BOSCH SENSORTEC

SMART SENSING FOR IOT

JULY 13TH 2016 - SEMICONWEST

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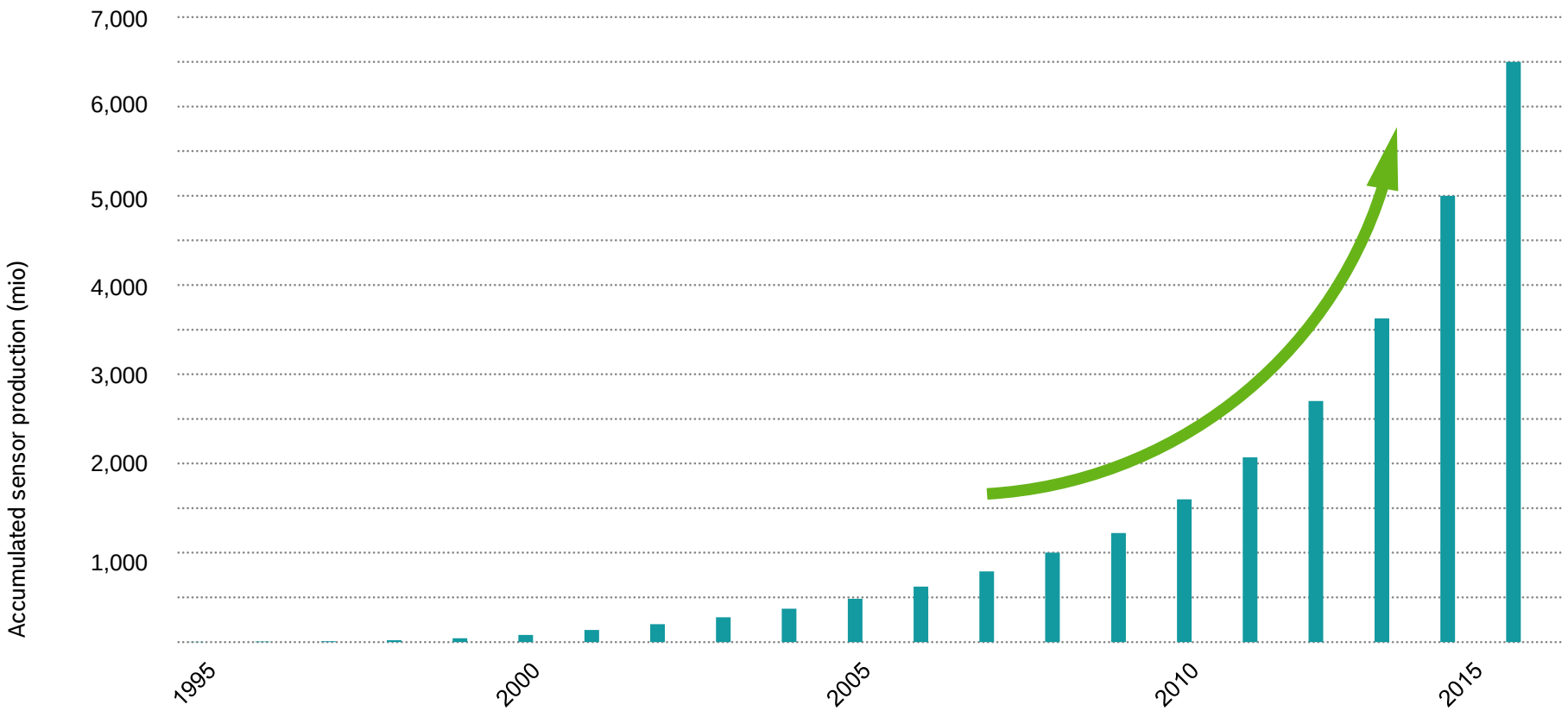
BOSCH SENSORTEC

Yearly volume increase of MEMS production



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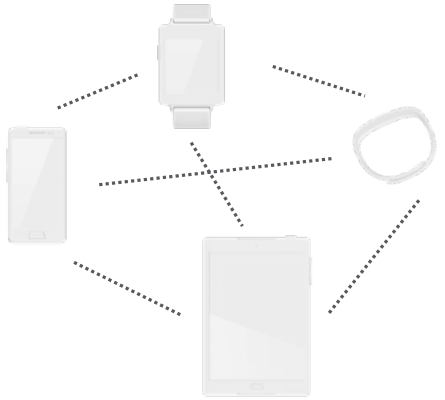
Bosch – The MEMS supplier

Automotives

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

Consumer Electronics

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



Internet of Things

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

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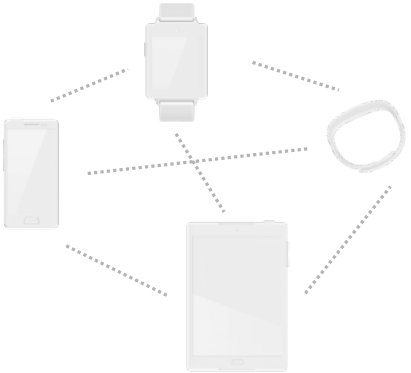
Waves of MEMS sensor proliferation

1st wave

Automotives

2nd wave

Consumer Electronics



3rd wave

Internet of Things (IoT)

1990 2000 2010 2020

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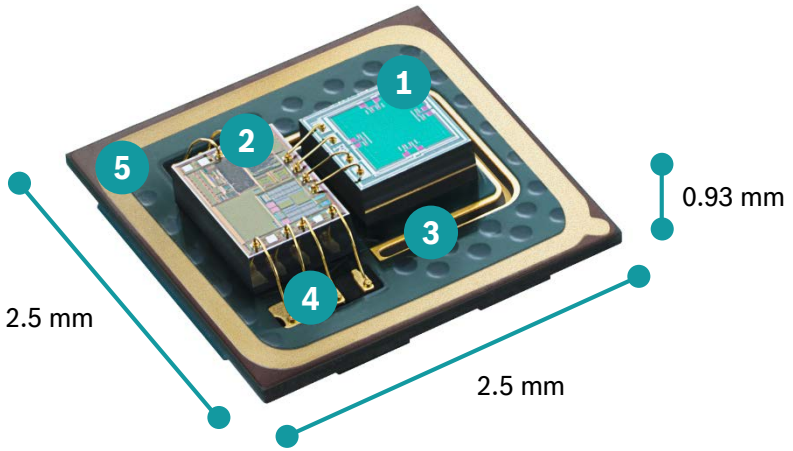
What are MEMS?
Micro-Electro-Mechanical Systems

- MEMS are miniature systems that combine tiny mechanical structures with electronic circuits. Typical individual structures have a size of a few µm.
- The MEMS sensor element is usually packaged together with an ASIC and made into one unit, e.g. into a LGA package.



1. MEMS
2. ASIC
3. Decoupling unit
4. Bonding wires
5. Printed circuit board (PCB)

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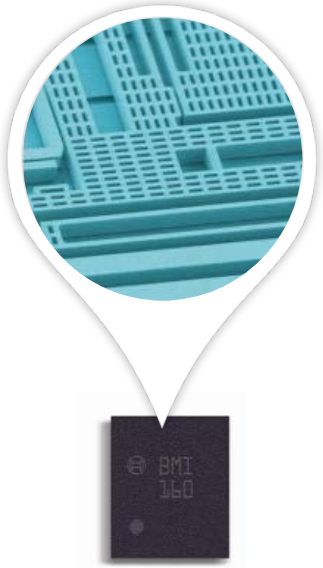
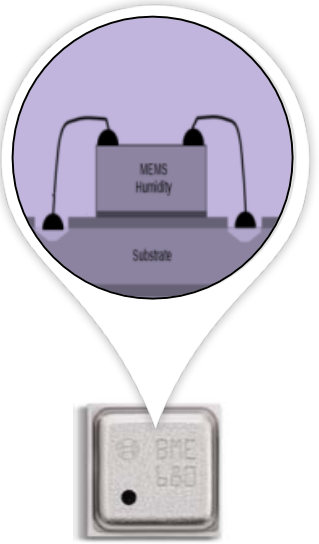
Full Solution Development
The Hardware Challenge

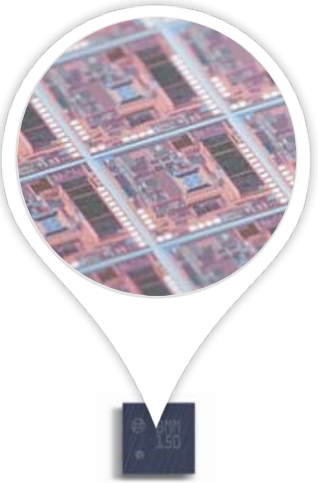


Inertial

Pressure



Environmental



Geomagnetic

Each product segment requires specific technology (not fully CMOS compatible)
Challenge for integration, need for advanced packaging technologies (SiP)

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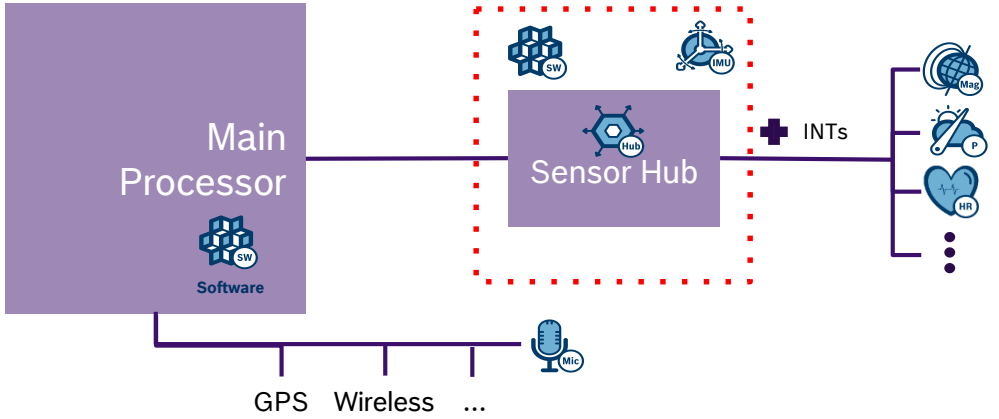
Sensors Subsystem Today



Details

- **Sensor Hubs** enable Always-on sensor monitoring in complex systems
- **Sensor Fusion** is happening at the lowest level
- Sensor types **expending** rapidly (HR, Environmental, …)
- **Sensor subsystems** offer the best **compromises** between **flexibility** (running on the main processor) and **optimization** (embedded within the sensor)
- No **One-size-fits-all**: Each Sensor Subsystem is tailored to its target application
- **Processing** can be **distributed** between multiple components of the subsystem depending on the requirements

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Sensor Subsystems
Integration of MEMS sensors and MCUs

Power efficiency (arrow points to more efficient location)

Memory cost efficiency (arrow points to more efficient location)

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More use cases than just portrait / landscape

Outdoor

Outdoor

- GPS

Indoor

- Step count & heading
- Localization
- Improve with pressure

Context

User's context

- In a meeting
- Outside
- Sitting and eating
- Watching TV
- Activity recognition

Fitness

Sports trainer

- Step counter
- Fitness level
- Calorie monitoring
- Swimming
- Running
- Snowboarding
- Climbing

Wellness

Well-being

- Sleep monitoring
- Activity
- Socializing

Stress monitoring

- Speaker assistant
- Stress level

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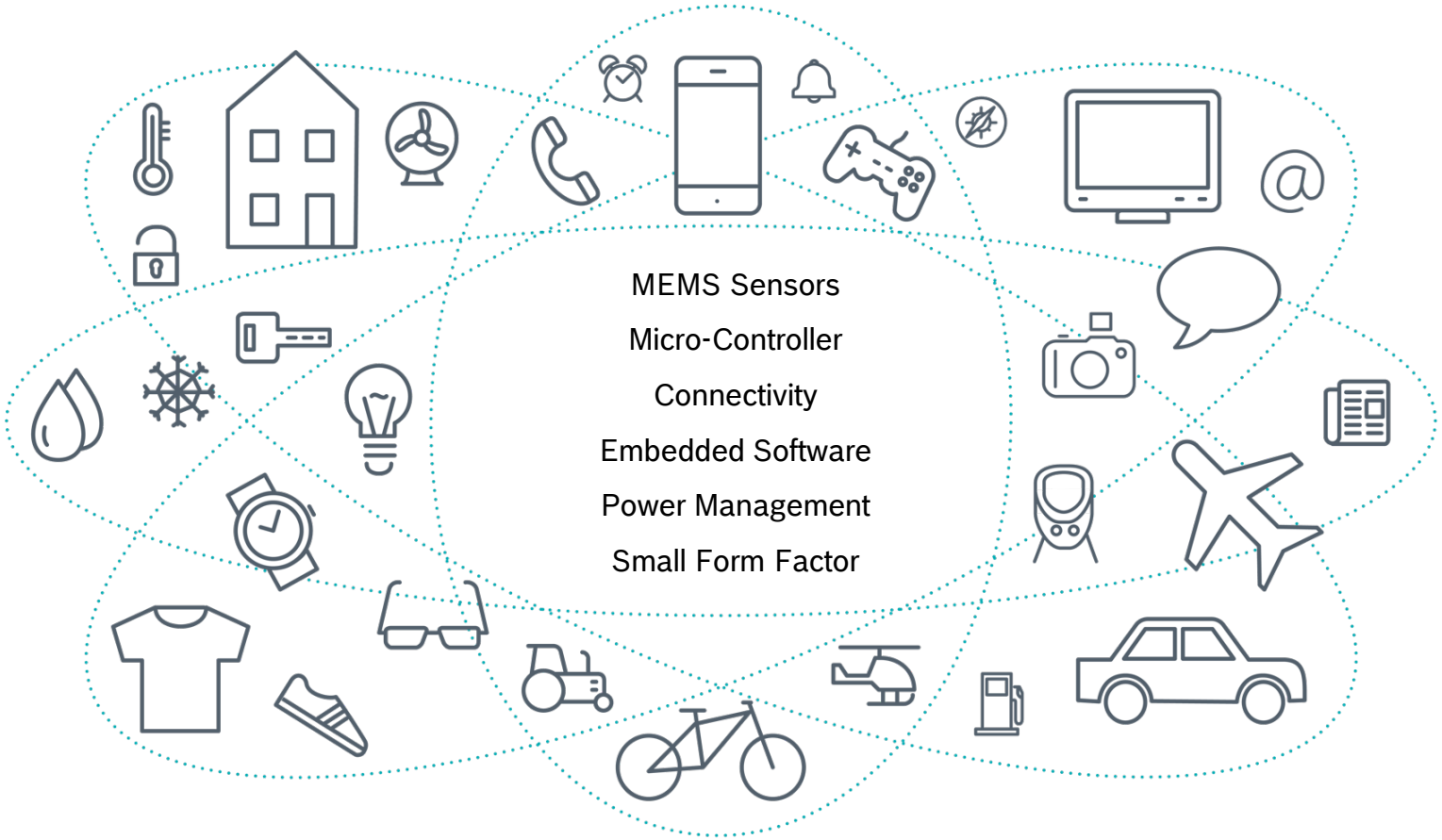
Internet of Things – Making objects smart



Wireless connected smart sensors and actuators are enabling the IoT

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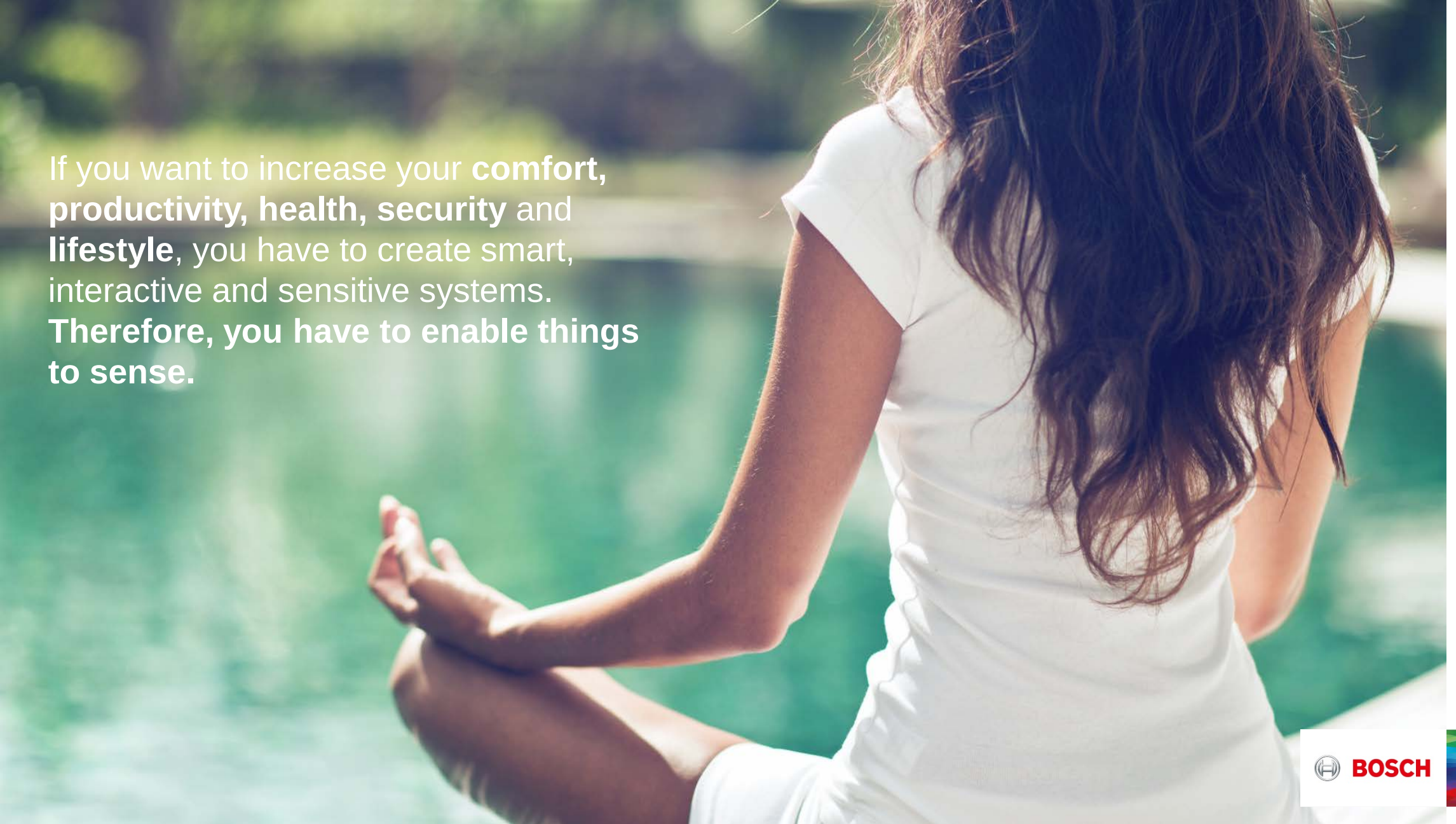
If you want to increase your **comfort, productivity, health, security** and **lifestyle**, you have to create smart, interactive and sensitive systems.
Therefore, you have to enable things to sense.
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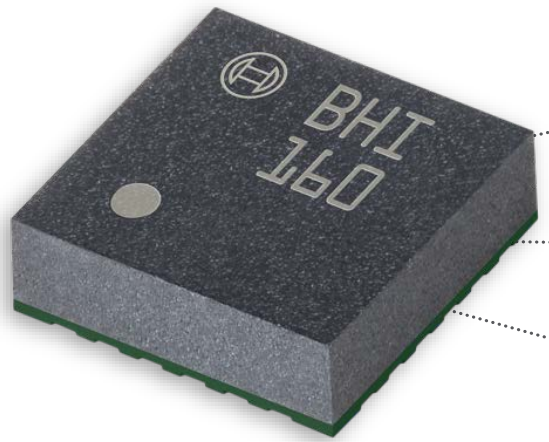

MEMS technology is ready for IoT

Size / power
Continue shrinking of sensor footprint / size and power consumption
(e.g. accelerometer)

Integration / µC + SW
Integration of multi-axis sensors + µC + SW in combo package (e.g. motion / orientation)

New measurements
Rise / emergence of novel sensor clusters
(e.g. environmental cluster – T, p, H, ...)

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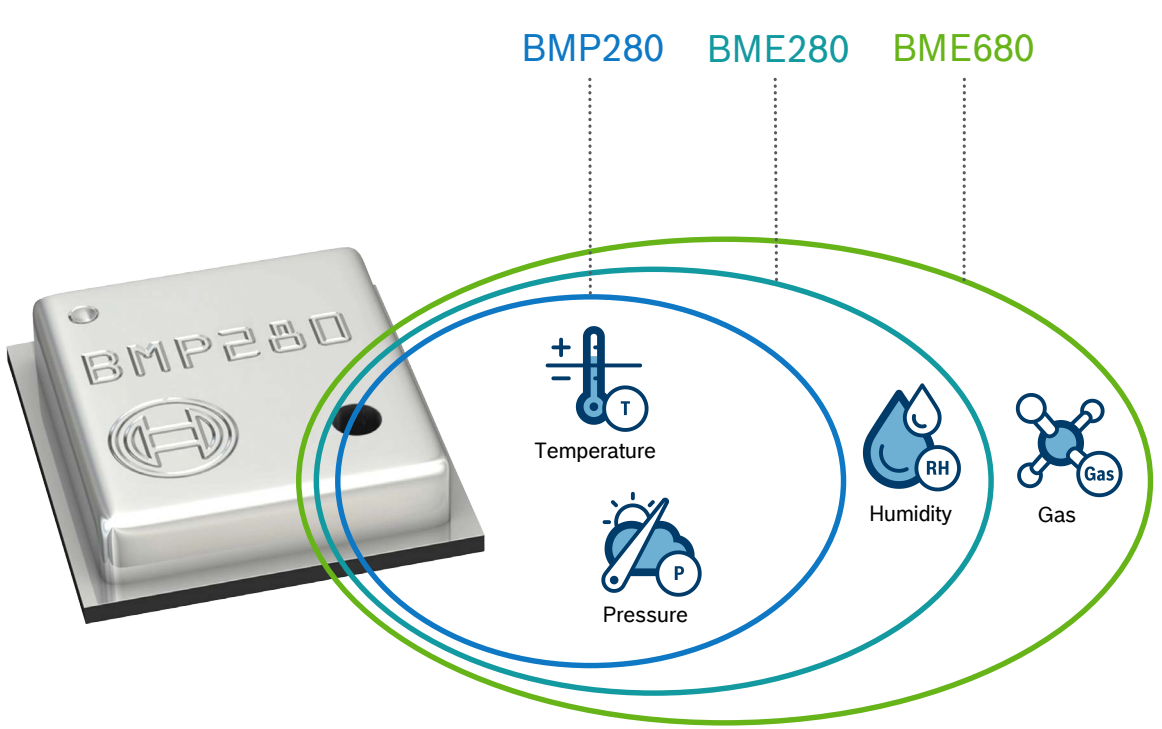
Fast innovation in environmental sensing

Combo sensors: Sensing our environment



New drivers for new applications

Quantify yourself

- Well-being recommendations
- Personalized environment
- Sport and fitness monitoring

Personalized control

- Environmental monitoring
- Personal weather forecast
- Home automation

Environmental measurement

- Barometric pressure
- Humidity
- Temperature
- Gas / indoor air quality

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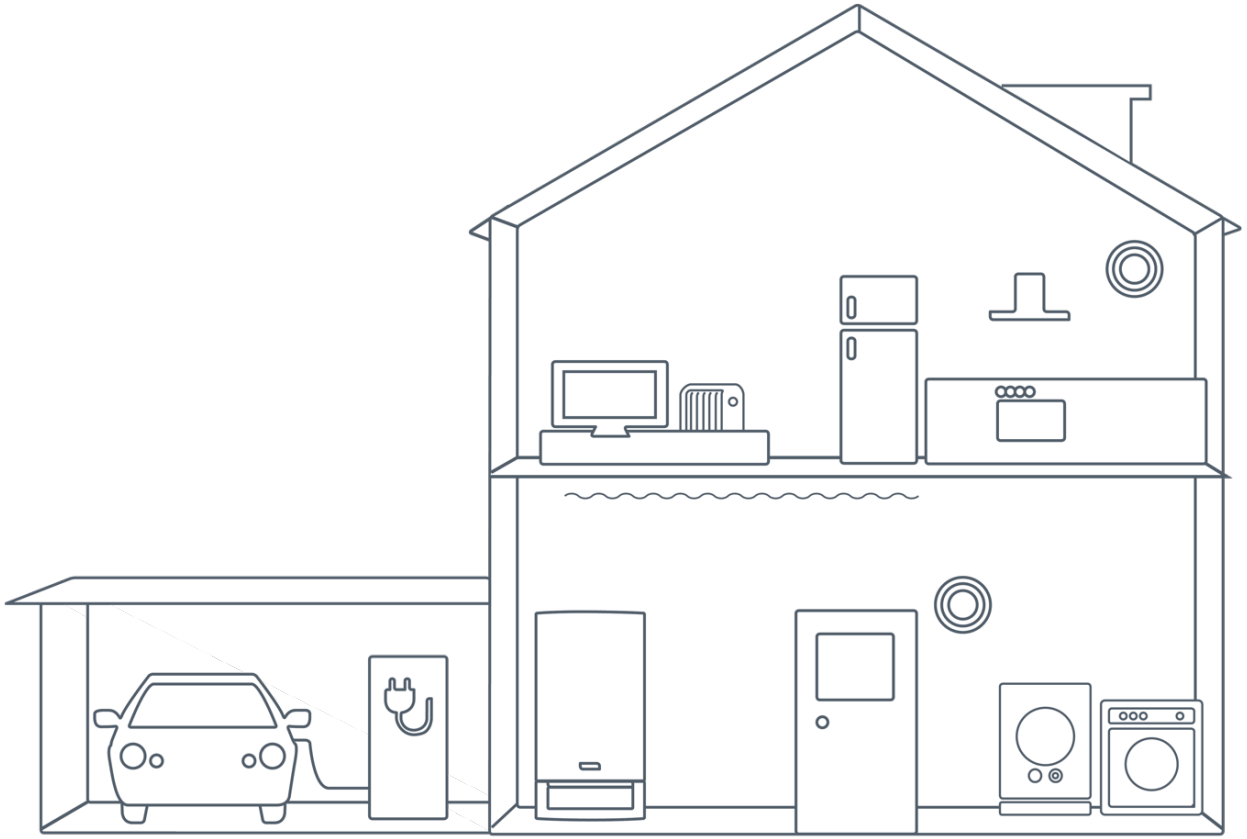
IoT – from monitoring to control

Connected smart, self-enabling sensor networks – integrated within one eco-system via Internet



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TODAY, **THREE OUT OF FOUR SMART PHONES WORLDWIDE** USE BOSCH SENSORTEC SENSORS.

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