Design of a dual band filter with SIW technology for a L band RF receiver

Aurélien PERIGAUD[1], Johann SENCE[1], Faycel FEZAI[1], Stéphane BILA[1],
Thierry MONEDIERE[1], Bernard JARRY[1], Philippe POULIGUEN[2], Patrick POTIER[2]

[1] : XLIM UMR 7252 Université de Limoges/CNRS (FRANCE)

[2] : DGA/DS (FRANCE)

The present work is financed in the framework of ANR ASTRID COCORAM.

Context
Theoretical design
EM design
Conclusion

Context

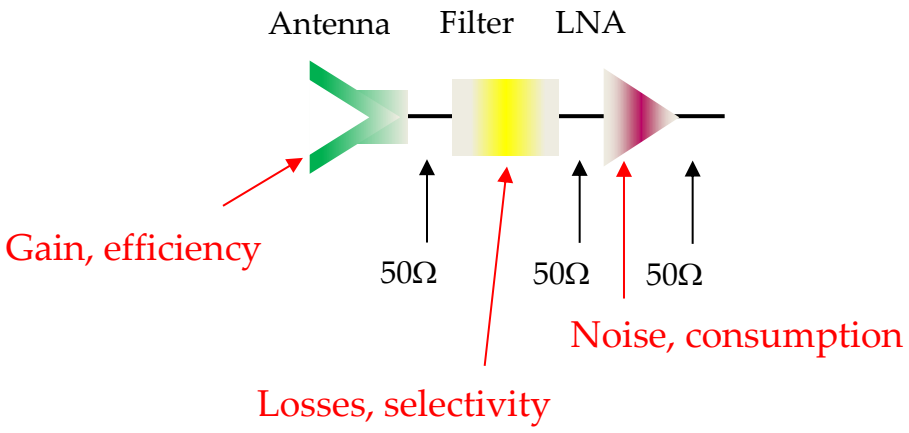
Context

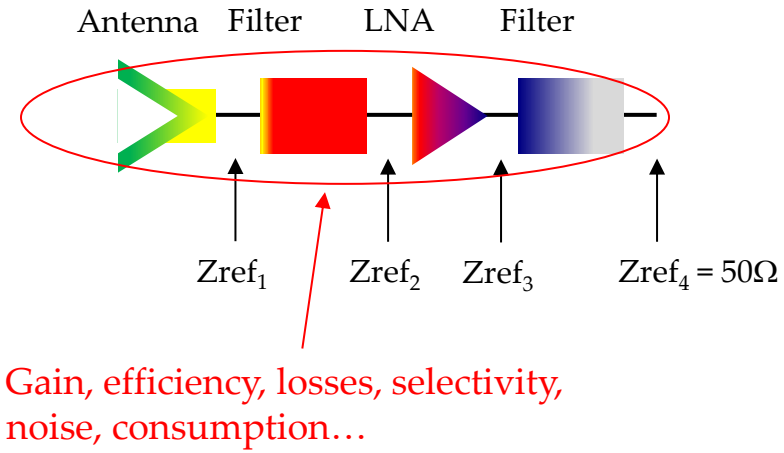
Co-design

Matching circuits and antennas on optimized impedance: optimize interconnections, reduce size, and improve performances (losses, …)

Synthesis at system level: benefit from contributions of other circuits

→ Development of a proper strategy (and tools)



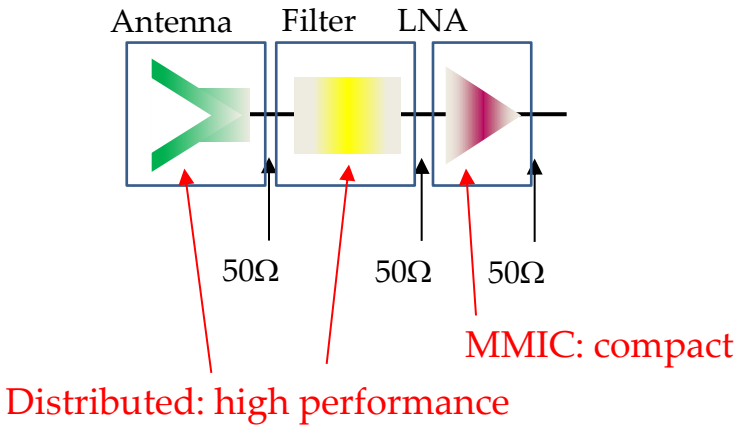


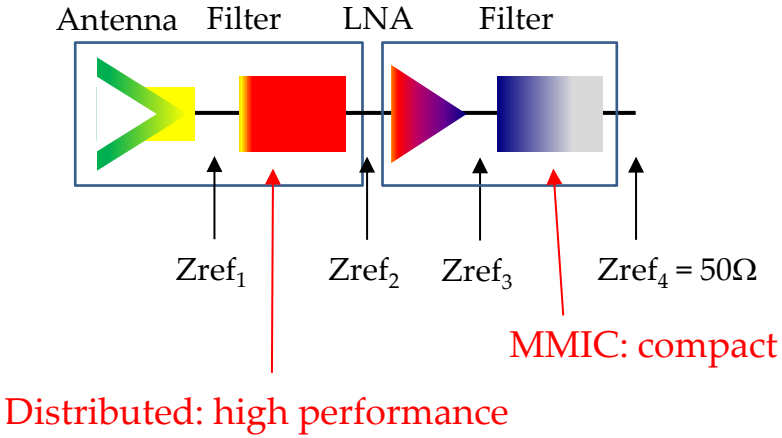
Context

Co-integration

Mixing technologies: optimize/balance performance and compactness

→ Design of GPS/Galileo Rx front-end





Context

- Filter both GPS and Galileo signals
  - Strong rejections to insure the immunity
  - Small footprint for integration with a wire-patch antenna

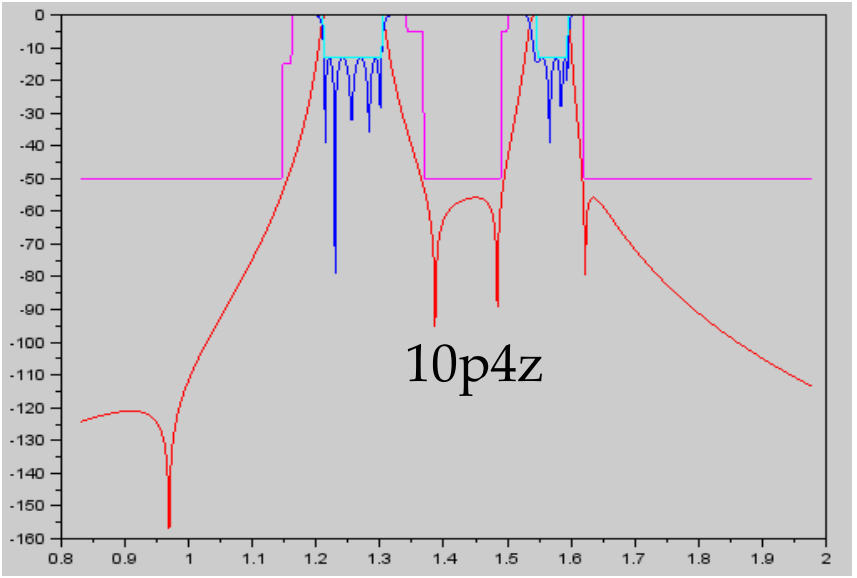
- Presented work
  - Preliminary work here: final work ➔ co-design flow (will untighten some specs)
  - Mainly theoretical
  - Feasability/cost

Theoretical design

Theoretical design

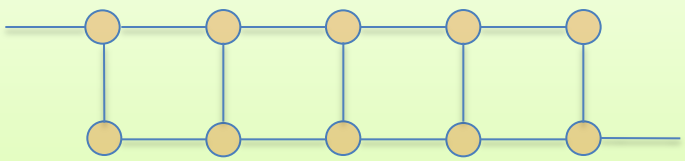
- Specifications: lossless study

	Fmin	Fmax	Spec (dB)
[S21]	0,800	1,145	-50
[S21]	1,145	1,162	-15
[S11]	1,2126	1,30375	-13
[S21]	1,344	1,370	-5
[S21]	1,370	1,495	-50
[S21]	1,495	1,505	-5
[S11]	1,55042	1,60042	-13
[S21]	1,625	2	-50



- 10p4z ➔ « lot » of CM to implement it …

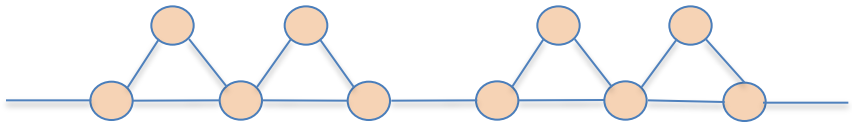
extended-box



=> 64 solutions

Here chosen

triplets



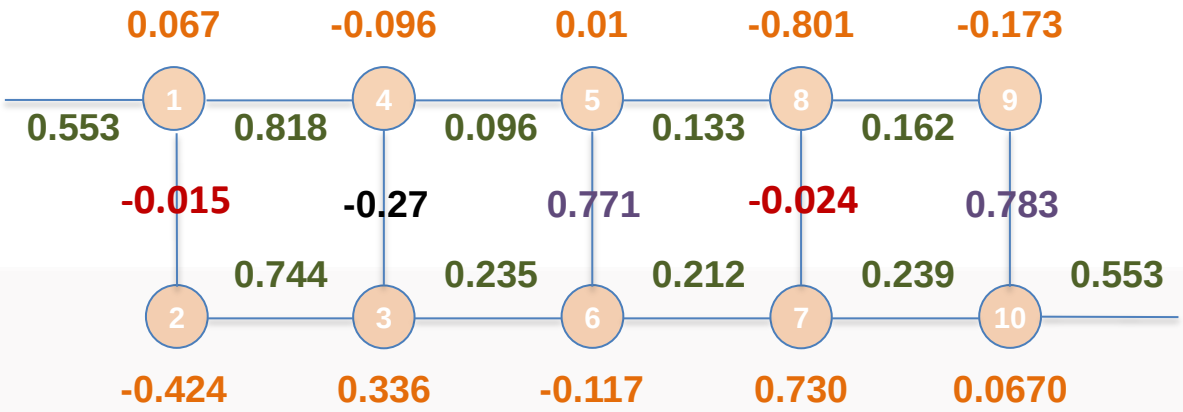
=> 24 solutions

Theoretical design

- Extended box solution: 64 possible CM.
  How to choose the best one ?

1. **Above** (horiz.) couplings **=** **bottom** (horiz.) couplings ➔ stackable res
2. **Weak negative** vertical couplings ← restrained range
3. Having **null** couplings ➔ simplify CM (becomes unique) ➔ greatly **ease** optimization process
4. **Positive** vertical couplings **as low as possible** ← restrained range (but 3 x wider than neg.)

➔ Among 64 solutions, no match for all criteria, however good compromise obtained (4 is not OK)
:

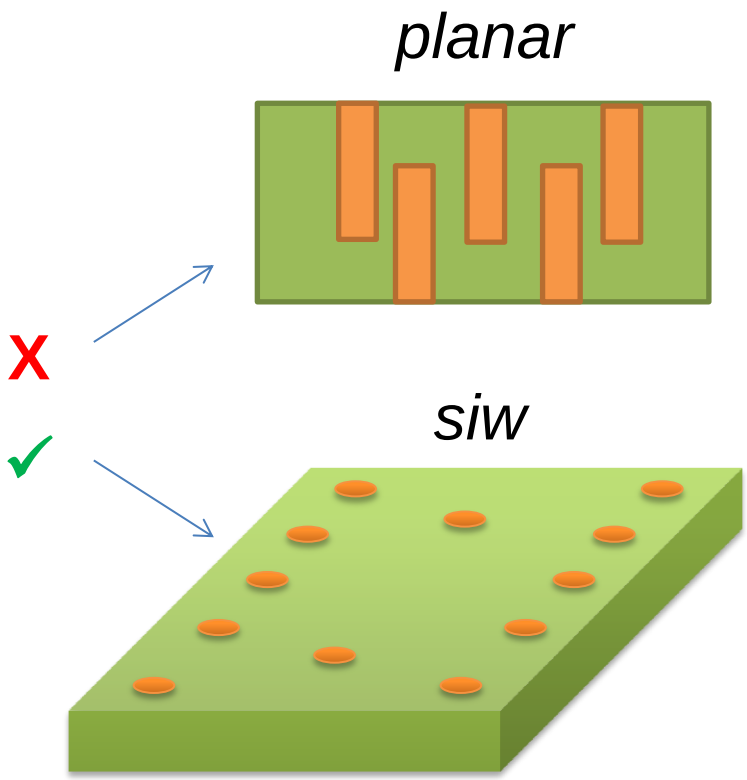


EM design

EM design

- Losses considerations

Q0	Insertion losses (dB)	
	First band	Second band
100	5.0	7.0
300	1.7	2.5

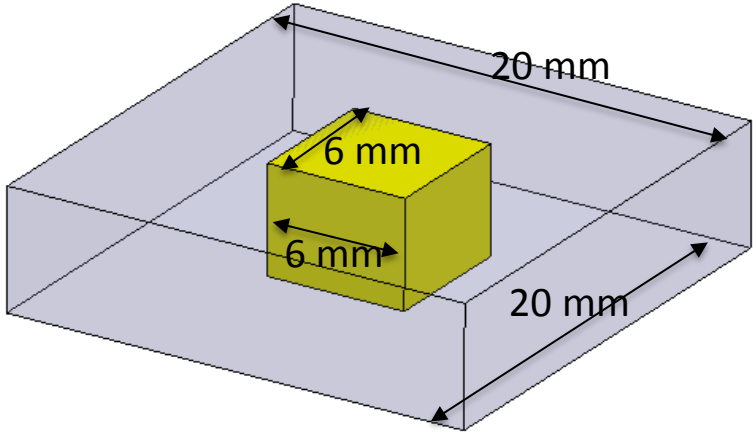


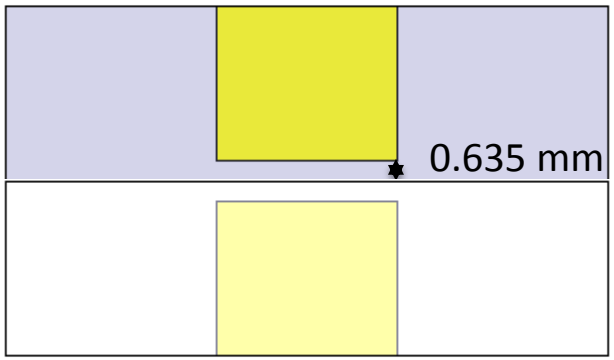
EM design

- But strong size constraints ➔ compact SIW

RO6010 :
- Er ~ 10.7
- Tand ~ 0.0023
- Cond ~ 20e7

➔ **Qo ~ 300**





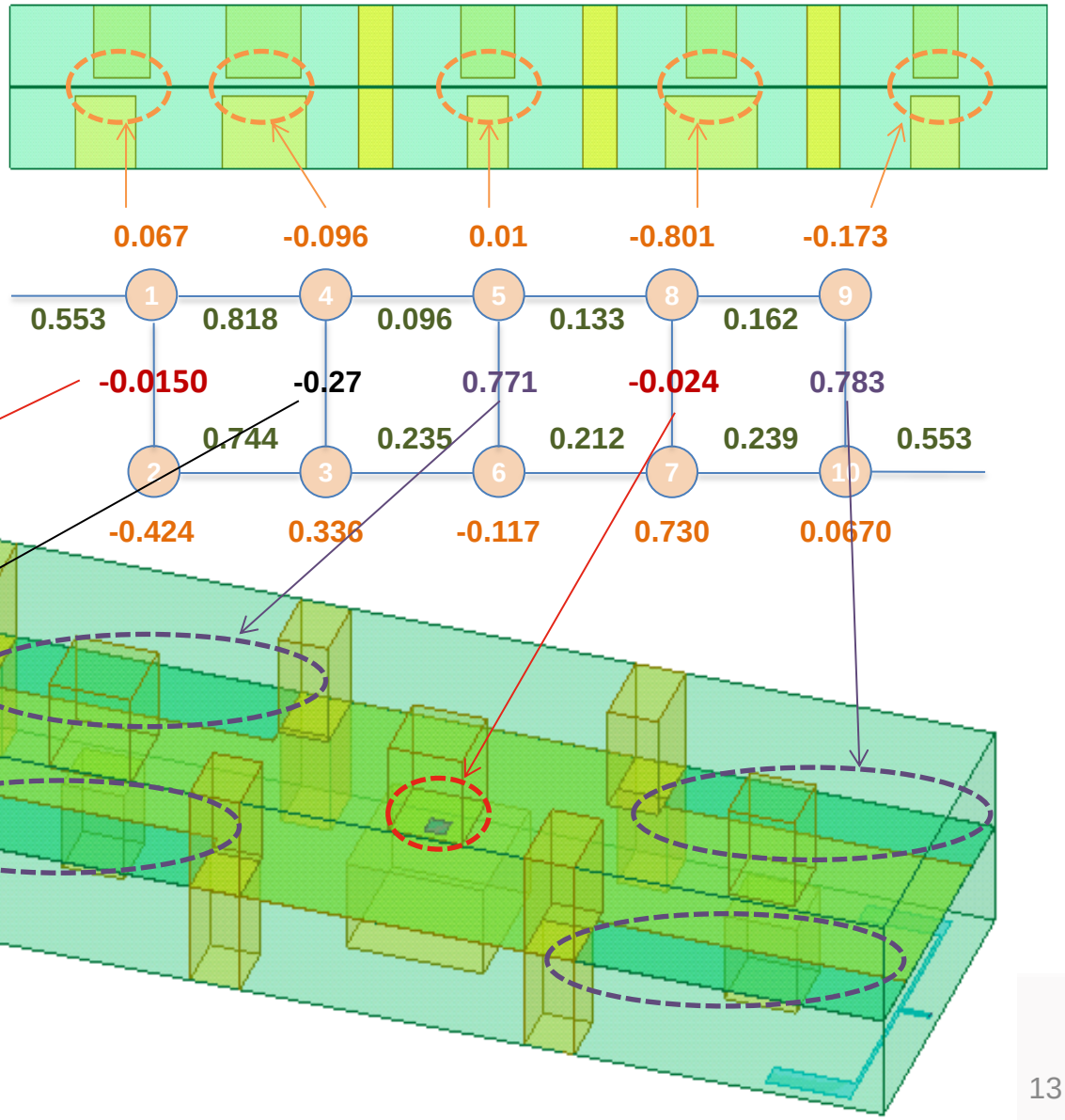
2 x 2.54 mm
+ 1 x 0.635 mm

X 2
(= stacked SIW-res)

- However, not easy to fabricate …
  (traditional fab ? Smart via ? …)

EM design

- Filter designed :

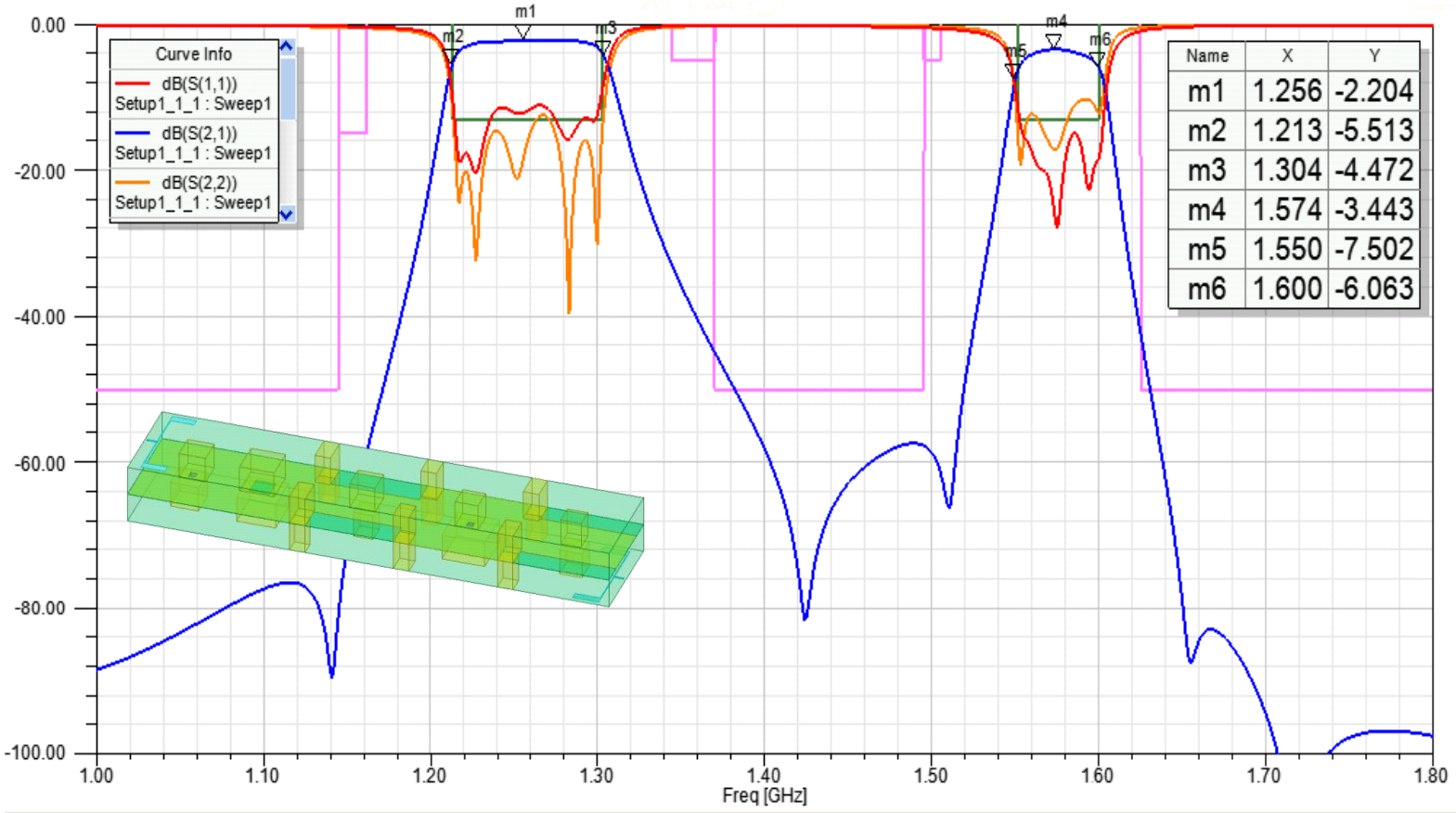


Weak couplings still necessary
BUT neglected in topology fitting
(➔ appear as parasitic couplings !)

Size : 20 mm x 93 mm x 11.52 mm

EM design

- Filter designed :



- Globally satisfies specs (final Qo eff. ~ 250)
- 1 TZ more ➔ « true » parasitic couplings (or equivalent to)

Conclusion

Conclusion

☺ Consistence of chosen topology proved

😐 In-line filter ➔ U-shape will be better

☺ Specs satisfied globally but better margins are possible

- 😐 Qo close to what necessary
- ☺ 1 transmission zero more

- Fabrication : rework when fab process fixed (Smart-via ? Standard ? ➔ cost !)