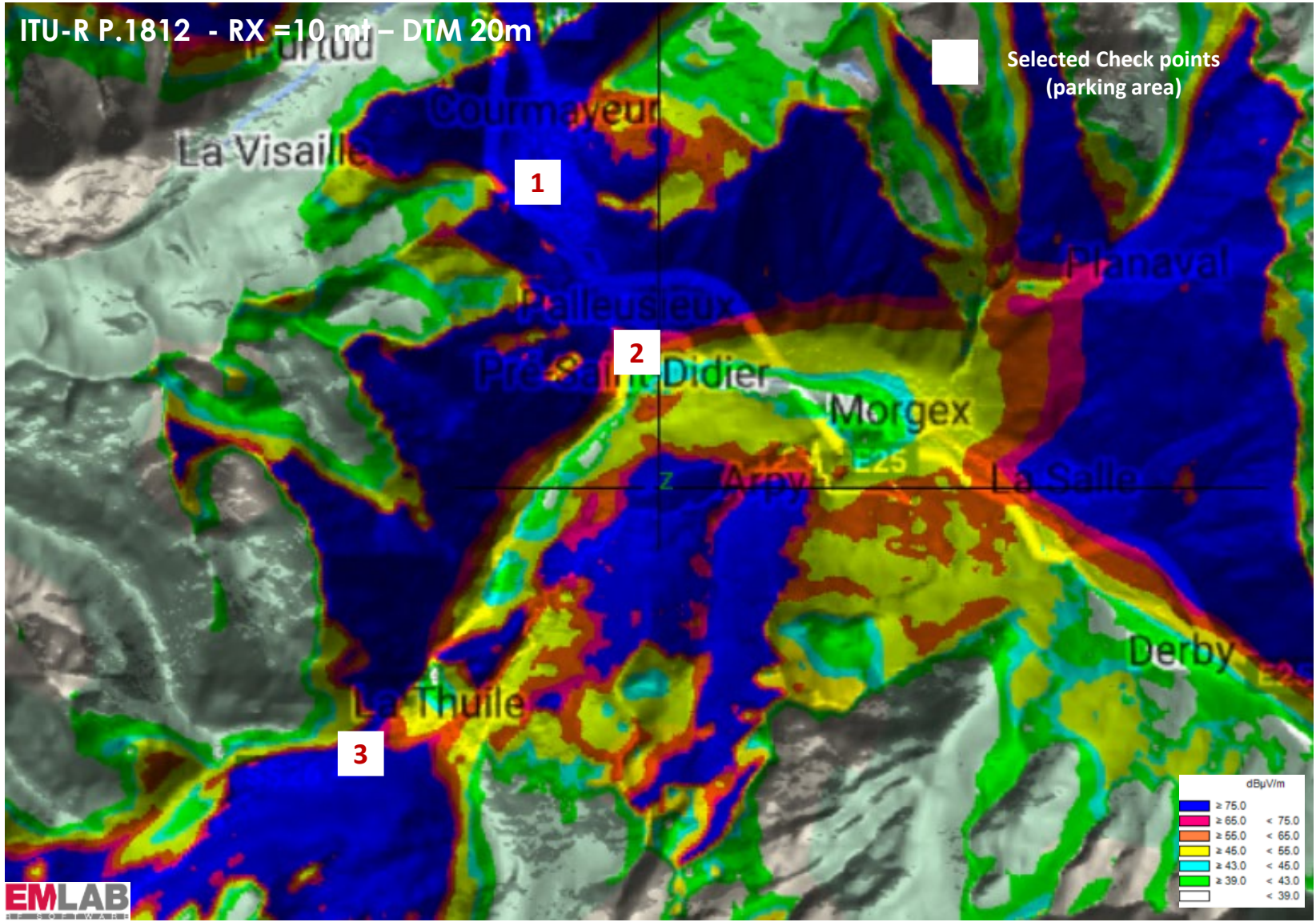
Case Study : ITALY – Valle D'Aosta Region



COVERAGE & MEASUREMENTS

Case Study : ITALY – Valle D'Aosta Region





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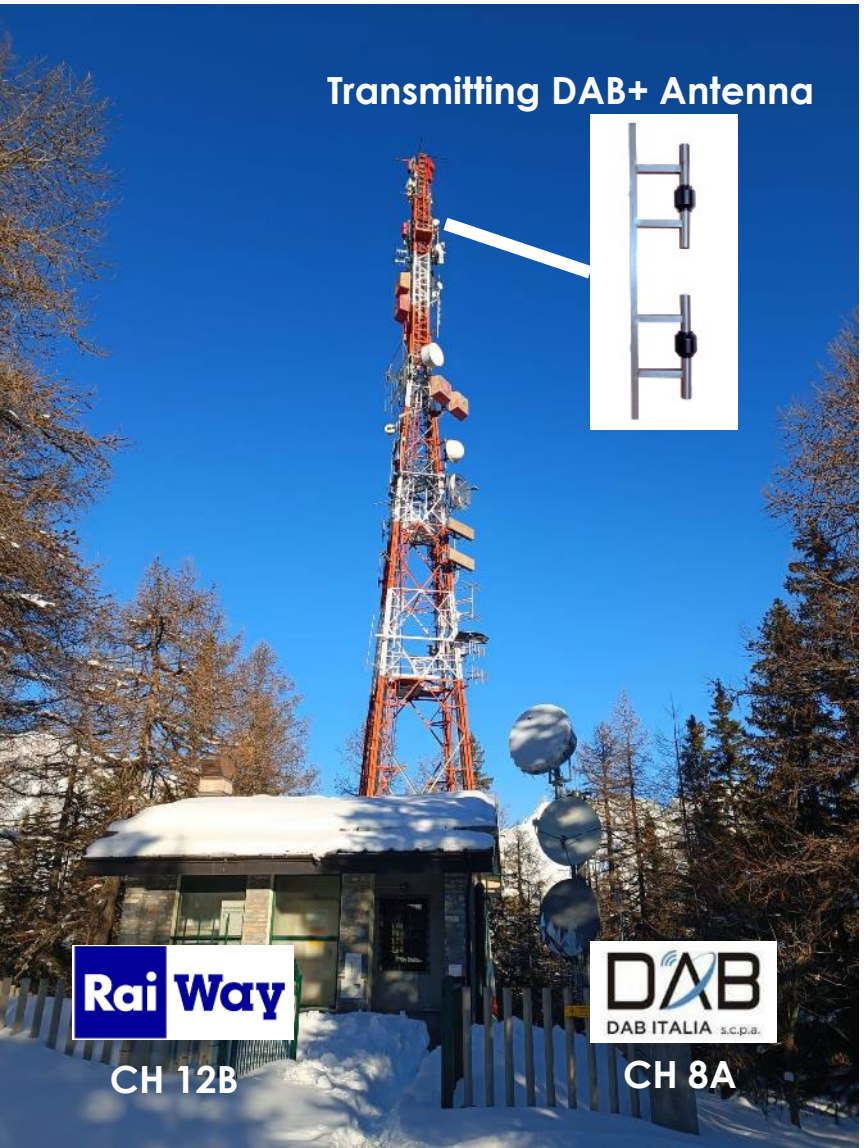
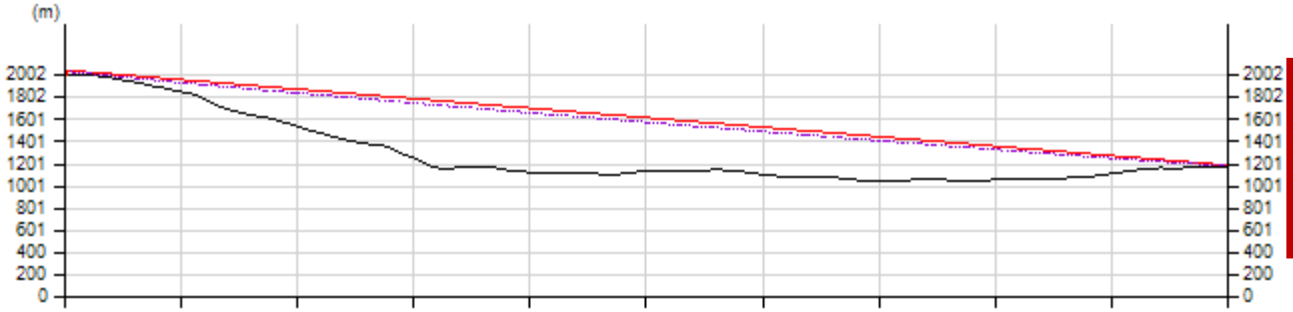
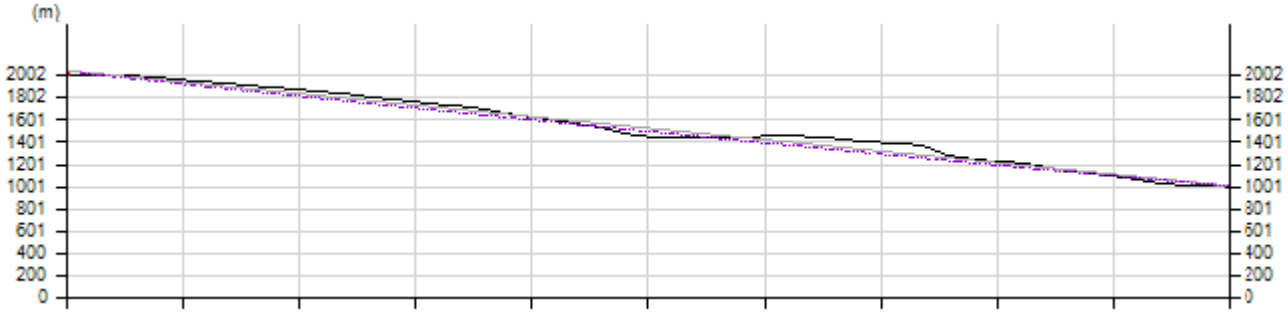


1



LOS: YES
Simulation matches measure

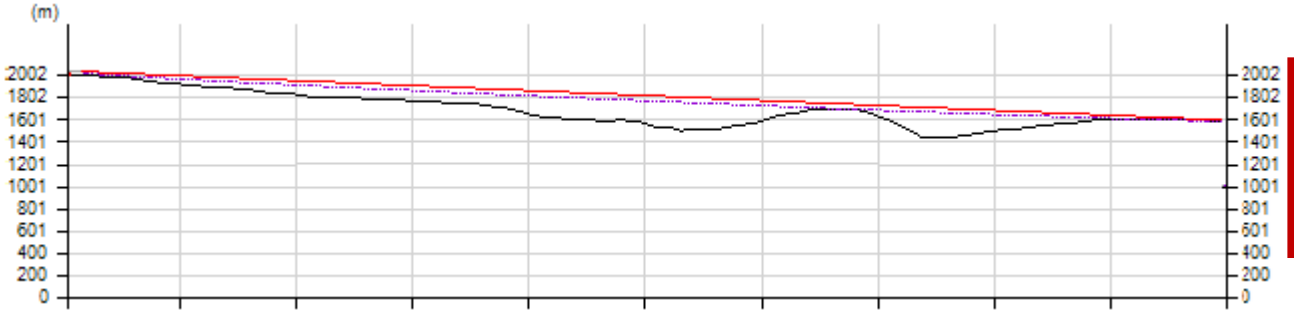
2



LOS: NO
Simulation DOESN'T match measure

Why ?

3



LOS: YES (Partially)
Simulation matches measure

COVERAGE & MEASUREMENTS

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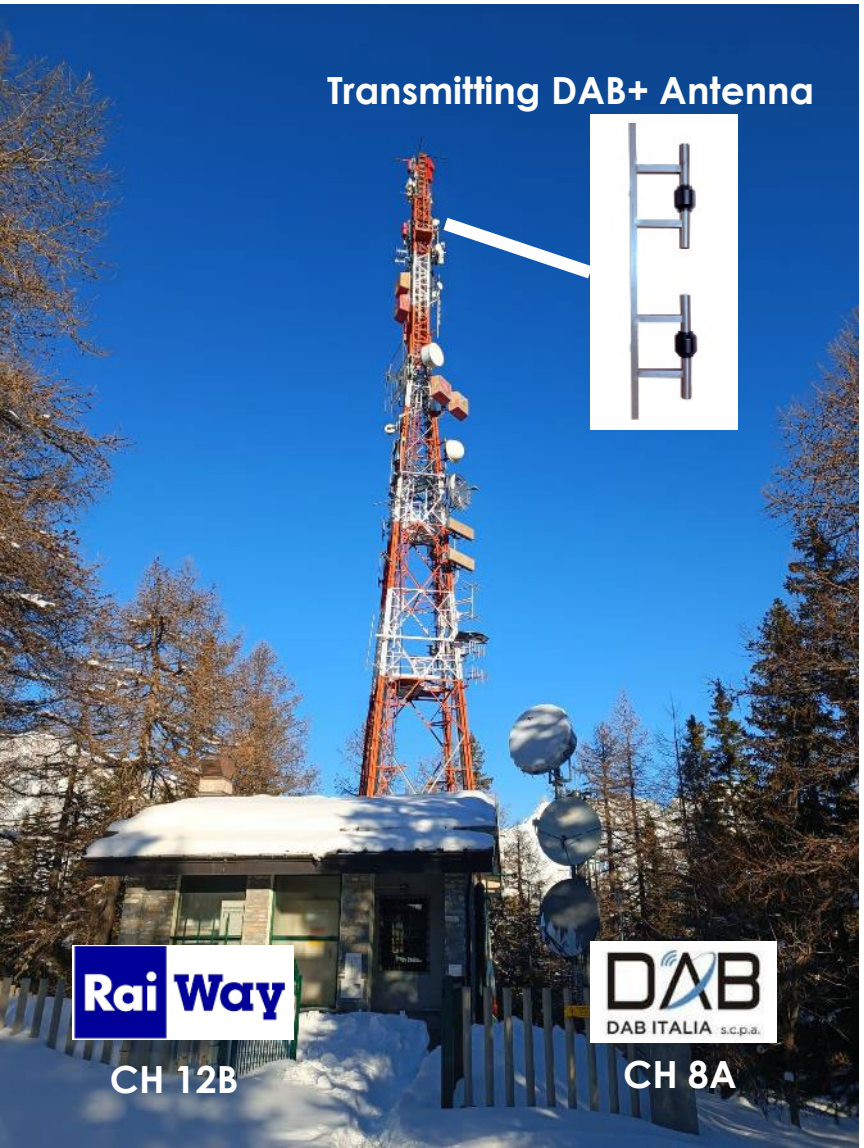
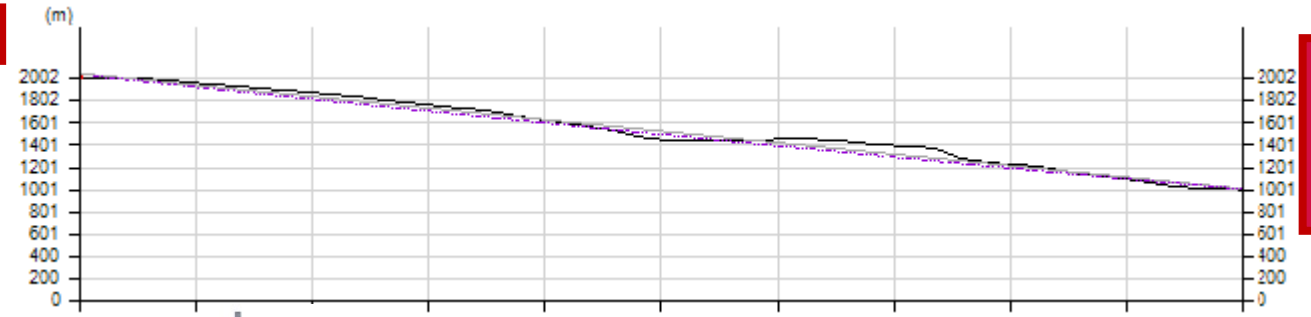
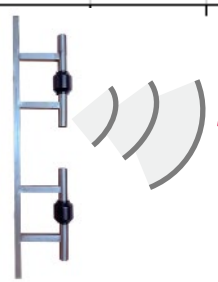


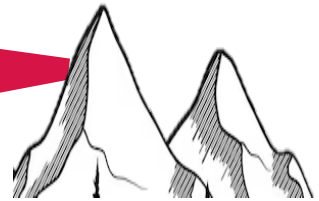
2



LOS: NO Simulation DOESN'T match measure

Because





Reception better than prediction!!!!

Signal from the opposite direction

REFLECTIONS!!!!

Conclusions
DAB+ Digital Radio

Planning is a continuous improvement

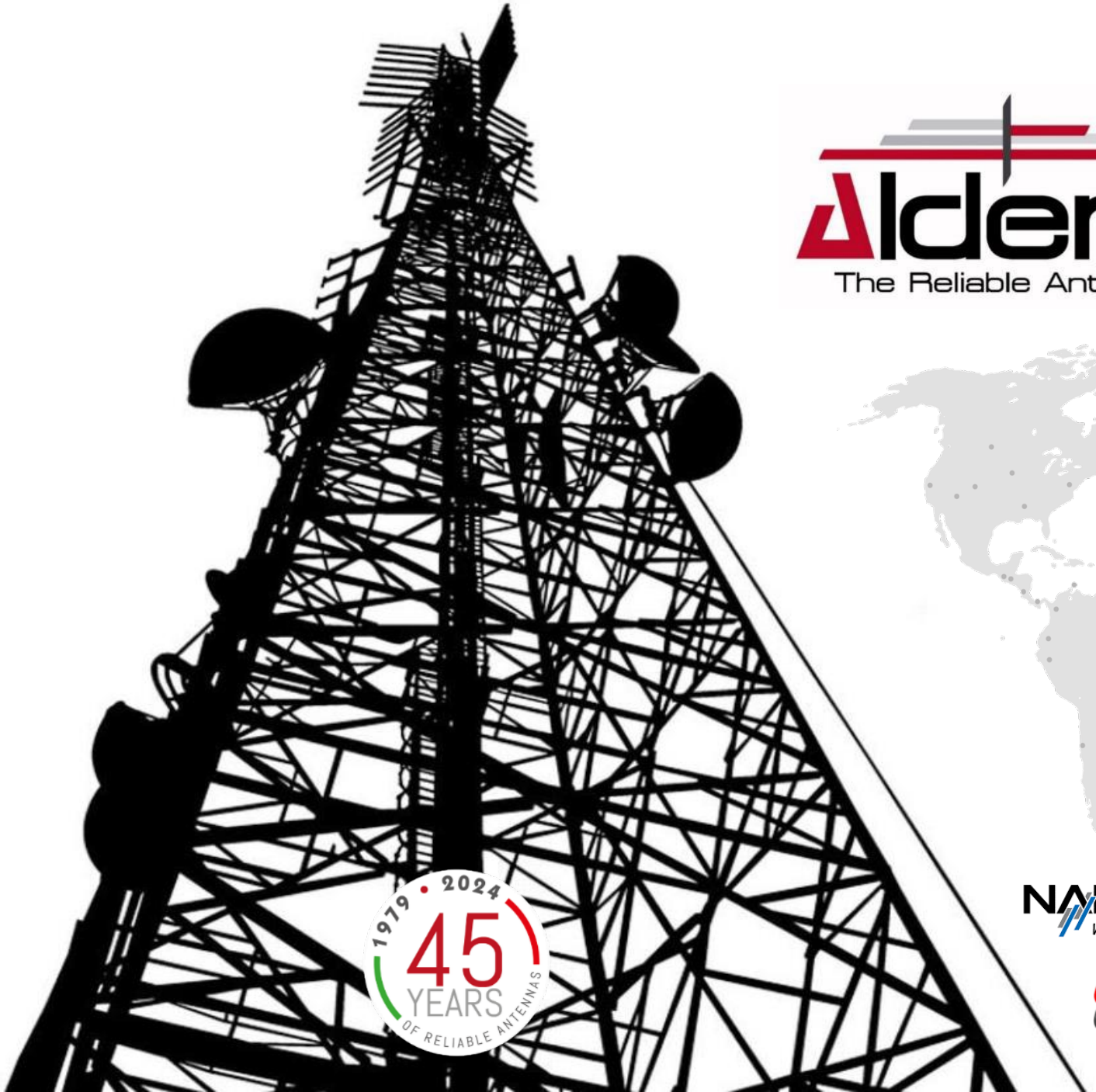
- ✓ Good planning can save SIGNIFICANT cost

- ✓ Antenna design is the "foundation" to build your network
- ✓ Make the antenna project "simple" by
  choosing the right … antenna!
  (It's possible to keep it simple also in presence
  of ERP restrictions)

- ✓ Use Field measurements to:
  --"tune" the used models
  -- gain KNOW-HOW for future coverage problem solving

- ✓ Scenarios evolve and so your network, don't be afraid to revise and adapt your planning

- ✓ Good planning needs good measurements too



Aldena
The Reliable Antennas

worlddab

Thank you!

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CABSAT

See you soon

BroadcastAsia