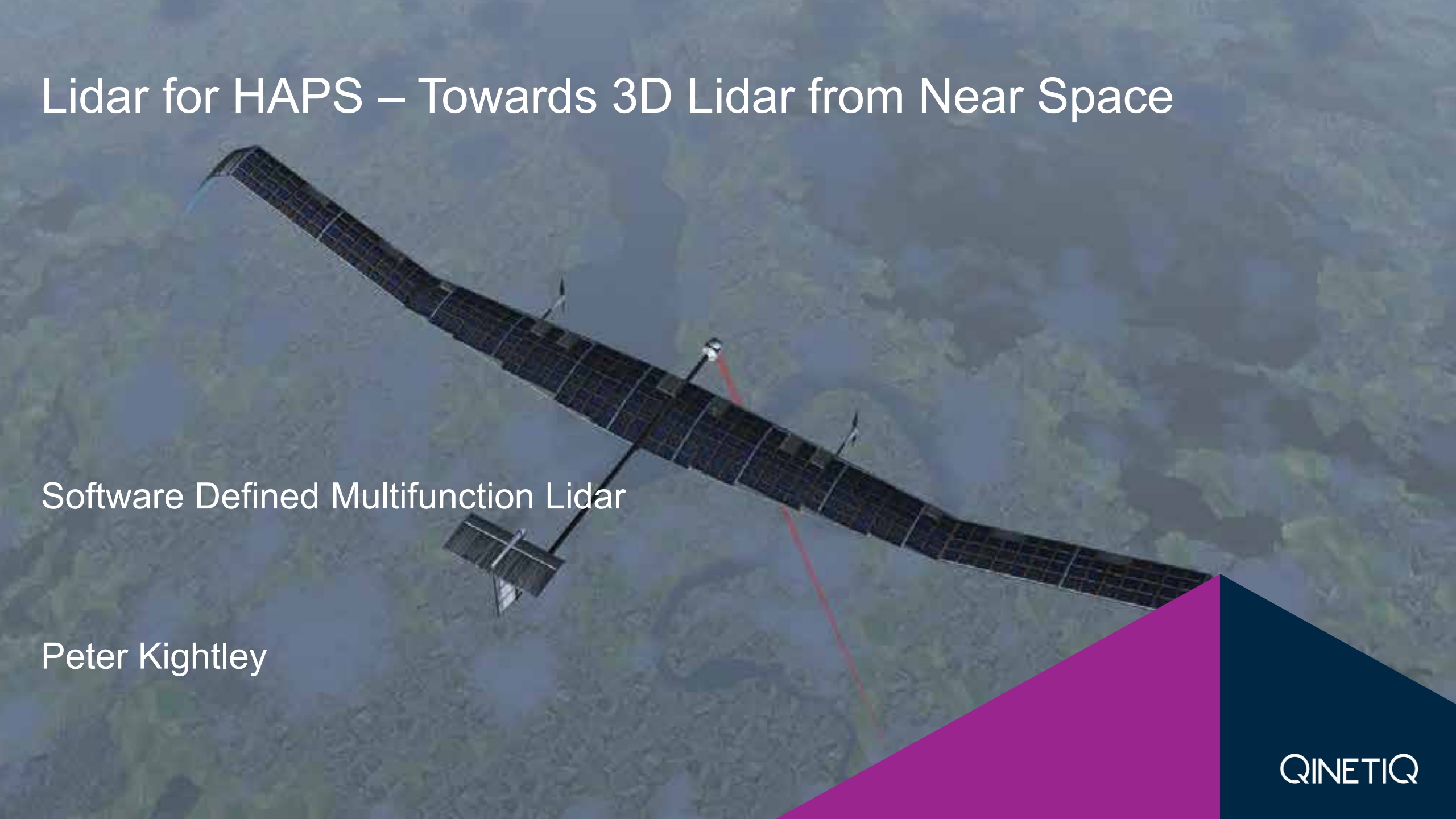


# Lidar for HAPS – Towards 3D Lidar from Near Space

Software Defined Multifunction Lidar

Peter Kightley



# Introduction: QinetiQ





# Introduction: Software Defined Multifunction LIDAR (SDML)

- What is LIDAR?

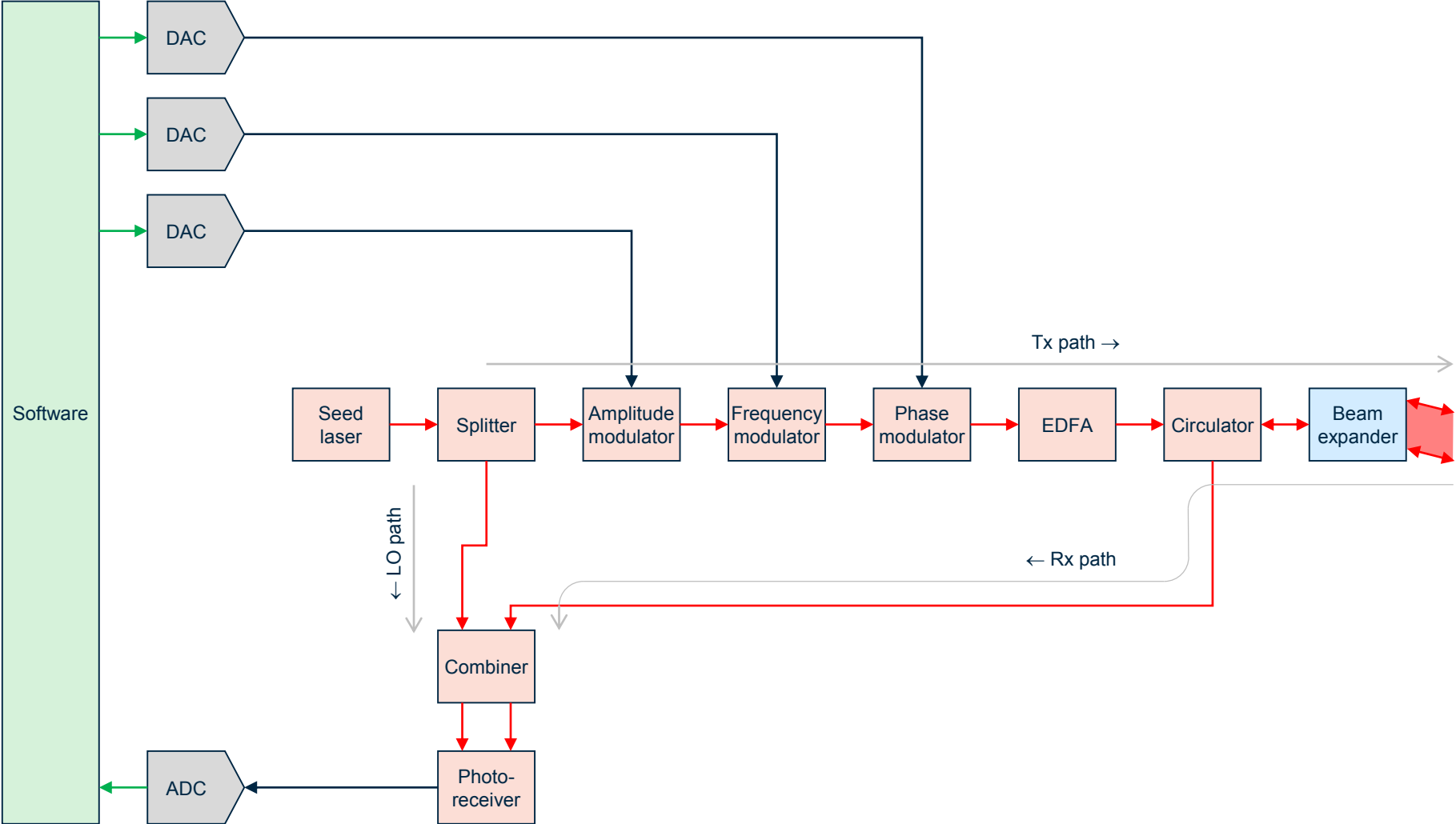
- Like radar but using light.
- Many different types:
  - Range finding, 3D imaging.
  - Velocimetry, vibrometry, anemometry.
  - Optical comms, retro-comms.
- Fundamentally, what discriminates them?:
  - The mod-demod scheme.
  - One or two schemes are 'hard-wired' into conventional LIDAR systems.

- What is SDML?

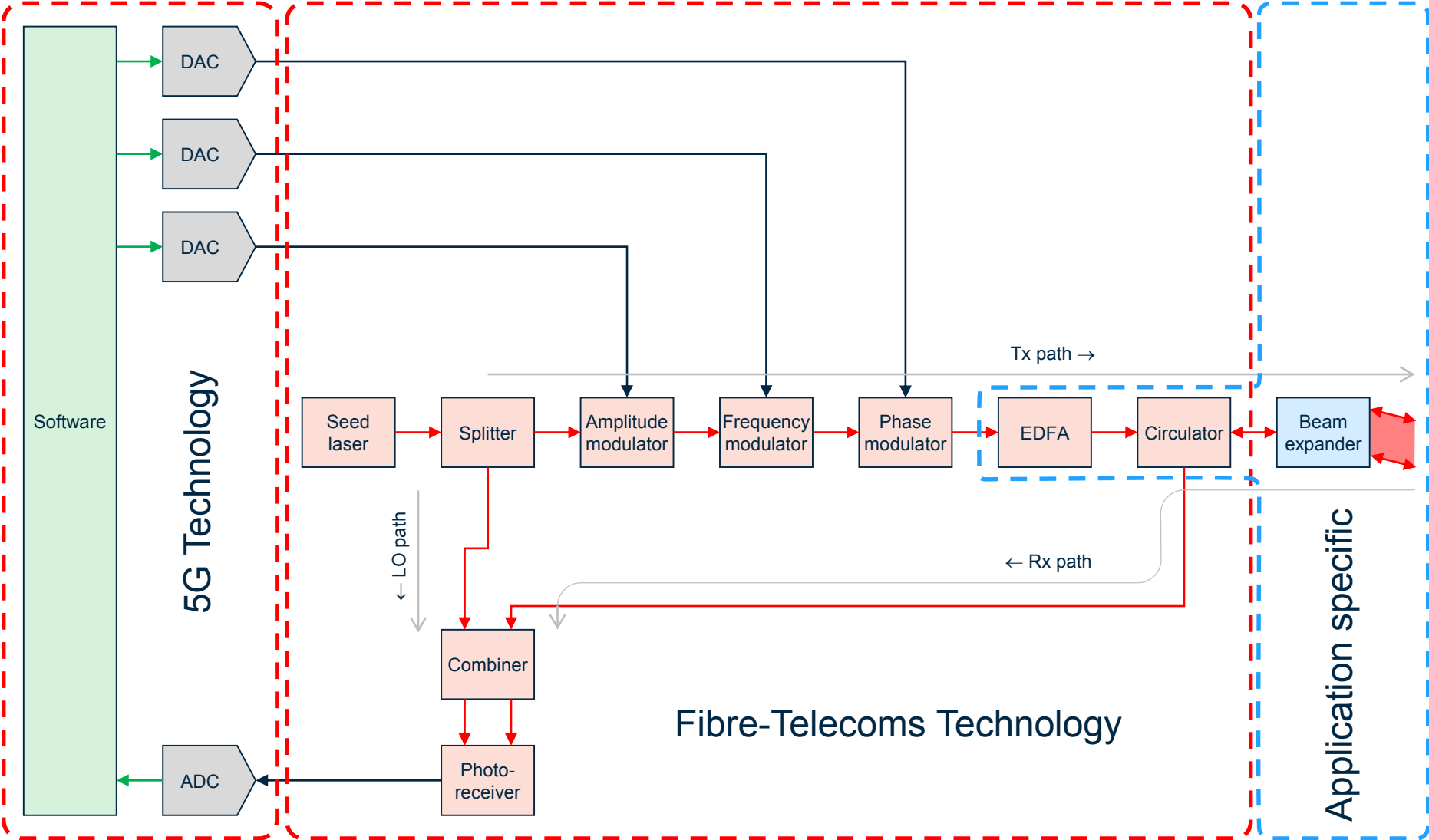
- Mod-demod abstracted into *software*.
- Switch between sensing modalities at run time.
- Allows *many modes in a single payload*.



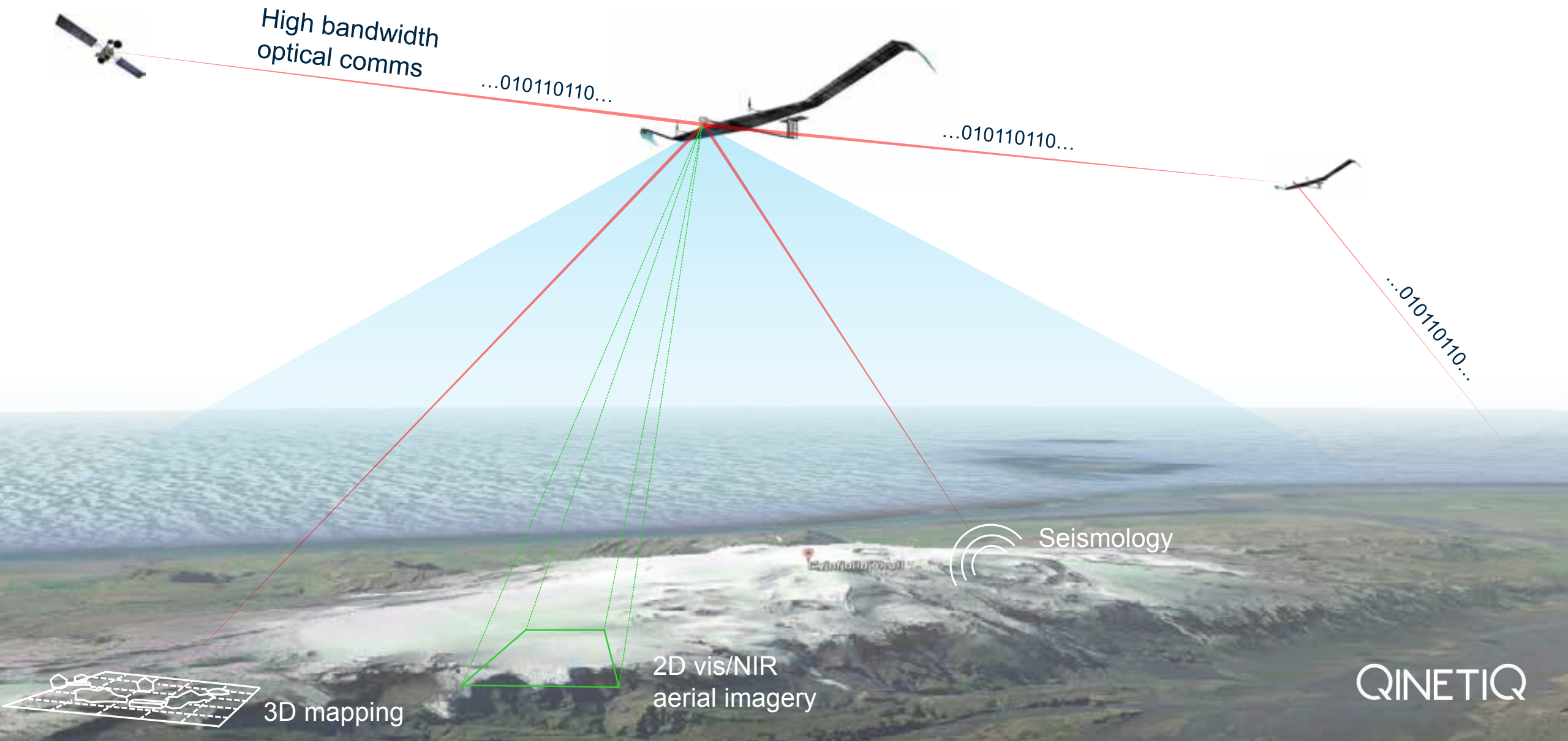
# Introduction: Software Defined Multifunction LIDAR (SDML)



# Introduction: Software Defined Multifunction LIDAR (SDML)



# SDML: HAPS-Based Earth Observation Capability





# SDML for High Altitude Pseudo Satellites (HAPS)

[video](#)

## QINETIQ



## THALES



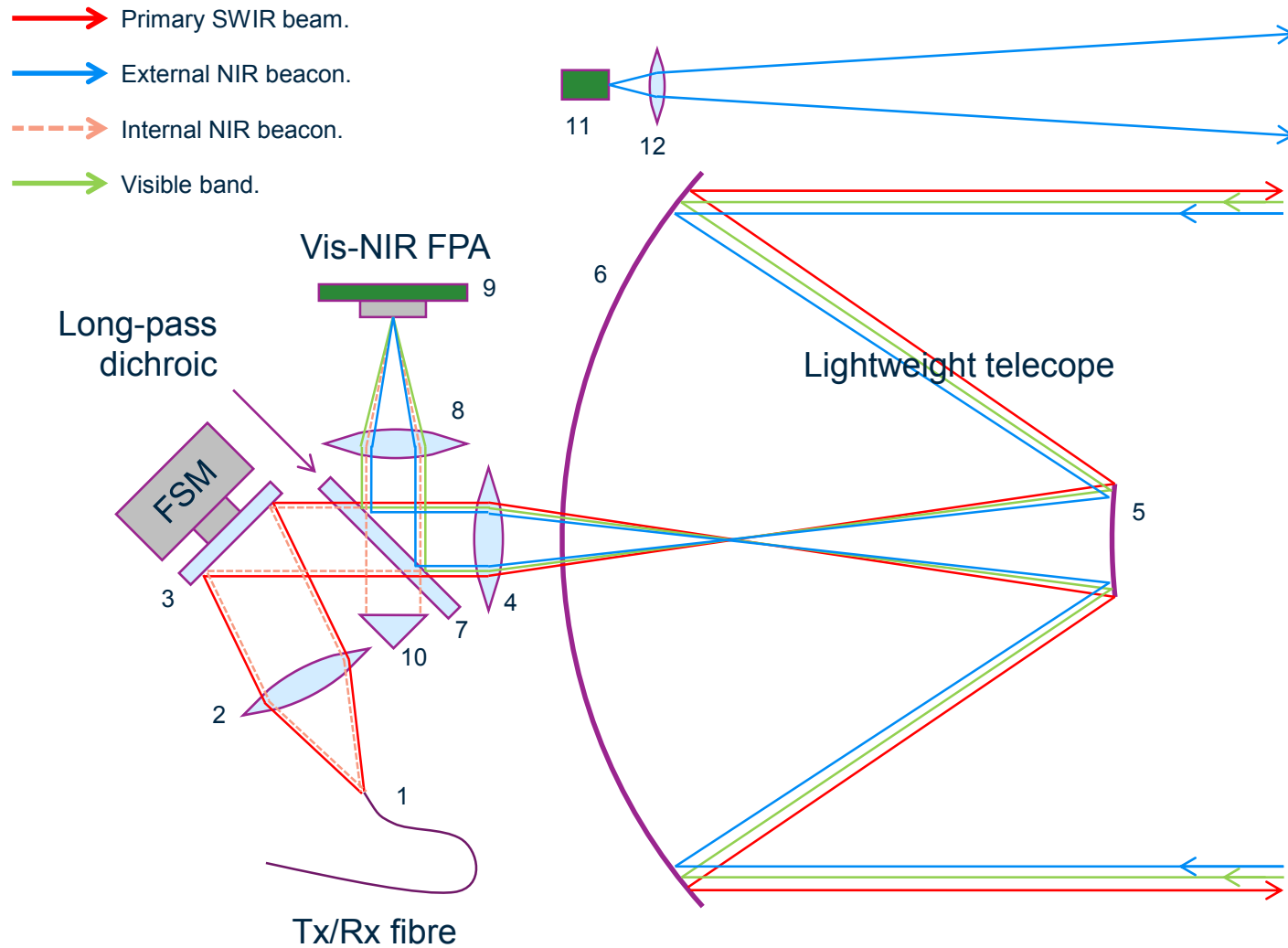
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# SDML: Earth Observation Capability Maturity

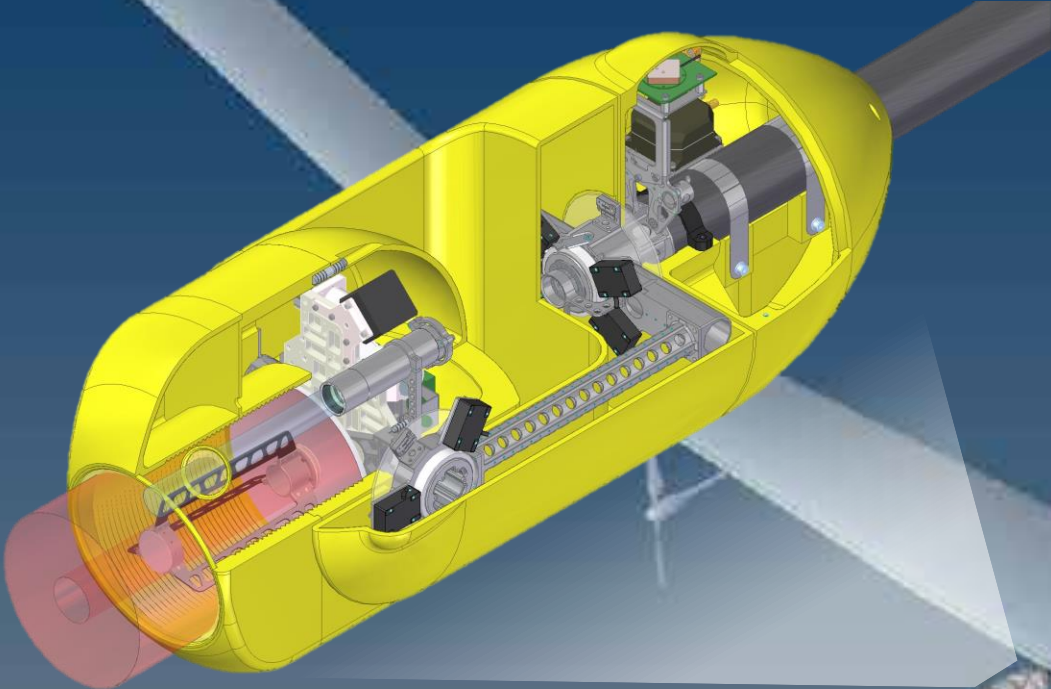
Capability / Maturity	Comment
3D imaging/mapping.	Mapping, planning, biomass monitoring, precision agriculture, disaster/damage assessment.
2D vis/NIR imaging	Conventional aerial imagery, NDVI imagery.
Vibrometry.	Stand-off seismology.
High bandwidth optical comms.	Gbit+ covert, secure, bidirectional comms.
Retro-comms.	Comms 'tags' for unattended ground sensors.
HAPS integration	Environmental testing of components & sub-assemblies successful, initial airframe integration successful.



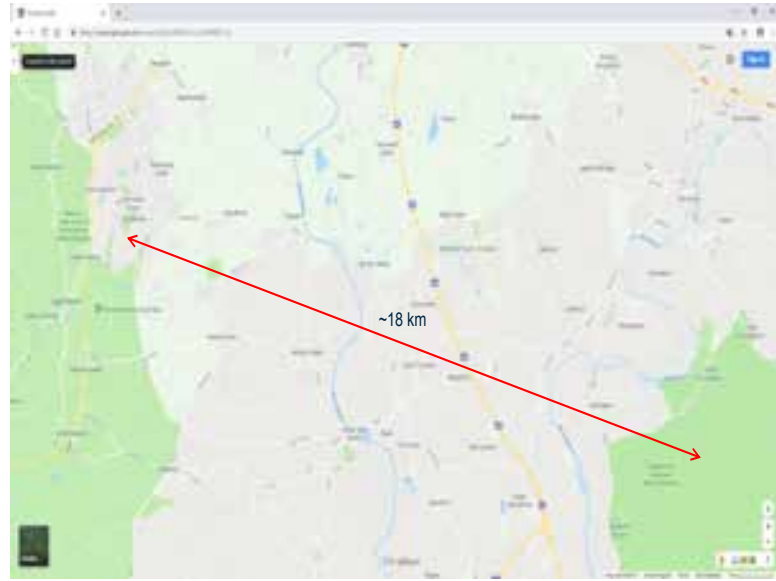
# SDML: Optical Schematic



# SDML: Hardware



# SDML: Hardware





# SDML: 3D LIDAR Mode Design Considerations

## • Requirements

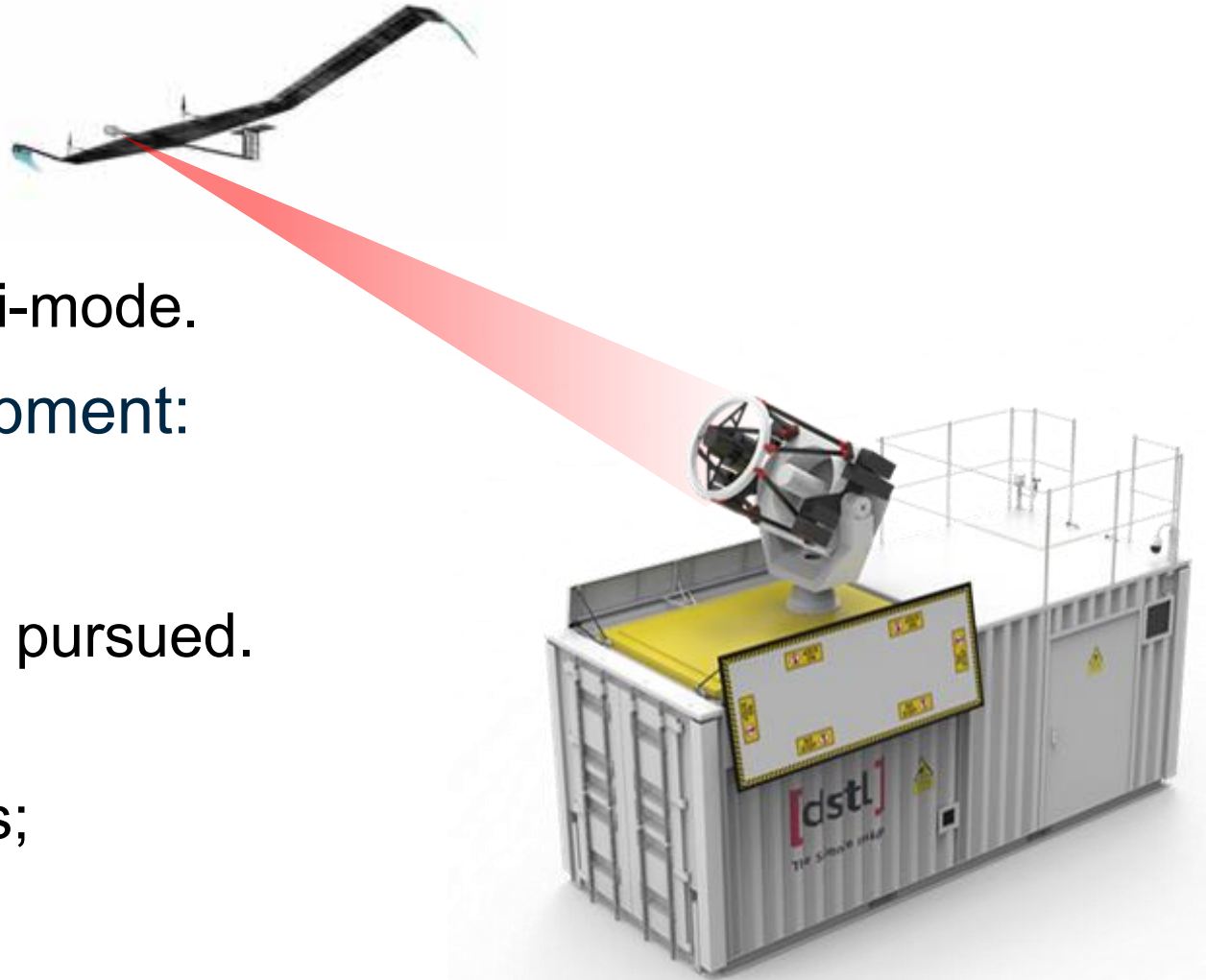
- Good cross-range resolution.
- Good down-range resolution.
- Good fill factor.
- Good SNR margin on target.
- High positional accuracy.
- Rapid scan.
- Full waveform.
- Photo overlay.
- Data recovery.
- Exploitation software.

## • Solution

- Diffraction limited beam.
- Flexure-mounted, voice-coil actuated scanner.
- Pulse compression with high time-bandwidth product.
- Best-in-class GNSS/INS + image-based scene stabilisation.
- Vis+NIR FPA.
- Optical comms mode.
- Optional high-bandwidth RF comms.
- Commercial solutions available!

# SDML: Summary (To Date!)

- SDML concept is proven:
  - Quantum limited sensitivity lidar;
  - No performance penalty with multi-mode.
- All sensing modes under development:
  - Various levels of maturity;
  - Comms demonstrated;
  - 3D lidar funding opportunity being pursued.
- Next steps:
  - Continue maturing sensing modes;
  - Interoperability with Dstl OGS?
  - Plan for flight trials 2022.



# QINETIQ

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