Université Nice Sophia Antipolis

LEAT
LABORATOIRE D'ELECTRONIQUE ANTENNES ET TELECOMMUNICATIONS

cnrs

Antennes à base de matériaux innovants

- Magneto-dielectric Materials
- Metamaterials

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➢ Axe : **Antennes à base de matériaux innovants**

✓ Objectives: Search the potential use of new composite materials in antenna applications

✓Magneto-dielectric Materials

- ✓NAOMI Project

✓ Méta-matériaux

- ✓CREMANT Project
- ✓METAVEST Project
- ✓PACID Textile Project

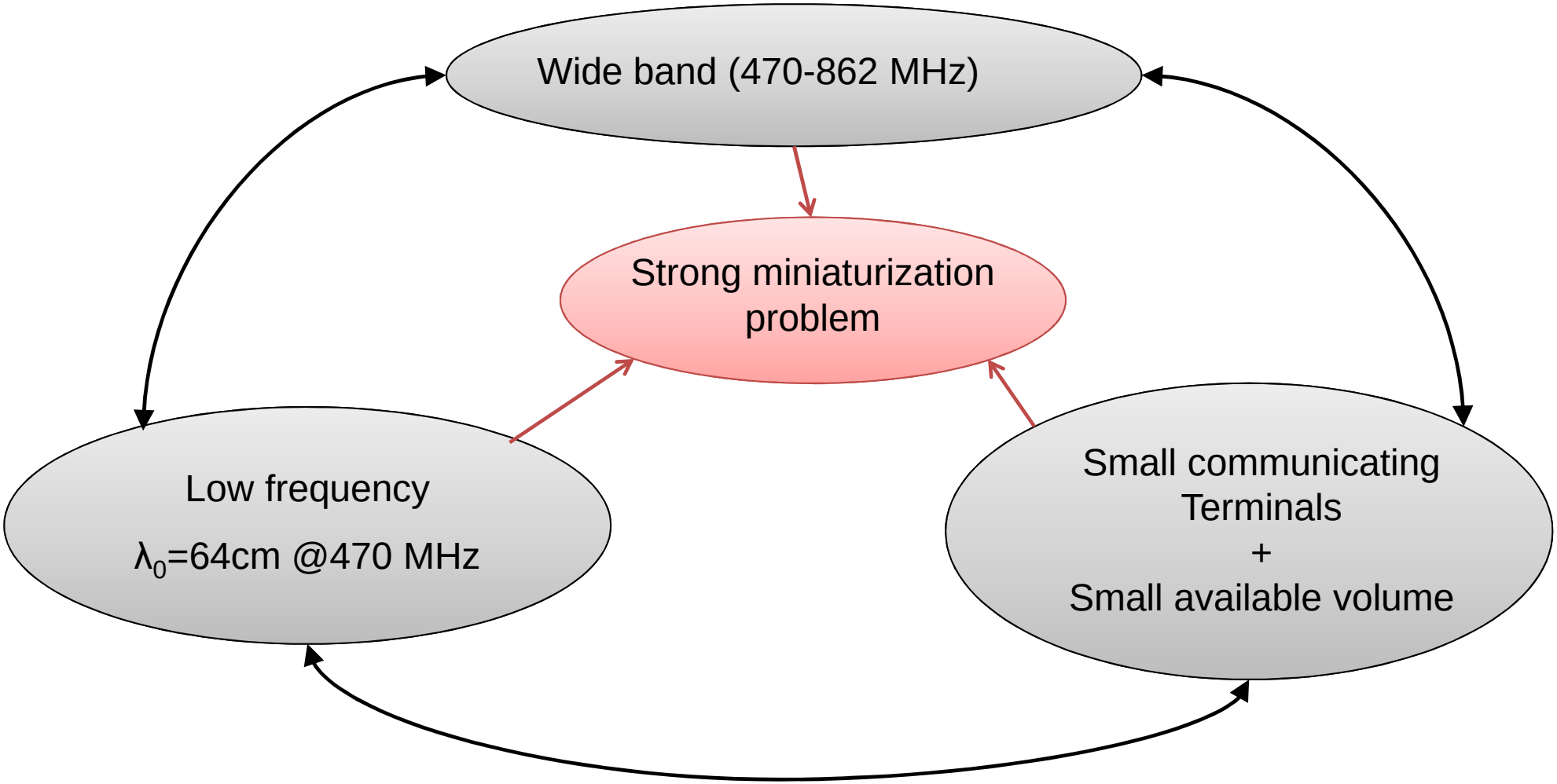
NAOMI Project

Nouvelles générations d'Antennes miniatures et agiles à matériaux cOMposites pour termInaux mobiles

- Objectives
  - DVB-H antenna for small communicating objects
- Originality
  - New materials for miniaturization
- Partners

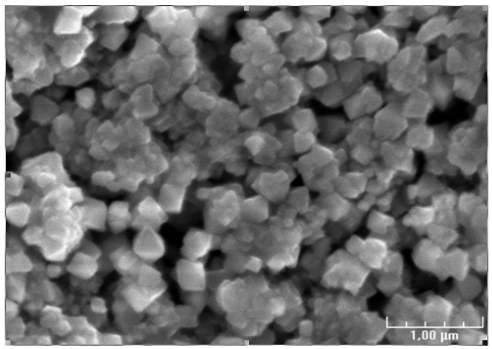
Funded by ANR (French National Agency for Research)

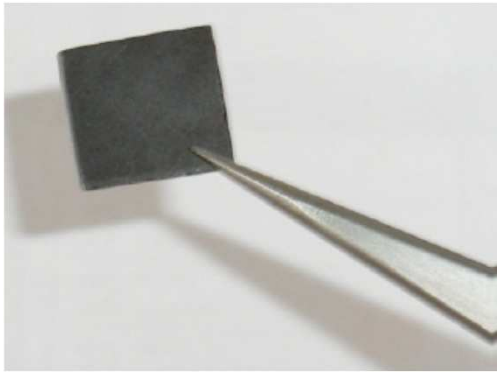
DVB-H reception challenges

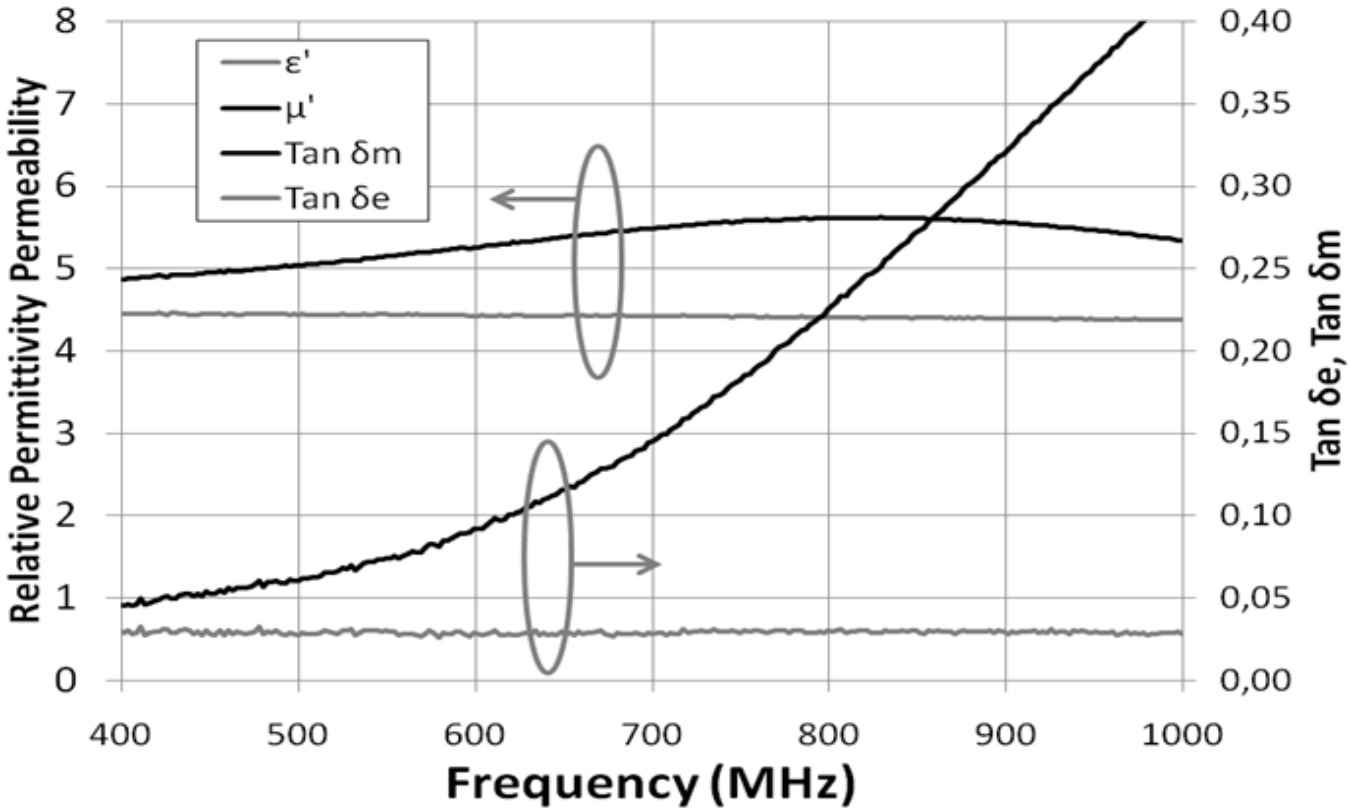


Characterization of magneto-dielectric materials

- Composed by $Ni_{0.5}Zn_{0.3}Co_{0.2}In_{0.02}Fe_{1.98}O_4$ nanopowder
- After shaping and appropriate thermal treatments, a porous ceramic is obtained
- High permeability materials have the capability to reduce the size of antenna without decreasing relative bandwidth and total efficiency



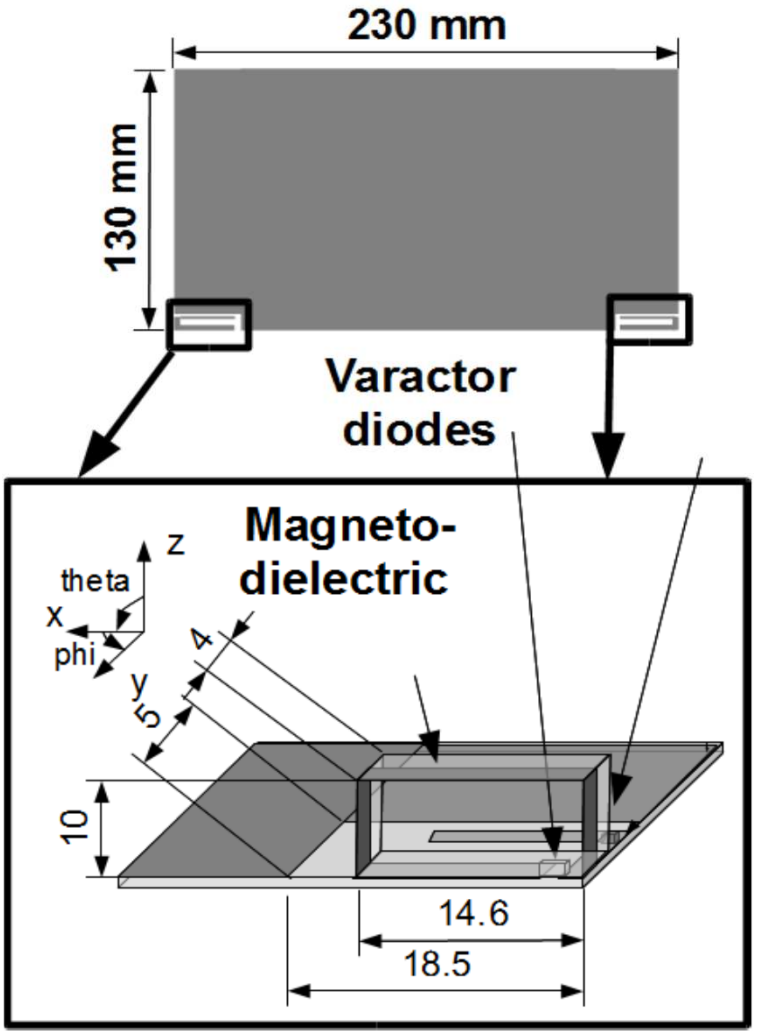




Characterization of magneto-dielectric versus frequency

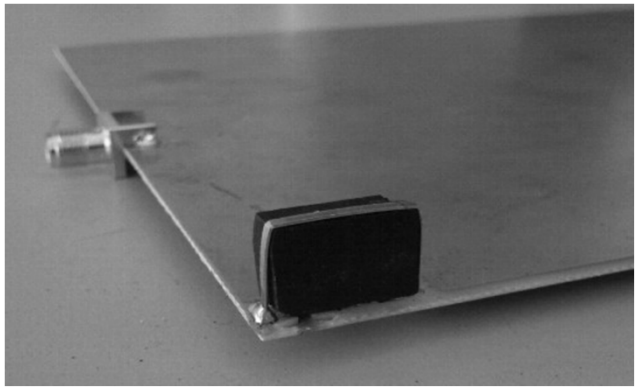
Antenna design

- Folded monopole structure
- Varactor diode for active frequency tuning
- Size of the antenna : $\lambda_0/34*\lambda_0/120*\lambda_0/60$ @470 MHz



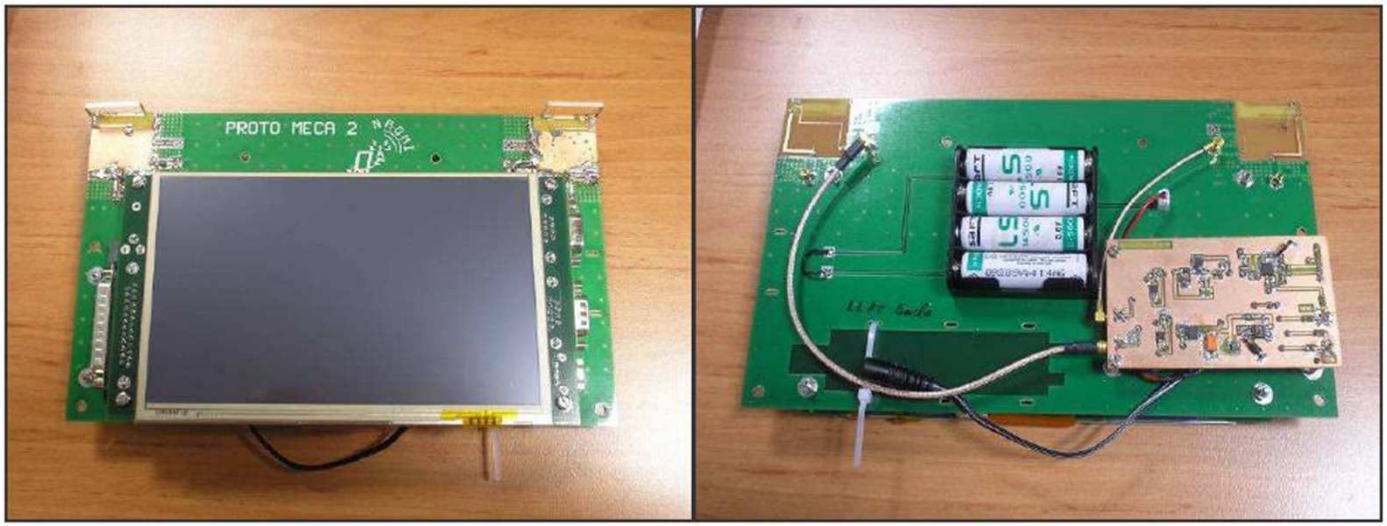
Prototype

- 0.8mm-thick FR4 substrate with εr=4.7 and tanδ=0.02

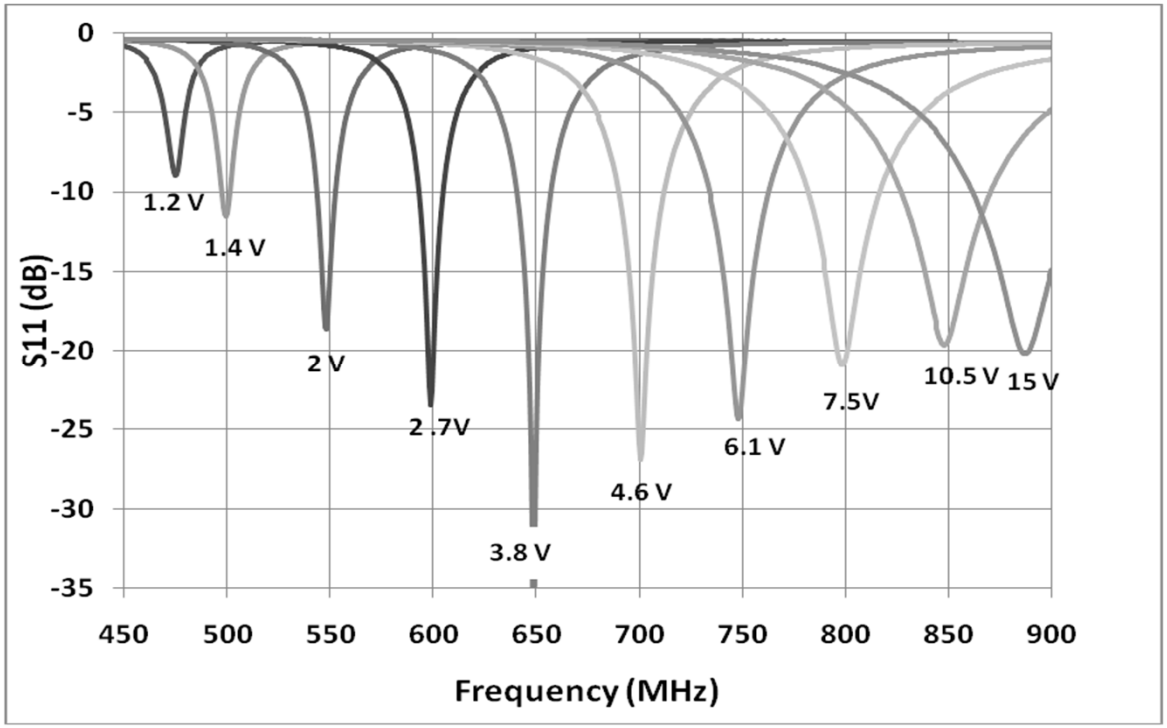


- Surface-mount GaAs hyperabrupt varactor from MACOM (MA46416)

- 14.6*5*10 mm3 for magneto-dielectric superstrate

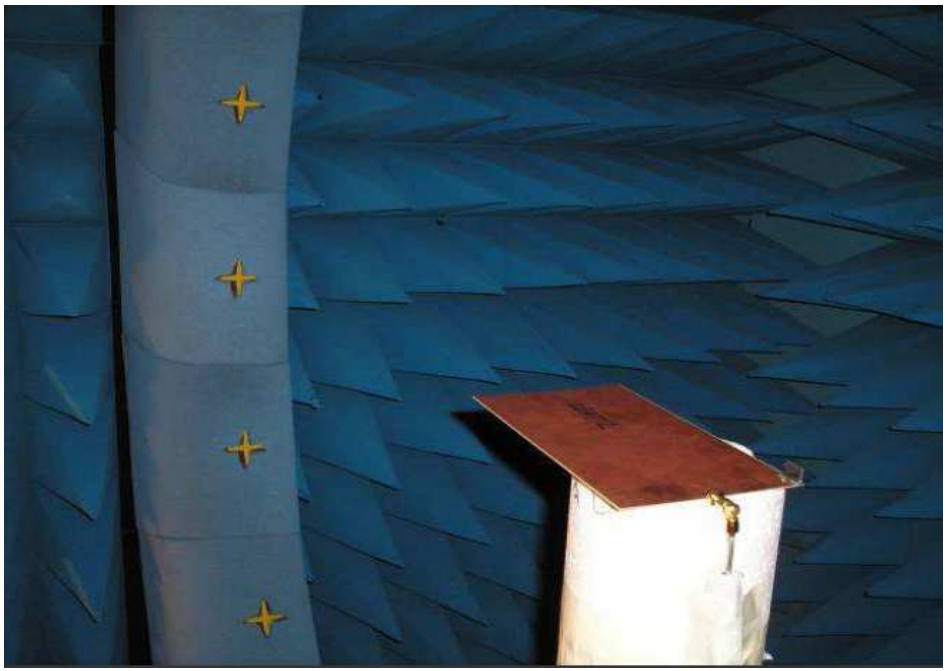


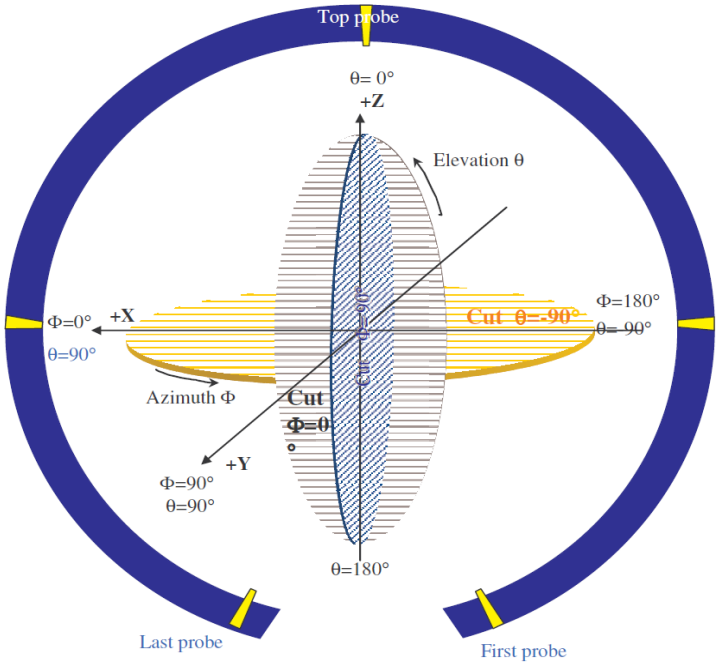
Return loss for reverse voltage from 1.2 to 15 V



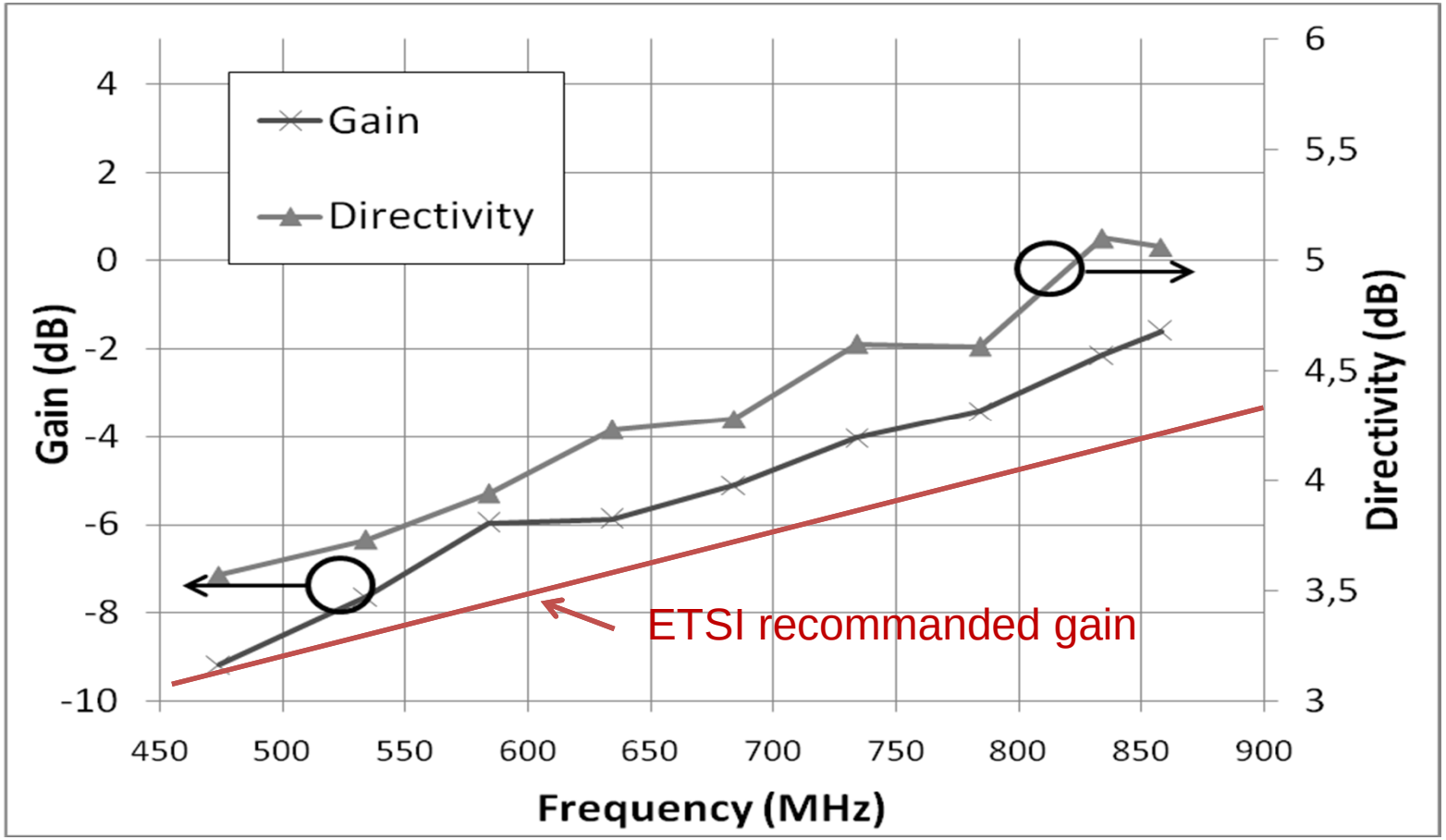
Radiation measurements

Performed on a Stargate-24 measurement station with SATIMO Bretagne facilities





Gain and directivity measurements



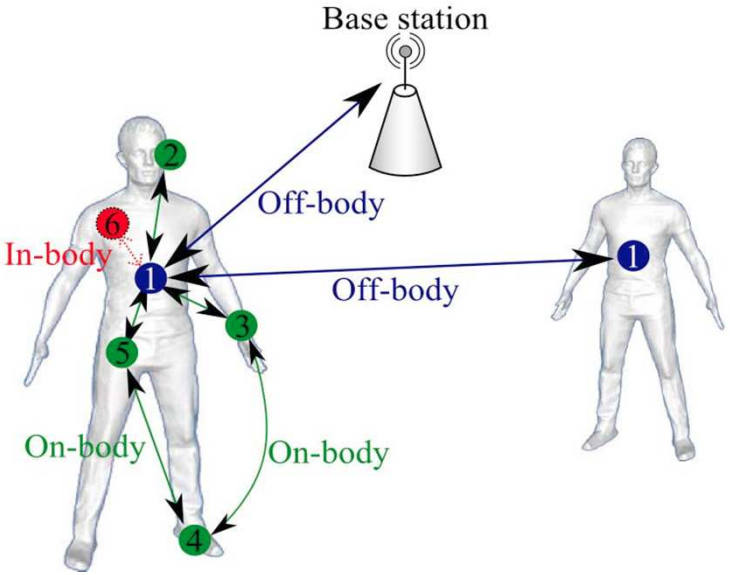
Conclusion

- All DVB-H band covered (470-858 MHz)
- -6 dB bandwidth always better than 11 MHz
- Measured total gain higher than ETSI recommended gain on DVB-H band
- Integration of magneto-dielectric for miniaturization

METAVEST Project

METamatériaux pour VEsTements intelligents

- Objectives
  - Integrated Sensors on Clothes
  - Applications to Proximity communications: WBAN, WPAN or DVB
- Originality
  - Association of Technologies (Textile, Foam) and Design of Metamaterials
  - Control of RF radiation Impact
- Partners



Characterization of flexible textile substrates

Substrat souple	Densité (kg/m3)	Epaisseur (mm)	Absorption humidité	Cout (€/m²)
Lanière PVC	–	2,5, 4	non	25 (Ep.2,5)
Mousse polyéthylène	32	3,2, 6,4	non	36 (Ep.3,2)
Feutrine	140	1, 2, 4	oui	13,8 (Ep 2)

Tableau : Données constructeurs des matériaux souples.

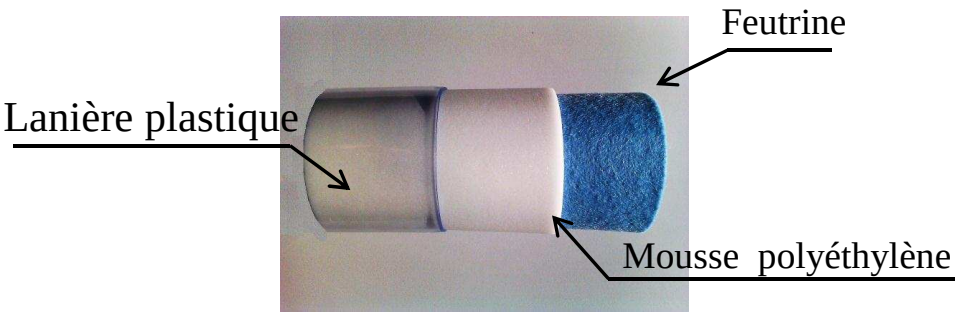
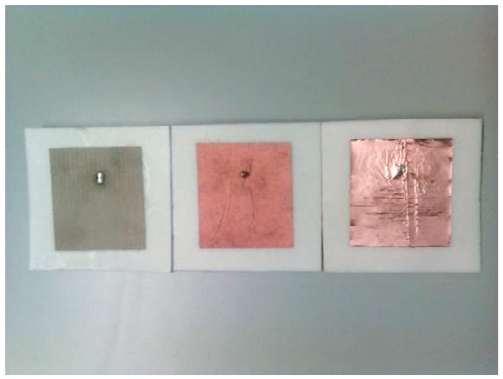


Figure : Photographie des échantillons de matériaux souples.

	Méthodes de caractérisation			
Substrats souples	Ligne résonante en T		Sonde coaxiale ouverte	
	ε_r	tan δ	ε_r	tan δ
Mousse polyéthylene	1,08	0,01	1,05	-
Feutrine	1,29	0,039	1,25	-
Lanière	2,8	0,035	2,87	0,05

Tableau : Données constructeurs des matériaux souples.

Characterization of electro-textile substrates



- Patch antenna :1,6 GHz,
- polyethylene foam,
- Two electro-textiles (Taffeta, ShieldIt),
- Feed coaxial probe.

- Taffeta Copper => 0,051Ω/□,
- ShieldIt™ Super => 1Ω/□.

Figure : Photographie des patchs avec de l'électro-textile.

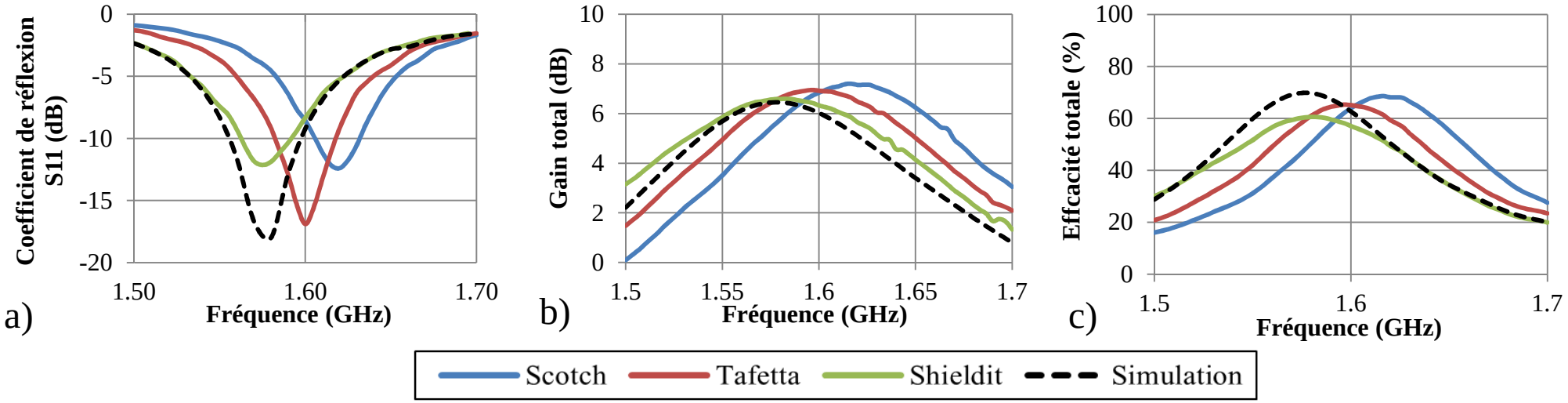
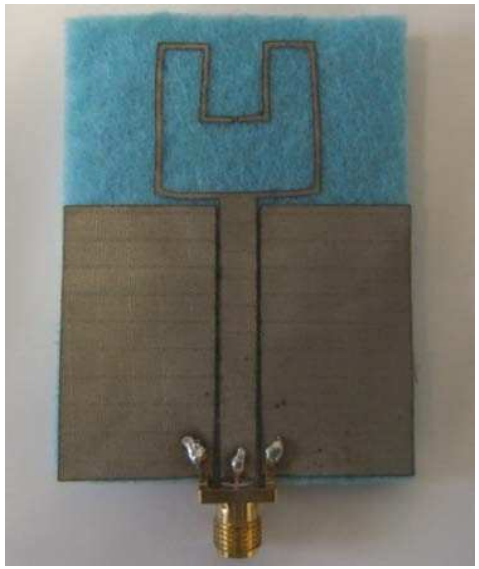
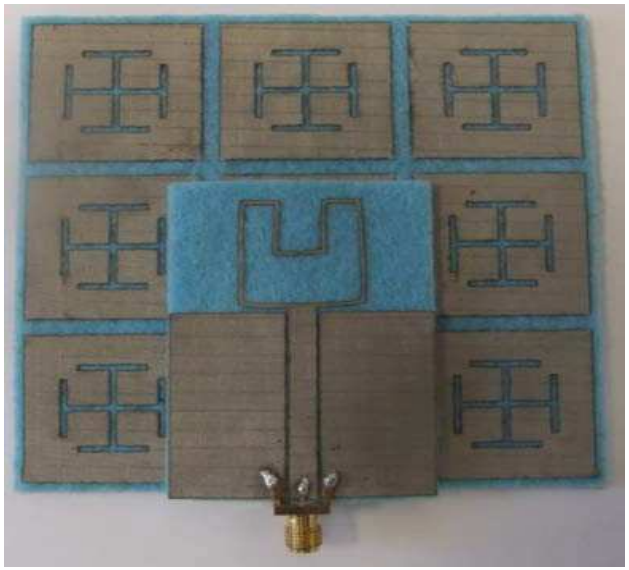


Figure : Mesure du rayonnement des antennes avec conducteurs scotch métallique, et électro-textile sTaffetas, ShieldIt.
(a) Coefficient de réflexion S11, (b) Gain total, (c) Efficacité totale.

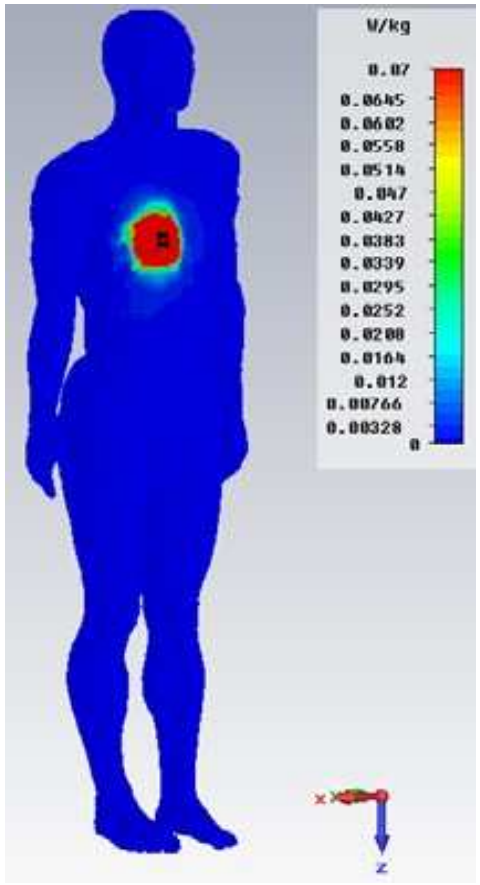
Specific Absorption Rate (SAR) simulation of the U antenna for WIFI application



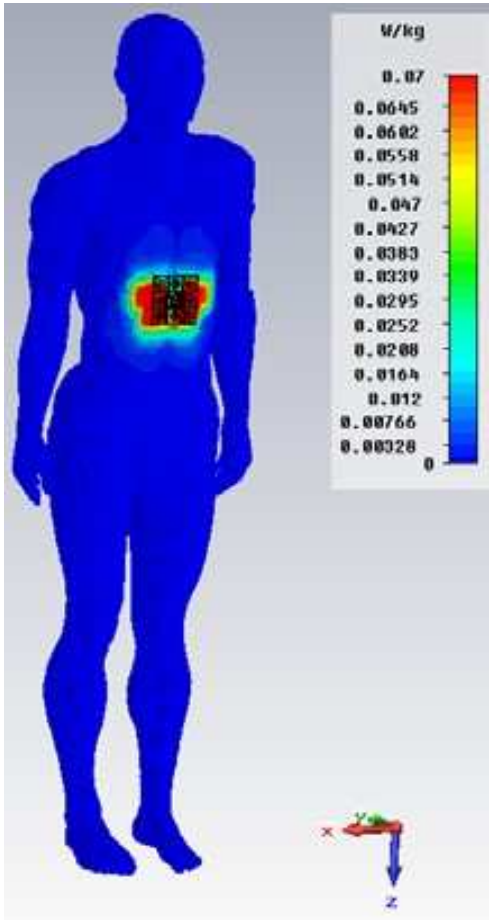


	SAR without AMC	SAR with AMC
2.6 GHz	13.1 W/Kg	0.15 W/Kg
5.2 GHz	11.8 W/Kg	0.02 W/Kg

Average SAR for 10g – Pin=1W (d=1 mm)



SARmax =13.1 W/kg



SARmax=0.15 W/kg

Conclusion

Flexible substrate :

- Low permittivity (1,05 < εr < 2,87) et (0,01 < tan δ < 0,05)
- Ease of integration,
- Low cost (11-35 €/m²).

Electro-textiles :

- Two electro-textiles with good performance in efficiency
- Flexible and tin solder possible,
- Low cost (3,2 €/m²)

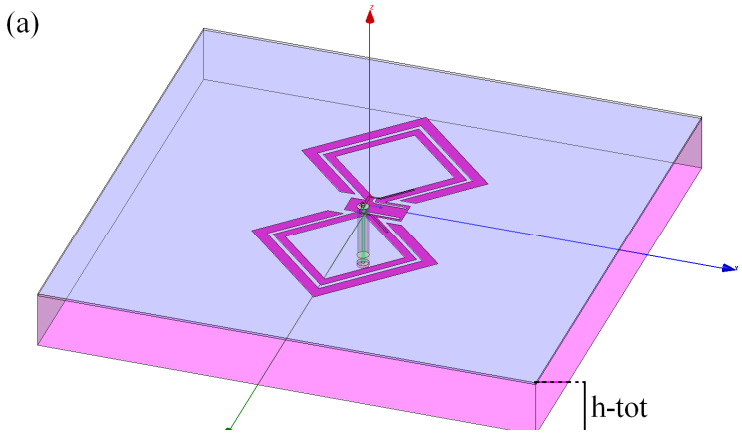
Antenna with AMC ⇒ 99% reduction of the SAR

CREMANT Project

Conception d'antennes large bande à base de matériaux BIE

Reference Antenna :

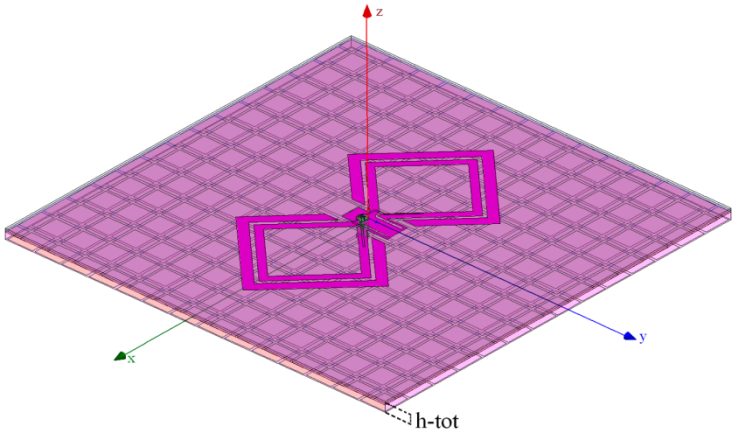
- Bandwidth 20%
- directivity (10dB)
- high : 20,75mm



Partners

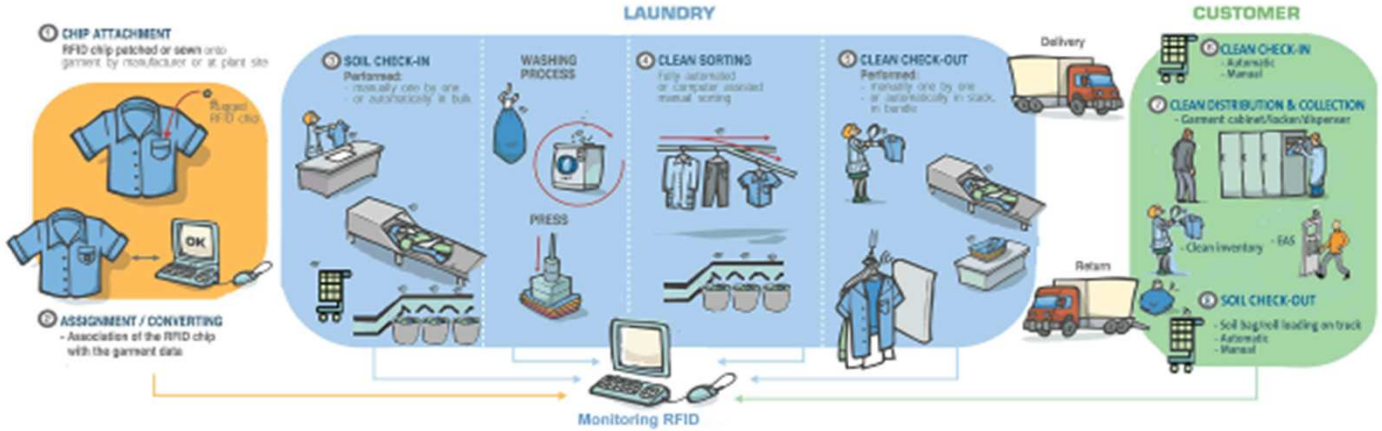
Antenna with EBG :

- Bandwidth 24%
- Directivity (8dB)
- high : 6mm



PACID TEXTIL

Solution innovante RFID UHF pour identification des produits textiles



❖ Objectives :

✓Design of an efficient and miniature tag (it can be integrated into textiles discretely)

✓Development of RFID tag reader to quickly identify textiles

Partners

TAGSYS RFID e-connecting goods · MAUGIN · SCALAGENT · GROUPE SOFILA · CENTRE HOSPITALIER DU PAYS D'AIX · Disney · JENSEN JENSEN GROUP · elis le propre en action · CIU Santé · LEAT Laboratoire d'Electronique Antennes et Telecommunications · Im2np