Next Generation of High Throughput Telecom Satellite Payloads Using Optical Interconnects

10th of December 2015

Airbus Defence and Space – Space Systems

Telecommunications Satellite Payloads – Javad Anzalchi

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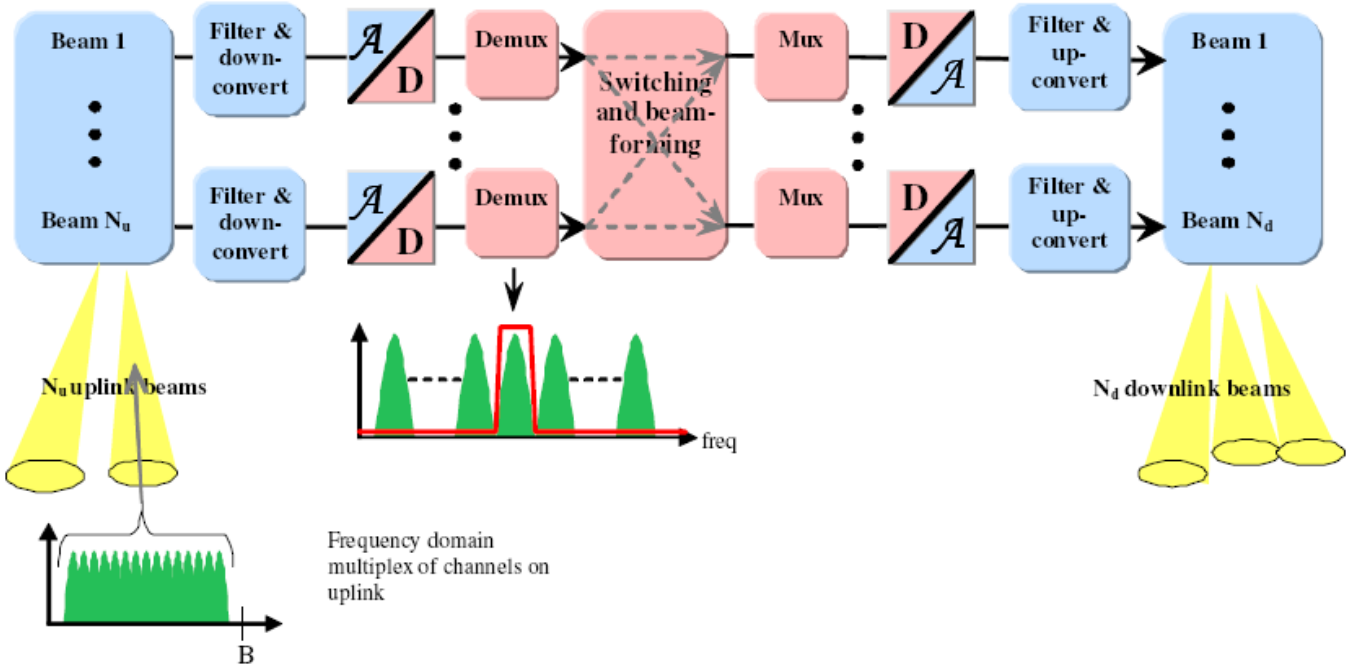
Introduction

- In the frame of a R&D study, Airbus Defence and Space and study partners have developed an innovative concept to introduce optical links on-board the Payload for future High Throughput Satellites (HTS).
- The primary objective of the study was the conceptual design/development of an innovative optical architecture which outperforms standard electrical equivalent used in current telecoms satellites.

Simplified Transparent Processed Payload Architecture

- Transparent router for mobile communication by satellite



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Challenges for the Next Generation of HTS Satellites

- Increasing bandwidth
  - Higher routing complexity due to signal crossings
  - Increasing number of channels
  - More cables/components: weight, volume and cabling operation increased
  - Higher power consumption and higher thermal dissipation constraints
- Greater Speeds:
  - Signal integrity
  - Higher power consumption and better thermal dissipation

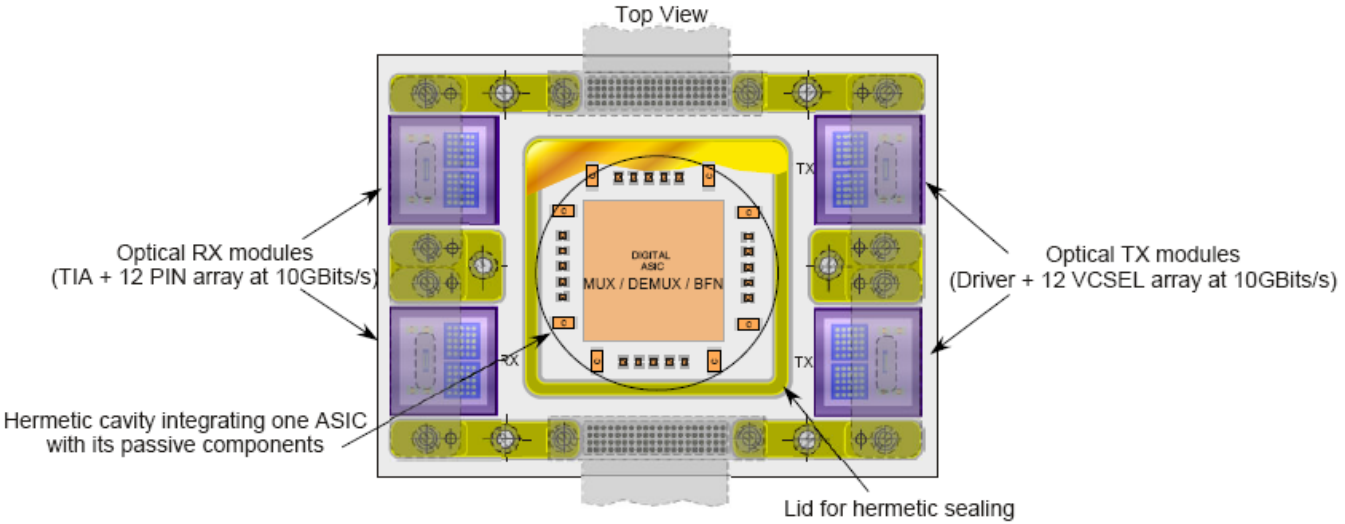
Solution:

- Optical links are a likely candidate to overcome the challenges just as they have done in terrestrial commercial applications:
  - Lower power consumption
  - No EMI/EMC
  - High speed links
  - Low weight
- Optical links could also represent a starting point for complete rethinking of the OBP architecture design
  - Separate ADC/DAC functions from the DSP function
  - Allow the use of a high performance modular architecture

Concept:

Optical Multi Chip Module (MCM) concept:

- One module in HTCC (High Temperature Cofired Ceramic) will contain 1 ASIC with optical TX/RX



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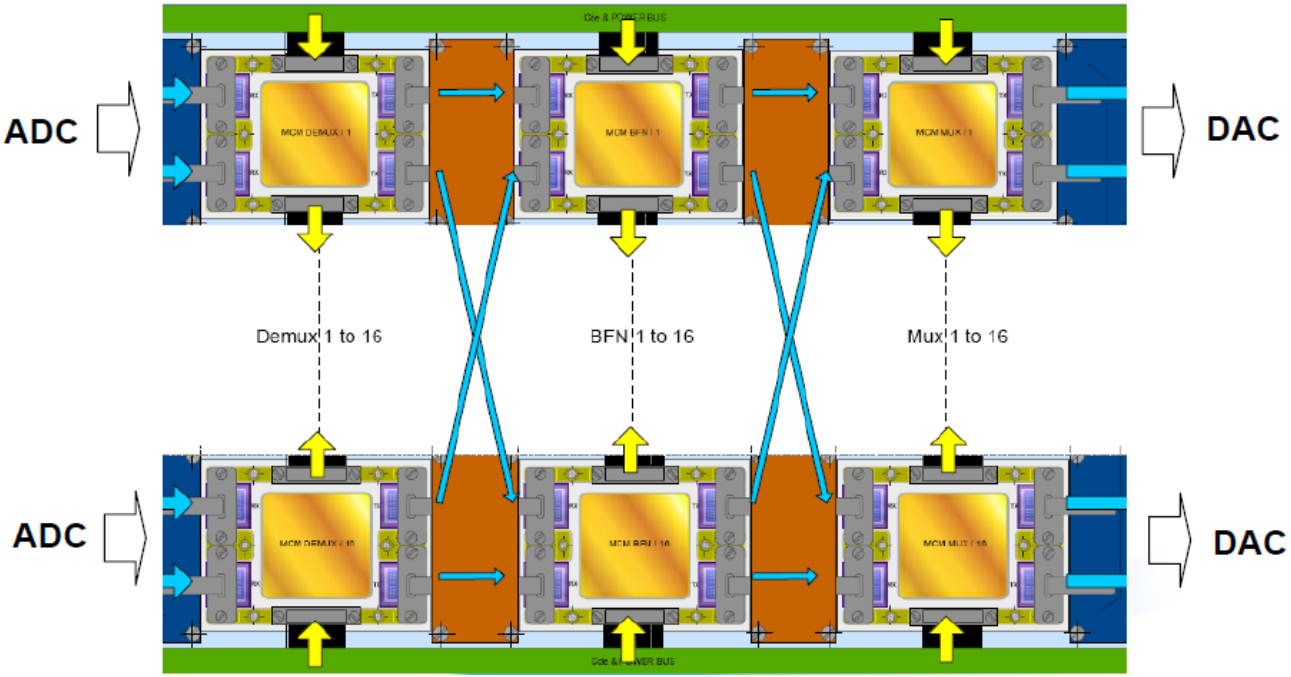
Concept:

Optical MCM benefits:

- Simple “tile”
- Thermal management: ceramic substrate, 1 ASIC per module
- High integration thanks to HTCC substrates: Weight and space saving
- TX/RX close to the ASIC: reduction of power consumption
- HTCC is a reliable and space qualified technology

Concept:

Full architecture concept: MCM linked with optical backplane



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Challenges:

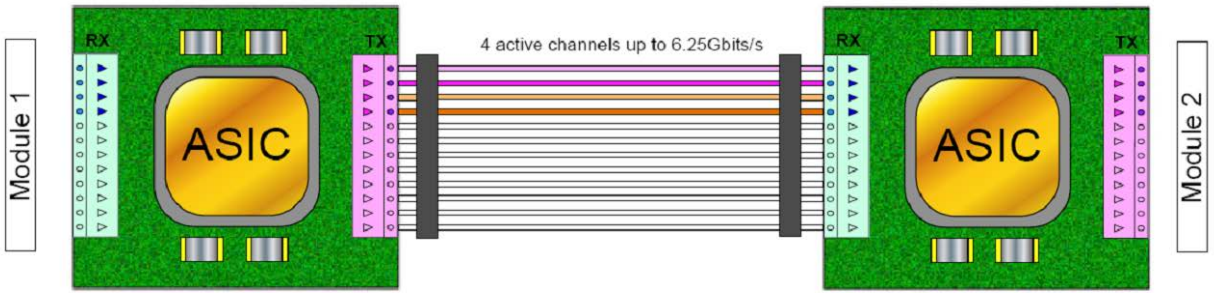
- The main drawback is the power consumption in the VCSELs and PIN diodes in converting from E-O and vice-versa. -22W per ASIC
- Other areas of concern include the integration of the optical devices on the ASIC PCB or ceramic substrates
- TRL status and space reliability of optical devices. Availability of optical flex manufacturers in Europe

Recommendations:

- Reliability assessment for Telecom missions of Opto-electronic components:
  - VCSEL, TIA (Trans Impedance Amplifiers), PIN, Drivers in discrete components or off the shelf TX/RX (transceivers)
  - Optical fibres and connectors
  - Space Qualification of selected candidates
- Proof of concept demonstrator with suitable ASIC and optical TX/RX
  - Evaluate the compatibility between a candidate ASIC and optical TX/RX
  - Evaluate modular architecture with the optical backplane

Recommendations - Demonstrator

- The objective is to evaluate the modular approach. The module will contain one ASIC and one TX/RX. As the ASIC will have four active channels the TX/RX chosen could be a 4-channels TX/RX or a 12 channels TX/RX with only 4 channels used.
- At least two functional modules should be manufactured to test the optical link. For the first demonstrator, components could be assembled on a PCB.



Future Programs

- Following the success of the proof-of-concept process, a small piggyback mission on-board a suitable payload is recommended.
- Such a mission could be composed of four ASIC modules – two transmit and two receive modules (with TX and RX transceivers on each pair respectively) connected by a network of optical fibres.

Thank you for your attention

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