Different photonic part approach strategies, from specific project to product range

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Introduction words - context

Airbus Photonics team is supporting part procurement, development, evaluation or qualification for many years

In 2022, two communications from the team regarding part selection and support

- ”Optoelectronics parts NewSpace qualification aboard FOLC2 optical modem mission”, Anna Salomon, ICSO 2022, 6th of October 2022

- ”Photonic Digital Data Handling : Applications and identification of the future needs for the components”, Tania Antonini, Workshop on optical interconnects, 16th of November 2022

This presentation will aim at depicting the difference and commonality in the two approaches highlighting the activity we are leading at Airbus Toulouse

Presentation outlines

Introduction

« Next space approach » for optical modem mission

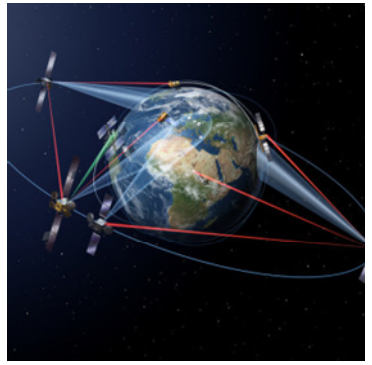
Future component needs for Photonic Digital Data Handling

One step back: how activities are linked…

Conclusion

« Next space approach » for optical modem mission (1)

FOLC2 (Optical communication Feeder Link) project is a free space optical (FSO) communication modem based on 1,55µm technology to **transmit several terabits over one active link. Objective is** surpassing the classical RF technology



This challenging project required :

- Accelerate the pace of new technology development for opto parts
- Eliminating excess capability and taking risk to reduce the cost of space program
- Develop space system “good enough” for the mission

From first analysis, ECSS-Q-ST-60-13C is **not adapted** for demonstrator project for optoelectronics parts due to the high number of qualification part required (50parts and 7 tests / ref)

→ **Standard space qualification replaced by alternative approach**

The approach mentioned as “Next Space” aiming at:

- Reducing cost of space programs by looking for alternative for selection, procurement and qualification of the EEE
- Accessing to high performance components not available in Hirel quality level

From « Optoelectronics parts NewSpace qualification aboard FOLC2 optical modem mission », A. Salomon, ICSO2022

« Next space approach » for optical modem mission (2)

- The ADS internal standard for Next Space programs is the following :
  - Reference selected are COTS to propose a cost effective solution
  - Limit the cost of qualification and upscreening : no need to re-perform tests already done if acceptable.
  - Identify risk of each technology supported by **heritage** from manufacturer and technology know how

- **Important analysis of heritage data required :**
  - Tested components shall be fully representative of the selected device for the mission
  - The level of tests shall at least cover the mission profile
  - The acceptance criteria for electro-optical performance shall be compliant to the mission requirement

  → Activities are selected for each part wrt to risk analysis

- According to FOLC2 study, Qualification for 20 references according to this Next Space approach required :
  - 45 tests and 15 construction analysis : reduction of more than 50% of test
  - Total of qualification with 170 parts : 830 parts saved compared to ECSS-Q-ST-60-13C

From « Optoelectronics parts NewSpace qualification aboard FOLC2 optical modem mission », A. Salomon, ICSO2022

« Next space approach » for optical modem mission (3)

Next space capitalization

Presented test approach is mission based, meaning specific study has to be carried out for each mission :

- If carry over, mandatory to verify no change on the components
- Change reported on Product Change Notification (PCN) by manufacturer
- Mission profile changes need to be checked as well

→ Relevant for recurring product. If no change of reference, no PCN and identical mission profile → few components needed, cost qualification highly reduced.

For each single new program, a new « engineering » loop is necessary. There can be limitation for product range development wrt to mission profile

Future component needs for Photonic Digital Data Handling (1)

Optical High Speed Serial Link (HSSL) are being implemented at Airbus D&S since 2019

- Boosted by the need of performance (increase of data)
- Driven by the need of improving the SWaP (Size, Weight and Power)

High speed serial links can be used for multiple use:

- Earth Observation payload:
  - Whole data chain by optical fiber from detector electronic to transponder.
  - No necessity for high data rate
  - Weight reduction is the main driver

- Telecom Payload application : On Board Processor
  - Much higher data rate needed
  - Performance is the main driver

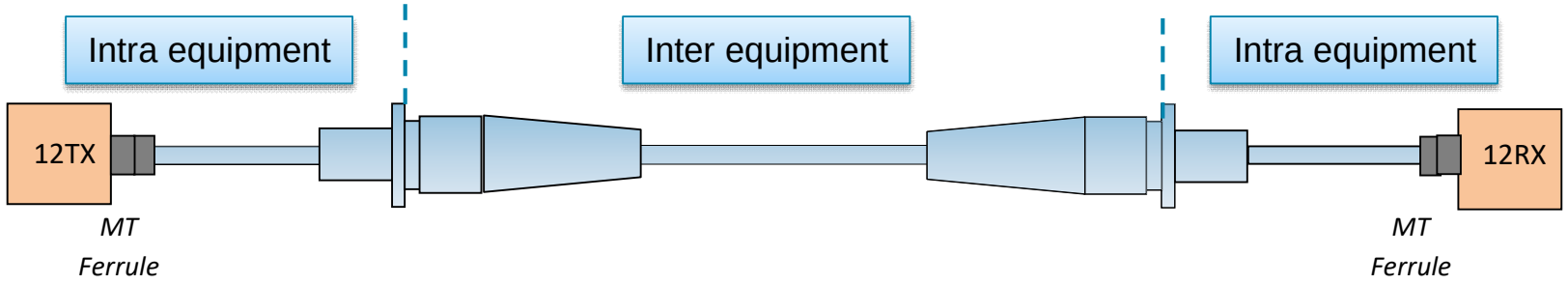
- New Applications emerging due to democratization of optical HSSL at lower data rate
  - Benefiting of a great SWaP
  - Leading to a strong impact on the global cost

  → Could be used on platforms, radiometer, Unmanned Air System, etc…

From Photonic Digital Data Handling : Applications and identification of the future needs for the components", Tania Antonini, Workshop on optical interconnects, 2022

Future component needs for Photonic Digital Data Handling (2)

High speed serial links are generally composed of different constituent:



Looking at the market, developments are needed on the constituents parts to spread HSSL

- On mid term, in the continuity of what is already done
  - Good maturity on transceivers, however improvement to perform
    - On reliability and operating mode
    - Power per bit is crucial for high data rate applications
    - Conformity with derating standard ECSS-Q-ST-30-11C
  - Generic optical harness (connector & optical cable) is necessary
    - Improvement of the SWaP and facilitate the implementation for AIT
    - At time of presentation, no normative standard on multi-fiber harness

- For a long term, benefiting from the use of optical HSSL, democratizing this type of link for standard data handling
  - Decrease of the HSSL cost, on each part is majorly needed
  - In a second level, reliability of the HSSL need to be enhanced
  - Finally SWaP should be improved for the whole HSSL

Future component needs for Photonic Digital Data Handling (3)

Improvement axis are then

- Transceivers
  - Reliability
  - Power consumption with optimization of the design for thermal drain
  - Surface mounting with possibility of automation
- Optical harness
  - Generic solution covering all type of missions
  - Improvement of compactness
  - Addressing complex routing
  - Normative standard to be created
- Cost for the whole optical transmission system will need to be decreased.

The coverage of this work axis can be done through supplier identifications, support of their roadmap, improvement at prime and equipment design and manufacturing, internal standardization, external standardization support

Time to take this from a more general view

Two different studies show different approaches

Next space based model

- hypothesis : next space, single project

→ Use existing product (COTS) and consider further usage as opportunity

- Part quality and reliability are the main drivers to achieve performance at cost

Photonic needs for HSSL

- hypothesis: all quality grade, range development

→ Identify roadmaps and stick to it

- Part quality and standardization is the main driver ; system within cost and performance budget is on a second level

From experience, in the two approaches Airbus can

- use heritage data from the product range to justify use in new space
- use experience on new space design to develop and put effort in specific opto part development for our product range

There is no golden approach. They can be completary

Depending on the need, the effort needs to be evaluated from the early stage base on project/product roadmaps

Conclusion

Two opto parts support were presented

- New space approach
  - **It requires a more important effort for engineering and possibly less testing**
  - **It offers opportunity to have high performance COTS and demonstrate good enough quality status**
- Equipment product roadmap
  - **Possible co engineering with manufacturer to stick to roadmaps**
  - **Support design and process to reduce time to market**

Amongst those two, none is better than the other → they need to be selected in relation with product roadmaps

Whatever the approach, selecting a part help to grow in experience, field return and then future use.

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Thank you