

# AR | VR | MR **focus**

Delivering the latest news from the AR/VR/MR markets

**Digital developments: making the most of virtual events with augmented content**

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# Surface Relief Grating etching: Maximum yield over 200 mm wafer area

Strict manufacturing tolerances delivered to achieve maximum coupling efficiency for waveguide combiner. This etching solution enables precise control of feature angle and CD to maximize yield over 200 mm wafer size area.

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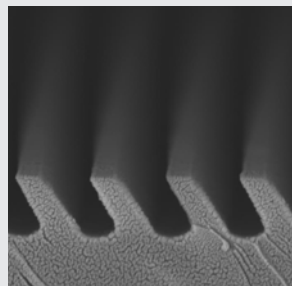
- High yield on large uniform areas
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# Digital events augment many virtual attendees' experiences

How the world has changed since the launch issue of ARVRMR focus, which coincided with Photonics West in February! But our themes of photonics technologies and software capabilities that support the latest augmented, virtual and mixed reality applications could not be more relevant or timely. Since then, our publisher and premier international event organizer SPIE has rapidly responded to the global pandemic and travel lockdowns by developing virtual "digital" events to meet the industry's insatiable need for information about innovation in these fields.

In April, we saw both SPIE Photonics Europe Digital Forum and SPIE Defense + Commercial Sensing Digital Forum replacing physical events in France and the USA, respectively. Besides the content from these free events – available as videos of presentations, downloads, and various interactive online resources – the virtual visitor numbers, interactions and responses were all of the highest quality; attendee participation was at a higher level than the expected "in-person" numbers.

Such events are likely to continue for some time; the next will one be SPIE Optics + Photonics 2020 Digital Forum (24 - 28 August 2020). This meeting, which usually takes place in San Diego, CA, will feature some "live" presentations that you can log into. It will continue to focus on research in optical engineering and applications, nanotechnology, quantum science, and organic photonics – only now in an online format. For further information about this and other forthcoming digital and real events visit [spie.org](http://spie.org).

## Highlights in this issue

Augmented reality was and continues to be the dream that consumer electronics companies want to make real to deliver the long-awaited revolution of replacing smart phones, says Dr. Zine Bouhamri, Technology & Market Analyst, Displays at technology market analyst company Yole Développement, Lyon, France ([page 04](#)).

Compound Photonics, a developer of compact high-res microdisplay solutions for AR-MR applications, has launched a compact, high-brightness optical engine design that fits into a volume under 3cm<sup>3</sup>. – a suitable optical engine for smart glasses ([page 06](#)).

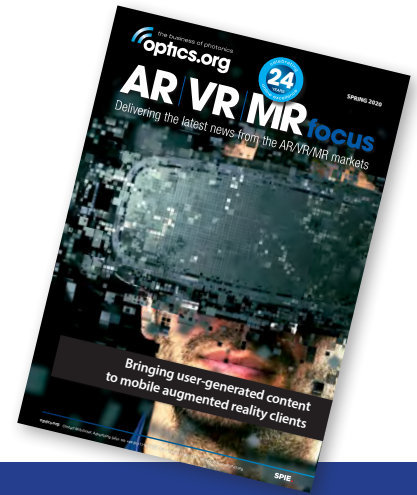
Schott, the Germany-headquartered manufacturer of glass optics, is ready to mass-produce its latest high-index RealView 1.9 material, designed to improve the augmented reality experience in consumer devices ([page 07](#)).

Embedded technologies company Plessey, which develops microLED technology for AR and MR display applications, is to work with Facebook to help achieve the social media company's vision of the next-gen interactive computing platform ([page 09](#)).

Intevac has won a \$8.1 million AR goggles order from US Army as night-vision applications grow. The Photonics division of the Californian company says latest gear will feature new active-pixel sensing ([page 14](#)).

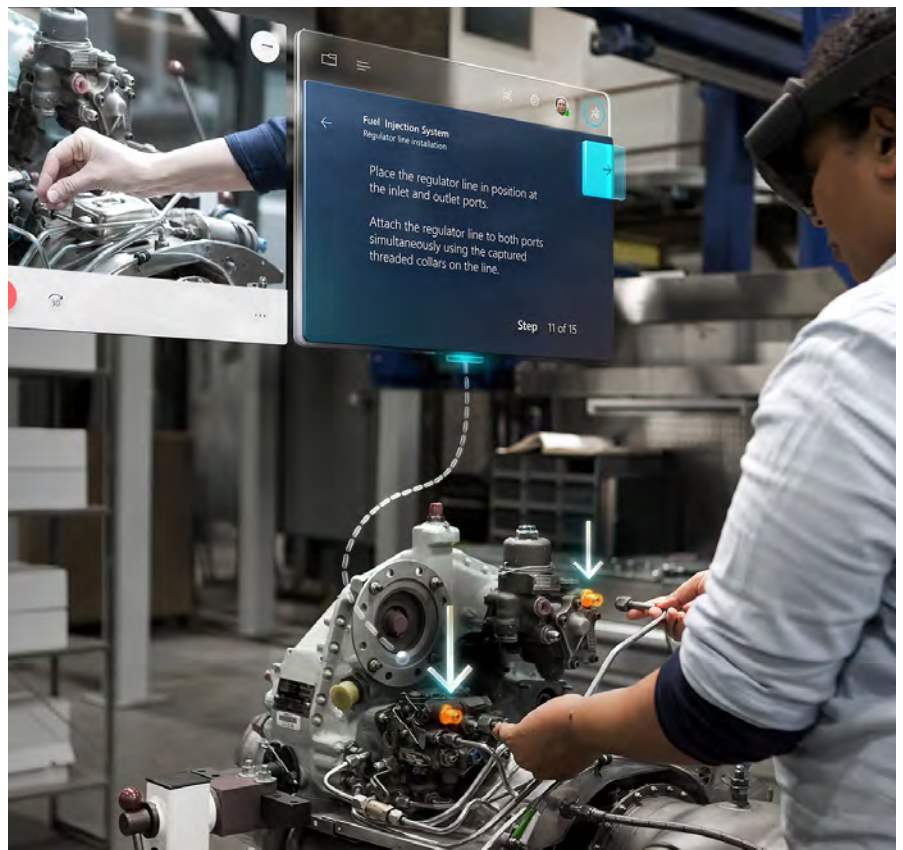
And in a second market review from Yole Développement, the French analyst company is predicting a boom for 3D imaging technologies as time-of-flight devices take off, especially in rear-facing smart phone applications. The annual global market for optical 3D imaging and sensing devices will treble to \$15 billion within five years ([page 16](#)).

Matthew Peach, Editor in Chief.  
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## This Issue

- Display and optical innovations transform AR and VR industries
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- Apple unveils new iPad Pro featuring LiDAR scanner
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- Intevac wins AR goggles order from US Army as night-vision applications grow
- 3D imaging set for rapid growth as time-of-flight devices take off
- Sony Semiconductor Solutions and Microsoft partner to create smart camera solutions for enterprise customers
- microLED display developer Plessey to work with Facebook
- plus the latest product launches from within the industry*



Microsoft's Dynamics 365 Guides for HoloLens 2 – can help employees learn new skills faster with Dynamics 365 Guides for HoloLens devices. See article [page 18](#).

# Display and optical innovations transform AR and VR industries

Analyst Yole Développement says microLED share will reach 30% in AR headsets by 2027.

Augmented reality was and continues to be the dream that consumer electronics companies want to make real to deliver the long-awaited revolution of replacing smart phones," says Dr. Zine Bouhamri, Technology & Market Analyst, Displays at technology market analyst company Yole Développement, based in Lyon, France.

"But as children of the flat panel display industry, we are used to having very high-quality displays all around us."

But without a compelling use case, the consumer will not jump into the game."

Yole analyzes this progress in a recent dedicated display report, titled Displays and optics for AR & VR 2020. In this, Yole offers a comprehensive overview and in-depth understanding of the displays and optics markets associated with these industries. The report analyzes the key challenges related to AR & VR systems and the future

most likely either MEMS or OLED-on-silicon display solutions, it states.

## Paradigm shift needed

However, for the market to really become enabled, a complete technological paradigm shift is required, says the report. In terms of optics, everything revolves around waveguide technologies. For a long time these devices have been improving and their developers were fighting against the typically poor optical efficiency they could deliver.

According to Dr. Bouhamri, "From less than 1% efficiency we can now see results that go an order of magnitude beyond that. So much so that, while uniformity of waveguides still needs to be improved, they meet the minimum requirements for OEMs. We expect a second milestone around 2023 when the big consumer electronics brands come in with a product that meets the consumer requirement trio of performance, cost and form factor."

But for optimum progress one element is still missing at the moment: the display engine. Though efforts are continuing, Yole's analysts have not yet seen a microLED product. MicroLED microdisplays can provide what the other solutions cannot, the right combination of brightness, form factor, color, and contrast. And all the OEMs are waiting for this opportunity to materialize, as Yole anticipates its penetration in AR-VR headsets to reach 30% by 2027.

"The AR market has been mostly a professional-based market, as the performance, cost and form factor trio is hard to balance," says Pierrick Boulay, Technology & Market Analyst, Solid-state Lighting at Yole. "But thanks to all the technological advancements, we can

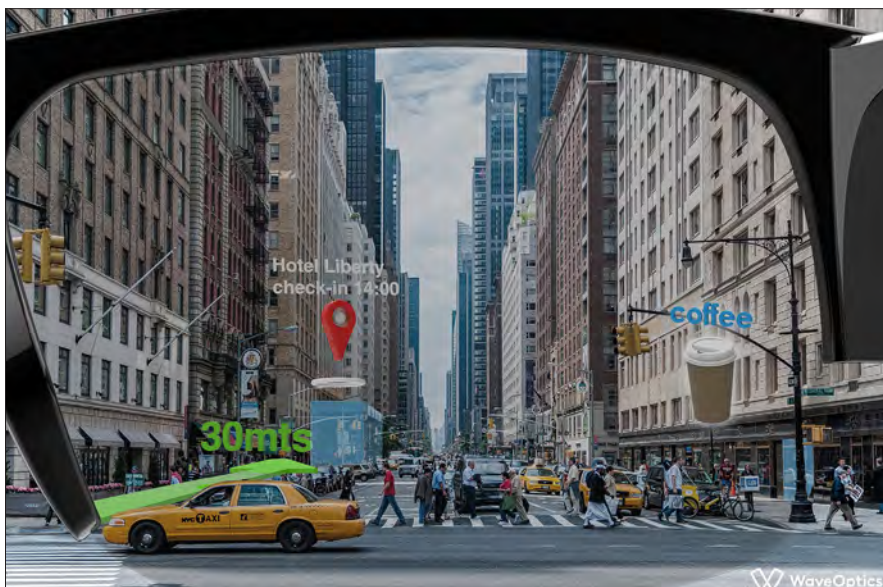


Photo: WaveOptics

Waveguide developer WaveOptics says its latest Katana waveguide thin, light design unlocks the potential for true mass market commercialisation for smart glasses and AR headsets.

This may be a fly in the ointment because the image quality that AR systems have so far been able to provide is not yet at this sophisticated level. Bouhamri continues, "Technology improvements such as waveguide optics and microLEDs are expected to enable an increase in functionalities and use case developments.

trends and evolution of AR & VR market landscapes.

Yole's analysts expect a first generation of headsets to come soon, with a 2021 set to be a milestone of significant volume, according to the report. These headsets will be based on conventional optics with

*continued on next page*

continued from previous page

## Display and optical innovations transform AR and VR industries

expect a rate of growth of 105% through to 2027 in volume for AR headsets. And this promise of a strongly growing market has sparked the interest of many in the supply chain, some still in stealth mode."

### Waveguide improvement

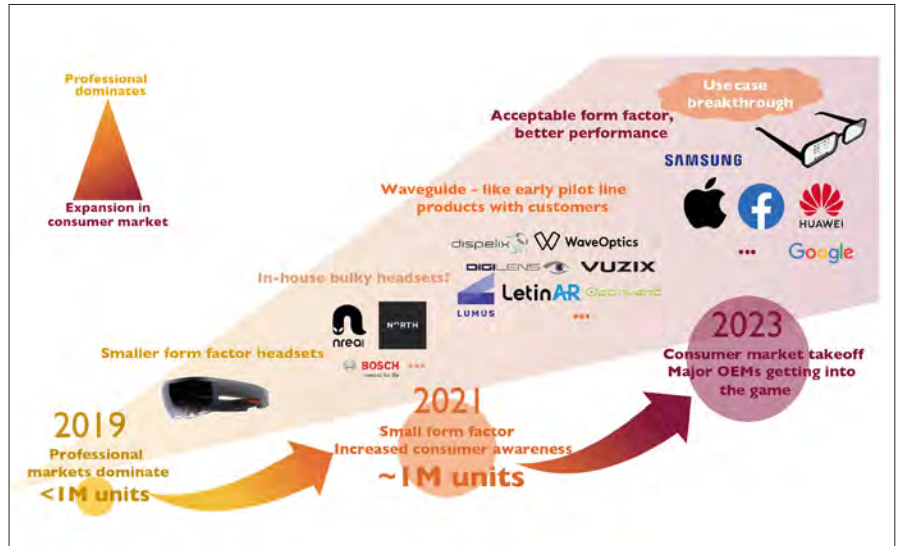
Indeed, waveguides have improved a lot thanks to design efforts but also thanks to the push from equipment makers intensifying their efforts, such as EV Group, Oxford Instruments, and substrate manufacturers. EV Group, based in St. Florian am Inn, Austria, supplies high-volume production equipment and process solutions for the manufacture of semiconductors, MEMS, and nanotechnology devices. Oxford Instruments, Abingdon, UK, develops and manufactures a wide range of high-tech tools and systems for industry and research.

The glass industry has also been working at providing high refractive index wafers to allow for waveguide manufacturing, trying to both push and enable the market. Given the projected wafer numbers and associated revenues, were the consumer market to thrive, it would represent a non-negligible portion of the glass business.

### More than hardware

But for the consumer market to thrive, it is about more than just the hardware and providing a high-quality image in something that looks like a regular pair of glasses. If the end-result simply consists of putting a smart watch screen in front of the eye, this is probably not compelling enough. Much like VR, there is a need for a real disruption in the use case.

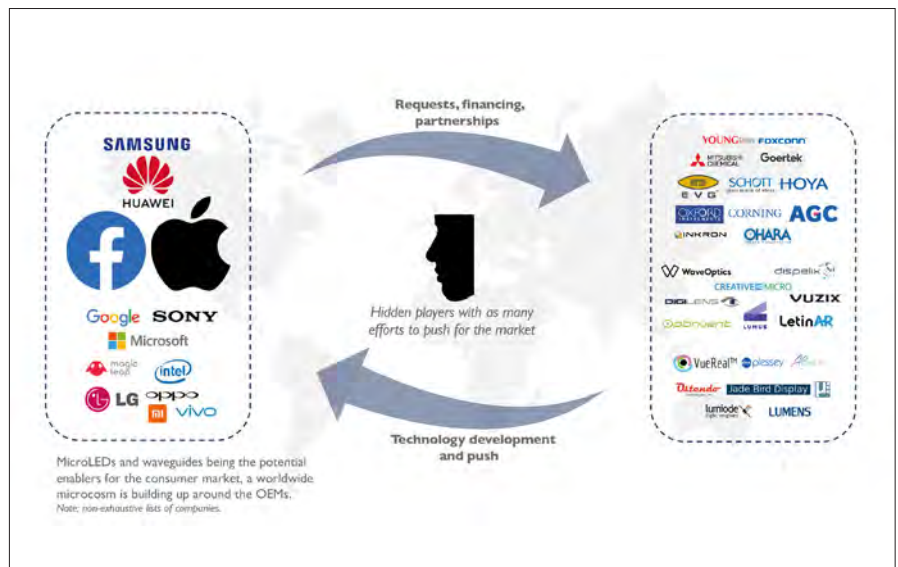
That is why Yole is expecting the OEMs to come in with a proper proposition "to really kick start this market," as Dr. Bouhamri puts it. "As with the history of the smart watch, we think the adoption curve for AR will follow the same path, with the early products maybe not providing compelling performance and use case, until a big gun jumps in."



Augmented reality market trends – Scenario expectations for consumers. Source: Displays and Optics for AR and VR 2020 Report, Yole Développement.

As an example of this, Yole suggests that Apple seems like a good candidate for that role: that company has the microLED effort, the waveguide effort, the application effort with ARKit and also the 3D sensing effort.

they will raise consumer awareness about AR, preparing the user for when everything is ready for a headset. And perhaps that will be seen as soon as 2023."



Augmented reality industry – Origins, players and relationships. Source: Displays and Optics for AR and VR 2020 Report, Yole Développement.

Apple's ARKit is Apple's AR development platform for iOS mobile devices. ARKit allows developers to build high-detail AR experiences for platforms such as the iPad and iPhone. Environments captured through the device can have animated 3D virtual text, objects and characters added to them. "ARKit 3.5 uses the new LiDAR Scanner and depth-sensing system on the latest iPad Pro to make AR experiences more realistic than ever before," says Apple.

Yole's analysis continues, "As such developers progressively integrate some of these technologies in their newer products,

Throughout the year, Yole Développement, publishes numerous displays and optics-related reports. The latest news coming from these industries and an overview of Yole and its clients' activities, including interviews with leading companies, analyses from its experts and dedicated online and onsite events is available on i-Micronews.

Links: [yole.fr](http://yole.fr) and [i-micronews.com](http://i-micronews.com)

Matthew Peach Editor in Chief, optics.org

# Compound Photonics announces 1080p optical engine for smart glasses

**Wide field-of-view reference design boosts brightness from smaller form factor for ARVR applications.**

Compound Photonics (CP), a developer of compact high-res microdisplay solutions for AR-MR applications, has launched a compact, high-brightness optical engine design that fits into a volume under 3cm<sup>3</sup>. The company is

scheduling demos for this engine and the design will become available for license.

It enables system designers to develop AR/MR smart glasses that deliver what the company calls “naturalistic visual

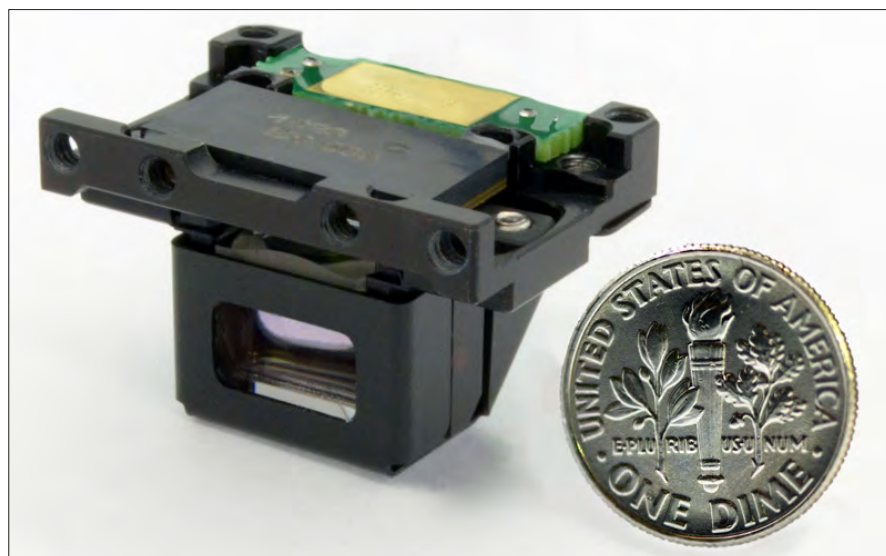


Image: Compound Photonics.

*ARMR focus: the new optical engine for smart glasses.*

experiences” in more ergonomic form factors approaching regular consumer eyewear. The design is optimized for CP’s 0.26in diagonal, 1920 x 1080 resolution, 3.015  $\mu\text{m}$  pixel, Integrated Display Module package.

The company claims that its prototype demonstration units, shown above, have shown up to double the brightness of other engine designs when projected into the new generation of 50°-plus wide field of view (WFOV) waveguides.

“Since size of the display drives the overall optical engine volume, this engine can be

up to 2x smaller than those built around similar resolution displays at larger pixel sizes,” commented Edmund Passon, Co-CEO at CP.

Compound Photonics (CP), also known as CP Display, is a leading provider of compact high resolution microdisplay technologies. CP’s microdisplay solutions are optimized to serve the augmented reality and mixed reality markets where high performance, small form factor, and low power consumption are most critical. Compound Photonics’ microdisplays enable engineers to innovate and create

cutting edge consumer and industrial products.

“The combination of CP’s high-reflectance LCoS display operating at above 90% duty cycle,” he added. “A new optical architecture delivers brightness improvement over previous designs to reduce power consumption while illuminating a larger field of view and eyebox along with the improved image quality needed to take advantage of the new WFOV waveguides.”

## Display subsystem

CP’s IDM package (7.25 x 15.5 x 3.4 mm) is a complete display subsystem (including driver ASIC and passive components) with MIPI input that can be flexibly configured for a wide range of integration needs. It also incorporates CP’s Nova display driver architecture for customizable refresh rate up to 240 Hz, and other parameters to optimize for low latency, short persistence and low power demand.

Andrew Shih, Compound Photonics’ Marketing and Business Development Manager, said, “With the release of our reference design, system integrators, ODMs, and OEMs will have a validated high-performance subsystem to simplify integration of microdisplay, optical engine and waveguide combinations into consumer AR glasses. This will reduce the development effort and accelerate time-to-market.”

CP develops high-res microdisplay technologies that are optimized to serve the augmented reality and mixed reality markets where high performance, small form factor, and low power consumption are most critical. Its microdisplays enable engineers to innovate and create consumer and industrial products.

*Matthew Peach Editor in Chief, optics.org*  
<https://optics.org/news/11/4/30>

## Photonics Europe Digital Forum: Schott ready to ramp higher-index glass for AR

Glass and optics giant's 'RealView 1.9' material for augmented reality (AR) waveguides broadens field of view in consumer devices.

Schott, the Germany-headquartered manufacturer of glass optics, says it is ready to mass produce its latest high-index material - designed to improve the augmented reality (AR) experience in consumer devices.

Presenting the latest advances in a virtual format for the SPIE Photonics Europe Digital Forum, which took place online in April as a replacement for the "live" event in Strasbourg, Schott's product manager for AR, Berthold Lange, said that Schott was now able to produce 1.9-index glass on 300 mm-diameter wafers.

Known as "RealView 1.9", the large format means that 25 individual waveguides - each measuring 50 mm by 36 mm - can now be produced on a single wafer, pushing economies of scale to a new level. The figure compares with ten waveguides per 200 mm wafer, and just four on 150 mm-diameter material.

### Transmission trade-off

The higher-index material is needed to broaden the field of view of AR glasses and headsets, but comes with a trade-off of lower light transmission, particularly at shorter wavelengths.

"Just increasing the refractive index of the glass is not the simple solution," noted Lange in his presentation. "Challenges like transmission, especially at short wavelengths, melting dimensions, and mechanical properties [of the glass] have to be resolved."

Those challenges led to the company's collaboration with waveguide specialist WaveOptics, wafer production equipment firm EV Group (EVG), and polymer developer Inkron. That effort has now resulted in the availability of the high-index material and waveguides that can be produced at the kind of volume required to meet consumer pricing targets.

Delving into the technical requirements for the waveguides, Lange explained how the

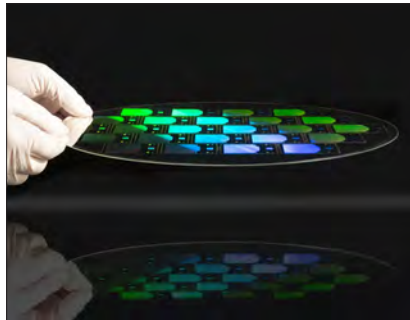


Photo: Schott.

Schott has been working with WaveOptics, EV Group, and Inkron to develop the large-format, high-index glass material required to improve the performance of consumer AR devices at reasonable costs. The 'RealView 1.9' wafers feature a nanostructured polymer from Inkron, and are produced on a 300 mm wafer-processing platform developed by EV Group for mass production.

total internal reflection angle was a critical factor that limits the ultimate field of view of the AR display.

### Field of view

With the latest approach, first revealed by Schott earlier this year at SPIE's Photonics West event, consumer-level AR designs are able to offer a field of view of 65°.

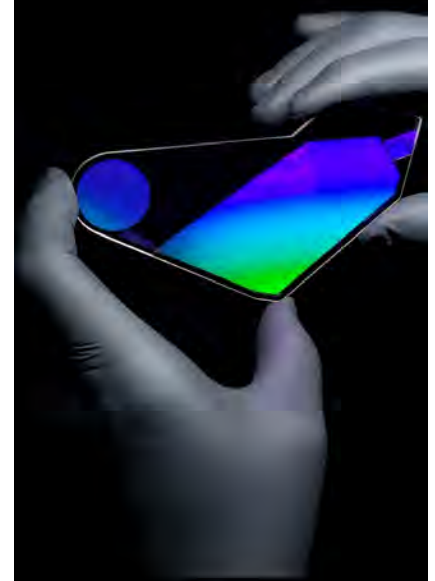
That followed fabrication of an initial demonstrator at EVG's nanoimprint lithography development center, using the Austrian firm's proprietary wafer processing equipment for 300 mm-diameter material.

Inkron's high refractive index resin is then combined with the "RealView" substrate material, providing the foundation for WaveOptics' waveguide design - said to offer the widest range of fields of view, combined with a very large eye-box onto which images can be overlaid, and delivering vibrant colors alongside high contrast.

Back in February, UK-based WaveOptics won a Photonics Prism Award for its development of those waveguides.

Mike Hatcher, Business Editor, optics.org  
<https://optics.org/news/11/4/10>

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# ASML using augmented reality to support lithography customers

**Semiconductor equipment giant says it has come up with creative solutions to the challenges of Covid-19, while prioritizing safety.**

ASML, the Netherlands-based company that dominates the market for advanced semiconductor lithography systems, has suggested that its sales revenues could jump by around 50 per cent in the first quarter of 2020.

Executives at the Veldhoven-headquartered firm confirmed that sales in the opening quarter of 2020 dropped to €2.44 billion, well below its earlier expectations of around €3.2 billion.

That shortfall, caused by a variety of factors - including local impact of the initial Covid-19 outbreak in Wuhan, China, and knock-on effects that hit ASML's complex supply chain - is still expected to be recouped in the second and third quarters of this year.

However, that will also depend on how governments around the world implement local restrictions on movement to mitigate the coronavirus crisis. So although ASML's executives are confident that demand for its lithography systems remains solid, they declined to issue any formal financial guidance for the current quarter, or the rest of this year.

"At this stage the demand actually looks really good," said CFO Roger Dassen. "If you look at our order intake for the [first] quarter, it has been really good, €3.1 billion including 11 EUV (extreme ultraviolet) purchase orders. We have had no push-outs or cancellations in the year."

## Creative solutions

Addressing an investor conference call remotely, Dassen and company CEO Peter Wennink reiterated their twin priorities - firstly the safety of the company's employees and their families, and secondly servicing customers and maintaining the supply of lithography equipment.

On the first of those, ASML has the benefit of utilizing some of the cleanest industrial spaces anywhere in the world, and has added

protocols such as isolation between shift changes.

And although restrictions on movement and staff absenteeism have inevitably had an impact, ASML's engineers have found some creative ways to support customers and installations, Wennink said.

Those have included the use of augmented reality (AR) headsets to provide remote engineering support from thousands of kilometers away. "It works," said the CEO, although he also pointed out that a small number of ASML engineers were still able to travel internationally to customer sites, thanks to special visas combined with the observation of local quarantining protocols for visitors.

"Despite the challenging circumstances, to date we have been able to continue ASML's operations," he added, paying tribute to the flexibility and creativity of the company's workforce. "Our order intake is strong. Many of the investments made by our customers are strategic and support their long-term plans."

Asked whether he anticipated a steep decline in demand for lithography tools following the inevitable recessionary impact of the health crisis on future consumer demand, Wennink replied that the company was "not planning for an Armageddon scenario", and that while the current situation was unprecedented, ASML's customers had largely kept their chip fabs operating normally.

As a result, the company still expects to ship 35 EUV tools to customers this year - no change on the plan prior to the Covid-19 outbreak.

## Cash preservation

Nevertheless, the company is taking measures to preserve cash - partly to help support suppliers that may be more seriously impacted by the crisis. Those measures include restrictions on operational and



Photo: ASML

*Using augmented reality headsets, ASML engineers in Veldhoven have been able to assist the company's customers around the world.*

capital spending, a pause in share buy-back plans, and a limited expansion of the ASML workforce this year.

However, a normal shareholder dividend is still expected, while both Dassen and Wennink stressed that they intend to continue with the development of future high-numerical aperture (high-NA) optics to further shrink the patterning capability of EUV systems.

"The [high-NA] accelerator is pushed down and will continue to be pushed down because we think it is critical that also coming out of the current situation, that we are able to provide our customers with the greatest technology and the latest and greatest tools that they will need in order to then cater to the demand that in that recovery situation will come up," Dassen said. The CFO also pointed to the recent SPIE Advanced Lithography conference as evidence of the continued push to further develop the technology.

- Although ASML's stock price slipped back a little following the latest financial update, the company's valuation has largely recovered from the wider rout of stock markets witnessed last month.

Trading at around \$278 on the Nasdaq on April 15, ASML's stock was down from the all-time high of nearly \$320 reached in February - but up strongly from the low of \$186 in mid-March.

*Mike Hatcher, Business Editor, optics.org  
<https://optics.org/news/11/4/24>*



# Report from the VR/AR Global Summit ONLINE Conference+Expo



The VR/AR Global Summit Online is the largest and fastest growing immersive tech event in the world! The online conference & virtual expo is brought to you by the VR/AR Association, connecting the best virtual reality and augmented reality solution providers with enterprise and media entertainment companies.

On June 1-3, almost 12,000 attended live, 250+ Speakers, Exhibitors, plus 1000s interactive 1-on-1s, 30 networking sessions, across three time zones... resulting in the ultimate global event. Sponsors included Lenovo, HP, Pico, AARP, PACE - a TXT Company, Calgary Economic Development, and others!

*"The VR/AR Global Summit is one of the year's most anticipated conferences. It attracts a broad, international cross-section of thought leaders, enterprise executives, entertainment companies, and developers for an intense two days of panels, demos and networking."*

**Charlie Fink, Forbes**

**5. AR & the Rise of the Digital Human**, was about AR, Deep Fakes, Avatars & AI – and how they might impact on us as a society; psychological, moral and the future of work.

*Note: Most talks will be uploaded on VRARA YouTube Channel by next week.*

## Highest rated sessions:

- **Daily Networking (Speed Dating)**, the online event platform enabled 1-on-1 video chat where executives got 3 minutes to network with other executive!
- **Future-proofing your Training Pilot Project**, explored what happens when your pilot goes well and the choices you can make so that your pilot can have a large impact on if it moves to the next stage or if the pilot is a one-and-done.
- **Collaboration Tools: Developing Virtual Creativity in the Age of Social Distancing**, touched on the many possibilities of online VR platforms and left people inspired!
- **The Experience Economy: New Mediums** included a group of industry veterans from the immersive space for a discussion on content creation with existing and new IP and how this translates into these new and evolving mediums.
- **LBE - Moving from Entertainment to Experience**, talked about how the LBE industry can move from location based entertainment to add other offerings such as education, training, health care and team building activities.



VR/AR Global Summit ONLINE Conference+Expo, 16-18 September 2020

## The next Online Summit is Sept 16-18.

**Apply now** to let the organizers know how you want to participate (Speak, Exhibit, Sponsor).

Highlights include the following talks, panels, sessions, virtual expo:

### Top talks:

**1. Remote Collaboration & Virtual Conferences, The End of Distance, and The Future of Work**, based on a tour of 150 sites offering a diversity of collaboration and conferencing tools available today, analyzed what's working, and attendees gained insight into what's needed. VR/AR is a big part of this story.

**2. How AR Experiences Will Save Retail**, was about how Retail is changing and how AR is playing a critical role in its evolution. VRARA Member 8th Wall outlined five ways AR is bringing experience to the forefront in retail today and how this will impact the retail industry.

**3. Futurist Panel** had four futurists explore the wild and imaginative side of immersive technologies and their impact on our cultures, behaviours and interactions.

**4. Investing in VR & AR - A Look at the Current Market**, was a look at the current state of the industry and where we are at in investment.

# Apple unveils new iPad Pro featuring LiDAR scanner

**“Pro” cameras, LiDAR, motion sensors and its Liquid Retina display suit the iPad Pro to augmented reality applications.**

Apple has released its latest iPad Pro, which it describes as its “most advanced” iPad. The company stated at its March 18th launch, “With the A12Z Bionic chip, the iPad Pro is faster and more powerful than most Windows PC laptops.”

The new iPad adds an ultra wide camera, studio-quality mics and a LiDAR scanner, described as “breakthrough”, that delivers depth-sensing capabilities, opening up

formers The Verge and Wired suggest that the addition of LiDAR functionality to an iPad may not lead to much extra LiDAR usage on its own, but they speculate that it might be in preparation for Apple releasing a corresponding AR headset or smart glasses: Apple rumored to be working on a proper augmented reality headset or glasses; and Apple put a lidar scanner in a tablet to prepare for when it puts one in a pair of AR glasses, respectively.



Now available: The most advanced iPad Pro ever and new Magic Keyboard coming in May 2020.

more pro workflows and supporting professional standard photo and video apps, states the tech giant.

The LiDAR Scanner, along with the device’s “pro” cameras, motion sensors and audio, and the Liquid Retina display suit the iPad Pro to augmented reality-supporting applications, the company adds.

Phil Schiller, Apple’s senior VP Worldwide Marketing commented, “The new iPad Pro introduces advanced technologies never before available in mobile computing. Combining the most advanced mobile display with the breakthrough LiDAR Scanner and new Magic Keyboard with Trackpad, this is another huge leap forward for iPad.”

Notable high-tech consumer sector opinion

## Display and camera

The new iPad’s edge-to-edge Liquid Retina display — available in both 11in and 12.9in sizes — is described by Apple as “the world’s most advanced mobile display. Featuring P3 wide color support, it lets customers see photos, videos, apps and games in vivid, true-to-life detail. ProMotion technology automatically adjusts the refresh rate up to 120 Hz for ultra-smooth scrolling and responsiveness.”

The camera system on the iPad Pro features a 12MP wide camera for capturing photos and 4K video, and a 10MP ultra wide camera that zooms out two times to capture a wider field of view. The company explains that adding the second camera “doubles

the photo and video possibilities, enabling different perspectives and multi-camera use.”

## LiDAR scanner

The LiDAR Scanner enables capabilities not previously possible on any mobile device, say the developers: “the LiDAR Scanner measures the distance to surrounding objects up to 5 meters away, works both indoors and outdoors.”

“New depth frameworks in the new iPadOS [operating system] combine depth points



Image: Apple.

iPad Pro: Two cameras, one LiDAR. LiDAR (Light Detection and Ranging) is used to determine distance by measuring how long it takes light to reach an object and reflect back. The custom-designed LiDAR Scanner uses direct time of flight to measure reflected light from up to 5m away.

measured by the LiDAR scanner, data from both cameras and motion sensors, and is enhanced by computer vision algorithms on the A12Z Bionic management chip for a more detailed understanding of a scene. The tight integration of these elements enables a whole new class of AR experiences on iPad Pro.”

The specification continues, “Every existing ARKit app automatically gets instant AR placement, improved motion capture and people occlusion. Using the latest update to ARKit with a new Scene Geometry API, developers can harness the power of the new LiDAR Scanner to unleash scenarios never before possible.

“The LiDAR Scanner improves the Measure app, making it faster and easier to automatically calculate someone’s height, while helpful vertical and edge guides automatically appear to let users more quickly and accurately measure objects.”

Matthew Peach Editor in Chief, optics.org  
<https://optics.org/news/11/1/132>

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# Lumentum predicts further growth in 3D sensing

**Quarterly revenue rise driven by telecoms but company expects to take a hit from coronavirus disruption.**

Lumentum reported improved results for the second quarter of fiscal 2020, although the effects of the coronavirus outbreak in Asia are expected to negatively impact revenues in its fiscal Q3.

Net GAAP revenue for Q2 was \$457.8 million, up slightly from \$449.9 million in the preceding quarter and also up from \$373.7 million for the equivalent quarter of fiscal 2019.

"The themes of the prior quarter - strong customer demand, an improving financial model due to increasing levels of new and innovative products and increasing scale and acquisition synergies - drove new record revenue, gross margin and operating margin in the second quarter," said Alan Lowe, President and CEO.

"Adding to these themes in calendar year 2020, we are seeing telecom transport demand strengthening, and we expect a strong expansion of the market for world-facing 3D sensing lasers."

The largest driver of sequential and year-over-year growth was telecom and datacom products, while quarterly revenue from the company's lasers business was \$48.4 million, almost unchanged from one year ago and up from \$33.8 million in Q1. Lumentum commented that it had now repaid in full the term loan that it took on in connection with the acquisition of Oclaro in 2018.

Speaking to analysts, Lowe confirmed that Lumentum foresees growth for 3D sensing lasers in smartphones for biometric security purposes, with similar technology likely to make its way into other sectors too.

"We expect 3D sensing to be incorporated in more consumer products in both user and world-facing applications, including computational photography

sensing lasers. Huawei's involvement in the UK's forthcoming 5G telecoms network is a further topic of current political discussion.

"Given our footprint in the customer base we are largely agnostic to which of our customers wins business," commented



Lumentum's micro-machining platform is used in OLED display processing and 5G antenna manufacture.

and augmented and virtual reality," he said. "Our R&D teams are working with a broad range of customers on their future generations of 3D sensing needs, including new products coming later this year and next, as well as for products several years away. We are well-positioned to grow in this market."

## Coronavirus affecting quarterly guidance

Lowe also highlighted Lumentum's PicoBlade 3 ultrafast laser for micro-machining applications, addressing OLED display processing, 5G antenna fabrication, and advanced via hole drilling and printed circuit boards. "These applications are all expected to see significant market growth in the coming years," he commented.

Events in China were a constant topic of the conversation with analysts, however. In May 2019 Lumentum halted shipments to Huawei Technologies, one of the first American companies to align with export restrictions imposed by the US government, although as Lowe noted Huawei are a major smartphone supplier and therefore a major customer for 3D

Christopher Coldren, Lumentum SVP. "If Huawei is restricted to a more limited portion of the UK network, we don't believe this is a significant change for us. In terms of understanding what the US government is going to do, I don't think we have any more insight that what you can read in the general news."

The ongoing coronavirus outbreak across the Asia region will have a more immediate impact on the company, Lowe confirmed. The company currently employs around 1000 people in China, in addition to maintaining a manufacturing facility in Thailand.

"Our guidance for the coming Q3 incorporates a \$15 million to \$20 million reduction in revenue at the midpoint due to the anticipated impacts of the coronavirus outbreak," said CFO Wajid Ali. "The coronavirus situation is fluid and evolving."

Shares in Lumentum rose by 11 percent immediately after the earnings announcement in February.

Tim Hayes, Contributing Editor, optics.org  
<https://optics.org/news/11/1/51>



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# Intevac wins AR goggles order from US Army as night-vision applications grow

Photonics division of the Californian company says latest gear will feature new active-pixel sensor providing digital night vision.

Intevac Photonics says it has won another \$8.1 million contract to provide a new generation of augmented reality (AR) night-vision goggles for the US Army.

The Santa Clara-based firm will develop the "Delta 1" goggles over the course of two years. They are set to be used by special operations forces from the US, UK, Canada, and Australia.

In a statement Timothy Justyn, executive vice president and general manager at Intevac Photonics, pointed out that the AR-enhanced goggle system would be the first to feature the company's latest generation of sensors.

He added: "This award continues to demonstrate Intevac's commitment to delivering the latest digital night vision technology to our warfighters."

## Active pixels

That new technology is the firm's latest electron-bombarded active pixel sensor (EBAPS). Based around a compound semiconductor photocathode and a silicon CMOS anode, EBAPS is designed to provide night vision in extremely low-light conditions.

"The electrons emitted by the [III-V] photocathode are directly injected in the electron-bombarded mode into the CMOS anode, where the electrons are collected, amplified and read out to produce digital video directly out of the sensor," Intevac explains on its web site.

The result is state-of-the-art digital night vision in a compact, lightweight, low-power and low-cost package that

eliminates the more complex and bulky designs more typically associated with image intensifier assemblies.

EBAPS works across the visible spectrum and out to around 1.7  $\mu\text{m}$  in the near-infrared.

In addition to the US Army contract, Intevac Photonics has landed a \$3 million order from giant defense contractor Northrop Grumman for its "M506 LIVAR" cameras - based on a slightly different version of the EBAPS technology.

Short for laser illuminated viewing and ranging, the LIVAR is described as a compact imager that enables system integration with an eye-safe laser illuminator to range and view images of targets at distances of up to 20 kilometers.

"The system works day or night, regardless of available light," states the company. "The illuminator is an eye safe laser and the reflected light is displayed as a digital video image. This enables real time, high-resolution imagery for target identification at much longer ranges than was previously possible."

## Growth market

Parent company Intevac, which comprises the photonics business unit and another focused on thin-film equipment for making displays and hard-disk drives, told an investor forum earlier this week that broader uptake of night-vision technology by the US military and its allies should provide a significant boost to its sales over the next few years.

Its investor presentation indicated that total company revenues should tick up to around \$108 million for 2019 - of which approximately one-third will relate to sales from the Intevac Photonics business unit.

Company managers are hopeful of increasing that total annual turnover figure to \$250 million in the medium term, with the photonics division's contribution growing to around \$100 million on the back of the opportunities in night-vision technology.

Mike Hatcher, Business Editor, *optics.org*  
<https://optics.org/news/11/1/24>



Image: Intevac.

Based on the combination of III-V and silicon semiconductor components, the digital night vision goggles from Intevac Photonics provide state-of-the-art awareness in low-light conditions. The company is expecting military applications to provide a significant boost to sales revenues over the next few years.

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# 3D imaging set for rapid growth as time-of-flight devices take off

**French analyst company Yole Développement predicts boom as ToF modules are adopted in rear-facing smart phone applications.**

The annual global market for optical 3D imaging and sensing devices will treble to \$15 billion within five years, according to the latest prediction from French analyst firm Yole Développement.

The Lyon-headquartered industry commentators reckon that following Apple's adoption of the technology for front-facing facial security in its recent

Industrial, medical, and defense applications will also push market growth - though at a much slower rate, thinks the Yole team.

## Switch to ToF

"With the introduction of the iPhone X in September 2017, Apple set the technology and use-case standard for 3D sensing in the consumer space," states Yole. "Two years

Liu explained. "ToF sensors have now improved a lot thanks to the BSI [back-side illumination] technique. They have also gained a cost advantage within a maturing ecosystem. This is the main reason why ToF has won the favor of Android phone makers."

According to Yole's updated 3D imaging & sensing report, that key trend will see rear-facing modules surpass front-facing applications in the coming years. Liu and colleagues suggest that by 2025 about 70 per cent of new smart phones will feature a 3D sensor of some kind - with the share of rear-facing units approximately double that of front-facing sensors.

"The most important component in this application, lidar, is now focused on by a large number of suppliers," Liu added. "There are a wide range of lidar technologies to choose from, making the field as a very competitive one."

## Key relationships

In its market report, Yole details some of the main supplier relationships that have sprung up in the fast-growing sector.

For example, it says that ToF receivers from key provider Sony feature in high-specification phones from Oppo, Samsung, and Huawei. However, the VCSEL components inside those Sony receivers are provided by a variety of photonic device manufacturers.

The Oppo R17 Pro, released in 2018, is based around Lumentum emitters, while Samsung's Galaxy Note 10+ features Trumpf subsidiary Philips Photonics, and Huawei's new Mate30 Pro uses VCSELs from fellow Chinese company Vertilite.

Another key VCSEL provider, the Austrian sensor maker ams, is designed into smart phones from Vivo and LG, alongside ToF receivers from Panasonic and Infineon Technologies respectively.

The Yole team cites a recent tear-down of Huawei's P30 Pro smart phone by analysts at System Plus. It is said to use VCSELs

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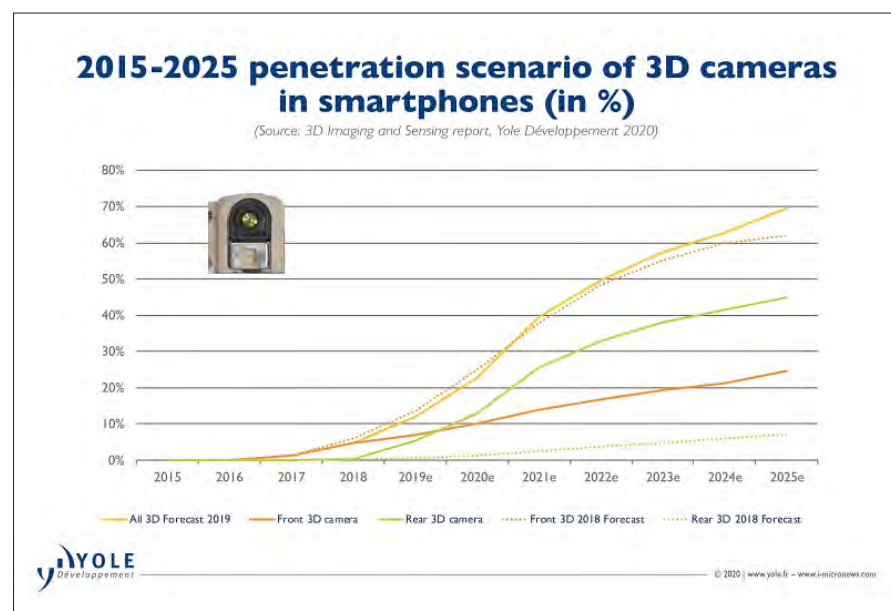


Image: Yole Développement.

Yole's analyst team predicts a broad shift towards ToF sensors being used in rear-facing phone applications - a complete change from the initial use of front-facing structured light technology in Apple's more recent iPhone launches.

iPhones, a broad-based switch to rear-facing applications in Android smart phones will propel a sustained 20 per cent annual growth rate through 2025.

It means that the market for 3D sensing devices in phones and consumer devices should grow from the current level of \$2 billion to \$8 billion in 2025, while the figure for automotive is set to jump from less than \$1 billion to \$3.7 billion over the same period.

later, Android phone makers have taken a different approach, using time-of-flight (ToF) cameras instead of structured light, and are placing them on the rear of the phone."

That distinction has certain advantages, points out Yole's Shenzhen-based analyst Richard Liu.

"Compared [with] structured light, ToF modules only need a VCSEL and a diffuser on the emitter, which is less complex,"



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### 3D imaging set for rapid growth as time-of-flight devices take off

from Lumentum, and to feature a Sony ToF sensor based on BSI with 10 µm size pixels and a resolution of 47 kilopixels.

#### Phones and beyond

In terms of applications, the Yole team stresses that ToF sensors remain in their infancy right now, but suggests they are primed to proliferate both inside phones and beyond.

"3D rear sensing in mobile [phones] should diversify its application use cases," stated the firm. "First used for photography, to enhance bokeh [i.e. soft-focus background] and zoom capabilities, it will expand into augmented reality and gaming.

"Beyond smart phones, ToF camera modules have a broad application market in front of them, including intelligent driving, robots, smart homes, smart TVs, smart security, and VR/AR."

Yole goes on to detail how the growing adoption of ToF technology and the US-China trade impasse have impacted the emerging supply chain for light-based 3D sensors.

"The mobile 3D sensing supply chain is changing rapidly," reports Yole's principal analyst for imaging, Pierre Cambou. "As structured light technology was introduced in iPhones in 2017, companies like Lumentum, ams, and STMicroelectronics won this first round."

Cambou adds that Princeton Optronics (now part of ams) and Finisar were then able to penetrate the market, quickly making it a more competitive space.

Among the key consolidatory moves since then have been last year's acquisition of Finisar by II-VI, Philips Photonics becoming part of Trumpf, and ams' ongoing attempt to buy Osram.

#### Supply chain development

Cambou reports that Trumpf and ams are both actively moving into the Android camp's 3D camera supply chain, providing VCSELs to Samsung and Huawei respectively.

Meanwhile in China, Vertilite has been able to enter the fray, taking advantage of the fact that the VCSEL output beam of the flood emitter used in ToF sensors requires no coding - and is therefore easier to produce.

"This move was also driven by the policy of China cultivating local supply chains in the middle of the US-China trade conflict," points out Yole.

Sony's key move was to acquire Belgium-based SoftKinetic back in 2015. "This move brought Sony from a zero market share position in 3D sensing receiver chips to 45 per cent by the time ToF camera modules took off in 2019," reckon Cambou and colleagues.

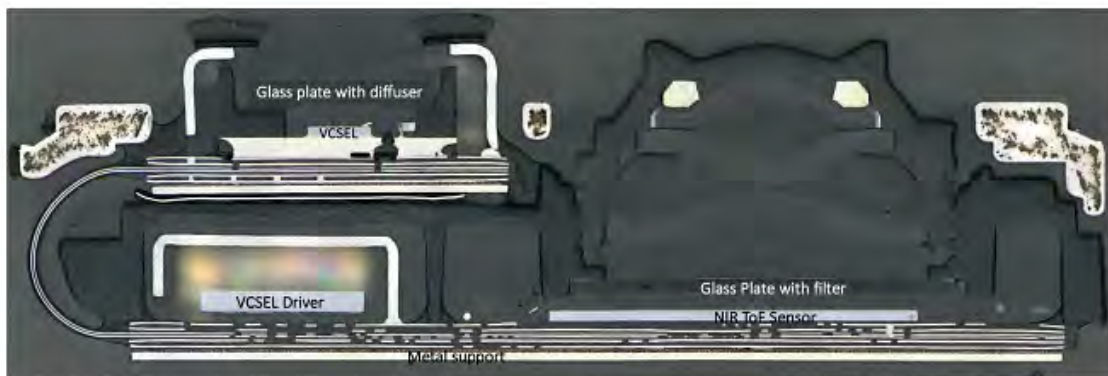
However, they also expect Samsung and STMicroelectronics to challenge Sony with their own new ToF array sensors this year - an early example of which is the Note 10+ incorporating VCSELs from Philips Photonics.

Links: [yole.fr](http://yole.fr) and [i-micronews.com](http://i-micronews.com)

Mike Hatcher, Business Editor, [optics.org](http://optics.org)  
<https://optics.org/news/11/1/72>

## Sony's 3D Time of Flight sensing solution in Samsung Galaxy Note 10+

(Source: Sony's 3D Time-of-Flight Sensing Solution in the Huawei P30 pro, System Plus Consulting 2020)



Optical picture of cross section of rear 3D sensing module with Sony's 2nd Generation CIS & Trumpf's flood illuminator



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Photo: System Plus/Yole

This tear-down of Samsung's Galaxy Note 10+ smart phone by France-based System Plus revealed a ToF sensor from Sony and VCSELs provided by Trumpf subsidiary Philips Photonics.

# Sony Semiconductor Solutions and Microsoft partner to create smart camera solutions for enterprise customers

Companies collaborate to make video analytics solutions more accessible in order to drive better business outcomes.

Sony Semiconductor Solutions (Sony) and Microsoft Corp. (Microsoft) are partnering to create solutions that make AI-powered smart cameras and video analytics easier to access and deploy for their mutual customers.

challenges in various industries," said Terushi Shimizu, Representative Director and President, Sony Semiconductor Solutions Corporation.

"Video analytics and smart cameras can



Photo: Microsoft

Microsoft's Dynamics 365 Guides for HoloLens 2 – can help employees learn new skills faster with Dynamics 365 Guides for HoloLens devices.

As a result of the partnership, the companies will embed Microsoft Azure AI capabilities on Sony's intelligent vision sensor IMX500, which extracts useful information out of images in smart cameras and other devices. Sony will also create a smart camera managed app powered by Azure IoT and Cognitive Services that complements the IMX500 sensor and expands the range and capability of video analytics opportunities for enterprise customers.

The combination of these two solutions will bring together Sony's cutting-edge imaging and sensing technologies, including the unique functionality of high-speed edge AI processing, with Microsoft's cloud expertise and AI platform to uncover new video analytics opportunities for customers and partners across a variety of industries.

"By linking Sony's innovative imaging and sensing technology with Microsoft's excellent cloud AI services, we will deliver a powerful and convenient platform to the smart camera market. Through this platform, we hope to support the creativity of our partners and contribute to overcoming

drive better business insights and outcomes across a wide range of scenarios for businesses," said Takeshi Numoto, corporate vice president and commercial chief marketing officer at Microsoft. "Through this partnership, we're combining Microsoft's expertise in providing trusted, enterprise-grade AI and analytics solutions with Sony's established leadership in the imaging sensors market to help uncover new opportunities for our mutual customers and partners."

Video analytics has emerged as a way for enterprise customers across industries to uncover new revenue opportunities, streamline operations and solve challenges. For example, retailers can use smart cameras to detect when to refill products on a shelf or to better understand the optimal number of available open checkout counters according to the queue length.

Additionally, a manufacturer might use a smart camera to identify hazards on its manufacturing floor in real time before injuries occur. Traditionally, however, such applications — which rely on gathering

data distributed among many smart cameras across different sites like stores, warehouses and distribution centers — struggle to optimize the allocation of compute resources, resulting in cost or power consumption increases.

To address these challenges, Sony and Microsoft will partner to simplify access to computer vision solutions by embedding Azure AI technology from Microsoft into Sony's intelligent vision sensor IMX500 as well as enabling partners to embed their own AI models. This integration will result in smarter, more advanced cameras for use in enterprise scenarios as well as a more efficient allocation of resources between the edge and the cloud to drive cost and power consumption efficiencies.

## Independent software vendors

Sony's smart camera managed app powered by Azure is targeted toward independent software vendors (ISVs) specializing in computer vision and video analytics solutions, as well as smart camera original equipment manufacturers (OEMs) aspiring to add value to their hardware offerings. The app will complement the IMX500 sensor and will serve as the foundation on which ISVs and OEMs can train AI models to create their own customer- and industry-specific video analytics and computer vision solutions that address enterprise customer demands.

The app will simplify key workflows and take reasonable security measures designed to protect data privacy and security, allowing ISVs to spend less time on routine, low-value integration and provisioning work and more time on creating unique solutions to meet customers' demands. It will also enable enterprise customers to more easily find, train and deploy AI models for video analytics scenarios.

As part of the partnership, Microsoft and Sony will also work together to facilitate hands-on co-innovation with partners and enterprise customers in the areas of computer vision and video analytics as part of Microsoft's AI & IoT Insider Labs program. Microsoft's AI & IoT Insider Labs offer access and facilities to build, develop, prototype and test customer solutions, working in partnership with Microsoft experts and other solution providers like Sony. The companies will begin working with select customers within these co-innovation centers later this year.

Matthew Peach Editor in Chief, optics.org

# microLED display developer Plessey to work with Facebook

Objective is to help Facebook prototype new optical technologies for applications in AR/VR space.

UK-based embedded technologies company Plessey, which develops microLED technology for augmented and mixed reality display applications, is to work with Facebook to help achieve the social media company's vision of the next-gen interactive computing platform.

Under the new commercial agreement, Plessey's LED manufacturing operations will be dedicated to helping Facebook prototype and develop new technologies for potential use in the AR/VR space.

With consumer devices like Oculus Quest and what the company calls "a continued legacy of breakthrough research", Facebook considers itself to be one of the companies best-positioned to make consumer-ready AR glasses a reality.

## Future vision

Plessey's announcement stated, "We share that vision for a future where technology and the barriers between people disappear. Over the past two years, Plessey has been making the pivot from our legacy semiconductor business into micro LED's for AR displays, garnering numerous accolades and industry recognition.

"In working with Facebook, we are charting an exciting path forward for Plessey and as we move into the next phase, we want to thank partners and customers who have been such a key part of our journey to date."

Dr Keith Strickland, Co-CEO and CTO at Plessey, commented, "We are delighted to announce this new commercial agreement with Facebook. Plessey has been at the forefront of micro LED display development and this agreement recognizes the significant advances in our capabilities that we have made in recent years and we very much look forward to working with Facebook to help bring their vision to life."

Plessey provides full-field emissive microLED displays that combine high-density RGB pixel arrays with high-performance CMOS backplanes to produce high-brightness, low-power and high-frame-rate image sources for head-mounted displays, AR and VR systems. The company operates 150mm wafer processing facilities to undertake design, test and assembly of LED products, and a suite of photonic characterization and applications laboratories.

Matthew Peach Editor in Chief, *optics.org*  
<https://optics.org/news/11/4/6>



AR-VR vision: next-gen interactive computing.

Image: Plessey.

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