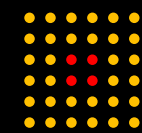


Photonic Integrated Circuits for LiDAR: Enabling 4D Machine Vision with PICs

May 2026 – CARLA Symposium



pointcloud

OUTLINE



Company introduction



Introduction to FMCW ranging



Introduction to FMCW focal plane arrays

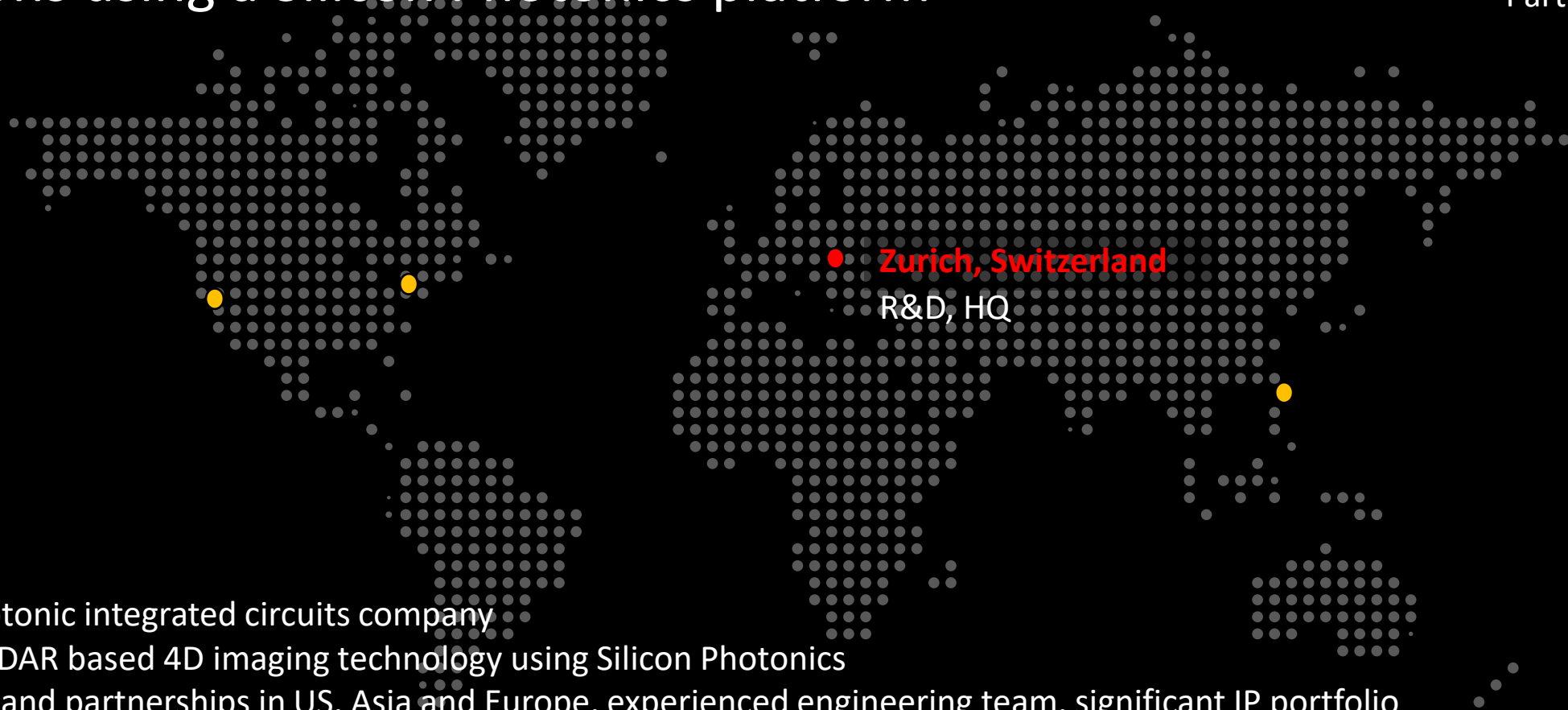


A virtual visit at Pointcloud

COMPANY

Fabless PIC/IC company developing coherent 4D imaging solutions using a Silicon Photonics platform

- Pointcloud
- Partners



- Fabless photonic integrated circuits company
- Develops LiDAR based 4D imaging technology using Silicon Photonics
- Operations and partnerships in US, Asia and Europe, experienced engineering team, significant IP portfolio
- Fabrication using large scale commercial processes from top tier manufacturing partners

TECHNOLOGY – MONOSTATIC COHERENT FOCAL PLANE ARRAY WITH PARALLEL READOUT

Coherent ranging combined with scalability of array technology:
performance, simplicity, versatility

Performance

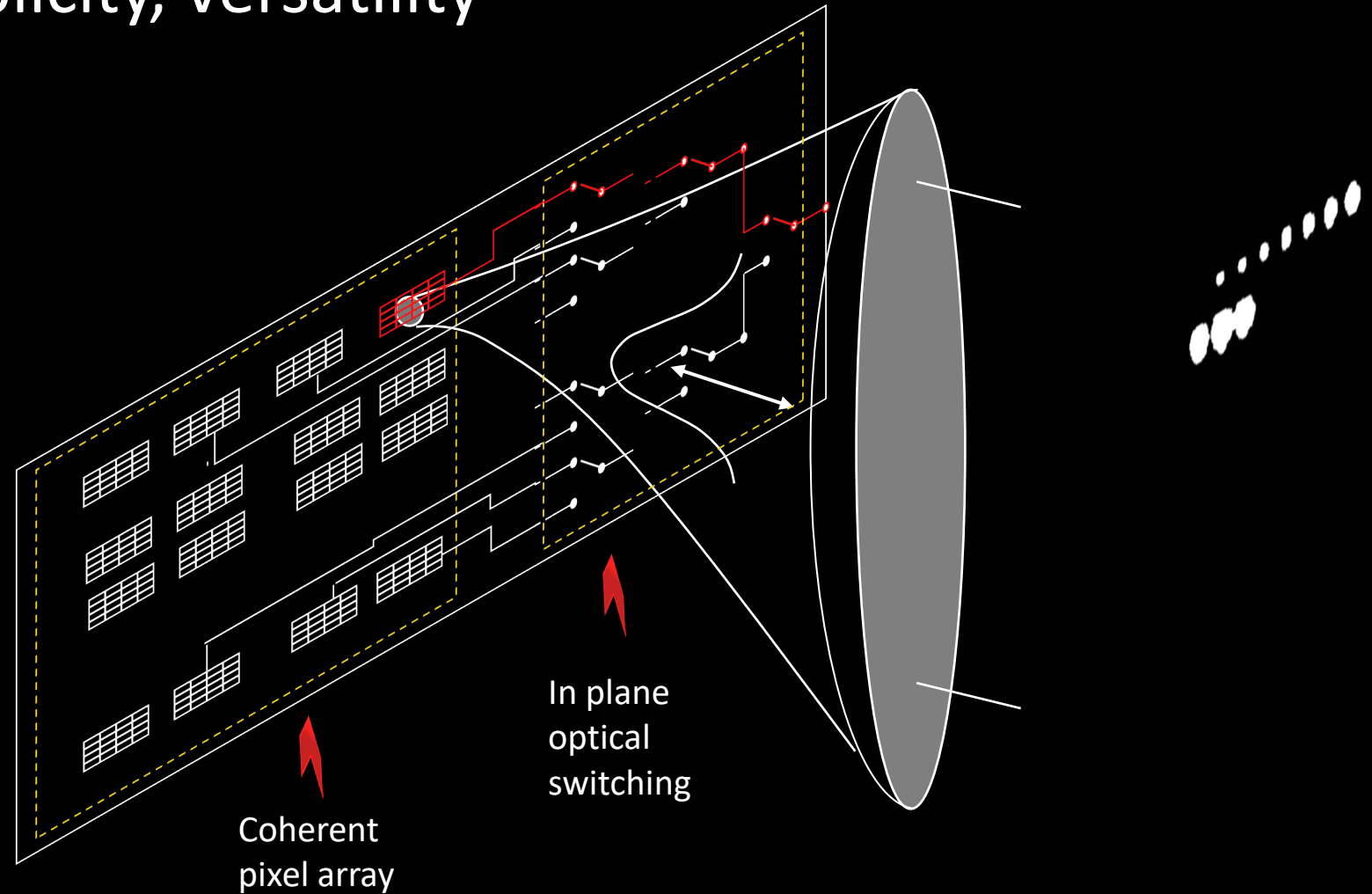
no compromise 4D imaging:
resolution, range, accuracy,
velocity measurement

Simplicity

one chip, one lens
no complex alignment
silicon CMOS manufacturing

Versatility

from mobile consumer to
industrial and automotive



OUTLINE



Company introduction



Introduction to FMCW ranging



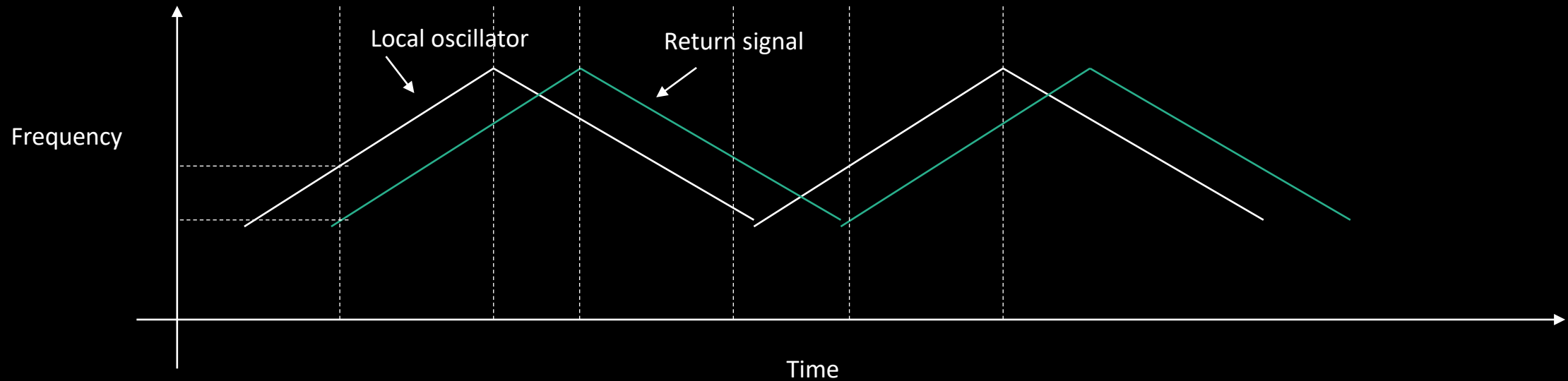
Introduction to FMCW focal plane arrays



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FMCW

Frequency modulated continuous wave ranging: measurement of the difference in frequency between a probe and local oscillator

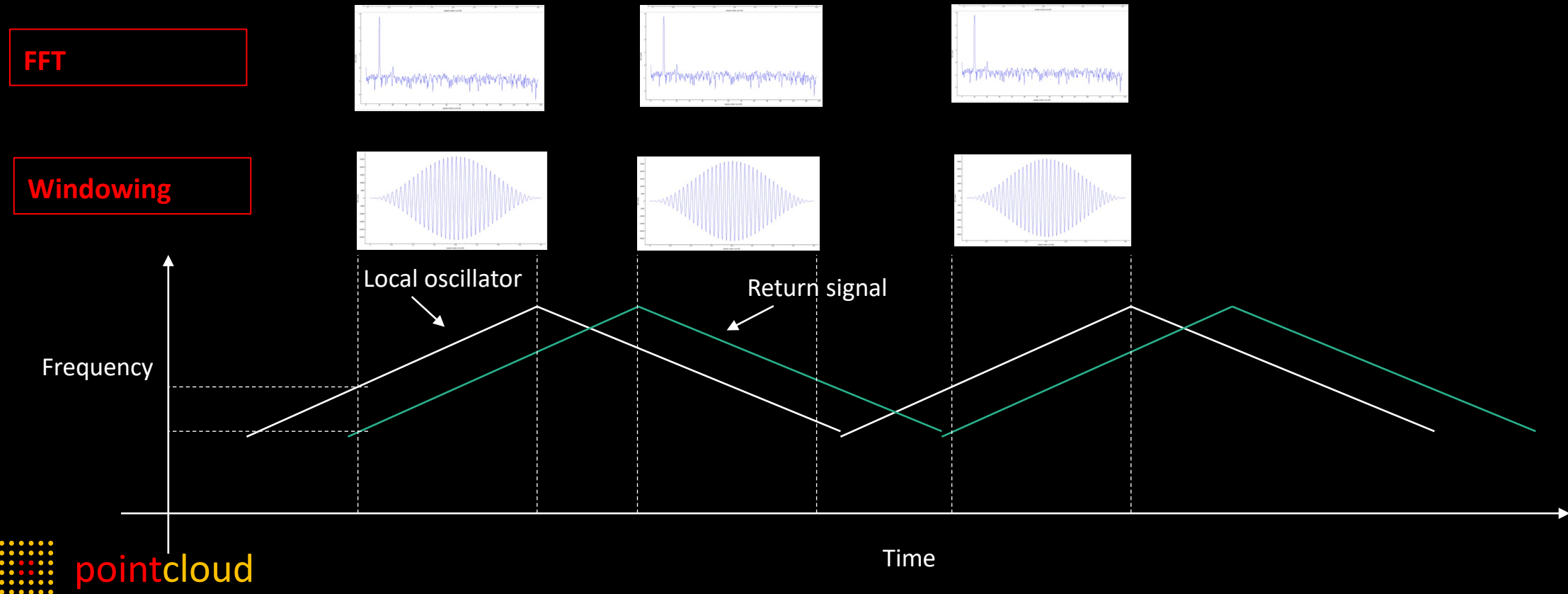


- Transmitter emitting a frequency modulated optical probe signal
- Return signal combined with local oscillator generates a beatnote at the frequency difference
- Beatnote frequency is proportional to distance to target

FMCW

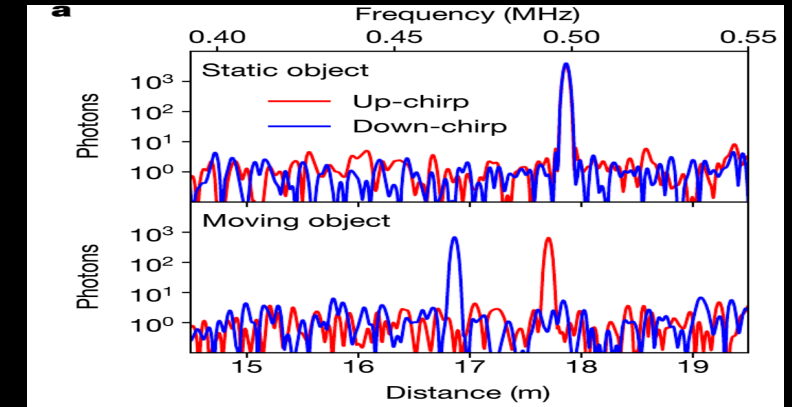
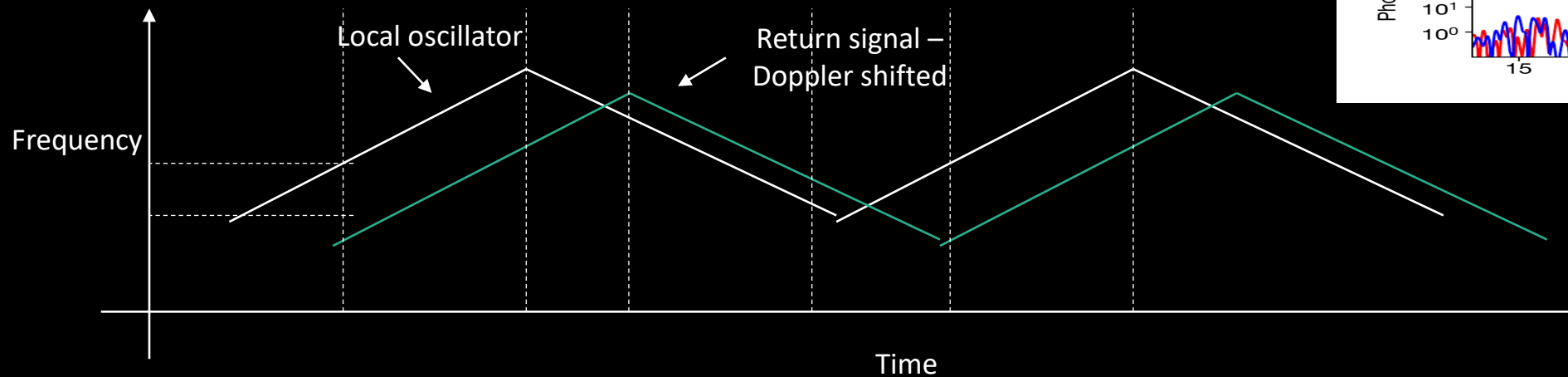
Frequency modulated continuous wave ranging: measurement of the difference in frequency between a probe and local oscillator

- A window function is applied on the acquired signal followed by an FFT to extract the frequency peaks corresponding to the target



FMCW

Frequency modulated continuous wave ranging: measurement of the distance and velocity for a moving target



- For static targets the frequency peaks generated during integration on the up ramp and down ramp overlap
- For moving targets, the peaks are shifted in opposite directions by an amount proportional to the Doppler shift
 - Radial velocity is proportional to the frequency difference
 - Distance to target is proportional to the average of the two frequencies

OUTLINE



Company introduction



Introduction to FMCW ranging



Introduction to FMCW focal plane arrays



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MONOSTATIC IMPLEMENTATION

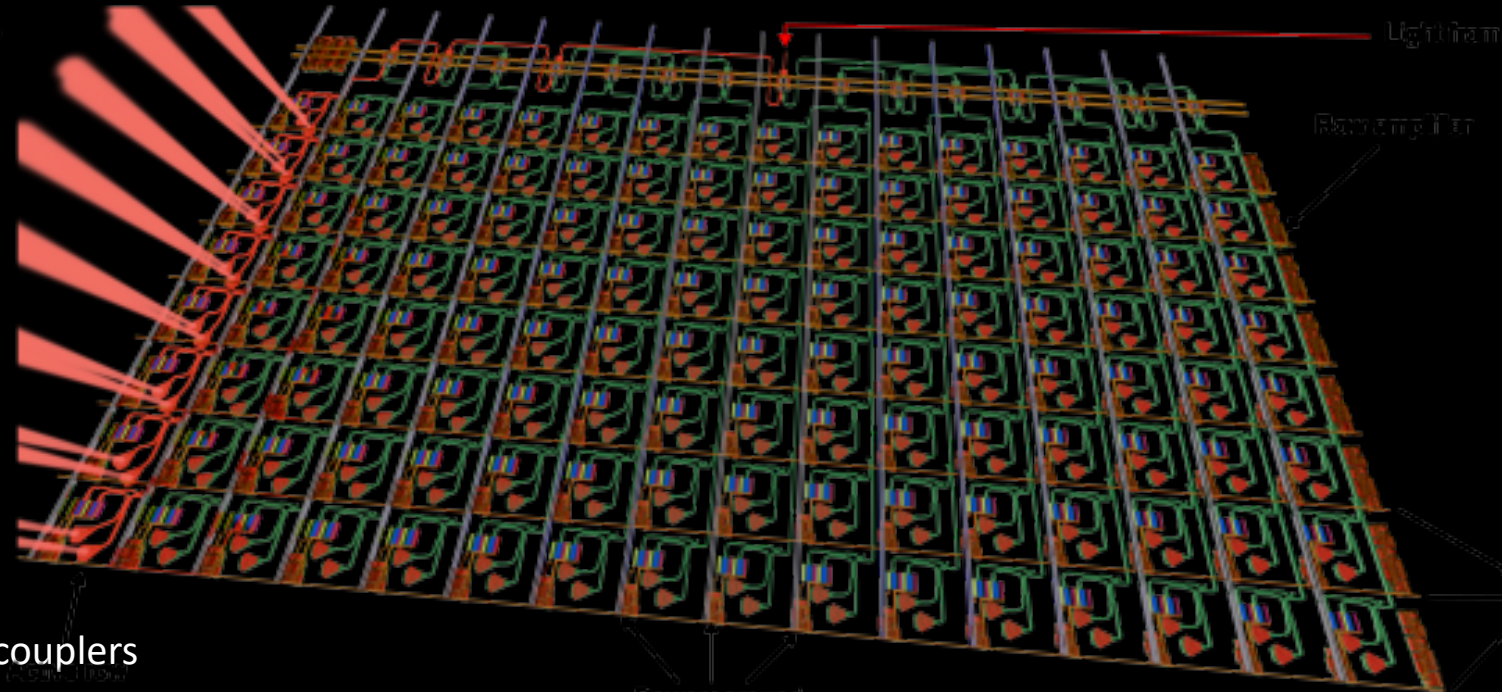
Pixel and block architecture

Transimpedance amplifier

Photodiodes

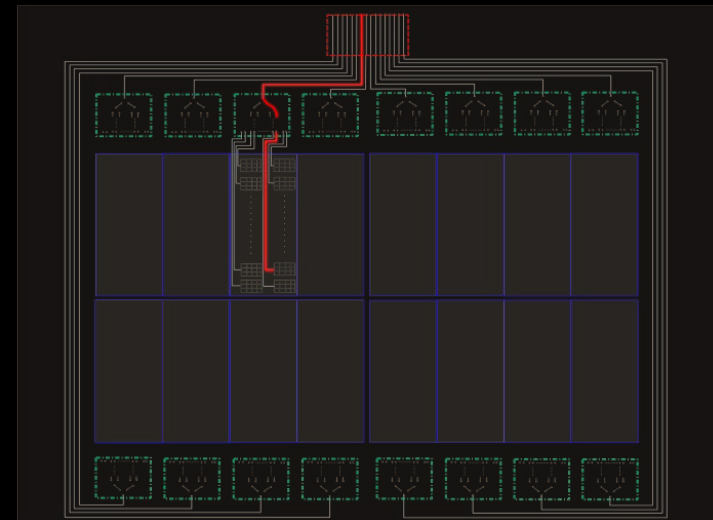
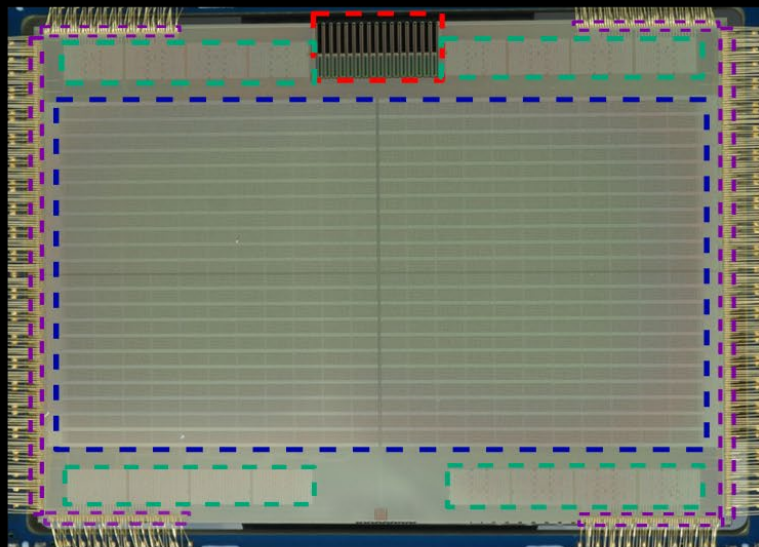
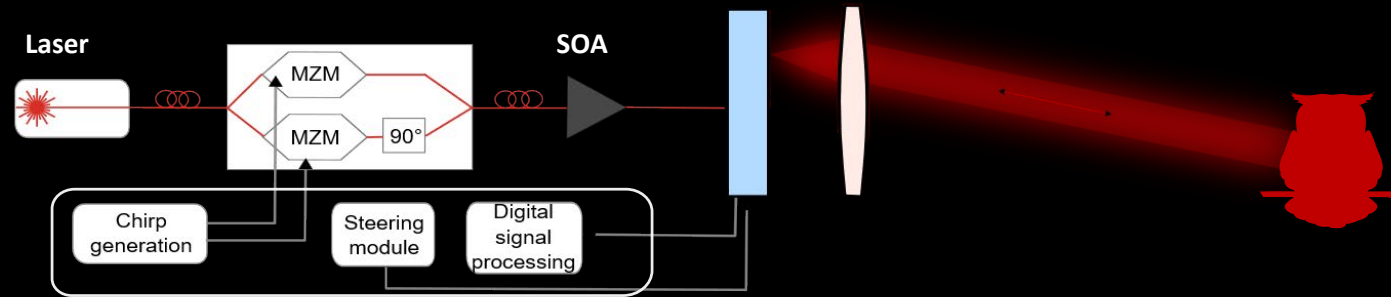
Local oscillator

Grating couplers



MONOSTATIC IMPLEMENTATION

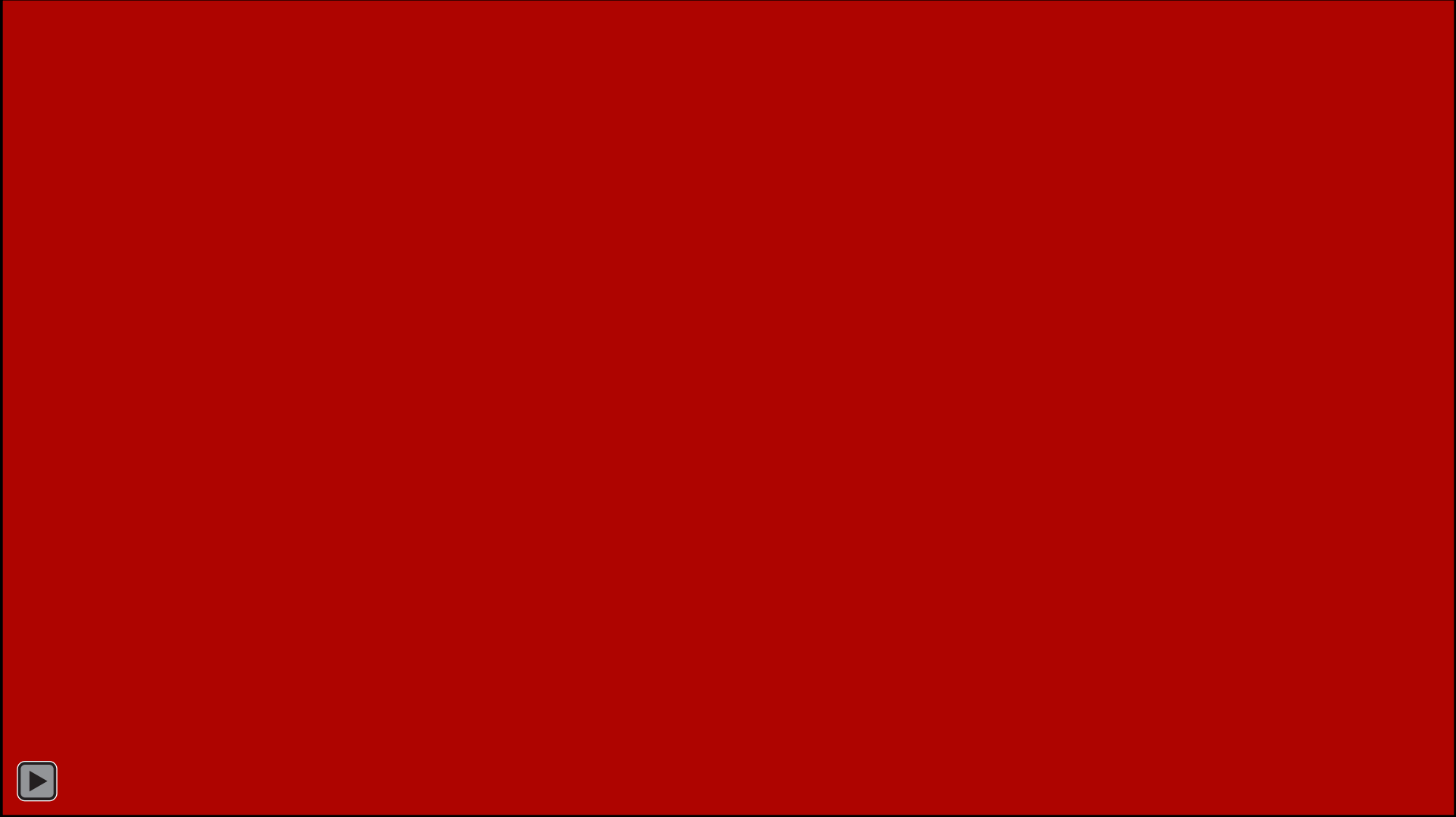
System level diagram and 352x176 array in silicon



- Wirebond pads
- Thermo-optical switches
- V-grooves
- Active optical area

- 16 v-groove input
- FPA block
- Cascaded 1x2 TOS
- MxN blocks

COHERENT FOCAL PLANE ARRAY – CURRENT GENERATION RESULTS



COHERENT FOCAL PLANE ARRAY – SUMMARY AND NEXT STEPS

Current generation highlights

- Largest produced Coherent Focal Plane Array (FPA): 5x resolution increase compared to prior largest demonstrated device
- First demonstration of a Coherent FPA with all electronics integrated on chip
- First coherent FPA with resolution exceeding competing technology dToF sensors designed for similar range & environmental conditions
- First large scale Coherent FPA architected for real world operation (real time, >10fps frame rate)

Future plans

- Further optimization of current silicon for longer range operation
- Next generation, 200 m+ range, high resolution sensor

OUTLINE



Company introduction



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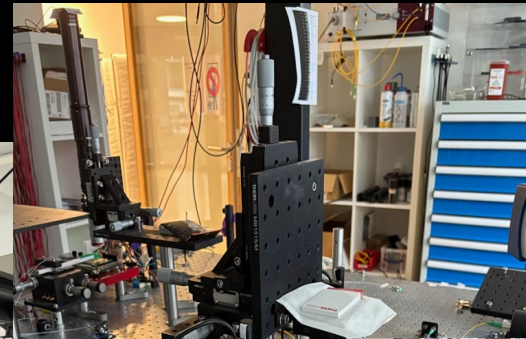
A virtual visit at Pointcloud

A VISIT AT POINTCLOUD

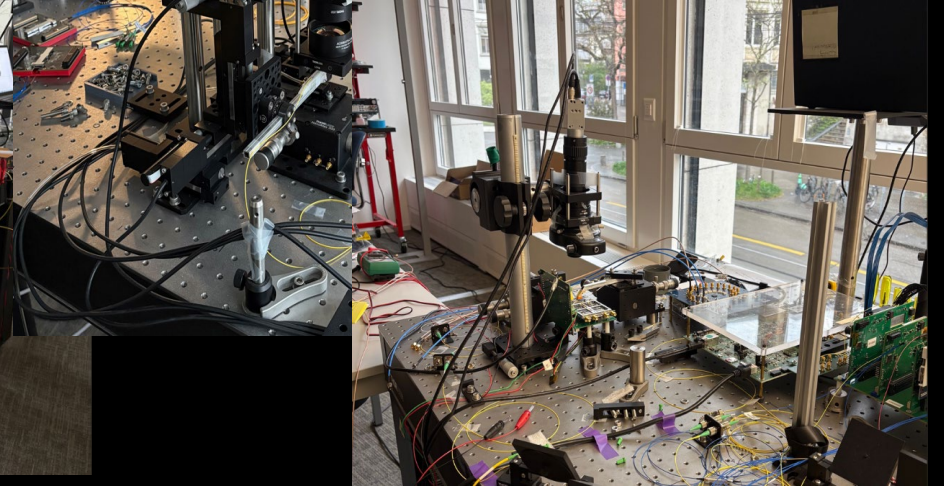
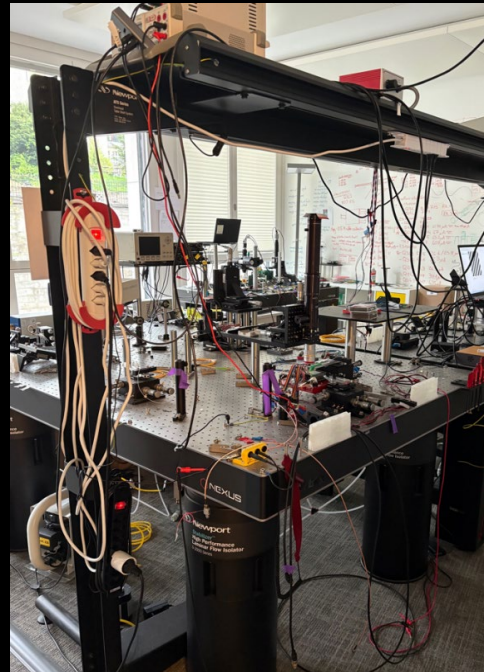
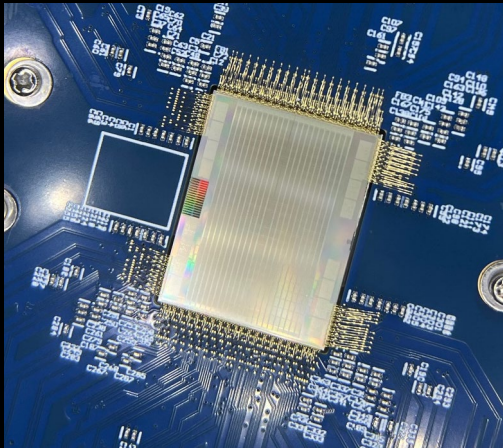


The office

The lab



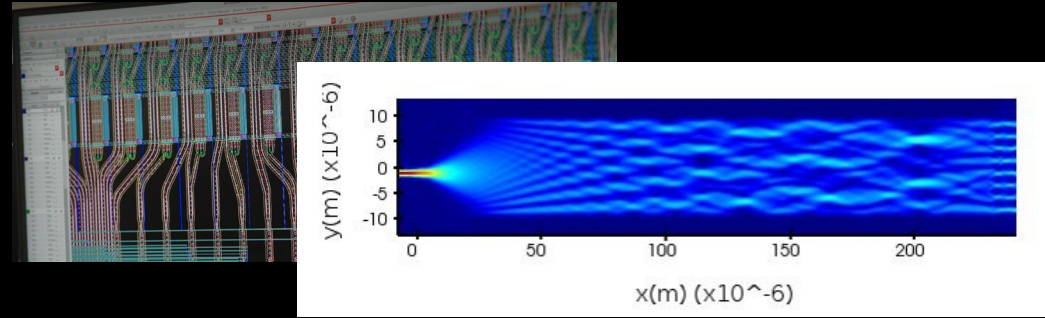
The product



THE THINGS WE DO AND THE TOOLS WE USE

Photonics semiconductor chip design

- Lumerical
- Cadence Virtuoso/Spectre/Pegasus



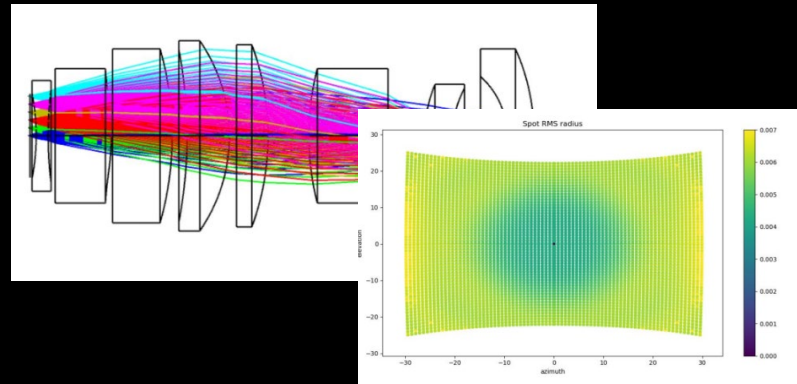
Mixed signal semiconductor design

- Cadence Virtuoso/Spectre/Pegasus



System design

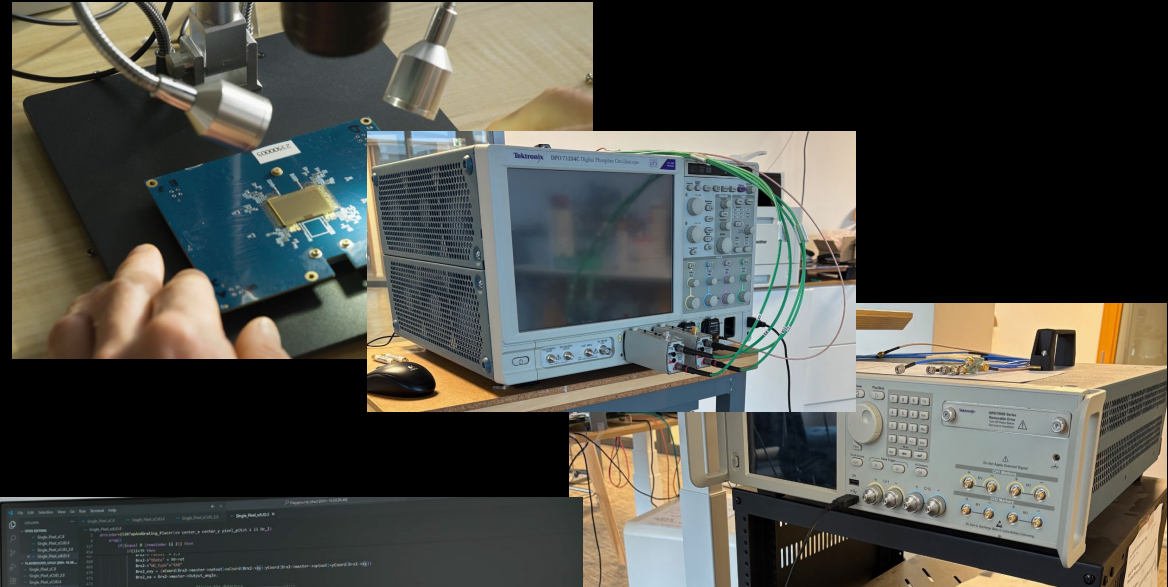
- Board design – Altium
- Optical system design: Zemax



THE THINGS WE DO AND THE TOOLS WE USE

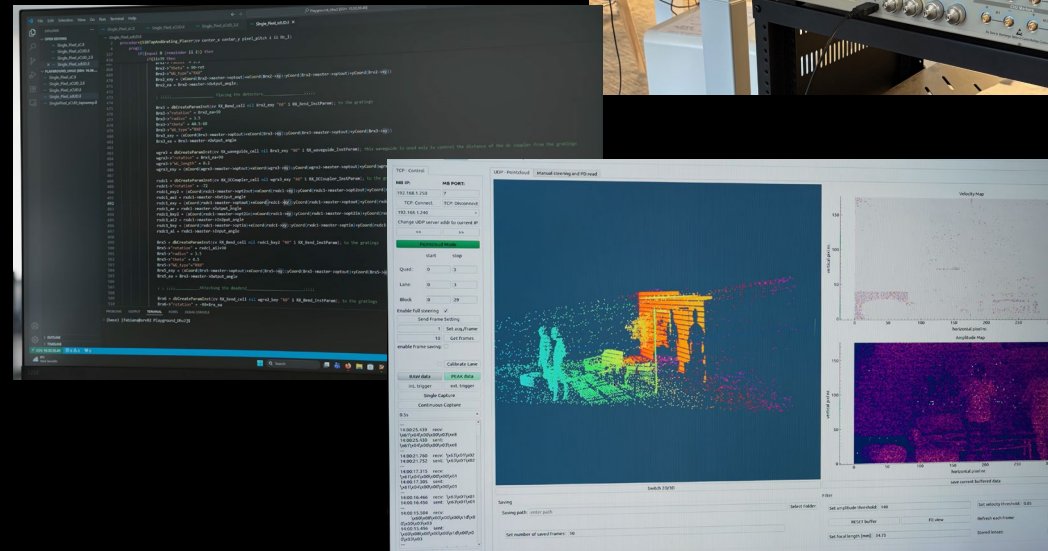
Characterization

- Electronics and optical test and measurement equipment



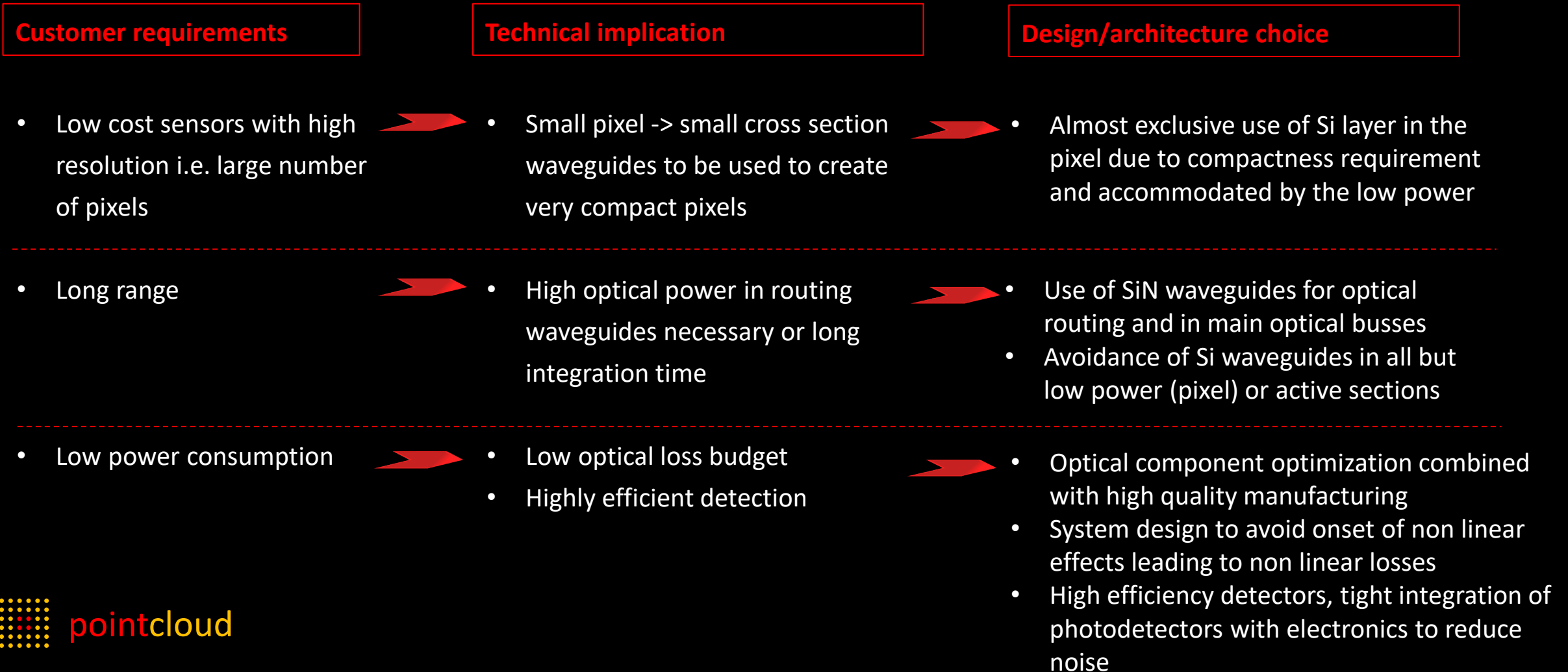
Software development

- Python, C, Verilog



DESIGN CHALLENGES

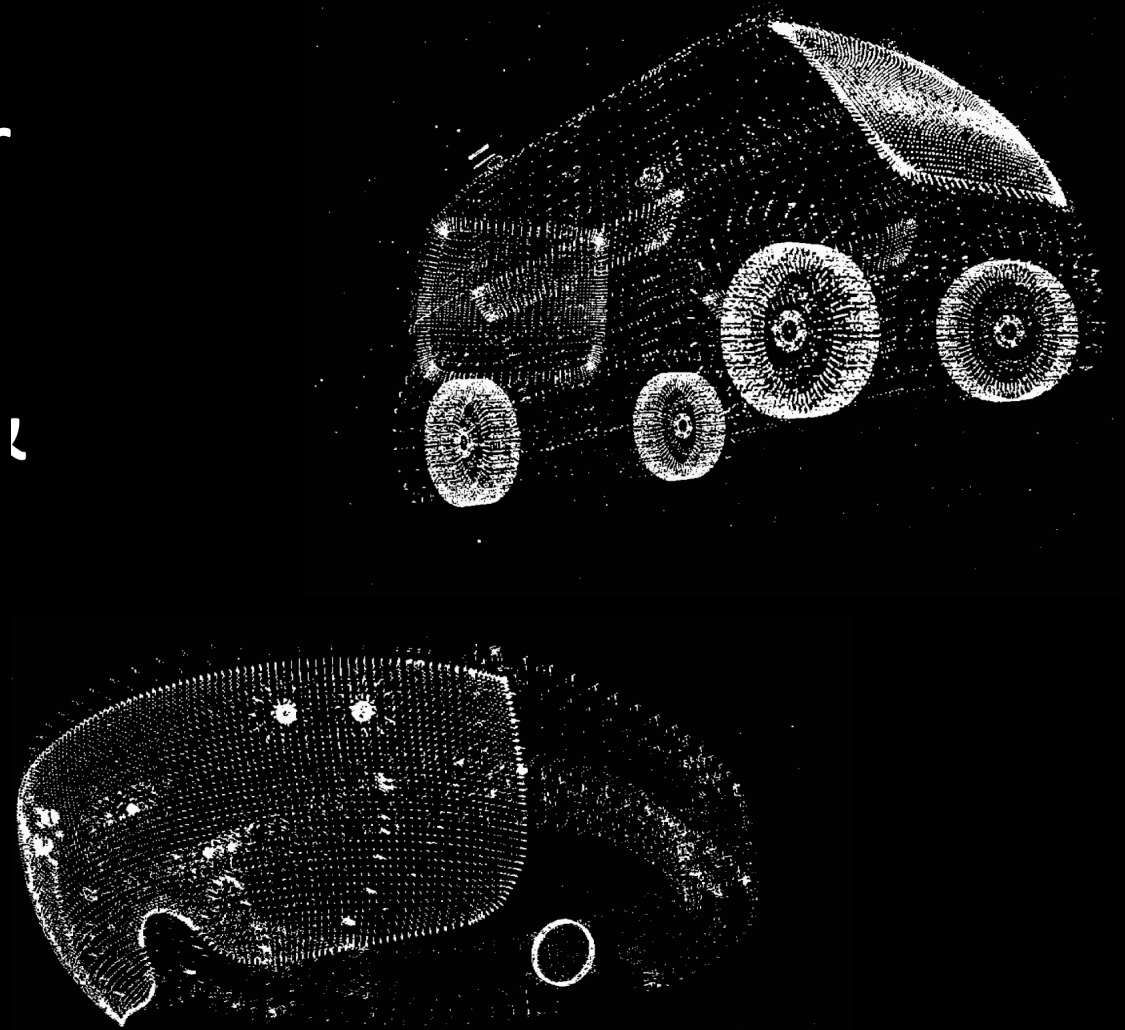
From customer requirements to design implications



Ubiquitous 4D cameras for autonomous mobility, industrial & consumer

Contact: remus.nicolaescu@point.cloud

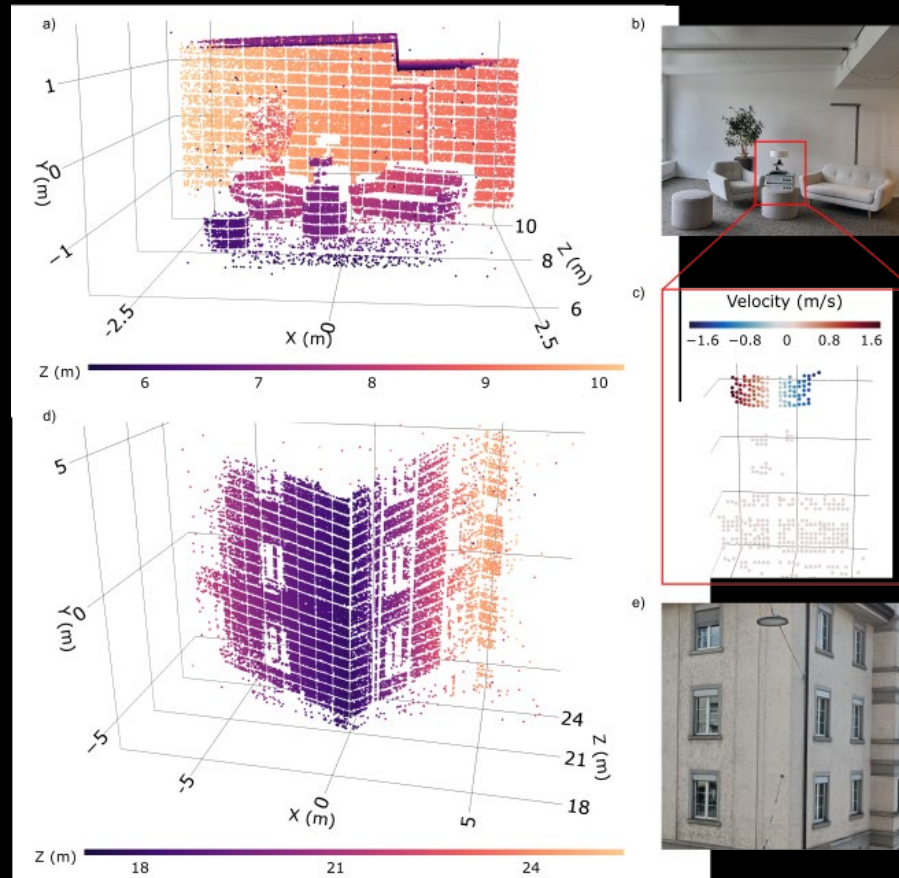
<https://point.cloud/>



BACKUP - COHERENT FOCAL PLANE ARRAY – CURRENT GENERATION RESULTS

QVGA class Coherent FPA sensor

- Large scale coherent FPA >60K pixels
- Off the shelf lens
- Real time acquisitions



- Single acquisition
- Per pixel acquisition time compatible with >20 fps
- Buffered image, 10 frames