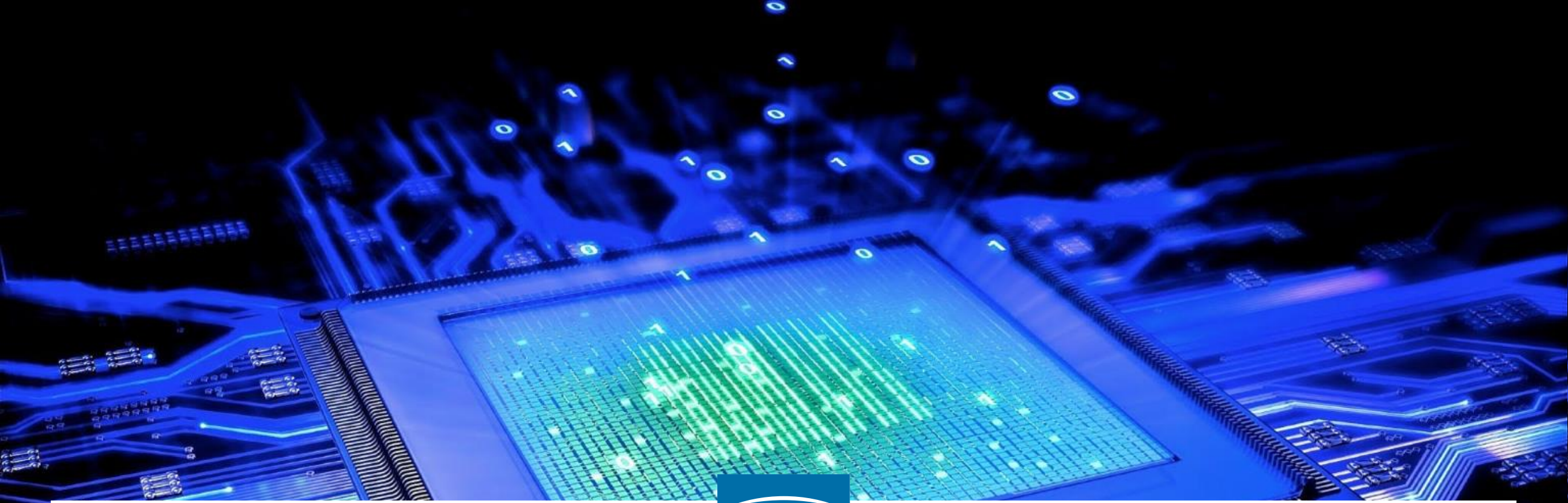
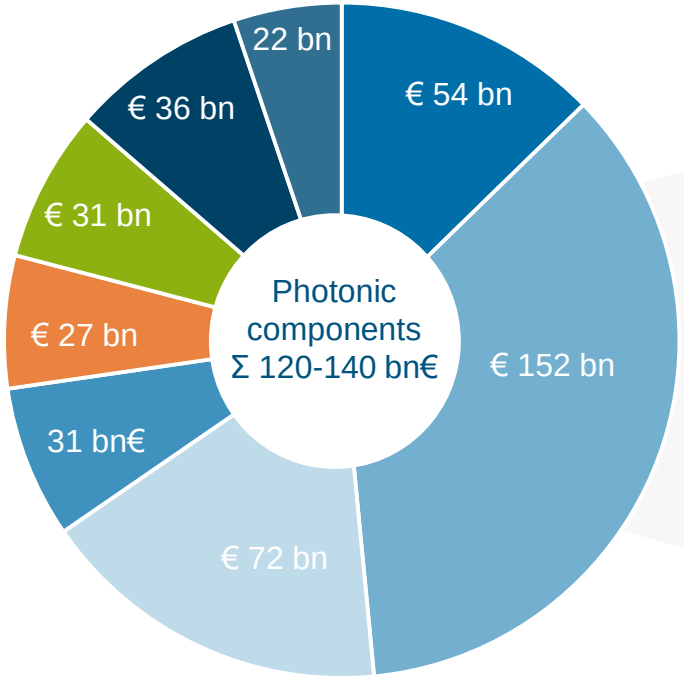


Jenoptik Capital Markets Day 2018

PHOTONICS – ENABLING TECHNOLOGY AT THE HEART OF JENOPTIK

Jay Kumler | Feb 8th 2018

Attractive photonic applications at the core of Jenoptik



World market in Photonics:

~ € 600 bn,
CAGR of ~5-6%

Jenoptik will focus on:

- Optical information processing
- BioPhotonics
- Smart manufacturing
- Sensing, monitoring, measurement

- Solar PV & Alternative Energy
- Lighting & Displays
- Consumer & Entertainment
- Defense, Security, Law Enforcement
- Advanced Manufacturing
- Sensing, Monitoring, Measurement
- BioPhotonics
- Optical Information Processing

Source: SPIE (2016), Agileon Strategic Consultancy

We aim at photonic applications allowing for technical differentiation.

Photonics impacts all of our lives

Live Longer – Photonics in Health Care

Detect disease early when it can be cured

- Diagnostic instruments
- Optical coherence tomography
- Lasers for ophthalmology
- Modular imaging platforms

Smarter and Safer Transportation

Photonic building blocks for smart roads and cities

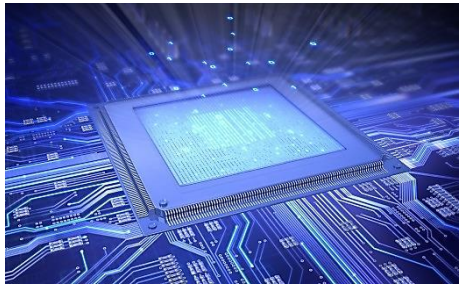
- Red light enforcement
- Speed control
- License plate recognition
- LiDAR (Light Detection And Ranging)

Smarter Factories

Precision laser machines and optical metrology

- Laser Material Processing
- Perforating, cutting and welding with lasers
- Integrated metrology
- In-line Optical inspection

Enabling the digital world



Faster communications for more people, better displays

- Critical components for next gen transceivers
- Silicon photonics
- Organic Light-emitting Diode (OLED) display inspection
- Free space optical communications

JENOPTIK's Photonics Qualifications

Photonics Innovation

- Strong IP portfolio
- Global reach
- Deep expertise in regions
- Able to recruit the top talent

Live Longer – Photonics in Health Care

Photonics is improving human health by unlocking the power of the genome. Our focus on innovation has established Jenoptik as a global OEM leader in DNA sequencing and array-based technologies, serving customers in the research, clinical and applied markets. Our customer's products are used for applications in the life sciences, oncology, reproductive health, agriculture, and other emerging segments.

Optical coherence tomography (OCT) is now the dominant diagnostic tool for conditions like macular degeneration and glaucoma. OCT is now being applied in areas of gastroenterology, dermatology and oncology.

Jenoptik Lasers enable Medical Applications & Solutions

Diagonstics
& Therapy

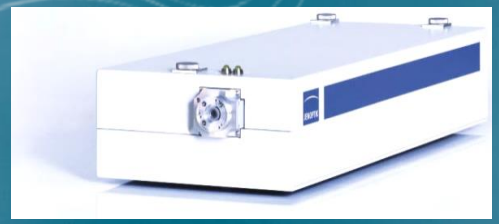
Skin Treatment

Ophthalmology

Surgery
& Endoscopy

Femtosecond Lasers

Picosecond Lasers



Nanosecond Disk-Lasers

Nanosecond Fiber-Lasers

PROGRES GRYPHAX® series
microscope cameras

PROGRES GRYPHAX® SUBRA

KEY FACTS

- Full HD microscope camera with 30 fps
- 5.5 x 5.5 µm pixel size
- 2/3" sensor
- Global shutter
- Software included

PROGRES GRYPHAX® PROKYON

KEY FACTS

- True color microscope camera 20.7 I 9.2 I 2.3 MPix
- 60 fps at 2.3 MPix
- Pixel size 5.86 x 5.86 µm
- Dynamic range 73.3 dB
- 1/1.2" SONY sensor (back-illuminated)
- Global shutter
- Software included

PROGRES GRYPHAX® ARKTUR

KEY FACTS

- 3.8 MPix microscope camera with 8 MPix option
- 30 fps at 8 MPix
- Fits perfectly to 4k monitors
- Dynamic range 66 dB
- 2/3" sensor
- Software included

PROGRES GRYPHAX® NAOS

KEY FACTS

- 5 MPix microscope camera with 20 MPix option
- 30 fps at 5 MPix
- Dynamic range 71.8 dB
- 1" sensor
- Software included

PROGRES GRYPHAX® KAPELLA

KEY FACTS

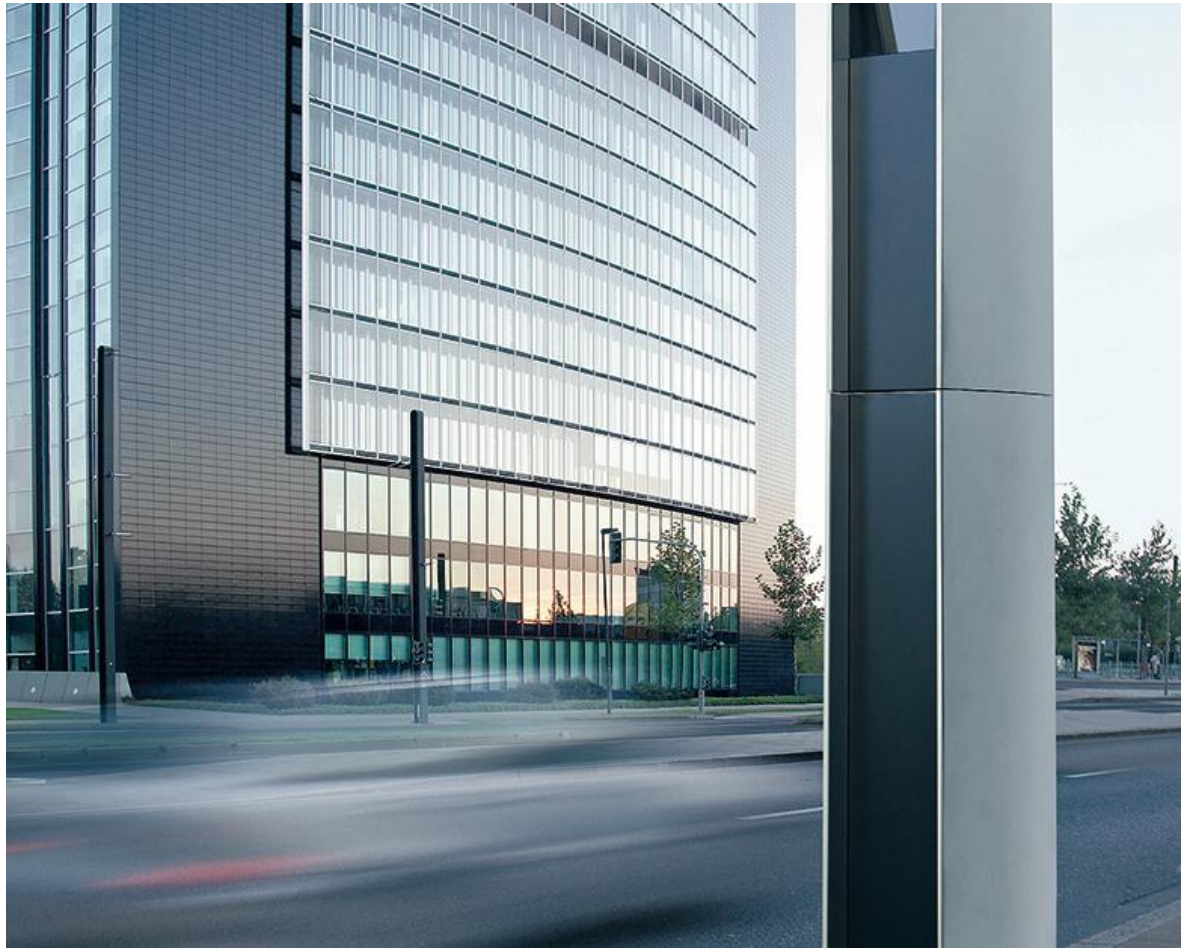
- Color microscope camera 2.3 MPix with 60 fps
- Pixel size 5.86 x 5.86 µm
- Full HD record at video speed
- Dynamic range 73.3 dB
- 1/1.2" SONY sensor (back-illuminated)
- Global shutter
- Software included

PROGRES GRYPHAX® RIGEL

KEY FACTS

- Monochrome microscope camera 2.3 MPix with 60 fps
- Pixel size 5.86 x 5.86 µm
- Dynamic range 73.3 dB
- 1/1.2" SONY sensor (back-illuminated)
- Global shutter
- Software included

Smarter and Safer Transportation



Safer roads with speed control and red light enforcement

LiDAR platform for autonomous vehicles

State-of-the-art systems allow to improve road traffic safety

Traffic Solutions

- The world's widest range of sensor technologies: lasers, radar, piezo sensors, induction loops
- Supplier for whole process chain of traffic law enforcement
- More than 30,000 installed systems in over 80 countries
- Areas of application
  - Stationary and mobile systems for speed and red light monitoring
    - Global No 1 for mobile and stationary traffic safety equipment
  - Measurement of average speed
  - Automatic license plate recognition for police and civil enforcement
  - Toll monitoring systems
  - Reliable and efficient modular back-office software for evaluating traffic monitoring data
- Traffic Service Provision: Financing and service solutions for your traffic safety projects

I3S – JENOPTIK LiDAR Scanner

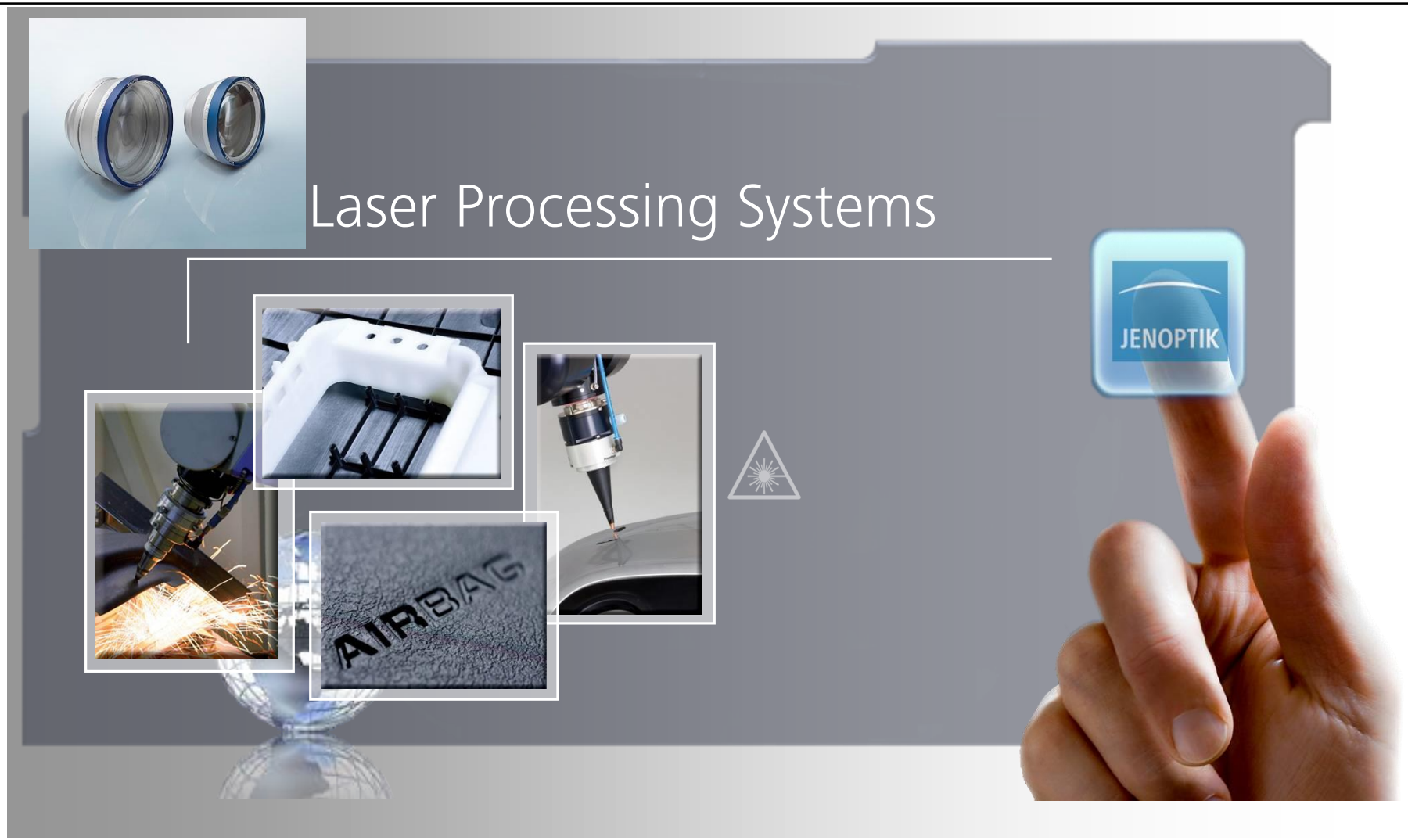
Industrial Automation and its latest trend Industry 4.0 requires reliable and immediate information for process control – for example, for guiding autonomous, driverless transportation vehicles delivering valuable goods. Environmental data collected by 3D LiDAR Scanners turn out to be vital for navigation and collision avoidance.

Our new I3S 3D LiDAR Scanner will play an important role not only in industrial automation and industrial safety, but also in public safety and security applications, for object protection, or surveillance.

Applications

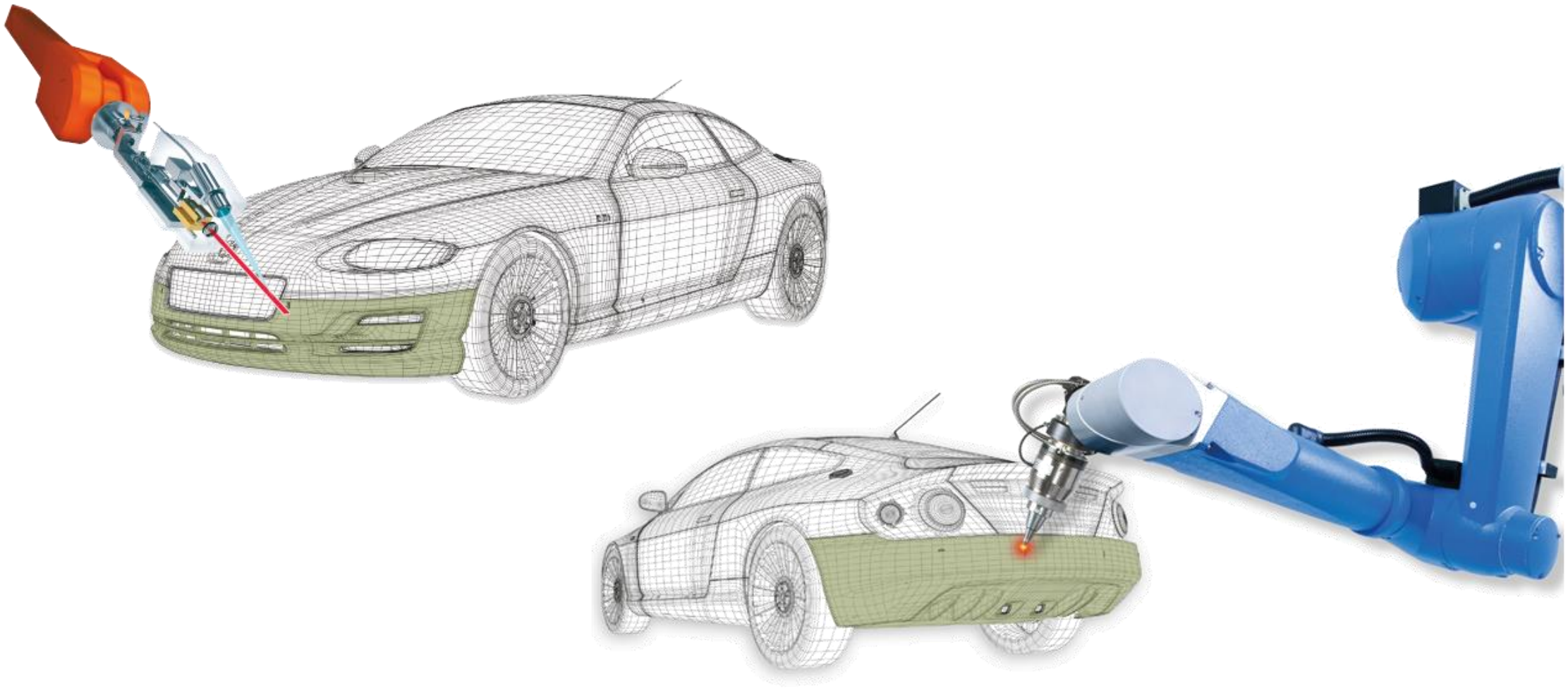
- Industrial automation, transport and logistics
- Driverless, autonomous transportation systems
- Unmanned Aerial Vehicles (UAV, drones)
- Unmanned Ground Vehicles (UGV)
- Autonomous agricultural machines
- Public safety & security, surveillance, object protection

Smarter factories



JENOPTIK-VOTAN®BIM & JENOPTIK-VOTAN®W

Laser processing systems for bumper cutting and welding

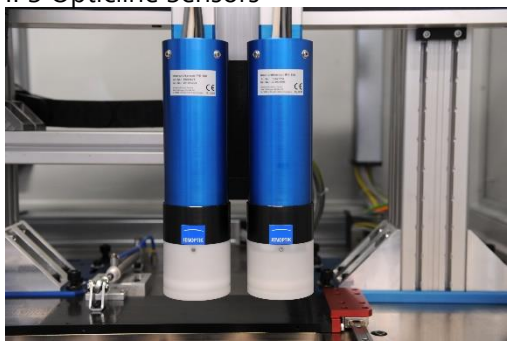


Photonics-enabled inspection in automotive industry

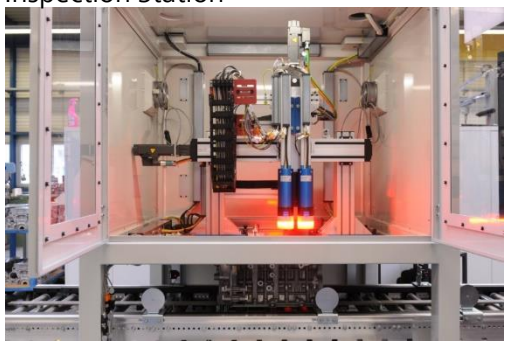
JENOPTIK IPS100 HR – Surface inspection of bores in engine blocks

- Automated part handling and measurement of engine blocks (In-line)
- 360 degree optical inspection, with focus module and LED ring illumination
- Control software with GUI interface
- Detects scratches, porosities, holes, defects
- 100+ systems installed worldwide

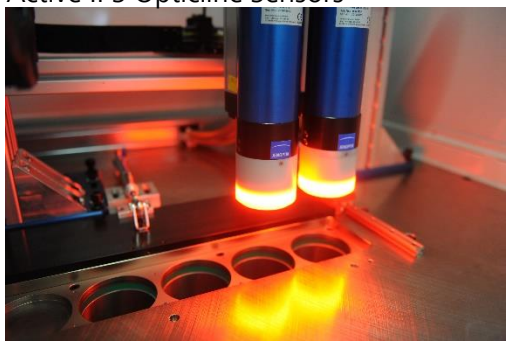
IPS Opticline Sensors



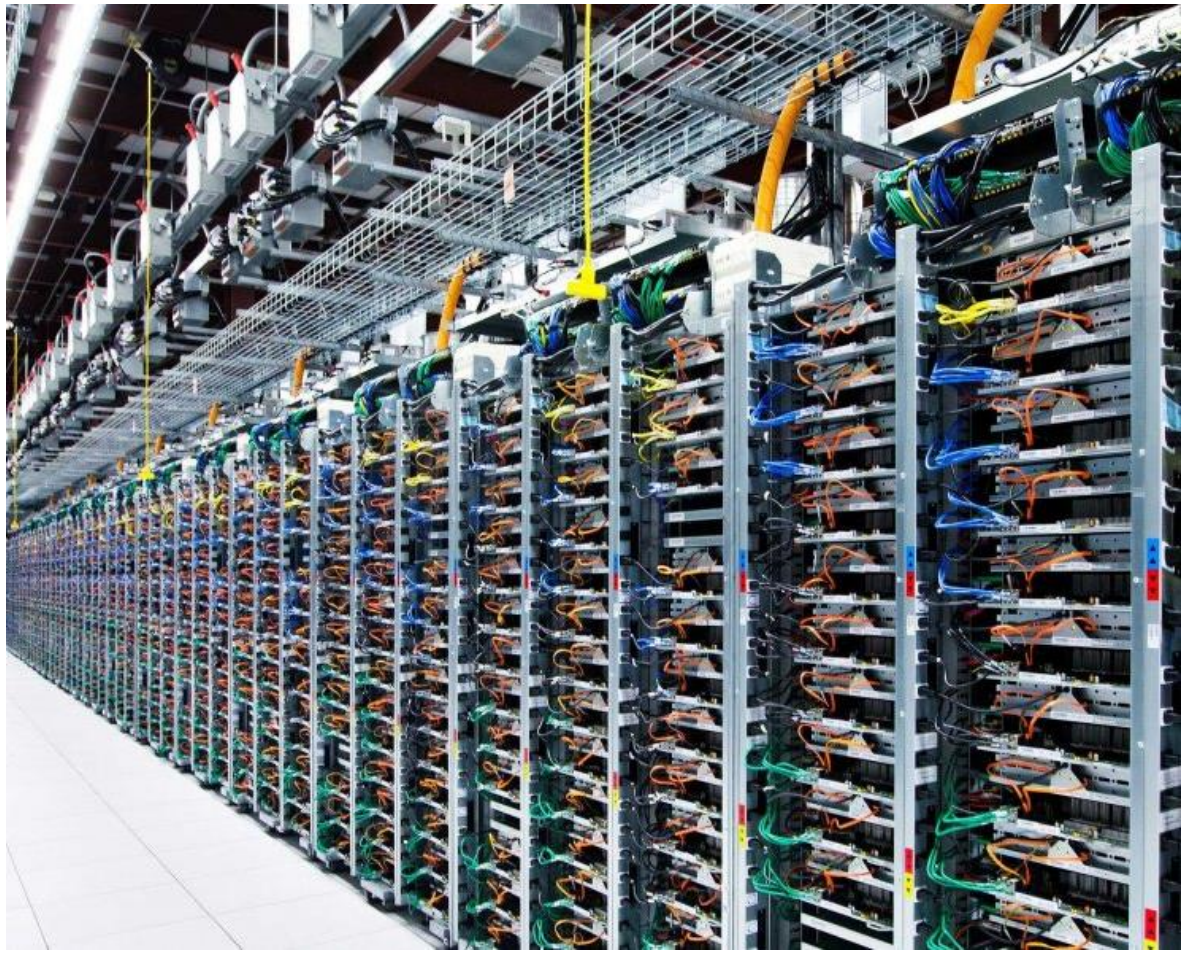
Inspection Station



Active IPS Opticline Sensors



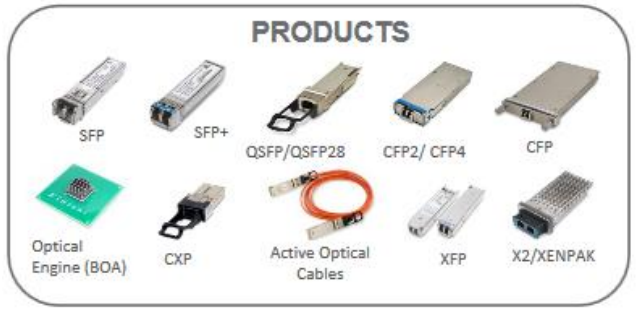
Enabling the Digital World

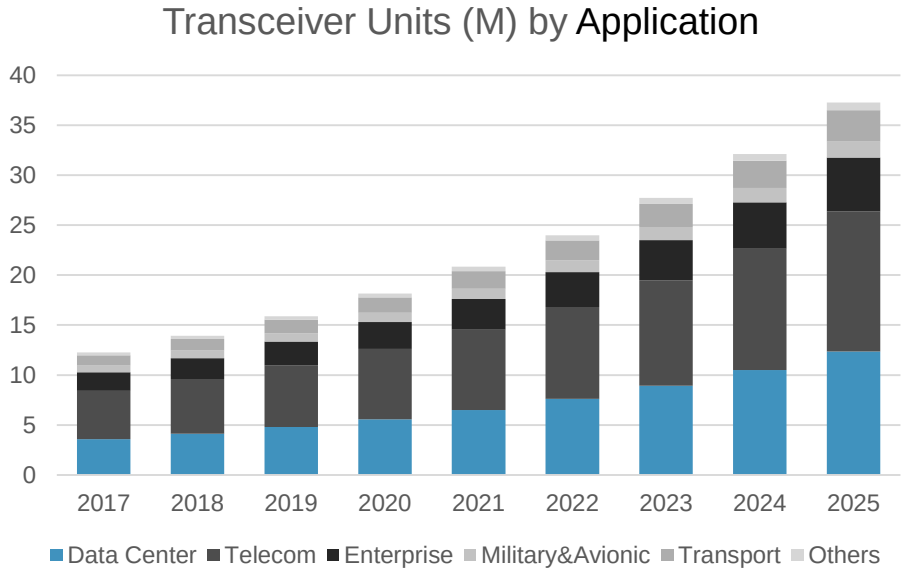


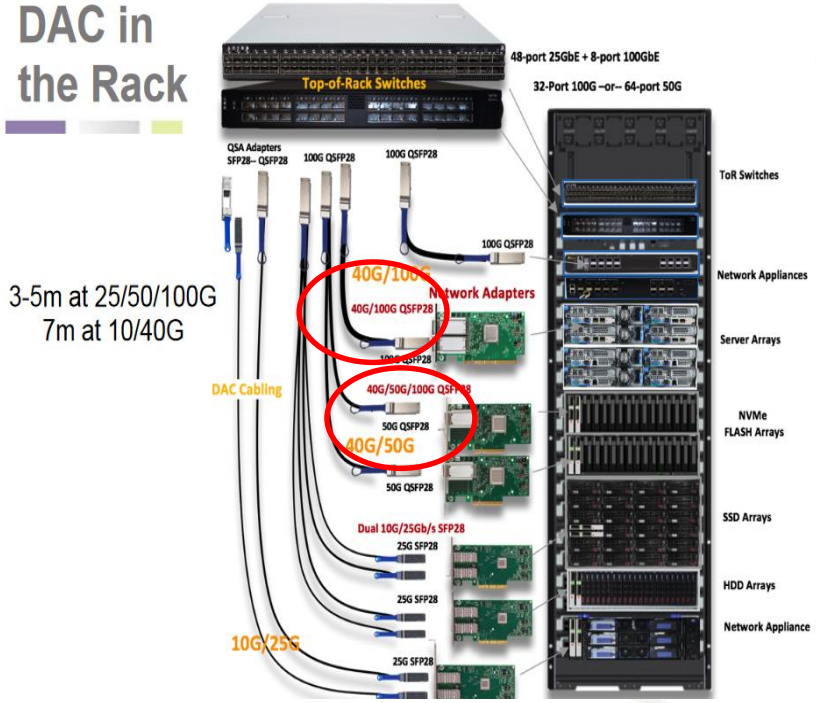
Hyper scalke data center

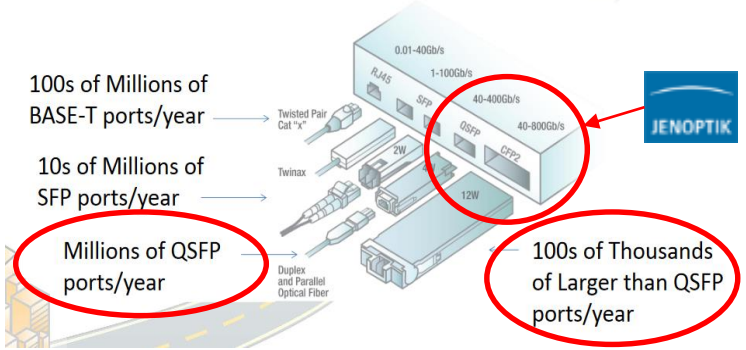
OLED displays

Jenoptik Products enabling Hyperscale Data centers









2017 Ethernet Roadmap for Networked Storage presentation (Association for Storage networking).

The State of Ethernet Optics" from Ethernet Alliance.org

JENOPTIK Products enable manufacturing and testing of Consumer Electronics

OLED Flat Panel Display inspection

The desire for thinner, better, more power-efficient and sharper displays in consumer electronics has fueled the demand for OLED displays.

Flexible OLED displays are the next progressive step in the technology's evolution.

Jenoptik delivers R-G-B imaging systems with diffraction limited performance and extended depth of focus.

JENOPTIK Products make ubiquitous broadband possible
New Development Projects with Google X

- AP State FiberNet announced that they'll be rolling out two thousand free-space optical communications links created by Google X.
- These FSOC links will form part of the high-bandwidth backbone of their network, giving them a cost effective way to connect rural and remote areas across the state. The links will plug critical gaps to major access points, like cell-towers and WiFi hotspots, that support thousands of people.
- Andhra Pradesh, a state in India which is home to more than 53 million people.
- **Less than 20% of residents currently have access to broadband connectivity**

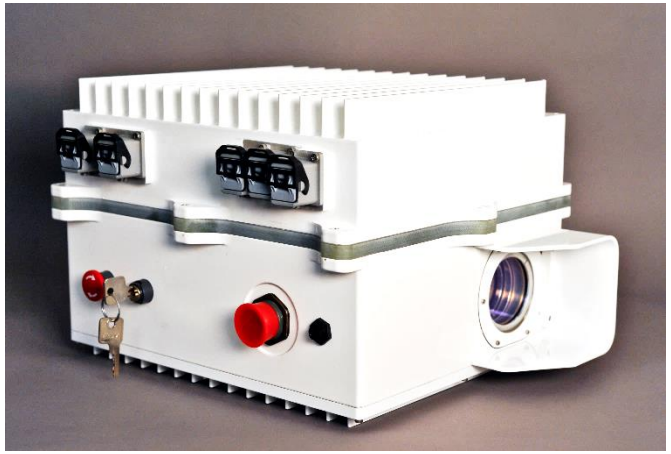
Google signed MoU with Andhra Pradesh (India)
To supply high speed internet to households, schools and public health centers

AP Fiber grid is an ambitious project launched to give affordable high-speed internet connection to every household in the state.

The pilot project aims to connect
- 14.5 million households
- 12,198 Panchayats (village councils)
- 60,000 schools
- 10,000 government offices
- 6,000 Public Health Centers with high-speed internet.

"This association with X labs to implement FSOC in AP is first of its kind in the world to provide wireless internet connection at a higher speed of up to 20Gbps and to a distance of up to 20kms.

This significant partnership will offer a major boost to the state's digital infrastructure and help overcome hindrances in terms of connecting isolated and difficult terrain, forest areas, river crossings, and railway crossings" said Andhra Pradesh IT minister Nara Lokesh.



Top photo credit Jenoptik
Bottom photo credit Google X, used with permission

Awarded and Active Photonics Patents

JENOPTIK AG

1,248 Active patents
in
465 Patent families

Optical Systems Division

274 Active patents
in
152 Patent families
+
85 Patents in progress

Health Care Division

148 Photonics patents

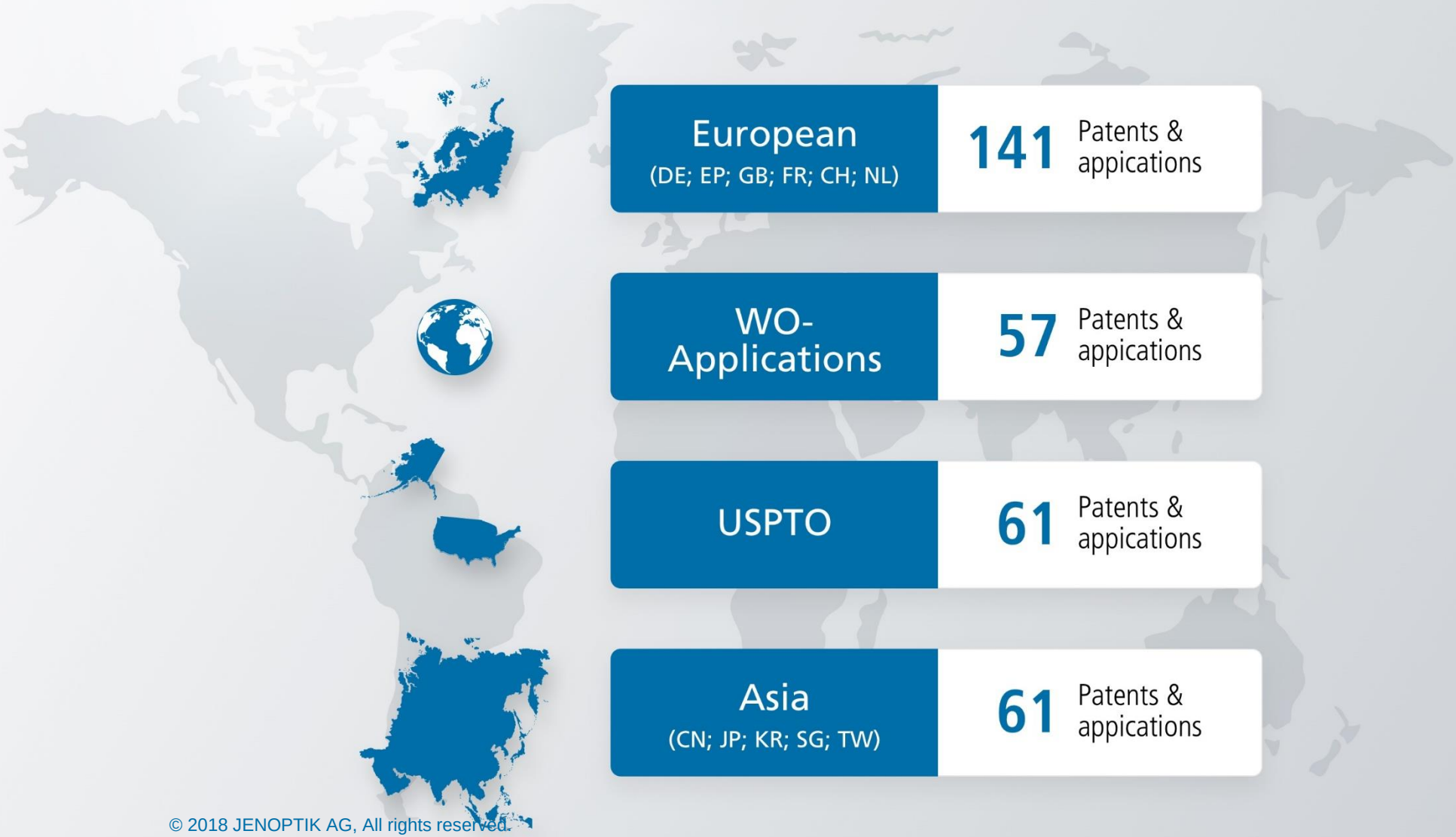
Defense Division

20 Photonics patents
in
6 Patent families

Traffic Solutions Division

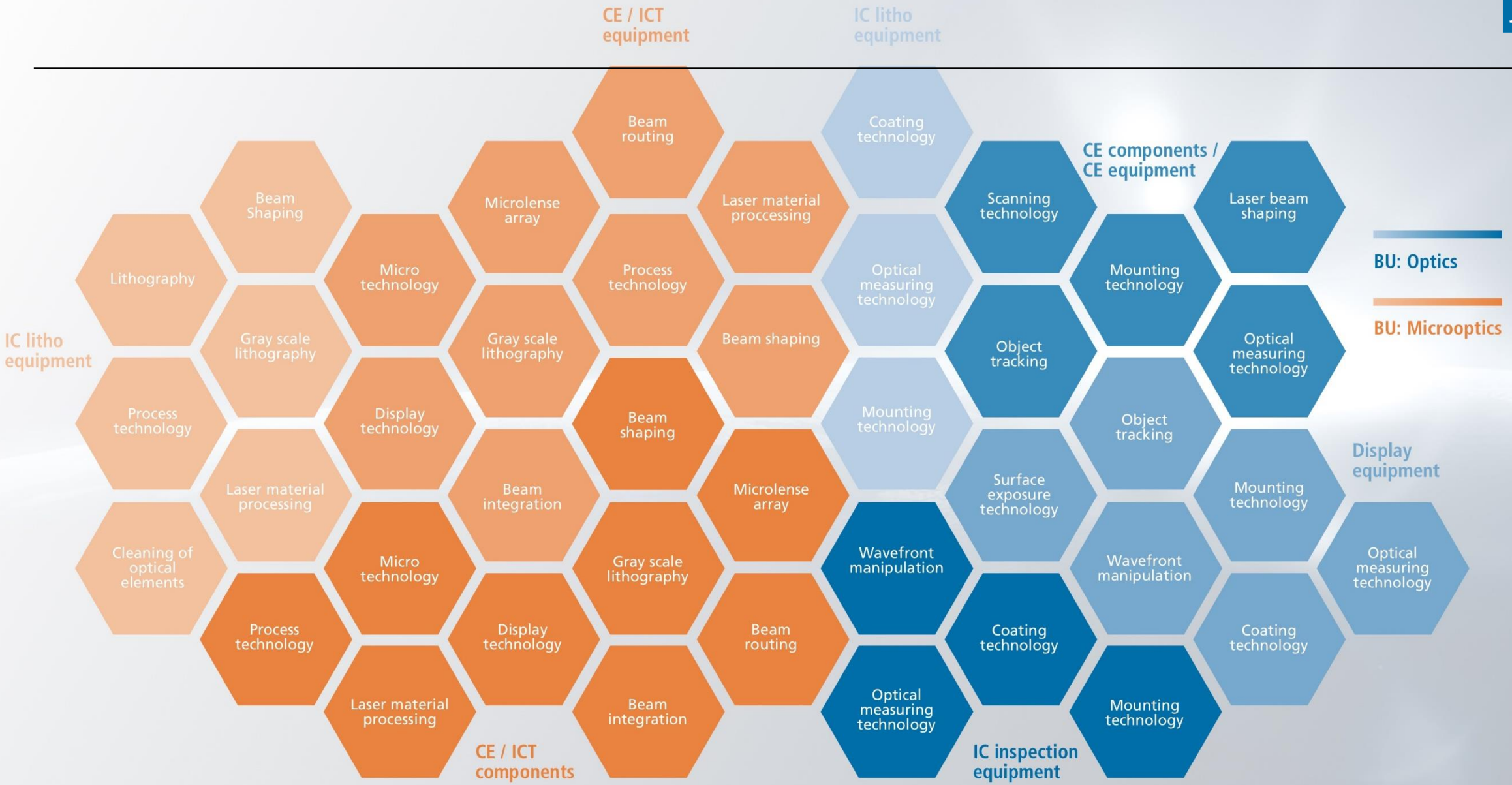
16 Photonics patents
in
5 Patent families

Optical Systems Division Patents

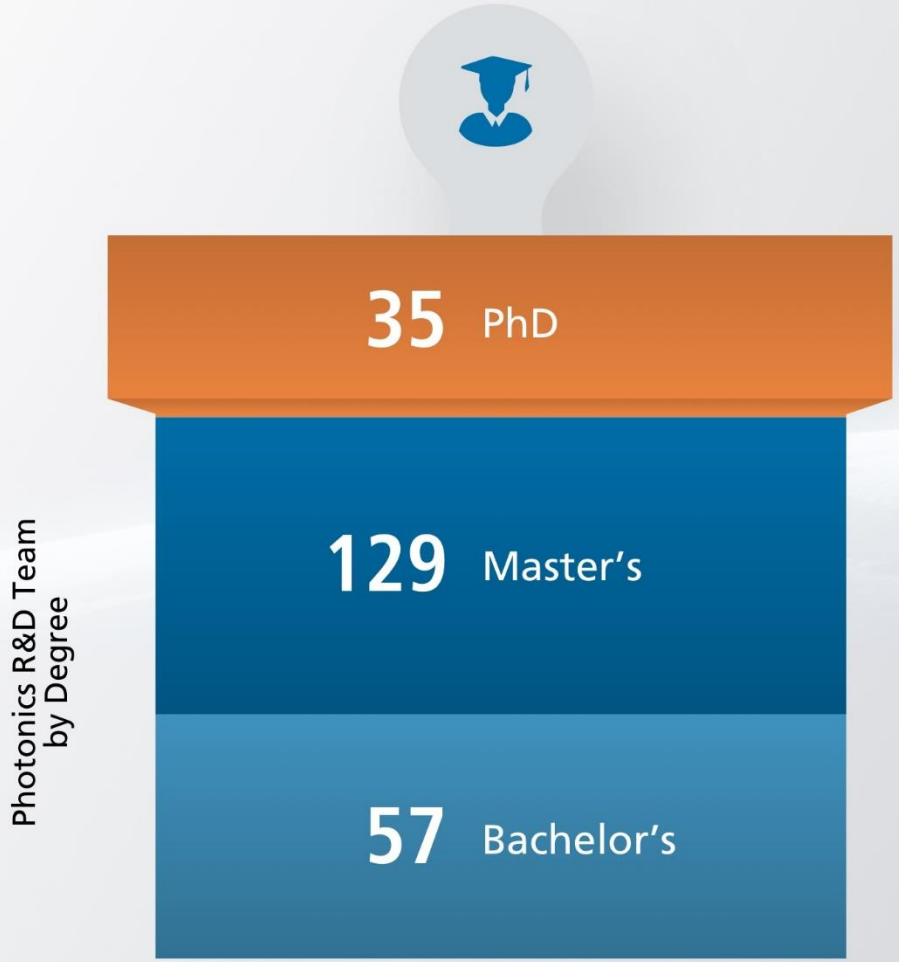


European (DE; EP; GB; FR; CH; NL)	141	Patents & appications
WO-Applications	57	Patents & appications
USPTO	61	Patents & appications
Asia (CN; JP; KR; SG; TW)	61	Patents & appications

Photonics IP Portfolio



Elite Talent from Elite Schools



Massachusetts Institute of Technology

Karlsruher Institut für Technologie

University of Rochester

Freie Universität Berlin

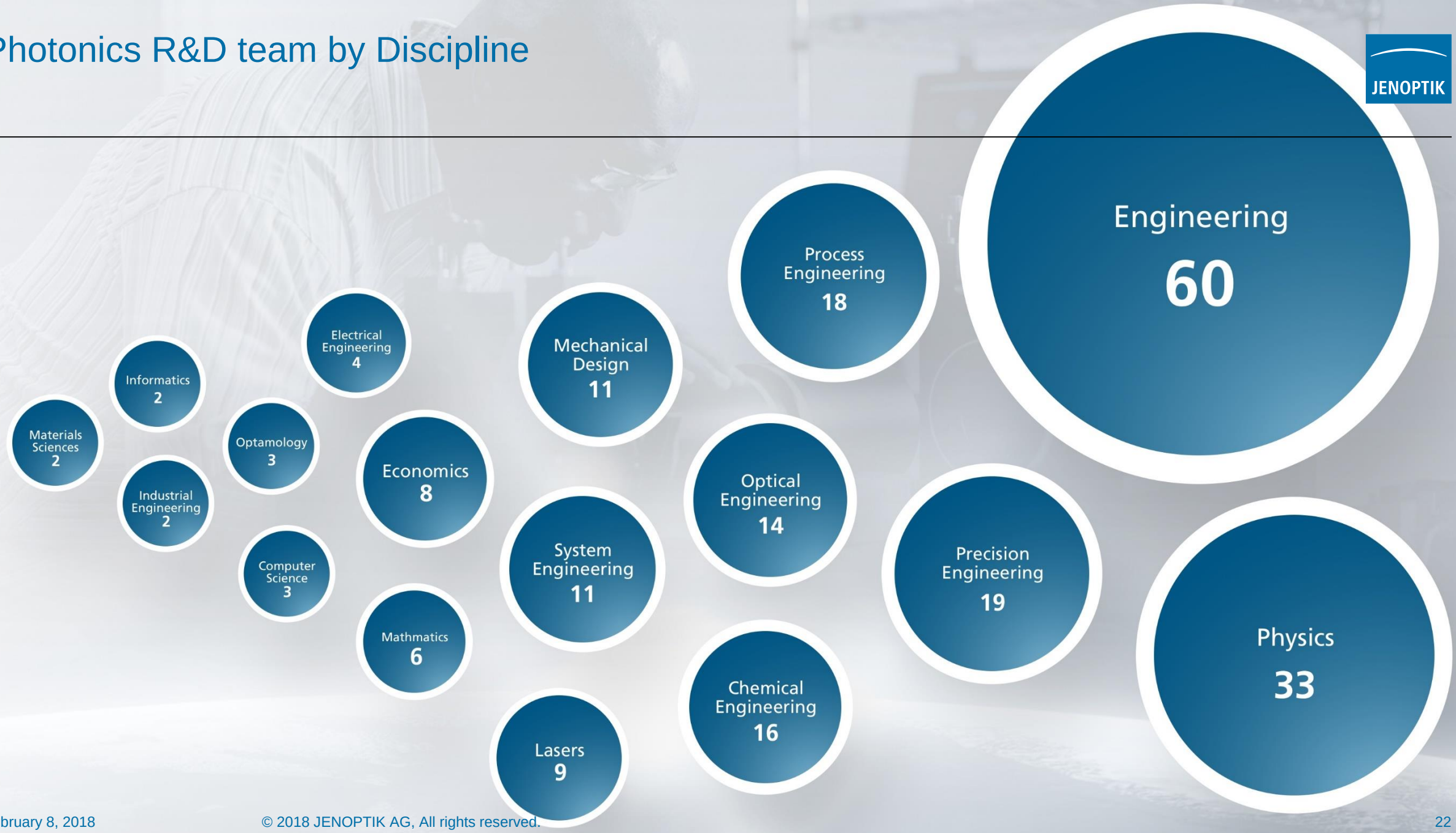
The University of Arizona College of Science

Technische Universität Ilmenau

RWTH Aachen University

Friedrich-Schiller-Universität Jena

Photonics R&D team by Discipline



Jenoptik Optics on Mars Rover 2020

Space Flight Hardware

JENOPTIK Optical Systems designed and is manufacturing lenses for the engineering cameras on the Mars Rover being launched in 2020.

Hazcam, Navcam and Cachecam.

All three designs incorporate sub cells, utilizing our in-house cell turning capability to control critical interface datum

JENOPTIK provided the optical and mechanical design, and the FEA analysis.

JENOPTIK is performing the assembly, alignment and system testing of the lenses.

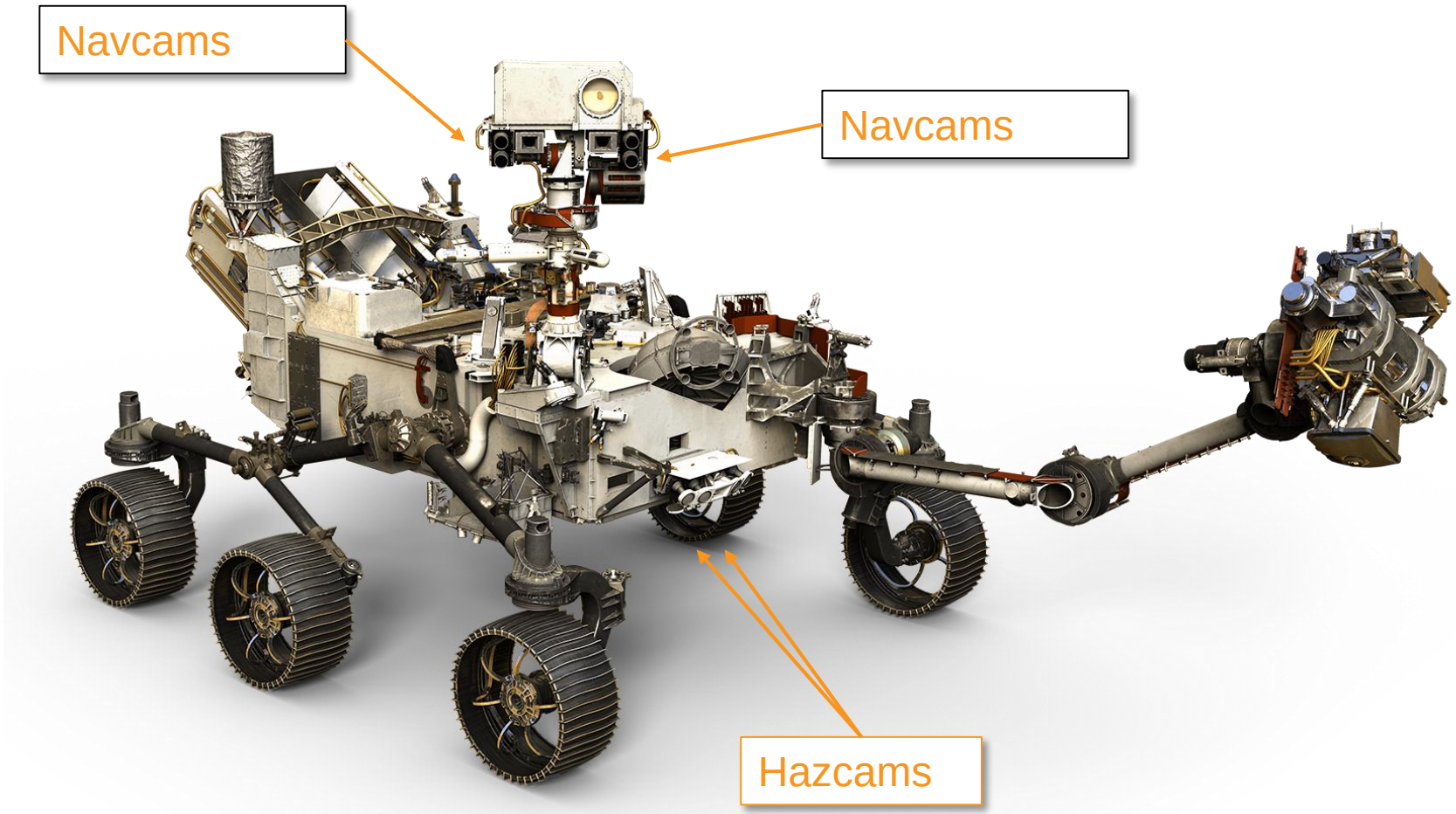


Image used with permission of NASA Jet Propulsion Laboratory

Photonics is moving markets and changing the world around us.

Jenoptik has the skills, experience and proven track record to lead the way

Safe harbor statement

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