



A New Generation of Camera Modules: A Novel Approach and Its Benefits for Embedded Systems



member of the TKH Group <

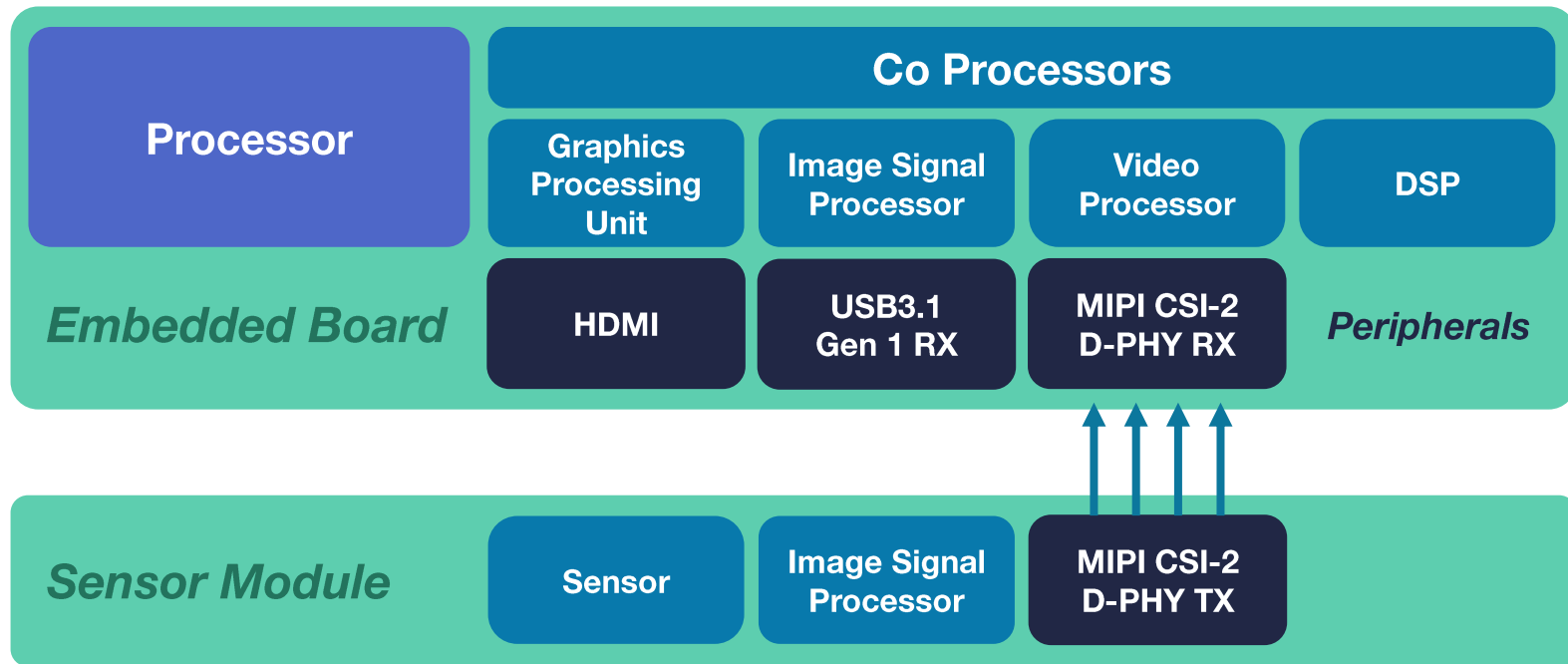
- Industrial and Machine Vision camera supplier since 1989
- >350 employees
- Headquarters in Germany
- Worldwide sales and distribution



Typical embedded vision system



Typical Embedded Vision System



Main challenges with current sensor modules

Sensor Variety



Image Processing Capabilities



Hardware and Software Integration



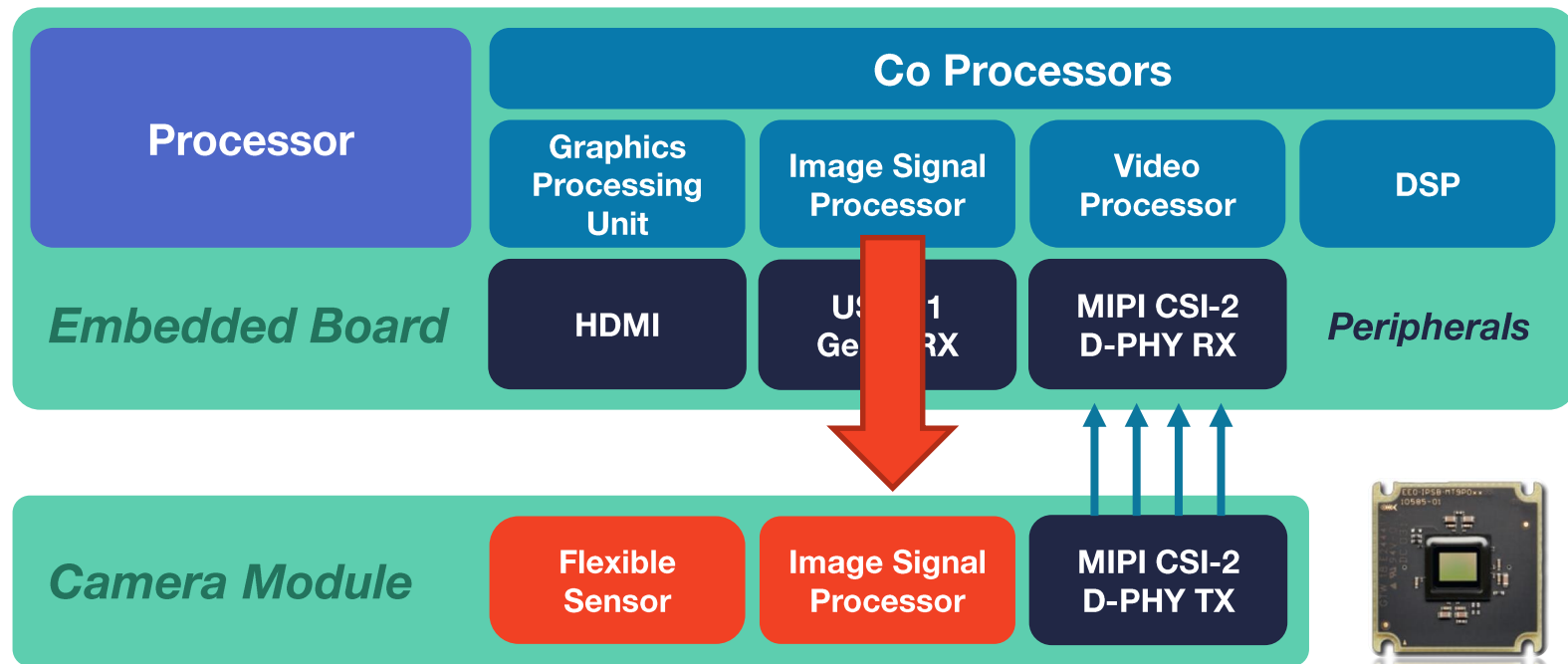
Flexibility



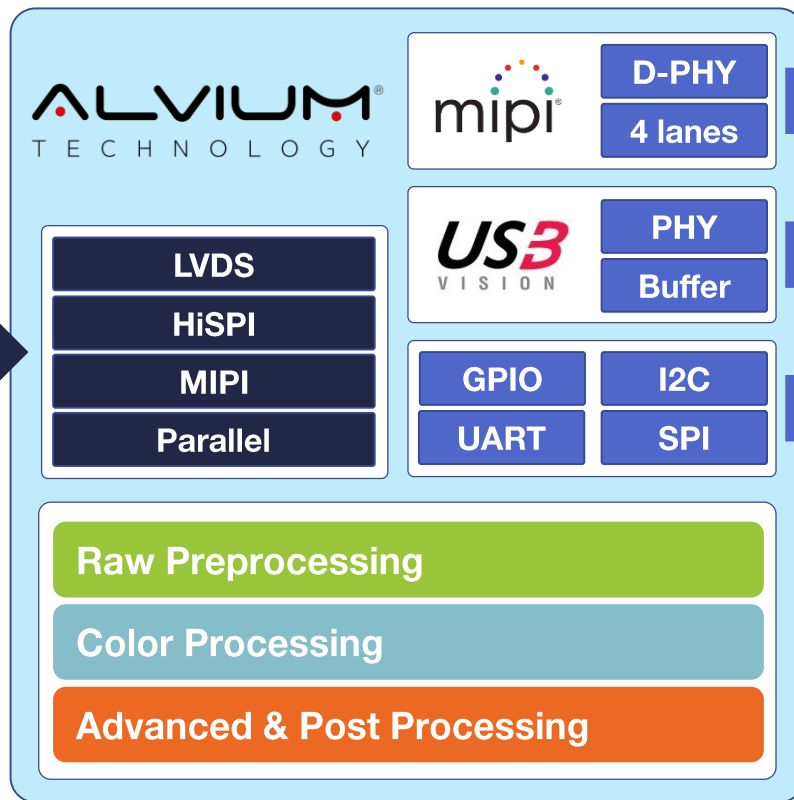
A novel approach



Novel approach for Embedded Vision System



1 Product Line and ALVIUM at one glance



Up to 6 GBit/s

Up to 5 GBit/s

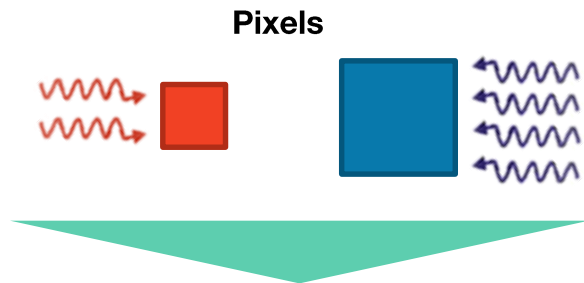
Embedded



Benefits for embedded vision designers

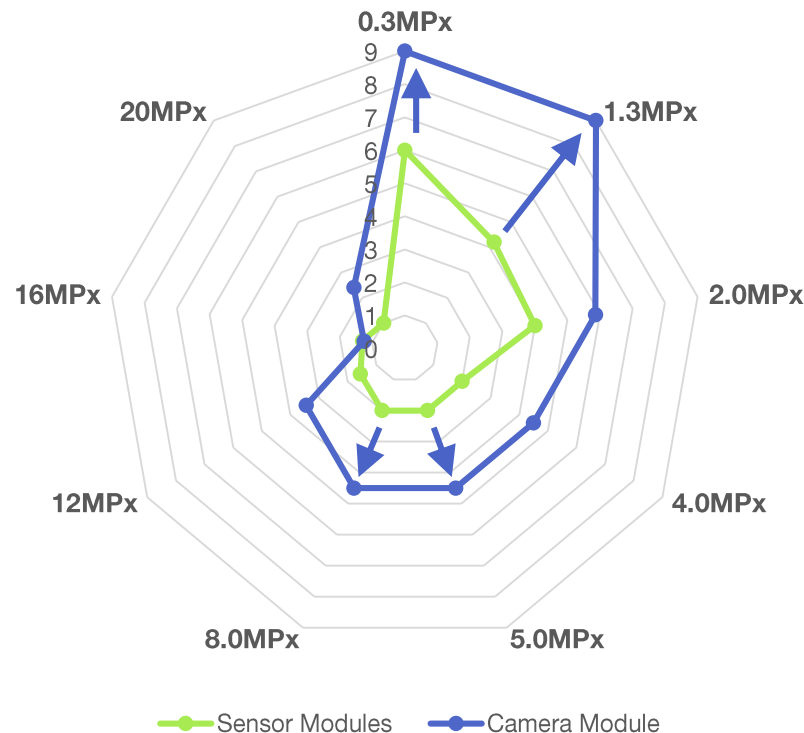


Greater choice of larger pixel sized sensors

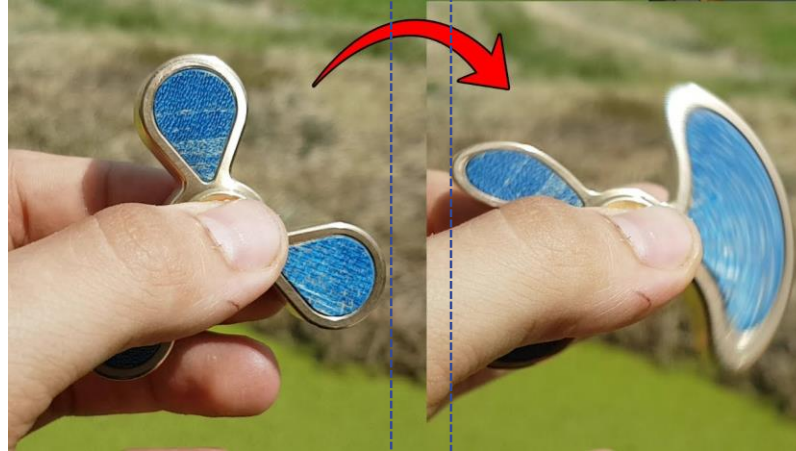
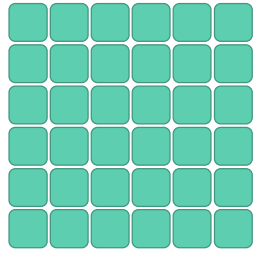


Higher sensitivity
e.g. for low light conditions

Shorter exposure time
e.g. sharper image acquisition

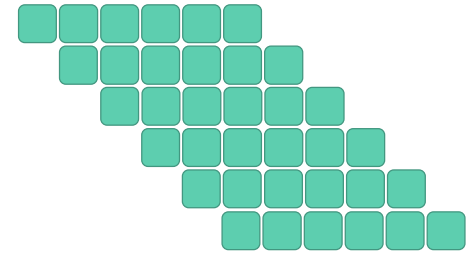


Avoidance of the rolling shutter effect with fast moving objects



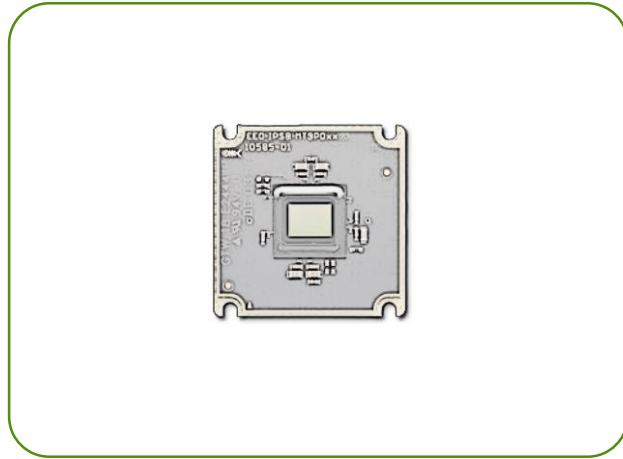
Source: Molten Science, YouTube Channel

Global Shutter exposes and read-out rows **simultaneously**



Rolling Shutter exposes and read-out rows **sequentially**

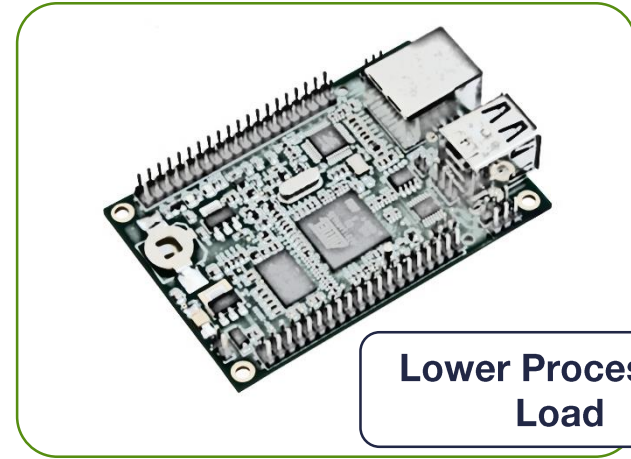
Shift image processing from the embedded board to the camera module



All supported standard
MIPI CSI-2 pixel formats



via MIPI CSI-2



Lower Processing
Load



ALVIUM
TECHNOLOGY

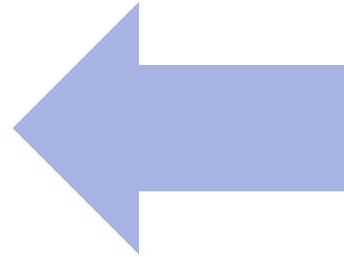


Image processing blocks in ALVIUM

Raw Preprocessing

Digital Binning	Fixed Pattern Noise Correction	Defect Pixel Correction
Gamma	Vignetting Correction	Black Level
3 Channel 12 Bit LUT	(Auto) White-balance	Reverse X
Histogram	(Auto) Contrast Enhancement	Digital Gain

Color Processing

De-Bayering 5x5	Focus Measurement
Adaptive Noise Filter	Sharpening Blurring
Color Transform	Y Channel 12 Bit LUT
Hue Saturation	Threshold

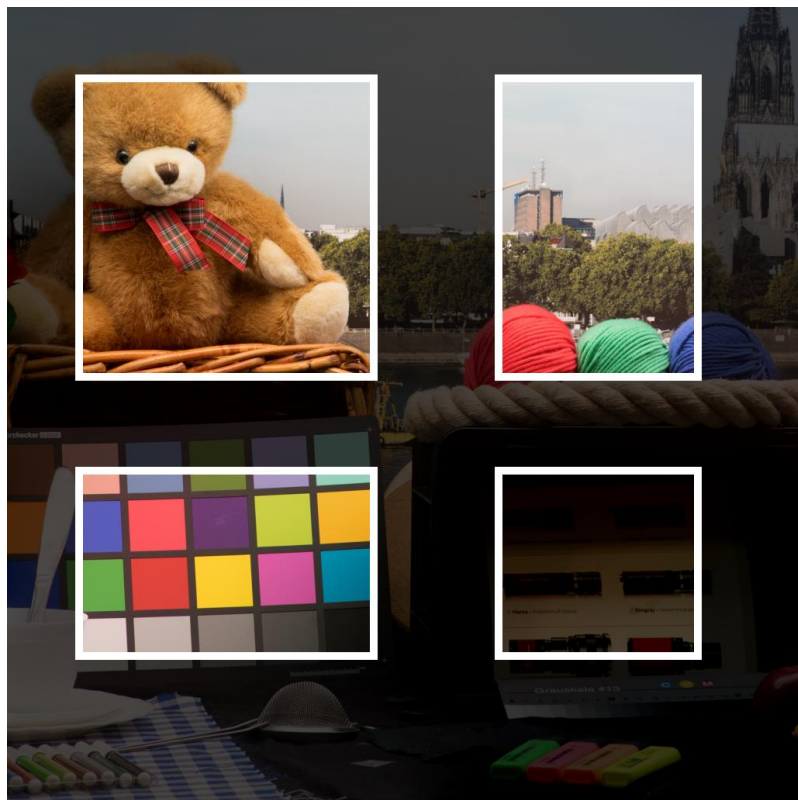
Advanced Processing

Image Stabilization	On Screen Display
Trapezoid Correction	

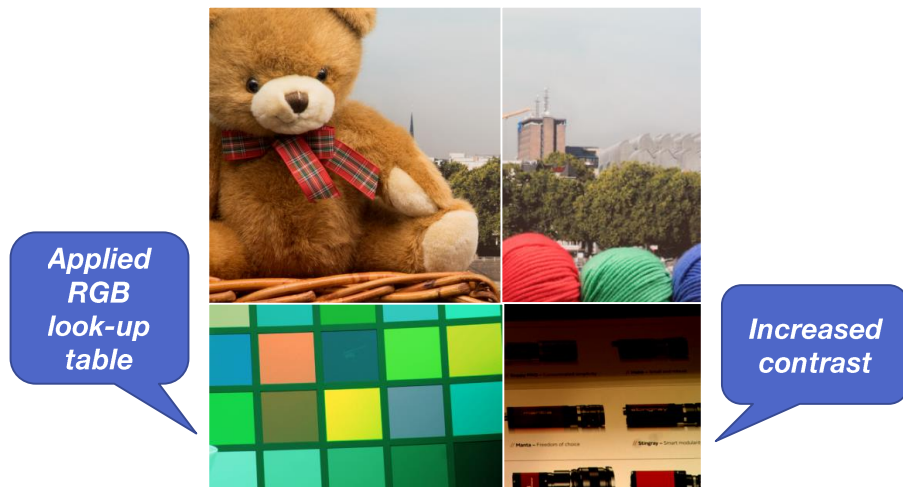
Post Processing

Pixel Format	MJPEG Compression
--------------	-------------------

Highlight: Support of Multiple Regions of Interest



Less pixel transferred → increase FPS



Individual settings for each Region of Interest

- **One MIPI driver for NXP i.MX6**
- **One MIPI driver for NXP i.MX8**
- **One MIPI driver for NVIDIA Tegra TX1/TX2**
- **SDK for ARM v7 32-bit and ARM v8 62-bit**



Once you start with a specific SoC, you can stay with it!

“Rapid prototyping” with the 1 Product Line



US3
VISION

Start sensor evaluation and test image processing capabilities on any ARM based embedded board with USB3 interface

SoC



Embedded Board



Power
Consumption



Sensor Evaluation



Image Processing



Software

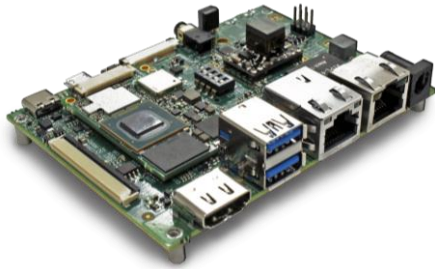


mipi

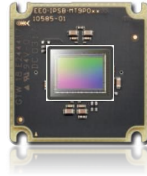
Switch to a MIPI CSI-2 based camera model with your preferred sensor and image processing and start your final development process

Easy exchangeable MIPI cameras on the same SoC

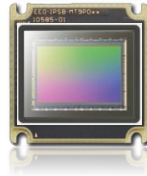
NXP i.MX8



Source: HummingBoard, SolidRun



2018: Decision for Full HD resolution



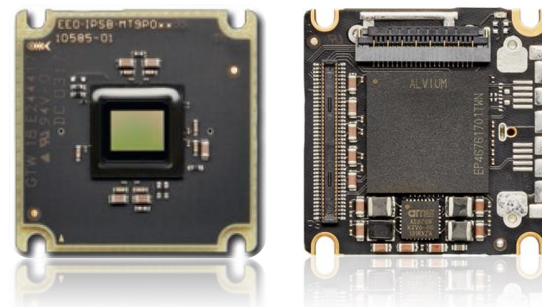
2020: Decision for 4K resolution

- **Image processing in the camera adapts automatically to the new resolution**
- **MIPI driver stays the same**

Conclusion



- Novel approach for embedded camera modules
- Unique vision processor ALVIUM
- Broad sensor selection for various use cases
- Advanced image processing on the camera
- Broad SoC support
- Modular concept for easy upgrades



ALVIUM[®]
T E C H N O L O G Y

Thank you very much

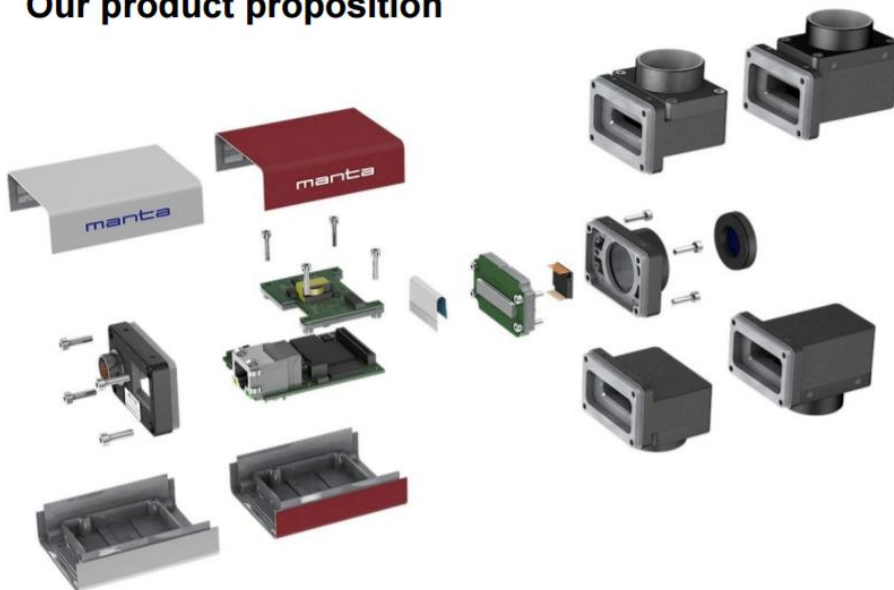
- Additional resources
 - <http://www.embedded-vision.com/>
 - <https://www.alliedvision.com/en/products/embedded-vision.html>
 - Molten Science, YouTube Channel
 - HummingBoard, SolidRun
- Come by and visit the Allied Vision demo table at booth #204.
We are looking forward to have deeper discussions with you!

Backup Material



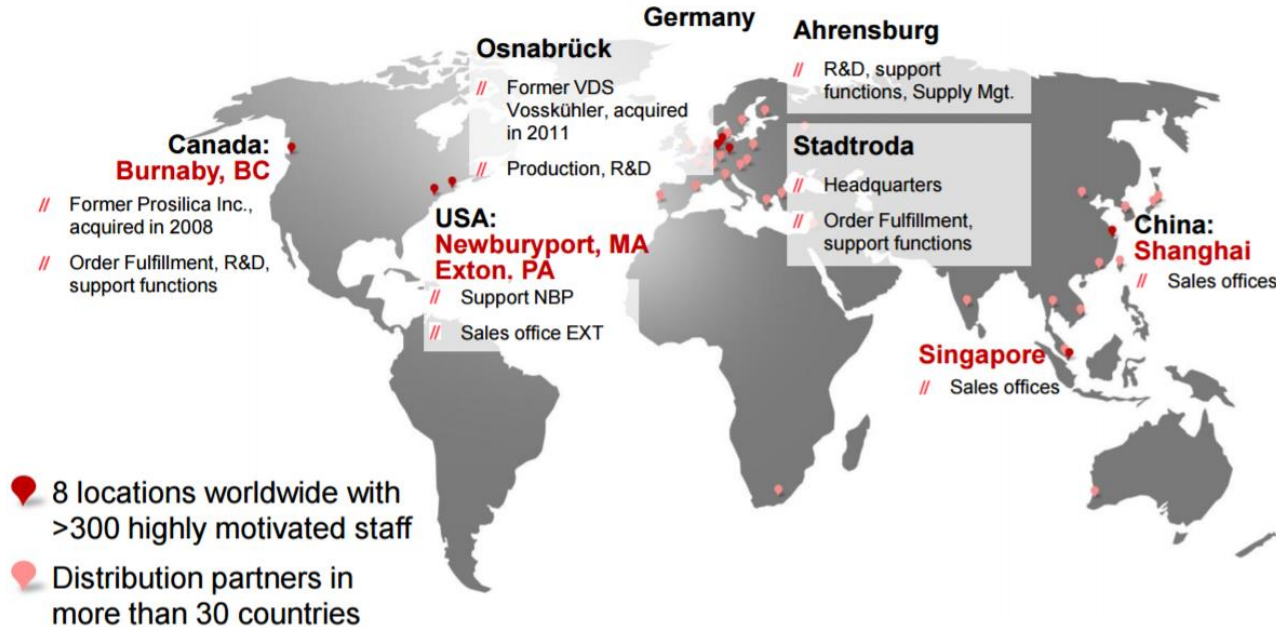
Who we are – the camera innovator

Our product proposition



- Camera design, production and validation
- Modular concept
- Customer-specific modifications
- OEM development
- Embedded & host software
- Accessories selection and validation (e.g. lenses, cables, etc.)
- Broad high-tech vision expertise (visible and non-visible imaging)

Who we are – a global player



Our cameras – used around the world

Industrial Inspection



Knorr Bremse
Quality control of disc brake components

Healthcare & Medical



Carl Zeiss Meditec
Ophthalmologic examination device

Science & Nature



NASA/ General Motors
ISS astronaut-robot Robonaut 2

Security & Traffic



Vexcel / Bing Street side
Mobile imaging to capture street views

Sports & Entertainment



Sport vision
Statistical analysis of baseball and other games