



# Looking Ahead 2020 and beyond

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Senior Vice President and General Manager of Sensors Business Unit

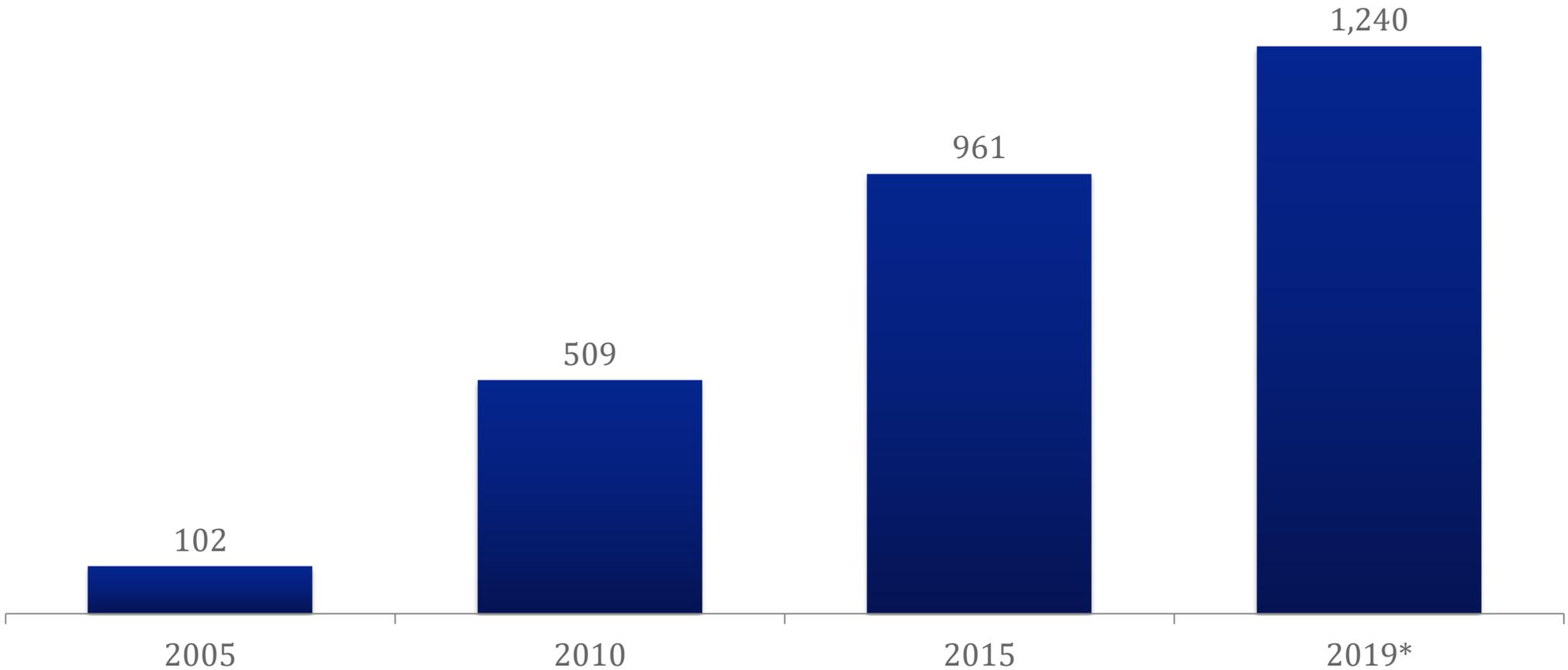
January 2020

# Safe Harbor

This presentation contains forward-looking statements within the meaning of the “safe harbor” provisions of the Private Securities Litigation Reform Act of 1995. These statements are based on management’s current expectations and beliefs and are subject to a number of risks, uncertainties and assumptions that could cause actual results to differ materially from those described in the forward-looking statements. All statements other than statements of historical fact are statements that could be deemed forward-looking statements. For example, statements regarding expected (i) customer demand, (ii) utilization and cross utilization of our Fabs, (iii) growth in our end markets, (iv) market and technology trends, and (v) growth in revenues, cash flow, margins and net profits are all forward-looking statements. Actual results may differ materially from those projected or implied by such forward-looking statements due to various risks and uncertainties applicable to TowerJazz’s business as described in the reports filed by Tower Semiconductor Ltd. (“Tower”) with the Securities and Exchange Commission (the “SEC”) and the Israel Securities Authority (“ISA”), including the risks identified under the heading "Risk Factors" in Tower’s most recent filings on Forms 20-F and 6-K. No assurances can be given that any of the events anticipated by the forward-looking statements will transpire or occur, or if any of them do, what impact they will have on the results of operations or financial condition of TowerJazz.

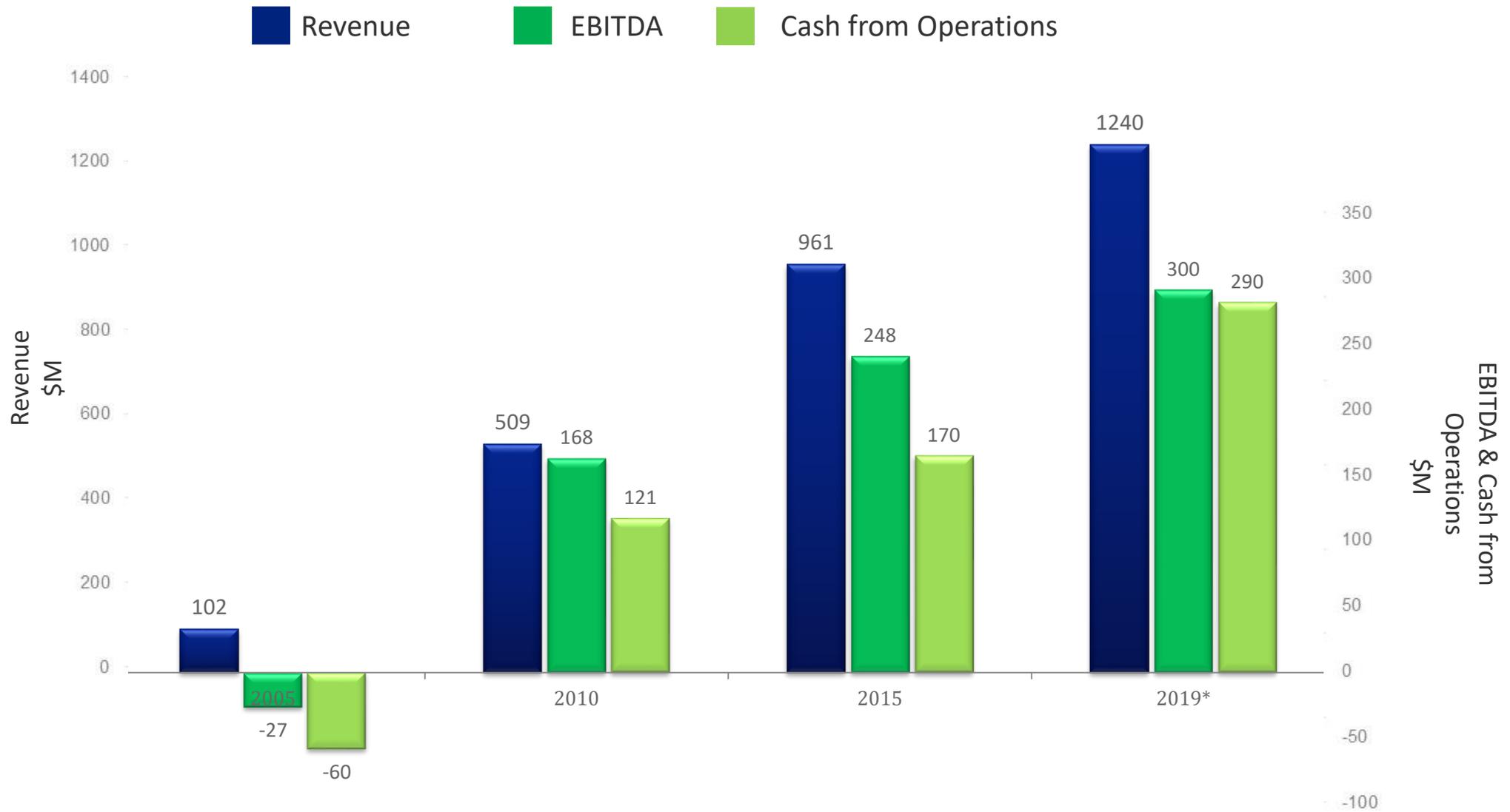
TowerJazz is providing this information as of the date of this presentation and expressly disclaims any obligation to update any of the forward-looking statements or other information contained in this document as a result of new information, future events or otherwise.

# Annual Revenues \$M – 5-year tracking



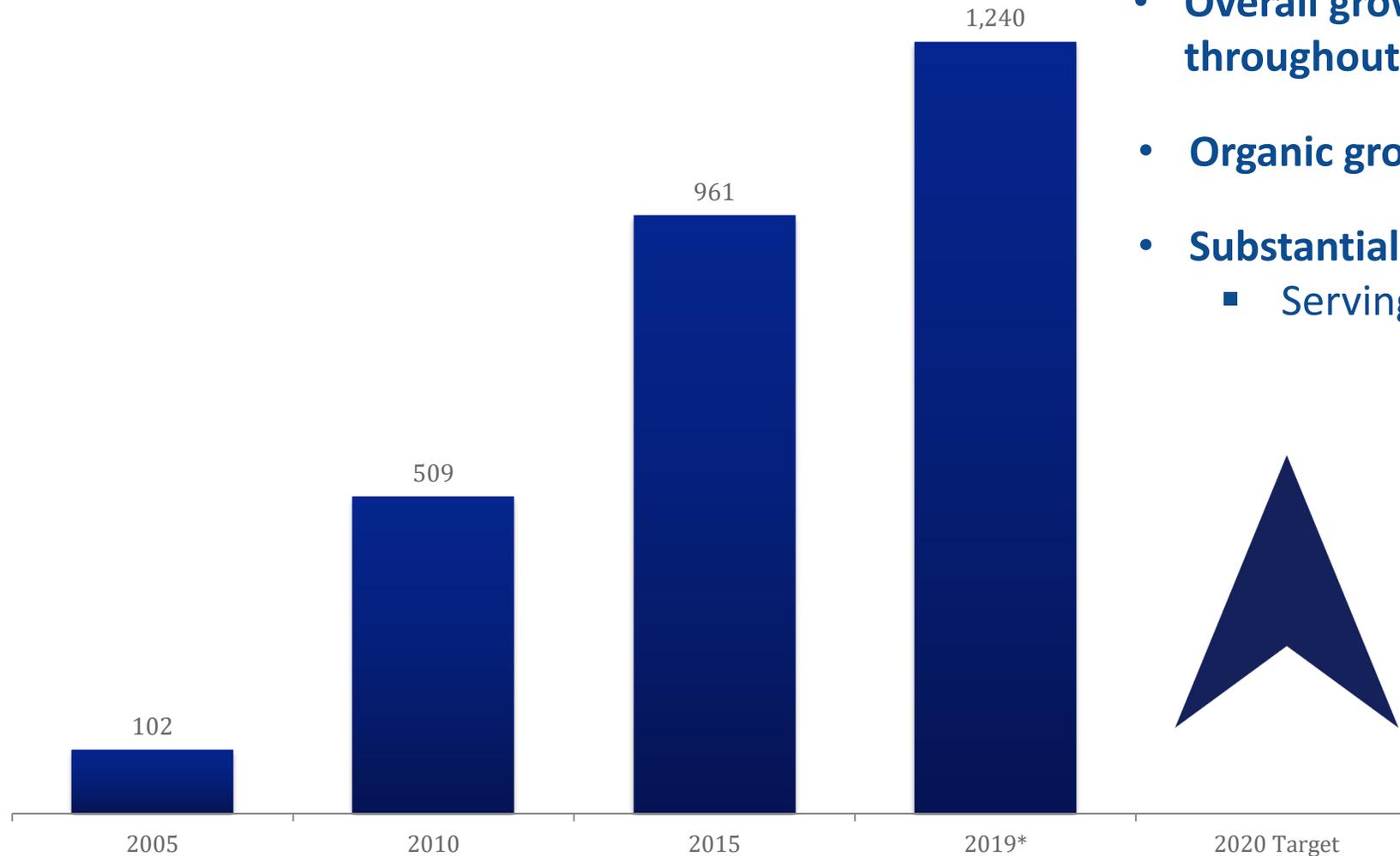
\* 2019 revenue includes actual YTD 09'19 and Q4'19 mid range revenue guidance

# Key Financial Metrics



\* 2019 revenue includes actual YTD 09'19 and Q4'19 mid range revenue guidance; EBITDA and Cash from Operations annualized based on Q3'19

# Annual Revenues \$M – 5-year tracking – 2020 Target



- Overall growth with growth throughout the year
- Organic growth of low double digit
- Substantial 300mm capacity capability
  - Serving all our business units

# High Quality and Flexibility of Worldwide Manufacturing Capabilities



Migdal HaEmek, Israel

6", 150mm  
Sensors, Power  
1 $\mu$ m to 0.35 $\mu$ m



Migdal HaEmek, Israel

8", 200mm  
Sensors, Power, RF SOI  
0.18 $\mu$ m to 0.13 $\mu$ m



Newport Beach, USA

8", 200mm  
SiGe, MEMS, RF SOI  
0.5 $\mu$ m to 0.13 $\mu$ m



San Antonio, USA

8", 200mm  
RF SOI, Power  
0.18 $\mu$ m



Tonami, Japan

8", 200mm  
Power  
0.18 $\mu$ m



Arai, Japan

8", 200mm  
Sensors, RF SOI  
0.13 $\mu$ m to 0.11 $\mu$ m

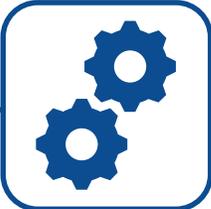


Uozu, Japan

12", 300mm  
Power, Sensors, RF SOI  
65nm to 45nm

# 2020 Focus and Targets

# 2020 Focus and Targets



Fill our factories  
200mm and 300mm



Increase 300mm  
capacity for mid to  
long-term demand



Driving future growth  
in each of our  
business units

# Analog IC

# 2020 Focus and Future Growth Drivers: Analog IC

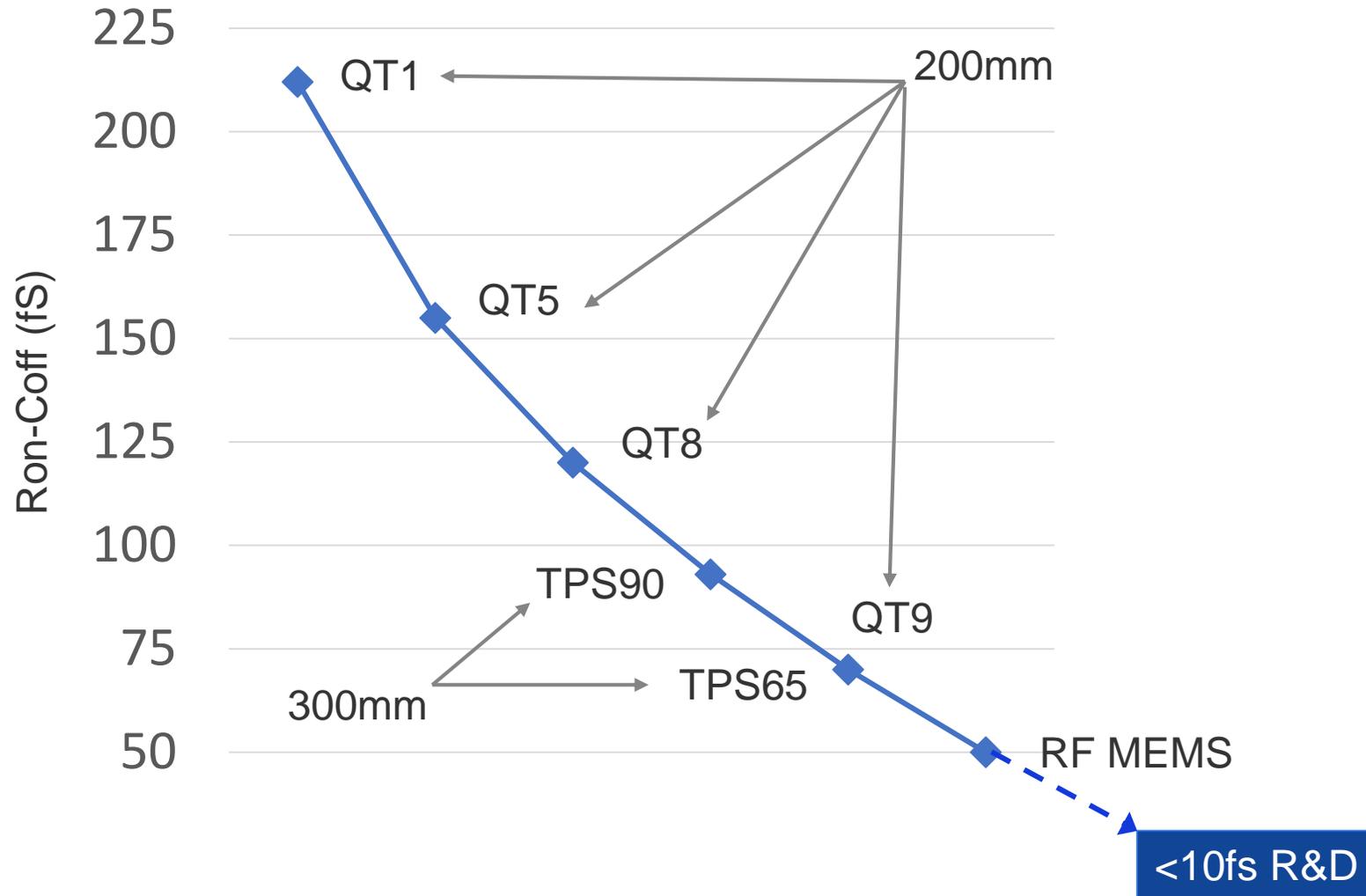
- Expand 300mm business with added capacity
  - RF SOI: strong traction on existing platforms; winning new designs on next-gen platform
  - 65nm BCD: strong orders beginning with large pipeline of new Tier 1 opportunities
- Capitalize on 5G opportunity
  - Infrastructure: initial SiGe ramp in optical link upgrade for 5G base-stations occurring
  - Mobile: strong content growth with 5G is expected by Yole to result in 17% CAGR for the RF market
- Re-establish growth in Optical data-com business
  - SiGe: good design wins for 400G SiGe products; anticipating 100G recovery in 2020
  - SiPho: established leading edge foundry technology with initial production now poised for strong growth in the next several years
- Expand 200mm Power
  - Release new 200mm BCD technology enabling strong area reduction to win larger market share
  - Continue to expand high-voltage power design wins with differentiated 140 and 200V offering

# 300mm Opportunity for TowerJazz: Analog IC

The ability to print smaller dimensions on 300mm wafers has enabled TowerJazz to expand its Analog/Specialty markets to include:

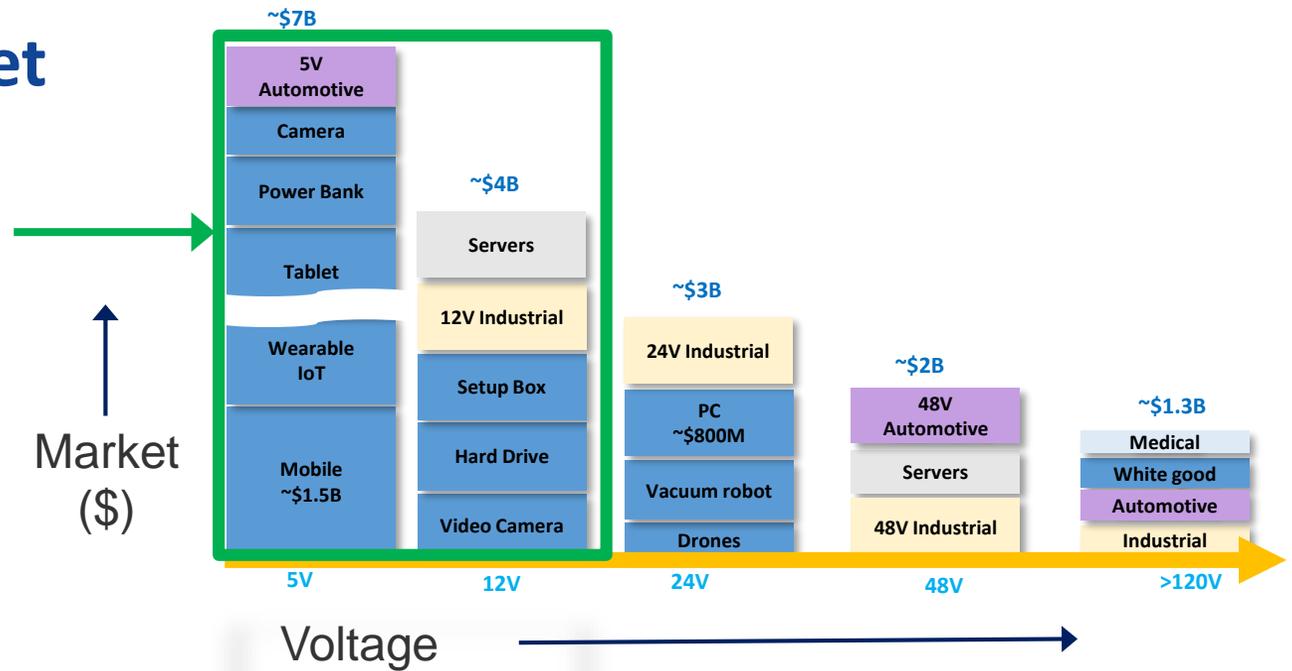
- **Smaller geometry RF SOI** with enhanced LNA and digital integration
  - 65nm RF SOI: 4x smaller digital and improved LNA performance for 4G and 5G
  - Now ramped to high volume
- **65nm SiGe** for next generation optical and mmWave products
  - Enabling SiGe with high performance CMOS and dramatically higher digital density
- **Low-Voltage Power Management 65nm BCD** (serving an \$11B analog market)
  - Best in class performance
  - Offering as much as 50% cost reduction vs. 0.18um at or below 16V

# RF SOI RF Switch Performance: Best-in-Class RonCoff

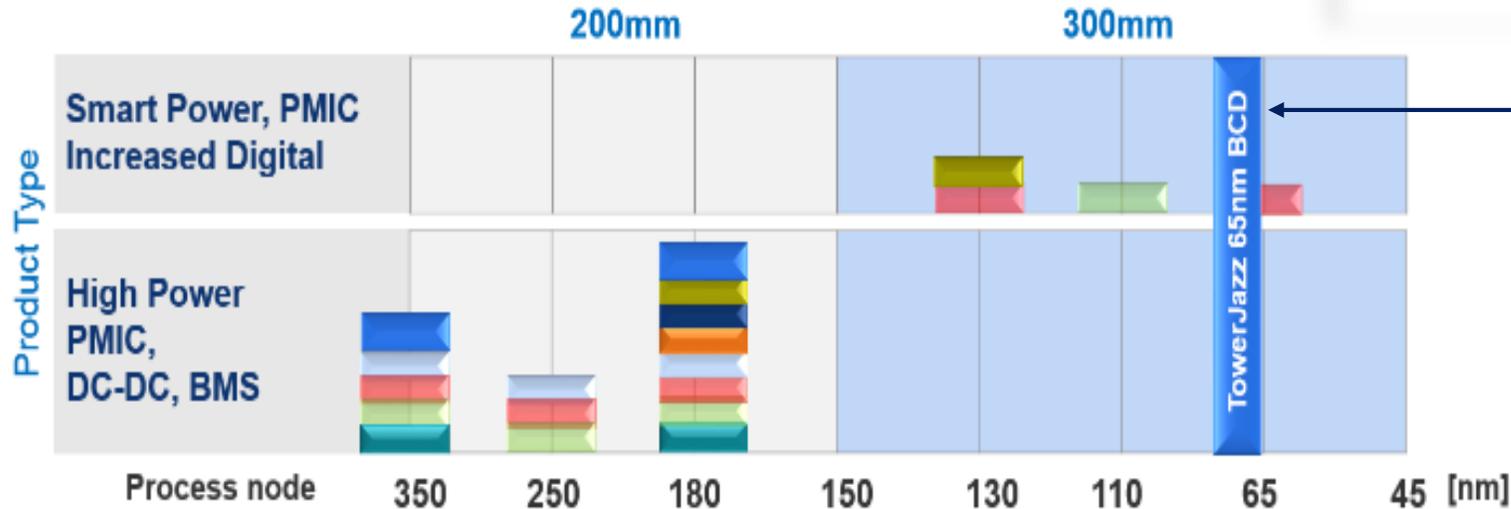


# 300mm Power Management Market

300mm, 65nm BCD Power Technology addresses an \$11B Analog Low-Voltage Market



## Power Management Foundry landscape



Few foundries offer 300mm BCD Power technology and among them TowerJazz has best-in-class performance at 65nm

Sources: Yole, IHS

# 5G



# RF HPA Enabled Markets and Technology

## Wireless Front-Ends

SiGe and RF SOI

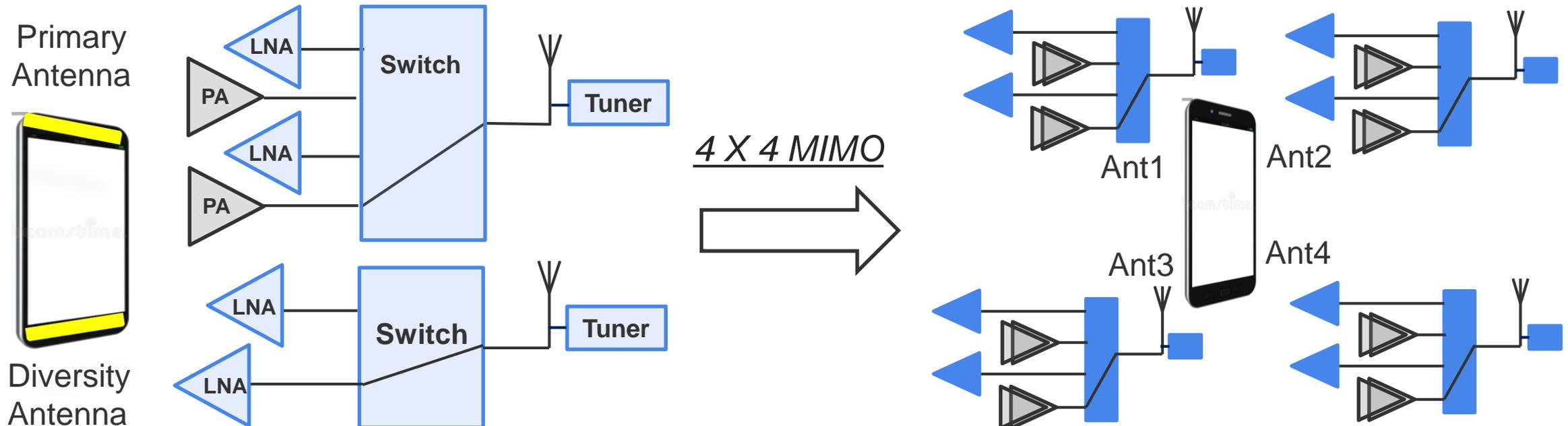


## Optical Fiber Communications

HP SiGe and Si Photonics

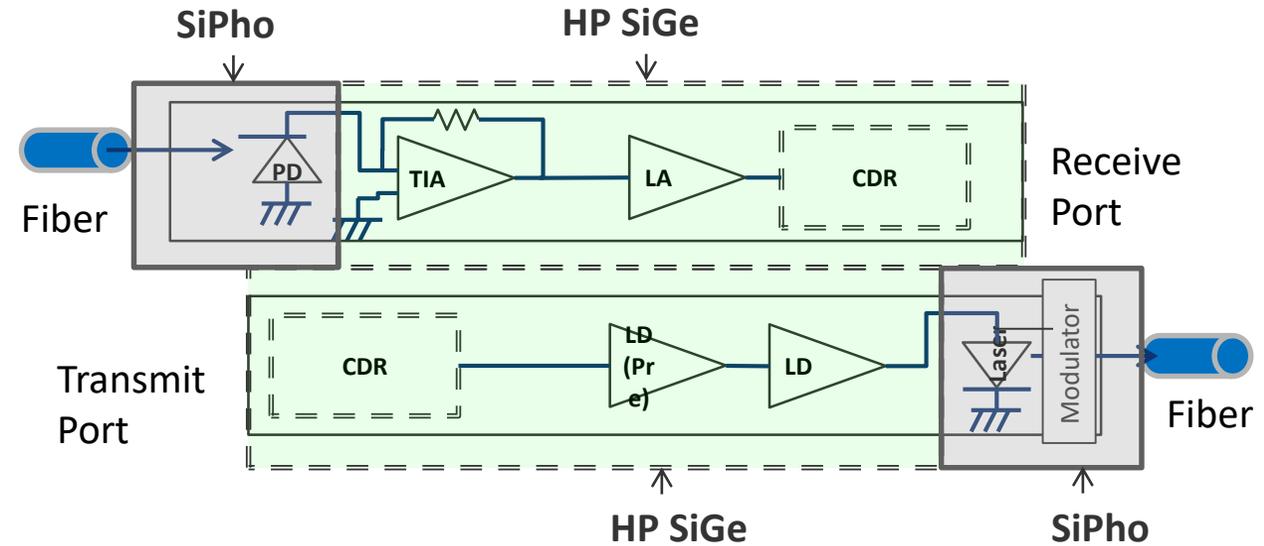
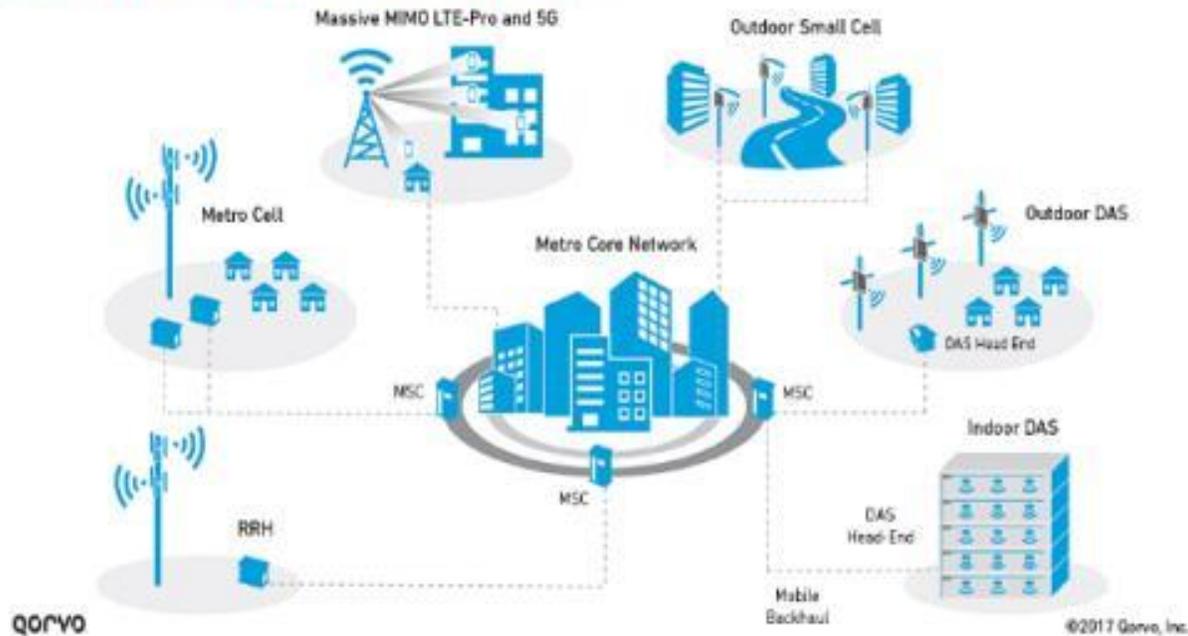
# 5G Implications to TowerJazz RF Market (Sub 6GHz)

- Industry expectation: 5G in ~25% of handsets by 2023 vs. <1% in 2019
- 5G offers higher data rates by use of more antennas and frequencies increasing RF content
  - More switches to select frequencies Built in **TowerJazz RF SOI**
  - More antenna tuners per phone Built in **TowerJazz RF SOI or RF MEMS**
  - More low-noise amplifiers (one per antenna) Built in **TowerJazz RF SOI or SiGe**



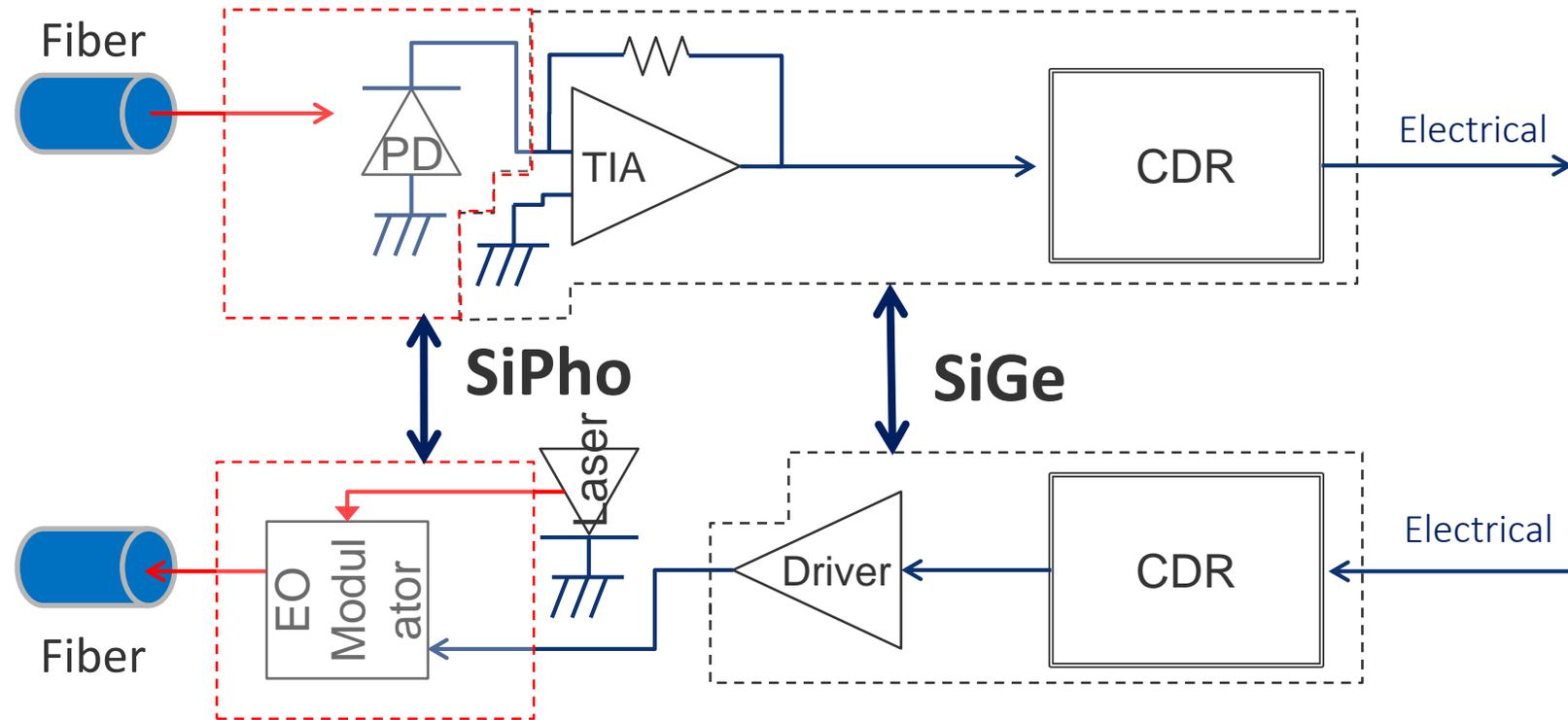
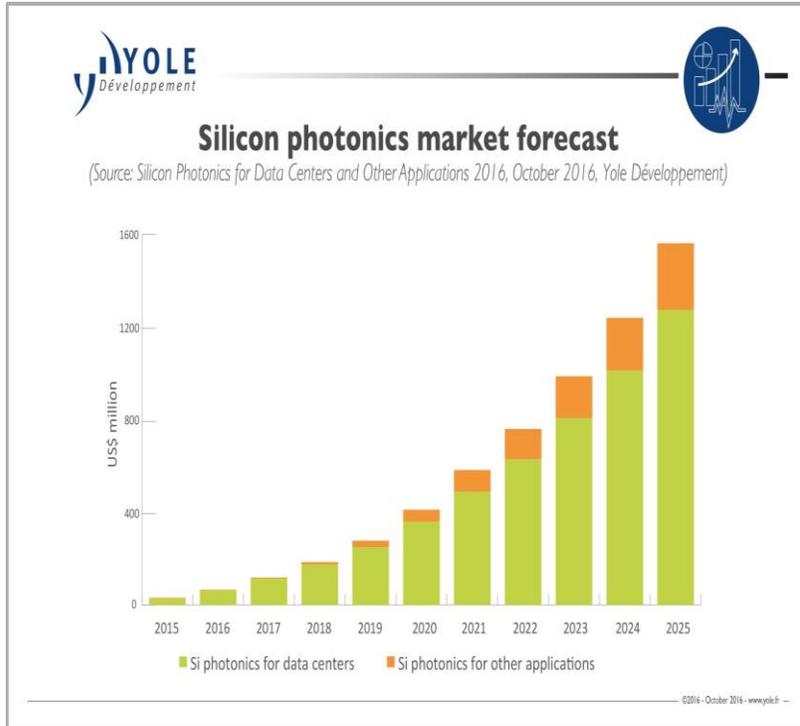
# 5G Infrastructure

Wireless Infrastructure: A Heterogeneous Network



- Optical fiber is likely to dominate transport from base-stations and small-cells into the network
- 5G increases the number of connections and also the speed (moving from 10Gb/s to 25Gb/s)
- Technology of choice is SiGe (TowerJazz holds >60% market share in this market)
- Silicon Photonics (SiPho) also expected to play a role in the coming years

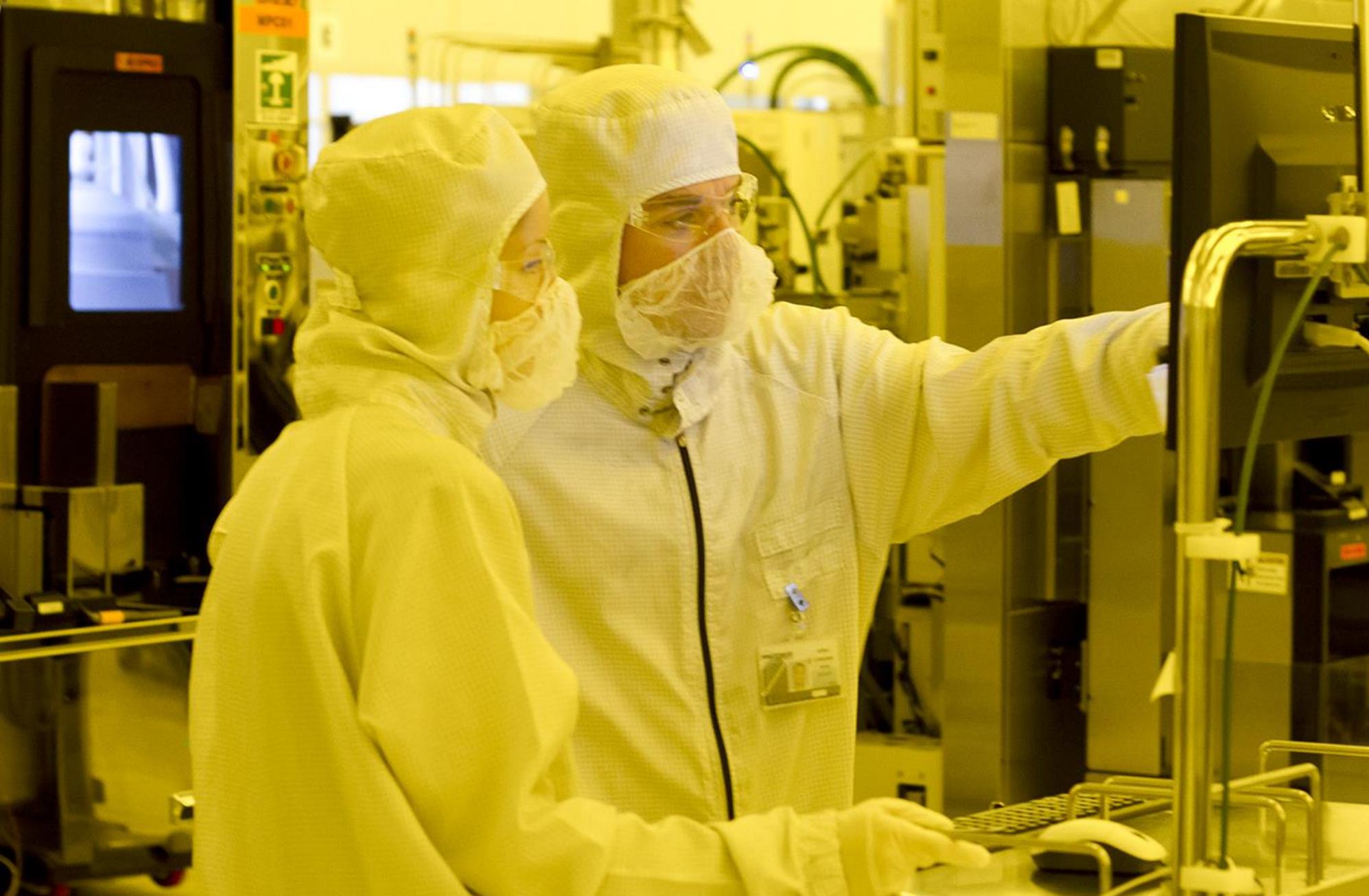
# SiGe and SiPho Opportunity for Data-com and Tele-com



- **SiGe** is used in most optical transceiver electronics (TowerJazz has >60% market share)
- **SiPho** enables integration of optical discrete components for next-generation transceivers

# TowerJazz Power Management

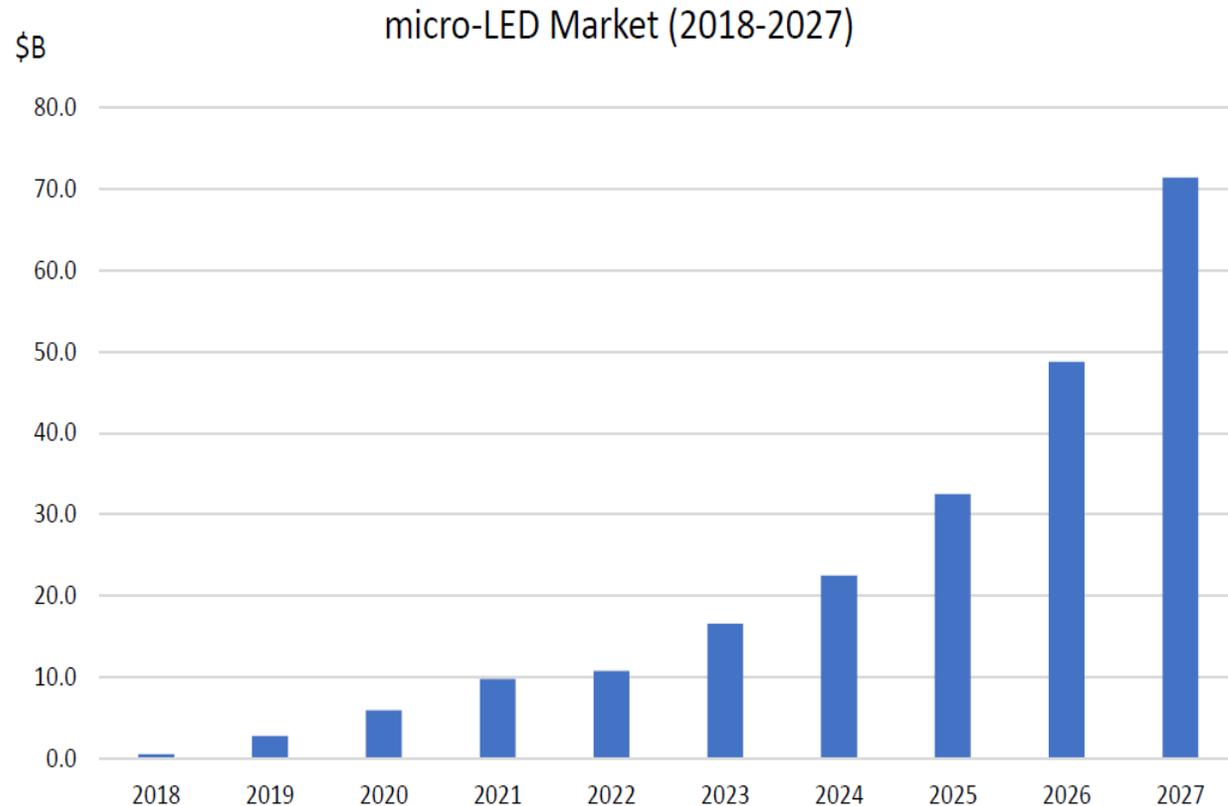
<p><b>200mm</b></p> <p><b>80V to 300V</b></p>	<p><b>Automotive</b></p> <p><b>Gate Drivers</b></p>		<p>180nm SOI BCD (200+ V)</p> <p>180nm Bulk Resurf (140V)</p>	<ul style="list-style-type: none"><li>• SOI 200V Available</li><li>• SOI 300V Roadmap</li><li>• Bulk up to 140V</li><li>• Galvanic Isolation</li></ul>
<p><b>200mm</b></p> <p><b>≤80V</b></p>	<p><b>Automotive</b></p> <p><b>Industrial</b></p> <p><b>Computing</b></p>		<p>180nm BCD</p>	<ul style="list-style-type: none"><li>• 1.8V Digital</li><li>• 5V to 80V Power</li><li>• 32V R<sub>dson</sub> (mohm-mm<sup>2</sup>): 9.8 Available; 5.9 Roadmap</li></ul>
<p><b>300mm</b></p> <p><b>≤16V</b></p>	<p><b>Computing</b></p> <p><b>Mobile</b></p> <p><b>Smart Power</b></p>		<p>65nm BCD</p>	<ul style="list-style-type: none"><li>• 1.2V Digital</li><li>• 5V, 12V, 16V Power</li><li>• 0.9 mohm-mm<sup>2</sup> at 11V</li><li>• NVM Options</li></ul>



# TOPS

Transfer,  
Optimization  
and Process  
development  
Services

# Micro LED Display



**\$71B by 2027 with CAGR ~65%**

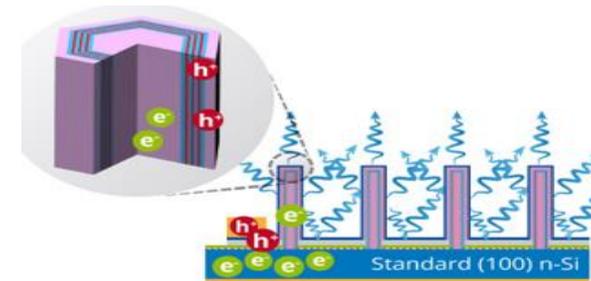
Source: n-tech Research 2018

## MicroLED Display Market

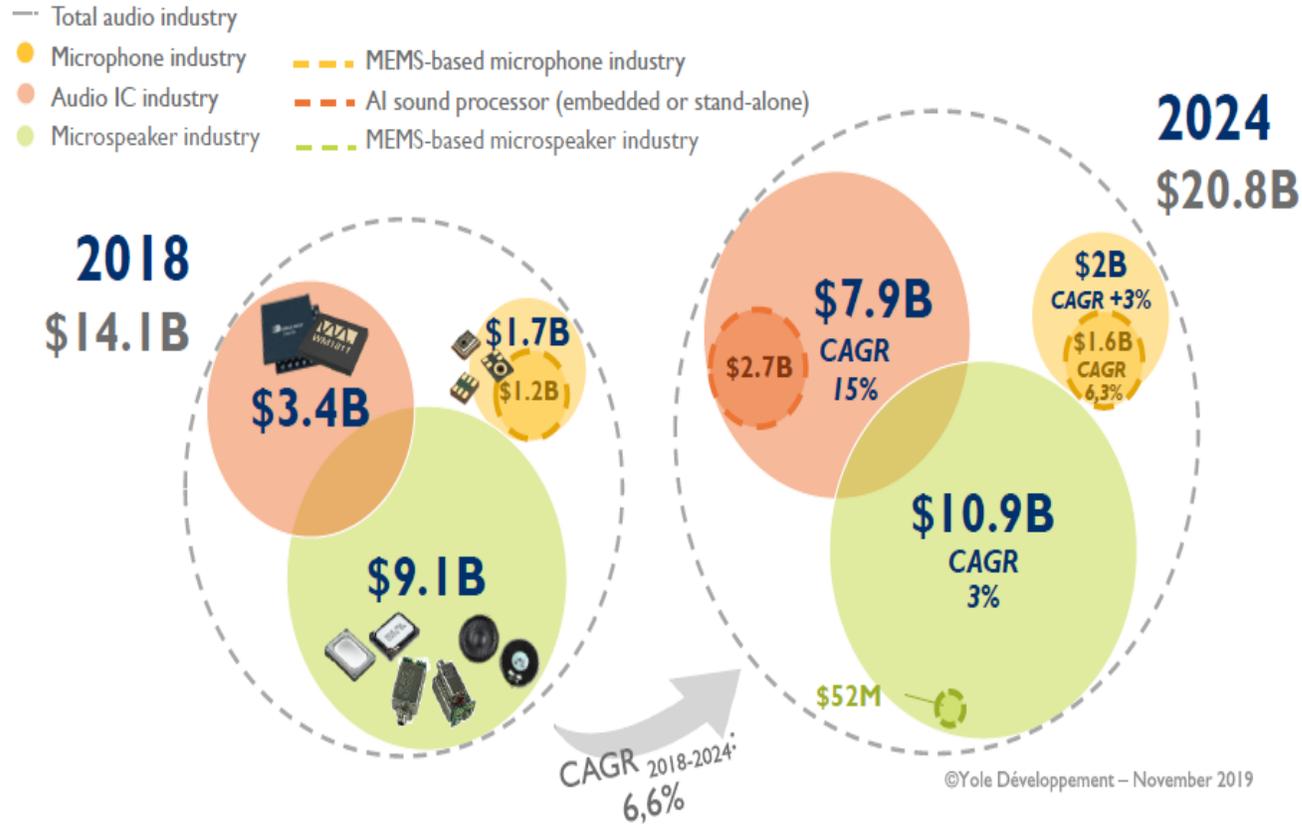
- MicroLED Display forecast at \$71B in 2027 with 65% CAGR
- MicroLED Display is suitable in AR, Smartwatch, HUD, Smartphone, Automotive.

## TowerJazz progress in MicroLED Display

- development partnership with Aledia on next-generation 3D LEDs for display applications based on its gallium-nitride-nanowires-on-silicon platform



# MEMS Microphone



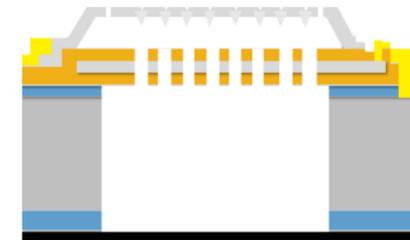
Source: Yole Development – Nov 2019

## MEMS Microphone Market

- MEMS microphone at \$1.2B in 2018
- MEMS microphone forecast at \$1.6B in 2024 with 6.3% CAGR
- Expand to MEMS microspeaker with forecast of \$52M in 2024.

## TowerJazz progress in MEMS Microphone

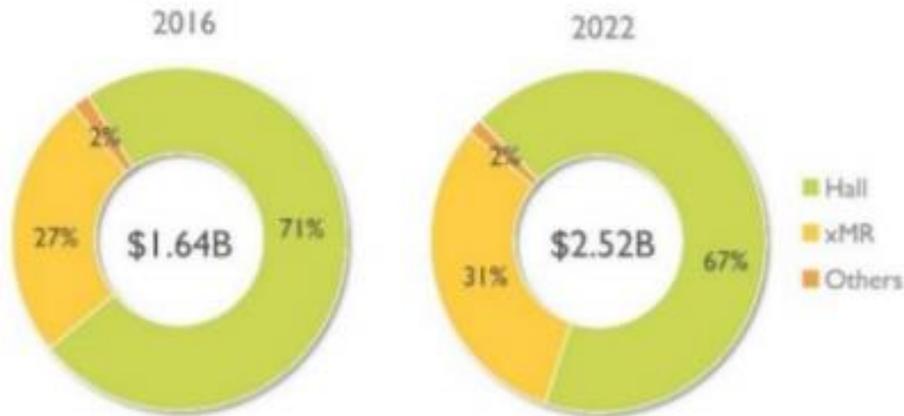
- MEMS microphone customer ready to production in 8" fab
- Actively engaging new MEMS microphone customers with proven process capability



# TMR sensor

## Technology market share evolution

(Source: Magnetic Sensor Market and Technologies 2017 report, Yole Développement, November 2017)



New technologies xMR (AMR, GMR, TMR) increase market share of total magnetic sensor forecast

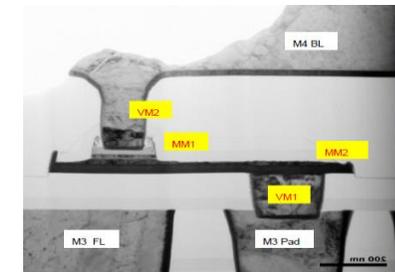
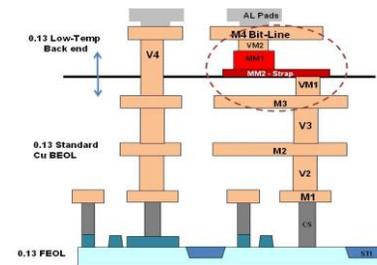
Source: Yole Development – Nov 2017

## xMR sensor Market

- 2022 Total magnetic sensor forecast is \$2.52B
- 2022 xMR (AMR, GMR, TMR) forecast is 31% of \$2.52B (\$0.78B)
- Total magnetic sensor forecast for 2025 is \$3.2B with 6.8% CAGR

## TowerJazz progress in TMR sensor

- Technology partnership with Crocus
- Actively engaging new TMR sensor customers with proven process capability

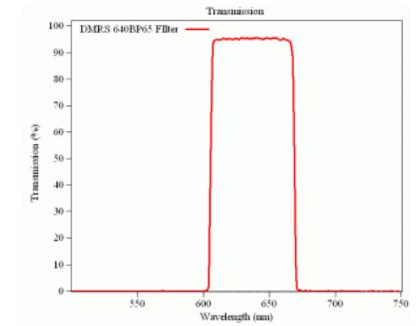
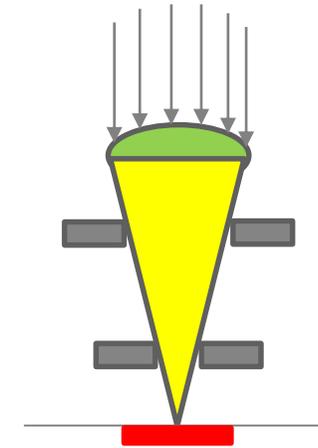
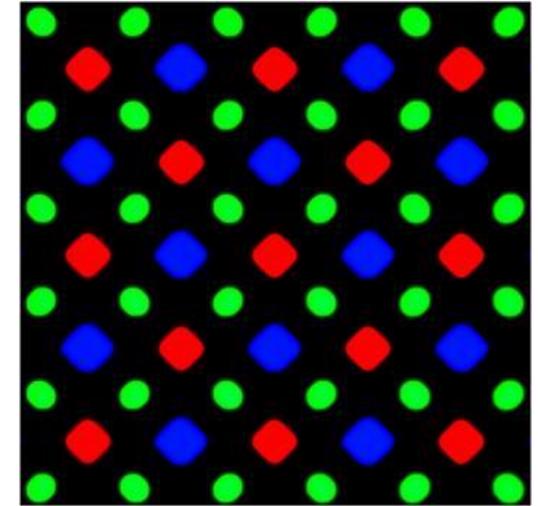


# Sensors



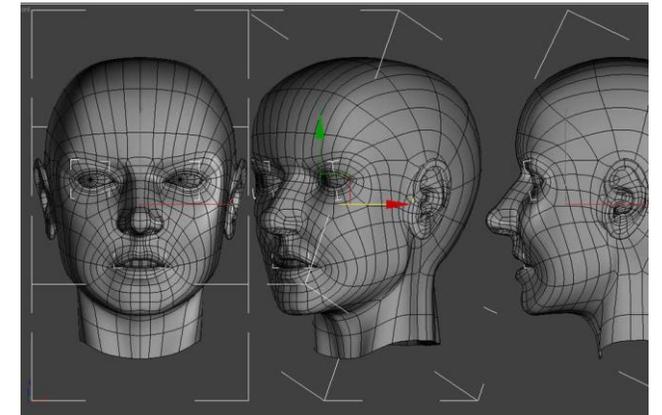
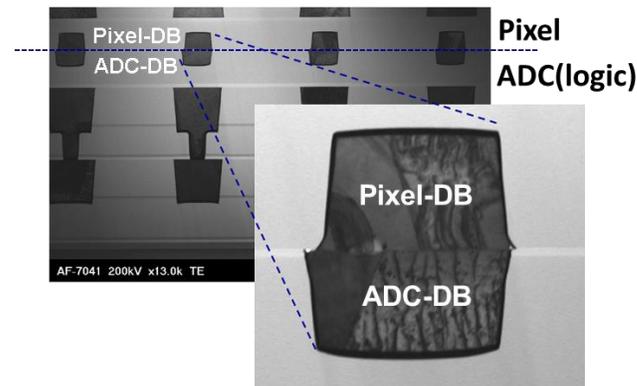
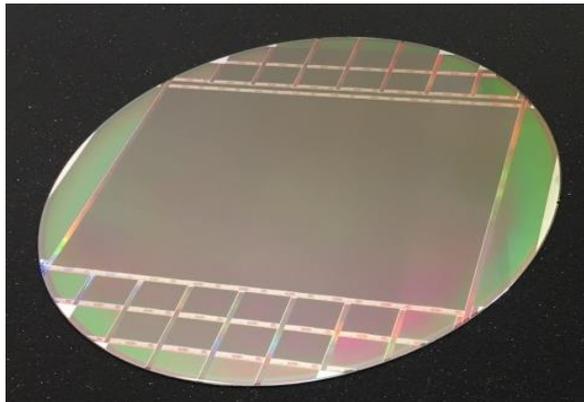
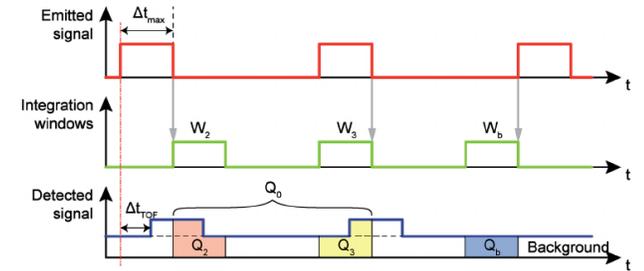
# 200mm 2020: filling our fabs

- Under OLED Optical Fingerprint 1:1 sensors for the next generation flagship smartphones
  - Unique pixel technology
  - Special optical filter solutions for best performance
  - Very large market as sensor size is big
  - Will utilize our 180nm capacity in several of our fabs
- Increase volume of medical and dental X-Ray using our state-of-the-art stitching technology



# 300mm Opportunity for TowerJazz Image Sensors

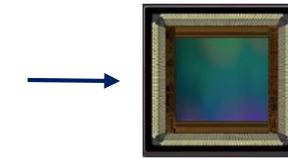
- Time of Flight (ToF) next generation sensors for face recognition:
  - Best in class wafer stacking technology with bonding pitch of less than 2um
  - Best dark current performance
  - Large opportunities in cellphone and pay points applications in China
- High-end photography: FSI and Hybrid bonding (3-Layer) BSI
- Machine vision next generation products based on state-of-the-art and smallest in the world global shutter pixel (2.5um), and global shutter BSI for generation +2.
- Medical X-Ray 1 DPW – unique stitching technology



# 300mm Global Shutter Pixel Technology

Gpixel GMAX0505

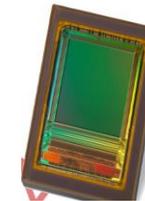
Industry Smallest Pixel at 2.5um with >10K of 1/PLS



SE: 80dB (100dB for 3.6um), Noise: 1e

E2v Emerald, Gpixel GMAX0806

200mm



SE: 70dB  
Noise: 2e

Intel



On Semi, e2v, Anafocus, CMOSIS, Dalsa, Gpixel, ..



Shutter Efficiency  
60dB, Noise: 15e

65nm, 2.5um

300mm

110nm, 2.8um

180nm (IS11), 3.6um

180nm, 5um

2007

2014

2016

2018

# 2020 Focus and Targets



Fill our factories  
200mm and 300mm



Increase 300mm  
capacity for mid to  
long-term demand



Driving future growth  
in each of our  
business units

The image features a stylized globe of the Earth as the background, showing continents and oceans. Overlaid on the globe are several white, glowing satellite orbits and bright starburst points representing satellites. The background is a deep blue gradient with faint stars. In the upper center, the logo 'TOWERjazz' is displayed in a bold, white, italicized sans-serif font. Below the logo, the website address 'www.towerjazz.com' is written in a smaller, white, italicized sans-serif font.

**TOWERjazz**

**[www.towerjazz.com](http://www.towerjazz.com)**