10.1. LiDAR sensor

☐ Localization completion of LiDAR sensor core parts (TRL 7)

Lidar Sensor Core Technology

16ch TDC

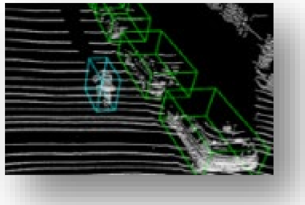
Object Recognition ASIC

Lidar Chipset

LD Driver

BLDC motor

BPF


Object Recogniton & GUI

Technology Optimization
of Commercialization

10.1. LiDAR sensor

☐ Line-up

Autonomous Vehicle / ADAS

Model	VL-R16
No. of Channels	16 Channels
Light Source	905nm Eye-Safety Class 1
HFOV & Resolution	145° / 0.125°
VFOV & Resolution	9.6° / 0.6°
Scanning Frequency	30Hz(Max)
Detection Range	Up to 150m (Max)
Operating Temperature	-40℃ ~ 85℃
Input Voltage	10~32V DC
Dimension(mm)	127(W) x 90(D) x 78(H)
Field of Application	ADAS, Autonomous Vehicle(Level 2, Level 3)

ADAS / Industrial (Safety, Security, Robot)

Model	VL-R330
No. of Channels	1 Channel
Light Source	905nm Eye-Safety Class 1
HFOV & Resolution	330° / 0.25°
VFOV & Resolution	-
Scanning Frequency	15Hz(Max)
Detection Range	Up to 100m (Max)
Operating Temperature	-40℃ ~ 85℃
Input Voltage	10~32V DC
Dimension(mm)	66(W) x 78 (H)
Field of Application	Safety, SLAM, Drone, Robot

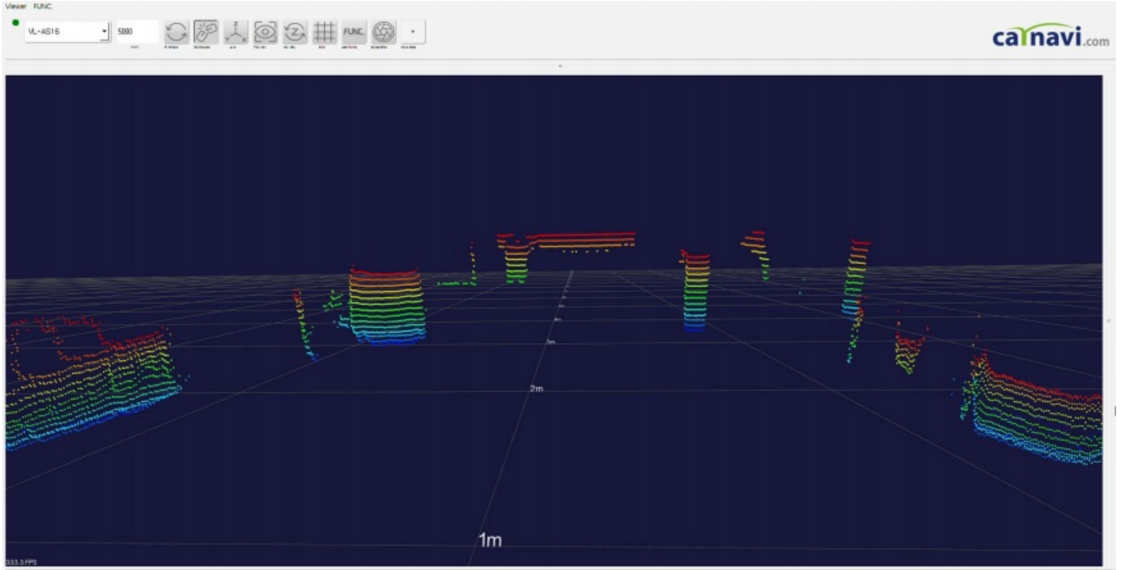
Model	VL-L1
No. of Channels	1 Channel
Light Source	905nm Eye-Safety Class 1
HFOV & Resolution	-
VFOV & Resolution	-
PRF	40Khz
Detection Range	Up to 200m (Max)
Operating Temperature	-40℃ ~ 85℃
Input Voltage	10~32V DC
Dimension(mm)	54(W) x 54(D) x 38(H)
Field of Application	Safety, SLAM, Drone, Robot

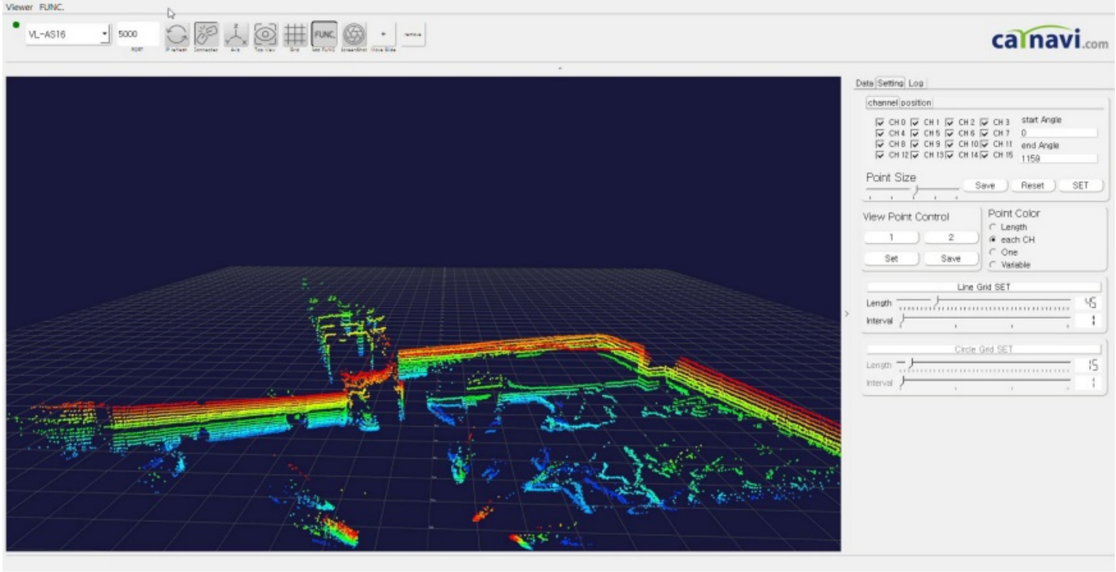
Model	VL-R2
No. of Channels	2 Channels
Light Source	905nm Eye-Safety Class 1
HFOV & Resolution	120° / 0.25°
VFOV & Resolution	3° / 3°
Scanning Frequency	15Hz(Max)
Detection Range	Up to 100m (Max)
Operating Temperature	-40℃ ~ 85℃
Input Voltage	10~32V DC
Dimension(mm)	102(W) x 65(D) x 57(H)
Field of Application	ADAS, Safety, SLAM, Drone, Robot

10.1. LiDAR sensor

☐ Introduction : 16ch Scanning LiDAR

- Development of LiDAR sensors that provide distance and space information on target objects and structures in front of driving environment
- Development of 3D LiDAR Sensors for Autonomous Vehicles and Industrial Applications
- Low Price Realization through Localization of Core Parts
  - LD / APD / BLDC motor / Signal Processing IC, Object Recognition IC


Viewer FUNC.
VL-AS16
5000
FUNC.
carnavi.com
2m
1m


Viewer FUNC.
VL-AS16
5000
FUNC.
carnavi.com
Data Setting Log
channel position
start Angle
end Angle
Point Size
Save
Reset
SET
View Point Control
Set
Save
Point Color
Length
each CH
One
Variable
Line Grid SET
Length
Interval
Circle Grid SET
Length
Interval

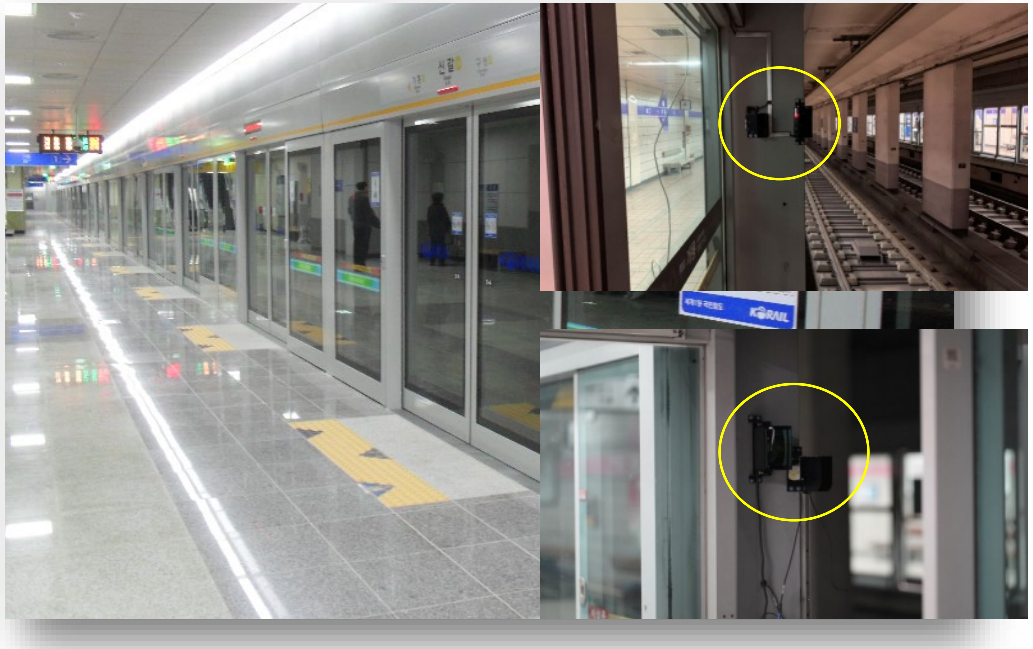
carnavi.com
VL-R16
16CH Scanning LiDAR

- Laser source: 905nm PLD
- Distance Range: to 100m
- FOV: 145°(H) x 10°(V)
- Angular resolution: 0.125°(H) x 0.625°(V)
- Range Precision: < 10cm
- Frame rate: 30Hz
- Ingress Protection: IP67
- Object Recognition

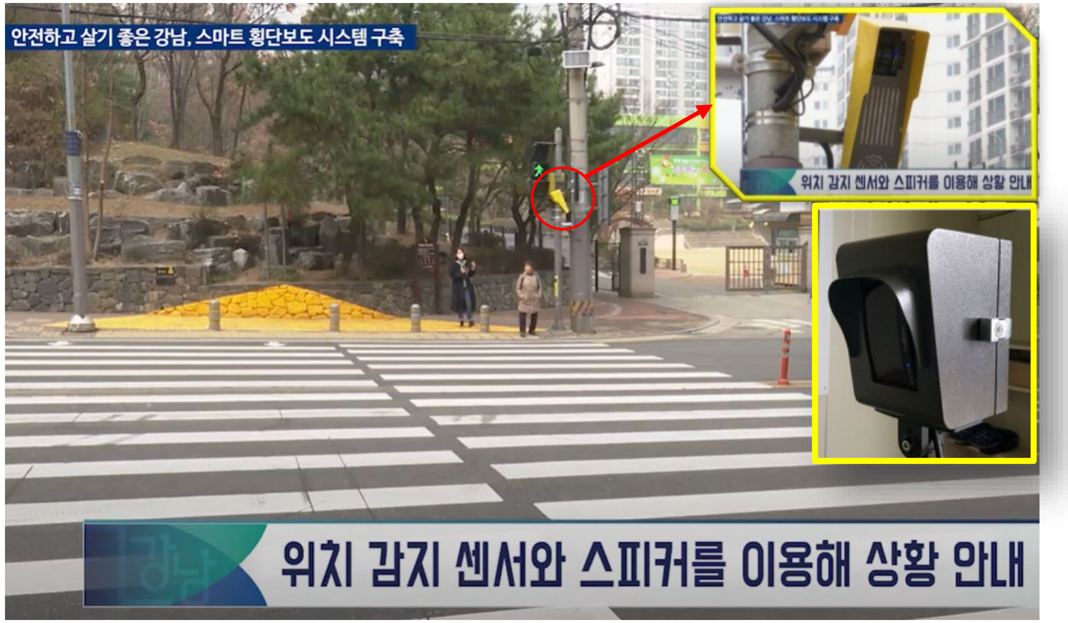
10.1. LiDAR sensor

□ Introduction : 4ch Scanning LiDAR

- Applied to [Platform Screen Door System]



- Applied to [Platform Screen Door System]


안전하고 살기 좋은 강남, 스마트 횡단보도 시스템 구축
위치 감지 센서와 스피커를 이용해 상황 안내
위치 감지 센서와 스피커를 이용해 상황 안내

VUCERA
S3
LIDAR SENSOR

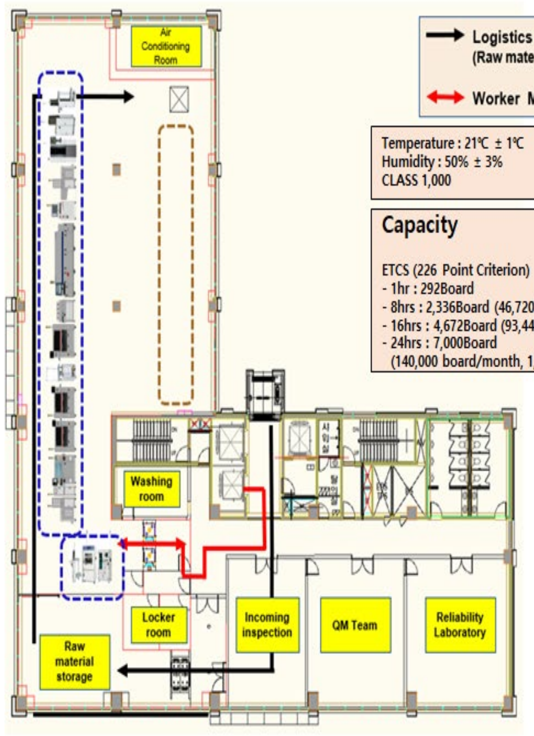
VUCERA
VL-R2
LIDAR SENSOR

10.1. LiDAR sensor

☐ LiDAR sensor Manufacturing facility

- Simplifies and underpriced structures using a single light source
- Application of domestic technology from optical design to signal processing technology (95%)
- Completed production line establishment and secured reliability

● SMT LINE


Air Conditioning Room
Washing room
Locker room
Incoming inspection
QM Team
Reliability Laboratory
Raw material storage

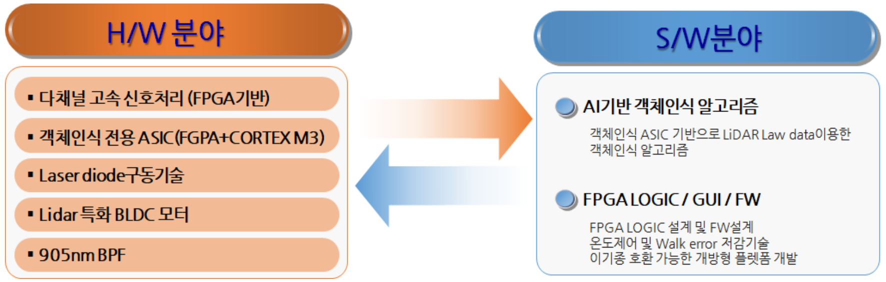
→ Logistics route (Raw material & Complete product)

↔ Worker Movement Path

Temperature : 21℃ ± 1℃
Humidity : 50% ± 3%
CLASS 1,000

Capacity

ETCS (226 Point Criterion)
- 1hr : 292Board
- 8hrs : 2,336Board (46,720 board/month)
- 16hrs : 4,672Board (93,440 board/month)
- 24hrs : 7,000Board (140,000 board/month, 1,680,000 board/year)



H/W 분야

- 다채널 고속 신호처리 (FPGA기반)
- 객체인식 전용 ASIC(FGPA+CORTEX M3)
- Laser diode구동기술
- Lidar 특화 BLDC 모터
- 905nm BPF

S/W분야

AI기반 객체인식 알고리즘

객체인식 ASIC 기반으로 LiDAR Law data이용한
객체인식 알고리즘

FPGA LOGIC / GUI / FW

FPGA LOGIC 설계 및 FW설계
온도제어 및 Walk error 저감기술
이기종 호환 가능한 개방형 플렛폼 개발

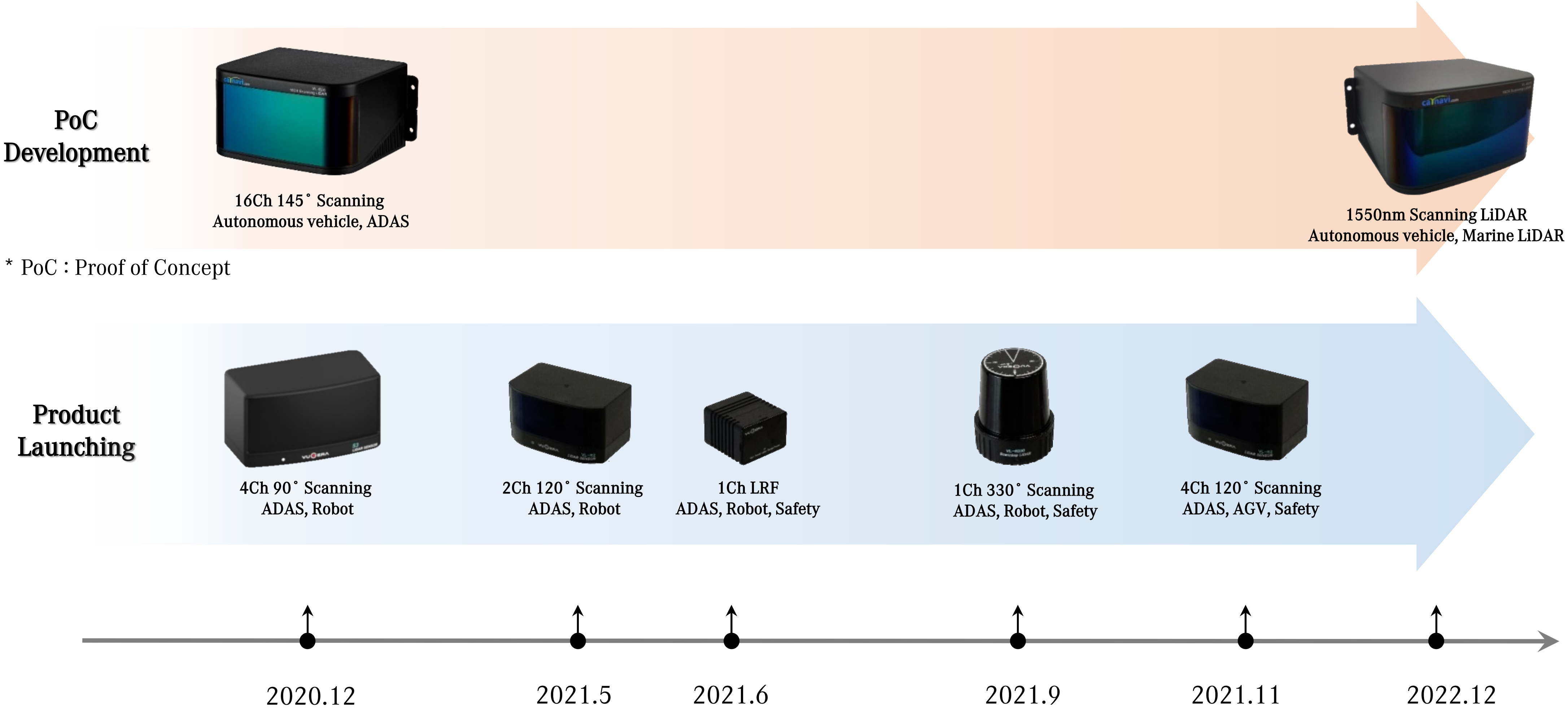
QUALITY ASSURANCE MANAGEMENT ISO 9001

ENVIRONMENTAL MANAGEMENT ISO 14001

Quality Management DQS IATF 16949

10.1. LiDAR sensor

☐ Road map



PoC Development

16Ch 145˚ Scanning
Autonomous vehicle, ADAS

1550nm Scanning LiDAR
Autonomous vehicle, Marine LiDAR

* PoC : Proof of Concept

Product Launching

4Ch 90˚ Scanning
ADAS, Robot

2Ch 120˚ Scanning
ADAS, Robot

1Ch LRF
ADAS, Robot, Safety

1Ch 330˚ Scanning
ADAS, Robot, Safety

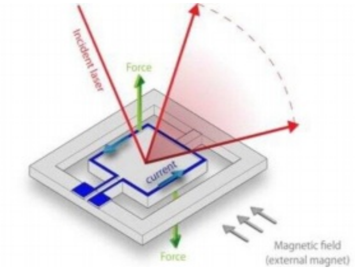
4Ch 120˚ Scanning
ADAS, AGV, Safety

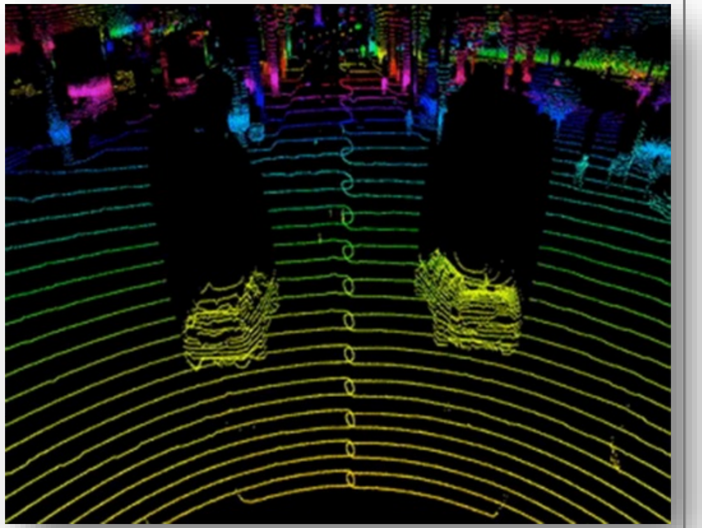
2020.12
2021.5
2021.6
2021.9
2021.11
2022.12

10.1. LiDAR sensor

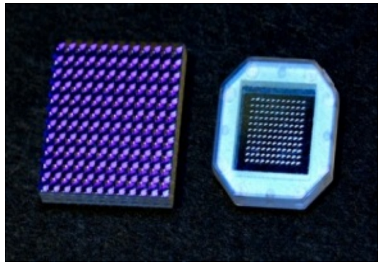
☐ Development of technology

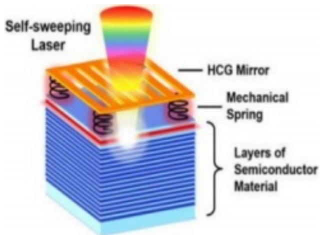
MEMS Mirror
Micro Electro Mechanical Systems

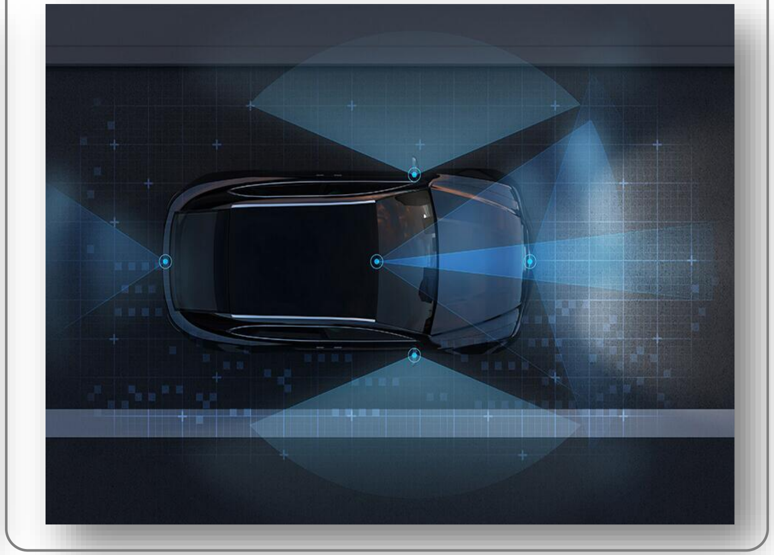

Incident laser
Force
current
Force
Magnetic field
(external magnet)



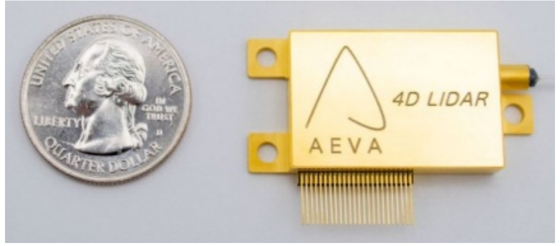
VCSEL
Vertical-Cavity Surface-Emitting Lasers

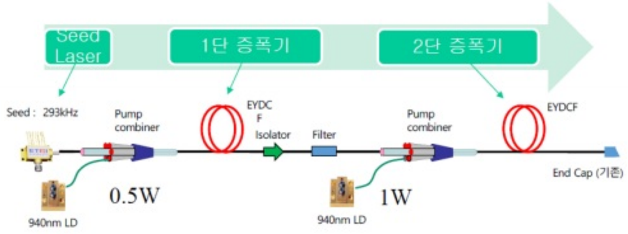



Self-sweeping
Laser
HCG Mirror
Mechanical
Spring
Layers of
Semiconductor
Material



1550nm Laser Module
1550nm Laser Module for LiDAR


4D LiDAR
AEVA


Seed
Laser
1단 증폭기
2단 증폭기
Seed : 293kHz
Pump
combiner
EYDC
F
Isolator
Filter
Pump
combiner
EYDCF
End Cap (기존)
0.5W
1W
940nm LD
940nm LD

10.2. V2X / IoT

☐ Line-up

OBU (On Board Unit)

- DSRC based OBU in WAVE & ITS-G5
- Compliant with USDOT J2945/1, IEEE802.11p, 1609.x, J2735
- Support LTE (cat.4 / rel.10)

RSU (Road Side Unit)

- DSRC based RSU in C-ITS
- Compliant with USDOT RSE v4.1, IEEE802.11p, 1609.x, J2735
- Support LTE (cat.4 / rel.10)

carnavi.com
C-ARS

Software Tool

- V2X performance measurement tool
- RSSI, PER (Distance, time), Mark on a map

Software 3rd service

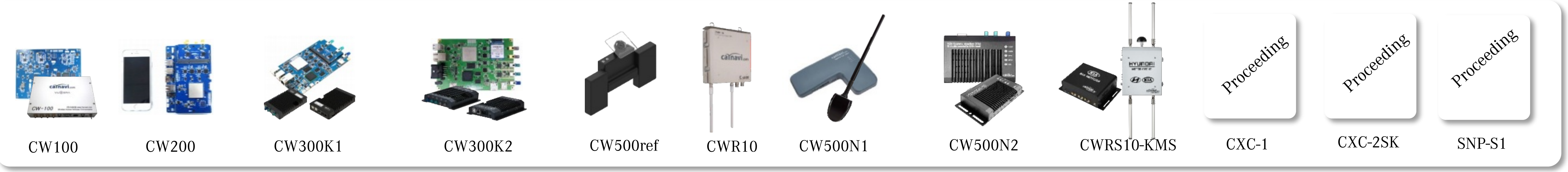
- We support development for enabling WAVE standard software on hardware of customer.

- Display V2X services on smart phone
- Support on WAVE & ITS-G5

10.2. V2X / IoT

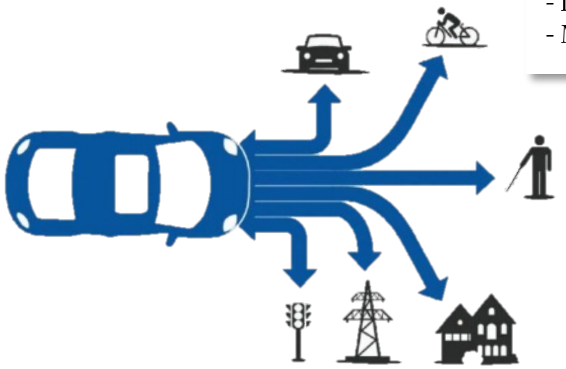
"From "V2X" to "IoT" for vehicle, move for leading ICT field"

2015 2016 2017 2018 2019 2020 2021 2022


CW100
CW200
CW300K1
CW300K2
CW500ref
CWR10
CW500N1
CW500N2
CWRS10-KMS
Proceeding
CXC-1
Proceeding
CXC-2SK
Proceeding
SNP-S1

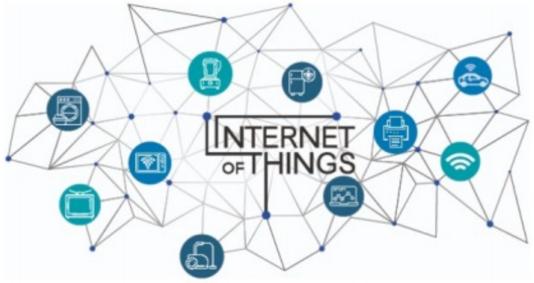
V2X Gen1

- DSRC based V2X
  - DSRC Only
  - Model: CW100, CW200, CW300K1



V2X Gen1-hybid

- DSRC + LTE Collaboration V2X
  - DSRC + Legacy LTE
  - Model: CW300K2. CW500Series


INTERNET OF THINGS

V2X Gen2

- V2X with AI Platform
  - DSRC/C-V2X, LTE/5G
  - nVIDIA Xavier, Camera I/F, Giga-Ethernet
  - Model: CWRS10, CXC-1,CXC-2SK

IoT & 5G

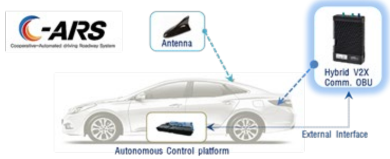
- Smart-Factory wireless gateway
  - WIFI6, BLE (With V2X)
  - for AGV, AMR, Mobility
  - SNP-S1

10.2. V2X / IoT

Cooperative-Automated driving Roadway System

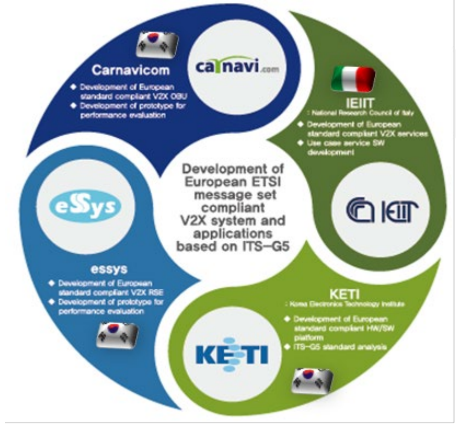
- June, 2015 ~ July, 2020
- Role : V2X communication device part
  (LTE+WAVE Hybrid)

C-ARS
Contact us | Sitemap | English
게시판검색
연구단 소개
연구내용
연구성과
홍보마당
알림마당
전체메뉴
안전하고 쾌적한 자율주행도로 환경 실현
Mobility, Safety, Convenience, Connectivity
스마트 자율협력주행 도로시스템
테스트베드 지원신청
국토교통부
KAIA 국토교통과학기술진흥원
한국도로공사

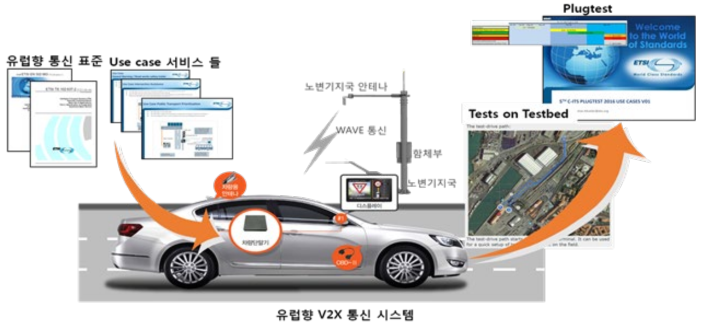

C-ARS
Cooperative-Automated driving Roadway System
Antenna
Hybrid V2X Comm. OBU
External Interface
Autonomous Control platform

Development of European ETSI message set compliant V2X system & application based on ITS-G5

- July, 2016 ~ Aug, 2019
- Role : V2X communication device part
  (ITS-G5 based on IEEE802.11p)


Carnavicom
◆ Development of European standard compliant V2X OBU
◆ Development of prototype for performance evaluation
IEIIT
: National Research Council of Italy
◆ Development of European standard compliant V2X services
◆ Use case service SW development
Development of European ETSI message set compliant V2X system and applications based on ITS–G5
essys
◆ Development of European standard compliant V2X RSE
◆ Development of prototype for performance evaluation
KETI
: Korea Electronics Technology Institute
◆ Development of European standard compliant HW/SW platform
◆ ITS–G5 standard analysis

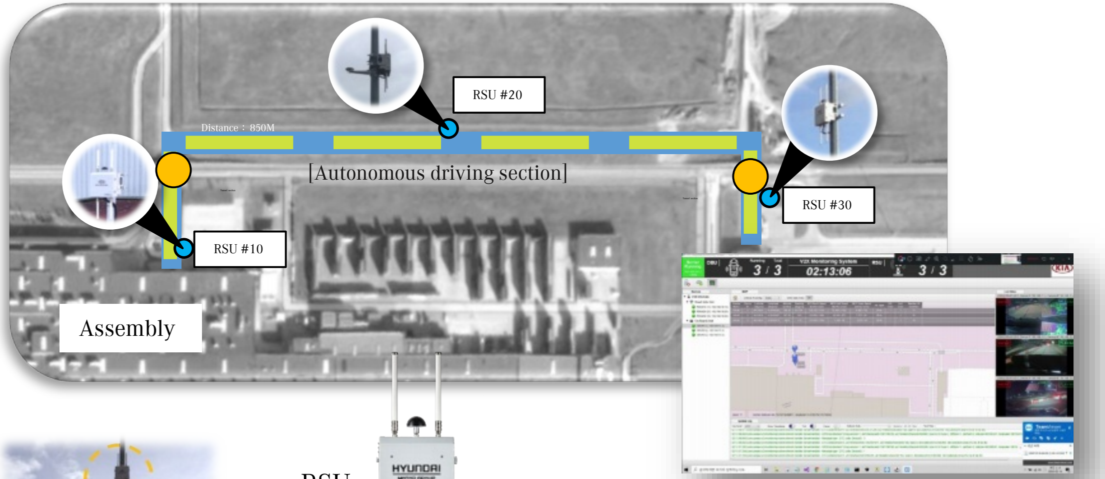
European V2X (ITS-G5) Collaboration Project


Plugtest
Welcome to the World of Standards
Tests on Testbed
유럽향 통신 표준
Use case 서비스 들
노변기지국 안테나
WAVE 통신
함체부
노변기지국
유럽향 V2X 통신 시스템

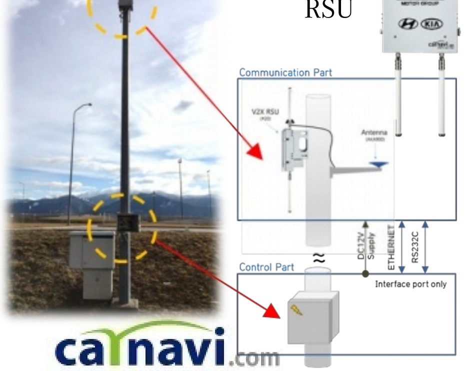
10.2. V2X / IoT

V2X communication system application for central control and vehicle control of autonomous car

- Target : KIA motors Slovakia plant
- RSU and OBU installation inside the plant (DSRC 4 channels applied)
- Wireless(DSRC) connection through the entire line (V2I, I2V, I2I)
- Video streaming of front view camera from vehicle using DSRC
- Hand-over technology for I2I communication


RSU #20
Distance : 850M
[Autonomous driving section]
RSU #30
RSU #10
Assembly
3 / 3
02:13:06
3 / 3

Monitoring S/W Tool


Communication Part
V2X RSU
Antenna
≈
DC12V Supply
ETHERNET
RS232C
Control Part
Interface port only

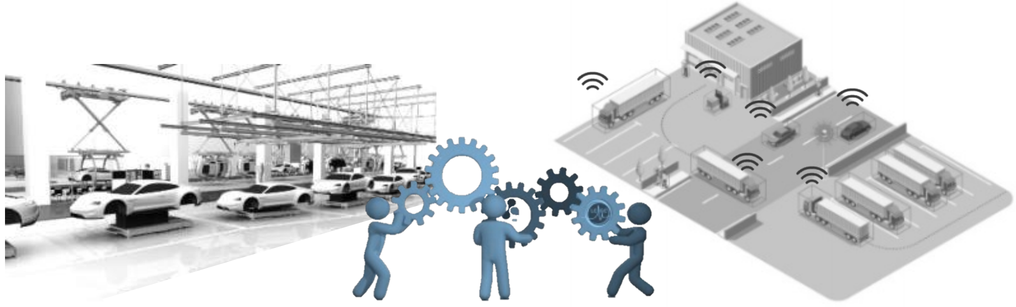
RSU

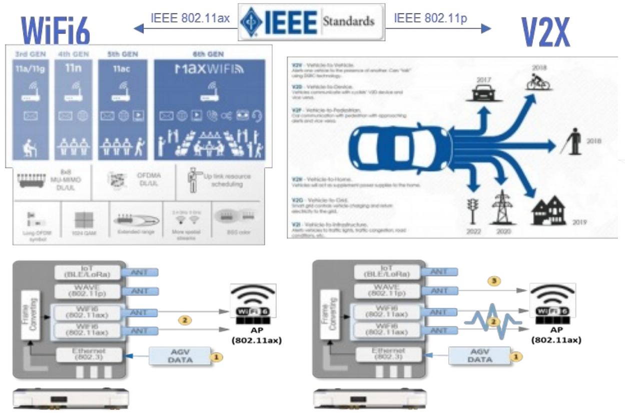
Multilayer GNSS Antenna
(GPS L1/L2, Glonass, Beidu)
IP Camera
(5.855GHz ~ 5.925GHz)
V2X OBU
[KMS Autonomous Shuttle]

OBU

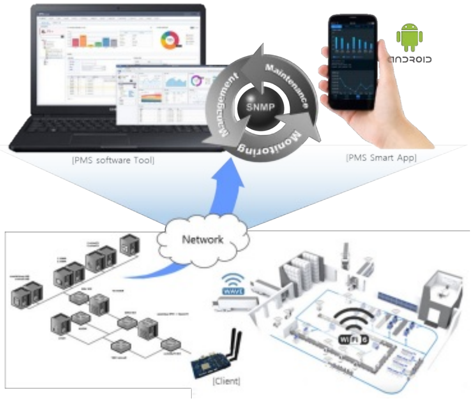
Industrial WLAN wireless device & management system (Smart factory)

- Wireless device development for information exchange and data processing of mobility, AGV, AMR, etc.
- Management tool development for device condition diagnosis and check
- WiFi6 dualization implementation
- Roaming function between V2X device and WiFi6 of Mobility




WiFi6
IEEE 802.11ax
IEEE Standards
IEEE 802.11p
V2X
3rd GEN
4th GEN
5th GEN
6th GEN
11a/11g
11n
11ac
MaxWIFI
8x8 MU-MIMO DL/UL
OFDMA DL/UL
Up link resource scheduling
Long OFDM symbol
1024 QAM
Extended range
More spatial streams
BSS color
2017
2018
2018
2019
2020
2022
IoT (BLE/LoRa)
WAVE (802.11p)
WiFi6 (802.11ax)
Ethernet (802.3)
ANT
Frame Converting
AGV DATA
AP (802.11ax)

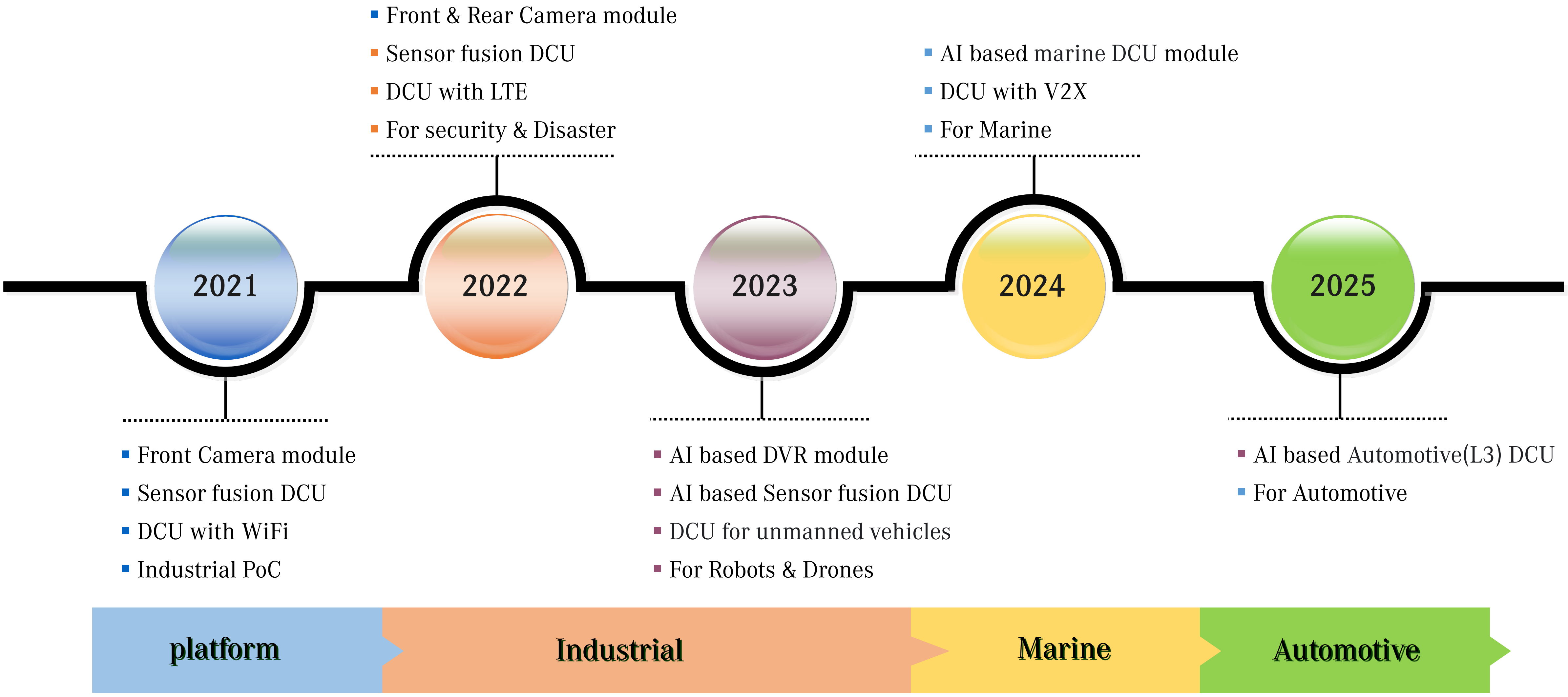
* 아래 UI 이미지는 이해를 돕기 위하여 참고용 자료 입니다.


Management
Maintenance
Monitoring
SNMP
ANDROID
[PMS software Tool]
[PMS Smart App]
Network
[Client]

10.3. DCU

☐ Roadmap

★ Sensor: Camera, LiDAR, Radar



2021

- Front Camera module
- Sensor fusion DCU
- DCU with WiFi
- Industrial PoC

2022

- Front & Rear Camera module
- Sensor fusion DCU
- DCU with LTE
- For security & Disaster

2023

- AI based DVR module
- AI based Sensor fusion DCU
- DCU for unmanned vehicles
- For Robots & Drones

2024

- AI based marine DCU module
- DCU with V2X
- For Marine

2025

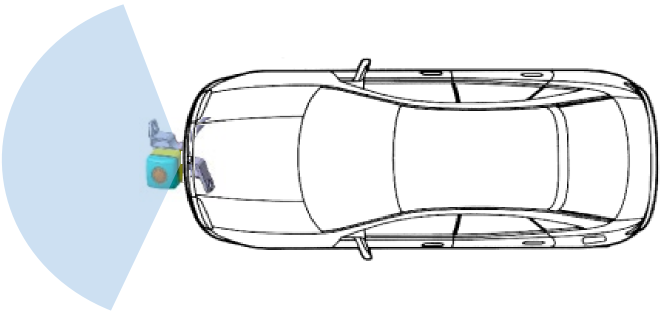
- AI based Automotive(L3) DCU
- For Automotive

platform → **Industrial** → **Marine** → **Automotive**

10.3. DCU

☐ Camera module

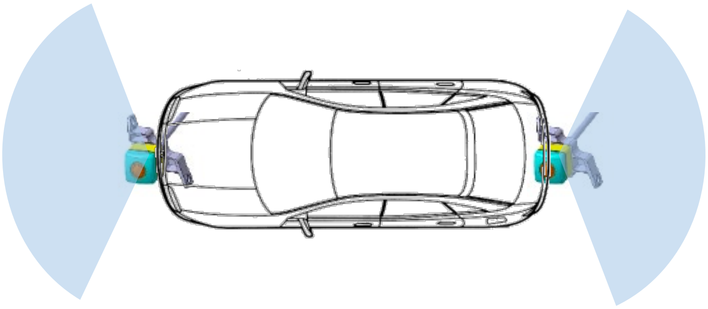
Front Camera



AI-based front camera can recognize lanes, vehicles, and traffic lights, and can implement various functions with a simple structure

- Traffic Light Recognition
- Forward Collision Warning
- Lane Departure Warning System
- Forward Vehicle Start
- AI-based object recognition (Vehicle, Pedestrian)

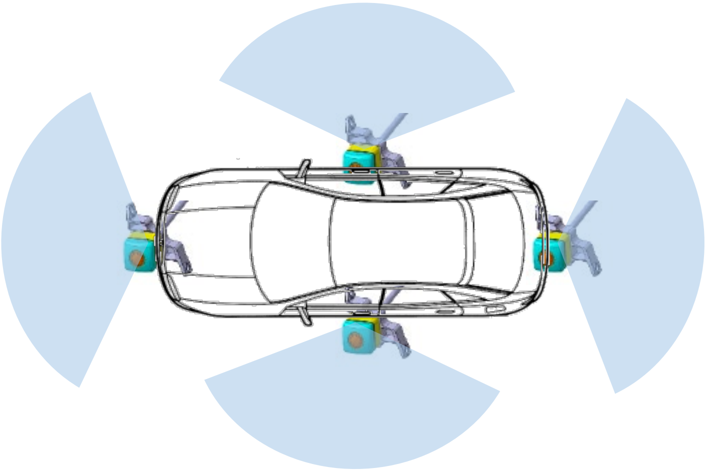
Front & Rear Camera



AI-based front and rear cameras can recognize lanes, vehicles, traffic lights and rear obstacles, and can implement driving and parking assistance functions.

- Traffic Light Recognition
- Forward Collision Warning
- Lane Departure Warning System
- Forward Vehicle Start
- Rear video support
- AI-based object recognition (Vehicle, Pedestrian, two-wheeled vehicle)

DVR



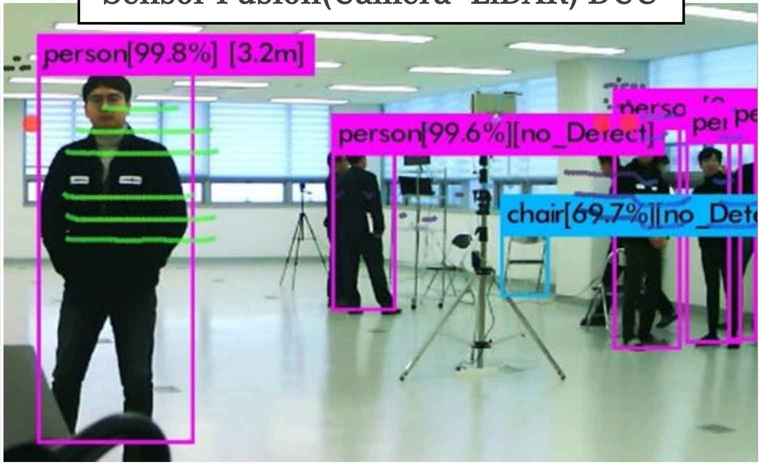
AI-based surrounding camera enables All directions monitoring around the vehicle, and can recognize obstacles around the vehicle.

- Traffic Light Recognition
- All directions (360°) Collision Warning
- Lane Departure Warning System
- Forward Vehicle Start
- Parking assistance system
- AI-based object recognition (Vehicle, Pedestrian, two-wheeled vehicle, facilities)

10.3. DCU

☐ Sensor Fusion DCU

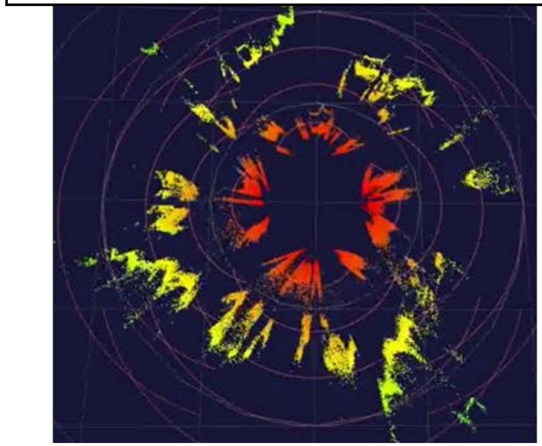
Sensor Fusion(Camera+LiDAR) DCU


person[99.8%] [3.2m]
person[99.6%][no_Detect]
chair[69.7%][no_Det

Sensor fusion DCU can recognize objects based on deep learning using Cameras and Lidars.

- Deep learning object (vehicle, person) recognition
- Physical object size awareness
- Object status (distance, speed) information recognition
- Matching Video and point cloud

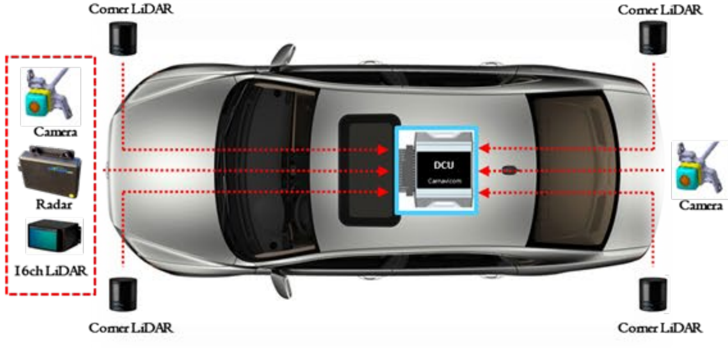
Multi-LiDAR DCU



The multi-Lidar DCU can recognize the surrounding situation by matching the point cloud output from multiple Lidar sensors.

- Object recognition in all directions (360°)
- Physical object size awareness
- Object status (distance, speed) information recognition
- Matching point cloud

Sensor Fusion(Cam+LiDAR+Radar) DCU


Corner LiDAR
Corner LiDAR
Camera
Radar
16ch LiDAR
DCU
Camera
Corner LiDAR
Corner LiDAR

Sensor fusion DCU provides information for autonomous driving (L3) by accurately recognizing the surrounding environment by integrating Cameras, Lidars, and Radars.

- Matching front image and point cloud
- Create side and rear point clouds
- High detection distance/recognition accuracy
- Alignment of rear image and point cloud

10.3. DCU

□ DCU w/ Network

DCU with WiFi

Real-time monitoring is possible by recognizing the surrounding environment using various sensors and interlocking with the control system using wireless communication (WiFi).

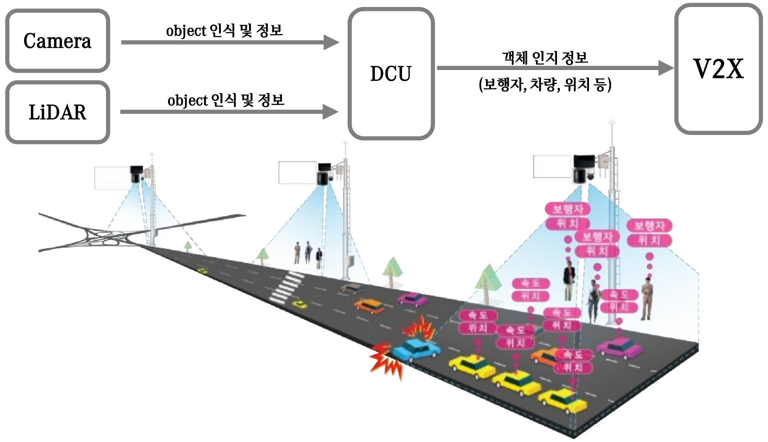
- Sensor fusion (Camera + Lidar)
- Indoor environment monitoring
- For Indoor Robot
- Indoor control system

DCU with LTE

Real-time monitoring is possible by recognizing the surrounding environment using various sensors and interlocking with the control system using wireless communication (LTE).

- Sensor fusion (Camera + Lidar)
- Outdoor environment monitoring
- For Outdoor Robot
- Outdoor control system

DCU with V2X



Camera

LiDAR

object 인식 및 정보

object 인식 및 정보

DCU

객체 인지 정보
(보행자, 차량, 위치 등)

V2X

Real-time monitoring is possible by recognizing the surrounding environment using various sensors and interlocking with the control system using wireless communication (V2X).

- Sensor fusion (Camera + Lidar + Radar)
- Vehicle condition monitoring
- Linkable with RSU
- For Autonomous Vehicle
- Traffic situation control system

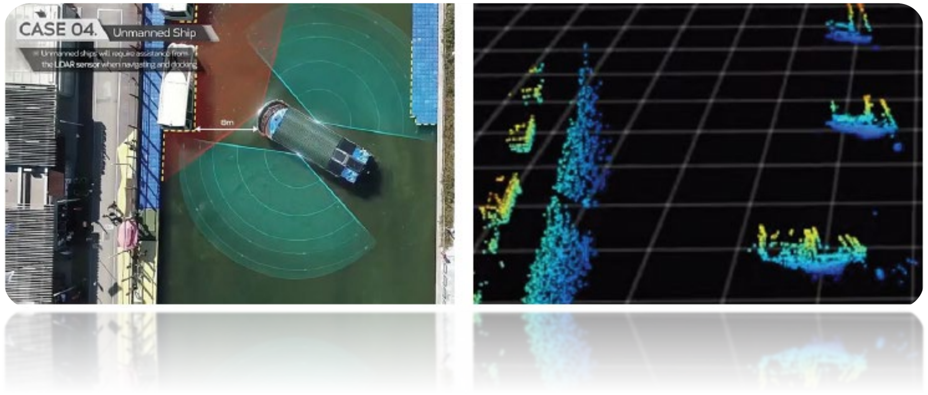
10.4. Marine-safety

☐ Marine navigation (based on S-57)

1km
100m
11:29 AM
속초 수산항
12:17 PM
49.9 km
QUICK
Komarine

- Emergency distress signal transmission function
- Entry and departure report function
- Route search function (reflection of location information of islands, water depth, facilities, farms, dangerous goods)
- Warnings and alarms when operating in dangerous and prohibited areas
- Dangerous attitude automatic alarm transmission function

☐ Maritime unmanned vessel technology



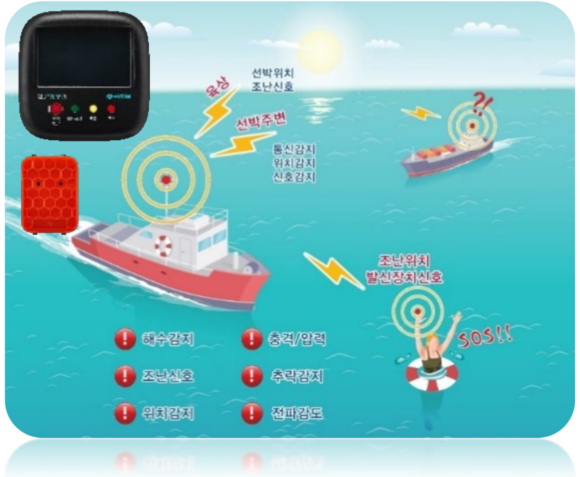
- Accurate recognition of facilities and obstacles in narrow waterways and berths
- Longer detection distance than land (0.3km ~ 1km)
- Applicable to autonomous ships and collision avoidance
- Securing visibility in sea fog or at night
- Automatic recognition of objects
- Multiple LiDAR/RADAR combinations are possible depending on the vessel size and purpose

10.4. Marine-safety

☐ e-Navigation service

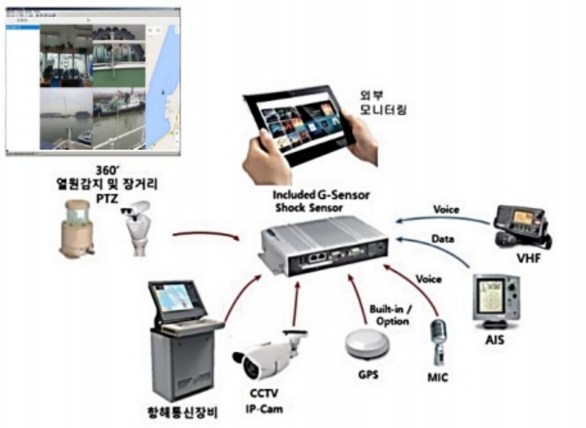
- Constructing a new system by adding services to fishing vessels and coastal small vessels to IMO's e-Navigation concept
- Electronic navigation chart and marine safety information display conforming to S-10X standard
- Route plan establishment

☐ Distress location transmitter


육상
선박위치
조난신호
선박주변
통신감지
위치감지
신호감지
조난위치
발신장치신호
SOS!!
해수감지
조난신호
위치감지
충격/압력
추락감지
전파감도

- Sailor's position transmitter (radio sensitivity, fall detection, position detection, distress signal, seawater detection, impact/input, etc.)
- Sailor’s distress location receiver (communication detection, location detection, signal detection, ship location, distress signal, etc.)

☐ NVR for small vessel


외부
모니터링
360'
열원감지 및 장거리
PTZ
Included G-Sensor
Shock Sensor
Voice
Data
VHF
Voice
Built-in /
Option
AIS
GPS
MIC
CCTV
IP-Cam
항해통신장비

- Real-time video check through mobile device
- Self impact sensor and location recording
- Save record for video camera
- AIS information record, which is the information of nearby sailing vessels
- Save voyage records

10.5. Dashcam/ETCS

Supply exclusive Dashcam to Mercedes-Benz Korea, Strength in B2B market and PIO business

● Starview S (MBK exclusive)

- ◇ Exclusive Dashcam to Mercedes-Benz
- ◇ Sony Exmor R STARVIS Sensor
- ◇ Front Full HD + Rear Full HD 2Ch
- ◇ Forward Vehicle Start Alert
- ◇ Dual Save
- ◇ Format Free
- ◇ Low Voltage Block
- ◇ Voice Guidance System
- ◇ Audio Recording
- ◇ PC Viewer Support
- ◇ External GPS Support (Standard)

● VG-Legend (B2B and Aftermarket)

- ◇ Sony Exmor R STARVIS Sensor
- ◇ Front/Rear Full HD 2Ch
- ◇ Forward Vehicle Start Alert
- ◇ Lane Departure Warning System
- ◇ Forward Collision Warning System
- ◇ Dual Save
- ◇ Format Free
- ◇ Low Voltage Block
- ◇ Voice Guidance System
- ◇ Audio Recording
- ◇ PC Viewer Support
- ◇ External GPS Support (Option)

Supply exclusive ETCS to Mercedes-Benz Korea, Developing next-generation ETCS

ETCS		
Model	MBH-1000	MBH-2000S
Applied Vehicle	Benz	Benz
Date of Cert.	2016.04	2018.04
Type	RF	RF

Customer

Mercedes-Benz
The best or nothing.

대한민국 No.1
롯데렌터카