



Wearable MEMS Sensor requirements

Shanghai, 14th of May 2014

Leopold Beer, Regional President Asia Pacific

Bosch Sensortec

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Agenda

- The MEMS Industry today
- State of the art solution portfolio and challenges
- Requirements for next generation & wearable solutions

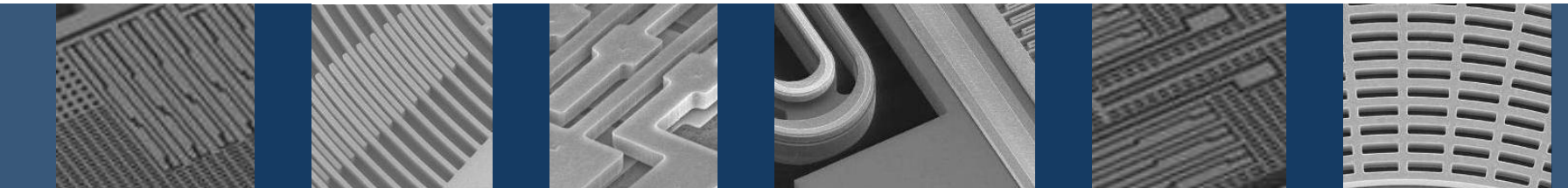
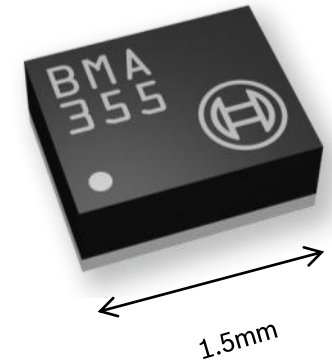
Bosch Sensortec – The MEMS technology leader



MEMS is microscopic fascination

“**MEMS**” = “**M**icro-**E**lectro-**M**echanical **S**ystem”

- MEMS are miniature systems which usually combine tiny mechanical structures with electronic circuits. Typical individual structures have a size of a few μm
- Bosch Engineers invented the DRIE process that is the basis for all MEMS manufacturing today



Bosch – Broad Application MEMS sensor supplier

Out of one hand MEMS sensors, actuators and solutions

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CE

- Accelerometers
- Geomagnetic sensors
- Gyroscopes
- Pressure sensors
- Humidity sensors
- Combo sensors
- ASSNs

Akustica



CE

- MEMS microphones

Bosch Connected Devices & Solutions



CE & Industrial

- Smart sensor/ actuator nodes
- Embedded SW & algorithms
- Customized IoT sensor & actuator solutions

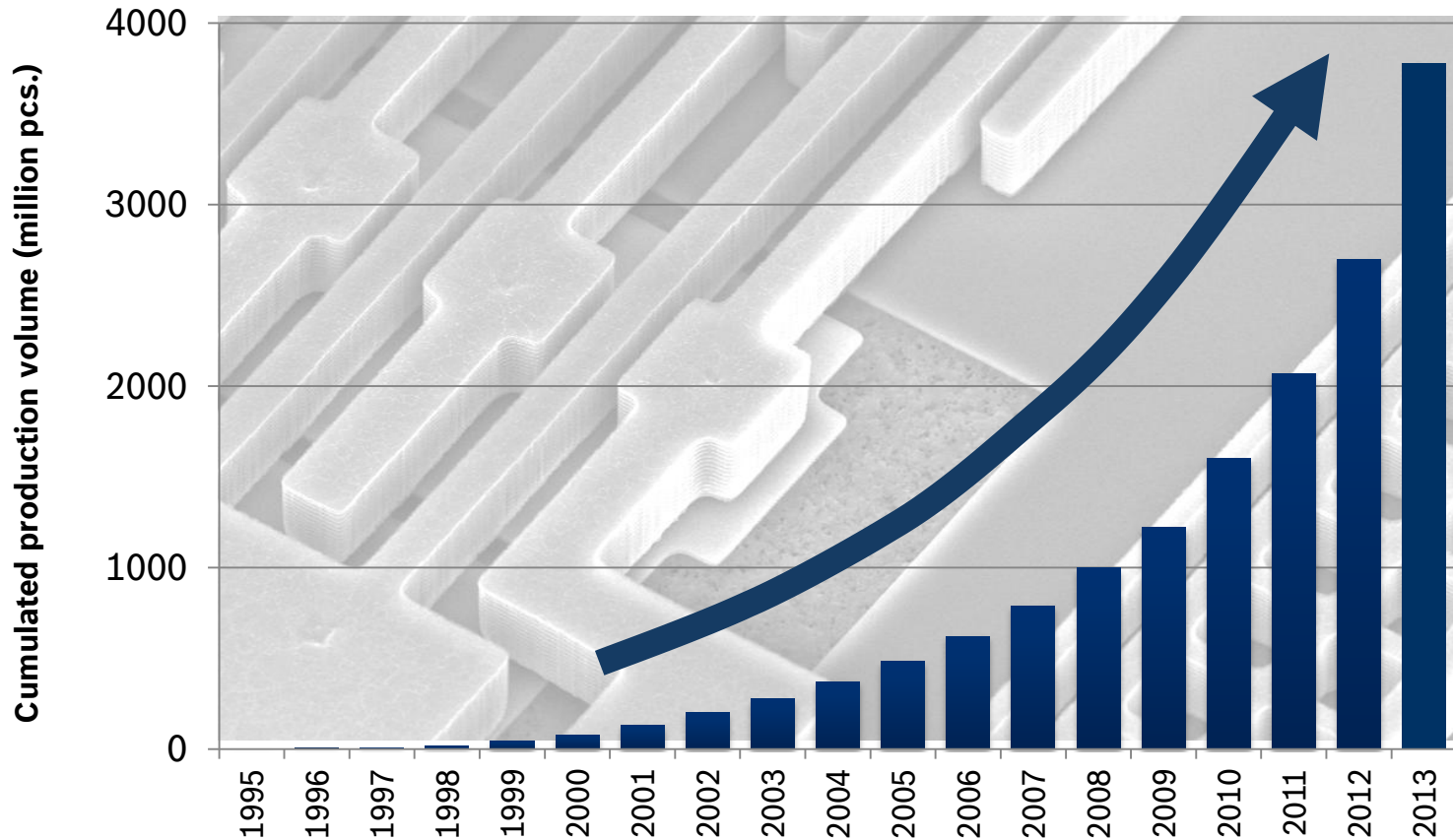
Automotive Electronics



Automotive

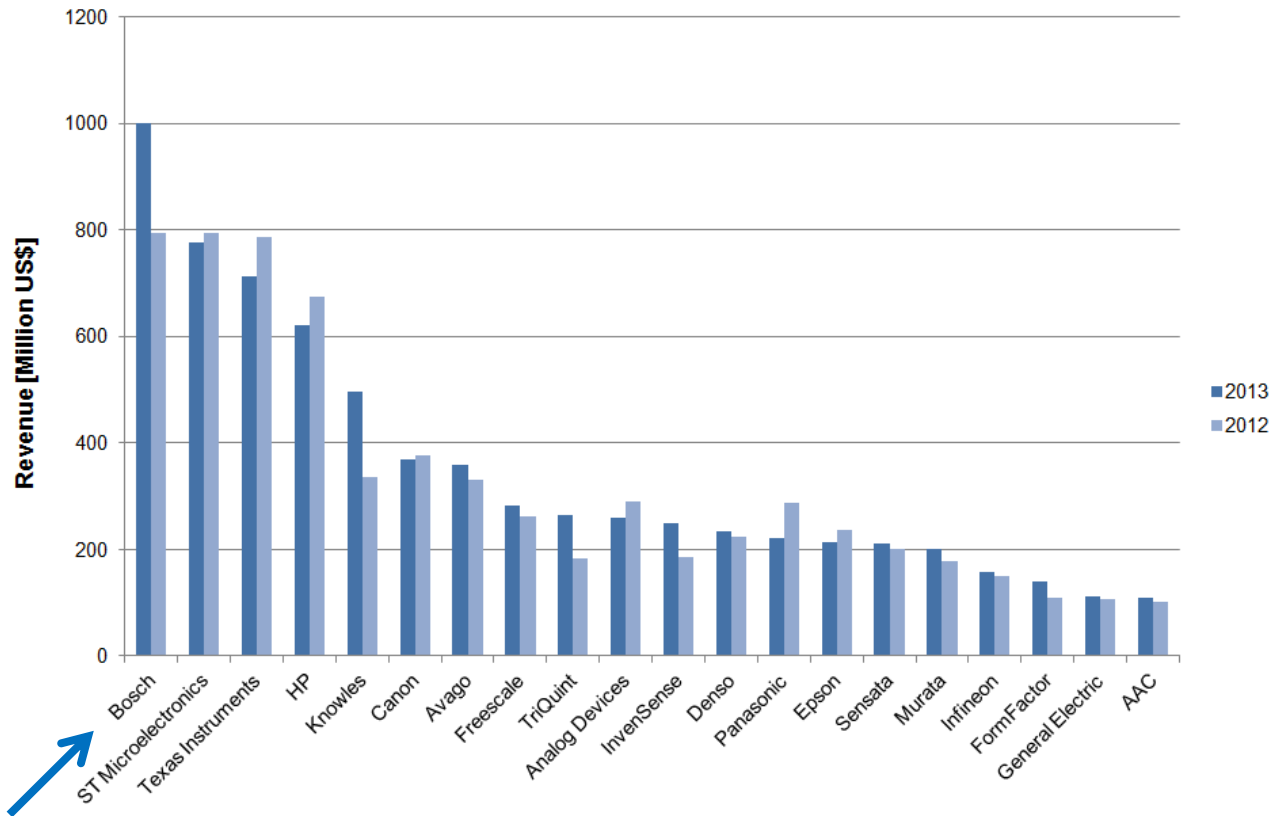
- Accelerometers
- Angular rate
- Pressure sensors
- Mass flow sensors

Bosch MEMS sensor shipments



MEMS a quite fragmented market

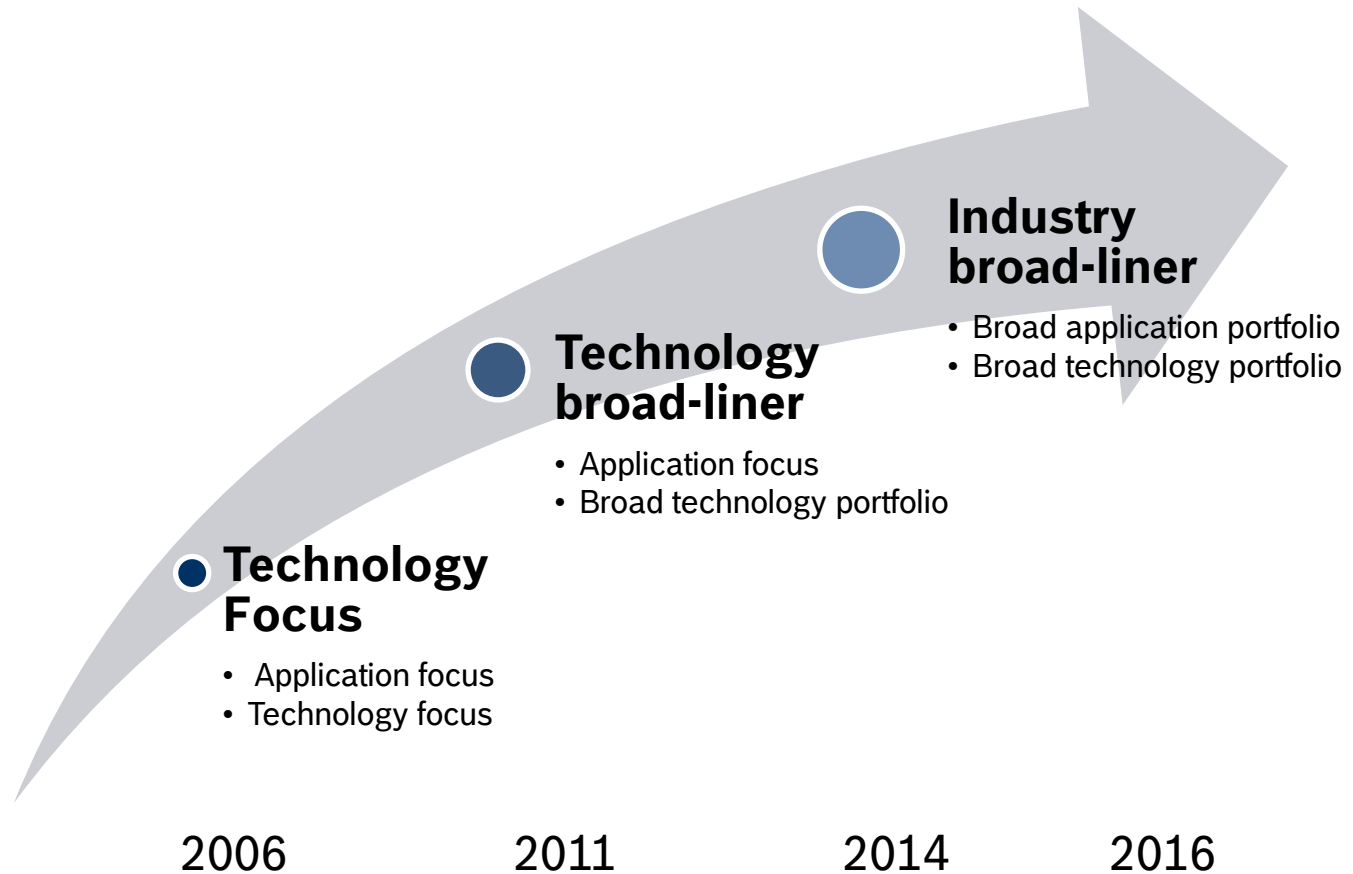
Top 20 MEMS Manufacturers in Revenue



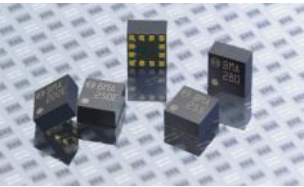

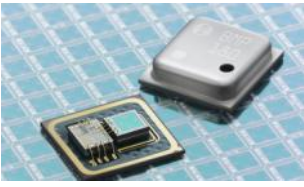
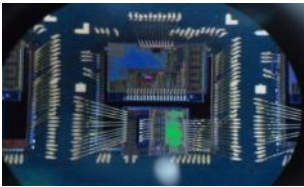
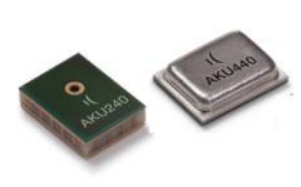






Source: IHS Technology, March 2014



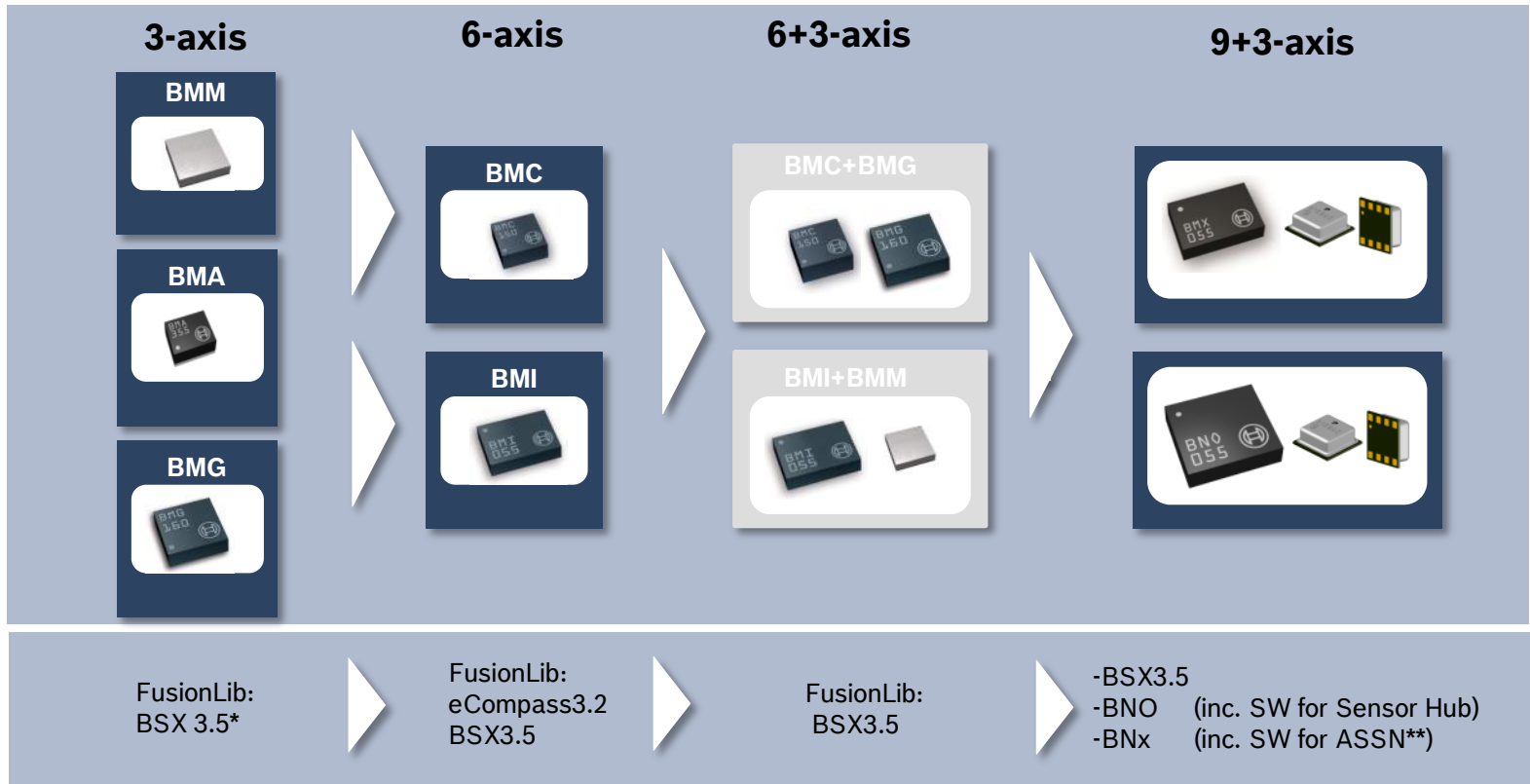
Bosch Sensortec Strategy



Requirement: Broad technology portfolio

Inertial	Geomagnetic	Environmental	Sensor Clusters	Microphones
				
<ul style="list-style-type: none">■ Accelerometer■ Gyroscope■ IMU■ 9-axis 	<ul style="list-style-type: none">■ eCompass■ GeoMag■ Magnetic Gyro 	<ul style="list-style-type: none">■ Barometric Pressure■ Integrated Environmental Unit 	<ul style="list-style-type: none">■ Sensor Hubs■ ASSN Application Specific sensor nodes 	<ul style="list-style-type: none">■ Analog and digital MEMS microphones (Akustica)■ High quality voice input for mobile devices 
<h3>Sensor data-fusion software ties everything together</h3>				

Solutions for all applications



Different applications require different solutions

*Bosch Sensortec Sensor Data Fusion
**Application Specific Sensor Node



What's Next ?

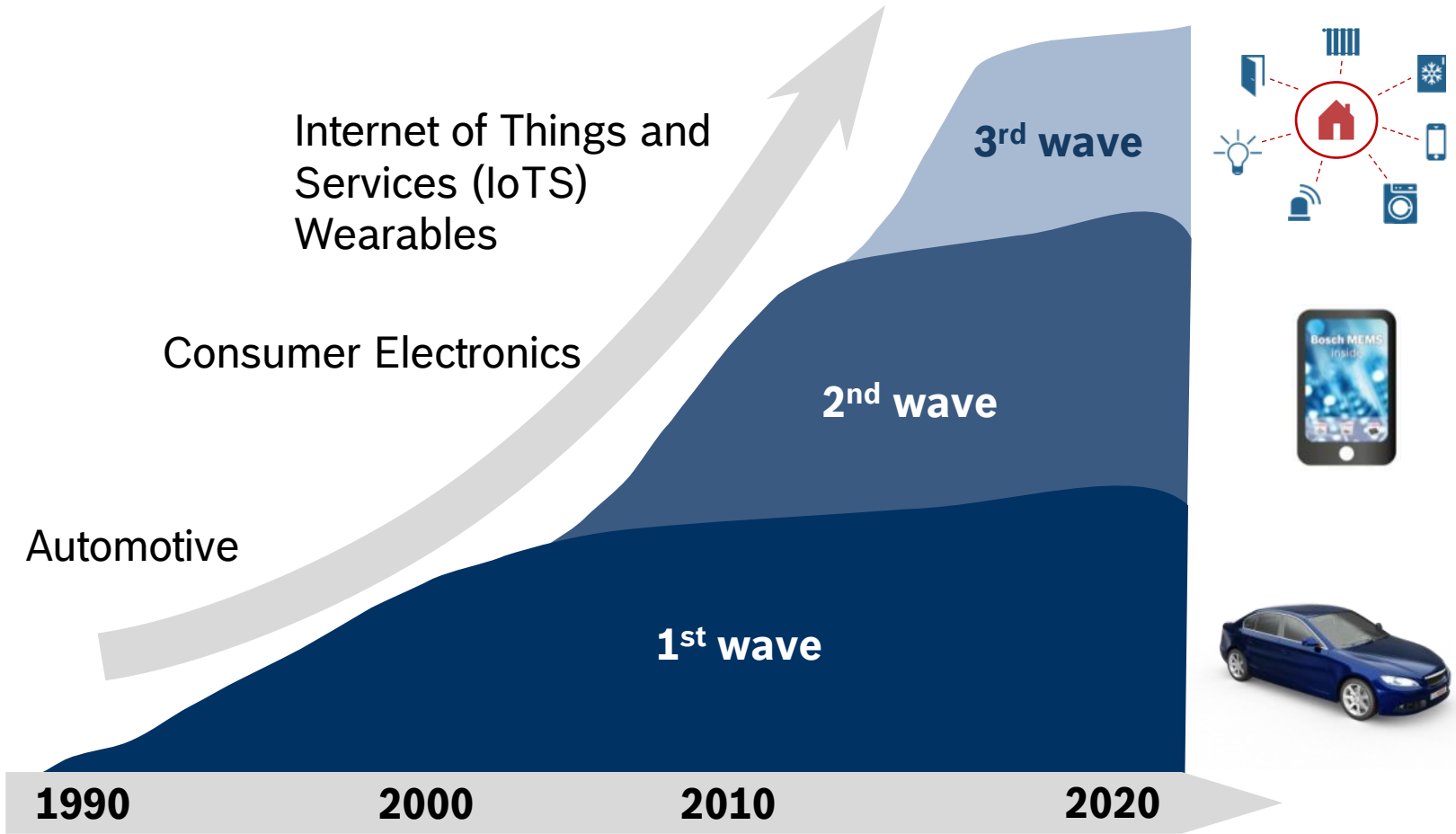
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Waves of MEMS sensor proliferation



Applications on parallel evolution paths

→ **Automotive**

- New applications related to driver assistance arising
- Integration trend and sensor function (platform) clustering
- Distributed intelligence sensor networks

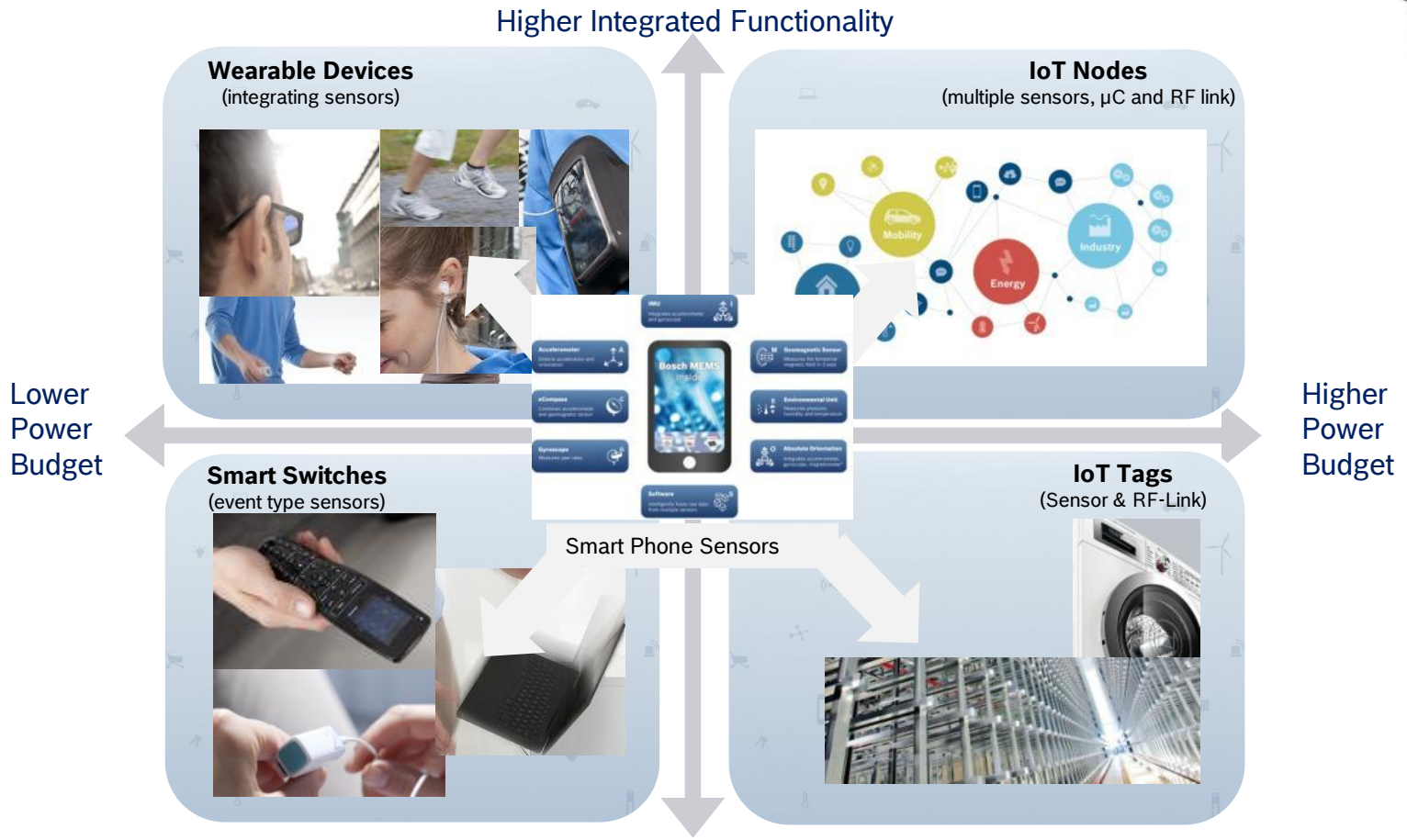
→ **Consumer electronics (biggest market today)**

- Development further driven by smartphone's & tablets
- SiP & SoC integration goes in parallel (application driven)
- Total integrated solutions (HW & SW) are the trend

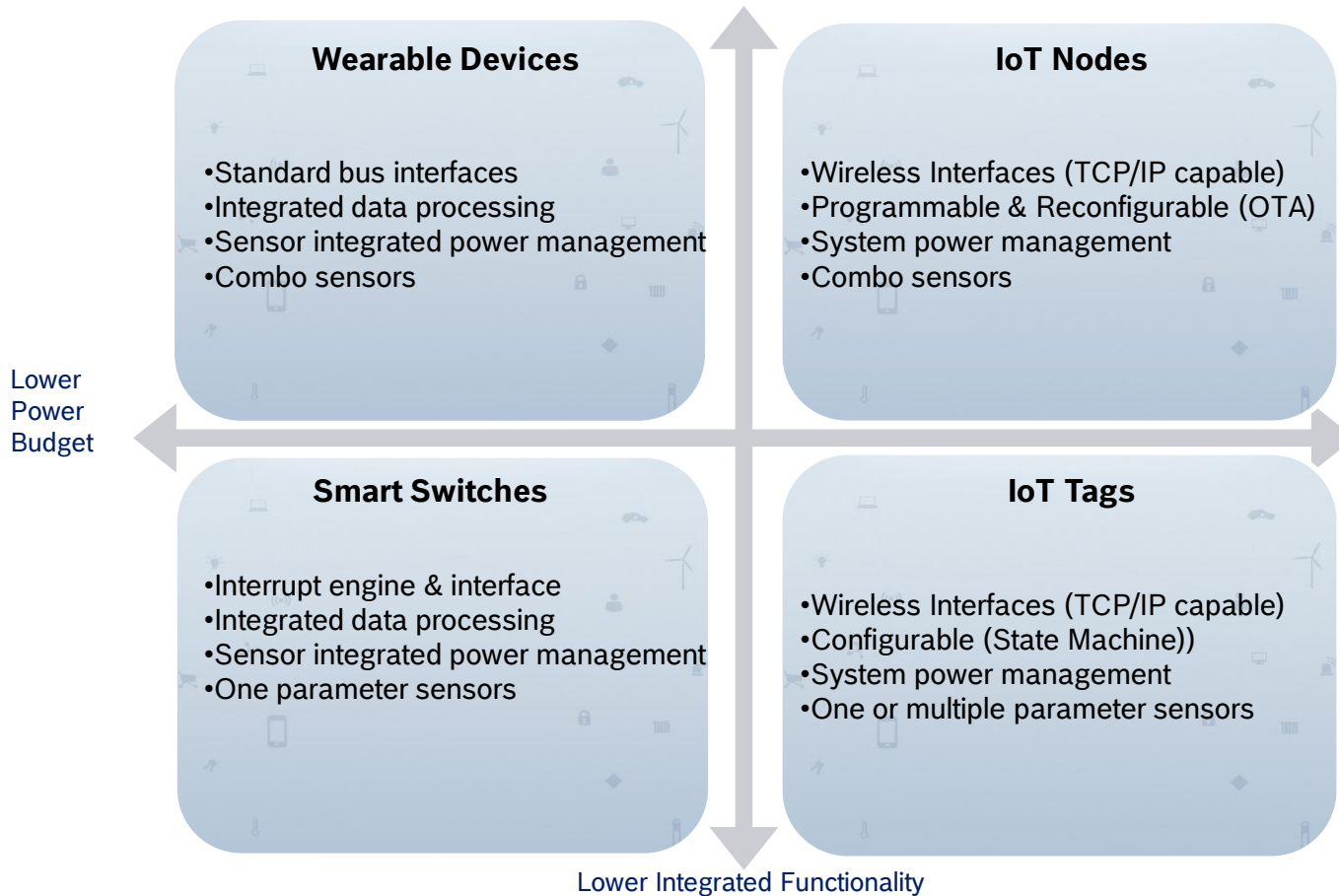
→ **New evolving markets**

- New applications related to wearable's and IoT's
- Will follow own integration rules – application driven
- Sensor nodes, smart switches and tags will be main categories

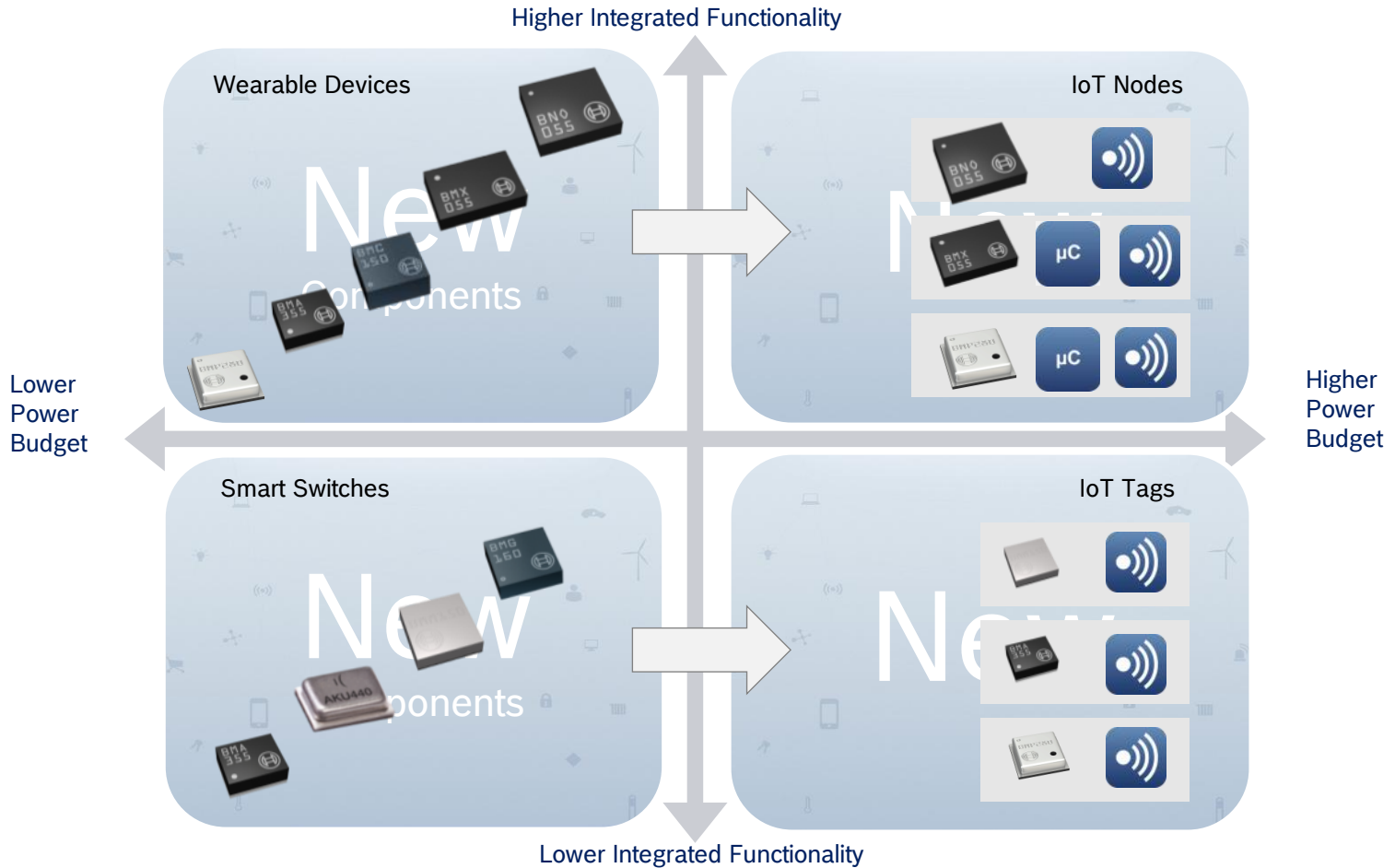
Market evolution



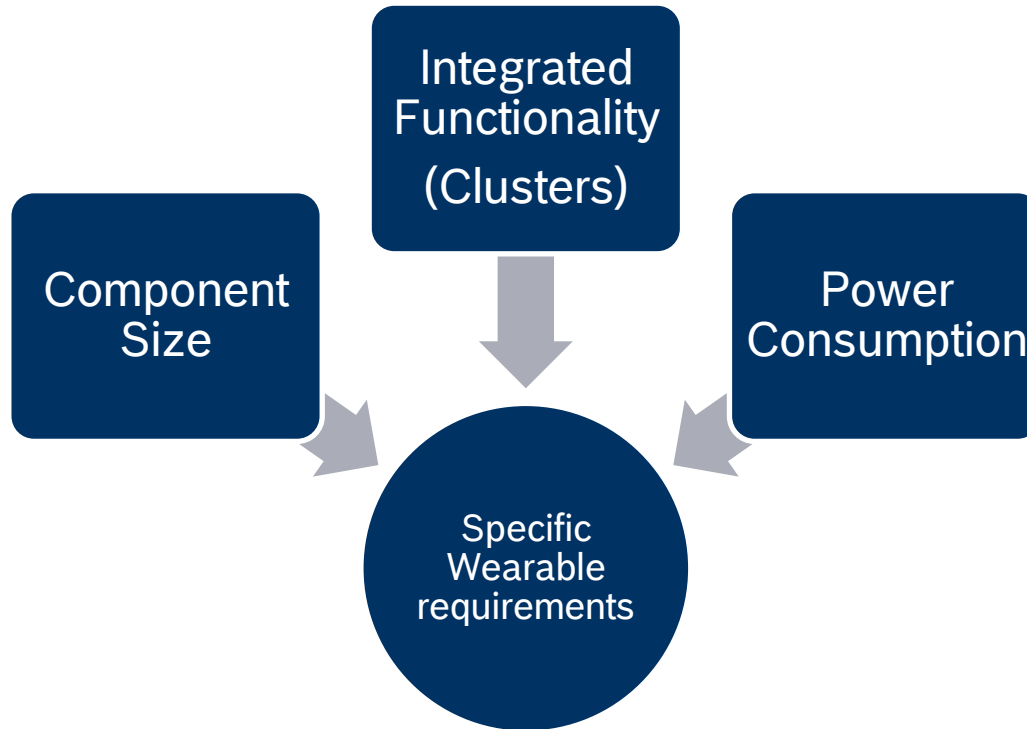
Top Level Product Requirements



The path towards new (interdependent) solutions



Key Component Criteria for Wearable devices



Conflicting requirements – to be solved by technology

Key Trend: sensor clusters



Inertial & Magnetic Sensor Cluster

- Integrated 9-axis (accel., mag., gyro)
- Integrated microcontroller
- Integrated sensor data fusion software



Environmental Sensor Clusters

- Barometric pressure sensors
- Humidity sensors
- Temperature sensors



Acoustical Sensor Clusters

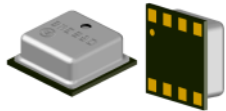
- Acoustical microphones
- Microphone arrays control

Clustering is package & application driven



Closed Packages

- Inertial & Geomagnetic sensors
- IMU & eCompass
- 9-axis nodes



Media port packages

- Barometric pressure sensors
- Integrated Environmental Unit
- Acoustical microphones



Window packages

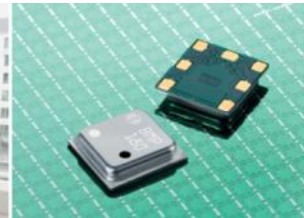
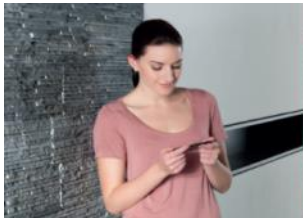
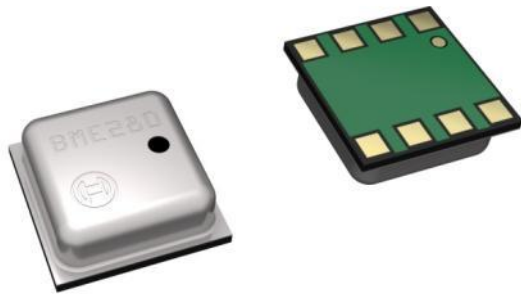
- Optical in port
- Optical out port

New: Integrated Environmental sensor BME280



→ Sensing: pressure, temperature and humidity @ 15 μ A

- Small (2.5 x 2.5 mm²) but excellent performance
- Accuracy tolerance of ± 3 %RH (typ @25 °C for humidity)
- Response time 1 S for humidity
- Absolute accuracy: typ ± 1 hPa after soldering (950...1050 hPa, 0...+40 °C)



New: Application Specific Sensor Node

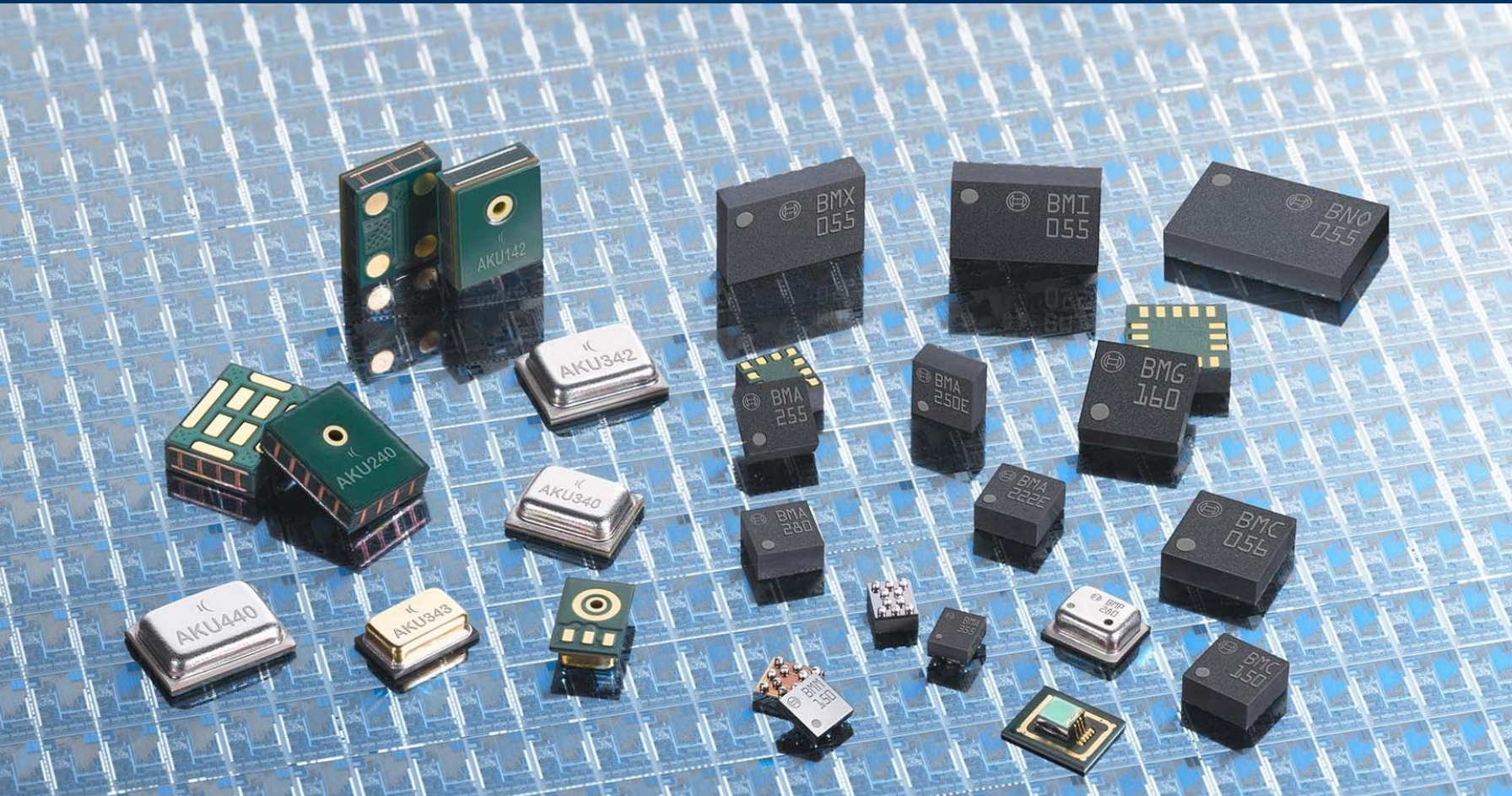


Motion software powered by
 hillcrestlabs.

BNO070, based on 9-axis BNO055, incorporates Hillcrest's SH-1 software optimized for head-mounted displays (HMDs)

BNO070	Technical data
Size	5.2 x 3.8 x 1.1 mm ³
Update Rate	≤250Hz
Static	Accuracy: 1.5° Heading: 1.0° Non-Heading: 1.0°
Dynamic	Accuracy: 1.5° Heading: 1.0° Non-Heading: 1.0°

Absolute orientation solution for head mounted displays (HMD)



Thank You, Questions ?

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