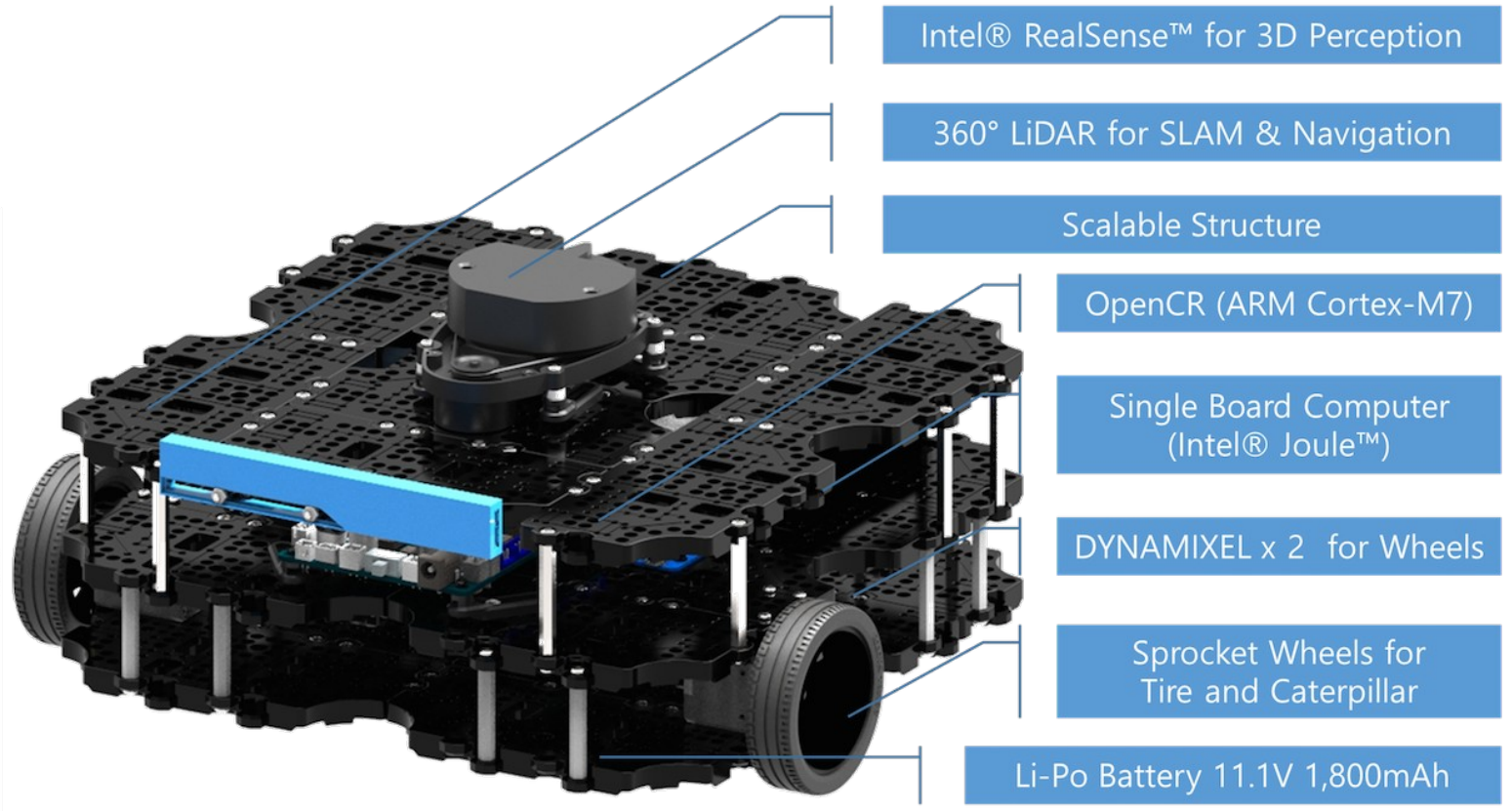
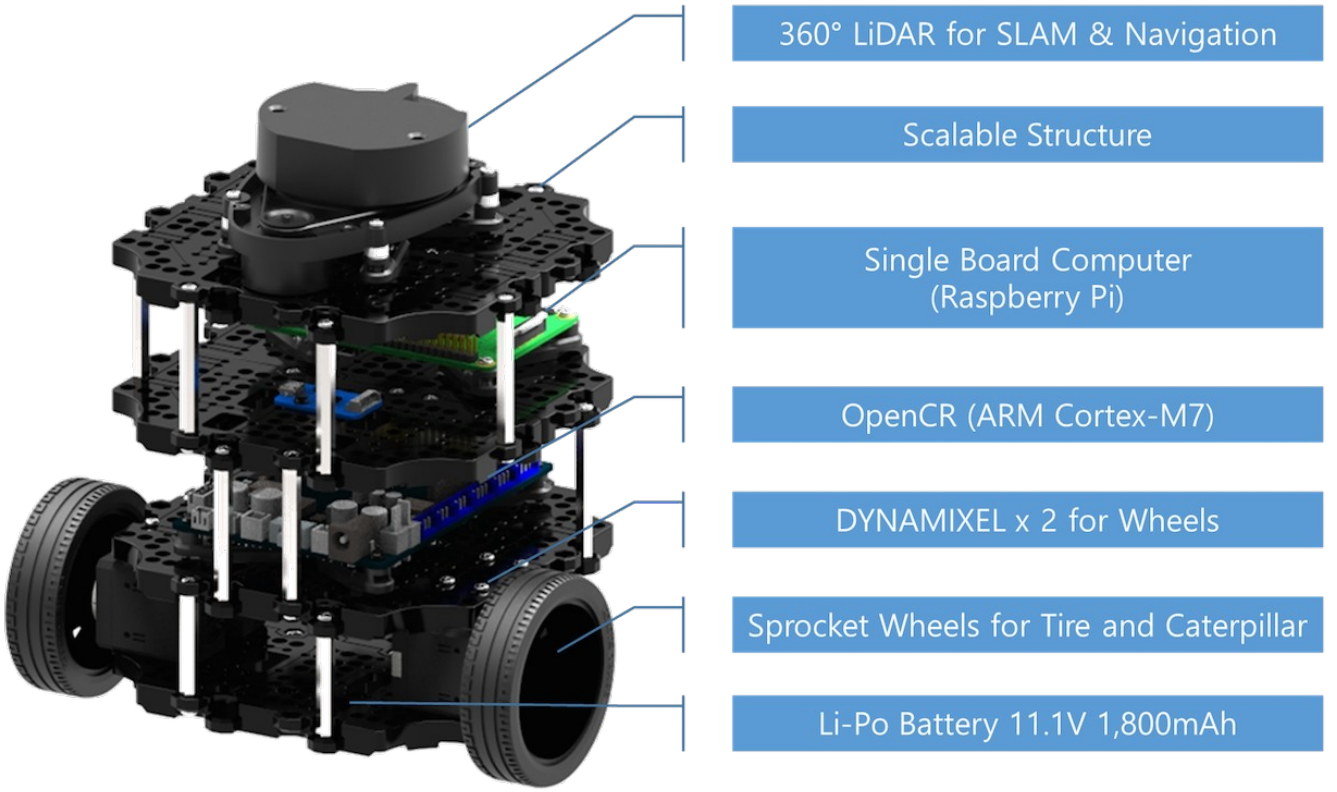
TurtleBot3, type waffle



TurtleBot3, type burger



TurtleBot3

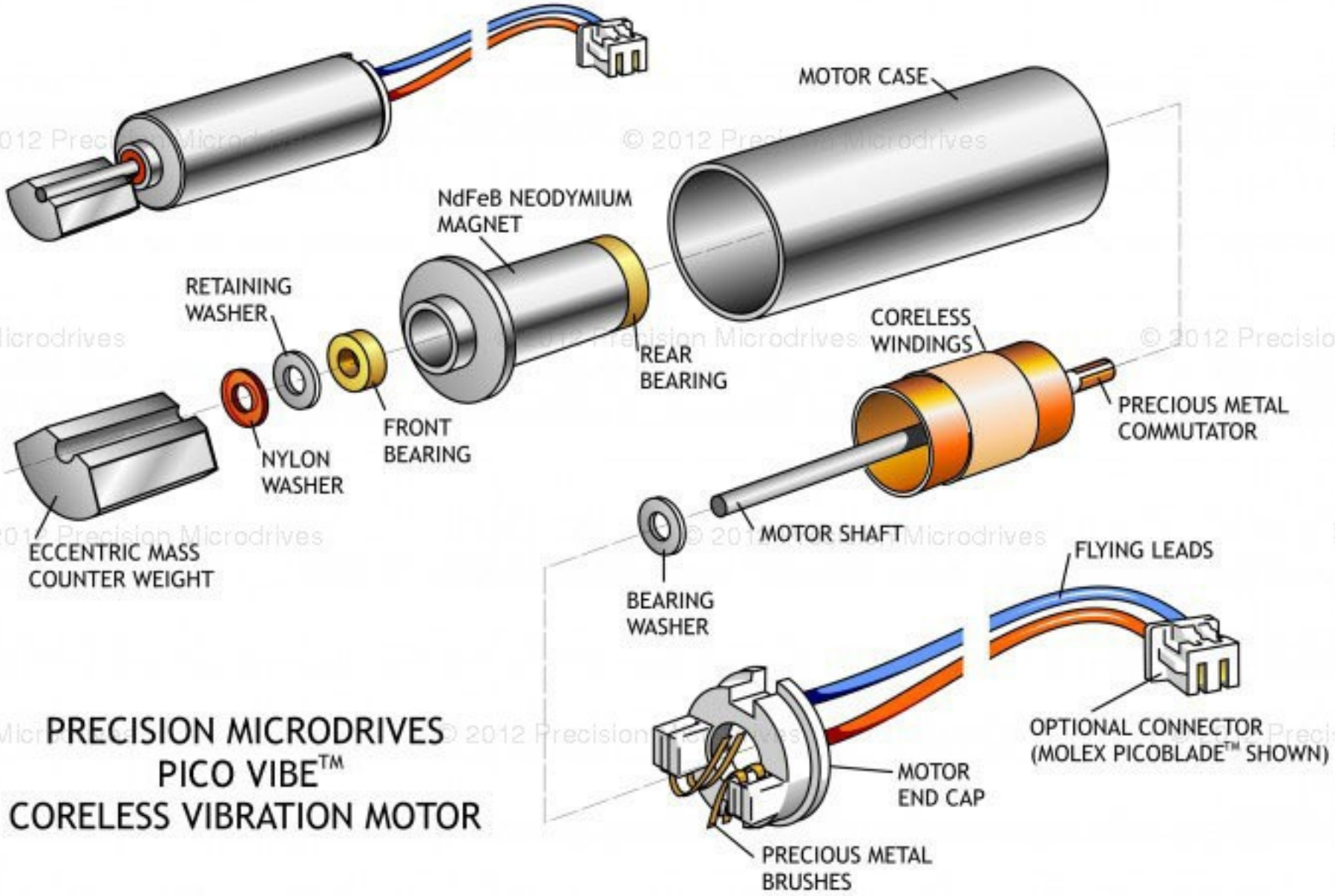
- Plateforme mobile low cost
  - Chassis: plate, post, pcb base (printed circuit board), ball caster, caster holder
  - Motors: Dynamixel-X series (XL430 or XM430) x 2
    - Servomotors (coreless DC motor + contactless magnetic encoder + MCU)
  - Wheel: multi purpose wheel (18x66) x 2
  - Embedded board: OpenCR x 1
  - Computer: SBC x 1 (Single Board Computer: Intel Joule or Raspberry Pi)
  - Sensors:
    - 2D laser rangefinder x 1
    - 3D RGBD camera (waffle) x 1
  - Battery: Lithium-polymer 11.1V 1800 mAh x 1

Burger - Waffle

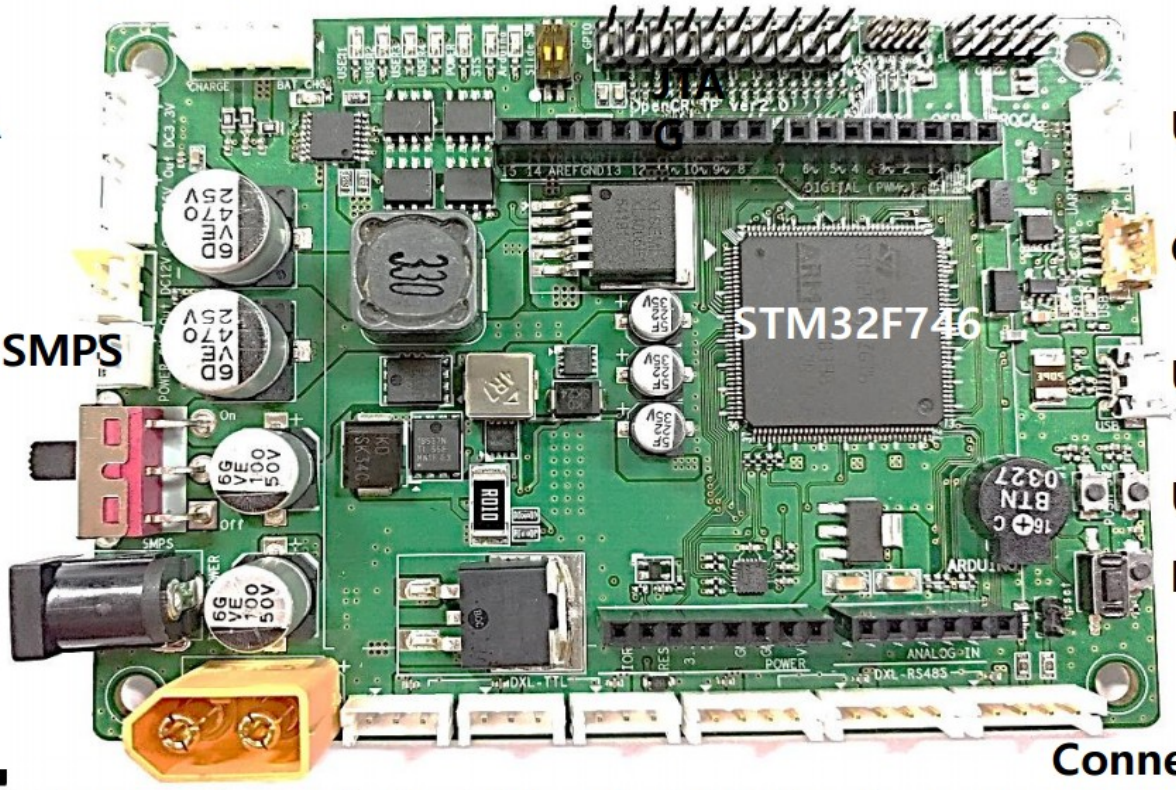
	Burger	Waffle
Max. trans. velocity	0.22 m/s	0.26 m/s
Max. rot. velocity	162.72 deg/s	104.27 deg/s
Maximum payload	15kg	30kg
Size (L x W x H)	138mm x 178mm x 192mm	281mm x 306mm x 141mm
Weight (+ SBC + Battery + Sensors)	1kg	1.8kg
Expected operating time	2h 30m	2h
MCU	32-bit ARM Cortex®-M7 with FPU (216 MHz, 462 DMIPS)	
IMU	Gyroscope 3 Axis, Accelerometer 3 Axis, Magnetometer 3 Axis	
Ext. sensors	LDS	LDS + 3D RGBD camera

Motors of Turtlebot3

- **ROBOTIS Dynamixel X series**
- 3 ways for cabling
- 6 operating modes: **velocity** (for wheels), **torque**, **position**, extended position, current-based position, and PWM.
- Networks: **daisy-chained RS-485 / TTL**


MOTOR CASE
NdFeB NEODYMIUM MAGNET
RETAINING WASHER
REAR BEARING
CORELESS WINDINGS
PRECIOUS METAL COMMUTATOR
FRONT BEARING
NYLON WASHER
ECCENTRIC MASS COUNTER WEIGHT
MOTOR SHAFT
BEARING WASHER
FLYING LEADS
OPTIONAL CONNECTOR (MOLEX PICOBLADE™ SHOWN)
MOTOR END CAP
PRECIOUS METAL BRUSHES
PRECISION MICRODRIVES
PICO VIBE™
CORELESS VIBRATION MOTOR

OpenCR of Turtlebot3



OpenCR : Open Source Control Module for ROS
SMPS : Switched Mode Power Supply

TurtleBot3

Single Board Computer: Intel Joule

Processor — Intel 64-bit, quad-core “Apollo Lake” Atom SoC (System on Chip):

Joule 570x — Atom T5700 SoC (1.7GHz clock; 2.4GHz burst)

GPU — Intel HD Graphics with 4K video capture and display

Memory:

RAM — 4GB (model 570x) LPDDR4 RAM

Storage — 16GB (model 570x) eMMC flash

- EMMC : mémoire flash avec contrôleur intégré

Wireless — Intel 8260 WiFi/BT module:

802.11ac WiFi with MIMO (optional)

Bluetooth 4.1 BLE

MHF4 antenna connectors

Graphics:

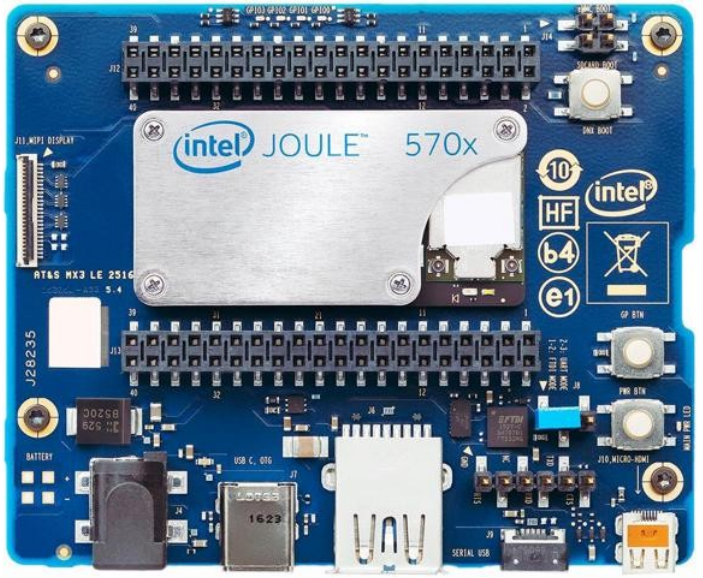
HDMI 1.4b out at 1080p

MIPI CSI and DSI interface

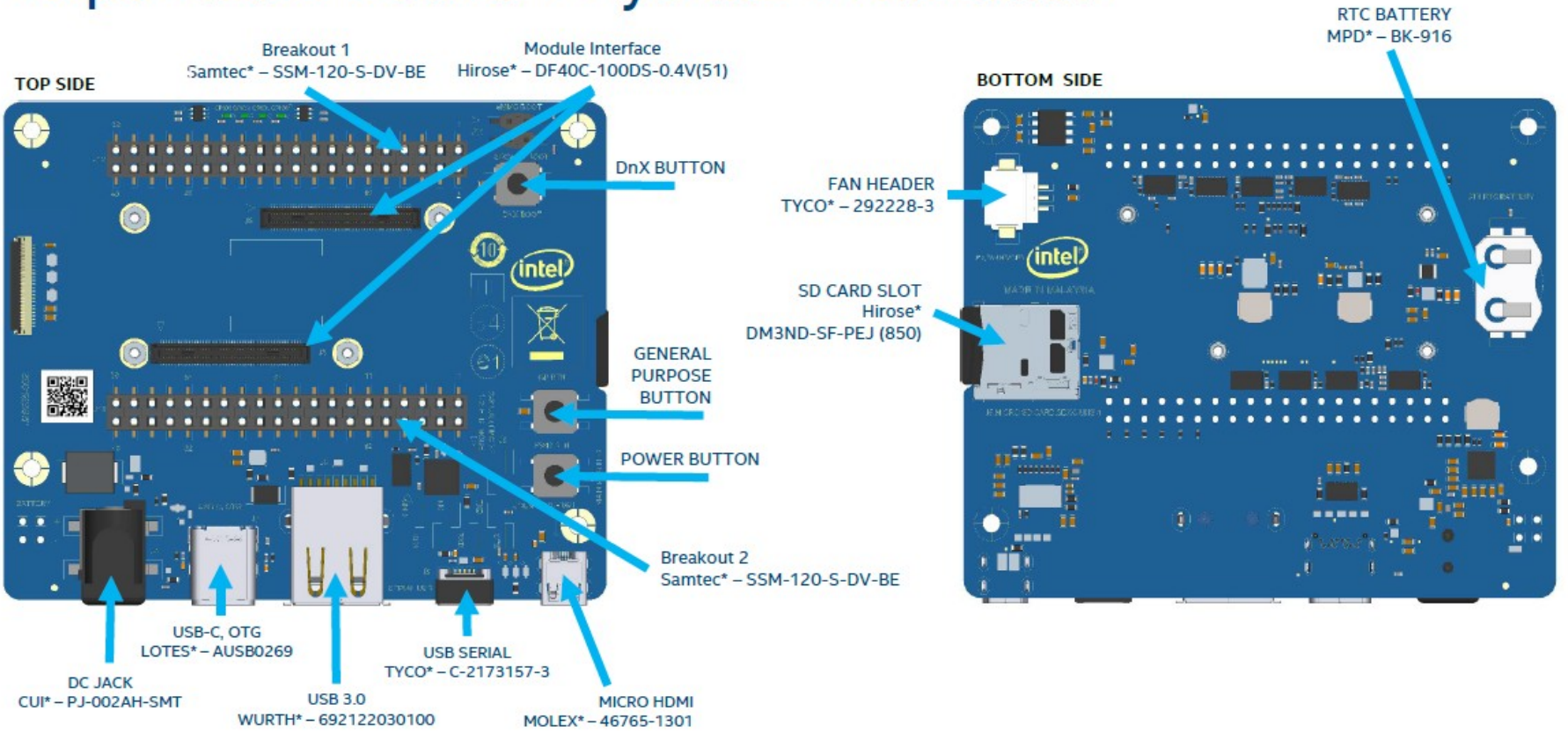
4K video I/O support

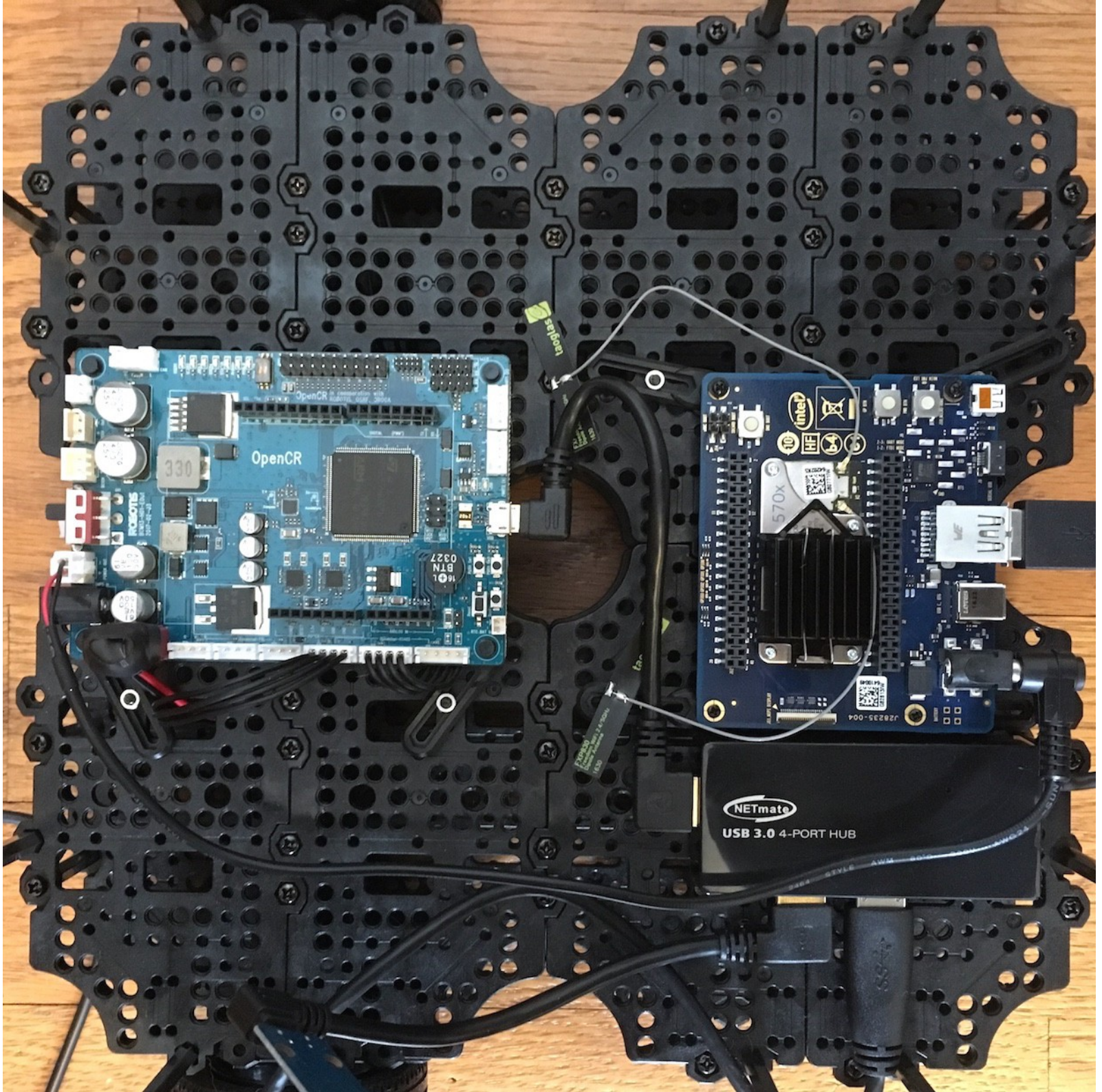
Other I/O:

- USB — up to 2x USB 3.0; 1x USB 2.0 with OTG support
- Serial — up to 3x UARTs
- GPIO — up to 26x GPIOs (including 4x PWMs)
- 2x digital mic inputs
- Expansion– 2x PCIe 2.0 lanes (muxed with USB 3.0)
- Other features — Intel RealSense compatible; I/O config. stored in EEPROM



Expansion Board Physical Interfaces




OpenCR
NETmate
USB 3.0 4-PORT HUB

TurtleBot3

LDS : laser detection sensor

- **LIght Detection And Ranging System** : 360-degree HLS-LFCD LDS (*Laser Detection Sensor*)
- Operating supply voltage 5V DC ±5%
- Light source Semiconductor Laser Diode(λ=785nm)
- LASER safety IEC60825-1 Class 1
- Current consumption 400mA or less (Rush current 1A)
- Detection distance 120mm ~ 3,500mm
- Interface 3.3V USART (230,400 bps) 42bytes per 6 degrees, Full Duplex option
- Ambient Light Resistance 10,000 lux or less
- Sampling Rate 1.8kHz
- Dimensions 69.5(W) X 95.5(D) X 39.5(H)mm
- Mass Under 125g
- ---
- Distance Range 120 ~ 3,500mm
- Distance Accuracy (120mm ~ 499mm)±15mm
- Distance Accuracy(500mm ~ 3,500mm) ±5.0%
- Distance Precision(120mm ~ 499mm) ±10mm
- Distance Precision(500mm ~ 3,500mm) ±3.5%
- Scan Rate 300±10 rpm
- Angular Range 360°
- Angular Resolution 1°

TurtleBot3

3D RGBD camera

- Intel's RealSense R200 depth-finding camera
- RGB Video Resolution 1920 x 1280, 2M
- IR Depth Resolution 640 x 480, VGA
- Frame Rate
  - 30 fps (RGB),
  - 60 fps (IR depth)
- Range 0.3m ~ 4.0m
- Operating Supply Voltage 5V
  - via USB port
- USB Port USB 3.0
- Dimensions:
  - 101.56mm L x 9.55mm H x 3.8mm W
- Mass Under 35g

- Laser Projector Class 1 IR Laser Projector (IEC 60825-1:2007 Edition 2)
- DxVxH FOV (Field-of-View)
  - 77°x 43°x70°(RGB),
  - 70°x46°x59° (IR depth)

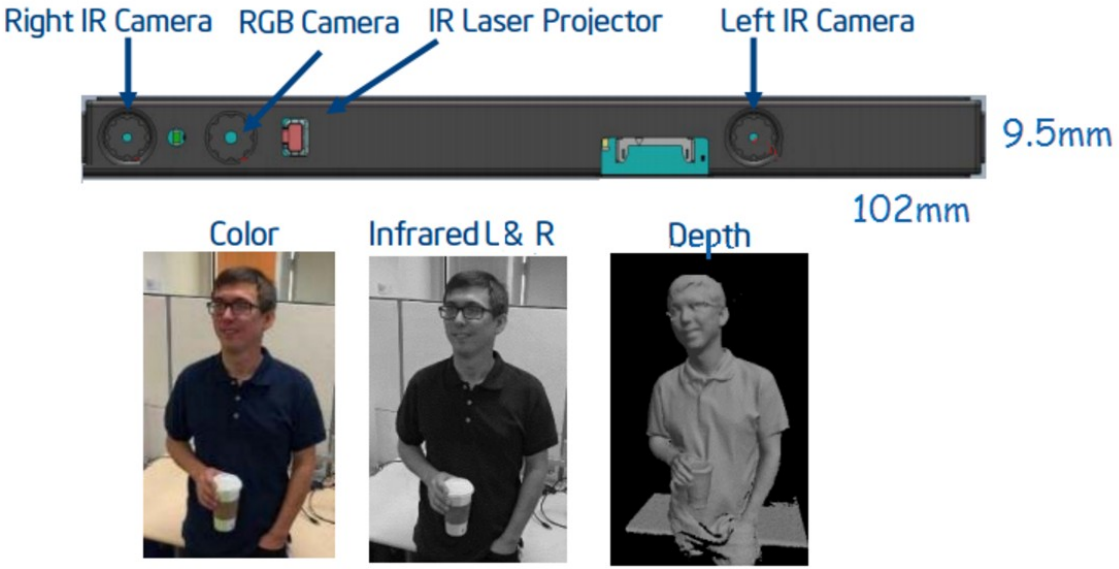


Image Source: Intel RealSense Developer Kit