

*EPIC Meeting on Photonics for Space
21st – 22nd September 2023, Paris*



MBRYONICS

***Co-Packaged Optical Transceivers for
Satellite Payloads***

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MBRYONICS***

Outline

- **Brief introduction to MBRYONICS**
- **The need for Photonics in space**
- **Why Co-packaged optics and open questions/challenges**
- **Introduction to TeraBIX CPO transceiver development**

About Mbryonics

A Unique Vertically Integrated Photonic Communications Technology Company

Mbryonics is a Technology Differentiated Leader of Photonic Communications, with a distinctive focus on satellite optical transport solutions



Founded in Galway, Ireland in 2014

Bootstrapped deep-tech company

Pilot line in operation for serial production with volume production in Q1 2025

Ireland's largest photonics company

A Unique Vertically Integrated Photonics Communications Company



In-house design, engineering and manufacturing taken to the next level across **optics**, photonics, **PICs**, robotics, **opto-mechanical systems**, embedded software, **advanced materials**, ASICs/FPGAs, and **co-packaged optics**.



Designed and Built by Market Leading Expertise

> 50 employees

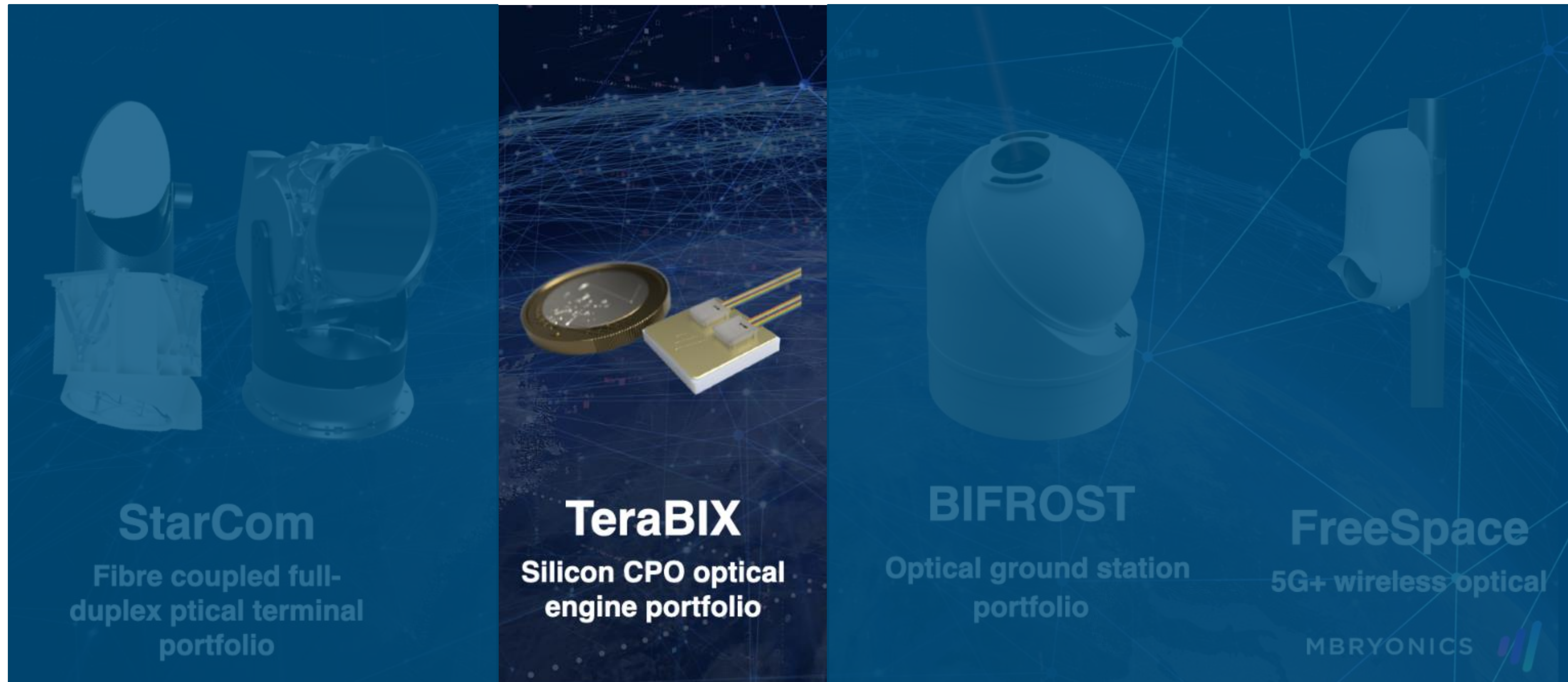


Top image: Industrial Pilot line for our optical communications product lines

Bottom image: Mbryonics optical communications product portfolio which addresses emerging market sectors in space, telecoms, datacoms, industrial and automotive.

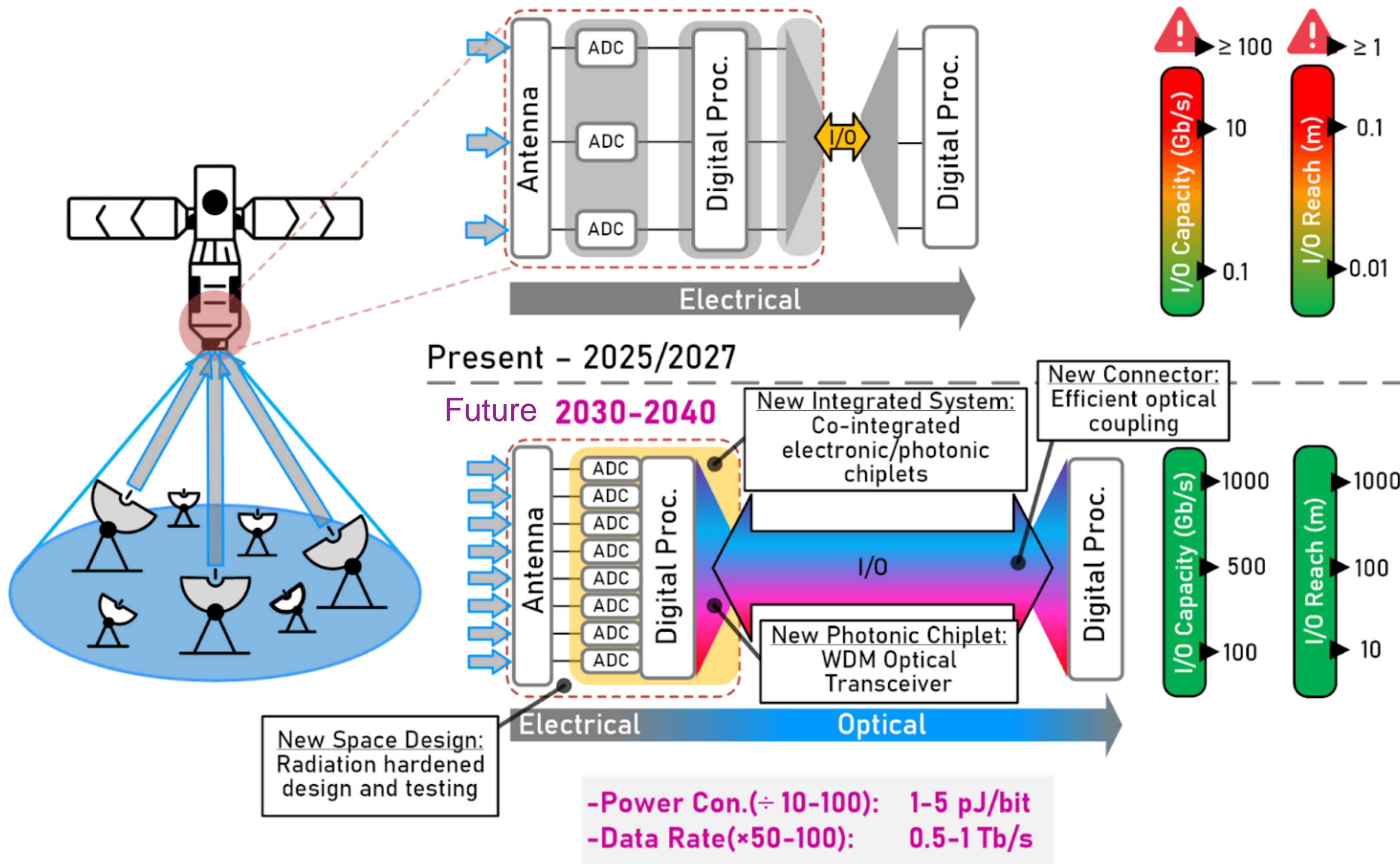
We are

A Leader in Photonic Communications Systems
across space, air, sea, land, and in-package optical
I/O



Mbryonics' family of industry leading optical communications products that will power the next era of connectivity across space, air, land, sea and compute

Why are photonics required in satellites?

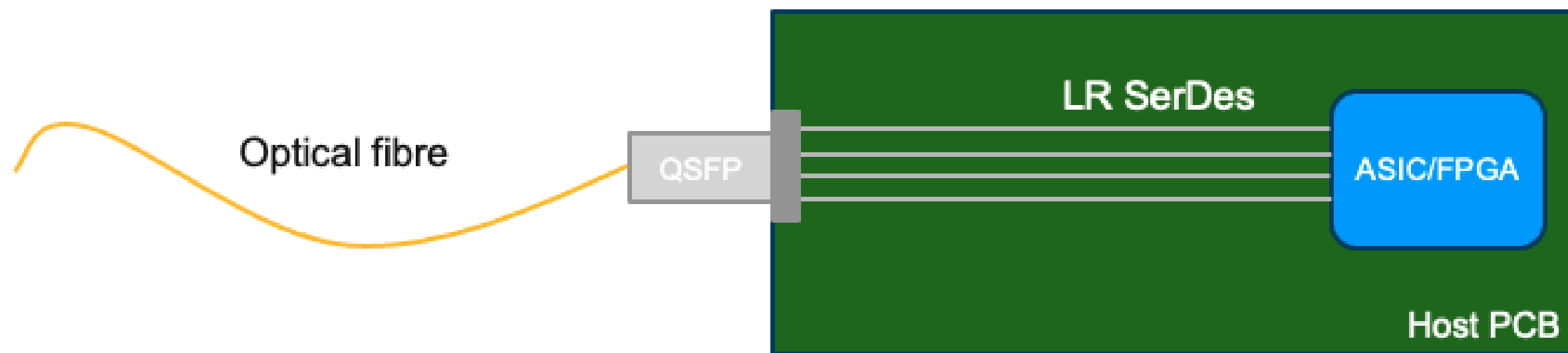


- **Electrical only interconnects will become a bottleneck as vHTS continue to scale up**
- **Moving to optical interconnects can allow much greater bandwidth and transmission distances while minimising power consumption and mass**
- **Many applications such as Linking digital payloads, digital beamforming and RoF on satellite payloads**

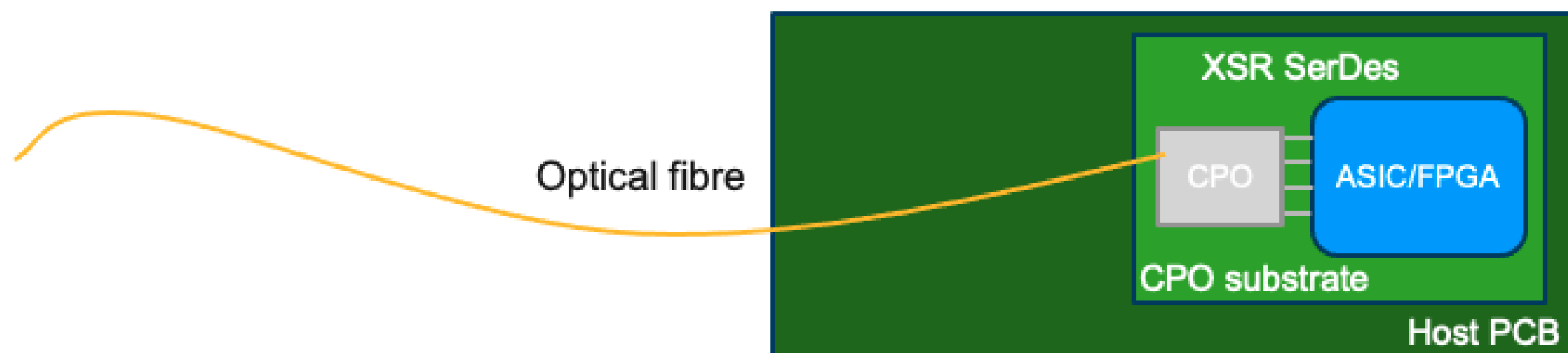
Example use case of photonic interconnects for digital beam-forming

Why Co-Packaged optics?

Today



Towards Co-Packaged optics



- Pluggable transceivers have been the standard for over two decades
- However, as data rates continue to increase this is putting additional pressure on the electrical interconnection between the ASIC and pluggable transceiver
- This results in more power hungry SerDes, signal integrity challenges and limitations on channel density
- CPO moves the optical transceiver from the edge of the host PCB to a common substrate close to the ASIC
- This results in much reduced transmission line distance enabling lower power SerDes and improved signal integrity
- For use on board satellites the power savings are of even greater importance than in terrestrial applications

Open questions/challenges for CPO in Space

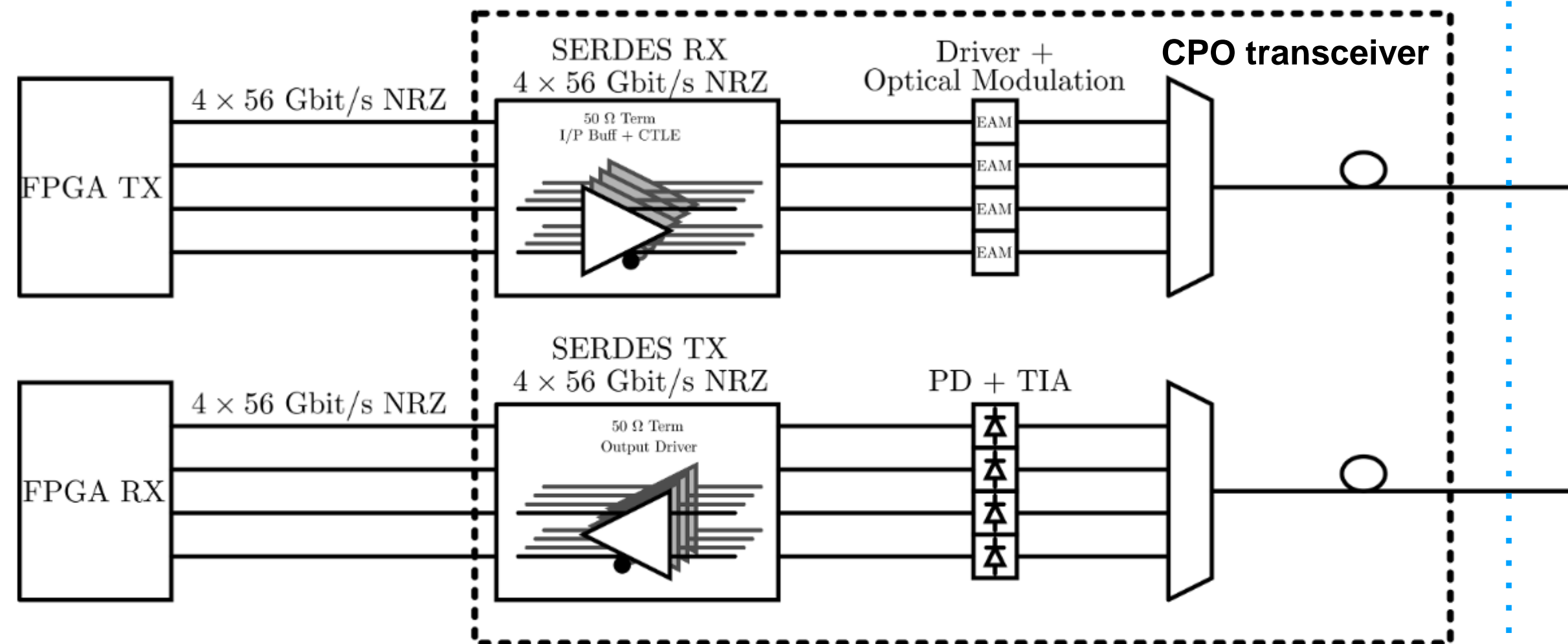
- **CPO does face challenges for adoption including**
 - **Packaging**
 - **ASIC vendor buy-in**
 - **initial cost of developing CPO substrates/host boards**
- **The best approach is still a somewhat open question?**
 - **Level of integration**
 - **Separate transceiver package or chiplet integration inside ASIC package?**
- **Electrical interface between ASIC and transceiver electronics?**
 - **Full rate SerDes or lower rate/higher channel interface (e.g. AIB) between ASIC and transceiver**
- **Modulation format?**
 - **Terrestrial developments focusing on PAM4 but NRZ may offer a better solution**

TeraBIX overview

- TeraBIX is MBRYONICS co-packaged optics Silicon Photonic Transceiver designed from the ground up for high throughput digital interconnects on satellite payloads
- Prototype being development through the ESA project ProtoBIX lead by MBRYONICS
- 56Gb/s NRZ per lane enabling direct drive to achieve ultra low power consumption and low latency
- Custom rad hard electronics
- Custom silicon photonic Tx and Rx fabricated on imec iSiPP200 SiPh platform
- Power consumption of transceiver expected at $\approx 3\text{pJ/bit}$ (excl. laser)

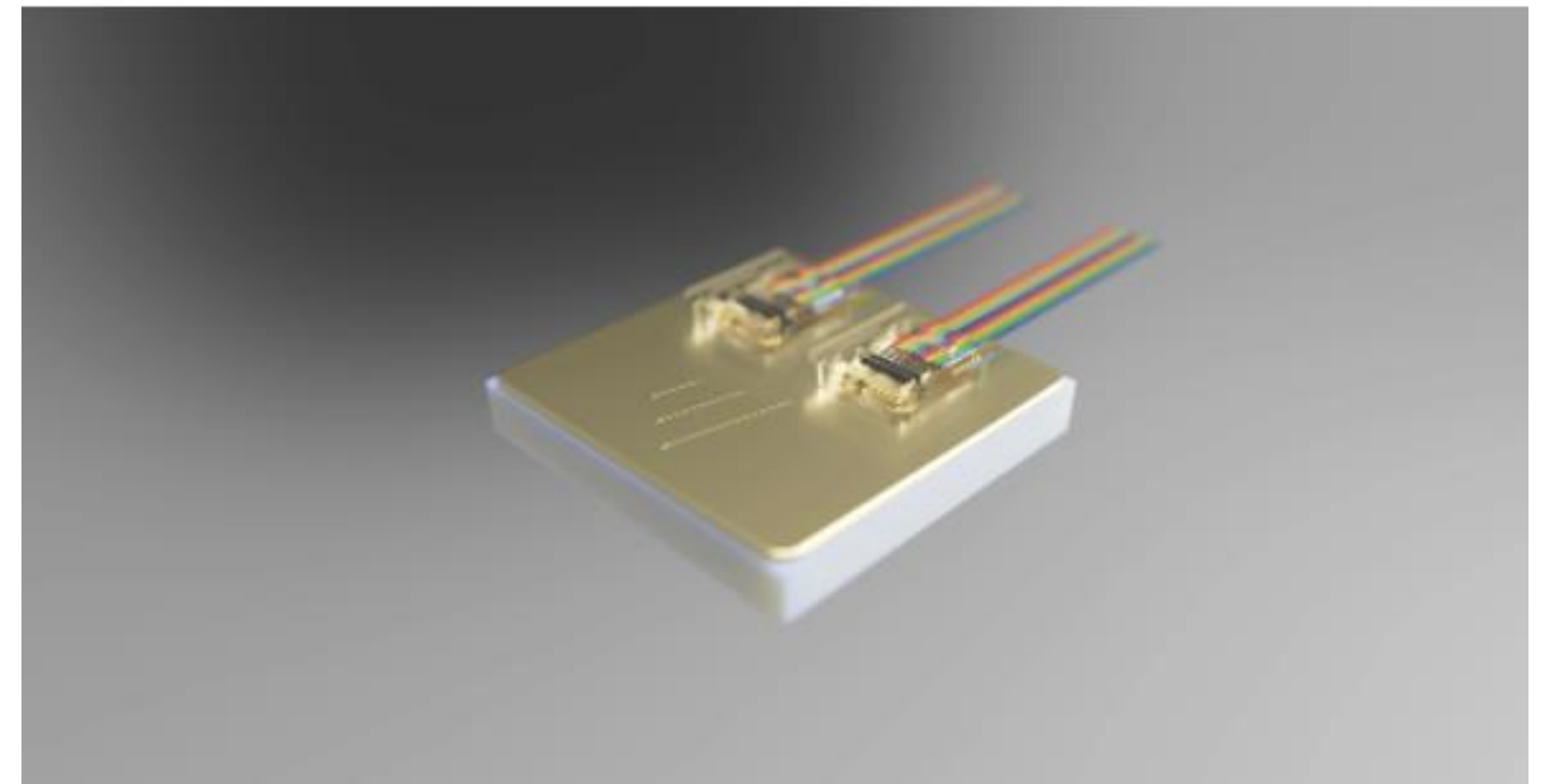
Block diagram of TeraBIX

CPO Substrate



MBRYONICS 

Render of TeraBIX targeted form factor



IDLab
INTERNET & DATA LAB
imec

 esa

MBRYONICS



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