Ubiquitous IoT Perspectives The Power of Connected Sensors and Actuators

Andrea Onetti

Vice President, General Manager MEMS Sensor Division STMicroelectronics



Digital Technologies are Transforming nearly every aspect of our lives





But the world is Analog



life.augmented

And we Interact Through Sensing and Actuating





Connected Sensing And Actuating A key part of the Internet of Things

5

IoT = Any system able to leverage the Internet and its ecosystem



Sensor Accuracy A key Challenge for IoT Sensing

- Sensors for IoT applications are required to become ever more accurate:
 - Precise rotation for VR and AR
 - Precise machine motion or vibration sensing
 - Highly accurate barometric reading for altitude measurement
 - High fidelity voice and ambient noise pickup for voice recognition & noise cancelling
- Higher accuracy generally means more power consumption so sensor makers must innovate to keep within power budgets





New Applications Driven by Accuracy

NAVIGATION **PDR**

AUTONOMOUS DRIVING

VIRTUAL & AUGMENTED REALITY

OPTICAL IMAGE STABILIZATION

PRESSURE ALTITUDE MONITORING

HUMIDITY & TEMPERATURE MONITORING







How to Make a Great Sensor









Sensor 10



Test and Calibration costs of Accuracy can be moved along the value chain



Sensors, Actuators and Artificial Intelligence

The power of AI comes from its connection to a network of sensors & actuators











Artificial Intelligence Centralized



Artificial Intelligence Distributed





life.augmented

Enabled by Connected Sensors & Actuators

Self-sufficient, environmental friendly and connected

Smart Home

Smart Sensing

Motion and environmental sensors, microphones

Connectivity

Sub-GHz Bluetooth Wi-Fi **Smart home** are self-sufficient, environmental friendly and connected to offer new services improving the quality of life and resource management

- Energy-efficient lighting
- Smart appliances and efficient power supplies
- Voice-controlled home environment
- Electric vehicle charger
- Smart Meters for electricity, gas and water
- Improved security



Enabled by Connected Sensors & Actuators



Smart Sensing	
Motion and environmental sensors, microphones	n n
Connectivity	•
PLC Sub-GHz Bluetooth Wi-Fi	•

Smart sensor nodes enabling new services

Smart Cities

Infrastructure evolution using smart sensor nodes enabling **new services** like traffic monitoring, weather station, improved security

- Remote activation and dimming control for energy saving
- Lamp failure monitoring
- Connected monitoring station for air quality, security and traffic
- Smart parking
- Battery charging stations



Smart Industry Enabled by Connected Sensors & Actuators

Programmable Logic Controller Example

O IO-Link

IO-Link Transceiver **Temperature Sensor** 32-Bit Microcontroller

Temperature

sensor

IO-I ink Master Controller

- 4x IO-I ink Master Controller
- Protection devices •
- 32-Bit Microcontroller







32-Bit Microcontroller

•



Enabled by Connected Sensors & Actuators



Motion Sensors For Automotive Safety, Navigation

& Telematics

6-axis inertial modules for navigation assistance



Hi-g accelerometers for airbag applications





Smart Driving



ST Strategy and Offer for the IoT 19







IoT Product Development Make it easy and make it fast

20



ST Solutions for the IoT 21

Common SW Platform

Cloud Provider SDKs supported, enabling sensor-to-cloud



SW packages from drivers to full application examples and Mobile Applications



STM32 Open Development Environment





ST & 3rd party form-factor boards



INTEGRATION

STM32

nterne

STM32 Nucleo development boards 27 Covering the broad portfolio of STM32 MCU families

STM32 Nucleo expansion boards (X-NUCLEO) Offering peripheral functions



Modular Hardware



Modular Hardware 22

27 development boards and growing... in two flavors (Processing & Security)



Covering all STM32 microcontroller families and different development needs

32 expansion boards and growing... covering all the key functions





Software for end-to-end Cloud Solutions 23

	Cloud Prototyping			3	Cloud providers SDK supported for direct connection to the Cloud	
	Mobile Apps Prototyping Pre-integrated application examples (Function Packs)			21	Mobile applications Sample applications, with ready-made Integrated Developer Environment projects	
	STM32Cube	High value middleware STM32Cube expansions		16	High value Libraries (Audio, Connectivity, Sensor) with usage examples and free-to-use license	
	middleware	STM32Cube expansion HAL		94	Specific pre-integrated drivers and libraries with usage examples supporting STM32 Nucleo expansion boards	
ube	STM32Cube Hardware Abstraction Layer (HAL)					
	STM32 Nucleo development boards	STM32 Nucleo expansion boards (X-NUCLEO)			STM32 Open Development Environment	

MEMS and Analog Empower the IoT 24





Sensors, Actuators and Connectivity for every IoT Application





life.augmented

Leading MEMS Sensors for the IoT 26

Smart Things		0			
OPTICAL IMAGE STABILIZATION GYROSCOPE	ACCELEROMETER & GYROSCOPE 6-AXIS IMU	Ultra Low Power Accelerometer	HIGH ACCURACY Pressure Sensor	ACCELEROMETER & MAGNETOMETER COMPASS	MEMS Microphone
L2G2IS	LSM6DSM	LIS2DW12	LPS22HB	LSM303	MP23AB0
High performance and accuracy	Low power, low noise for User Interface and Image Stabilization	Embedded smart functions for wearable applications	Compact, low power, water resistant	Compact, high accuracy, with pedometer.	Compact low, lower power, high- performance
					State of the second sec



IIS2DH3-axis accelerometer with digital outputI3G4250D3-axis digital output gyroscopeIIS328DQ3-axis digital output accelerometer		3-axis accelerometer with digital output
		3-axis digital output gyroscope
		3-axis digital output accelerometer



Connectivity 27





Bluetooth Low Energy for smart innovators



Sub-1GHz for Sensor to Cloud 29

Sensor to Cloud world-wide connectivity



life.auamented



Combo-radio IoT Node Dual-radio turnkey solution

Application scenarios

Wireless Sensor Nodes, Remote diagnostic, Smart Parking, Smart Objects

Smartphone

- User Interface
- Configurability
- Local monitoring
- Diagnostic
- Firmware upgrade



Cloud

- Remote monitoring
- Tracking and Positioning
- Notifications of events
- Data aggregation
- Diagnostic and assistance



Takeaways 32

- Connected sensors and actuators are at the heart of IoT applications
- Sensors are required to become more and more accurate but with strict power budget constraints
- Artificial intelligence reaches it full potential when connected to a network of smart sensors and actuators
- Smart Home & City, Smart Industry and Smart Driving applications are enabled thanks to common IoT device building blocks
- ST has comprehensive approach to the IoT to make development easy and fast.



