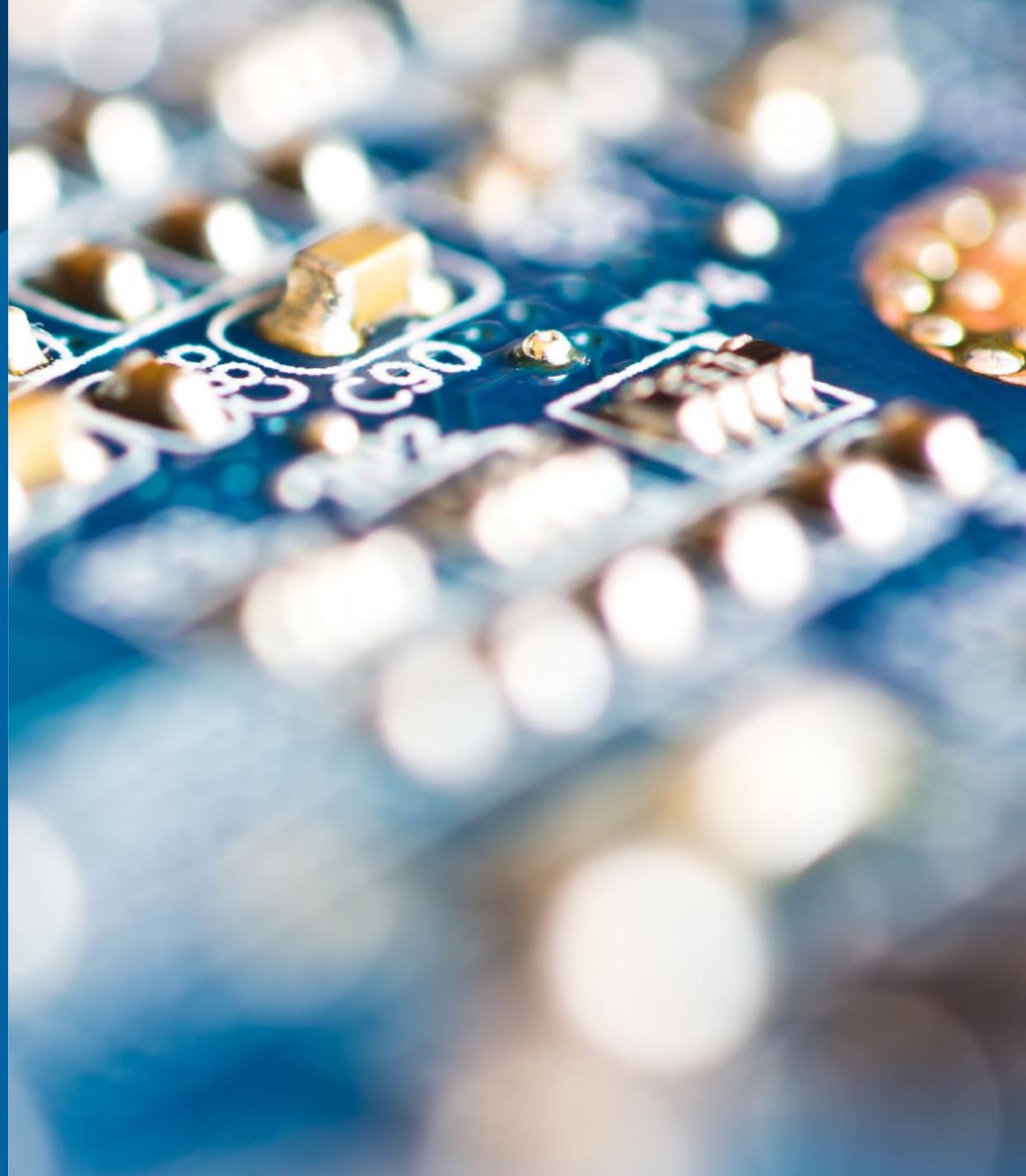


Precision Alignment for LiDAR

From Design to large-scale
Manufacturing

Dr. Hendrik Zachmann | Nov 30 | hendrik_zachmann@jabil.com

JABIL



Jabil - Built on a Solid Foundation

1966

FOUNDED IN
MICHIGAN, USA



TENURED
MANAGEMENT TEAM

100+

SITES STRATEGICALLY LOCATED
AROUND THE WORLD

TOP TIER

MANUFACTURING
SERVICES PROVIDER

250K+

DEDICATED
EMPLOYEES

50M+

SQUARE FEET OF
MANUFACTURING SPACE

\$34.7B

REVENUE
IN FY23

400+

CUSTOMERS ACROSS
DIVERSE MARKETS

27K+

SUPPLY CHAIN
PARTNERS

Solid State LIDAR System



Active Alignment Use Cases

- Transmitter Tx (Laser) alignment optimized for beam position, orientation, power, focus, beam uniformity
- Receiver Rx (Detector) alignment optimized for intensity, position, and parasitic pulse reduction

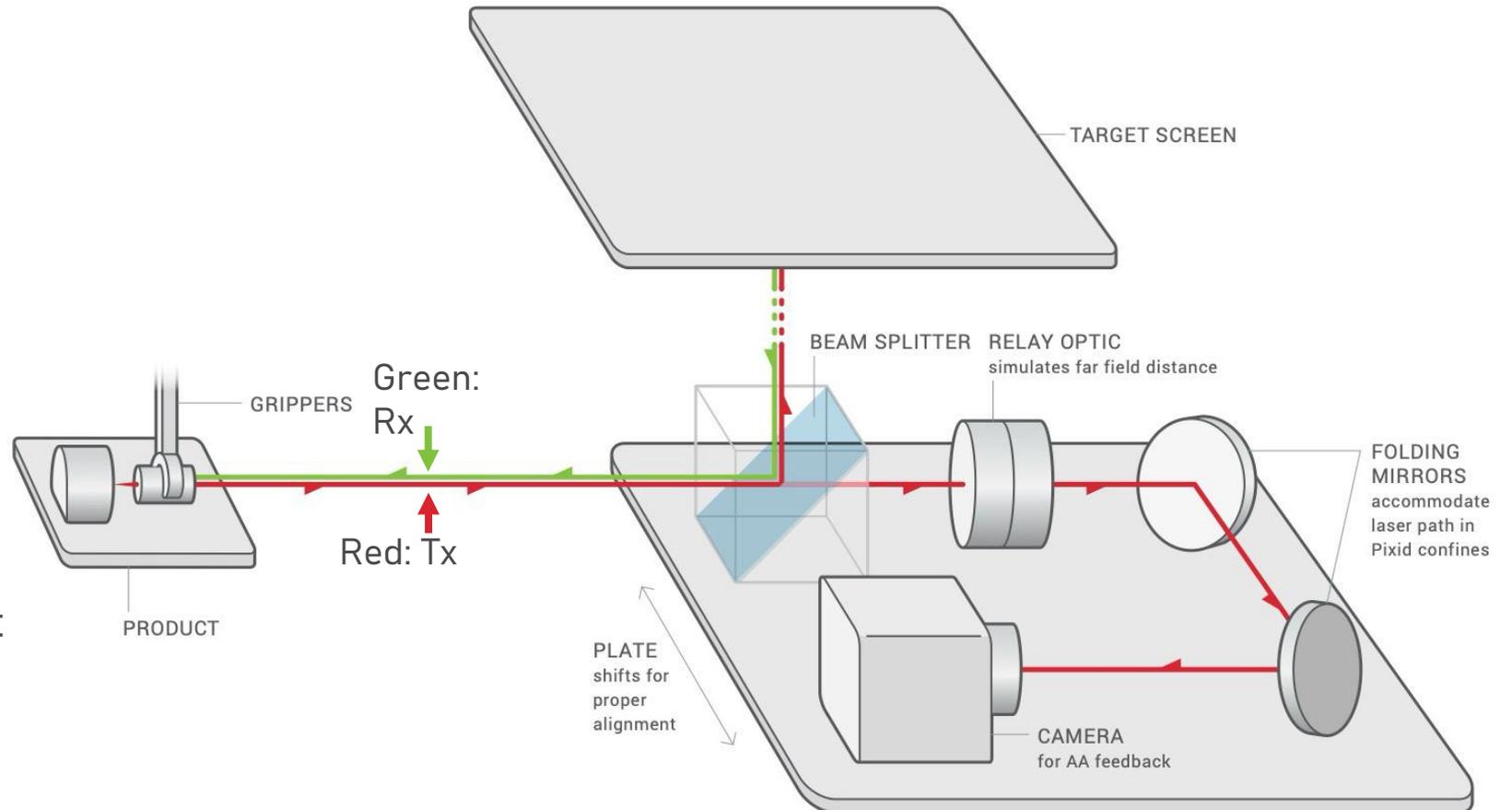
Whats in for the next Minutes:

1. Alignment Needs for LIDAR – Why? What? How?
2. LIDAR systems: No Standards – Many Options
3. Solution and Conclusion

1. Alignment Needs for LIDAR

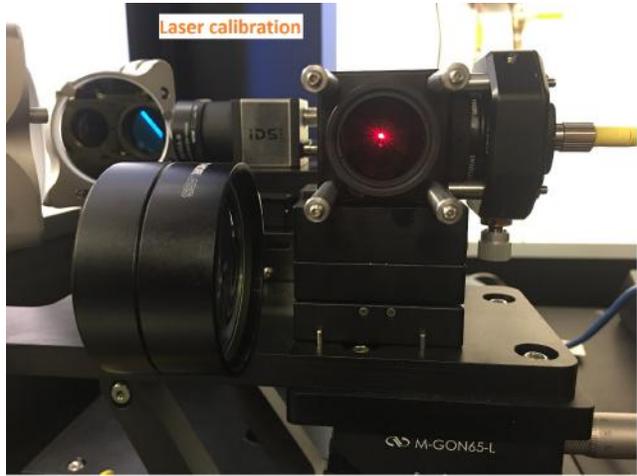
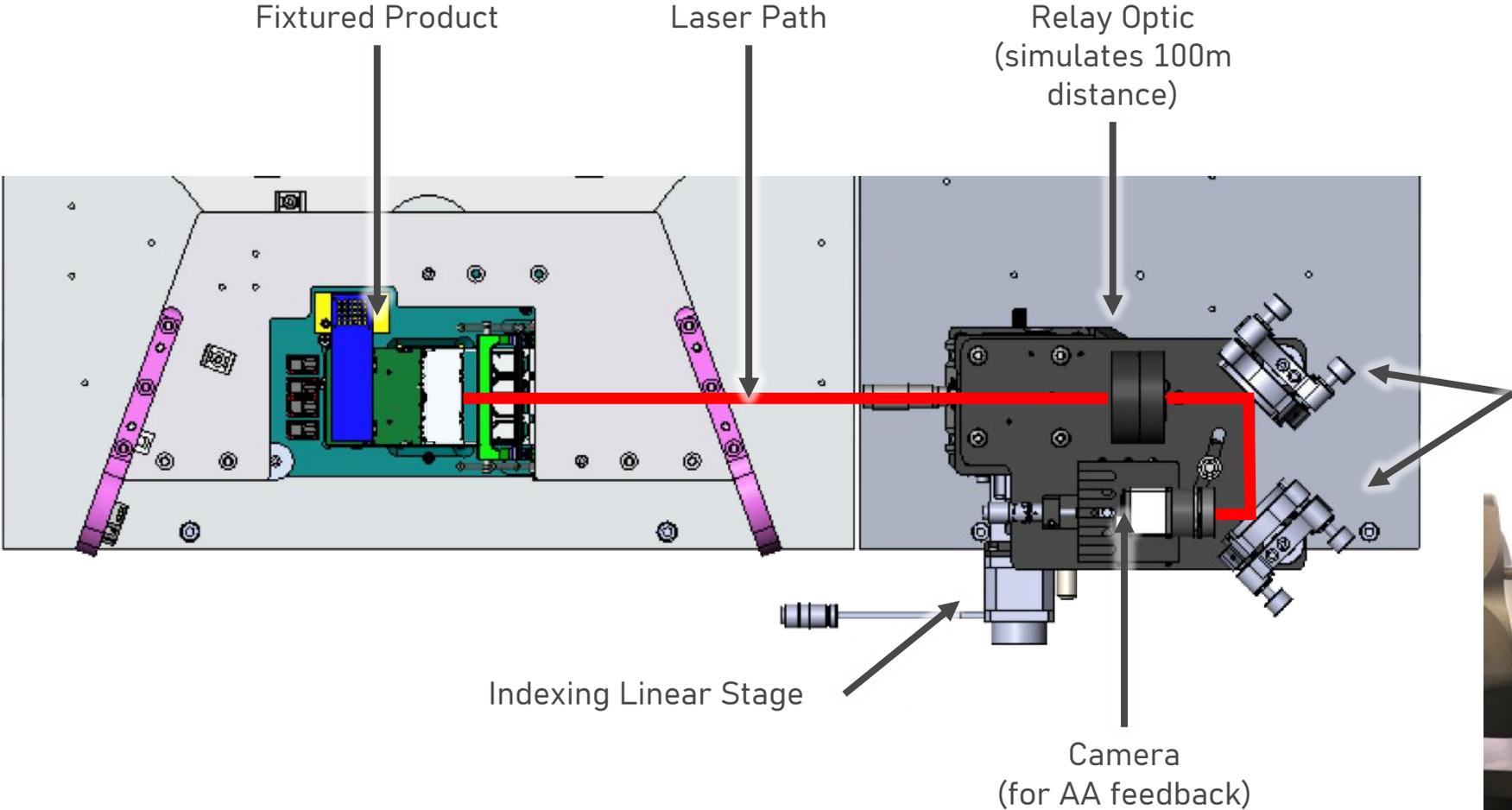
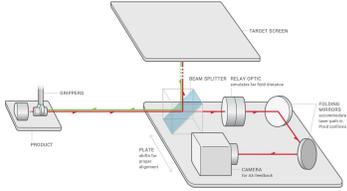
Alignment needs:

- Lens collimation
- Receiver alignment
- Module-to-module relative pointing (tip, tilt, rotation)
- Module-to-module baseline distance setting (XY)
- Complex feedback system
- Integration into machine is not trivial,
→ **need to design the machine “around the product”**

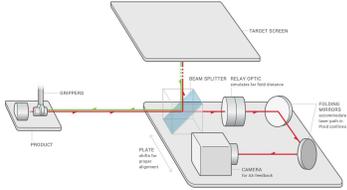


(same is true for EOL testers – PLUS high working distance)

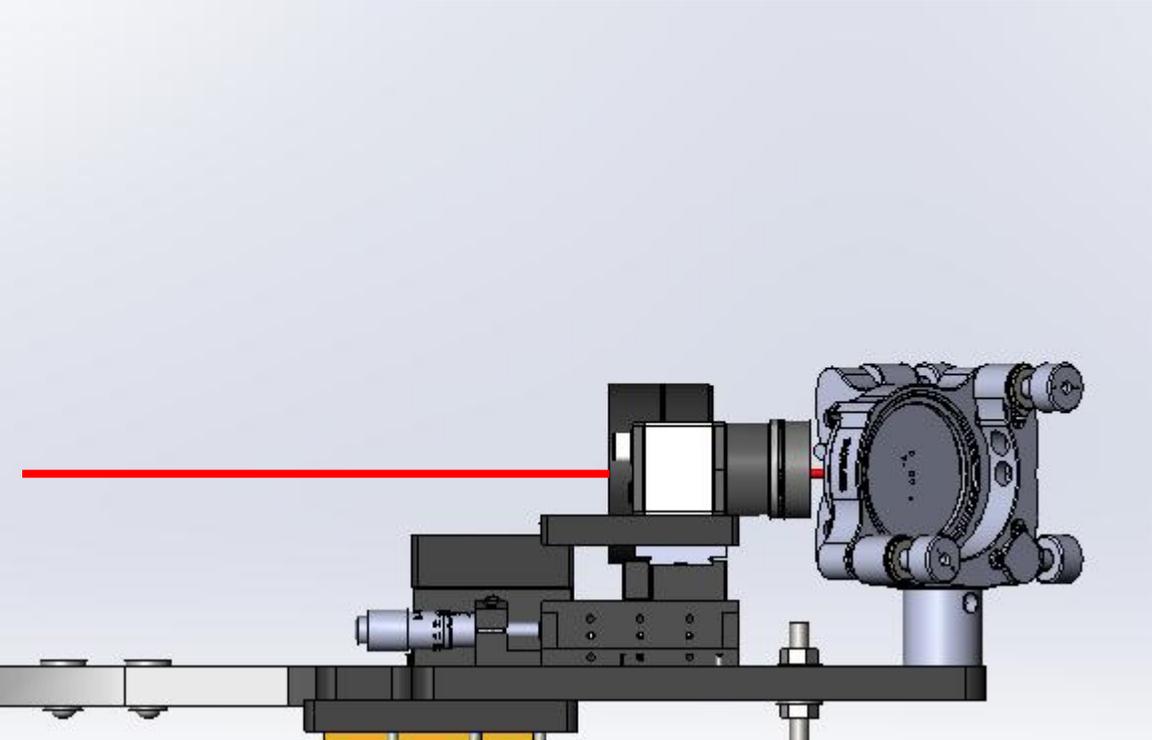
LiDAR Transmitter Alignment System



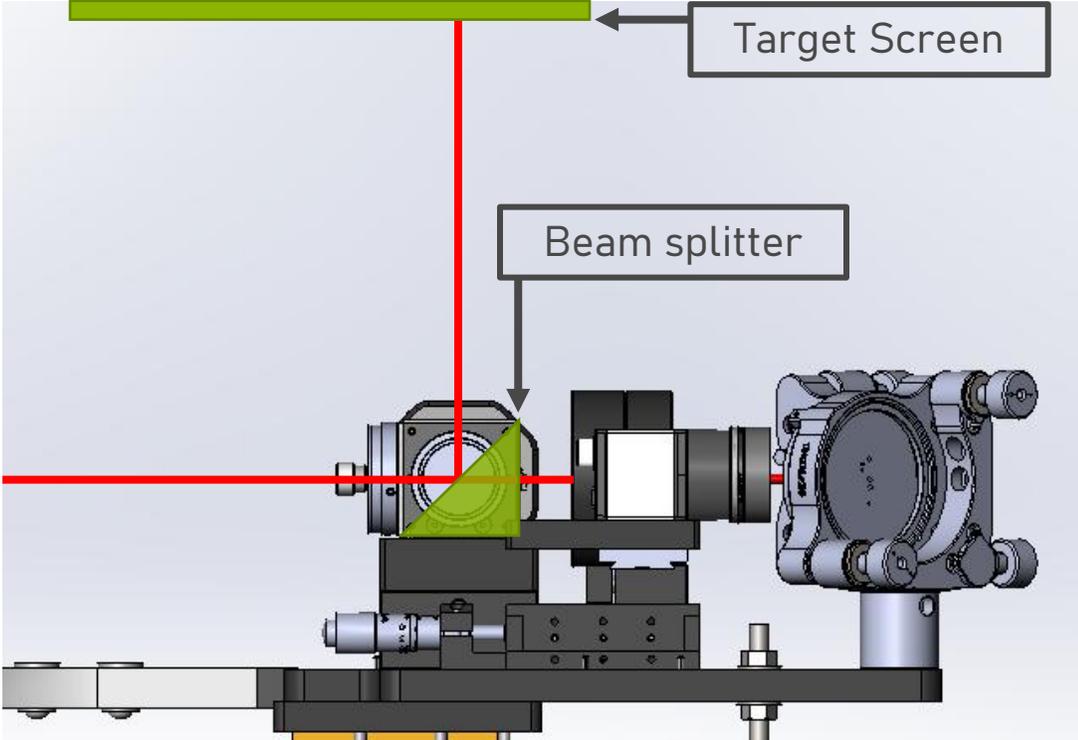
LiDAR Receiver Alignment System



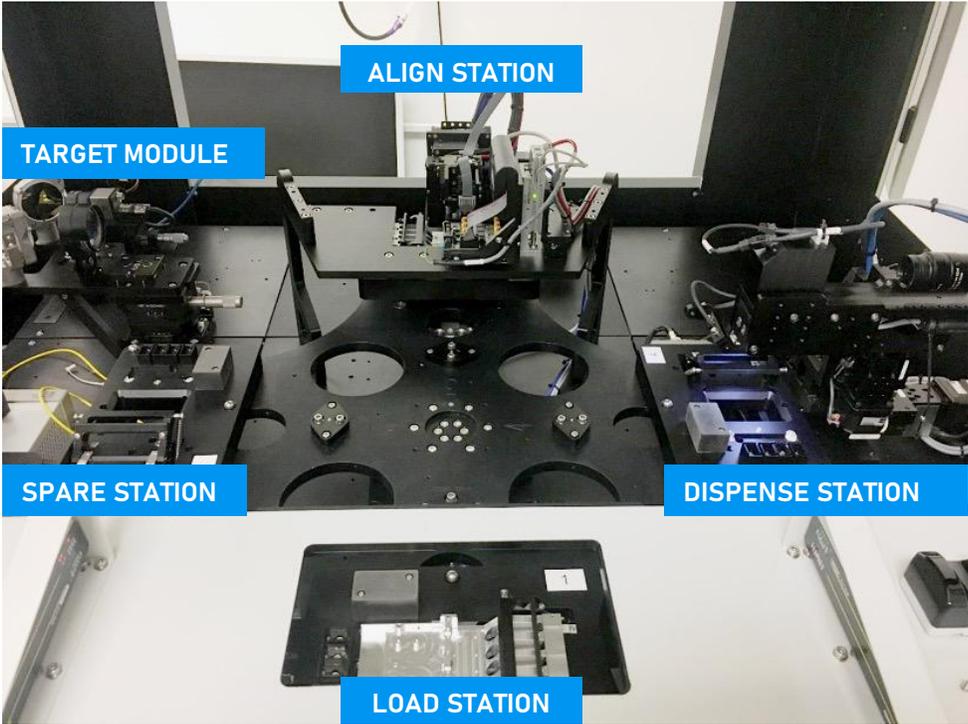
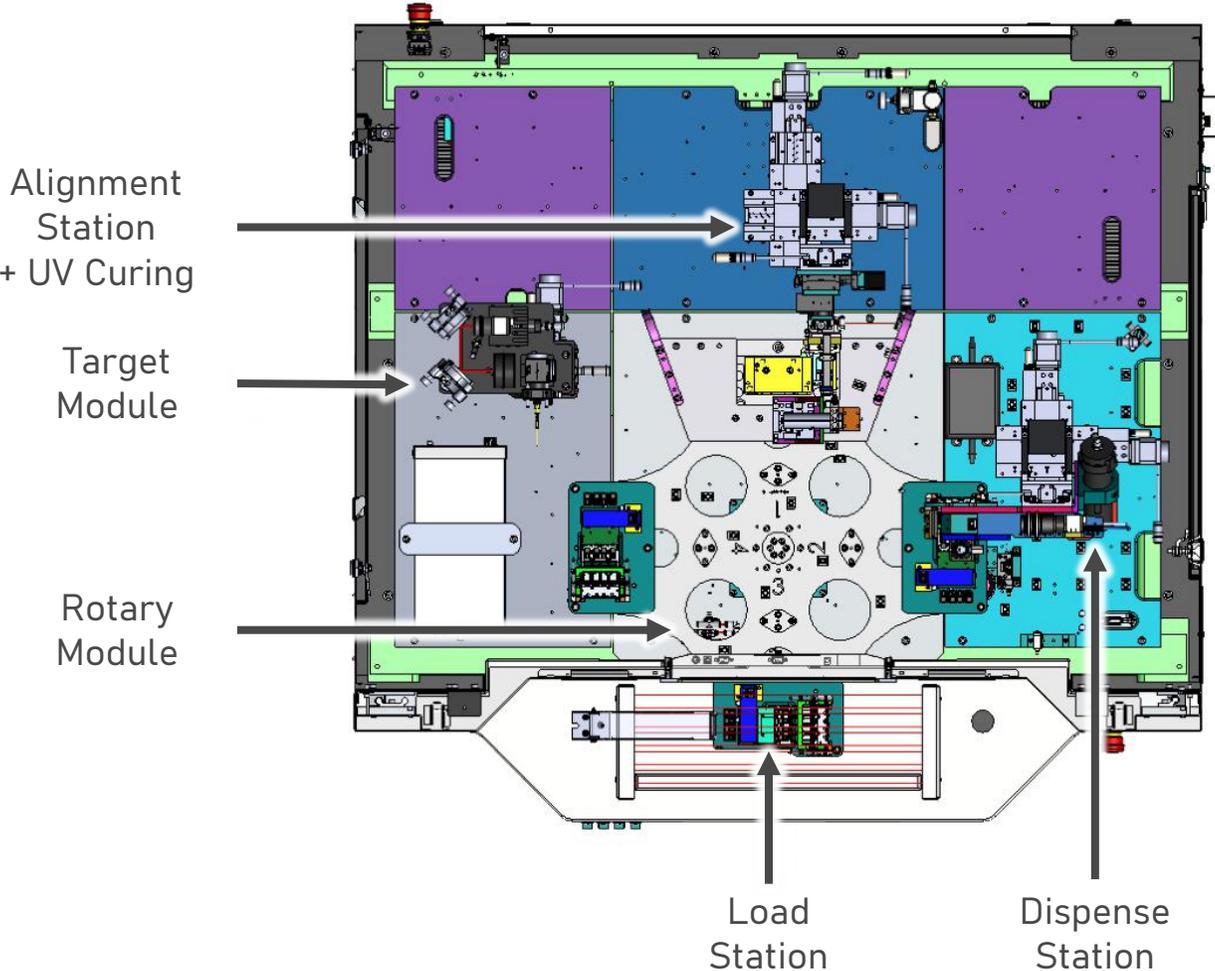
TRANSMITTER-ONLY TARGET



TRANSMITTER PLUS RECEIVER TARGET



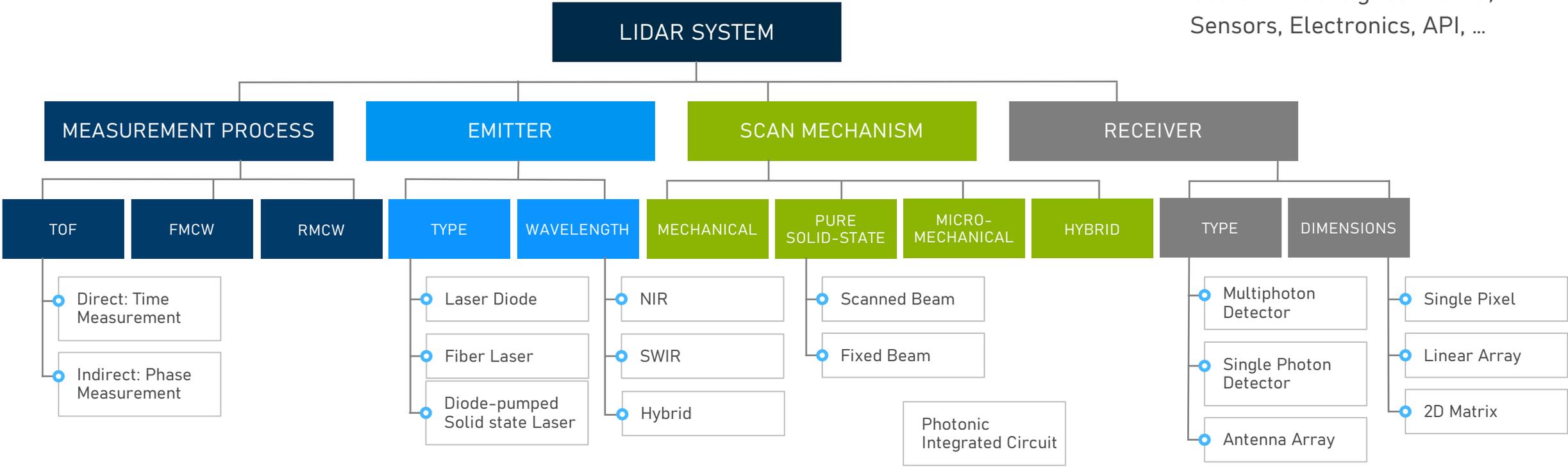
Machine Layout for LiDAR Active Alignment



1. Alignment Needs for LIDAR – Why? What? How?
- 2. LIDAR systems: No Standards – Many Options**
3. Solution and Conclusion

2. No Standards – Many Options

Customer consigned: MEMS, Sensors, Electronics, API, ...



Detailed system knowhow and joint development is needed for product, process and machine development – look out for a suitable partner!

1. Alignment Needs for LIDAR – Why? What? How?
2. LIDAR systems: No Standards – many options
- 3. Solution and Conclusion**

Jabil Optics Engineering – Product, Process, Machines

Jena, Germany

Located in the heart of Germany's Optics valley, Jabil's **Optical Technology** group in Jena provides **in-depth optics knowledge** to customers worldwide.

Burlington, MA, USA

Located in the technology belt of Boston, Jabil's **Kasalis** group in Burlington provides **active alignment and assembly expertise** to customers worldwide.

PASCAL
GRAHNERT

OPERATIONS MANAGER

2006

YEAR ESTABLISHED

JUSTIN
ROE

OPERATIONS MANAGER

2011

YEAR ESTABLISHED

~110

EMPLOYEES

~62,000

SQUARE FEET

~50

EMPLOYEES

~30,000

SQUARE FEET

Active Alignment for LIDAR: Pixid 700

USE CASES

- Lens collimation
- Receiver alignment
- Relative pointing (tip, tilt, rotation)
- Baseline distance setting (XY)

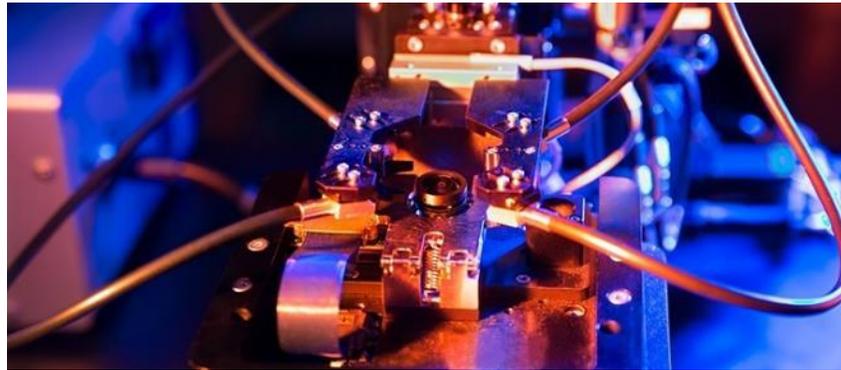
FEATURES

- Single or dual head 6 DOF AA
- Linear axes: <math><5\text{ nm}</math> resolution, <math><\pm 0.1\ \mu\text{m}</math> repeatability
- Angular axes: <math><0.2\ \mu\text{rad}</math> resolution, <math><\pm 3\ \mu\text{rad}</math> repeatability
- Customized AA feedback systems and AA algorithms
- Automated adhesive dispense with post dispense inspection
- Integrated pick and place capability
- Systems delivered with turnkey process for high volume manufacturing



Our Value For You

We design **products**, **processes** and **equipment**



for **low volume / high mix** and **high volume** production.

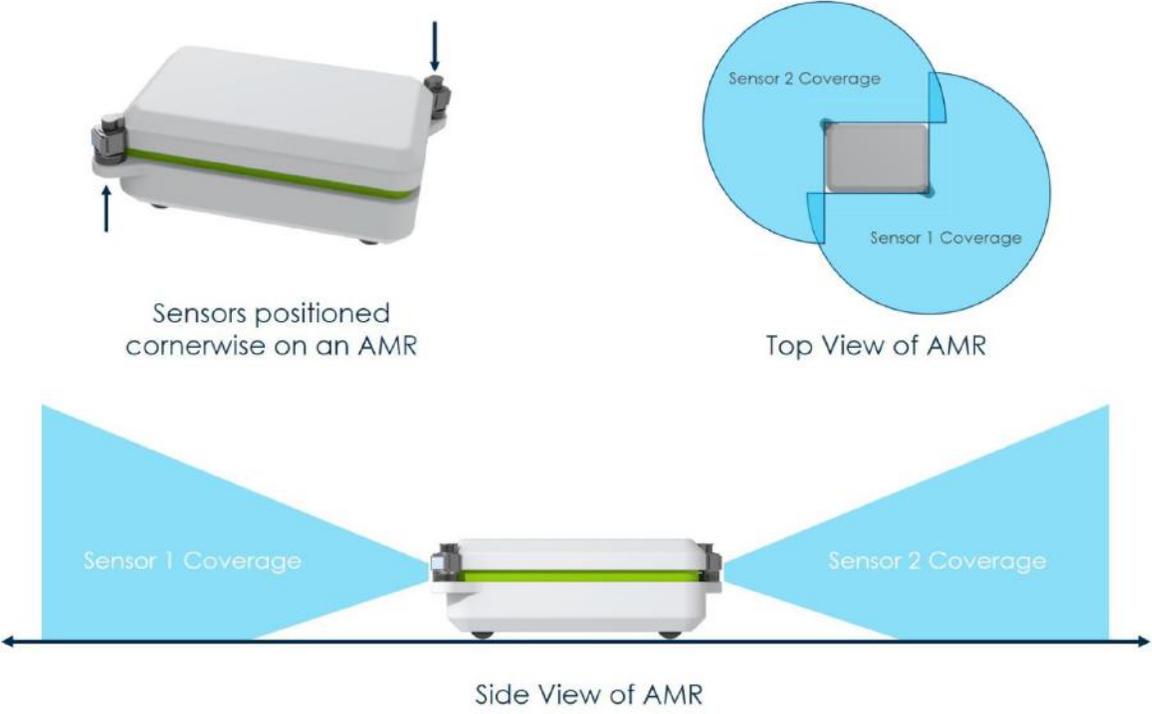
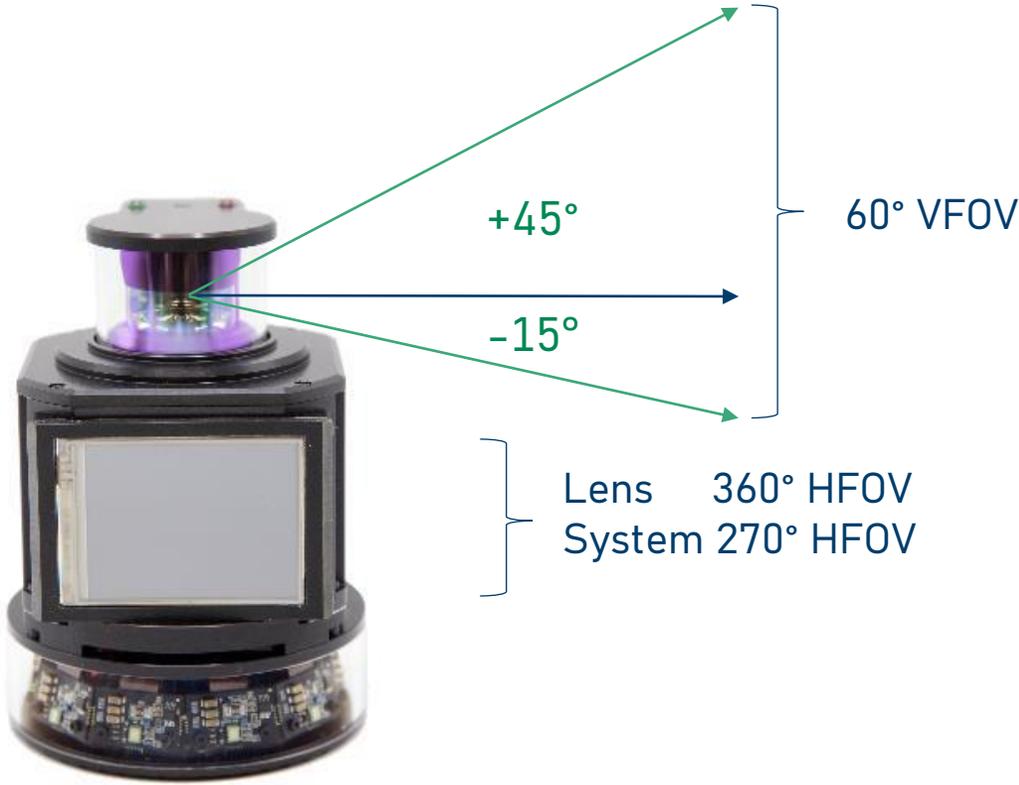


Jabils Omnidirectional ToF Sensor

A configurable, cost-effective solution with up to 360° coverage

Solid state – no moving parts.

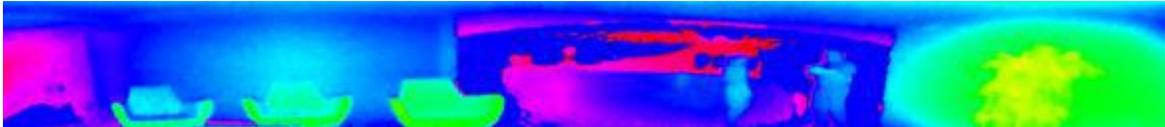
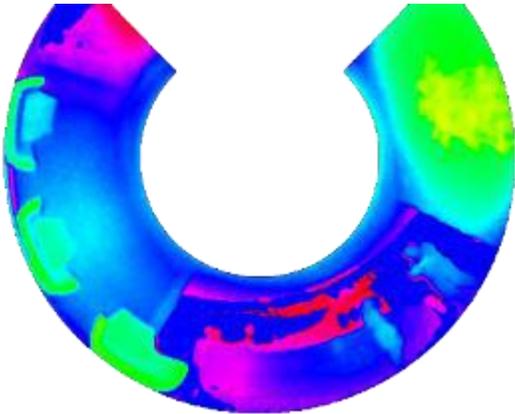
Sensor Coverage: 270° Hfov / 60° Vfov



Sensor Master and Slave topology prevent interference between different sensors.

Omnidirectional ToF Sensor

FOV	HFOV: 270° VFOV: 60°
Resolution	VGA (640x480)
Wavelength	850nm / (940nm is possible)
Range	30cm to 5m
Dimensions	Height: ~125mm Width: ~95mm
Custom Lens	Designed by Jabil Optics



Omnidirectional Sensor Benefits

Innovative Time-of-Flight Technology

World-class product roadmap based on innovations in TOF sensing

State-of-the-Art FOV

60° VFOV which leads to a better object detection and collision avoidance algorithms.

Dynamic Illumination

Sensor illumination is optimized based on real-time positions of objects in a scene.

Reduction in Noise From Stray Light

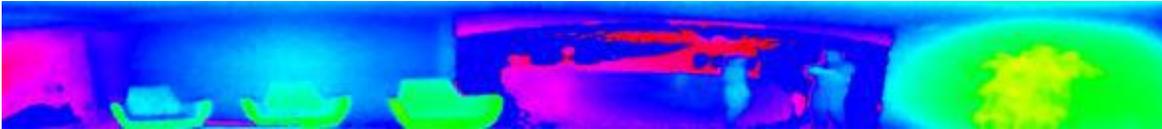
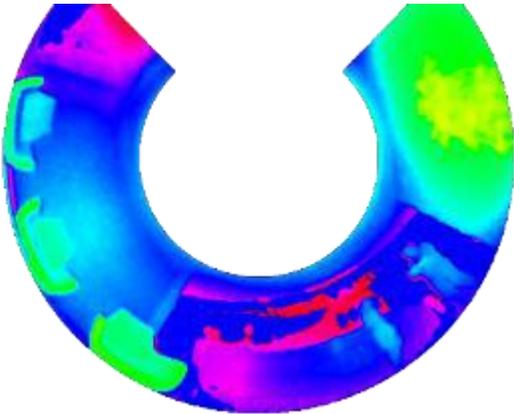
Custom lens design reduces impact of stray light on sensor depth error.

Solid State

Increases reliability and performance on a moving platform.

Low Cost

Increased FOV reduces number of sensors required for object avoidance and robot situational awareness.



We are your partner!

Learn more at jabil.com/optics or contact us via jabil_optics@jabil.com to start your project with us.



JABIL

JABIL

**MADE POSSIBLE.
MADE BETTER.**