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New Time-of-Flight technology enhances performance

IMAGING Division

March 28th, 2023



FlightSense™ introduction ... Making Light work

Time-of-Flight Principle



ST proprietary **FlightSense™** technology

True distance measurement

Fast and low power

Truly invisible 940nm illumination

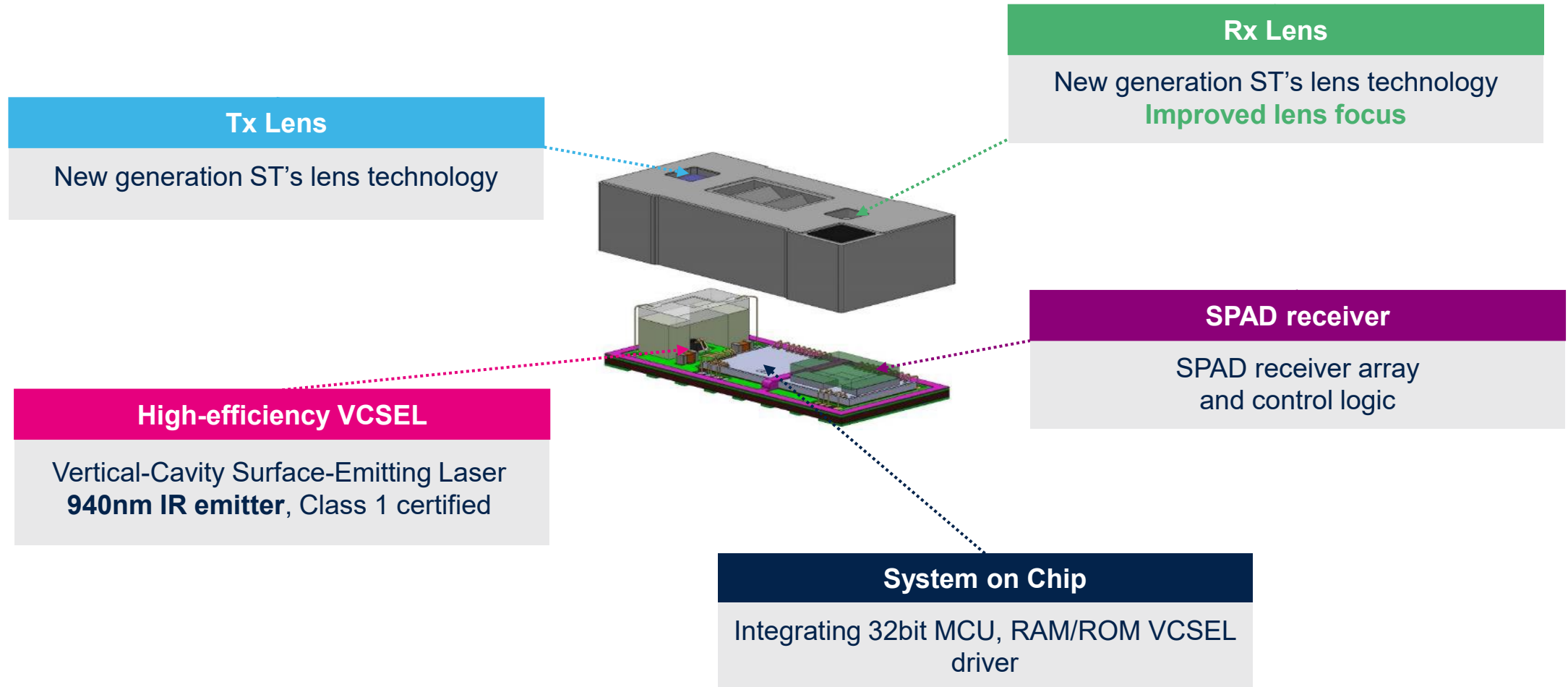


State-of-art assembly & testing
ST manufacturing line in Shenzhen

FlightSense

Typical module overview

Easy and quick integration thanks to its innovative “all-in-one” module





FlightSense™

ST Pioneer and Leader in Time-of-Flight (ToF)

ST is #1 Worldwide Time-of-Flight sensor supplier

4 Generations

Of all-in-one ToF solution deployed for 8 years

> 400 devices

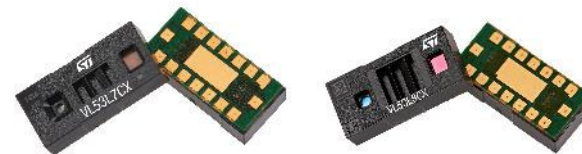
Several hundreds of non-wireless end products on the market

Unlimited variety of use-cases beyond smartphones



> 80,000

Evaluation kits deployed



VL53L7CX VL53L8CX
4th generation FlightSense™

>> 2 Billions

ToF units shipped. Mastering end-to-end supply chain



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What's new?

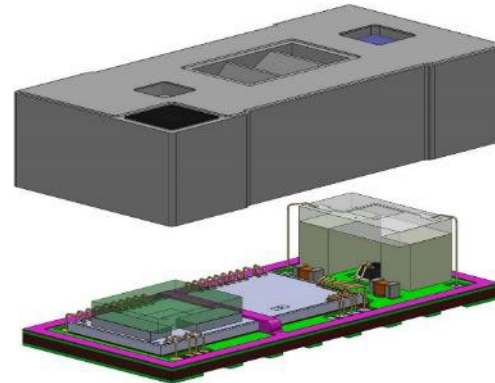
VL53L7CX and VL53L8CX improvements allow higher performances and cost-efficiency

VL53L7CX

NEW

Tx and Rx ST's lens technology
90° ultrawide FoV

Gesture recognition solution
STSW-IMG035



VL53L8CX

NEW

Tx and Rx ST's lens technology
Sharper optics than VL53L5CX

VCSEL laser emitter
3x powerful than previous generation

SPI interface
20x faster than I²C

Interrupt auto-stop feature
Quicker decision

Common features

Histogram mode
Xtalk immunity >60cm

Autonomous mode
Interrupt threshold

I²C interface
Up to 1MHz

Motion indicator
Movement variation

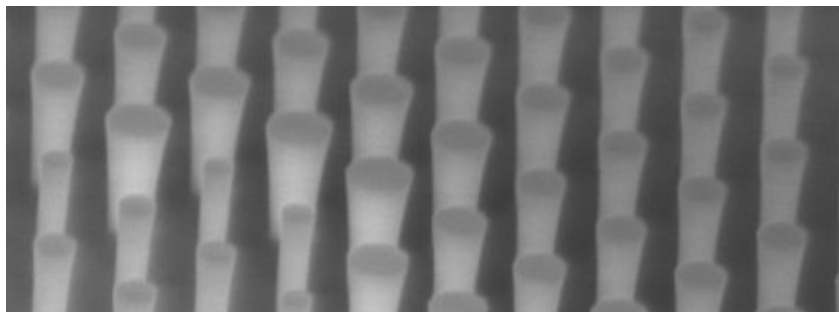
STM32CubeMX
X-CUBE-TOF1

Small size
6.4 x 3.0 x 1.6 mm



Optical diffuser & collector lens - metasurface

Transmissive optical metasurface manufactured in our 300 mm silicon foundry



In-house silicon-based technology

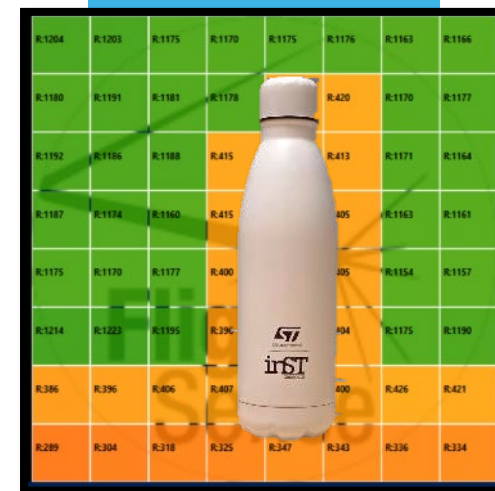
High optical performance

Sharper optics

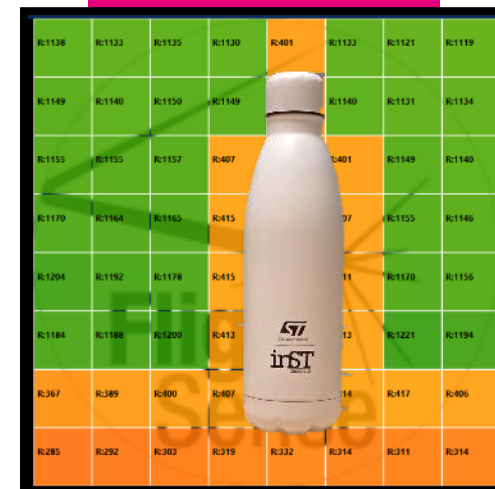
Key advantages

- No tooling or manufacturing limitations to the optic function – enables combined lens functions
- Traditional “lens” parameters (EFL, Distortion) geometrically set, stable over process and temperature avoiding active alignment
- Embedded Diffractive Optical Element (DOE) for best-in-class safety
- Robust planar surface resists contamination & damage, and compatible with optical coatings

Before



Now



New products



VL53L7CX and VL53L8CX



VL53L5CX

45° x 45° (65° diag.)



VL53L7CX

60° x 60° (90° diag.)



VL53L8CX

45° x 45° (65° diag.)

Field of view

Resolution

Processing mode

Common features

Additional features

Driver

Module size

Interface

Distance ranging Dark condition*
 Under ambient light*

Power consumption**

8x8 and 4x4

Histogram

Autonomous low power mode
Motion indicator
Crosstalk immunity >60 cm

Auto-stop
External synchronization pin

100% compatible

6.4 x 3.0 x 1.5 mm

6.4 x 3.0 x 1.6 mm

6.4 x 3.0 x 1.75 mm

I²C

I²C

I²C and **SPI**

400 cm

350 cm

400 cm

170 cm

65 cm

285 cm

4.5mW

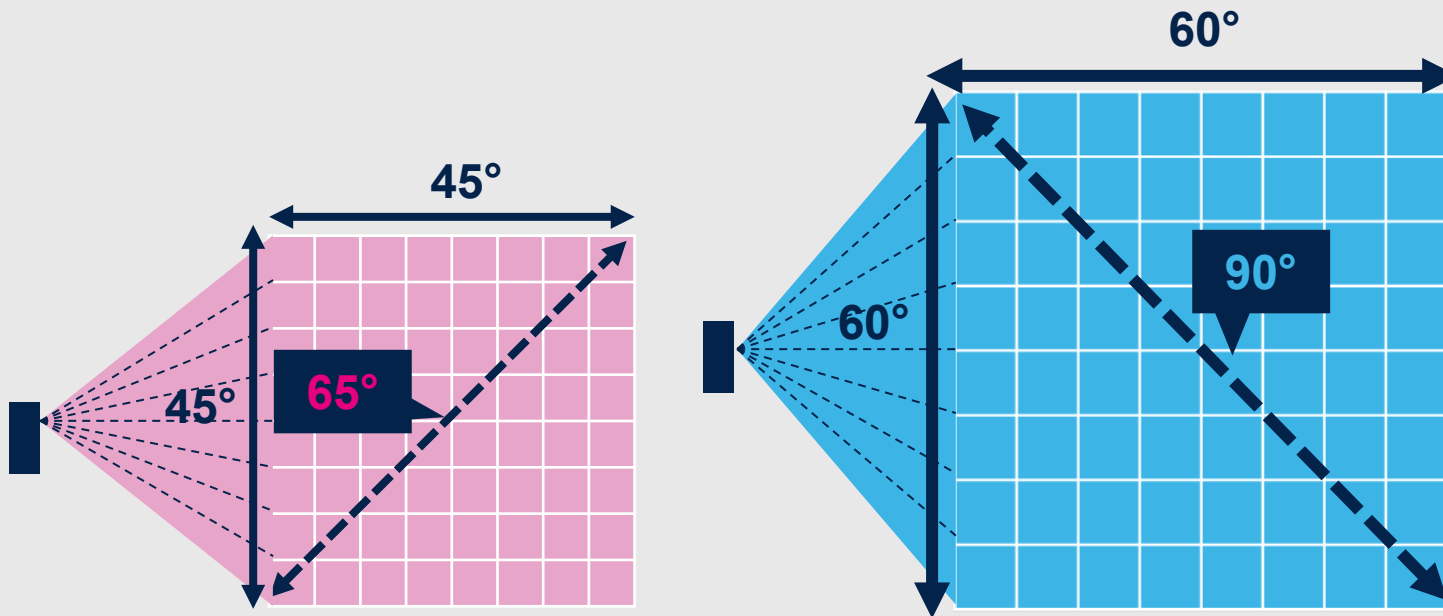
8.3mW

1.6mW

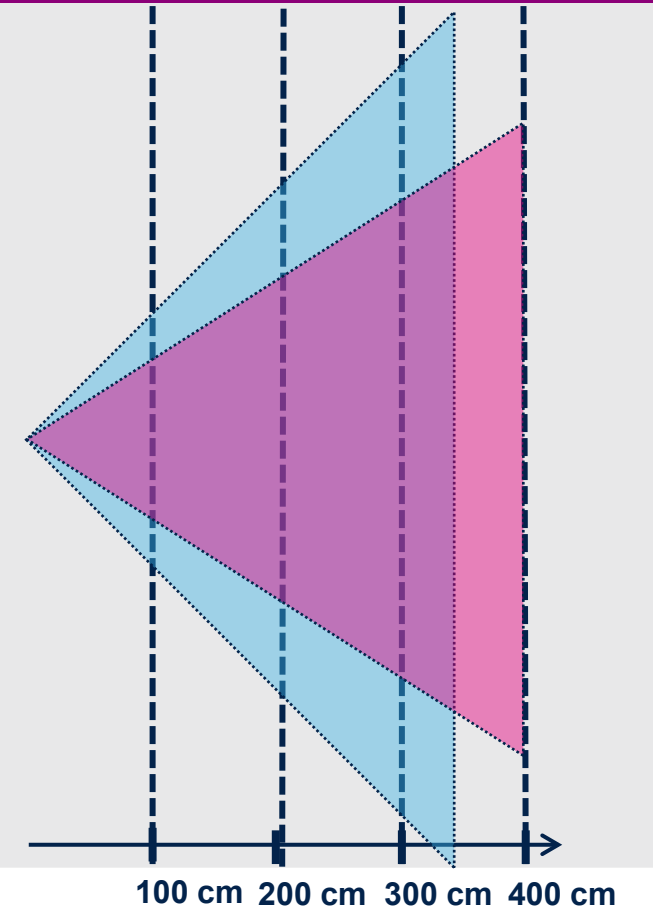


The **VL53L7CX** has a wider FoV, the **VL53L8CX** ranges further

Coverage zone



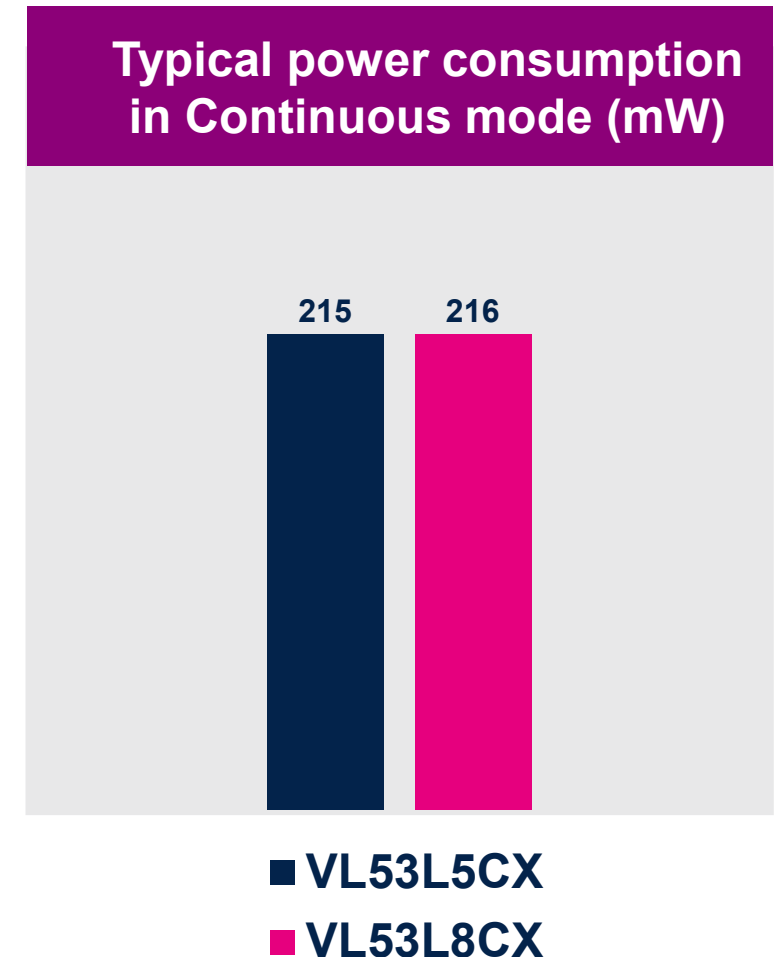
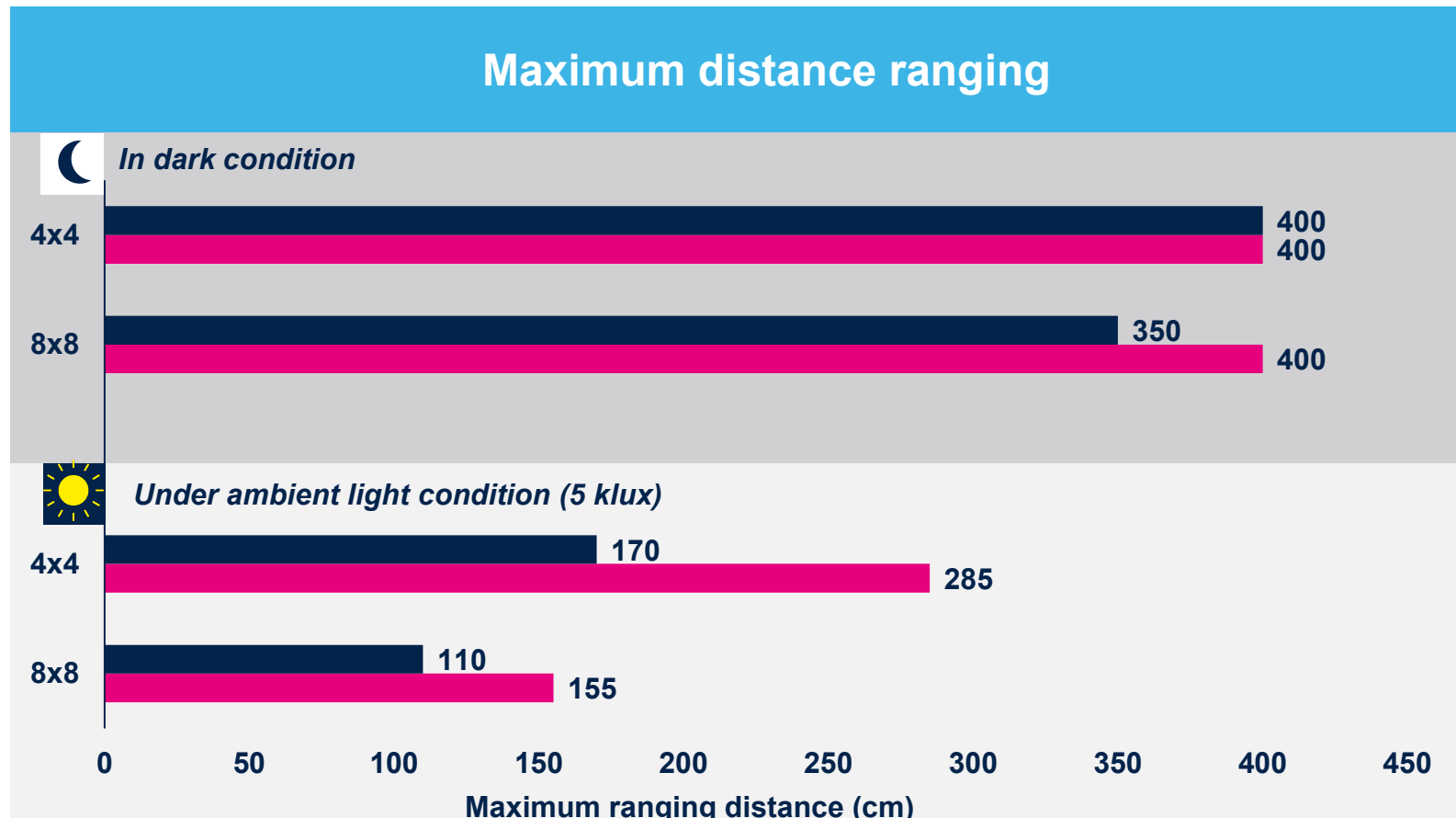
Maximum distance ranging
Drawing at scale





VL53L8CX - Continuous mode

+ Equal power consumption for increased maximum ranging distance with VL53L8CX



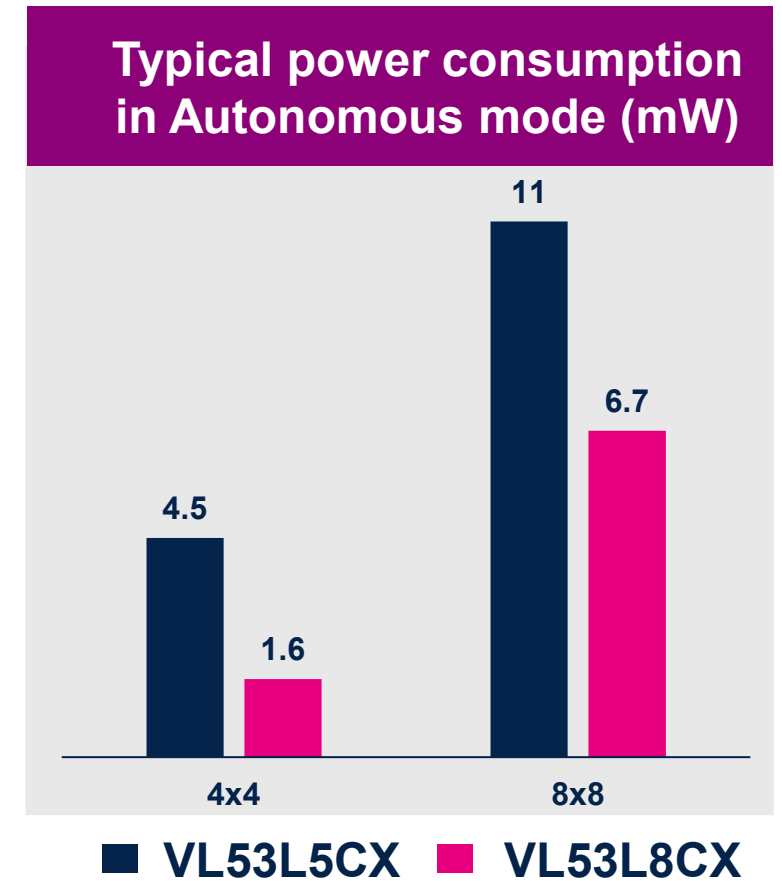
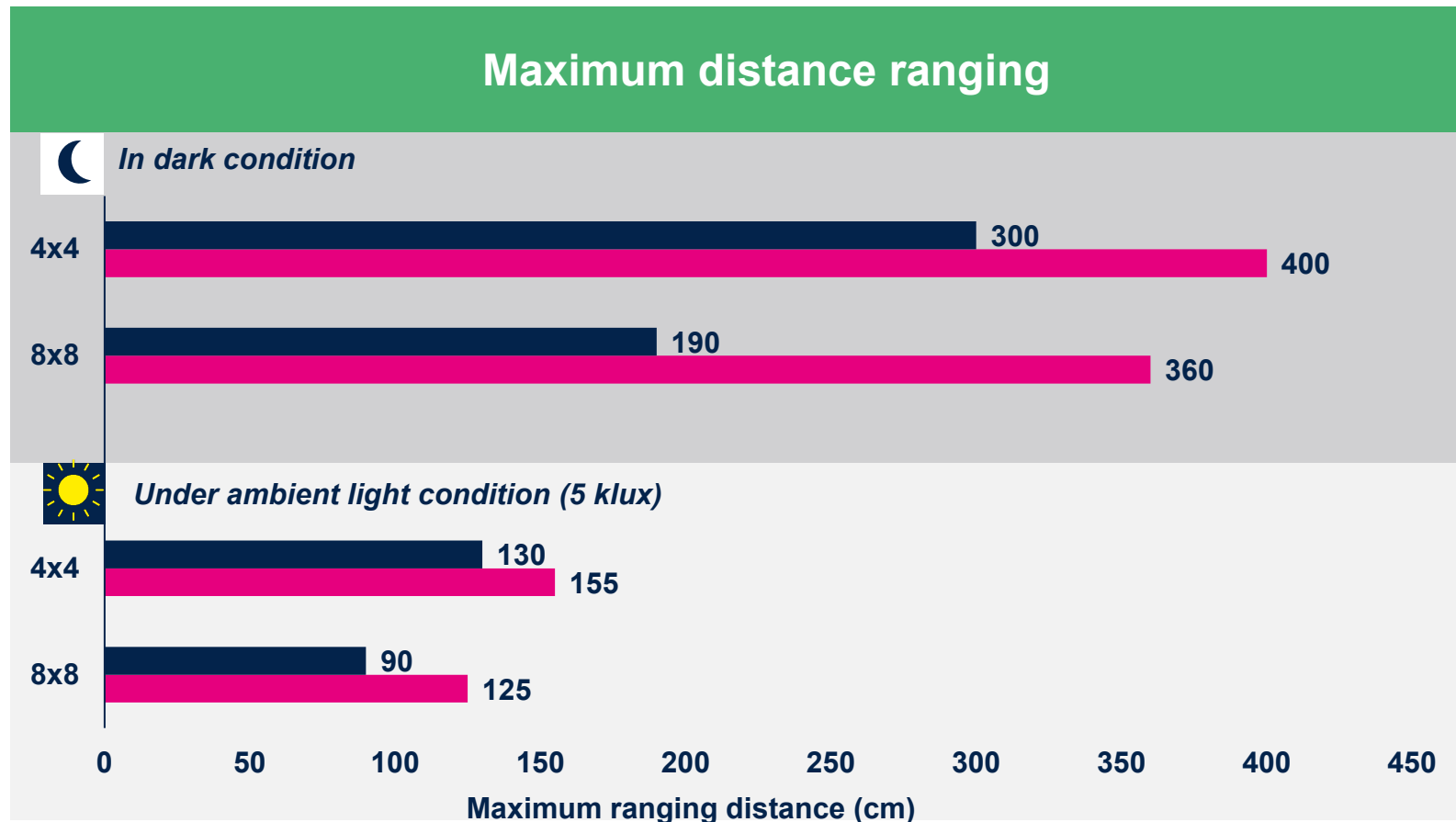
- Measurement conditions :
 - Power consumption measured with 3.3 V analog and VCSEL supply
 - Ranging continuously at 30Hz, with white target reflectance 88%



VL53L8CX - Autonomous mode



Reduced power consumption for increased maximum ranging distance with VL53L8CX



- Measurement conditions :
 - Power consumption measured with 3.3 V analog and VCSEL supply
 - Integration time 5 ms at 1Hz, with white target reflectance 88%

Markets & applications



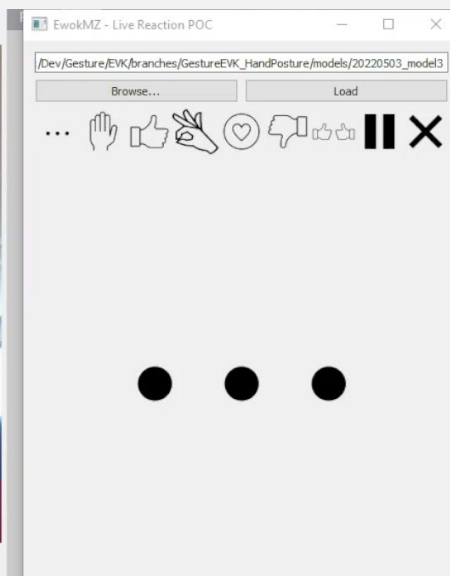
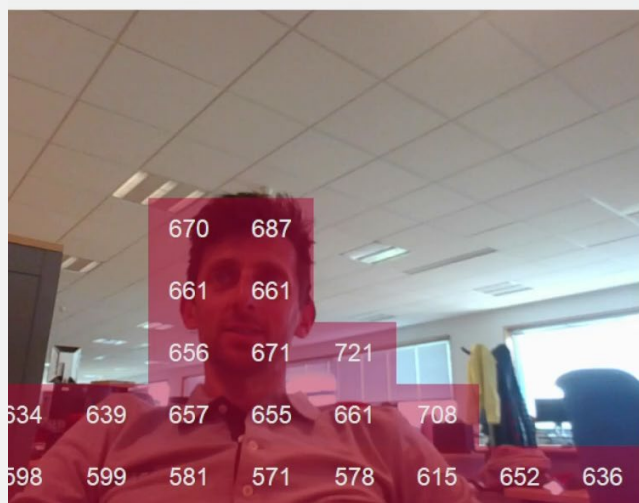
Gesture Recognition

A full ST solution package designed for your unlimited applications



STSW-IMG035

Hand posture recognition now possible thanks to AI



- ✓ **Cost-friendly sensor**, system architecture, and development
- ✓ **Ready to use** and easy to integrate solution
- ✓ **Privacy**, no image unlike camera
- ✓ **Low power** ToF compared to other technology

User-friendly



Thermostats



Switch



Service robots



Smart speakers
/ assistants



Tablets



AR/VR

Entertainment



Toy robots



Gaming

Safety



Digital Signage



Sanitary



Elevators



Vending machines



ATMs

Hygiene



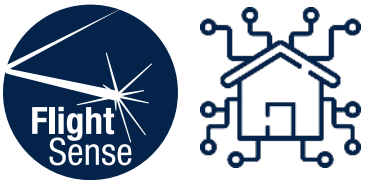
Kitchen
appliances



Industrial
robots

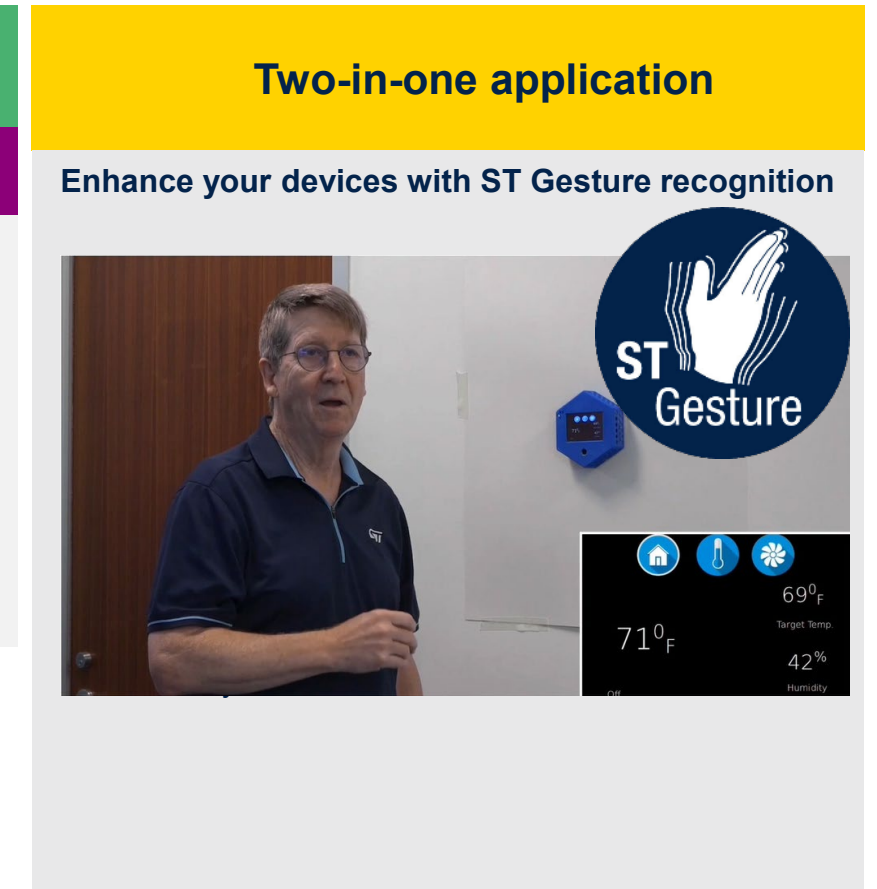
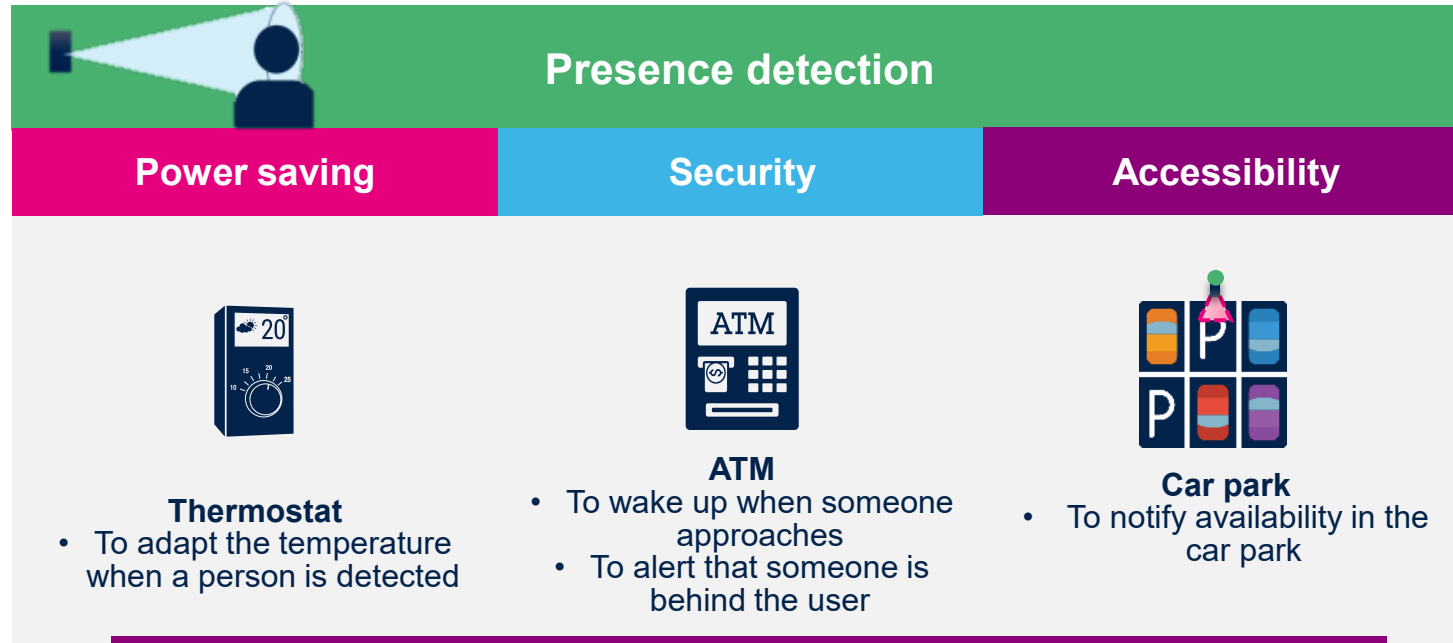


Production
lines



Presence detection

Choose VL53L7CX for wider detection range or VL53L8CX for better ambient light immunity





Robotics and vacuum cleaners

Multizone capability increases use-cases possibilities for robotics

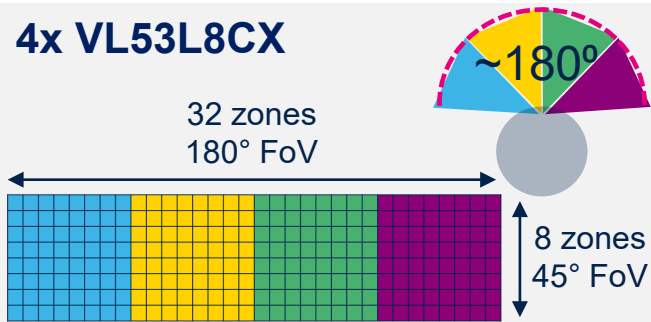
Up to 6 applications covered by one single sensor



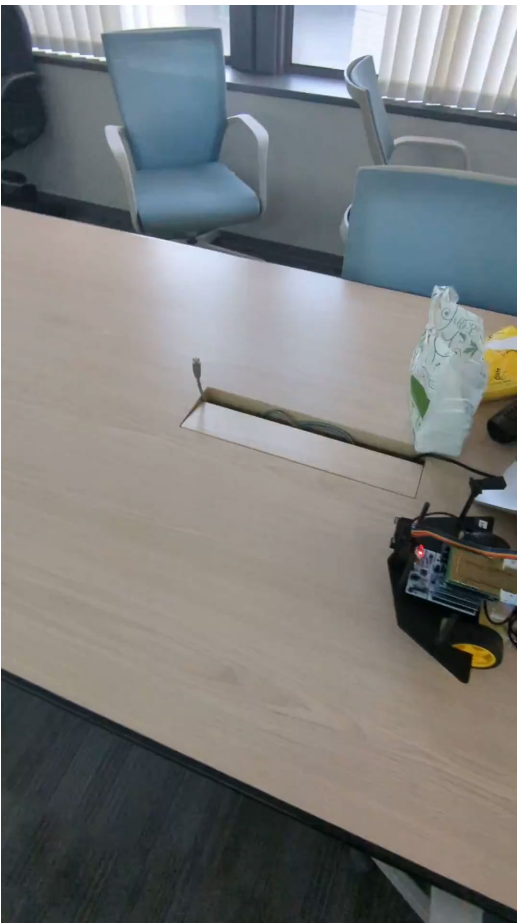
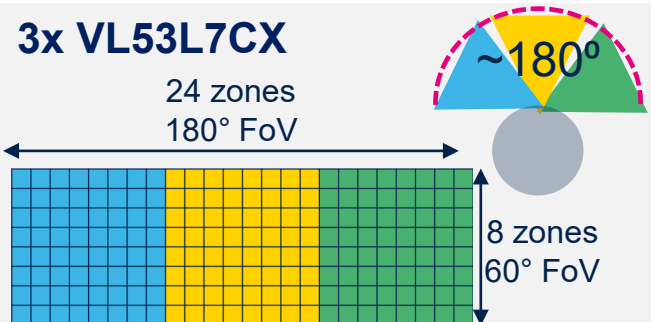
- Floor sensing
- Cliff prediction
- Small object detection
- Collision avoidance
- Ceiling detection
- Safe docking assist

Up to 9 applications using multiple ST Time-of-Flight

4x VL53L8CX



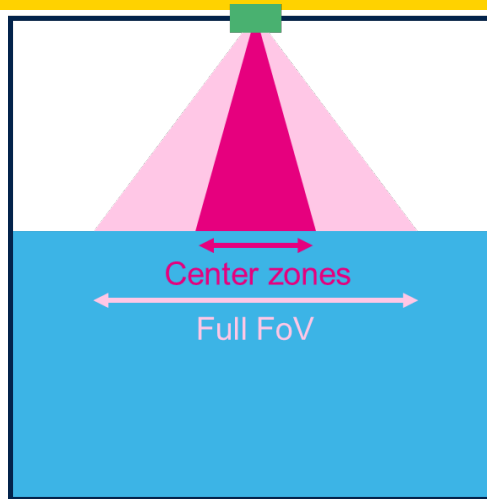
3x VL53L7CX





Liquid Level Monitoring

8x8 multizone liquid level monitoring solution uses 12 perpendicular center zones



Step 1

Extract signal strength and distance from center zones

52	50	71	77	54	72	89	97
86	61	83	73	60	80	91	96
85	52	88	368	5006	100	64	100
63	59	62	90	4064	67	52	56
73	70	56	97	57	76	58	89
64	87	76	53	78	62	53	87
67	98	51	64	83	54	100	86
50	90	50	67	51	70	83	66

Step 2

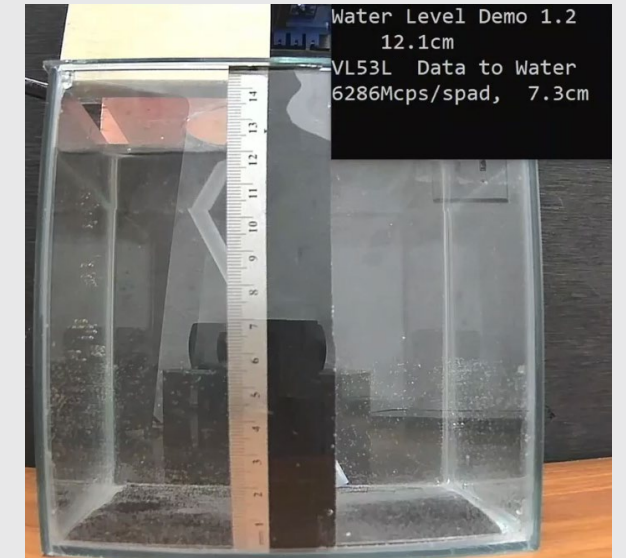
Extract signal strength and distance from center zones

60	70	71	63	60	66	66	73
78	61	62	71	80	60	67	63
61	65	74	76	77	78	65	73
62	68	70	62	78	63	63	62
60	78	78	64	72	61	63	61
64	62	75	62	62	69	77	67
70	62	65	77	70	64	69	64
71	60	64	73	63	66	79	80

Step 3

Extract the distance of this zone

Water level monitoring demo



Not
"intrusive"

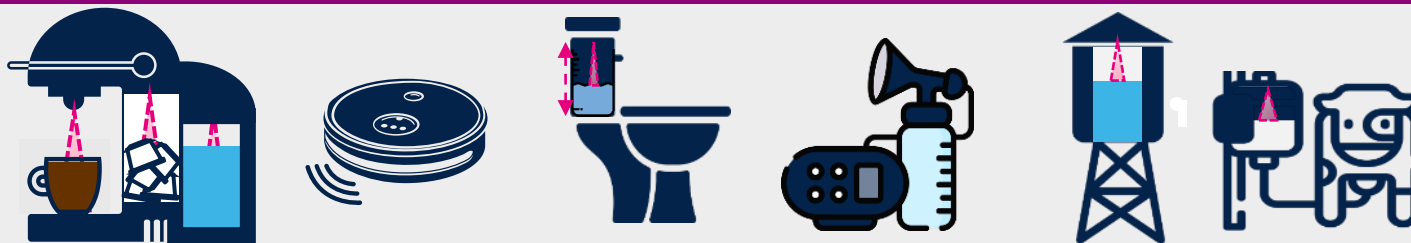
Works with
all type of
liquids

Small size

Cost
Saving

Connected

Applications

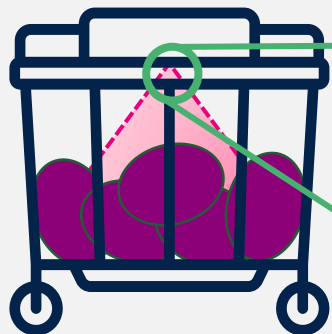




Content management

Whatever the environment, VL53L7CX or VL53L8CX will fit with user expectations

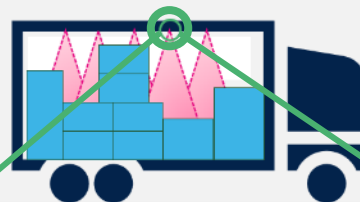
Trash bins



Content level monitoring
Level management

Monitoring in real time
Track full and empty bins

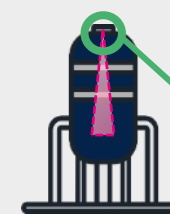
Trucks & Container



Content level Management
Remaining space measurement

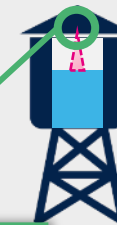
Package falling detection
Detect if something is moving in
the truck/container

Storage tank



Monitoring in real time
Avoiding empty tank

Water tower



Other applications



Tanks

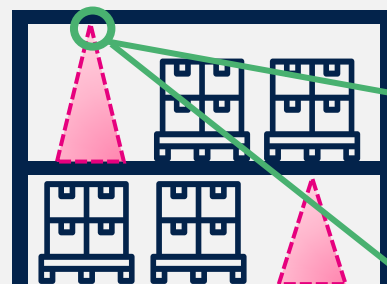


Logistics



Warehouse

Storage racks

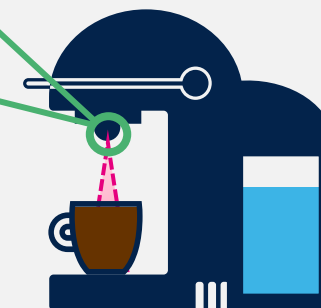


Occupancy detection
Storage management

Entry/Exit counting
Statistics and flow management

Coffee cup detection
Avoiding to dispense coffee if
there is no coffee cup

Coffee cup



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Technical



Thresholds Detection

Autonomous mode permits to wake up the host only when a threshold is reached

- Can be used to trigger an interrupt when conditions are met
- Smart reduction of I2C bandwidth: sensor wakes up the host only under predefined criteria

For more information



User Manuals

VL53L7CX → UM3038

VL53L8CX → UM3109

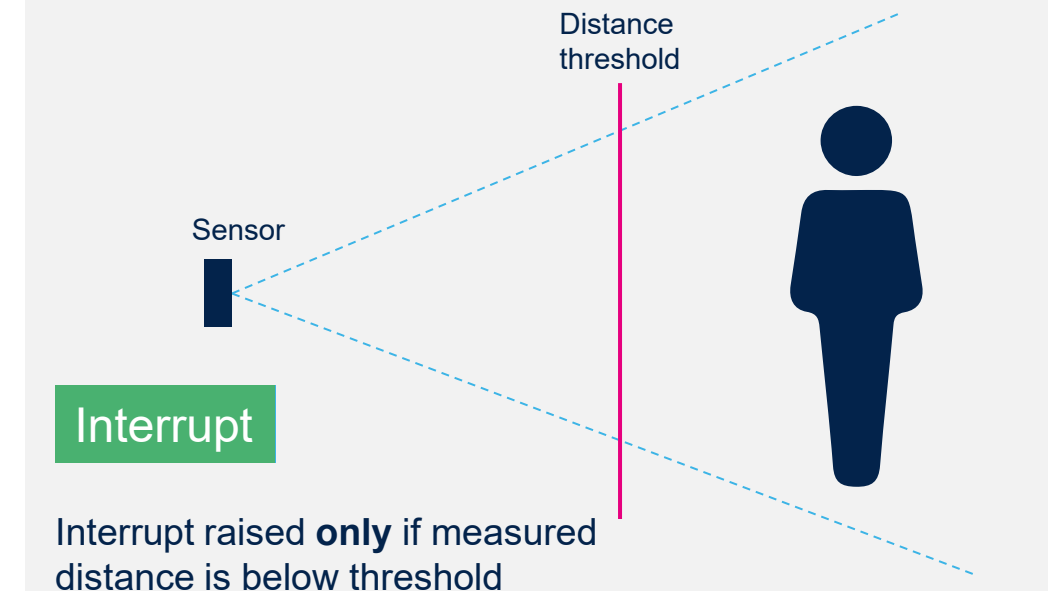
Threshold criteria

- Distance
- Signal rate
- Motion
- ...

Configurable windows

- One or two thresholds per zone
- Multiple criteria available
 - Above threshold
 - In windows
 - Out windows
 - ...

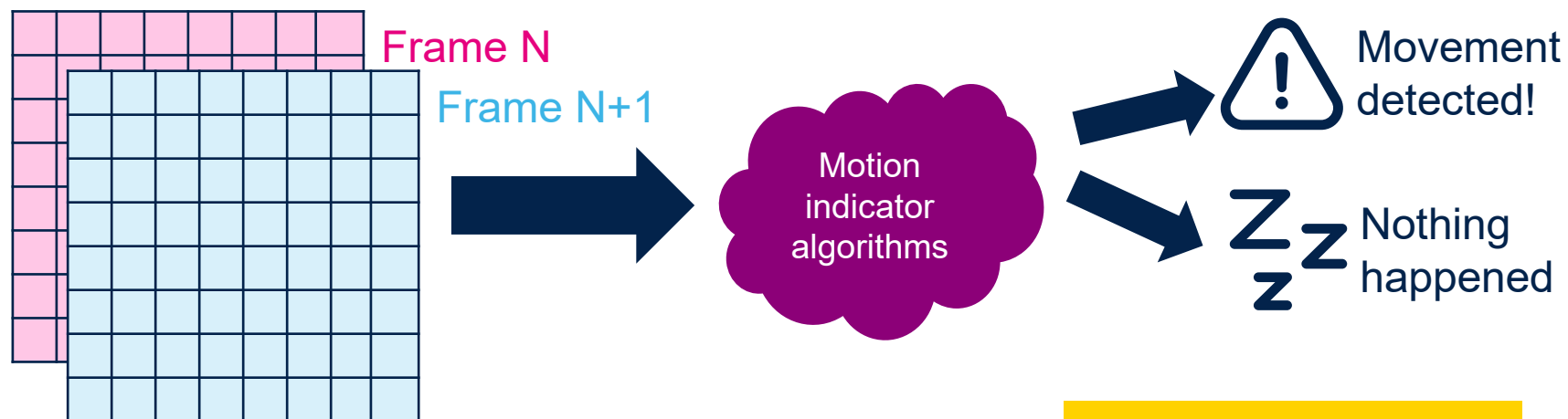
Example with a distance threshold





Motion indicator

Sensor detects motion in each zone



Features

- Based on histogram algorithms
- Movement variation in each zone
- Motion intensity is the output data

Benefits

- Works in 4x4 or 8x8 zones
- Works with detection thresholds
- Runs in Autonomous mode

Market and use-cases



Home Appliance &
Home Automation



White
Goods



Smart
Home



Laptops



Monitors

For more information



User Manuals

VL53L7CX → UM3038

VL53L8CX → UM3109



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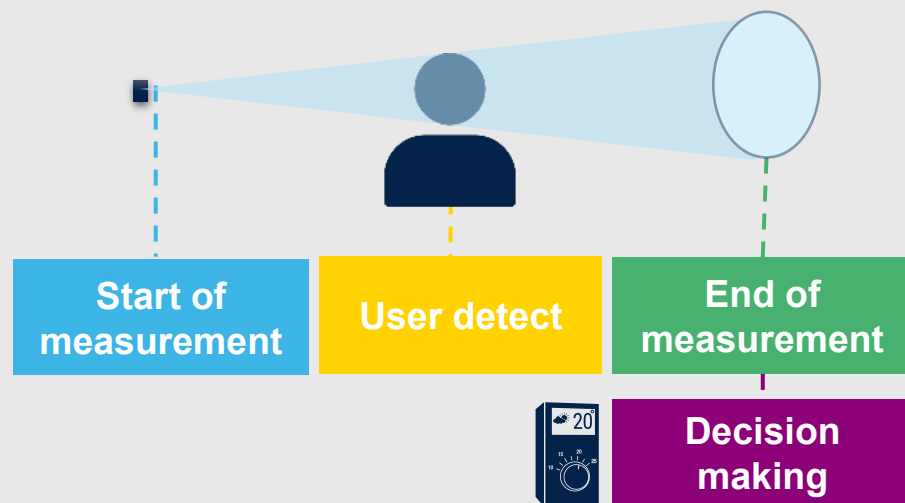
VL53L8CX, auto-stop feature

Example of faster decision making of the 8x8 multizone Time of-Flight sensor with user detection

Benefits

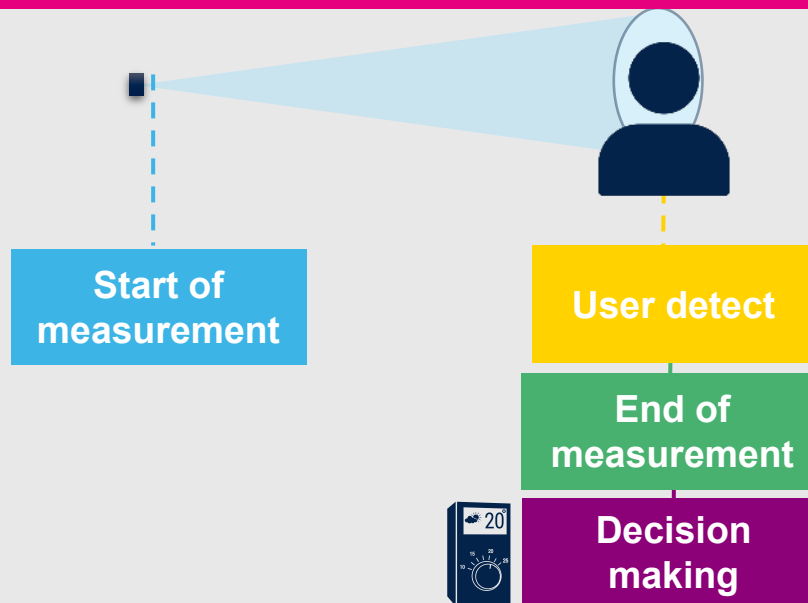
- Real-time action
- Measuring efficiency
- Power saving

Without auto-stop feature



The measurement continues during a determined timing budget, and stops at the end, even if a change has been detected

With auto-stop feature



An interrupt stops the measurement as soon as a change is detected, and the system can act directly

Technical resources



VL53L7CX and VL53L8CX online support

Boards



VL53L7CX

VL53L8CX

Expansion board

[X-NUCLEO-53L7A1](#)

[X-NUCLEO-53L8A1](#)

Expansion kit

[P-NUCLEO-53L7A1](#)

[P-NUCLEO-53L8A1](#)

Breakout boards

[SATEL-VL53L7CX](#)

[SATEL-VL53L8](#)

Software



Ultra Lite Driver (ULD)

[STSW-IMG036](#)

[STSW-IMG040](#)

GUI

[STSW-IMG037](#)

[STSW-IMG041](#)

Linux driver

[STSW-IMG038](#)

[STSW-IMG042](#)

Gesture recognition

[STSW-IMG035](#)

soon

X-CUBE package

[X-CUBE-TOF1](#)

Documentation



Datasheet

[DS13865](#)

[DS14161](#)

User Manual

[UM3038](#)

[UM3109](#)

SATEL connection

[AN5883](#)

[AN5945](#)

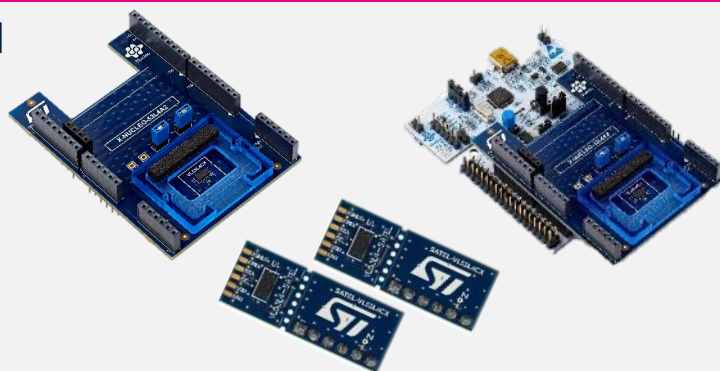


Ecosystem and tools

Imaging products supported by ST ecosystem

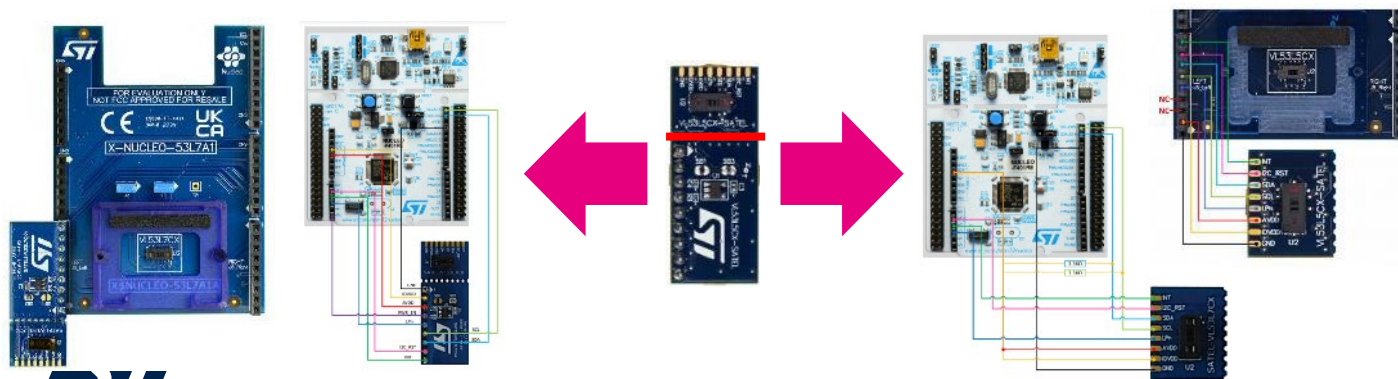
Development boards

- X-NUCLEO expansion board
- P-NUCLEO packs with STM32 NUCLEO
- Stand-alone Breakout boards
 - Breakout boards enable easy & swift integration at customers
 - Can be connected to X-NUCLEO or any NUCLEO board



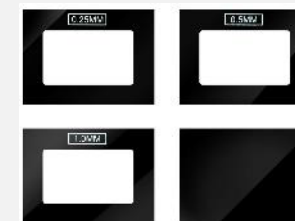
STM32 ODE

- FlightSense™ fully integrated in STM32 Ecosystem
- Compatible with all STM32 NUCLEO boards thanks to **CubeMX**
- Referenced on mbed, Arduino & Raspberry Pi platforms



Cover glass





- Square cover glass
- 3 spacers 0.25/0.5/1mm to create various air gaps
- Cover glass holder





VL53L7CX Ordering codes



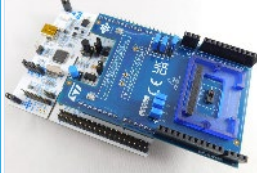

Go to www.st.com/en/product/VL53L7CX or contact your usual distributor

Item	Picture	Commercial Product (= Order Code)	Comments
VL53L7CX sensor		VL53L7CXV0GC/1	Delivery in T&R MOQ: 3.6ku With protective liner LT = 24 weeks
VL53L7CX Expansion board		X-NUCLEO-53L7A1/	To go along with STM32F401 Nucleo board. Comes with cover-glass holder, cover-window sample, 3x spacers
Pack: VL53L7CX Nucleo™ Expansion board + STM32F401 NUCLEO		P-NUCLEO-53L7A1/	X-NUCLEO-53L7A1 expansion board delivered together with STM32F401 NUCLEO board
VL53L7CX Breakout boards		SATEL-VL53L7CX	2x Breakout boards delivered



VL53L8CX Ordering codes

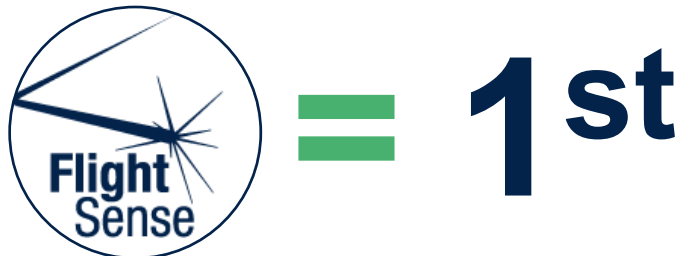
Go to www.st.com/en/product/VL53L8CX or contact your usual distributor

Item	Picture	Commercial Product (= Order Code)	Comments
VL53L8CX sensor		VL53L8CXV0GC/1	Delivery in T&R MOQ: 3.6ku With protective liner LT = 24 weeks
VL53L8CX Expansion board		X-NUCLEO-53L8A1/	To go along with STM32F401 Nucleo board. Comes with cover-glass holder, cover-window sample, 3x spacers
Pack: VL53L8CX Nucleo™ Expansion board + STM32F401 NUCLEO		P-NUCLEO-53L8A1/	X-NUCLEO-53L8A1 expansion board delivered together with STM32F401 NUCLEO board
VL53L8CX Breakout boards		SATEL-VL53L8	2x Breakout boards delivered



FlightSense™ Summary

Leader on Direct ToF

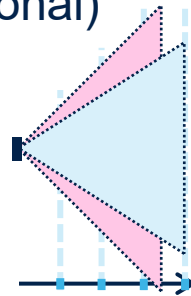


VL53L7CX ultrawide FoV

- 60° x 60° FoV (90° diagonal)



- +33% dFoV

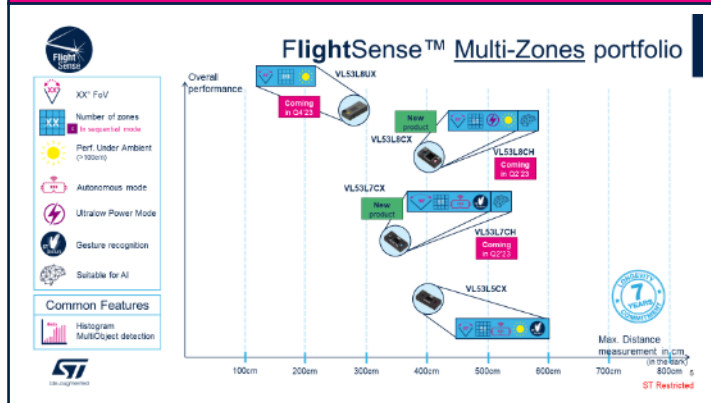


VL53L8CX high performances

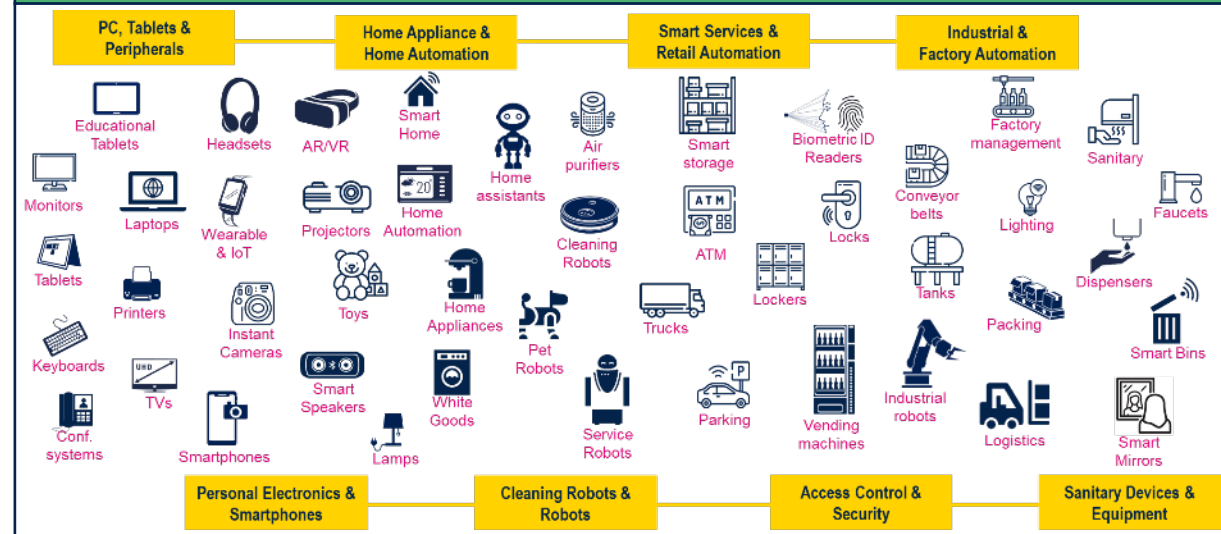
- 45° x 45° FoV (65° diagonal)
 - Up to **285cm** under ambient light
 - Power consumption down to **1.6mW**



Continuous improvement



Unlimited markets & applications



Our technology starts with You



Find out more at www.st.com

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