

ESCCON 2021

FEEDBACK ON COTS USE... PART2 NANOSATELLITES

... OR HOW SMALL SATELLITES EXPERIENCE ON COTS CAN BE AN
EXAMPLE FOR FUTURE CONSTELLATIONS ?

THALES ALENIA SPACE, SYRLINKS

04/03/2021

0005-0013088091 N.JAUSSEIN

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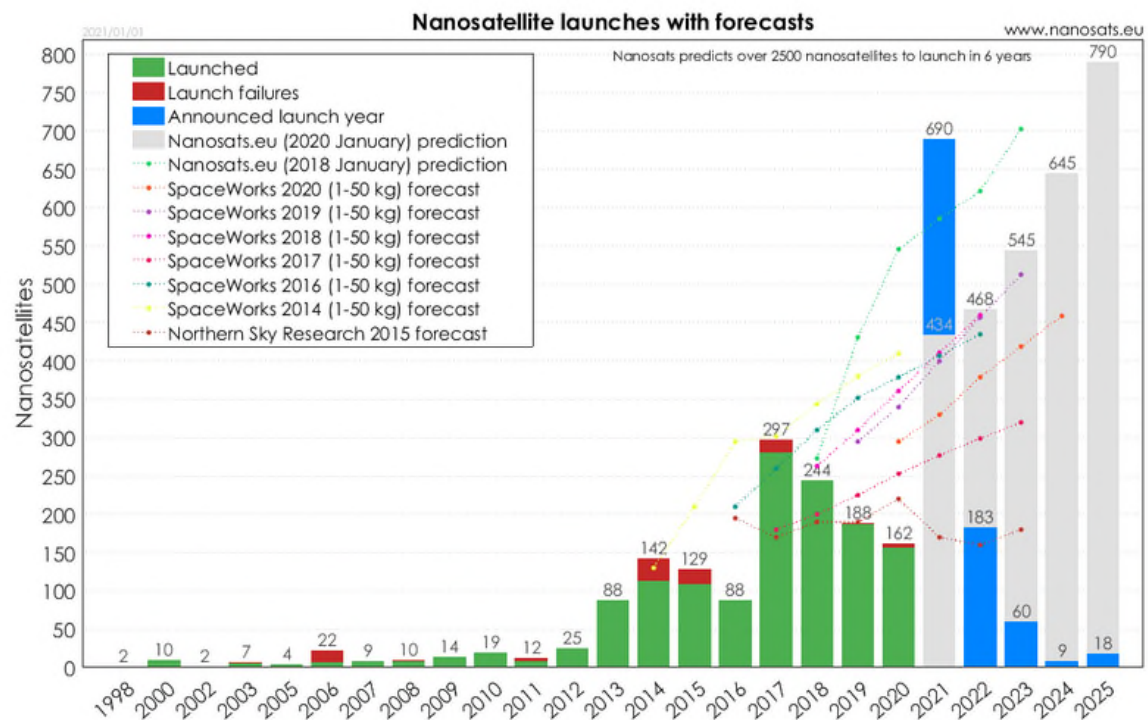
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ANNEX - SYRLINKS SUPPLIER

NANO SATELLITES WORLDWIDE



EXTRACT FROM <https://www.nanosats.eu/>

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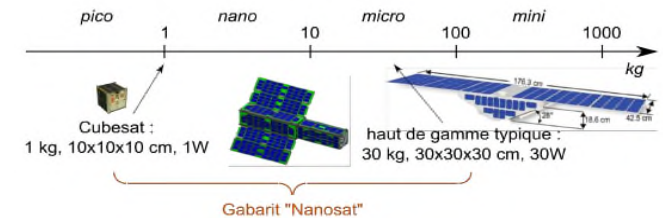
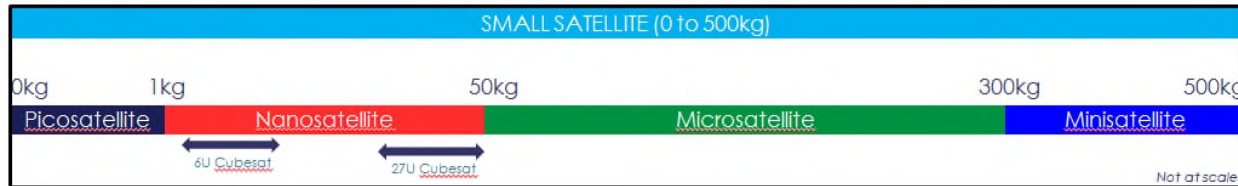
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THALES ALENIA SPACE INTERNAL

QUALITY
IS WHAT WE DO

THALES ALENIA SPACE AND NANO SATELLITES

DEFINITIONS



Current programs

- ANGELS supported by CNES (Argos NEO on a Generic Economical and Light Satellite) **ON FLIGHT**

<https://www.thalesgroup.com/en/worldwide/space/press-release/angels-frances-first-industrial-nanosatellite-extends-scope-space-iot>

- KINEIS dedicated to Internet of Things (IoT), 25 satellites

<https://www.thalesgroup.com/en/worldwide/space/news/thales-alenia-space-bolsters-position-internet-things-market>

- OMNISPAC Thales Alenia Space Prime, Internet of Things (IoT), 2 satellites

<https://www.thalesgroup.com/en/worldwide/space/press-release/omnispace-selects-thales-alenia-space-develop-satellite>

- + other Nano satellites on going

https://www.thalesgroup.com/en/worldwide/space/press_release/start-production-skylark-constellation

➡ **VARIOUS MISSIONS:** various objectives from a single satellite to constellations



OMNISPAC

DEDICATED APPROACH

NEW CUSTOMER SPECIFICATION

NEW THALES ALENIA SPACE FLOW DOWN TO EQUIPMENT SUPPLIERS

Equipments adaptation with COTS or already existing “COTS equipment” can be used

NANOSAT approach for COTS selection, due to short mission duration :

- Tests performed at board or equipment level (FM: Burn in +thermal cycles, EQM: standard tests+ life test + RVT)
- NO additional SCREENING @component
- Data collection from EEE manufacturer in Justification Documents

NEW ACTORS (equipment suppliers, customers)

ANGELS



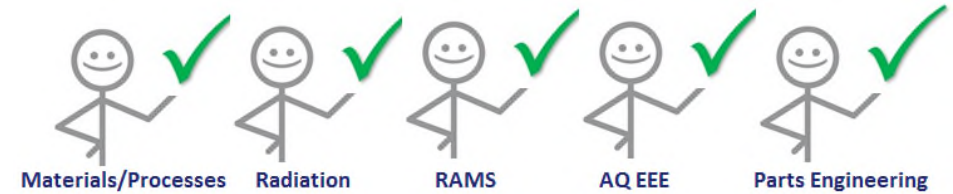
GUIDELINES


///COTS SELECTION in conjunction with the PST*

(*) Parts Selection Team

///"Justification document" (JD) process

- Data collected from databases, manufacturer website, audits
- Construction analysis (if any)
- Lot Acceptance coverage (if any)
- Radiation tests activities (if any)
- Mounting capability validation
- Reliability data collection
- Equipment Supplier technical audit to verify COTS procurement conditions, ... (Storage, CoC, franchised distributors,...)



- 
- These requirements are declined towards our equipment suppliers
 - Additional tests must be realized at board or equipment level : as burn in and/or thermal cycling tests, to validate the use of components in the application

RESULTS AND FINDING

///SELECTED COMPONENTS

- 99% COTS including AEC-Q

///RESULTS at board level (nothing done at component level)

- Success QUALIFICATION tests (Life test)
- Successful SCREENING tests (Burn in + cycling)

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QUALITY
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CONCLUSION

/// How NANOSATELLITES Qualification on COTS can be an example for future constellations ?

- At the origin, NANO SATELLITES were dedicated to universities research. There are more and more used in Space application (IoT, scientific mission, constellations...)
- Good return of Experience in flight and on ground test with justification documents and additional tests requested at board level (nondestructive & destructive)
- New approach for EEE requirements. No reference to ESA Specifications
- AEC-Q and other COTS widely used
- COTS equipment also embedded



Good Feedback on NANO SATELLITES experience in flight and on ground tests
Share of expertise on different domains as Material and Process, Radiation, EEE parts engineering and Dependability -> has to be performed very early in the process for parts approval and use.

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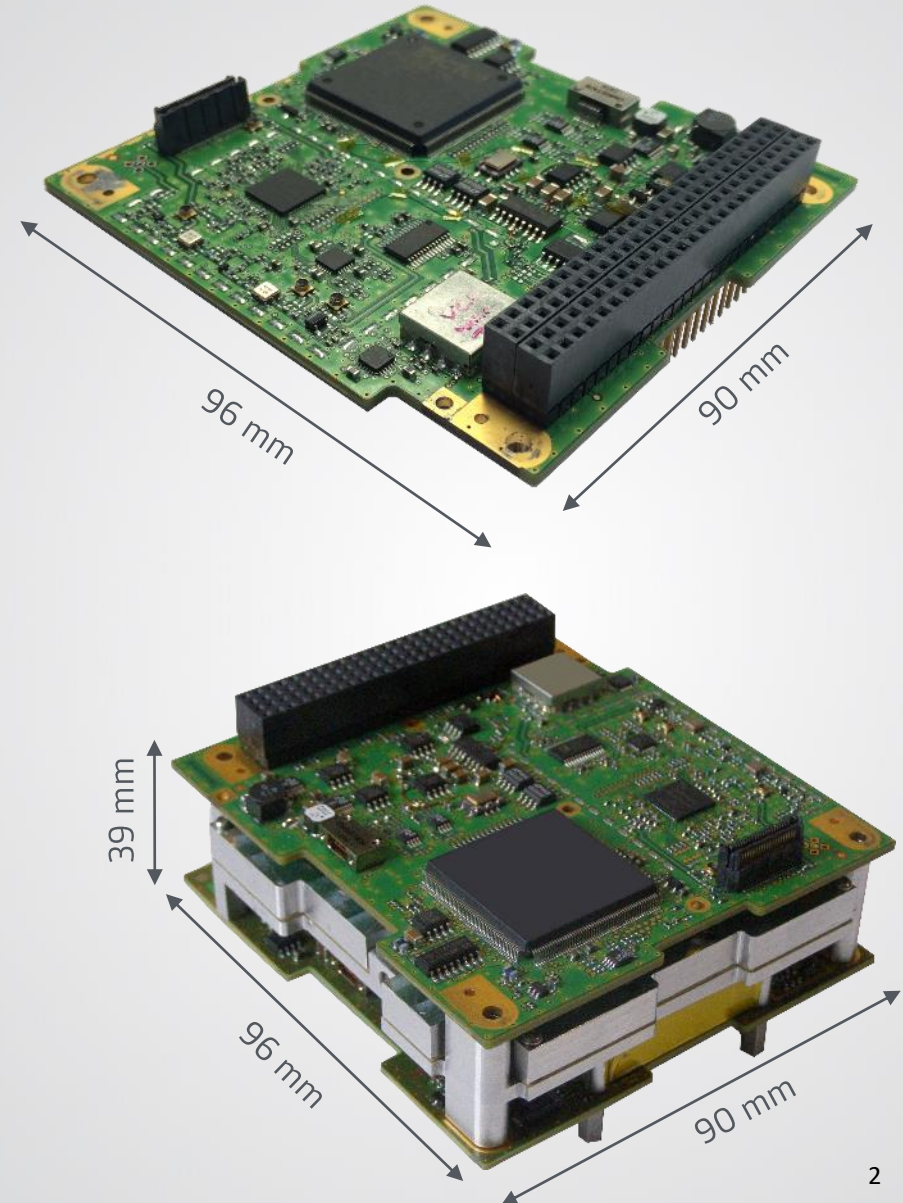
Your Space Radio Partner

March 2021



Cube/Nano-Sat design is challenging

- Big constraints due to the board size (10 x 10 cm) and use of COTS
 - ✓ Improvement of design to miniaturize the electronic functions
 - ✓ Innovative solution of routing and shielding to limit the EMC interactions
 - ✓ Improvements of design to manage
 - the SEL to avoid destructive effects
 - the SET/SEU to limit the unavailability of the product
 - the thermal dissipation
 - the power consumption





Cube/Nano-Sat design is challenging

- Selection of COTS components
 - ✓ Reliability data
 - ✓ Components with flight heritage
 - ✓ Size
 - ✓ Maturity (Obsolescence)
 - ✓ Type of packages (for assembly)
 - ✓ Traceability

Some solutions are proposed by some manufacturers:

- ❖ AEC-Q components (automotive qualified) for reliability
- ❖ “Enhanced product” for traceability
- ❖ “Space Enhanced product” for radiations guarantees
- ❖ RadHard plastic (RadHard die packaged in plastic) but as this manufacturing is for a large quantity of components it is for constellation,





Cube/Nano-Sat Qualification

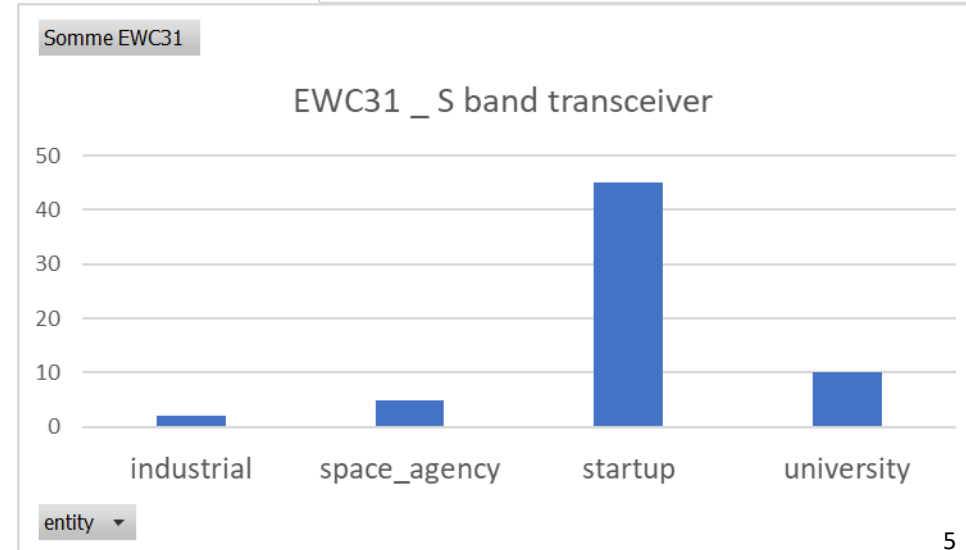
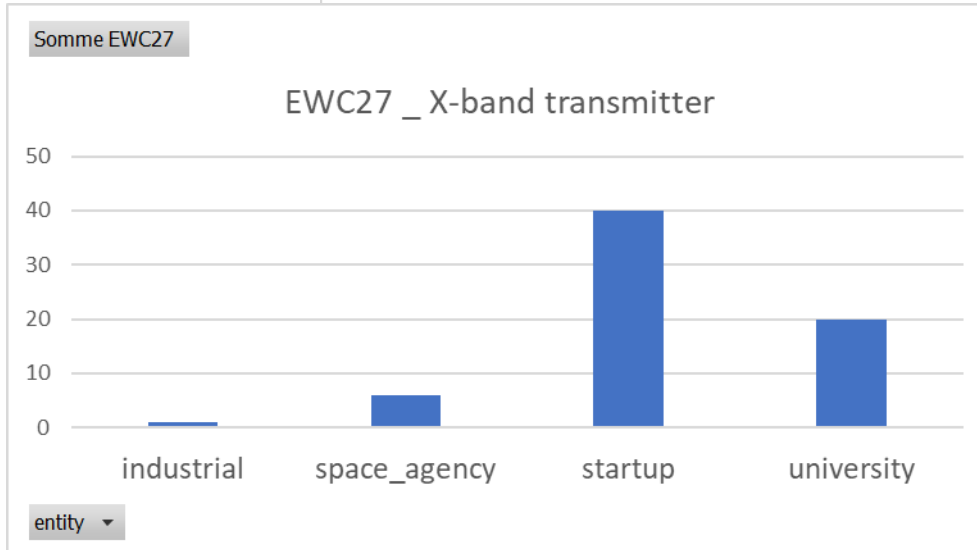
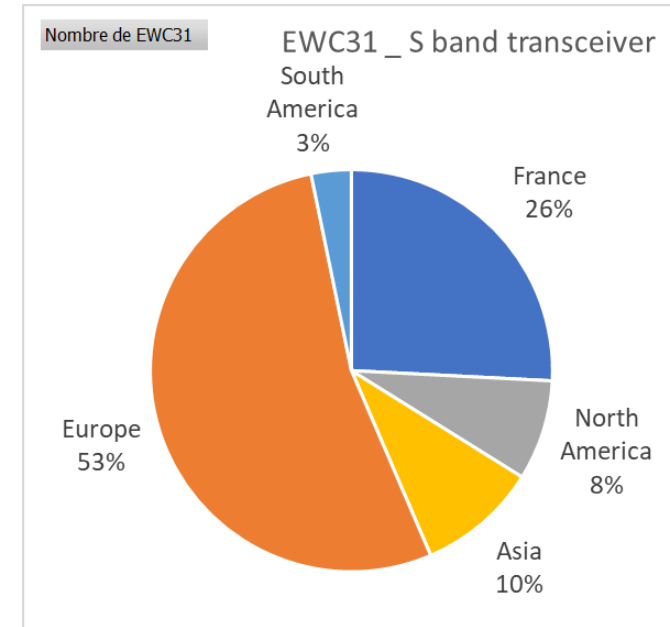
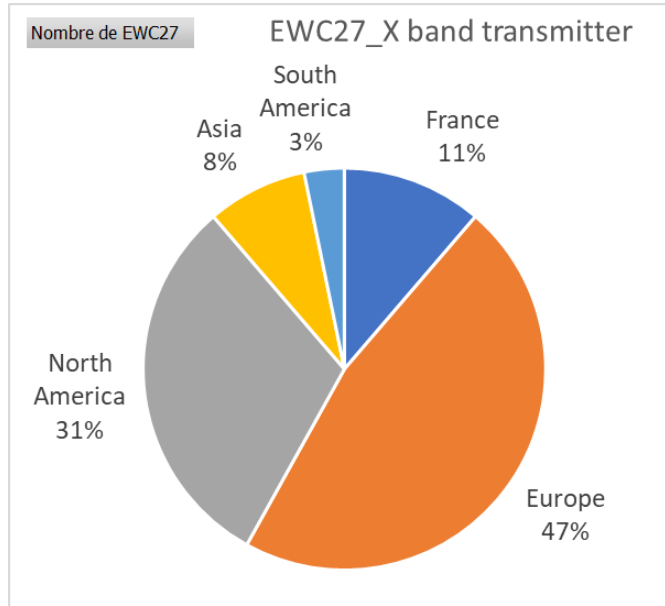
is challenging

- Product qualification
 - ✓ Adapt PA/QA approach
 - ✓ Determine the qualification and acceptance tests according to the needs of the missions
 - ✓ Add screening tests at product level to compensate the lack of screening at component level
 - ✓ Perform risk mitigation for pure tin termination (SnPb material is always used for soldering)
 - ✓ Perform TID test at product level and use dedicated batches of components (same batches for QMs and FM)s)





Customer distribution for CubeSat products





CUBESAT- PRODUCT LINE



QUALITY LINE

- ✓ 2+ years life-time LEO
- ✓ Radiation tested & hardened Functional, Mechanical, Thermal Tests, TVAC, EMC
- ✓ SEL Smart protections

PRODUCT CONCEPT

- ✓ CubeSat footprint
- ✓ ITAR FREE
- ✓ CCSDS compatible



X BAND TRANSMITTER
EWC27 SERIES



S/S BAND TRANSPONDER
EWC31 SERIES



X/S TRANSCEIVER
EWC27 + OPT-C27-SRX



S BAND RECEIVER
EWC31-RX

APPLICATIONS

- ✓ High DataRate TeleMetry
- ✓ Observation & Scientific payloads
- ✓ Lunar Missions
Deep-Space options
- ✓ **TRL 9 since 2015 - GOMX-3 (ESA/GOMSPACE)**
- ✓ **> 70 units commissioned: US/CA, EU, ASIA**
- ✓ **Some Famous Missions: OPS-SAT, EYE-SAT, HAWKEYE360, PLANETIQ, SOCON, ...**

- ✓ Telemetry Tracking&Control (TT&C)
- ✓ InterSatellites & Proximity Links (ISL)
- ✓ Observation & Scientific payloads
- ✓ **TRL 9 since January 2018**
- ✓ **> 70 units commissioned: EU, ASIA, US/CA**
- ✓ **Some Famous Missions: OPS-SAT, EYE-SAT, ...**

- ✓ Telemetry & Control
- ✓ High DataRate TeleMetry
- ✓ Observation & Scientific payload
- ✓ Lunar Missions
Deep-Space Adaptations/options

- ✓ CCSDS TeleCommand
- ✓ Observation & Scientific payload



NANOSAT- PRODUCT LINE



QUALITY LINE

- ✓ 2+ years life-time LEO
- ✓ Radiation tested & hardened Functional, Mechanical, Thermal Tests, TVAC, EMC
- ✓ SEL Smart protections

PRODUCT CONCEPT

- ✓ ITAR FREE



GNSS
EWC40 SERIES



X Band HDR TM
EWC28 Series



Software Defined Radios
for PAYLOAD

APPLICATIONS

- ✓ **GPS/L1 & Galileo**
Advanced PVT,
GNSS/L1
(Position, Velocity & Time)

- ✓ **Some Missions:**
 - **MICROSCOPE**
CNES - 2016
 - **MICROCARB**
CNES - 2021

- ✓ Telemetry & Control
- ✓ High DataRate TeleMetry
- ✓ Observation & Scientific payload
- ✓ **GREAT2 - ESA**
GaN Reliability Technology
Transfer initiative
- ✓ **Some Missions:**
 - PROBA-V, Kent-1,
Nemo-HD, Spaceflight

- ✓ **IoT/M2M: Narrow**
Band Rx + LBT*
- ✓ **RF Sensing: Wide &**
Narrow Band Rx, Mass
Memory & XBT
- ✓ **Some Missions:**
 - ANGELS

THANKS FOR YOUR ATTENTION



Syrlinks
Zac des Champs Blancs
28 Rue Robert Keller
35510 Cesson Sévigné

contact@syrlinks.com

Social Media :



LinkedIn (@syrlinks)



Twitter (@syrlinks)

+33 (0)2.99.00.94.52

Théo Lebrun | Business Developer

Tel : +33 (0)6 31 16 25 95

E-mail: theo.lebrun@syrlinks.com