



World's
Smallest
Projection
Display

SPIE 2021 Industry Talks, Part 1

Ultra-compact displays to enable the AR glasses mass market

Presented by Dr. Peter Weigand, CEO TriLite

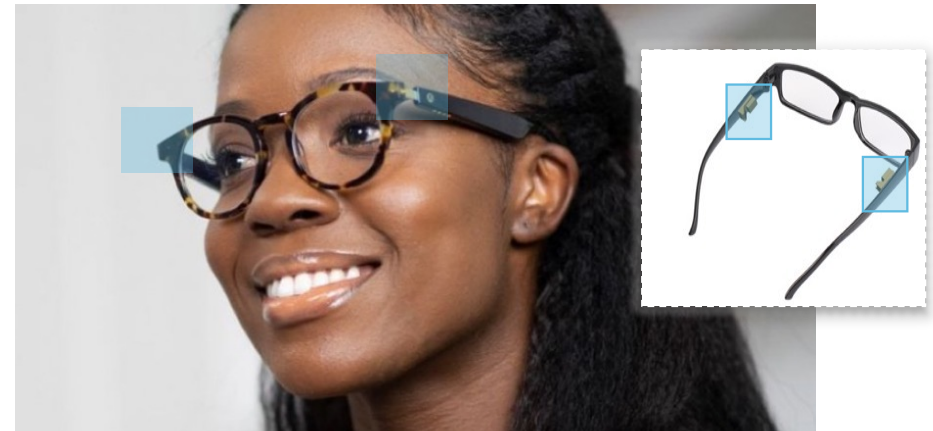
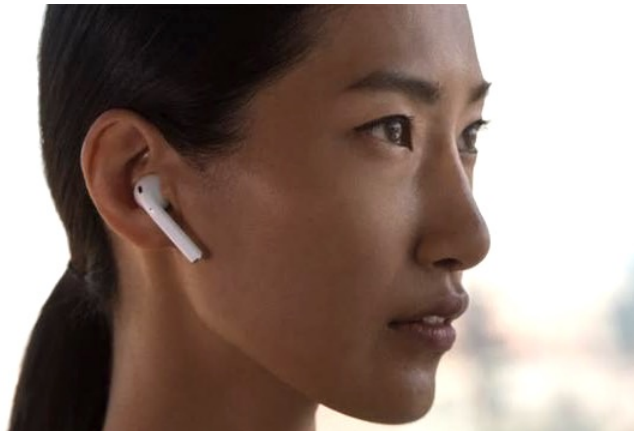
28 March 2021

Conference **SPIE.AR|VR|MR**
2021, Online Live

© TriLite, 2021
Author: Dr. Peter Weigand, CEO TriLite

- Introduction
- From earwear to eyewear
- Our vision for the eyewear of the future
- Key requirements for always-on eyewear – and how to address them
- Outlook

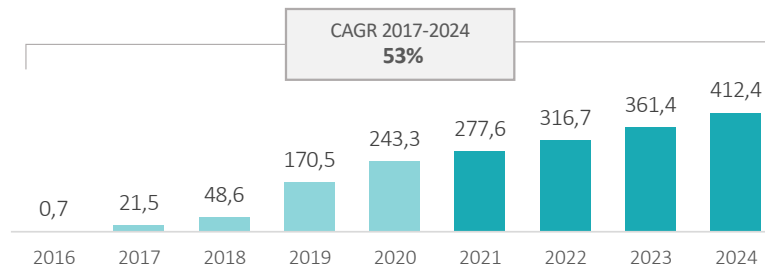
Speakers have gone personal. Displays are next!



Hearables

[electronic in-ear-devices / smart headphones, enabled by True Wireless Stereo technology]

Worldwide Hearables annual shipments estimates and forecasts (m units) ¹

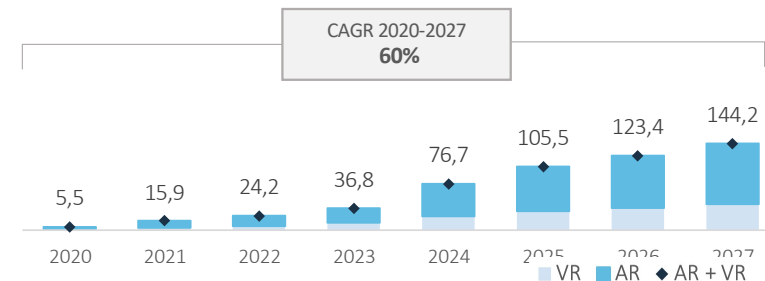


1) Data generated by TriLite based on main sources from (1) IDC, Worldwide Wearables Market Forecast Sep '20 & (b) IDC, Shipments of Wearable Devices Mar '20

Head-Mounted Display (HMD)

[electronic display worn on the head, enabled by disruptive display technology]

Worldwide HMD annual shipments estimates and forecasts (m units) ²



2) Data generated by TriLite based on main sources from (a) IDC Worldwide Quarterly AR and VR Headset Tracker, Mar '20, (b) DigiCap Report 2019 & (c) Grand View Research Jun 2020

Our Vision!



**Everyone enjoys augmented vision as
lightweight as the eyewear of today.**



We design and build the world's
smallest projection displays based on
our proprietary hardware and software
laser beam scanning (LBS) technology.

Key requirements for always-on eyewear!

End User

PERFECT FIT



small & lightweight

STYLISH & FASHIONABLE



flexible integration

ALWAYS ON



brightness & contrast

OEM

End User

GREAT IMAGE QUALITY



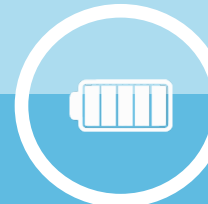
color gamut
& distortion-free

IMMERSIVE EXPERIENCE



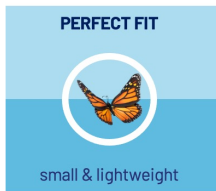
low latency & high FOV

LONG CHARGING INTERVALS



low power consumption

OEM



End User: Need AR glasses that are lightweight and fit perfectly

OEM: Need a display with small size & low weight

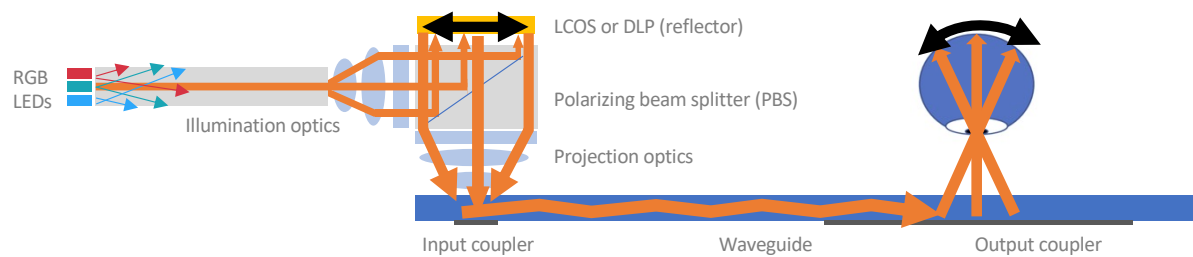
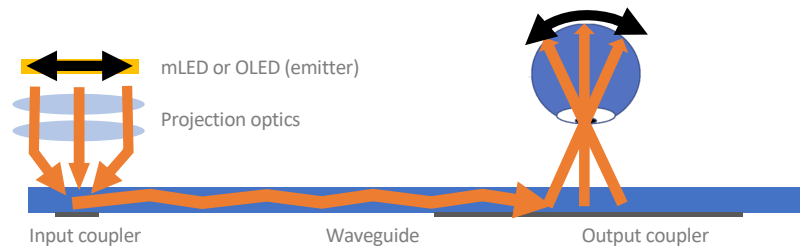
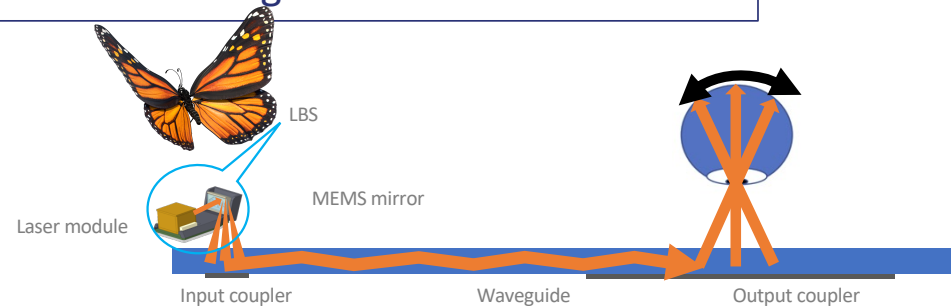
Scanning-based Display

Laser Beam Scanner (LBS)

Panel-based Display

mLED & OLED

LCoS & DLP



For details: see SPIE 2021, Paper 11765-7, Nouri et al., Laser beam scanner and combiner architectures

STYLISH & FASHIONABLE



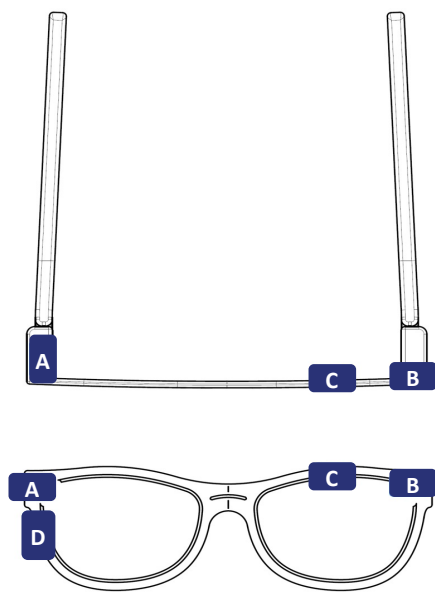
flexible integration

End User: Need AR glasses which are stylish and cool to wear

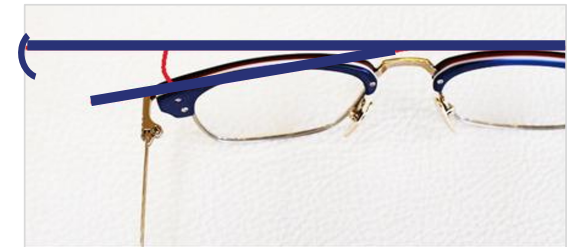
OEM: Need a display that is easy to integrate into different glass types

TRILITE

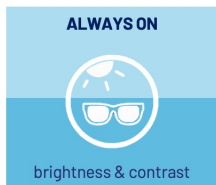
World's
Smallest
Projection
Display



- Fitting adaptability to different combiners and position
- Fitting to meet face wrap and pantoscopic tilt requirements for different combiners
- Adaptable to monocular and binocular displays.

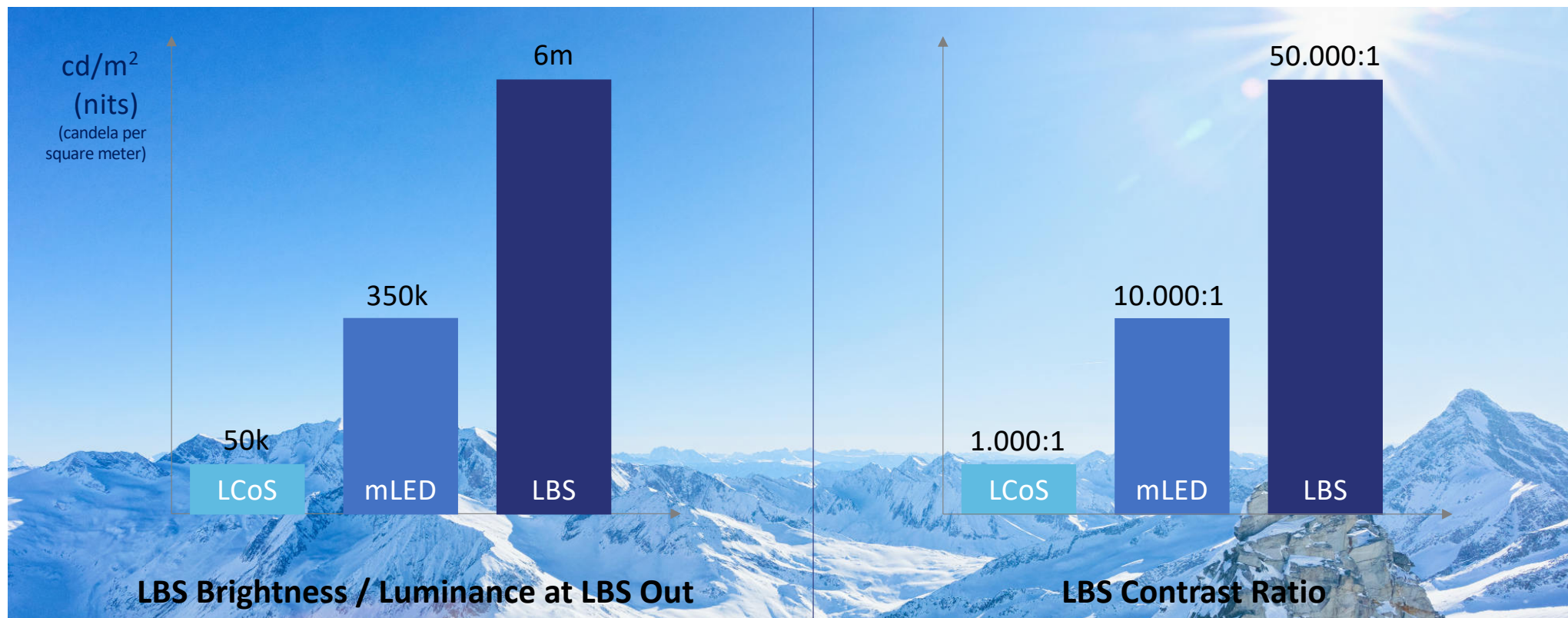


Various integration geometries for LBS displays



End User: Need AR glasses which work also on really sunny days

OEM: Need a display with outstanding brightness & high contrast



For details: see SPIE 2021, Paper 11765-1, Fidler et al., Laser beam scanning in XR: benefits and challenges

GREAT IMAGE QUALITY



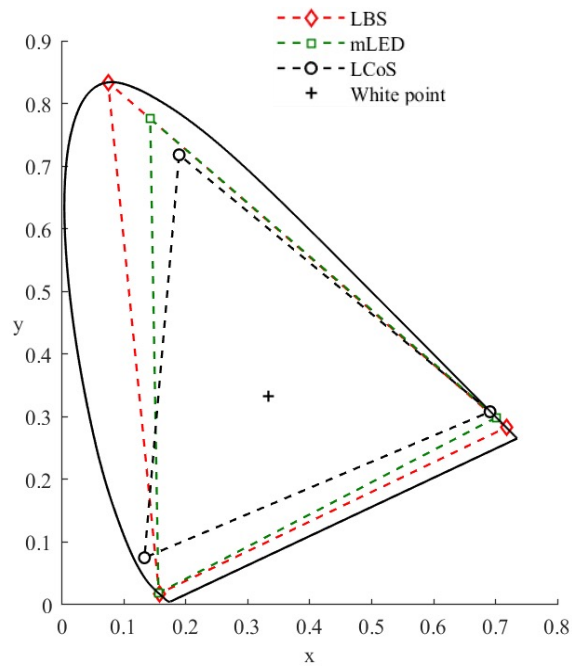
color gamut
& distortion-free

End User: Need AR glasses with full range of colors and real life geometries

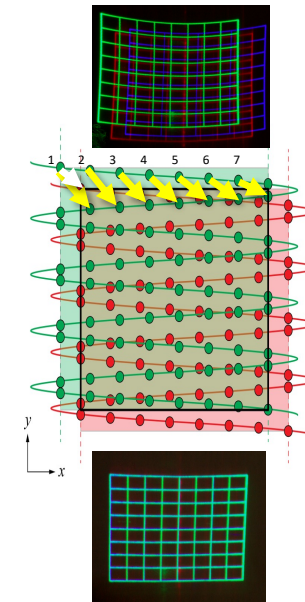
OEM: Need a display with high color gamut & without distortion

TRILITE

World's
Smallest
Projection
Display



LBS color gamut



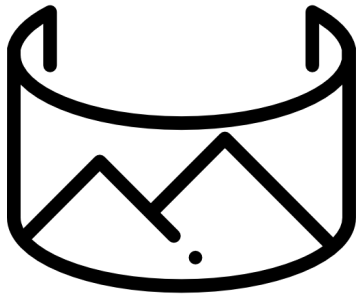
LBS can correct image distortion by using advanced calibration algorithms

LBS distortion correction

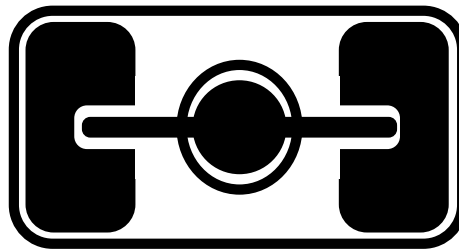


End User: Need AR glasses that provide an outstanding user experience

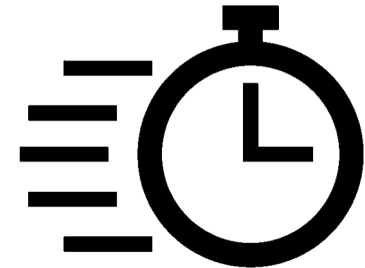
OEM: Need a display with high FOV, high refresh rate & low latency



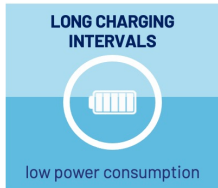
LBS allows ultra high FOV since projection optics can be eliminated and since the resulting FOV is limited only by the combiner optics



LBS allows high refresh rates through advanced pixel painting algorithms and high speed MEMS mirror design and its optimum integration

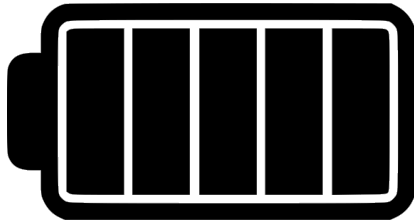


The perceived latency of LBS is significantly lower than panel based displays due to high speed scanning



End User: Need AR glasses with a long runtime

OEM: Need a display with low power consumption



- Laser diodes convert electrical current into photons with very high efficiency, further optimization can be achieved by driving the laser diodes in a smart way taking the low-power MEMS mirror characteristics into account (e.g. pulse shapes)
- Minimization of optical elements in the beam path (e.g. no projection optics) optimizes the efficiency
- Laser light is highly polarized (for combiners where it matters)

LBS allows ultra-low power consumption

Our outlook for upcoming LBS devices optimized for AR user experience



Weight:

< 1.5 g



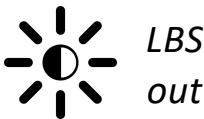
Volume:

< 1 cm³



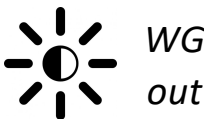
Power Consumption:

< 500 mW



Brightness (at Laser Beam Scanner out):

> 15 lm



Brightness (at waveguide out):

> 3000 nits



Field of View (at > 90 Hz Refresh rate):

> 50°



World's
Smallest
Projection
Display

Thank you for joining this session - we are looking forward to talking to you!

© TriLite, 2021

Contact

info@trilite-tech.com

+43 1 947 5371

Headquarter Vienna

Frankenberggasse 13
1040 Vienna
Austria

Office USA

1501 Mariposa St
San Francisco, CA 94107
USA

For additional information,
refer to our other SPIE AR, VR, MR 2021 technical talks:

- **SPIE 2021, Paper 11765-1, Fidler et al.,**
Laser beam scanning in XR: benefits and challenges
- **SPIE 2021, Paper 11765-3, Reitterer et al.,**
Ultra-compact micro-electro-mechanical LBS for AR applications
- **SPIE 2021, Paper 11765-7, Noui et al.,**
Laser beam scanner and combiner architectures

TRI
LITE

World's
Smallest
Projection
Display