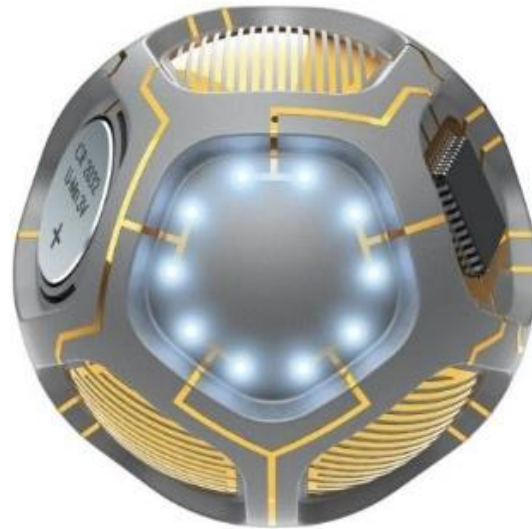




Electronics fits the curves...

ELECTRONICS FITS THE CURVES...



Maël Moguedet

Séminaire « Electronique imprimée et flexible » - 28 Juin 2022 – CRESITT ORLEANS

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Sommaire

- S2P en quelques mots
- Présentation du procédé LDS
- Exemples d'applications
 - Antennes
 - Capots anti-intrusion
- Conclusion : complémentarité LDS et Electronique Imprimée



S2P IN WORDS



Company skills and values

Sharing, Customer satisfaction, Innovation



- SME expert in 3D-MID, with an innovative multidisciplinary team of mechanics/plastics, chemistry and electronics
- Unique know-how in France, independent and major actor of an international network
- A single desk from the idea to the manufacturing of high added value products, focused on customer quality requirement through design and prototyping steps.





Markets



*Aero, Space
& Defence*



*Cybersecurity
& Banking*



*Manufacturing
Industry*



*Health &
Welfare*



*Watch and
Luxury*



3D-MID : an alternative to design electronics products



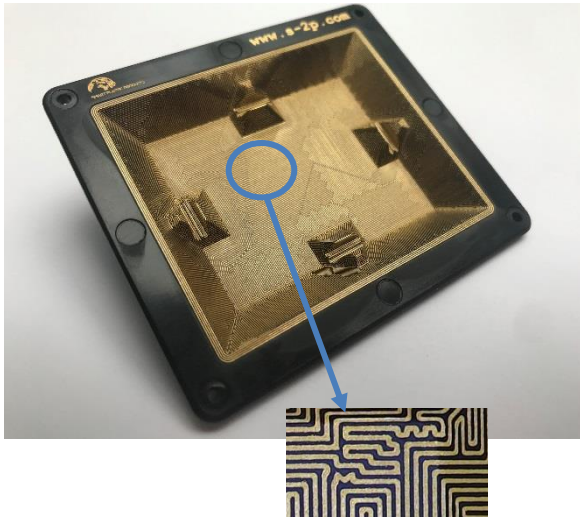
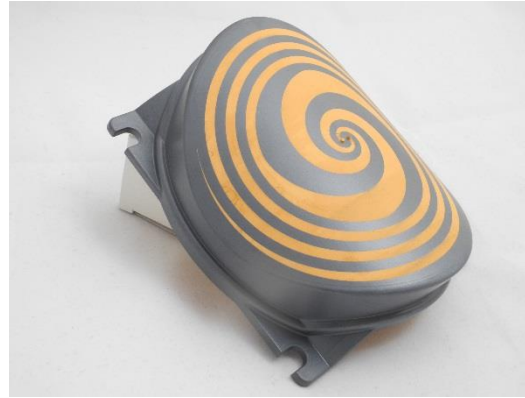
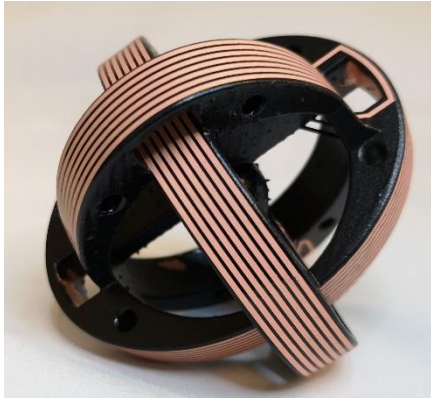
3D-MID (Mechatronic Interconnect Devices) are made by selective plating technologies that enable to build in one sub-assembly

- **The mechanical function**
- **The electronic function**



Advantages

Design freedom and flexibility



- ✓ Increase performance
- ✓ Accuracy and repeatability
- ✓ Customization and standardization



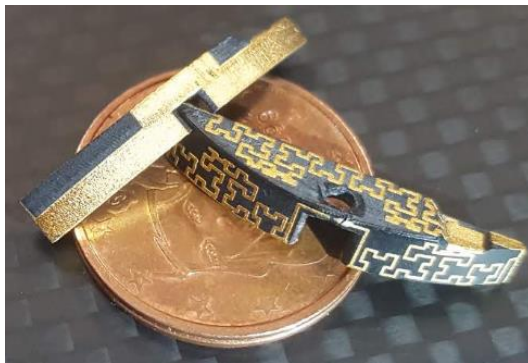
Advantages

Miniaturisation of electronics systems



✓ **Weight reduction**

✓ **Functions integration**



✓ **Assembly simplification**



Functions

3D Antennas & FSS

- GSM
- WIFI
- RFID
- Etc.

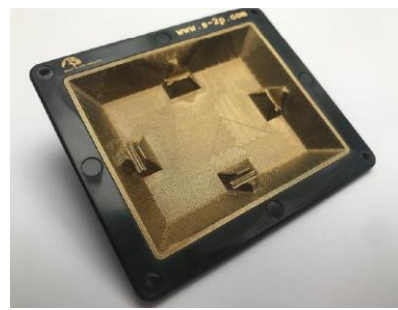


Battery holder



Safety caps

- Anti-tampering
- EM selective shielding



Smart IC Packaging

LED

- Signalisation
- Ambiance
- Power



Local Heating

- Anti fogging
- Temperature maintain
- Fuses / Pyrotechnics

Sensors

- Capacitives
- Inductives
- Magnetic
- MEMS
- Etc.

3D interconnexions Connectors





LE PROCÉDÉ LDS



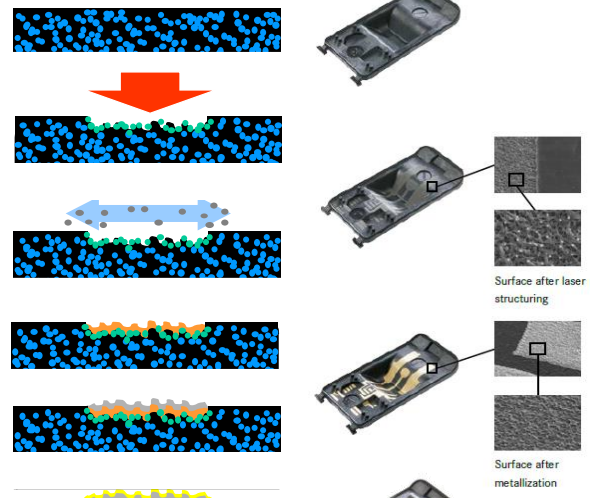
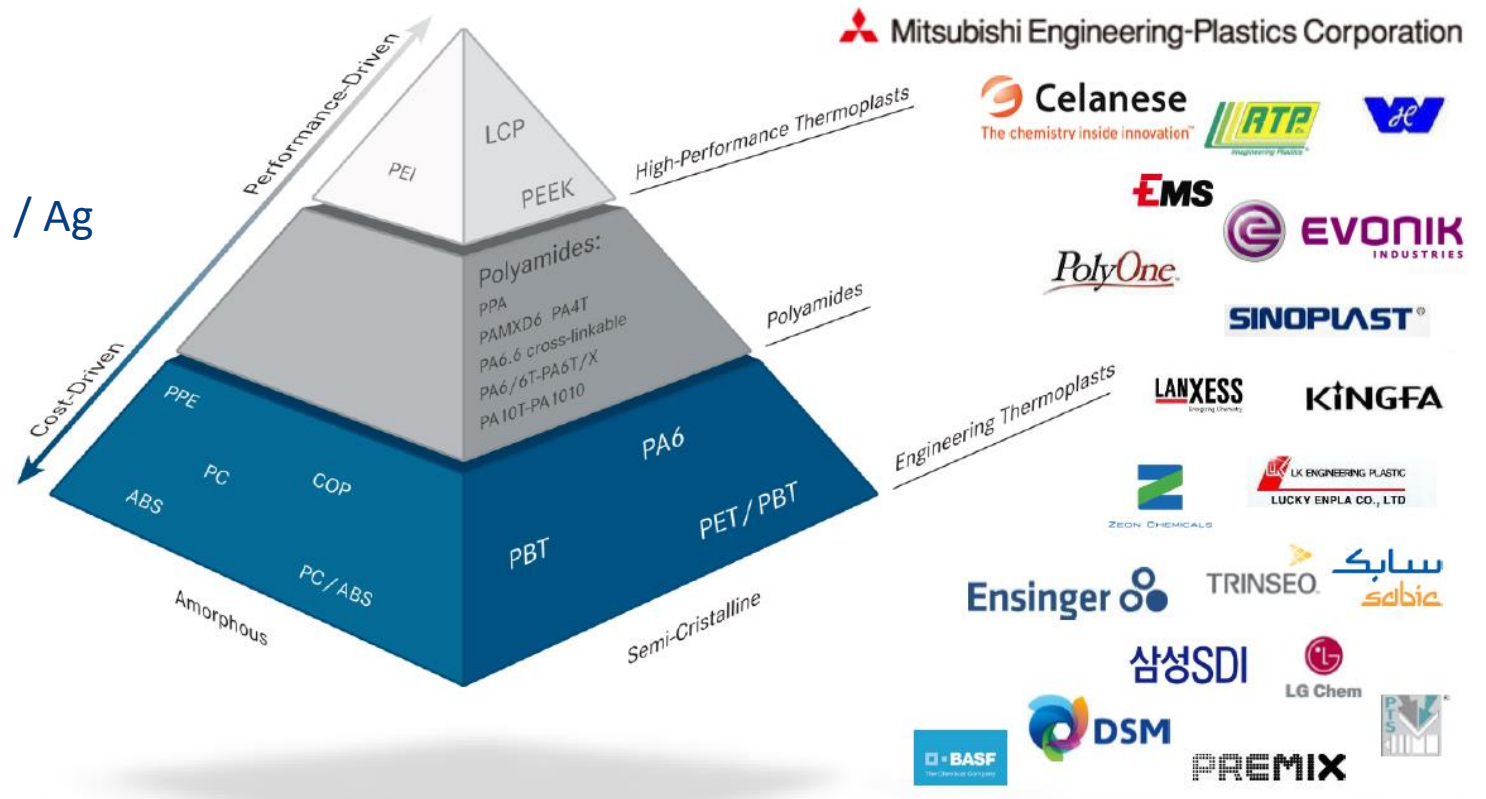
The LDS process

Laser Direct Structuring (LDS) Process



1. Single material injection molding/machining
2. 3D laser activation
3. Electroless Cu plating + surface finishing : Ni+Au / Ag
4. SMD component assembly / soldering

Over **90 plastics** are commercially available and LDS-approved by LPKF



Skills and Industrial Means

Product Design

- Mechanics / Plastics
- Electronics



Part Manufacturing

- Injection moulding
- Machining and 3D printing



Selective activation

- 2 LPKF lasers
- Protos & mass production



Selective plating

- E-less and electrolytic Cu
- ENiG, Ag finitions



Quality control

- Dimensions
- Electronic test benches
- Cross sections...



Components assembly

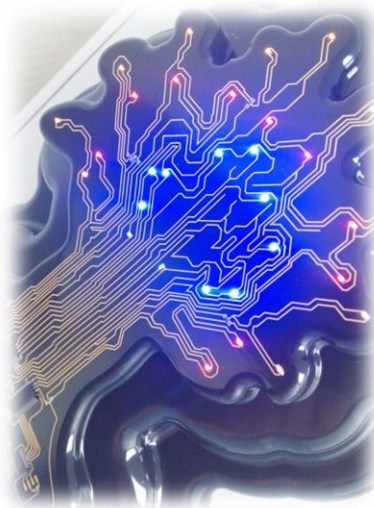
- Down to 0201 and QFN 0,4mm
- Dispense and jetting heads



The LDS process

Substrate manufacturing

- Injection Moulding
- Compression moulding + machining
- LDS Lacquer on existing materials / AM parts
- PEEK LDS FDM



Ensinger 
TECAFIL PEEK LDS black - Filament


arianeGROUP



The LDS process

Laser Direct Structuring (LDS) Process



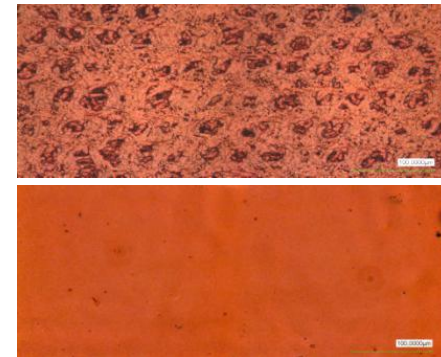
- Possibility to increase the copper layer by **galvanic plating** (electroplating)
 - up to 1µm/min: 65% time reduction compared to electroless-only
 - Decrease of roughness down to Ra=0,2µm



Cu 35µm / NiP 4 µm / Au 0,1 µm

Example on PC-ABS Xantar LDS 3710

- . E-less Cu : Rz=11,4µm; Ra=1,2µm
- . Galv. Cu : **Rz=1,4µm; Ra=0,2µm**



Source: LPKF



EXEMPLES D'APPLICATIONS 1/2 : ANTENNES



LDS for Antennas

First market of LDS technology:

Miniaturized and multiband antennas, for smartphones & consumer electronics devices



Source: Molex, TE, Samsung, Nexus, Palm, Sony, Mitsubishi, Winstron, Apple, Polar ...



LDS for antennas

Examples of S2P realizations



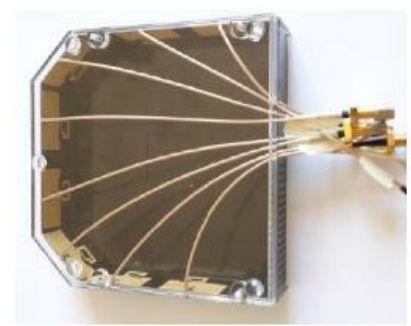
LTE antennas mobile communications
ST Microelectronics



170MHz miniaturized antenna for firemen pagers
CEA-LETI, TPL Systems



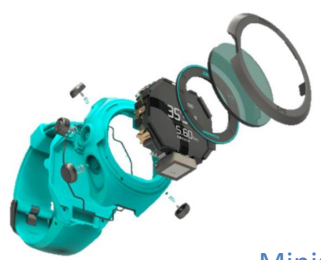
UHF RFID antenna
MIND



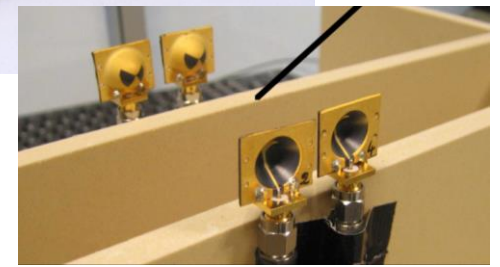
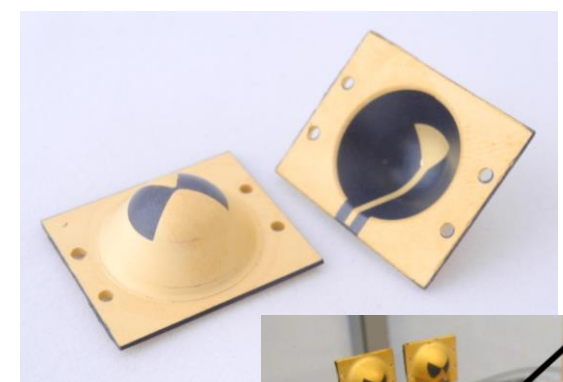
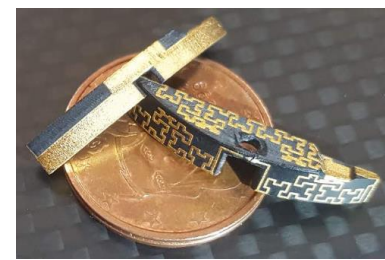
Array of wifi antenna patch antennas
Orange and LEAT



PMR, BT antennas and integrated shielding in one part
Airbus D&S, Radiall



Miniaturized GPS antenna
Decathlon



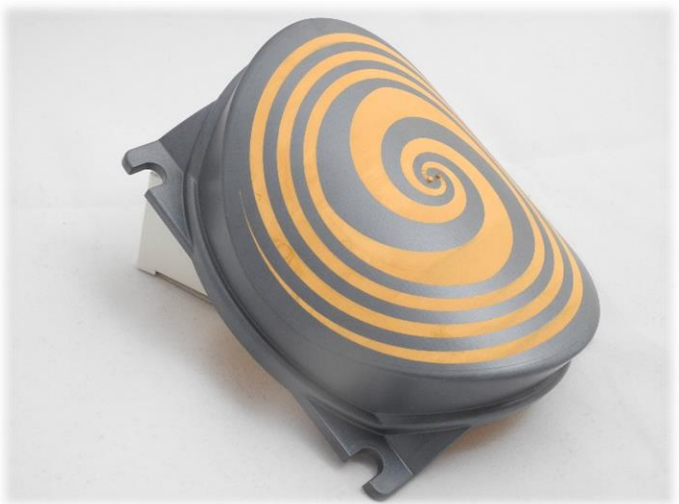
Slotted antennas in Ku band (14 GHz)
for MIMO 2x2 communications
LAMIPS

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LDS for antennas

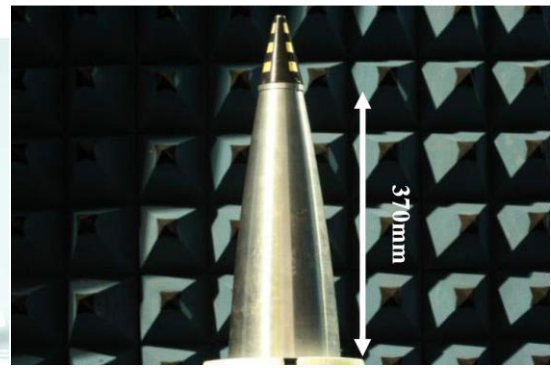
Examples of S2P realizations



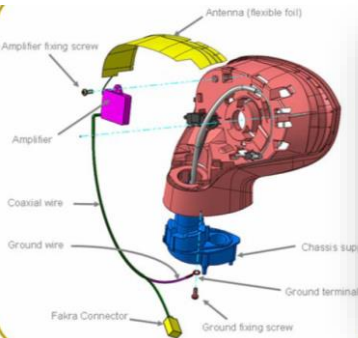
Wide band conformal antenna
THALES



8 MHz double helix antenna
for agriculture sensors
LAAS



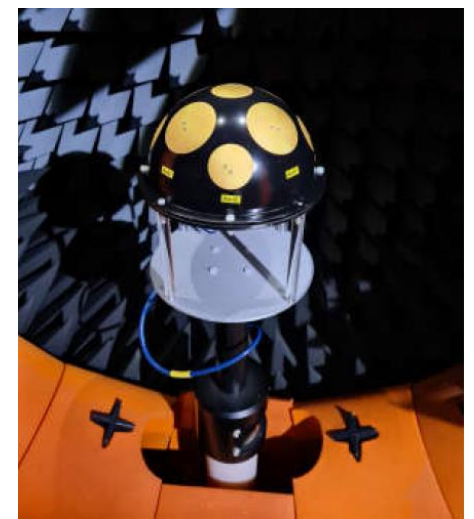
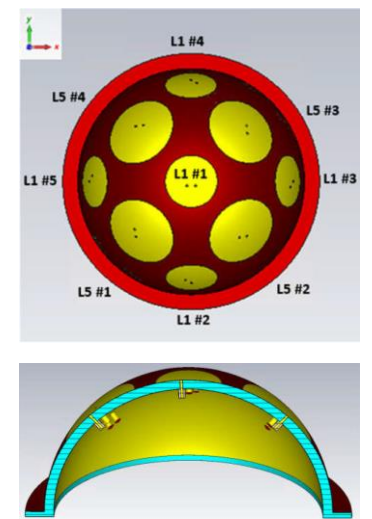
12-element conical phased array antenna for discrete communications in the 5,2 GHz band.
ISL, DGA



AM/FM fractal antennas
Ficosa



Antennes compactes dual-band (268 MHz et 2,45GHz) et ULB (3,1-10,6 GHz) pour la location indoor
Lacroix Electronics

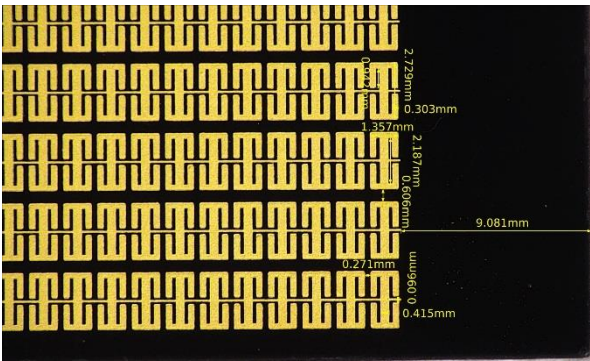
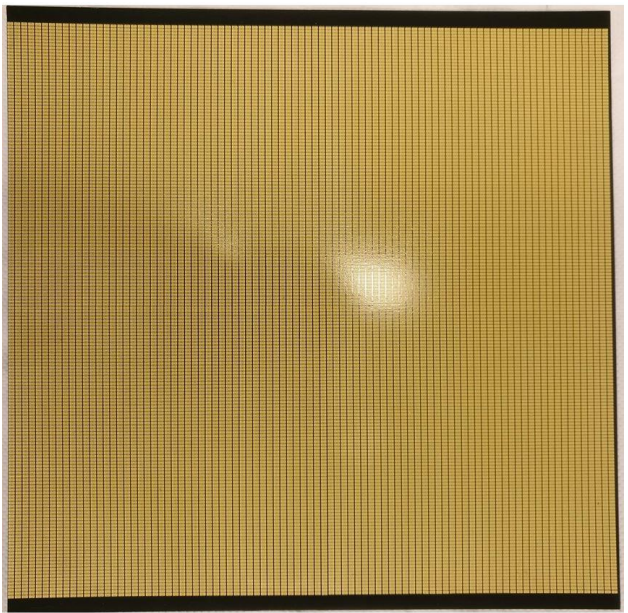
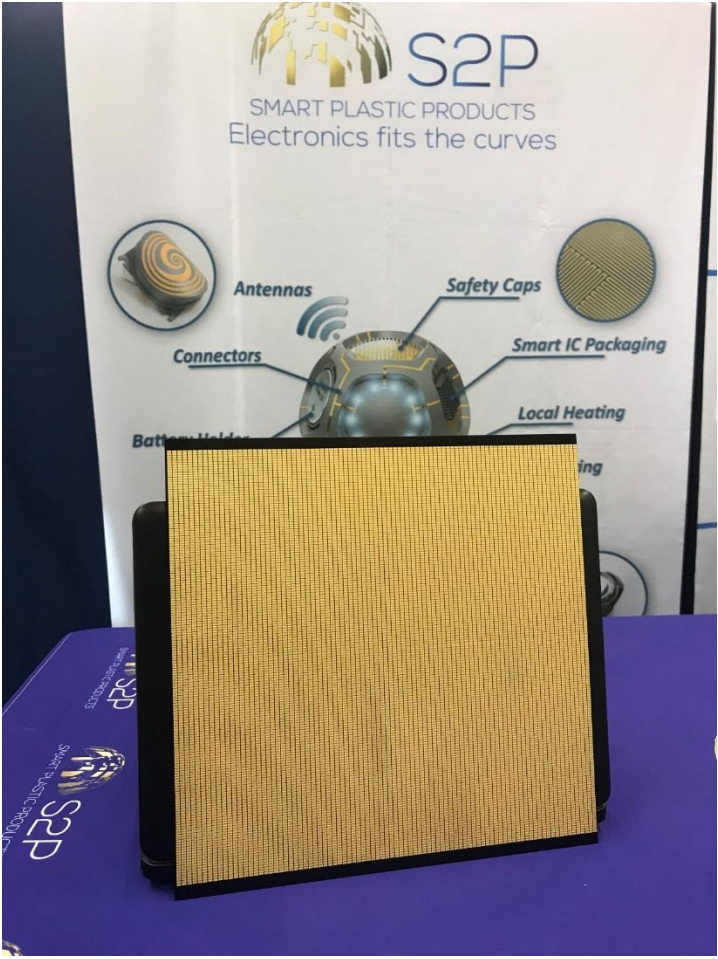


A GNSS Conformal Antenna Achieving Hemispherical Coverage to maximize the field-of-view with respect to satellites in L1/L5 Band
DLR



LDS for antennas : FSS

Linear to circular polarizing reflector 20/30 GHz



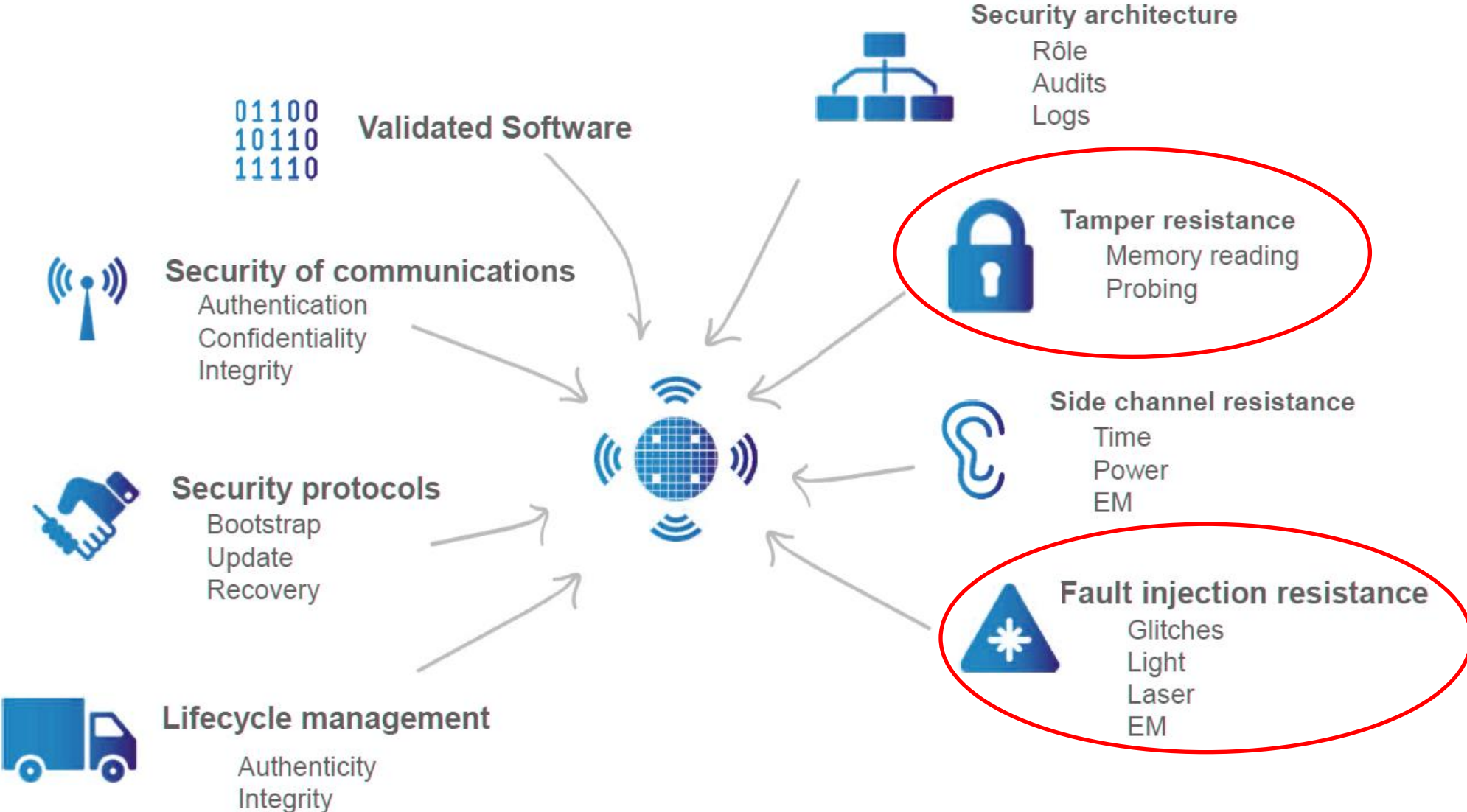
300*300mm²
100μm tracks !
2D → Parabolic



EXEMPLES D'APPLICATIONS 2/2 : BOITIERS ANTI-INTRUSION



Cybersecurity as a whole



Source : CEA



The market

Banking

- Payment terminals
- ATM
- HSM



PCI/PTS/POI/POS v6



DTR A1 Tamper-Detection Mechanisms

The device uses tamper-detection and response mechanisms that cause it to become immediately inoperable and result in the automatic and immediate erasure of any sensitive data that may be stored in the device, such that it becomes infeasible to recover the sensitive data. These mechanisms protect against physical penetration of the device by means of (but not limited to) drills, lasers, chemical solvents, opening covers, splitting the casing (seams), and using ventilation openings; and there is not any demonstrable way to disable or defeat the mechanism and insert a PIN-disclosing bug or gain access to secret information without requiring an attack potential of at least 26 per device for identification and initial exploitation, with a minimum of 13 for exploitation, exclusive of the IC card reader, as defined in Appendix B.

Note: The replacement of both the front and rear casings shall be considered as part of any attack scenario. All attacks shall include a minimum of ten hours' attack time for exploitation.

- Guidance
- Minimum width / separation (of active traces) of 6 mil.

Defense

- Communication devices
- Missiles
- State servers



FIPS 140-3 standards

- “Level 3 : strong enclosures and tamper-detection/response
- “Level 4 : complete envelope of protection around the cryptographic module”



Other Markets

- Critical industrial sites
- Sensitive IOT
- Secure automotive
- Medical / personal data



Common Criteria

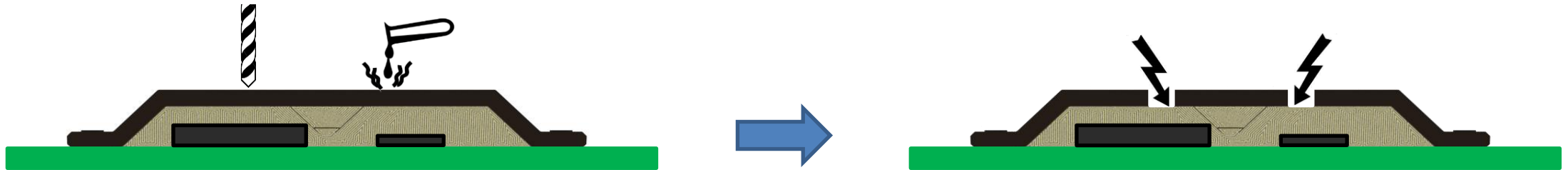
- Higher certification levels requires a tampering detection





Our solution

We provide a **complete envelope of protection** around the electronic module by integrating **conductive tracks all over plastic covers**.



○ Attacks by :

- Opening / Lifting
- Drilling
- Etching
- Probing

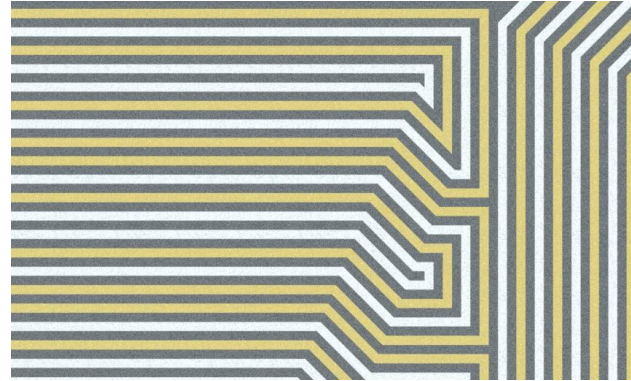
○ Change in electrical properties :

- Tamper state detection
- Deletion of sensitive data

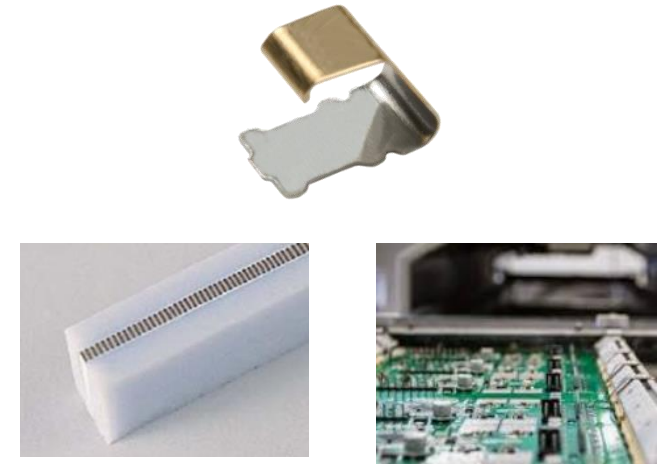
Our solution



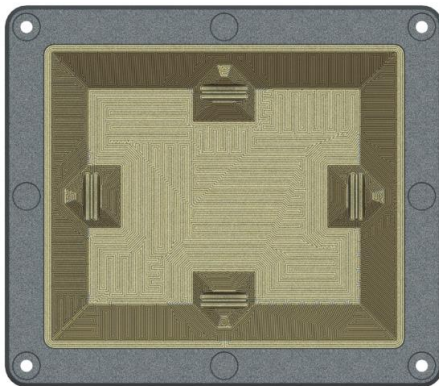
Full coverage of the enclosure
Outside of the part available for a
two layer mesh



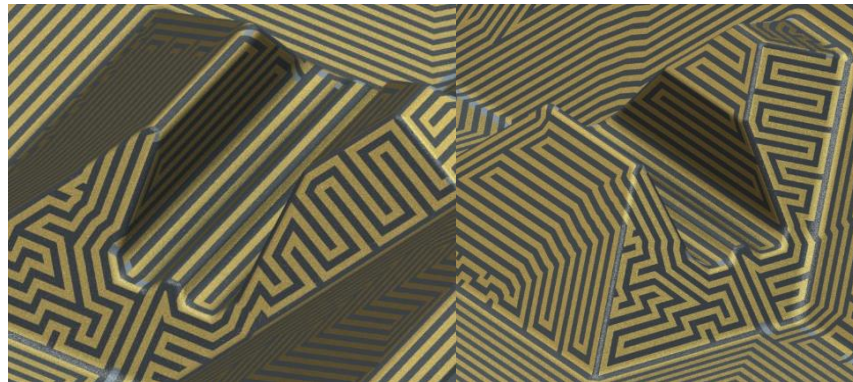
Track width/spacing of 150 μm
Two intertwined meshes



Several interconnection
solutions



Multiple connection points
Guided connector assembly



Full protection of the connections



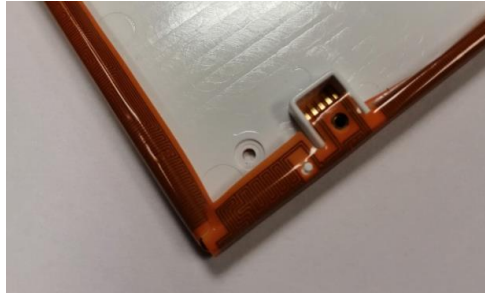
Thermoset coating for more
security



Competition

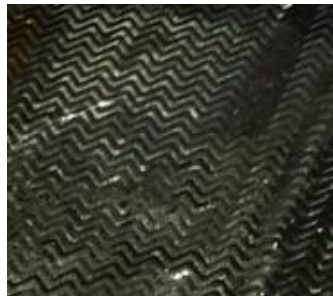
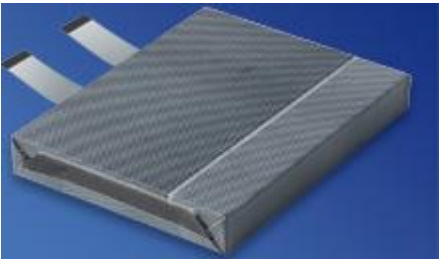
Other technical solutions :

PCB, Flex-PCB assembly



- Complex assembly / Poor reliability / Security Concerns

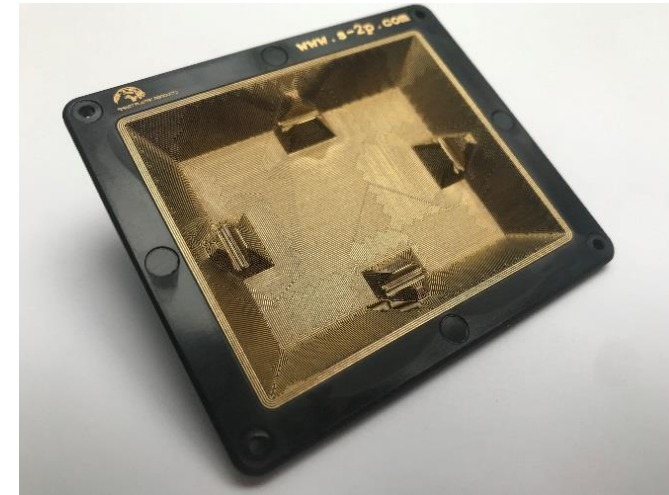
Protective “sock”



- Complex assembly / Expensive / No more available

Our solution :

3D mesh of conductive tracks on plastics



- Complex patterns on full 3D covers without gaps
- Best security to price ratio
- Easiest assembly process



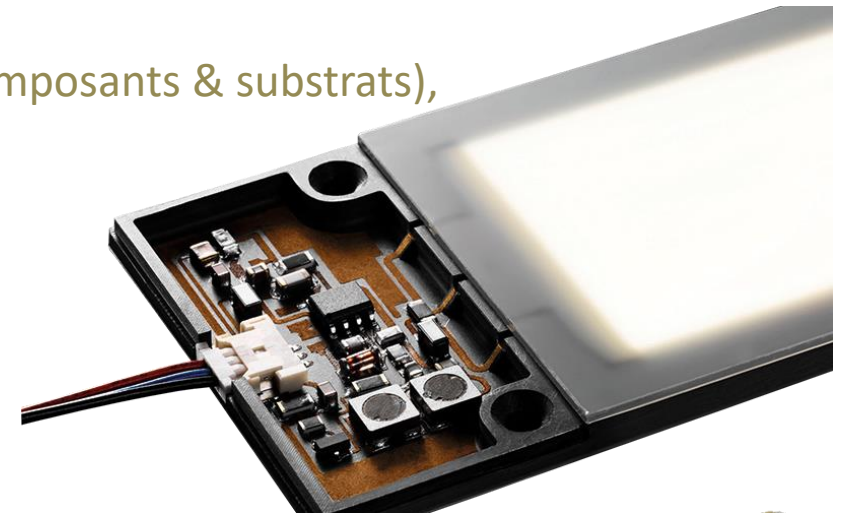


Conclusion

Complémentarité avec l'électronique imprimée

- Le procédé LDS permet de créer des pistes en 3 dimensions sur des supports plastiques ou composites
- Il existe depuis plus de 20 ans, avec des applications y compris en environnement sévère et pour des fonctions de sécurité.
- De nouveaux matériaux apparaissent régulièrement en fonction des propriétés recherchées, et des marchés visés.
- Il est complémentaire de l'électronique imprimée, il ne répond pas aux mêmes besoins.
 - LDS : pièces complexes 3D/non développables, bonne conduction électrique (Cuivre/ENiG), soudabilité CMS, utilisation en environnements sévères
 - Electronique imprimée : grandes pièces, multi-matériaux (fonctions/composants & substrats), multicouches, flexible.

Merci de votre attention !



Exemple de complémentarité LDS/PE (2E mechatronics)



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bpifrance



La Région
Auvergne-Rhône-Alpes

