SFN synchronisation in complex environments

1° SNIC SEMINAR, Budapest, 22 May 2019

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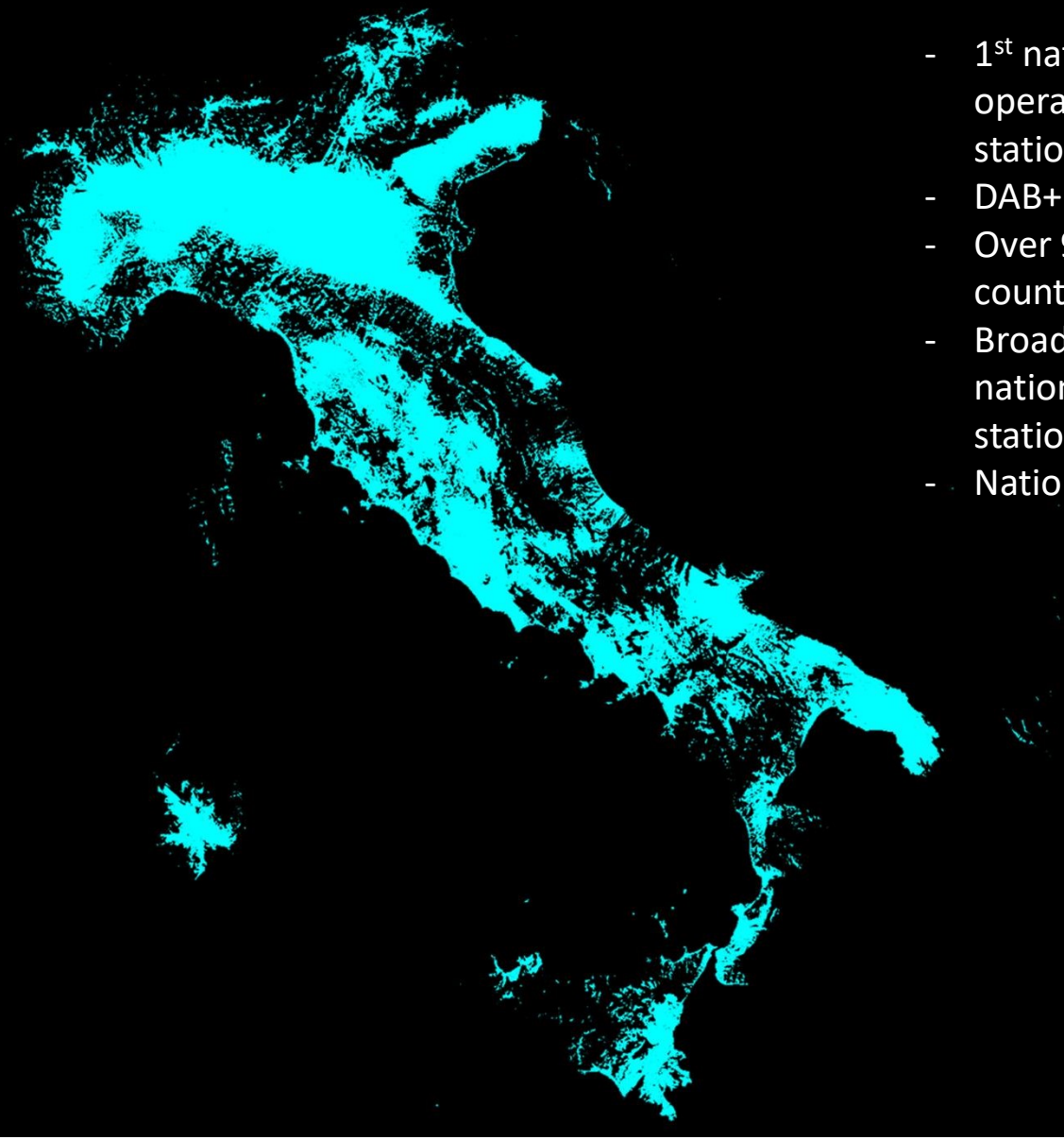
Introduction

- DAB Italia scpa
- Territory
- Why SFN???
- Transmitters sites and coverage build-up
- Approach to planning and tools
- Lessons learned



- 1st national DAB network operator –> consortium of radio stations
- DAB+ since 2007
- Over 90 active sites…and counting!
- Broadcasting 18 stations, 8 national simulcast service, 7 new stations and 3 test channels
- National SFN

DAB ITALIA s.c.p.a.


Territory

Territory

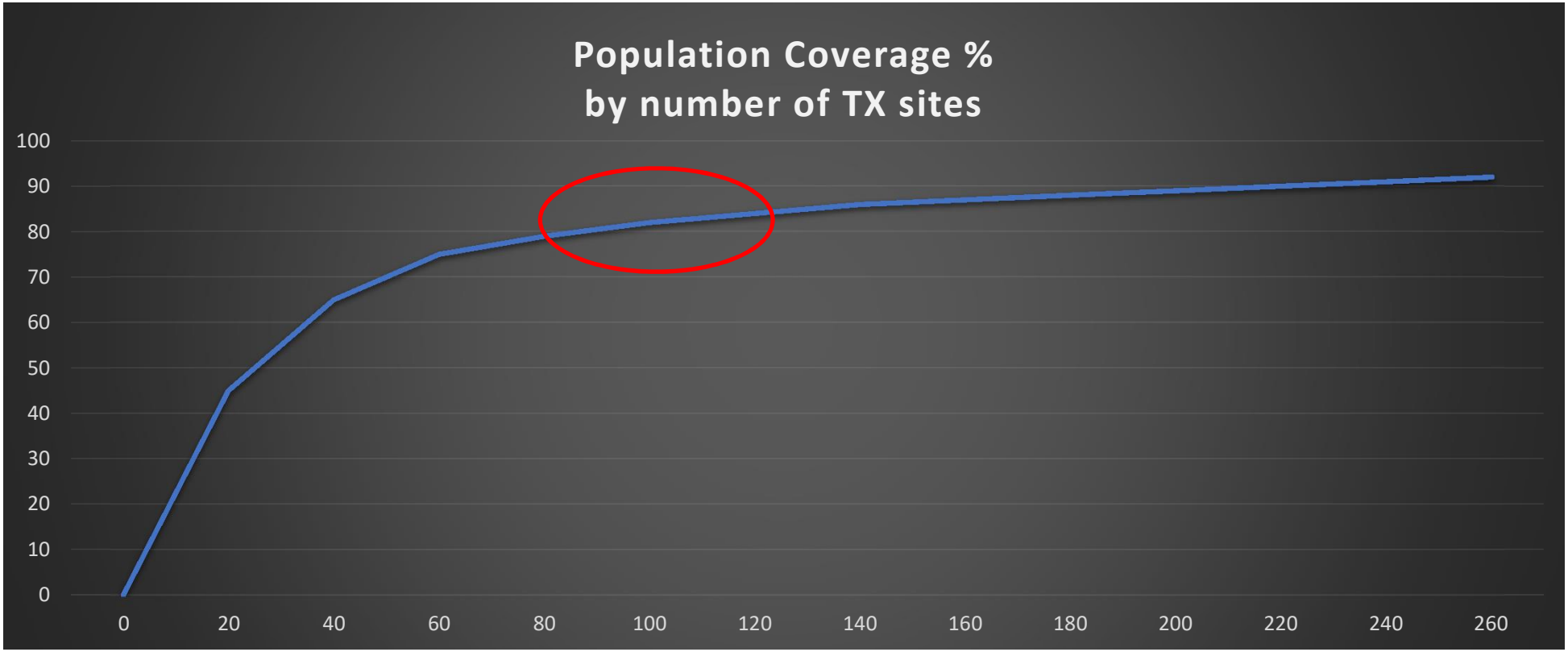
- Italy has a very complex landscape
- We have…
  - Very large flat areas surrounded by high mountains
  - Lots and lots of hilly terrain
  - Lots of real mountains and deep valleys
  - 2 really big islands: Sardinia and Sicily
  - Lots of smaller islands too…
  - High mountains next to the sea
  - An endless coastline
  - Lots of warm water supporting great propagation effects
  - Many many neighbors!

Transmitter sites and coverage build-up

Transmitter sites

- Towers
  - Big towers
  - Small towers
  - Full towers
  - Towers which are difficult to reach
  - ….
- Ownership
  - Big tower companies like EiTowers or INWIT
  - Public tower company RaiWay
  - Local operators

Coverage build-up




Why SFN?

Why SFN?

1. Most efficient use of radio spectrum
2. Easier HW management
    1. Antennas
    2. Filters
    3. Transmitters
3. Network gain and coverage augmentation
4. No switching/service following issues on car radios

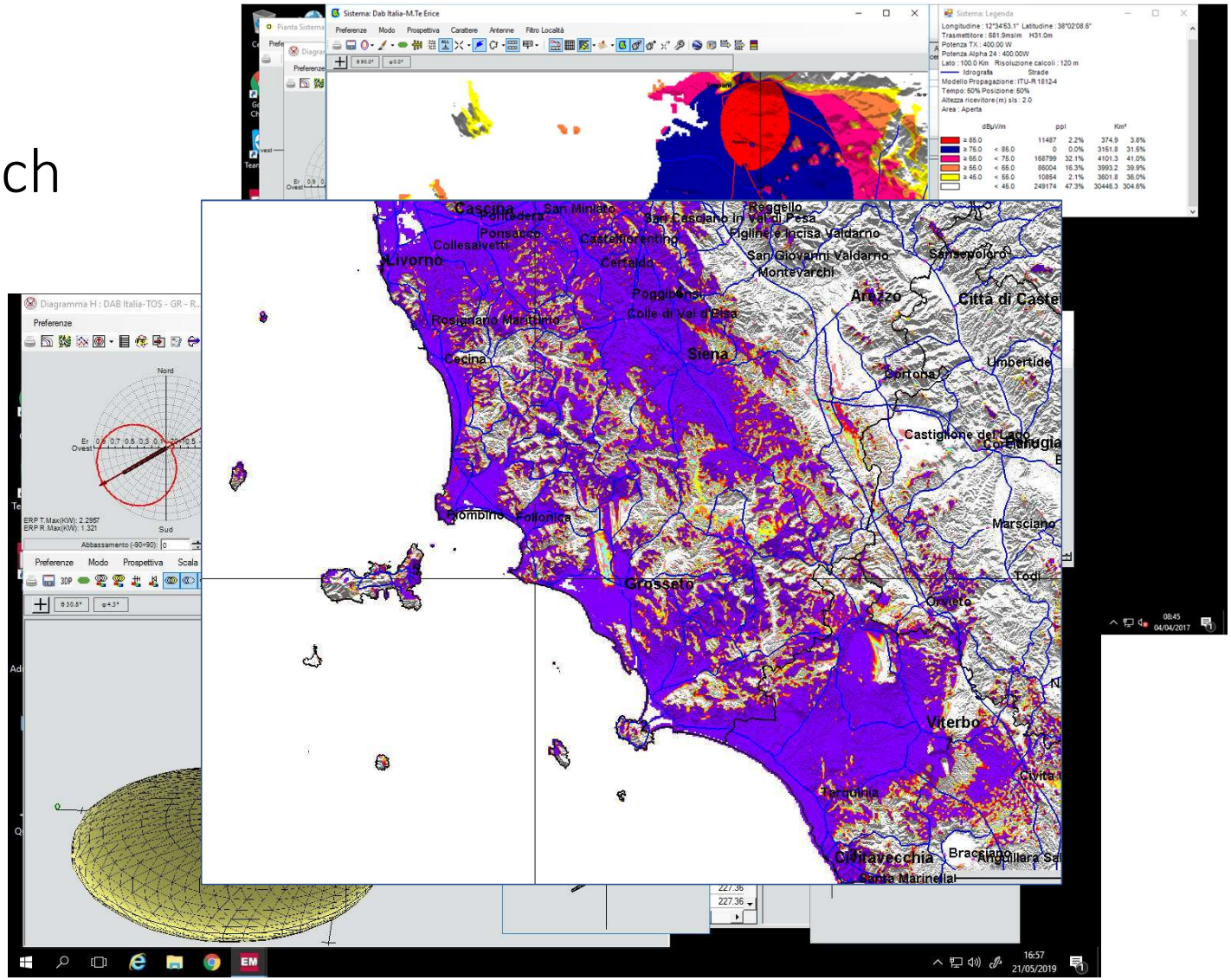

Approach to planning
and tools used

Network design

- We plan the network accordingly to the strategy decided by the board
- Site evaluation – also on site
- Coverage analysis
- Lots of paperwork!

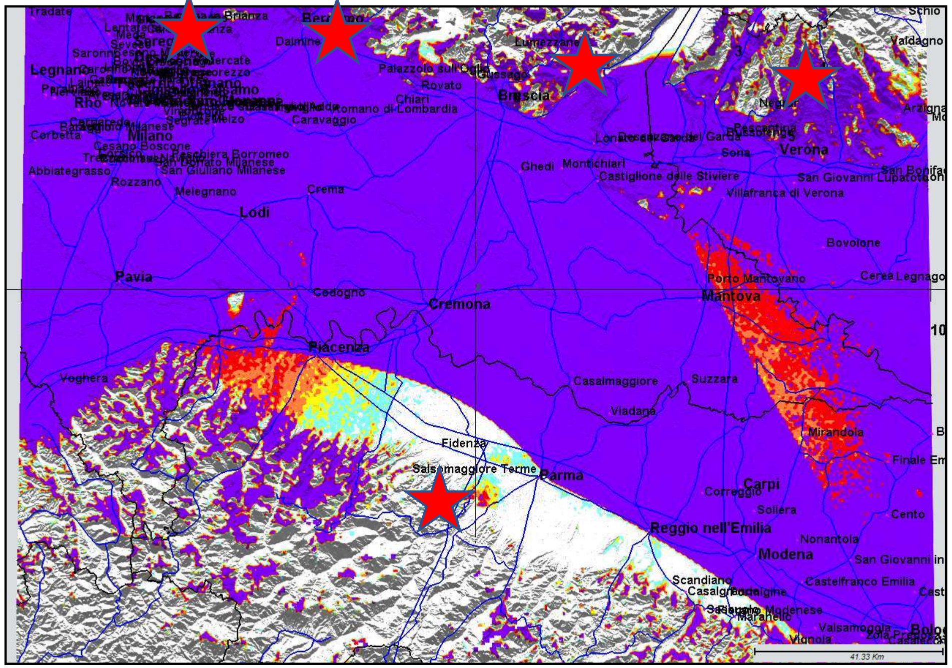
Software approach

- Transmitter sites are always evaluated via software (in our case Aldena EMLAB)
- This tool helps to predict expected coverage, field strengths and population served
- It also allows the design of the antenna system and the step-by-step optimisation
- Software tools also allow SFN analysis



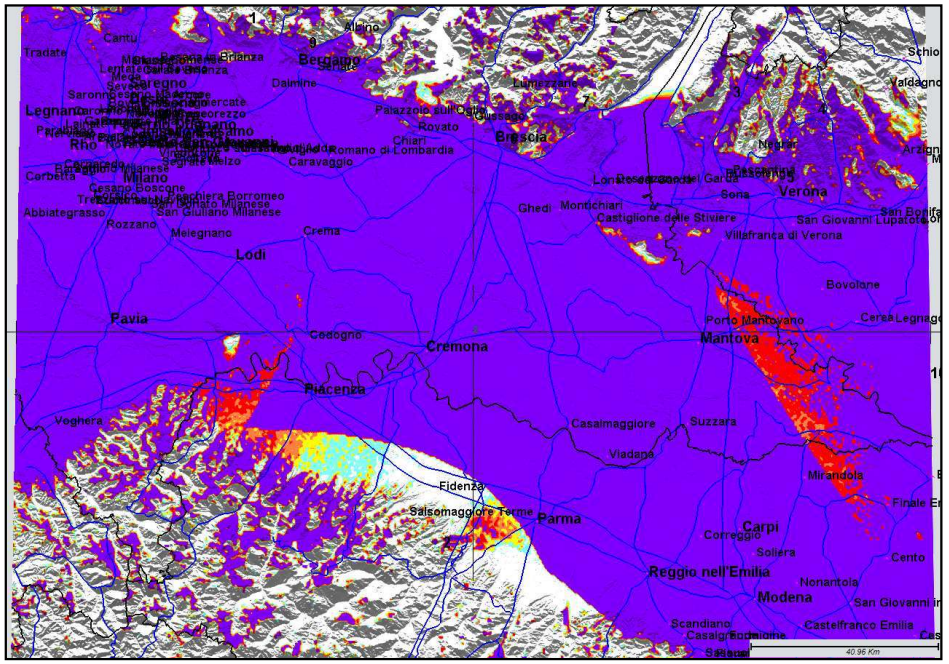
SW optimisation - iteration 1

Copertura con antenna ricevente omnidirezionale



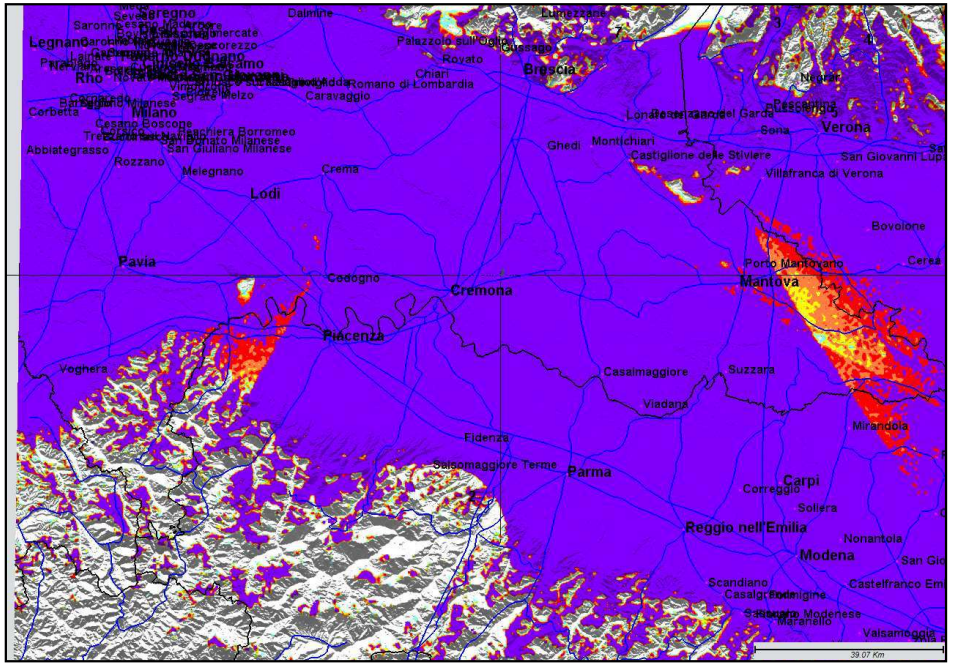
SW optimisation - iteration 2

Copertura con antenna ricevente omnidirezionale

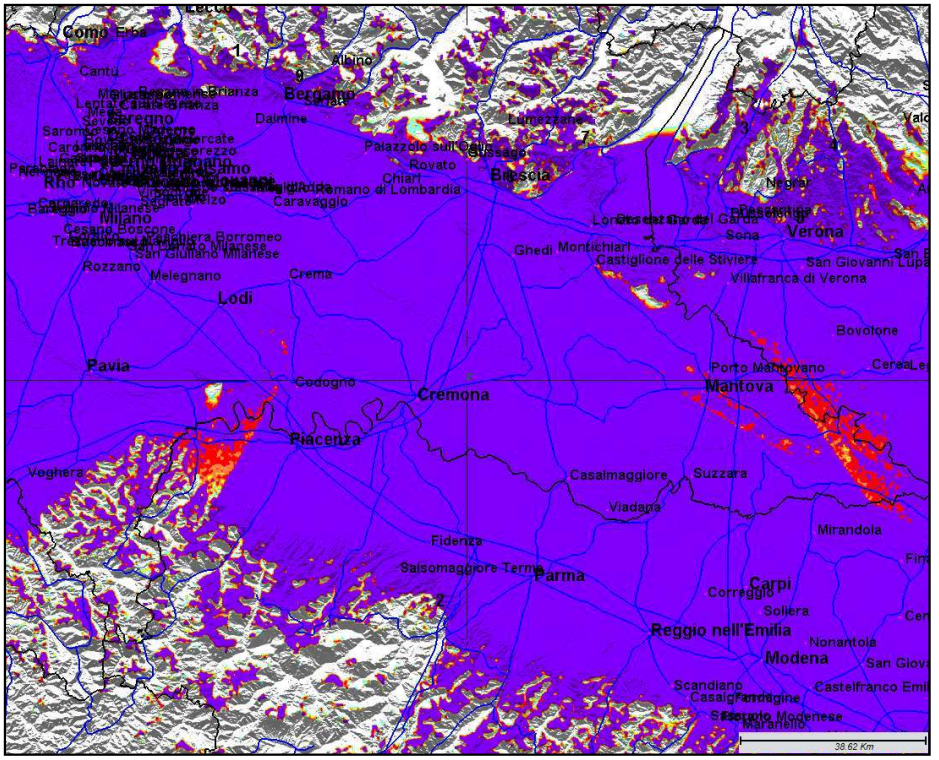


SW optimisation - iteration 3

Copertura con antenna ricevente omnidirezionale



SW optimisation - iteration 4



Lab measurements of “out of SFN” behaviour

LAB configuration	Offset	Relative offset	TX Power in W	C/N local TX	C/N remote TX	Ber	Fieldstrenght	Reception
LAB next to zero	83	8	5	46,1	13,6	0	91	ok
Middle of guard interval	203	114	5	46	13,5	0	91,3	ok
End of guard interval	330	NA (241)	5	37,5	NA	0	91	ok
Far outside guard interval	380	NA (291)	5	37,1	NA	0	91,3	ok

△ 30 dB

Field measurements of “out of SFN” behaviour

Description	Offset	Relative offset	TX Power in W	C/N local TX	C/N remote TX	Ber	Fieldstrenght	Reception
Static – inside guard interval	83	6,5	5	13	38	0	74	ok
Static – outside guard interval	380	Remote: -141us Local: +180us Relative: 321us	5	NA	30	0	74	ok
Static - end of guard interval, different position and power	83	5	20	31	26,4	0	65	ok
Static - end of guard interval	330	Remote: -121us Local: +122us Relative: 243us	20	30	27	10e-5	65	ok
Static – outside guard interval	340	253	20	30	27	10e-2	65	ok

Field measurements of “out of SFN” behaviour while driving

Description	Offset	Relative offset	TX Power in W	C/N local TX	C/N remote TX	Ber	Fieldstrenght	Reception
Car A - Static – outside guard interval	340	253	20	NA	NA	NA	NA	OK
Car B - Static – outside guard interval	340	253	20	NA	NA	NA	NA	Interruption when local tx becomes predominant

So what???

Lessons learned

Lessons learned

- Know your territory
- Know your sites
- Know your tools
- Get rid of FM planning mindset
- Respect the SFN!!!!
- Use simple antenna systems as much as possible
  - Best by experience
    1. Dipoles
    2. Yagis
    3. Panels
    4. Logs

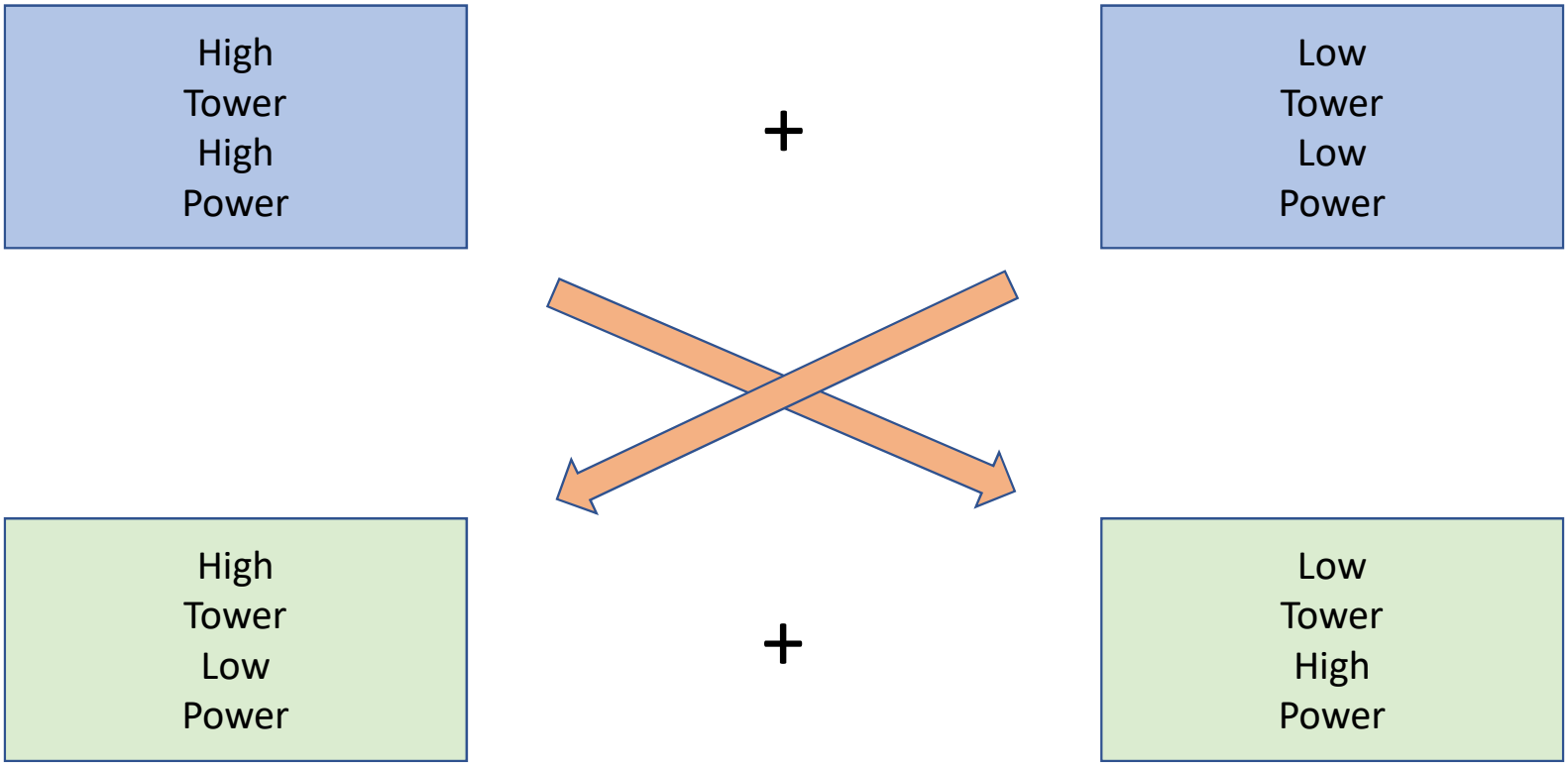
Lessons learned

1. When planning SFN start simple
2. Build, measure, verify
3. Extend number of transmitters
4. Build, measure, verify
5. Make changes and correct “errors”
6. Start again from number 3

- Find your MAIN transmitter of the network
- Let all the others follow

- Don’t be afraid to make mistakes and to change the planning!

Site selection: my little theory



The Wolter Law


Thank you!