



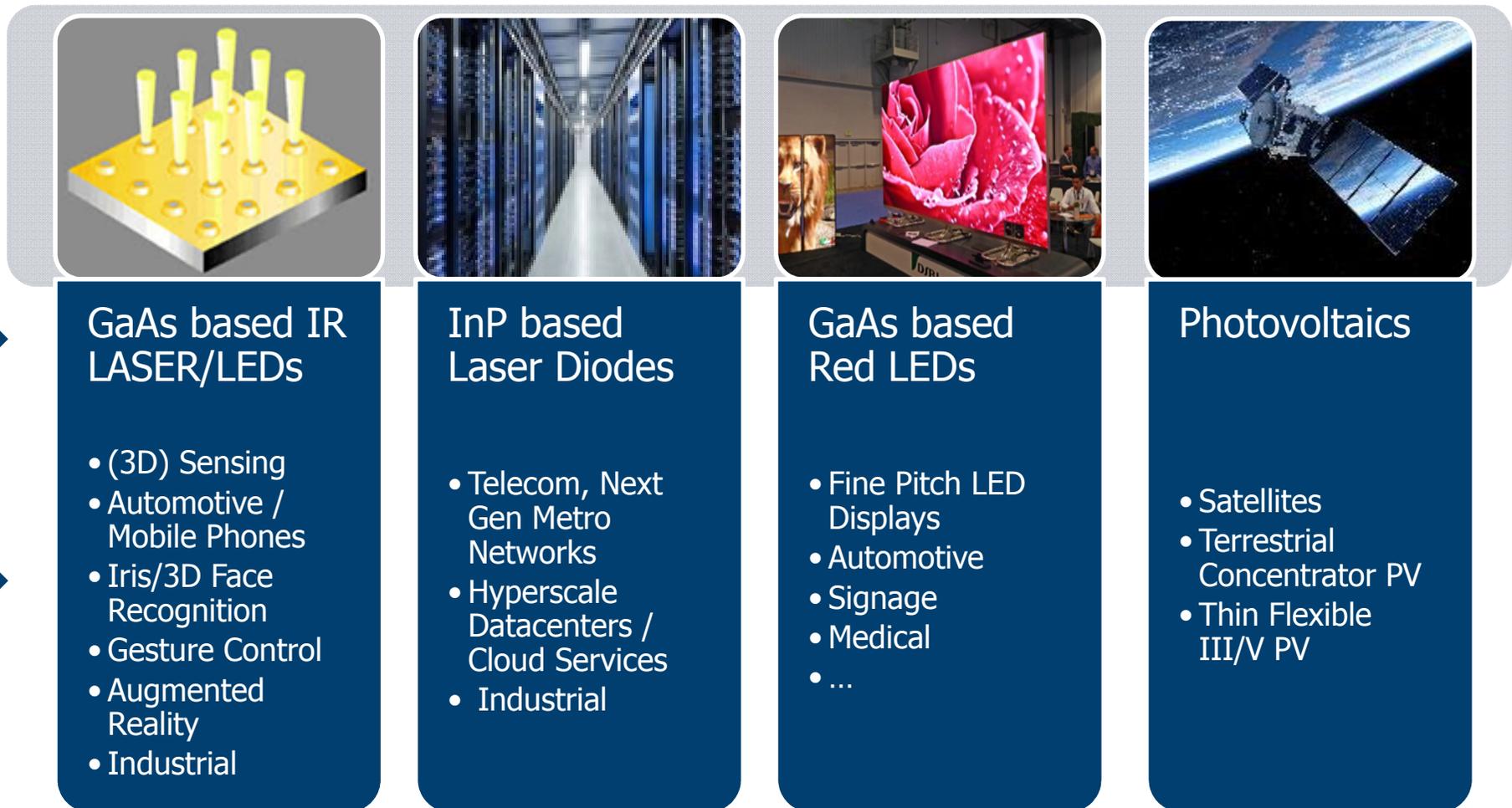
AIXTRON 1. Capital Markets Day

CMD 2018 Presentation 3
(FSE: AIXA, ISIN DE000A0WMPJ6)

Optoelectronics & Laser Technology

-Focus: 3D Sensing & μ LED-

Overview of AsP MOCVD Application



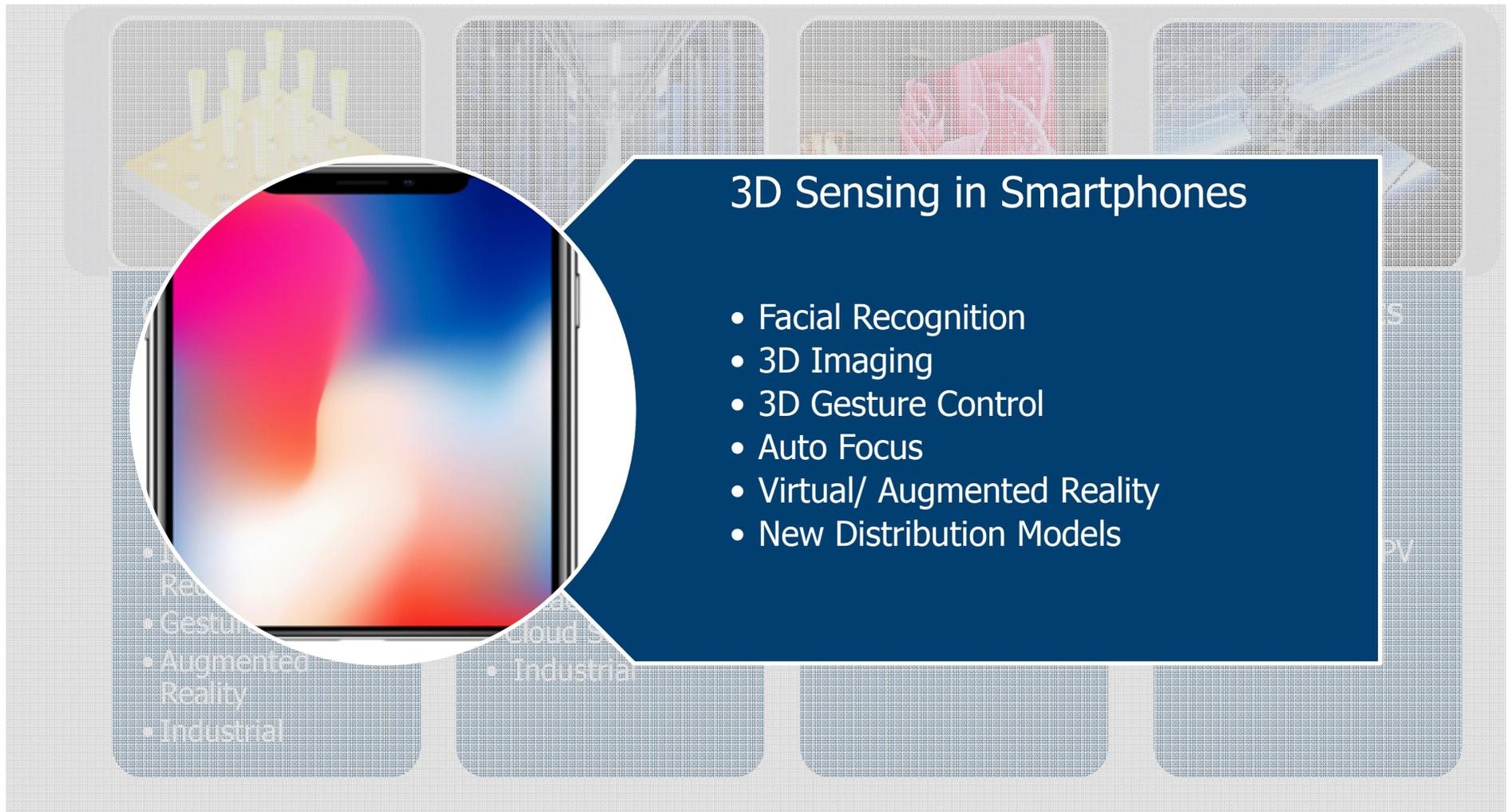
+ Many Other Photonic Applications, Power/RF Devices

AIX 2800G4-TM is No. 1 For AsP Related Key Markets

Optoelectronics & Laser Technology

3D Sensing

Major Growth Areas for Diode LASER Applications



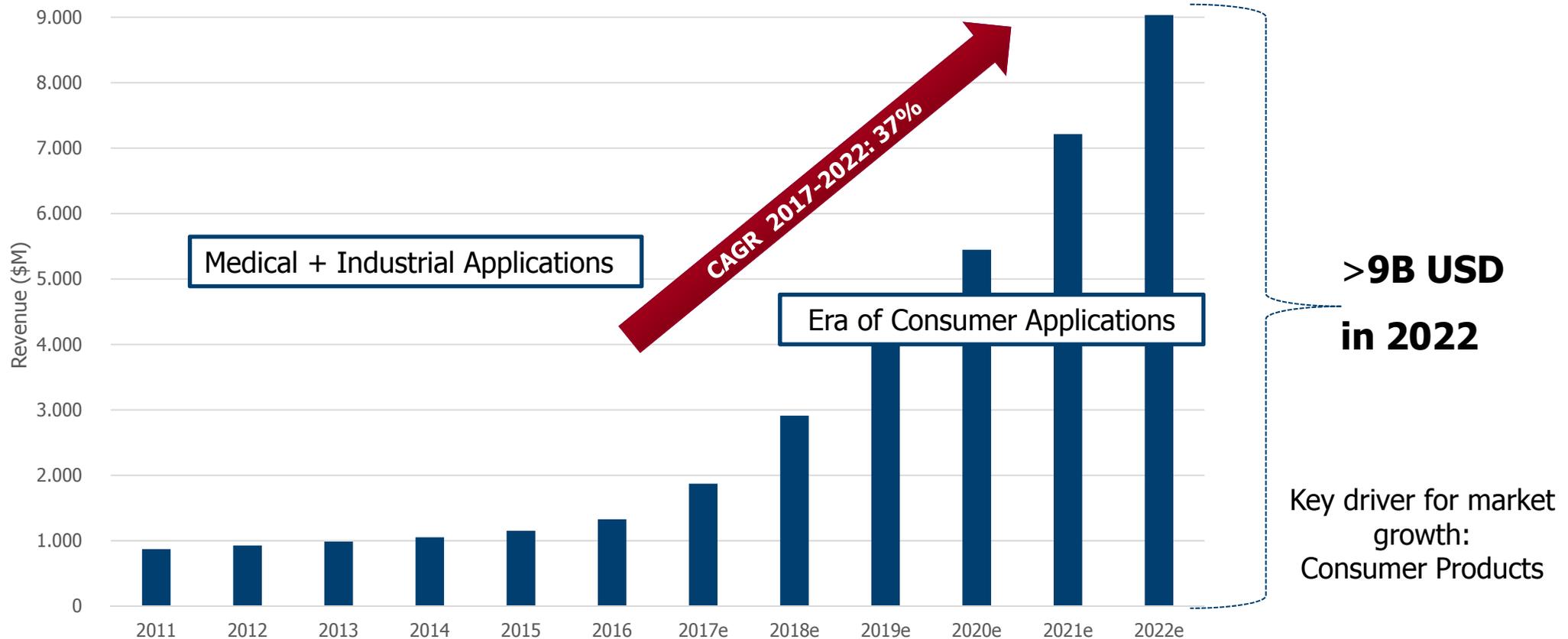
3D Sensing in Smartphones

- Facial Recognition
- 3D Imaging
- 3D Gesture Control
- Auto Focus
- Virtual/ Augmented Reality
- New Distribution Models

AIX 2800G4-TM is No. 1 For 3D Sensing Related Markets

Market Forecast 3D Sensors

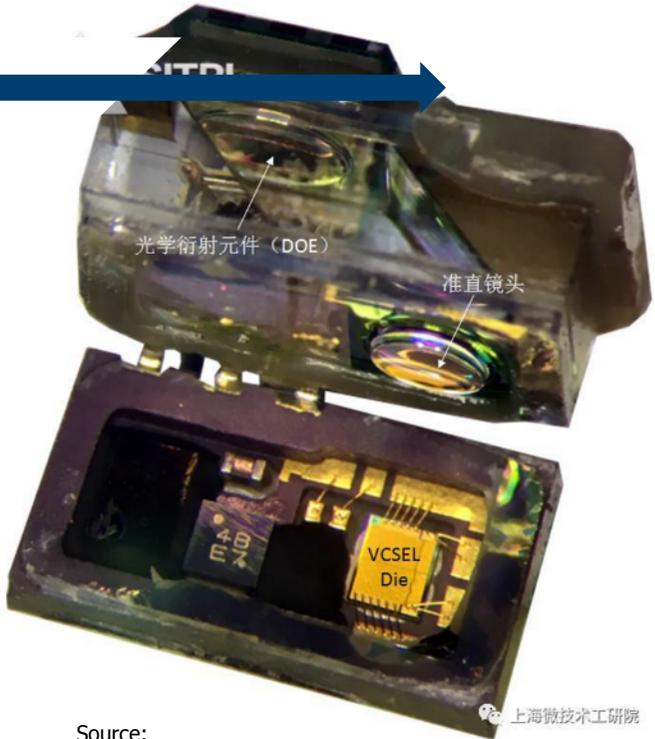
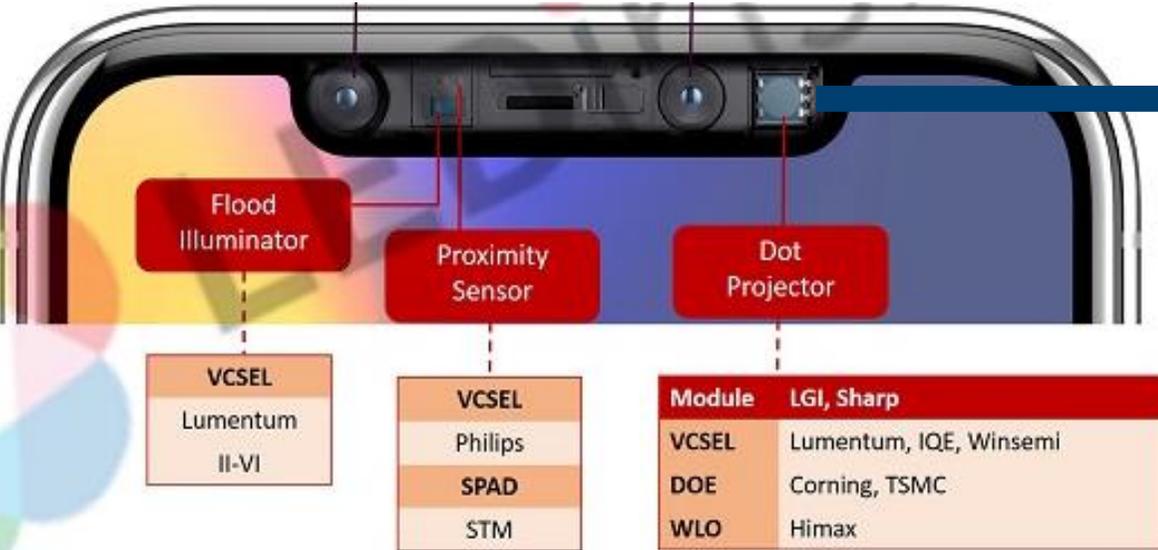
3D Imaging and Sensing revenue Forecast (M\$)



IR Imaging and Sensing – Exceptional Market Growth

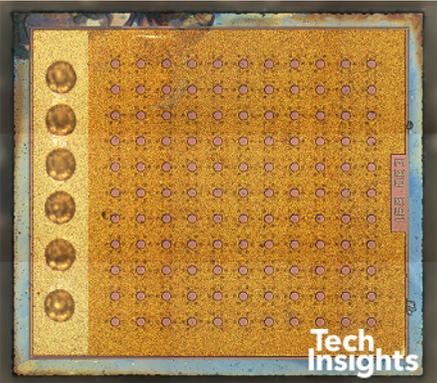
source: YOLO Development

VCSEL Technology in Smartphones



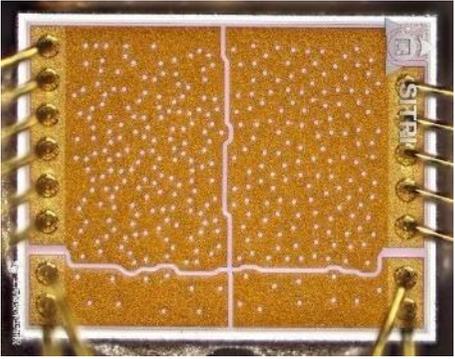
Source: <http://www.esmchina.com/news/article/201711280942>

Flood Illuminator – VCSEL array



1 x 0.8 mm

Dot Projector - VCSEL array



1 x 1.2 mm

~ 2 mm² / device

2 large VCSEL array chips per FaceID device (+ small VCSEL for ToF)

Source: https://www.techinsights.com/news/2018/1/faceid2_most_mentioned_companies_you_will_hear_when_speaking_of_3d_sensing
<http://www.esmchina.com/news/article/201711280942>
<http://www.techinsights.com/about-techinsights/overview/blog/apple-iphone-x-teardown/>



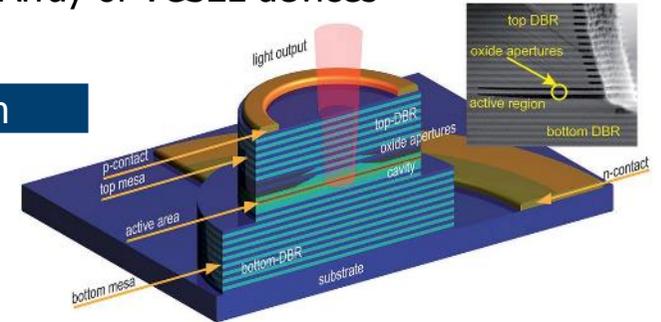
Apple's Face ID in Operation



Source: Jongdeng.com
<http://www.jongdeng.net/post/19710>

- Laser-Dot Matrix deformed by Object's 3Dimensional Shape
- Camera + Intelligent Software calculate Object's shape
- → Angular distribution of Dot Matrix must be very precise

Array of VCSEL devices



Determine face "ID"



Source: The Verge.com
<https://www.theverge.com/2017/9/12/16298192/apple-iphone-face-id-legal-security-fifth-amendment>

The enabling solution

- **3D Imaging – Potential for Multiple Applications – Exceptional Opportunity**
 - Application requires large amounts of AlGaAs VCSEL light sources (arrays)
 - Consumer product: HVM with high sensitivity to yield, cost and productivity
- **Requirements to MOCVD System**
 - Best Deposition Uniformity Control – at Wafer Level
 - Lowest Particle Count
 - Highest Epi / Product Yield
 - Lowest Production Cost



Enabling Solution: **AIX 2800G4-TM**
the technology leading Reactor for HVM of LASER Devices
>90% market share over last 4 years

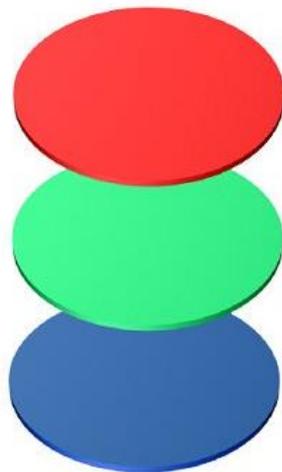
Optoelectronics & Laser Technology

μLED

Micro LED Technology - Introduction

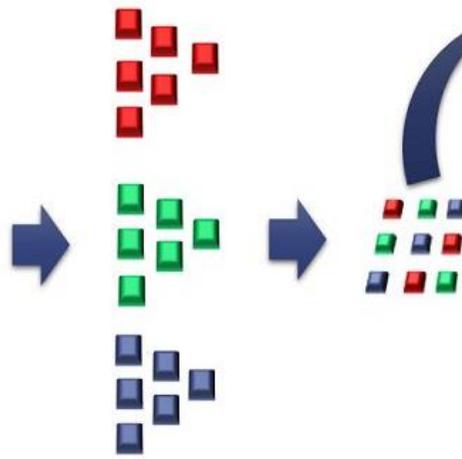
- In a typical display, each pixel is constituted of Red, Green and Blue (RGB) sub pixels and controlled independently by a matrix of transistors. The idea of micro LED (mLED) is to use individual, small micron sized (ranging from 3-40 μm) LED chips as sub pixels.
- In most cases, the mLED chips are then positioned and connected to the transistor matrix via a Pick and Place or Optimized Transfer Process (parallel transfer developments ongoing)

Red, Green and Blue
Epiwafers



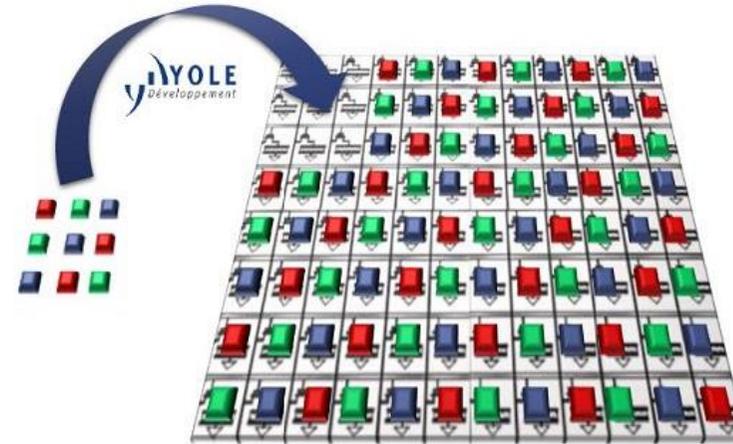
Red, Green, Blue LED
Epiwafers

Chip Singulation



Chip singulation

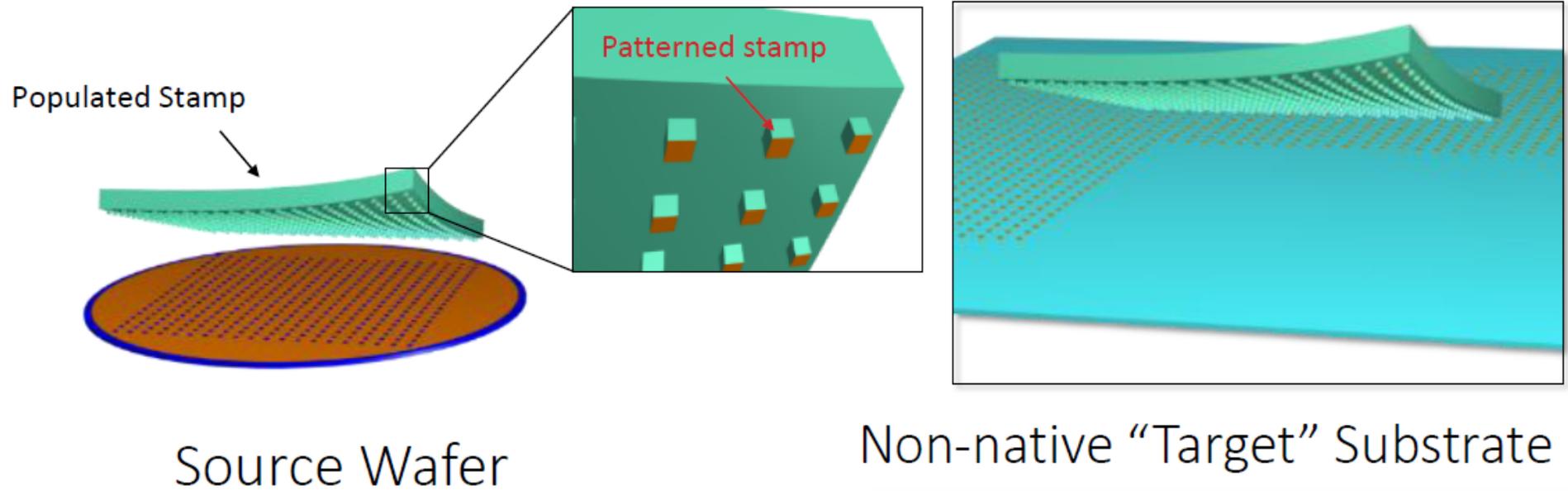
Sorting and Pick and Place – Connection to the
Transistor Matrix that controls individual Pixels



Sorting and Pick and place + hybridization/connection to the transistor matrix that controls individual pixels

Source: https://twitter.com/Yole_Dev/status/910081729188294657

Micro LED technology - Singulation and Mass Transfer



Densely packed micro components

Printing
→



Dispersed micro components

Micro LED Technology - Samsung CES Showcase

Samsung introduces The Wall Professional and 3D LED Cinema displays



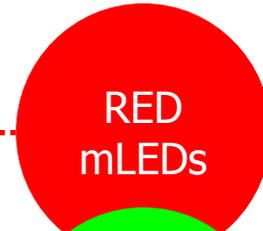
Source: Samsung
<https://news.samsung.com/de/samsung-prasentiert-the-wall-den-weltweit-ersten-modularen-146-zoll-microled-tv>

The Enabling Solution - AIXTRON Planetary Technology

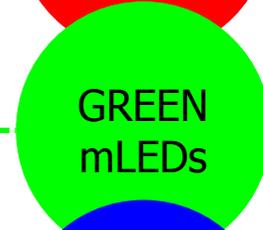


AIX 2800-G4TM

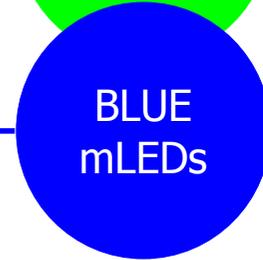
One Technology,
Two Platforms,
Three Primary Colors –
enabling HVM of mLEDs



RED
mLEDs



GREEN
mLEDs



BLUE
mLEDs



AIX G5+ C

Micro LED Applications



Optoelectronics & Laser Technology

Focus 3D Sensing

Market Opportunities

Adoption of 3D Sensing

Jan 30, 2018 Nikkei Asian Review

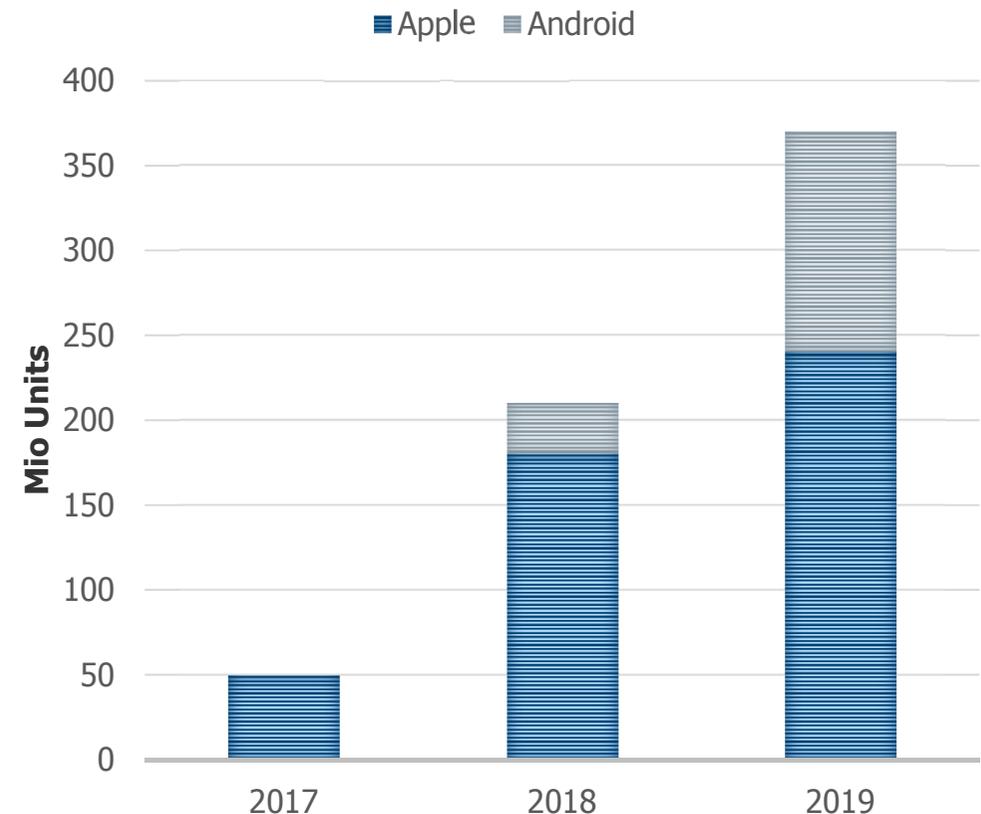
Apple to halve iPhone X output on weak holiday sales

TOKYO -- Apple will slash its production target for the iPhone X in the three-month period from January by half from the more than 40 million units envisaged at the time of its release in November.

The U.S. tech giant notified suppliers that it had decided to cut the first-quarter production target to around 20 million units, in light of slower-than-expected sales in the year-end holiday shopping season in key markets such as Europe, the U.S. and China.

- **2017: iPhone X**
 - Seen as strategic move to pave way for era of future AR/AI applications
- **2018: More Products expected**
 - 2H/18: iPad Pro and MacBooks,
 - Q3/18 3 new iPhone models
 - Android camp will follow (Huawei, Oppo, Xiaomi, Vivo, Samsung,...)
- **2019 Rear Sensor implementation**

3D ENABLED MOBILE DEVICES



Significant further Volume Adoption of 3D Sensing Expected