Speeding Up Revolution of Drones

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...with high growth in consumer

2010-2021 Drones & Robots revenue forecast (in $M) by market

CAGR ~+9.4%

	CAGR 2015-2021
Defense	5%
Industry	7%
Security	15%
Medical	10%
Transport	46%
Commerci	25%
Consumer	20%

Source: YOLE
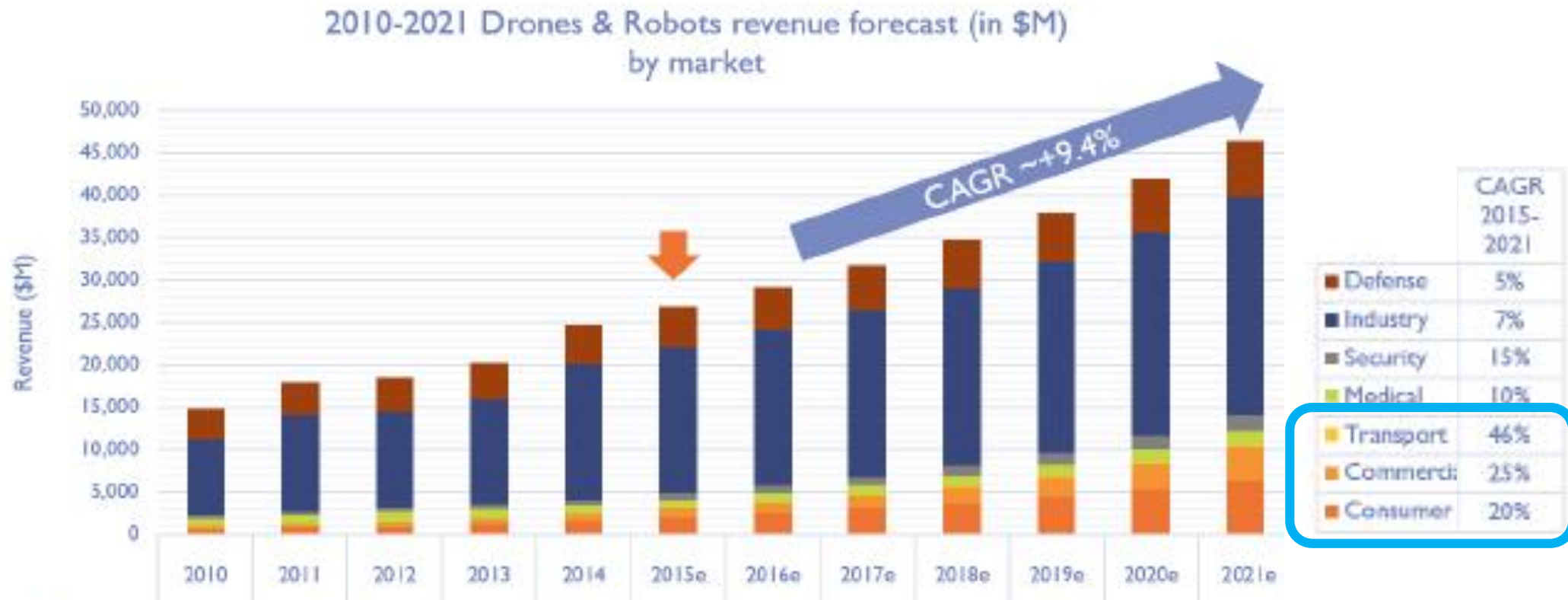
Drone Features

Propeller Control

Flight Cruising

Visual Navigation

Power & Battery Managing

Stability Control

Connectivity & Positioning

How Semiconductor Innovations
answer these challenges?

MEMS, Sensors & GPS

32-bit Microcontrollers

RF Connectivity

Smart Drivers,
LV & HV MOSFETs and
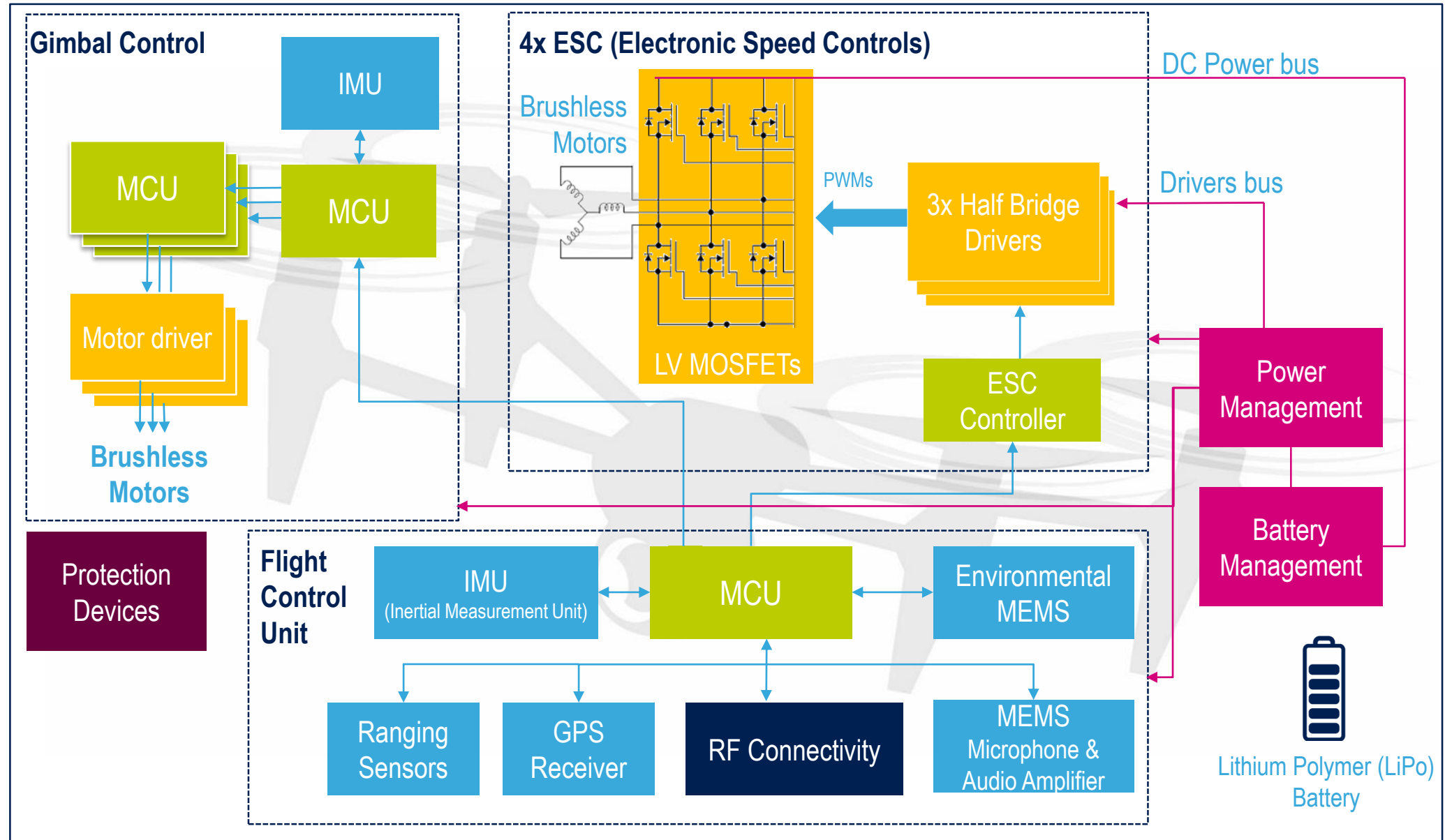Motor Drivers ICs

Power & Battery
Management ICs

Toys

Consumer

Professional

Electronic Speed Control
Microcontroller
STDRIVE™ gate driver
STripFET™ Low voltage MOSFET

Flight Control Unit
Microcontroller
6 axis Inertial Module
GNSS transceiver
Bluetooth Low Energy
NFC Tags
Sub-1 GHz transceiver radio

Gimbal Control
Accelerometer
Gyroscopes with image stabilization
Magnetometer
STSPIN™ Motor Driver

Power Management
Switching and Linear regulators
Battery Management

Contextual awareness
Temperature & humidity sensor
Pressure sensor
Digital MEMS microphone

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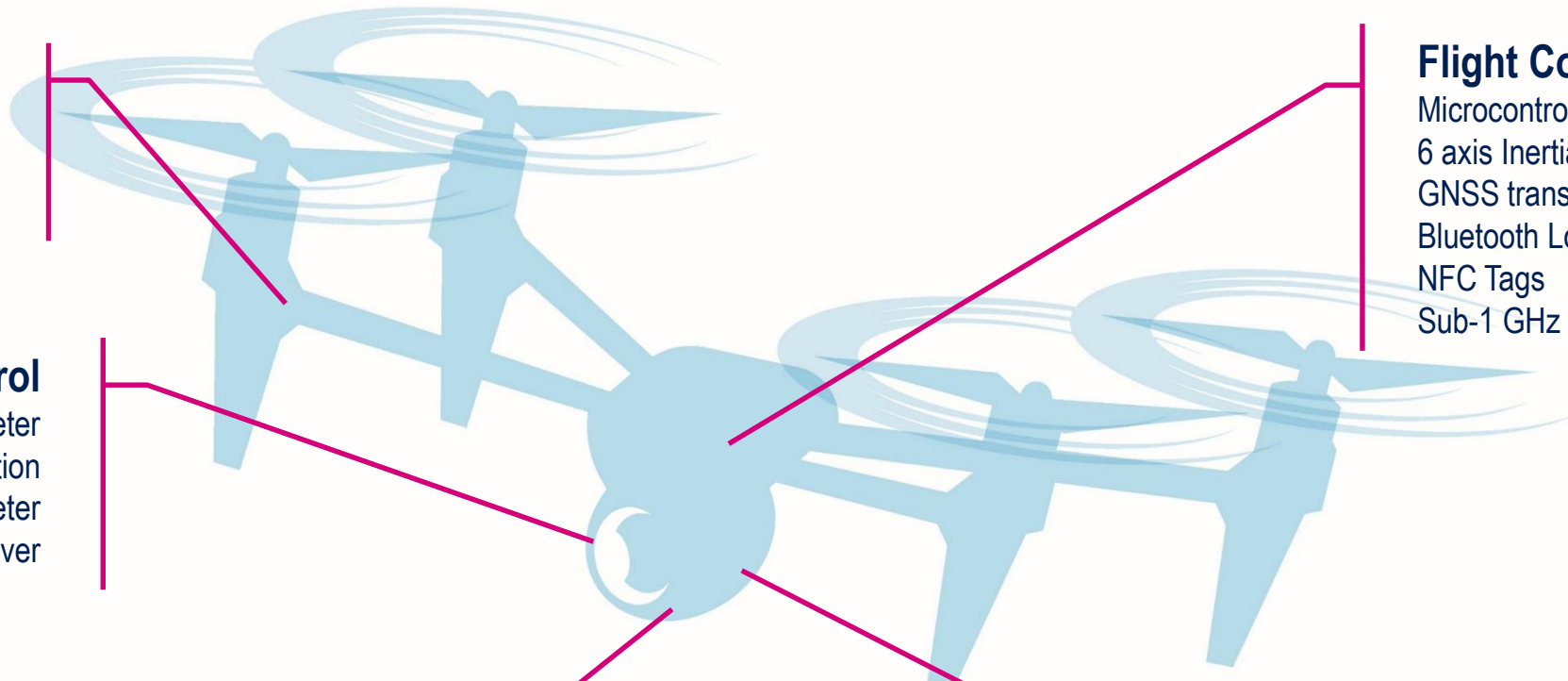
Propeller Electronic Speed Control

Flight Control Unit

Contextual Awareness

Gimbal Control

Click on the Subsystem

Electronic Speed Control

CAN

PWM

UART

I2C

STM32F0 / F3
MCU

STM32 F0

STM32 F3

STDRIVE™
Gate Driver L6398

STDRIVE™
Gate Driver L6398

STDRIVE™
Gate Driver L6398

STripFET™ F7
Low Voltage MOSFET

STripFET™ F7
Low Voltage MOSFET

STripFET™ F7
Low Voltage MOSFET
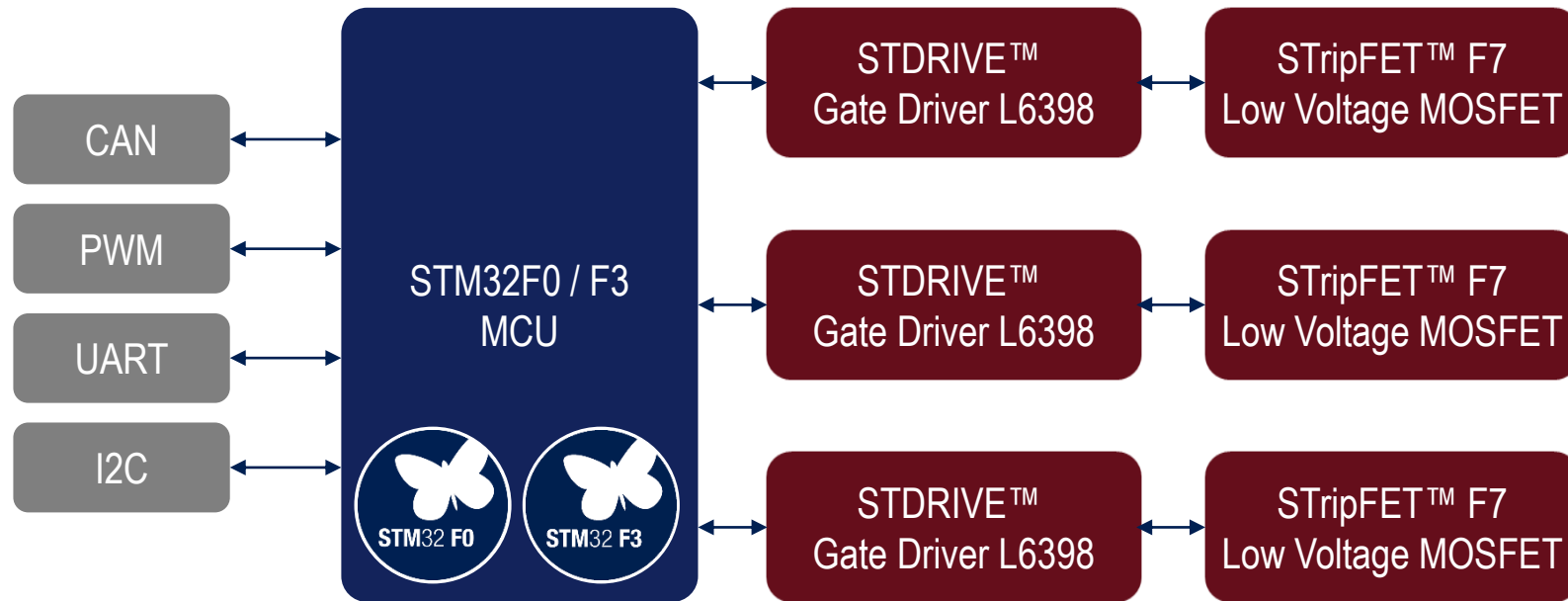
Efficiency and high performance self commissioning features

6-Step & FOC motion control algorithms with dedicated libraries and ecosystem

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STM32 Microcontrollers

STM32F0 Series
ARM Cortex®-M0

Entry level

- 48MHz - 38 DMIPS
- 1.8 – 3.6V
- 16 to 256 KB Flash
- Motor Control PWM timer
- 12-bit ADC 1Msps
- Multiple serial communication
- Clock free USB FS, CAN 2.0B

STM32F3 Series
ARM Cortex®-M4

High End Control Loop

- 72MHz - 90 DMIPS - FPU
- 0 wait state Routine booster
- 1.8 – 3.6V
- 16 to 512 KB Flash
- 144Mhz Motor Control PWM timer
- 12-bit ADC 5Msps
- Fast Comparators, Op. Amp., DAC
- Multiple serial communication
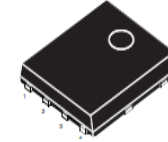- USB FS, CAN 2.0B

Drivers and MOSFETs

Half bridge gate drivers

L639x

Very compact and Robust

- High reliability
- Integrated bootstrap diode
- Cross-conduction prevention
- UVLO protection

Low voltage MOSFETs

STripFET H7 & F7 series

Industry's lower RDS(on)

- H7 MOS for consumer/professional drones
- F7 device for professional drones with battery voltage >20V
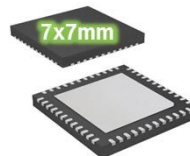
STSPIN32F0

32-bit MCU-based motor driver

STSPIN32F0 System-in-Package: STM32F0 + Advanced 3-phase driver

STM32F031 MCU

- 32-bit ARM M0 Core, 48 MHz
- 32 KB Flash + 4KB SRAM
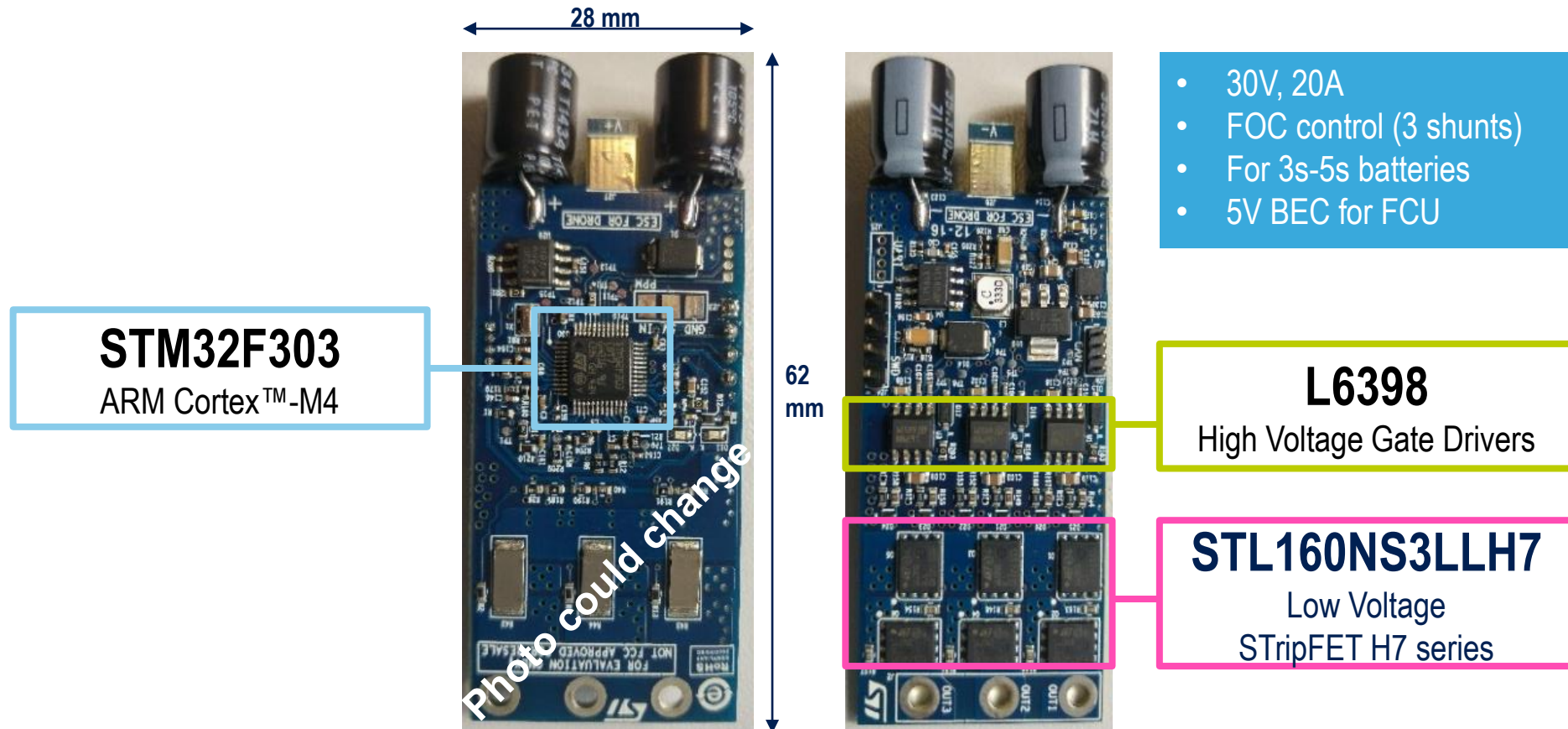- 12-bit ADC
- I2C, USART & SPI Interfaces

3-phase gate drivers

- 45 V supply, 600 mA capability
- 12 V LDO & 3.3 V DC-DC regulators
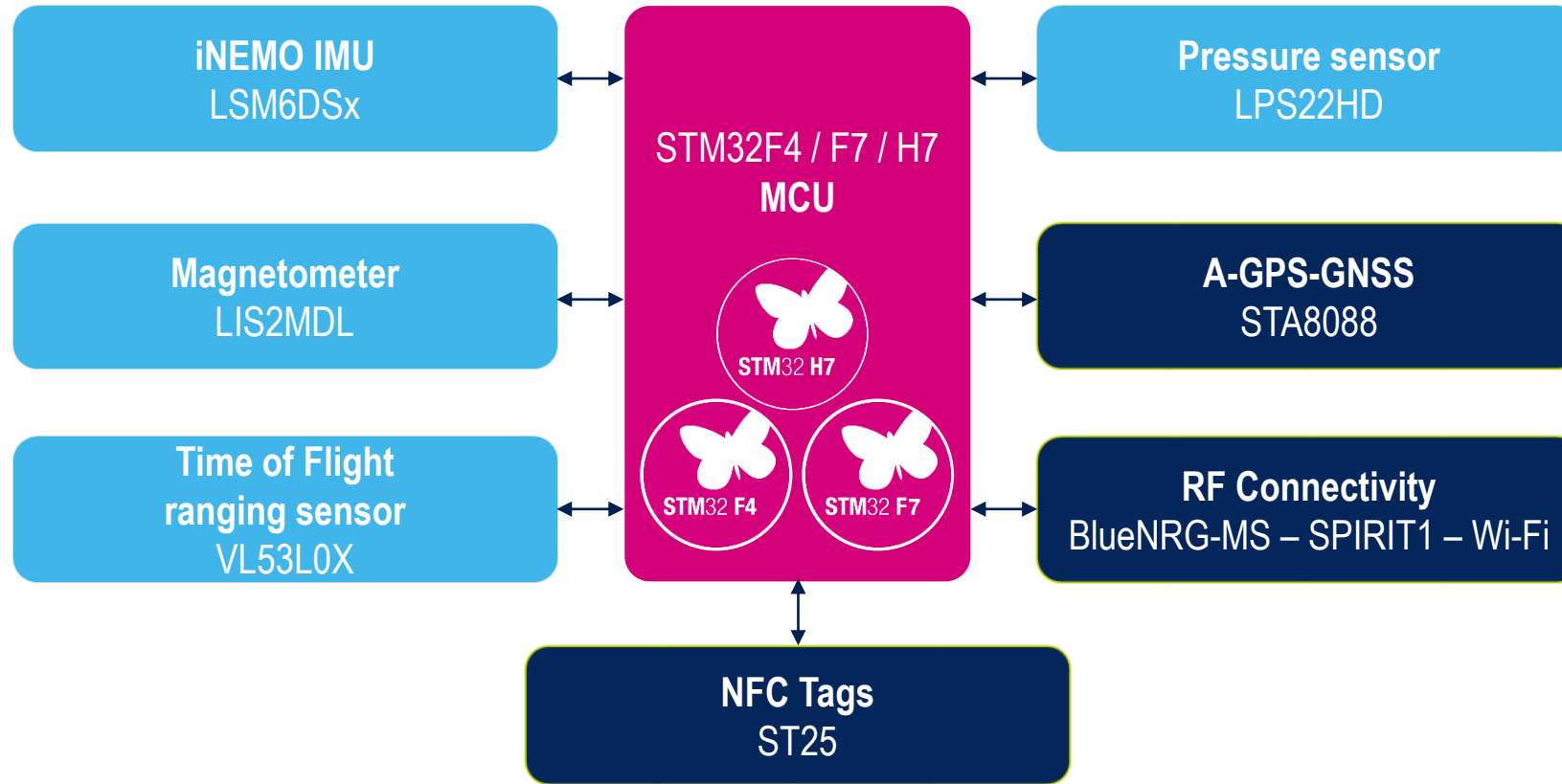- 4 Op amps & 1 Comparator
- UVLO, OCP & OTP protections

7x7mm

ESC Demo Board

The professional UAV ESC with CAN Interface

28 mm

62 mm

Photo could change

STM32F303
ARM Cortex™-M4

- 30V, 20A
- FOC control (3 shunts)
- For 3s-5s batteries
- 5V BEC for FCU

L6398
High Voltage Gate Drivers

STL160NS3LLH7
Low Voltage
STripFET H7 series

STEVAL-ESC001V1: Available from Q1'17

STM32 Microcontrollers

STM32F4 Series
ARM Cortex®-M4

High performance

- 180MHz - 225 DMIPS – FPU
- Execution ART Accelerator
- Graphic accelerator
- From 64 KB to 2 MB Flash, up to 384 KB RAM
- CAN, Ethernet, Camera
- Dual quad SPI
- From Access lines to Advanced Lines

STM32F7 Series
ARM Cortex®-M7

Very high performance

- 216 MHz – 462 DMIPS - FPU
- Execution ART Accelerator
- Graphic accelerator
- From 512 KB to 1 MB Flash, 320 KB RAM
- CAN, Ethernet, Camera
- Dual quad SPI
- Very High performance from Flash and external mem.

STM32 Microcontrollers
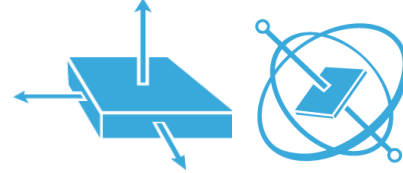
STM32H7 Series
ARM Cortex®-M7

Ultimate performance

- 400 MHz – 856 DMIPS - FPU
- Execution ART Accelerator
- Graphic accelerator
- Up to 2 MB Flash (ECC), 1 MB RAM
- 14 bit ADC 2Msps
- CAN, Ethernet, Camera
- Dual quad SPI
- Very High performance from Flash and external mem.

STM32 H7

STM32H7

- 2010 EEMBC® CoreMark®
- 400 MHz
- a new generation of peripherals

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Motion Sensors

6-axis Inertial Measurement Unit

LSM6DSN
Designed for UAV

- Sensitivity 1%: narrow sensitivity trimming for flip-over automatic functions
- Advanced features (activity recognition) and accuracy

6-axis Inertial Measurement Unit

LSM6DSM
OIS features for on-board camera

- Two-channel gyroscope for flight control and EIS/OIS camera stabilization
- No interference between the two channels → no flight miscontrol during movie or photo capture
- Image stabilization: both EIS and OIS

Motion Sensors

e-Compass

LSM303AGR

Superior sensing precision
and low power consumption

- Ultra low magnetic offset and offset
  stability over temperature
- Easy to compensate despite motor
  magnetic noise
- Integrated accelerometer for compass
  tilting compensation

Magnetometer

LIS2MDL

Ultra low-power high performance

- Ultra low magnetic offset and offset
  stability over temperature
- Easy to compensate despite motor
  magnetic noise
- Pin-2-pin and SW compatibility with
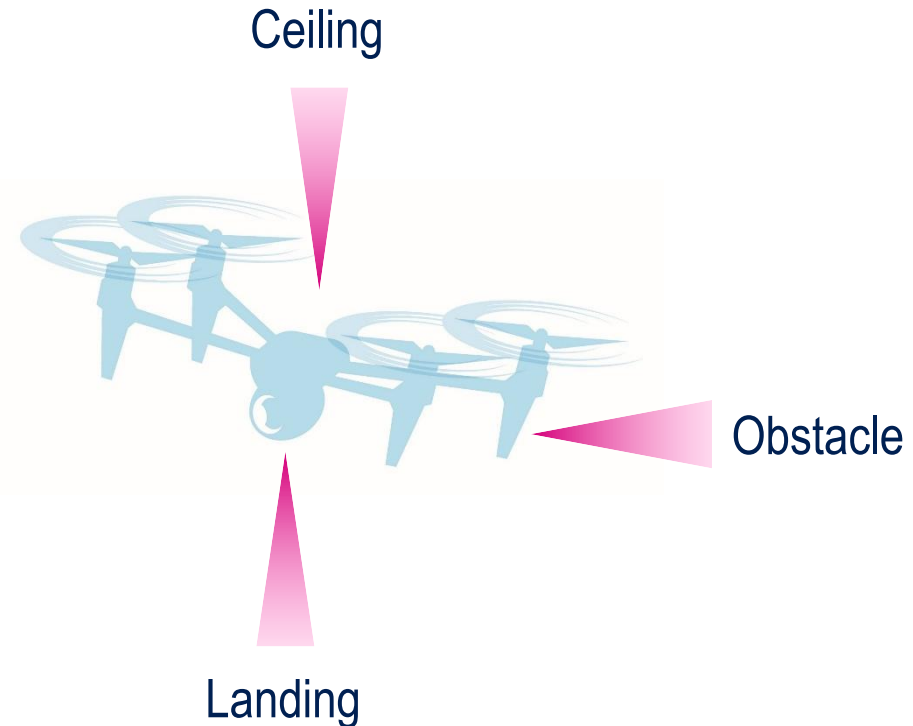 LSM303AGR for easy system upgrade

Ranging Sensors

Time-of-Flight ranging sensor

VL53L0

Accurate range measurement up to 2 meters

- Very fast (up to 50Hz)
- Small form factor, easy integration
- Low Power
- Independent of target reflectance
- Module including Laser class1 IR emitter

Ceiling

Obstacle
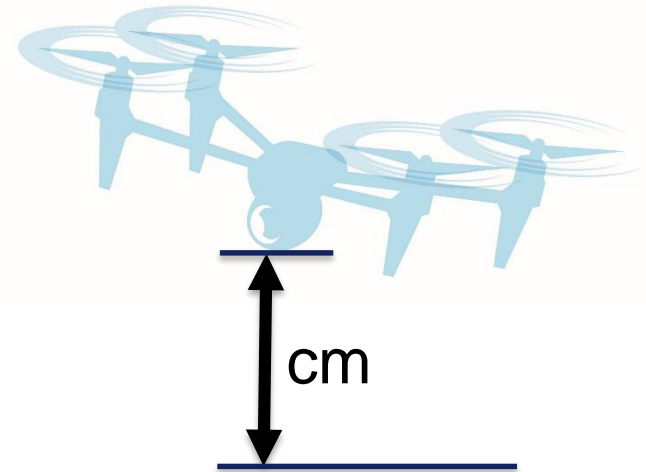
Landing

Pressure Sensors

Pressure Sensor

LPS22HD

Designed for UAV

- 8 cm vertical resolution: superior absolute height estimation

- Unprecedented ascent and descent speed estimation: 200Hz equivalent data rate

cm

GNSS Positioning

Multi-constellation positioning ICs

Teseo III

- Accurate positioning
- GNSS location HUB
- High Dynamics (5 to 10Hz)
- Access to Carrier Phase Measurements for advanced station hold and precision operations
- Sensor Interfaces (SPI, I2C, ADC)
- Logging/Map SD-Card Storage
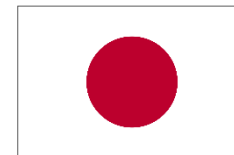- Software SDK for Autopilot and INS code integration
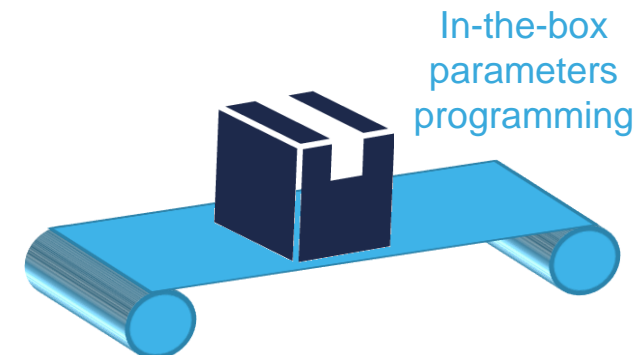
Galileo

GPS

GLONASS

BeiDou2

QZSS

Dynamic NFC Tags & Readers

ST25

Usage in UAV

- Program drone parameters in production wirelessly with RFID reader
- Set flight parameters with NFC phone
- Use dynamic NFC tag as drone's wireless black box

Flight parameters

In-the-box parameters programming

Pilot ID

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Bluetooth® Low Energy

Bluetooth® Low Energy Network Processor

BLUENRG-MS

- Qualified Master and Slave stack
- Supports Bluetooth Smart 4.1
- Superior Battery Life
  - RX 7.3mA
  - TX 8.2mA @0dBm
  - Sleep 1.7µA
  - Shut Down 5nA
- Integrated DCDC converter enables ultra low power operation
- RF certified (ETSI,FCC,IC)

Bluetooth® Low Energy Module

SPBTLE-RF

- Based on BlueNRG-MS
- Tx power: + 4 dBm
- Rx sensitivity: - 88 dBm
- Host IFs: SPI, IRQ, and RESET
- RF certified (ETSI,FCC,IC)
- BQE End Product qualified

ST Balun for the BlueNRG family: BAL-NRG-01D3

Sub-GHz Modules

SUB GHz

Sub-GHz Module with STM32

SP1ML

- Based on SPIRIT1 transceiver, STM32L1 MCU and BALF-SPI
- 868MHz and 915MHz Frequency
- Embedded antenna on module
- Output power up to +11.6dBm
- Air data rate up to 500kbps
- CE compliant and FCC certified
- 6LoWPAN Contiki and WMBUS

Sub-GHz Module

SPSGRF

- Based on SPIRIT1 transceiver and BALF-SPI-01D3 balun/filter
- Embedded antenna or UFL connector
- Output power up to +11.6 dBm
- RX: 9mA, Tx: 21mA @ +11dBm, Shut Down: 2.5nA
- Air data rate up to 500kbps
- CE compliant and FCC certified
- 6LoWPAN Contiki and WMBUS stack

BALF-SPI-01D3 for SPIRIT1 @ 868-915MHz
BALF-SPI-02D3 for SPIRIT1 @ 433MHz

Wi-Fi Module

Wi-Fi Module

SPWF01S

- 2.4 GHz IEEE 802.11 b/g/n low power transceiver
- Embedded high gain antenna or UFL connector
- Pre-certified RF (FCC, IC, CE, SRRC)
- 1.5 MB or 512 kB integrated flash
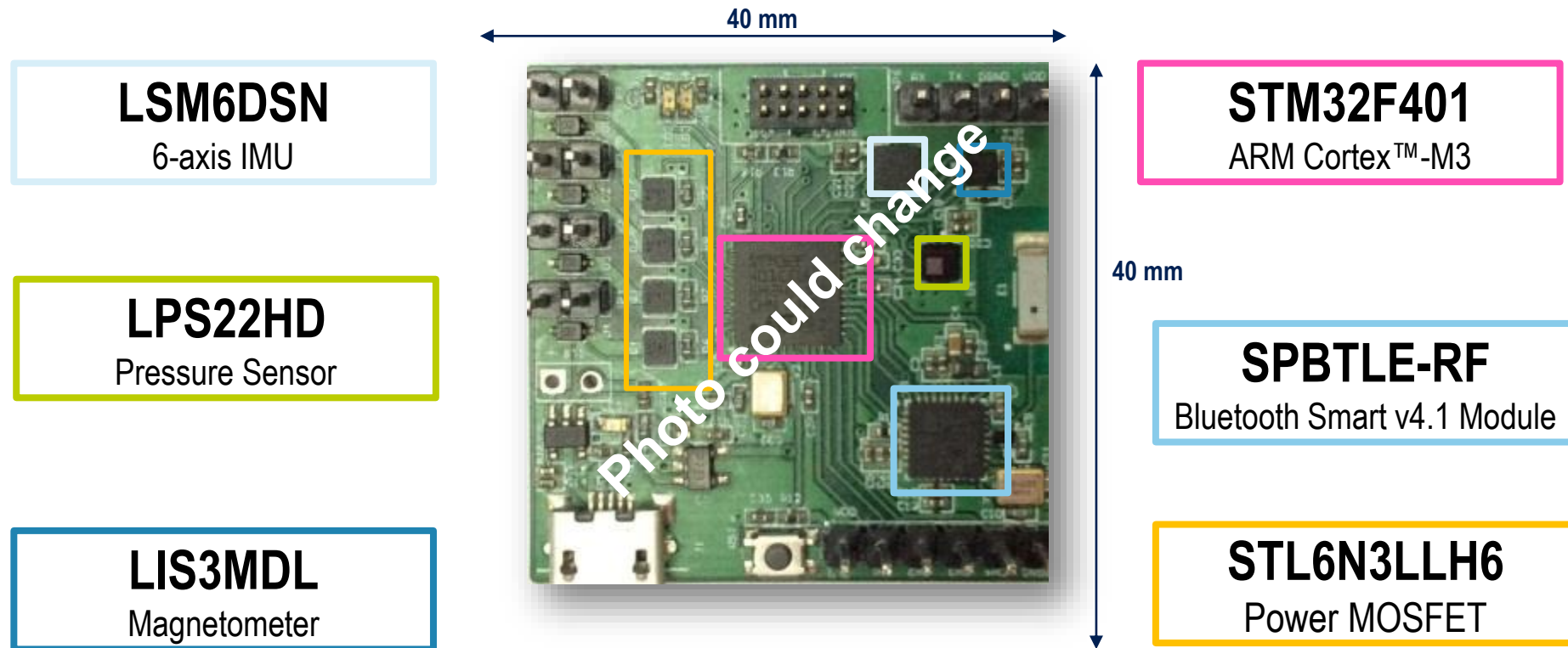- Over The Air firmware update

Built-in applications:
Sockets
Web server
Rest API for cloud service connection

FCU Demo Board 1

FCU for Toy Drones: 6+1 axes of freedom

Compatible with one of the most used Open Community firmware

40 mm

40 mm

Photo could change

LSM6DSN
6-axis IMU

LPS22HD
Pressure Sensor

LIS3MDL
Magnetometer

STM32F401
ARM Cortex™-M3

SPBTLE-RF
Bluetooth Smart v4.1 Module

STL6N3LLH6
Power MOSFET

STEVAL-FCU001V1: Available from Q1'17

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FCU Demo Board 2

FCU for Consumer Drones: 10 axes of freedom

Compatible with one of the most used Open Community firmware

50 mm

50 mm

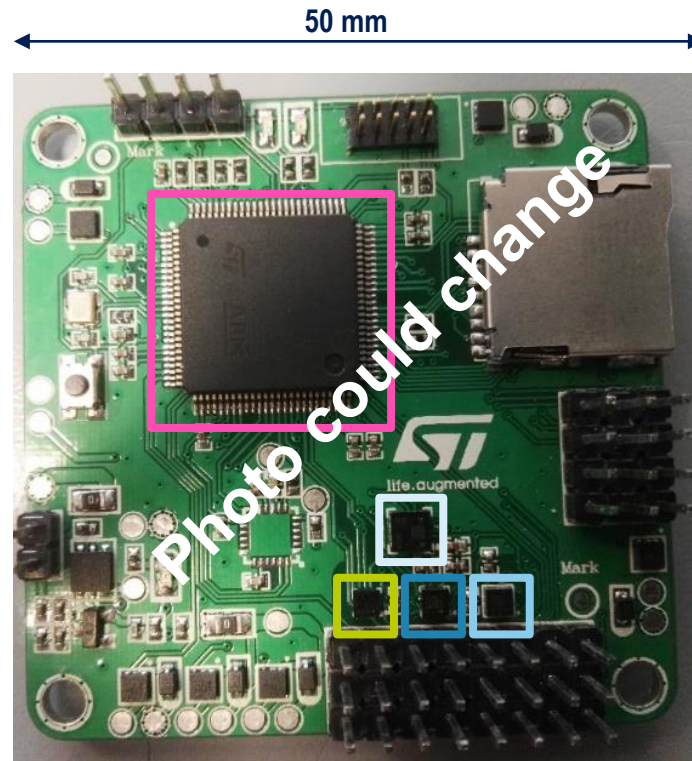**LSM6DSN**
6-axis IMU

LSM303AGR
3-axis e-compass

LIS3MDL
Magnetometer

STM32F756VGT6
ARM Cortex™-M7

LPS22HD
Pressure Sensor

- UART-SPI for GPS Integration
- Pixhauk Open Source

STEVAL-FCU002V1: Available from Q2'17

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Gimbal

IMU with IS LSM6DSM	⟷	STM32F3 / F4 MCU	⟷	STM32F0 MCU	⟷	STSPIN™ L6230/4
Magnetometer LIS3MDL	⟷		⟷	STM32F0 MCU	⟷	STSPIN™ L6230/4
			⟷	STM32F0 MCU	⟷	STSPIN™ L6230/4
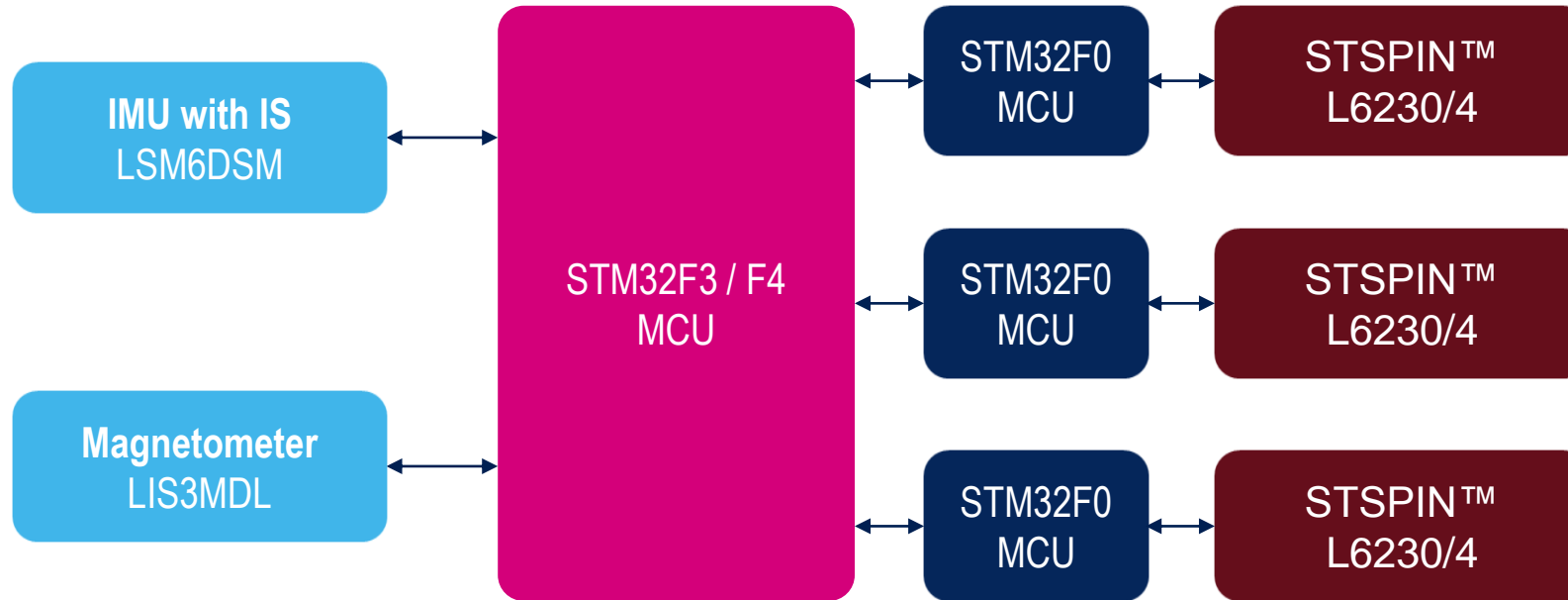
Integration, performance, efficiency, leading in motion control

Image Stabilization features – Position Control algorithms

STM32 Microcontrollers

STM32F0 Series
ARM Cortex®-M0

Entry level

- 48MHz - 38 DMIPS
- 1.8 – 3.6V
- 16 to 256 KB Flash
- Motor Control PWM timer
- 12-bit ADC 1Msps
- Multiple serial communication
- Clock free USB FS, CAN 2.0B

STM32F3 Series
ARM Cortex®-M4

High End Control Loop

- 72MHz - 90 DMIPS - FPU
- 0 wait state Routine booster
- 1.8 – 3.6V
- 16 to 512 KB Flash
- 144Mhz Motor Control PWM timer
- 12-bit ADC 5Msps
- Fast Comparators, Op. Amp., DAC
- Multiple serial communication
- USB FS, CAN 2.0B

SIL Ready

LONGEVITY 10 YEARS COMMITMENT

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3-Phase Motor Driver ICs

Motor driver for sensor-less FOC

L6230

- Wide V, I ratings (up to 52V & 2.8A)
- RDS(on) = 0.7Ω
- Fully protected
- Broad package offer (QFN, SO & PowerSO)
- Complete ecosystem ensuring fast and easy development

Motor driver for low voltage gimbals

STSPIN230

- Best for 2/3 Li-Ion battery powered 1.8V – 10V, up to 2A
- RDS(on) = 0.2Ω
- Fully protected
- Extremely low stand-by consumption
- Complete ecosystem ensuring fast and easy development

STSPIN

LONGEVITY 10 YEARS COMMITMENT
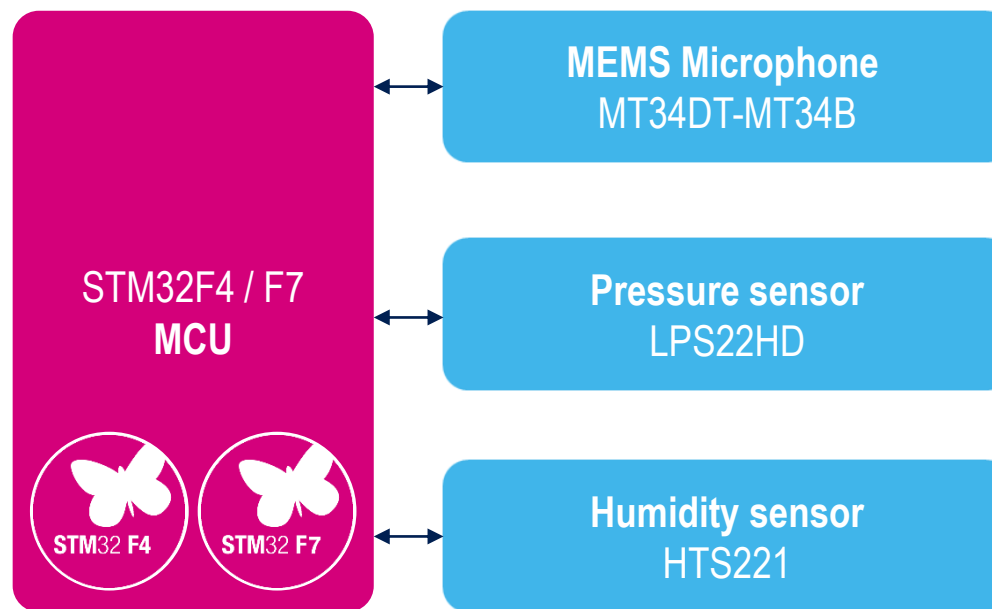
Motion Sensors

6-axis IMU
with OIS functions

LSM6DSM

- Two-channel gyroscope for flight control and EIS/OIS camera stabilization
- No interference between the two channels → no flight miscontrol during movie or photo capture
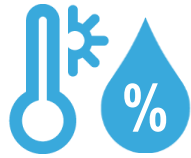- Image stabilization: both EIS and OIS

Contextual Awareness

STM32F4 / F7 MCU

MEMS Microphone MT34DT-MT34B

Pressure sensor LPS22HD
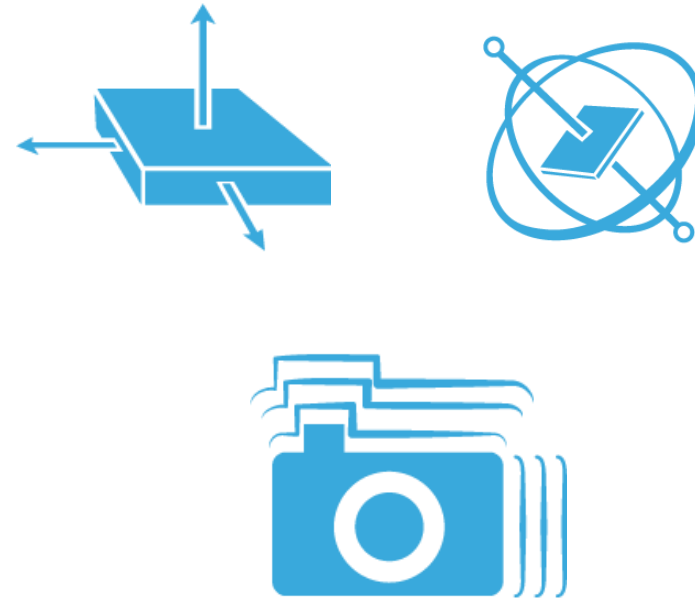
Humidity sensor HTS221

High resolution and low power consumption

Advanced beam-forming, noise suppression, sound source localization algorithms

Environmental Sensors

Humidity & temperature sensor

HTS221

Extended operating range

- 0 to 100% RH range
- Low-power consumption: 1 µA @1Hz ODR
- Humidity Accuracy: ±3.5%RH (20%RH to 80%RH)
- 16 bit ADC measurements

Pressure Sensor

LPS22HD

Designed for UAV

- 8 cm vertical resolution: superior absolute height estimation
- Unprecedented ascent and descent speed estimation: 200Hz equivalent data rate

MEMS Microphones

MEMS Microphones

MT34DT-MT34BT

Ready for Smart Functions

- Power-efficient microphones
- Voice controlling
- Sounds and contests recognition and monitoring

Headphone Audio Amplifier

Class-D audio power amplifier

TS2012

- Filter-free stereo 2 x 2.8 W
- Supply voltage 2.5V to 5.5V
- Dedicated standby mode per channel
- Output power per channel: 1.15 W (5V/8Ω) – 1.85 W (5V/4Ω) – 0.63 W (3.6V/8Ω)
- Output short-circuit protection
- Four gain setting steps: 6, 12, 18, 24 dB
- PSSR: 63 dB typ. at 217 Hz.
- CSP16: 2 x 2 x 0.6mm, 500µm pitch

3W Class-D mono speaker amplifier

TS4962MEIJT

- Power supply range 2.4 V - 5.5 V
- Low Power: low stand by current <1 µA
- Pout = 0.8 W into 8 Ω, at 10 % THD+N, VCC = 3 V
- SNR = 85 dB @ 1 kHz
- Flip-chip package
- Reduced external BOM