

# How Megatrends will impact MEMS & Sensors.

Leti Innovation Days 2018

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*Yole Développement*



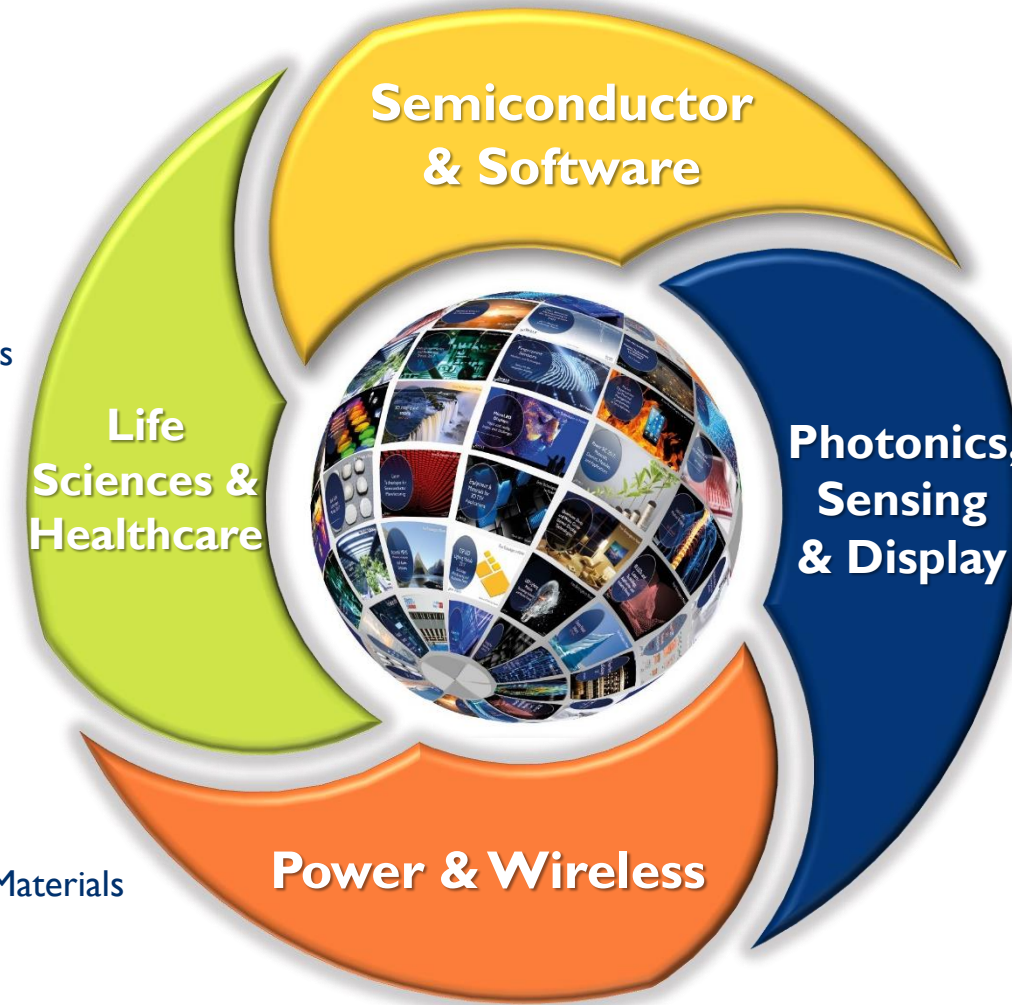


## Life Sciences & Healthcare

- Microfluidic
- BioMEMS
- Inkjet Printing
- Solid-State Medical Imaging & BioPhotonics
- Bio Technologies

## Power & Wireless

- RF Devices & Technology
- Compound Semiconductors & Emerging Materials
- Power Electronics
- Batteries & Energy Management



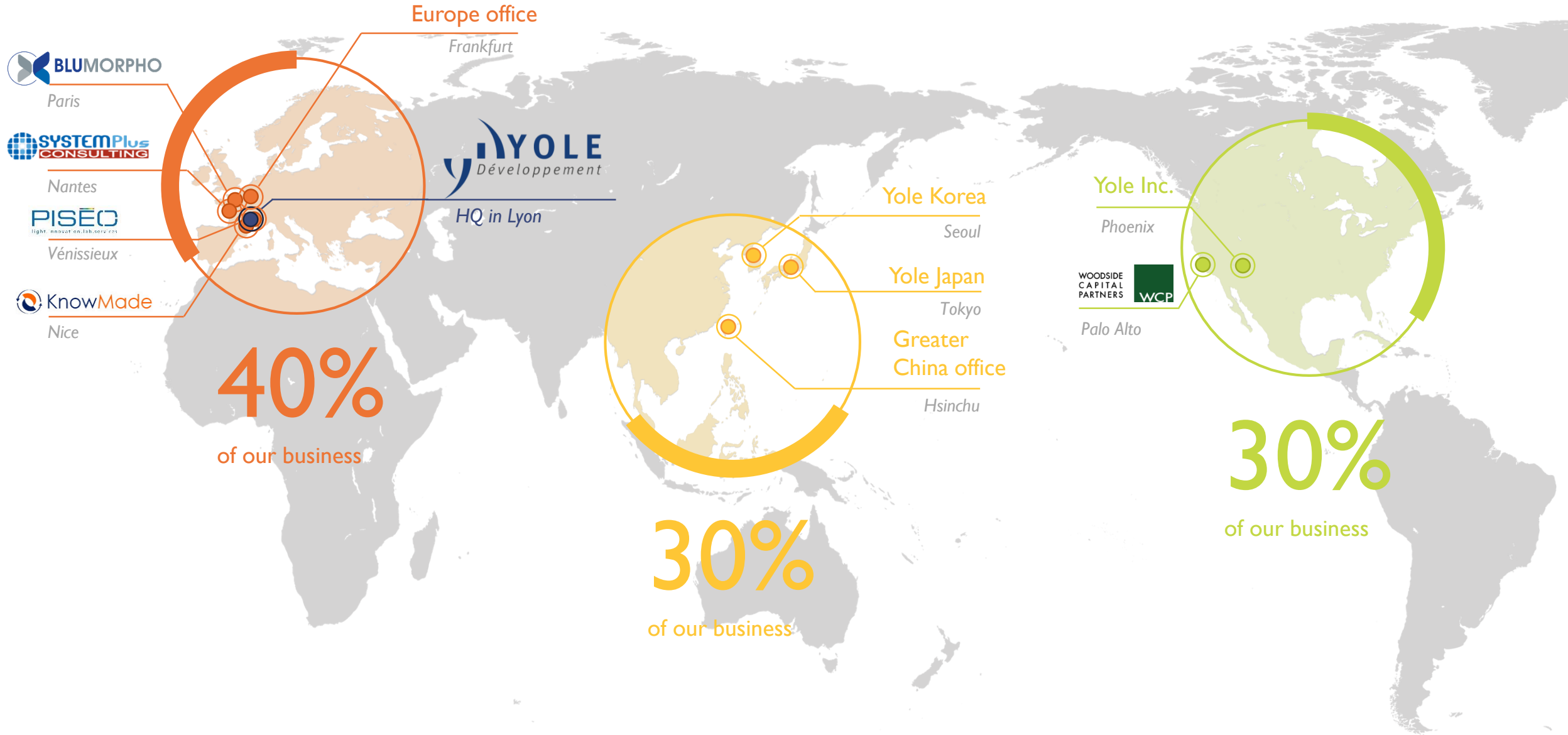
## Semiconductor & Software

- Package & Assembly & Substrates
- Semiconductor Manufacturing
- Memory
- Software & Computing

## Photronics, Sensing & Display

- Solid-State Lighting & Display
- MEMS, Sensors & Actuators
- Imaging
- Photonics & Optoelectronics

# OUR GLOBAL ACTIVITY



# ELECTRONIC MEGATRENDS: 2021 MARKET INDICATORS



2021

\$1,630B  
100M

(incl. 25%  
autonomous cars  
at Level 2 and  
more)



**Smart Automotive**

2021

\$500B

Market value

2.5B

Units sold  
per year



**Mobile**

2021

\$272B

Bandwidth

x100

Latency

/100

Compared to 4G



**5G**

2021

\$ 80B

Hardware

value



**Hyperscale  
Data Centers**

2021

\$8.5B

35M

(included  
VR/AR/MR  
untethered and  
tethered  
headsets)

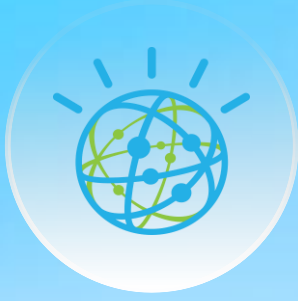


**AR/VR**

2021

\$12B

Hardware  
Market  
value



**AI/ML**

2021

\$20B

(µphone +  
audio IC +  
µspeaker)



**Voice Processing**

2021

\$8.5B

BioMEMS  
Market  
value



**Healthcare**

2021

\$100B

Robotics, IoT,  
Advanced HMI



**Industry 4.0**

# A \$75B MARKET FOR MEMS AND SENSORS



2021  
\$1,630B  
100M  
(incl. 7% autonomous cars at Level 2 and more)

**2023 sensors value: \$20.4B**

Radars, image sensors, lidars

**Smart Automotive**

2021  
\$500B  
Market value  
2.5B  
Units sold per year

**2023 sensors value: \$48B**

3D sensing, RF, image sensors

**Mobile**

2021  
\$272B  
Bandwidth  
**x100**  
Latency  
**/100**  
Compared to 4G



**5G**

2021  
\$ 80B  
Hardware value



**Hyperscale Data Centers**

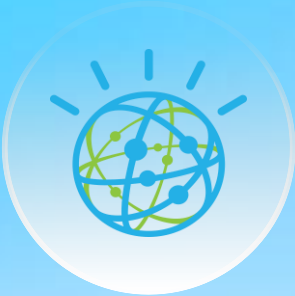
2021  
\$8.5B  
35M  
VR/AR/MR untethered and tethered headsets)

**2023 sensors value: \$100M**

Image sensors

**AR/VR**

2021  
\$12B  
Hardware Market value



**AI/ML**

2021  
\$20B  
(µphone + audio IC + µspeaker)

**2023 sensors value: \$1.4B**

Microphones

**Voice Processing**

2021  
\$8.5B  
BioMEMS Market value

**2023 sensors value: \$2.3B**

Microfluidics

**Healthcare**

2021  
\$100B  
Robotics, IoT, Advanced HMI

**2023 sensors value: \$3.2B**

Magnetic, image sensors, 3D sensing

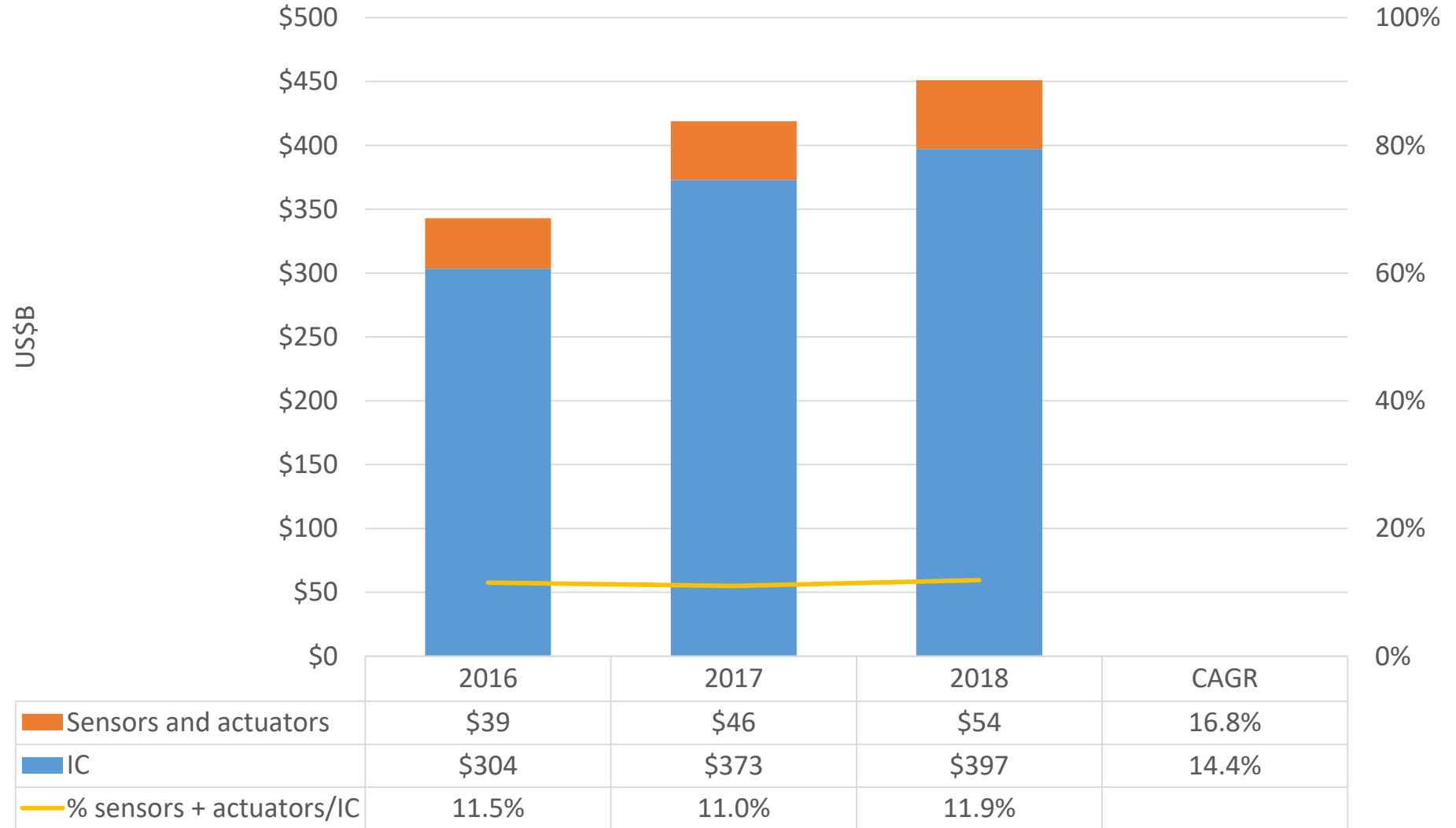
**Industry 4.0**

# TOTAL IC & SEMICONDUCTOR-BASED SENSOR AND ACTUATOR MARKET



The sensor and actuator market is growing faster than the IC market.

Sensors and Actuators vs. IC forecast



# 2018 PLANE, CAR, SMARTPHONE SENSOR CONTENT



**1 year** for manufacturing

**1-2 days** for manufacturing

**Few hours** for manufacturing

**5k** sensors

**50-100** sensors

**10-20** sensors

**%** Sensor value/system: **5%**  
Sensor value: **\$5M**

**%** Sensor value/system: **2.5%**  
Sensor value: **<\$1,000**

**%** Sensor value/system: **6%**  
Sensor value: **\$30**



Plane ASP: \$100M  
Sensor ASP: \$1,000

**10 years** of R&D



Car ASP: \$30,000  
Sensor ASP: \$10

**5 years** of R&D

**Sensor value will grow**  
(autonomous vehicles)



Smartphone ASP: \$500M  
Sensor ASP: \$2

**6 months-1 year** of R&D

**Sensor value will grow**  
(3D sensing)

# 2018 PLANE, CAR, SMARTPHONE SENSOR CONTENT



**1 year** for manufacturing

**1-2 days** for manufacturing

**Few hours** for manufacturing

**BY 2030, SENSOR VALUE WILL BE**

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**BY 2030, SENSOR VALUE WILL BE**

**10% OF THE SYSTEM**

**20% OF THE SYSTEM**

**30% OF THE SYSTEM**

Plane ASP: \$100M  
Sensor ASP: \$1,000



**10 years** of R&D



**5 years** of R&D

Car ASP: \$30,000  
Sensor ASP: \$10  
**Sensors value will grow (autonomous vehicles)**



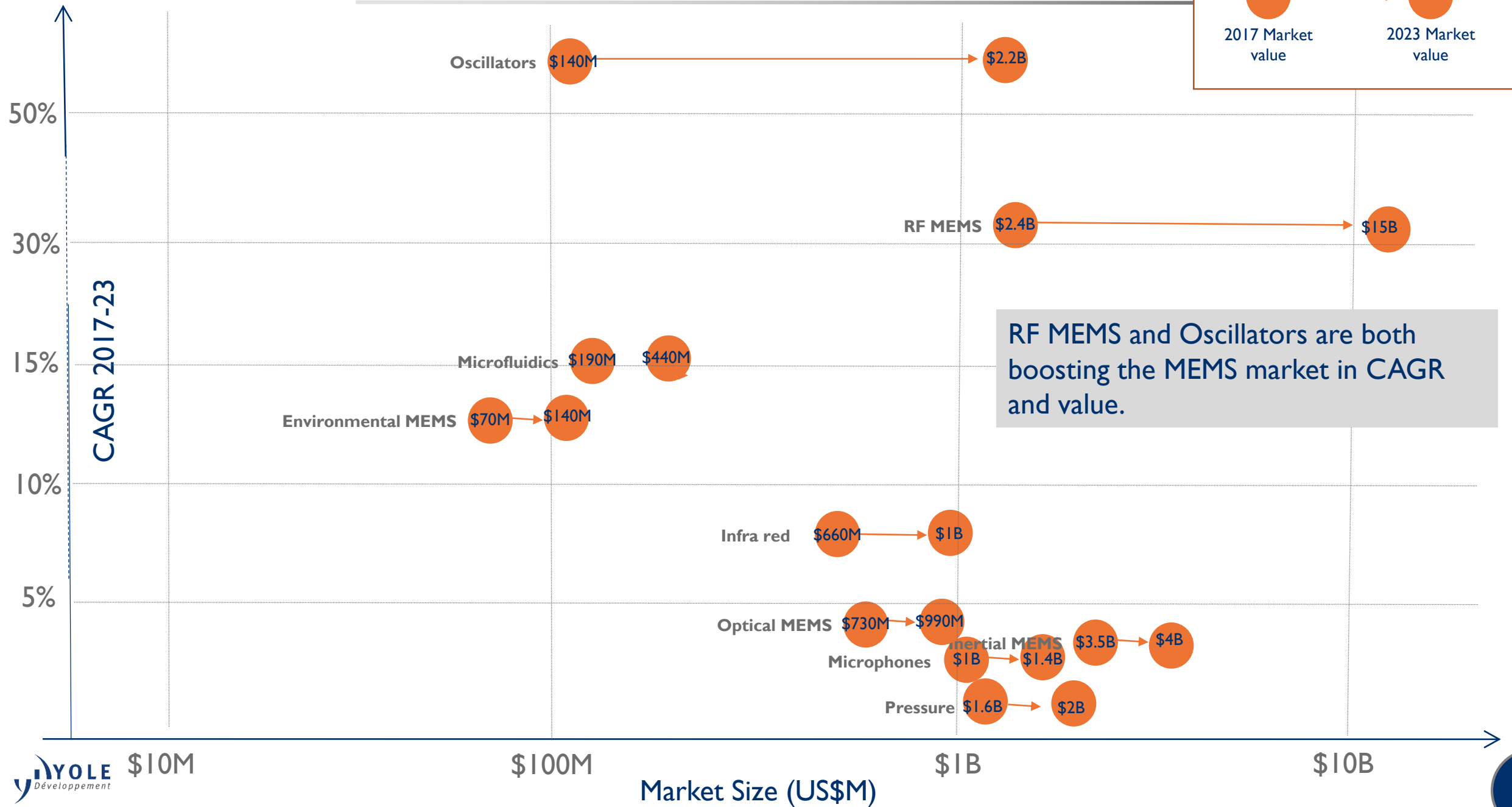
**6 months-1 year** of R&D

Smartphone ASP: \$500M  
Sensor ASP: \$2  
**Sensors value will grow (3D sensing)**





# MEMS MARKET SIZE VS. CAGR



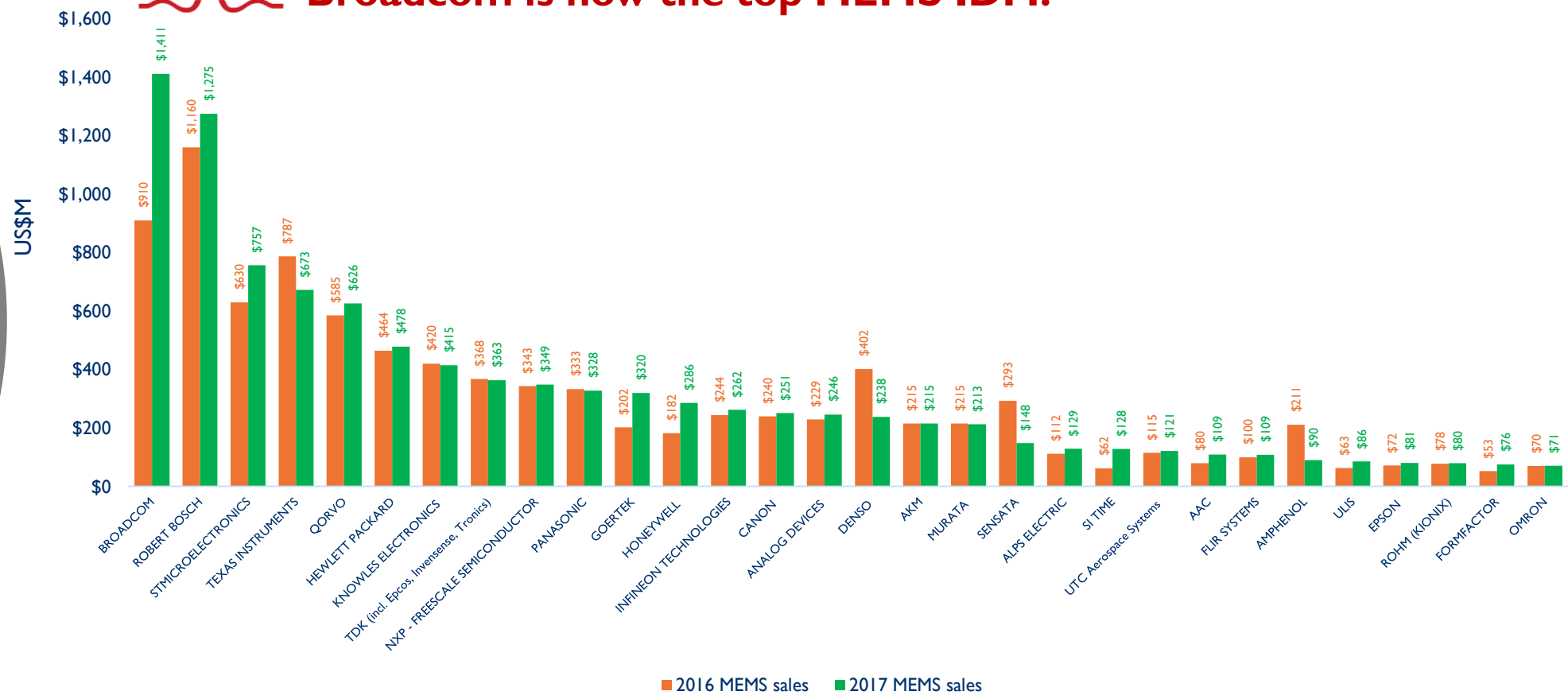


# 2017 RANKINGS - TOP 30 MEMS PLAYERS

Broadcom climbed from #2 in 2016 to #1 in 2017!

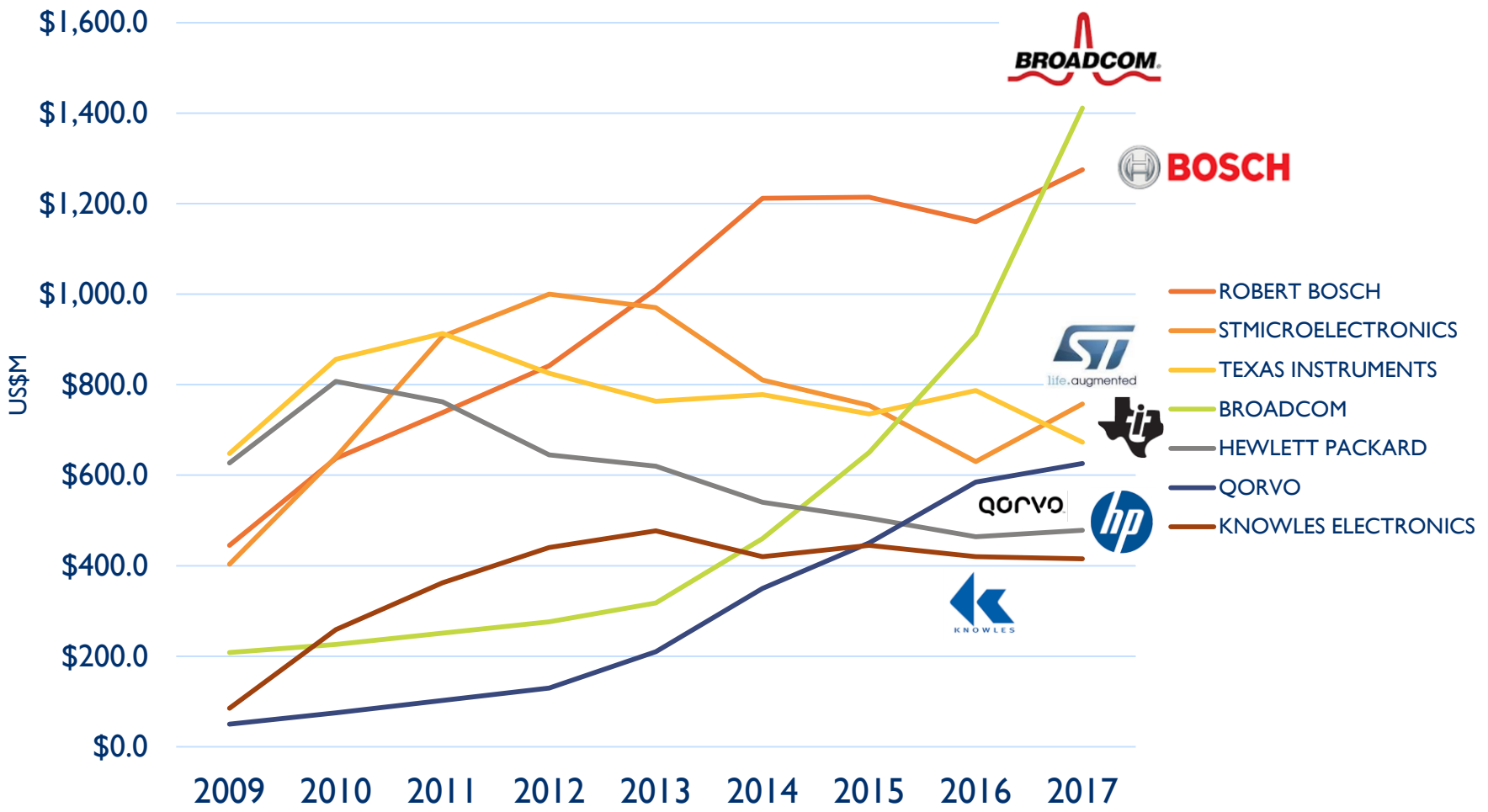


**Broadcom is now the top MEMS IDM.**

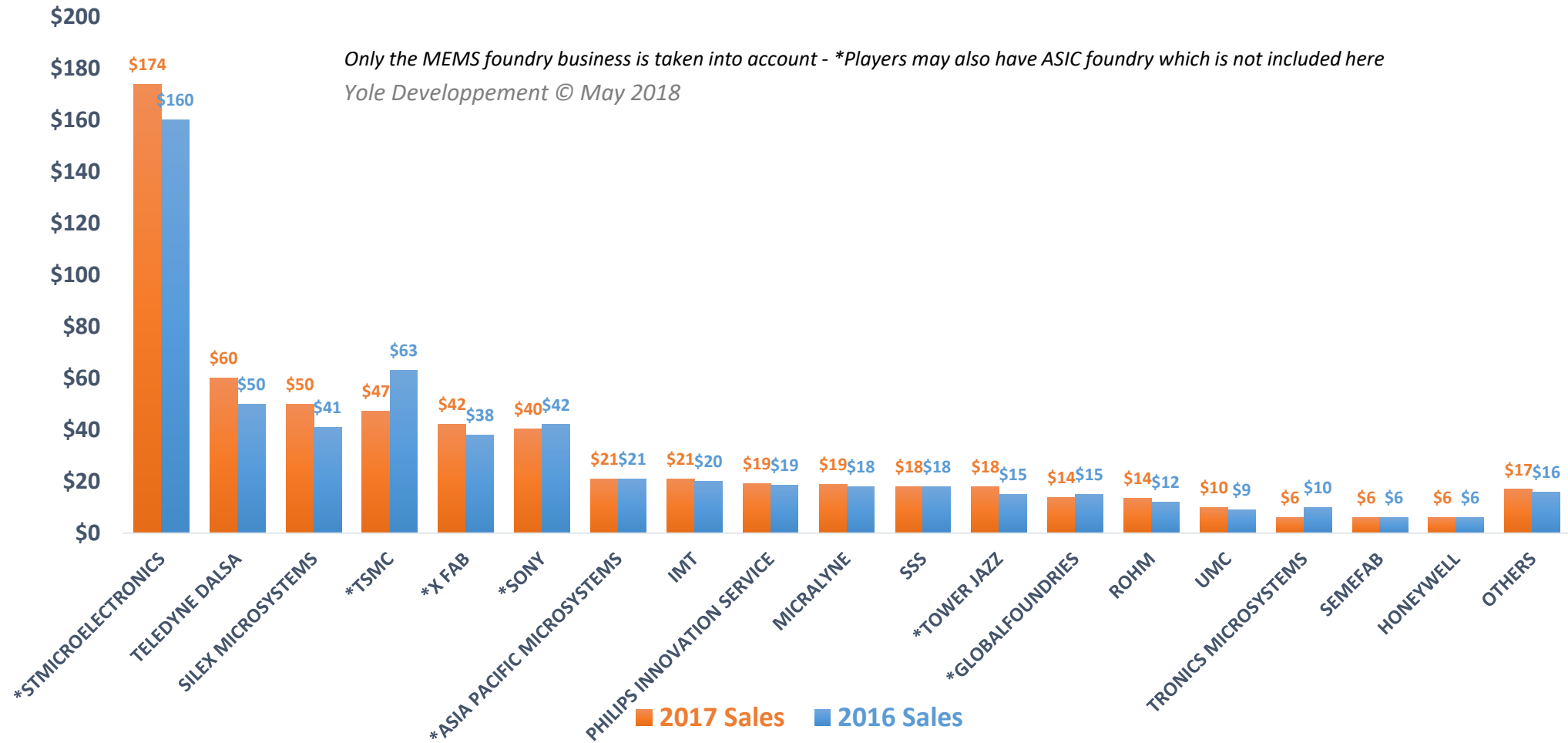




## Different MEMS companies, different stories









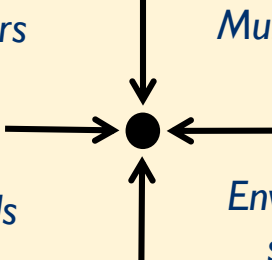


# MEMS FOUNDRIES



# A NEW INNOVATION WAVE FOR MEMS: ANOTHER 10 YEARS OF R&D



Areas	<p><b>DETECTING AREA</b></p> <p>Si as a new sensor material</p>	<p><b>MEASURING AREA</b></p> <p>New materials and processes</p> <p>New sensor design</p> <p>Improved electronics</p>	<p>New use cases</p> <p><b>GLOBAL ENVIRONMENT PERCEPTION AREA</b></p> <p>New integration and packaging approaches</p>	<p>Sensor fusion</p> <p>New detection principles</p> <p>AI</p>
Parameters	<p>Pressure</p>  <p>Acceleration</p> <p><math>g = 9.81 \text{ m/s}^2</math></p>	<p>Yaw</p>  <p>Visible</p>  <p>Sound</p>  <p>Infra red</p> 	<p>Hyperspectral</p>  <p>IR, Visible</p> <p>Gas</p> <p>Ultra sound</p>  <p>Radio frequency</p> 	<p>Odors</p> <p>Multi spectral</p> <p>etc .. (empathy)</p> <p>IMUs</p> <p>Environment sensors</p> <p><b>Multi-parameters</b></p> 
Time scale	<p>1980-1990s: only mechanical movement / pressure / shock can be sensed by MEMS.</p>	<p>1990-2000s: rotation sensing and visible light management (DLP) are now accessible to MEMS technologies.</p>	<p>2000-2015s: sound and IR wavelengths are accessible to MEMS technologies.</p>	<p>2015-future: MEMS will sense and manage a wide range of waves: ultrasonic / directive sounds / ultrasonic / RF / hyperspectral ...</p>



- 2017 has been quite a good year for the MEMS markets.
- Although the MEMS market reached maturity, it is still expected to grow at a significant rate: 18% in value and 27% in units, over 2018-23.
- With new mega trends such as robotic cars, autonomous vehicles, AI, AR/VR, 5G, Industry 4.0, ... the demand for sensors will grow as for MEMS.
- It is still a domain with a lot of innovation as new devices are in R&D (speakers, gas sensors, hyperspectral imagers ...). This wave of innovation is also confirmed by the good 2017 business year realized by most of the MEMS foundries.
- This business is highly dynamic, as shown by the shuffle of the MEMS players ranking in 2017/2016 where RF MEMS players are moving to higher ranks.

**THANK YOU FOR YOUR ATTENTION.**



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