QZSS L6 Enabled Multi-band Multi-GNSS Receiver

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Marketing Department. High Precision Product Director

Contents

PART 1 ALLYSTAR

- Brief Profile
- News

ALLYSTAR Technology Co. Limited (2017)

Allystar is dedicated to GNSS chips designing & algorithm, and products' designing, R&D, sales and other related business. We provide chipsets and application solutions to terminal market of consumer electronics, national vital industry, automotive industry and IoT

Addition information:
http://www.allystar.com/en/

CHINA	SHENZHEN , BEIJING
HONG KONG	Sha Tin (Science Park)
CANADA	Calgary
SINGAPORE	Worldwide Distributor

At a Glance

ABOUT US

2013
Team established and entered GNSS market

Acquired Fujitsu GNSS team (part of MCU business group);
Re-organized HED wireless LAN team;
HD8010 (GPS) shipped to Japan and China markets.

2014
1st Beidou SoC supplier in China

BeiDou/GNSS products launched to the market.

2015
HD8020 GNSS chipset in MP

HD8020 Beidou/GNSS SoC chip to China and WW markets;
HD8020 won the first prize of Technology & Innovation at CSNC.

2016
HD8030 GNSS MCU chipset in MP

HD8030 GNSS MCU chip to consumer markets;
HD8030 won the first prize of Technology & Innovation at CSNC.

2017
ALLYSTAR technology established

Spin-out from HED to be location service technology provider.
Dedicated on Multi-Band GNSS chip design

2018
HD8040 GNSS chipset in MP

Multi-band Multi-GNSS SOC to consumer market
L1 & L5 PVT

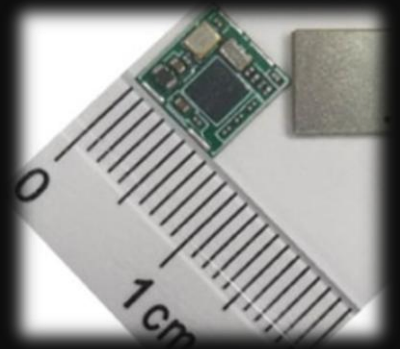
2019
HD9300 GNSS chipset in MP

Multi-band Multi-GNSS SOC to support high precision applications
GPS / QZS L1 , L2, L5 , L6
BDS B1 B2 B3
GLO L1OF L2OF
GAL E1 E5
IRNSS L5

Technology News

LENOVO Z6/L6 SE Version

Allystar offers dual-antenna GNSS-aided INS platform
https://www.gpsworld.com/allystar-offers-dual-antenna-gnss-aided-ins-platform/
Dual-frequency GNSS smartphone supports BDS phase III signal
https://www.gpsworld.com/dual-frequency-gnss-smartphone-supports-bds-phase-iii-signal/
Allystar launches tiny dual-band GNSS module
https://www.gpsworld.com/allystar-launches-tiny-dual-band-gnss-module/
Allystar launches multi-band, multi-GNSS chip for devices
https://www.gpsworld.com/allystar-launches-multi-band-multi-gnss-chip-for-devices/
Allystar offers GNSS antenna for high-precision positioning
https://www.gpsworld.com/allystar-offers-gnss-antenna-for-high-precision-positioning/
Allystar releases multi-band GNSS raw data chip and module
https://www.gpsworld.com/allystar-releases-multi-band-gnss-raw-data-chip-and-module/
Allystar Technology Offers Multi-Band, Multi-GNSS Single Chip
https://insidegnss.com/allystar-technology-offers-multi-band-multi-gnss-single-chip/



International GNSS Seminar & Workshop

2019

GNSS+ 2019 September @USA
Multi-Band Multi-GNSS SoC for Mass Market Applications

Summer School 2019 August @ TOKYO
QZSS L6 Enabled GNSS receiver

GNSS workshop 2019 June @INDIA
NAVIC Enabled GNSS Receiver and Testing by Spirent Simulator

PACIFIC PNT 2019 April @USA
Chip-grade Multi-Band Multi-GNSS RTK and Attitude Determination
with Low Cost Dual Antennas for Mass Market Applications

ITM/PTTI 2019 January @USA
Single-Chip Delivers Multi-Band Multi-GNSS Raw Measurement and Built-In RTK Engine
For Mass Market Applications

2018

GNSS workshop 2018 October @CHINA
Multi-band Multi-GNSS SoC for Mass and Automotive Applications

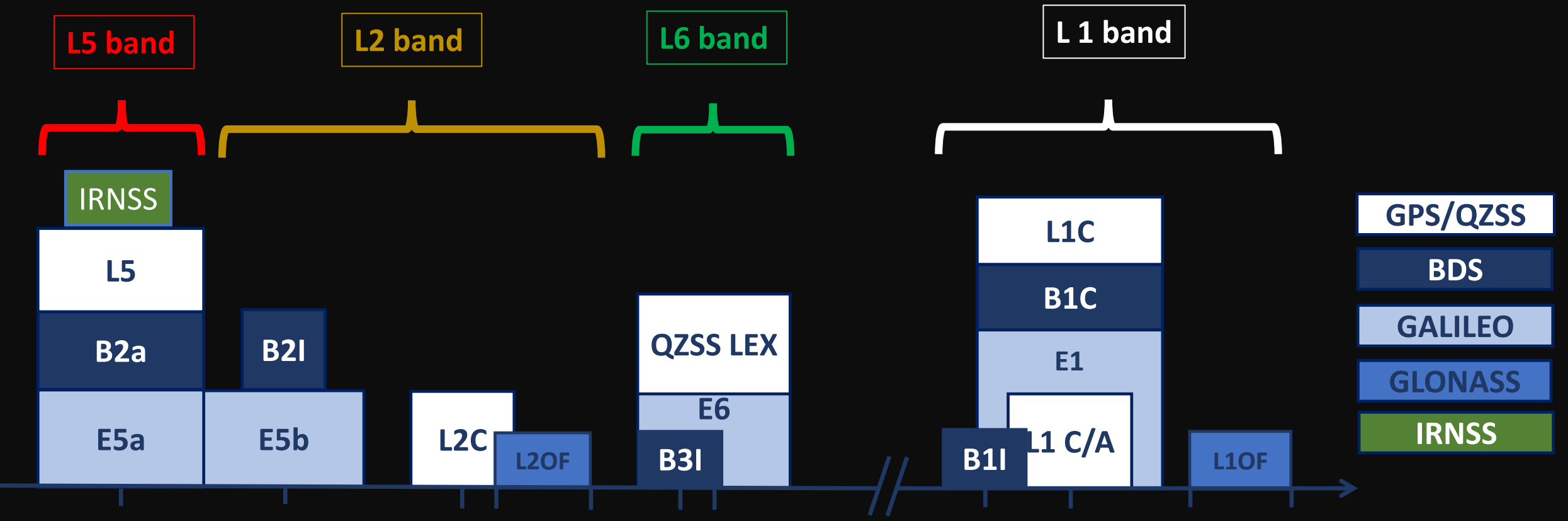
PART 2 Multi-band Multi-GNSS Technology

- GNSS Reception Status and Advantages of each band
- The design concept of ALLYSTAR cynosure III architecture in SoC
- output protocol : NMEA , RTCM, Proprietary Messages

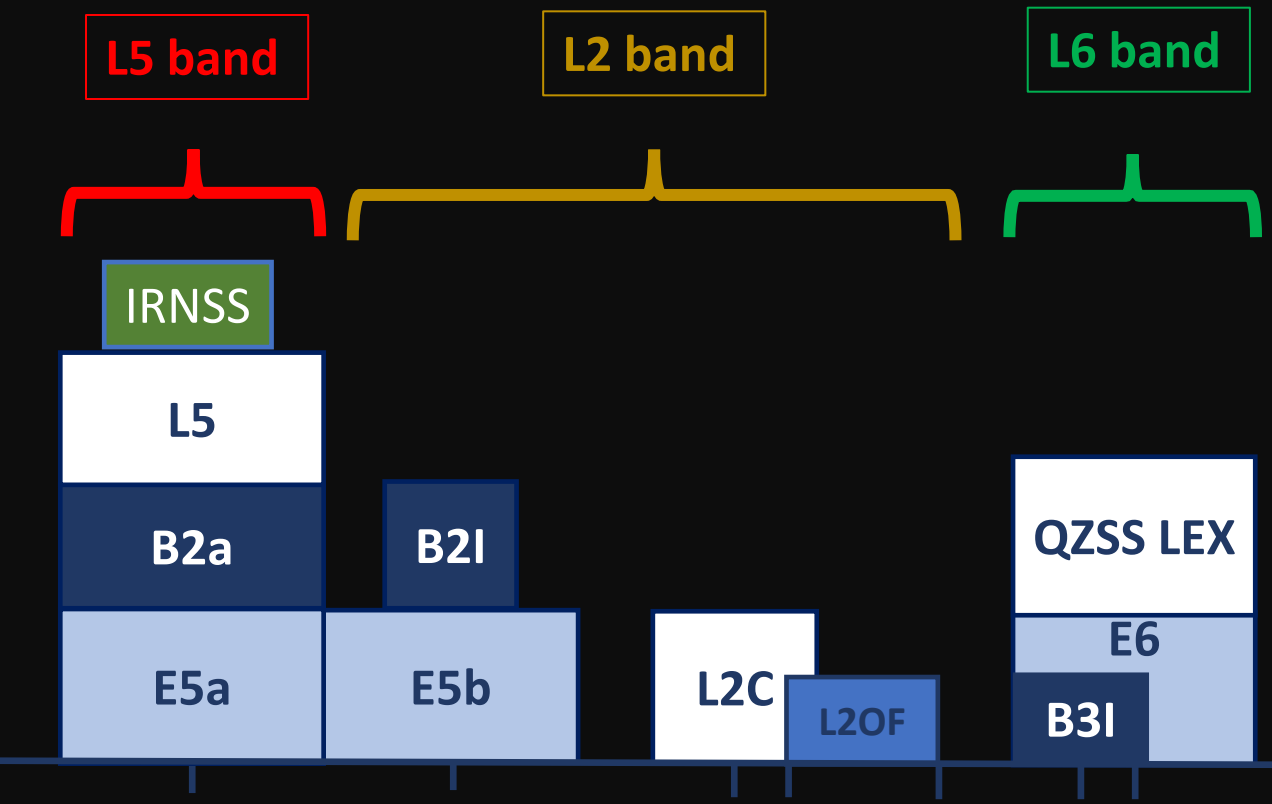
GNSS Signal and Reception Status

- What are the advantages of applying in the future?

- Has been widely used in the consumer market



GNSS Advantages and Applications in each band



L5 band : Single Point Positioning

- L5/E5 maximizes measurement accuracy
- Multipath Mitigation based on higher chip rate
- Standalone / Mass market mainly

L2 band : Relative Positioning

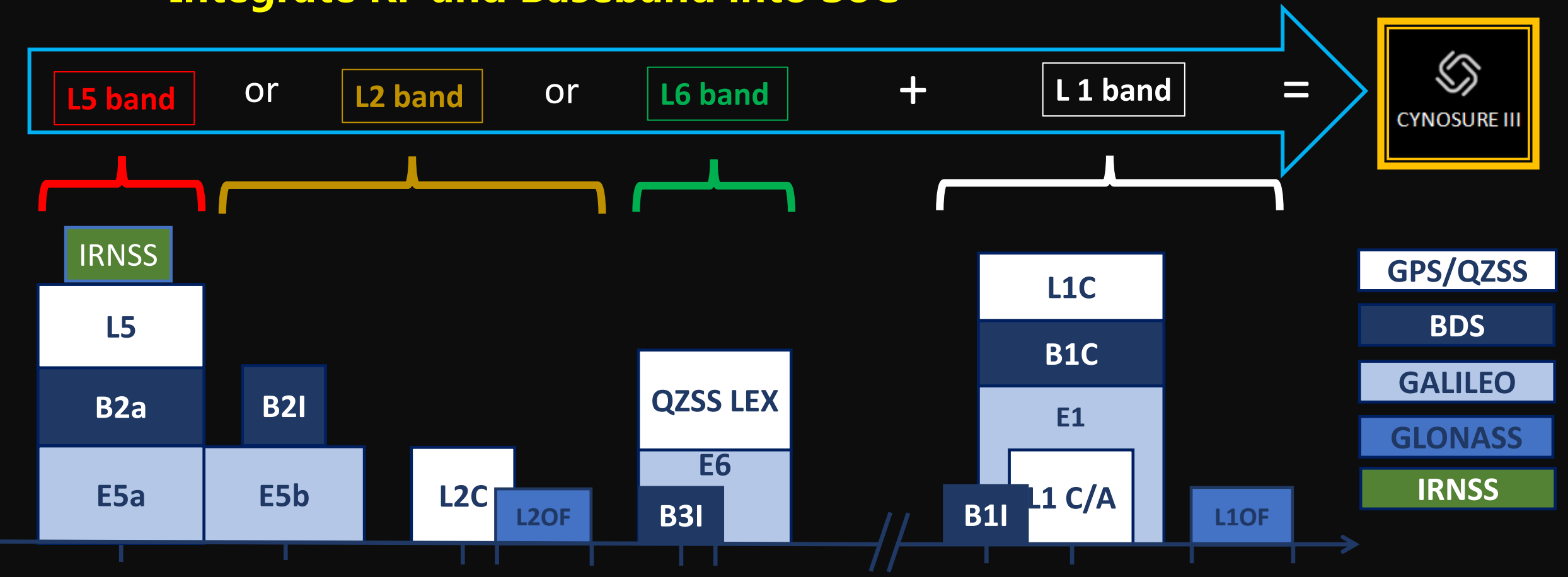
- maximizes satellites visibility
- common CORS support :
  - GPS L1 / L2
  - GLO L1 / L2
  - BDS B1 / B2
- RTK Technology mainly

L6 band : Precise Point Positioning

- SSR-type correction service
- B3I / LEX is operating
- PPP Technology mainly

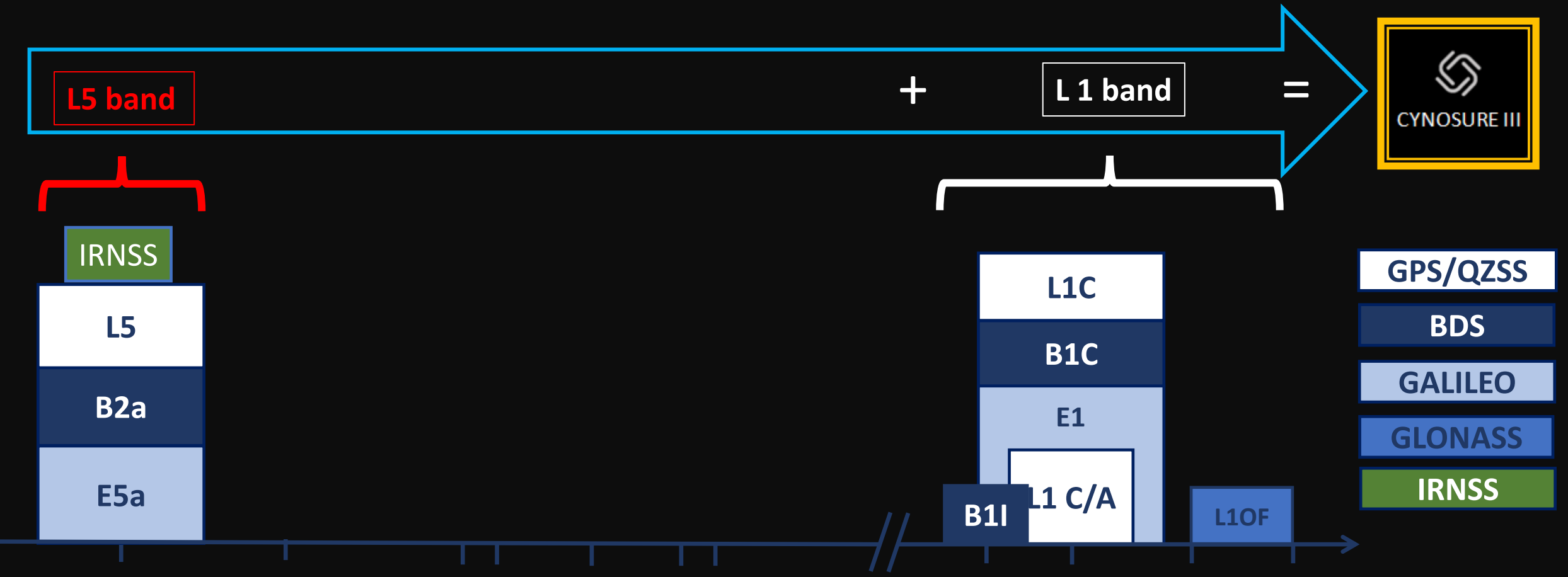
The design concept of CYNOSURE III architecture

- **Cover all GNSS civil signals in three RF settings**
- **Integrate RF and Baseband into SoC**



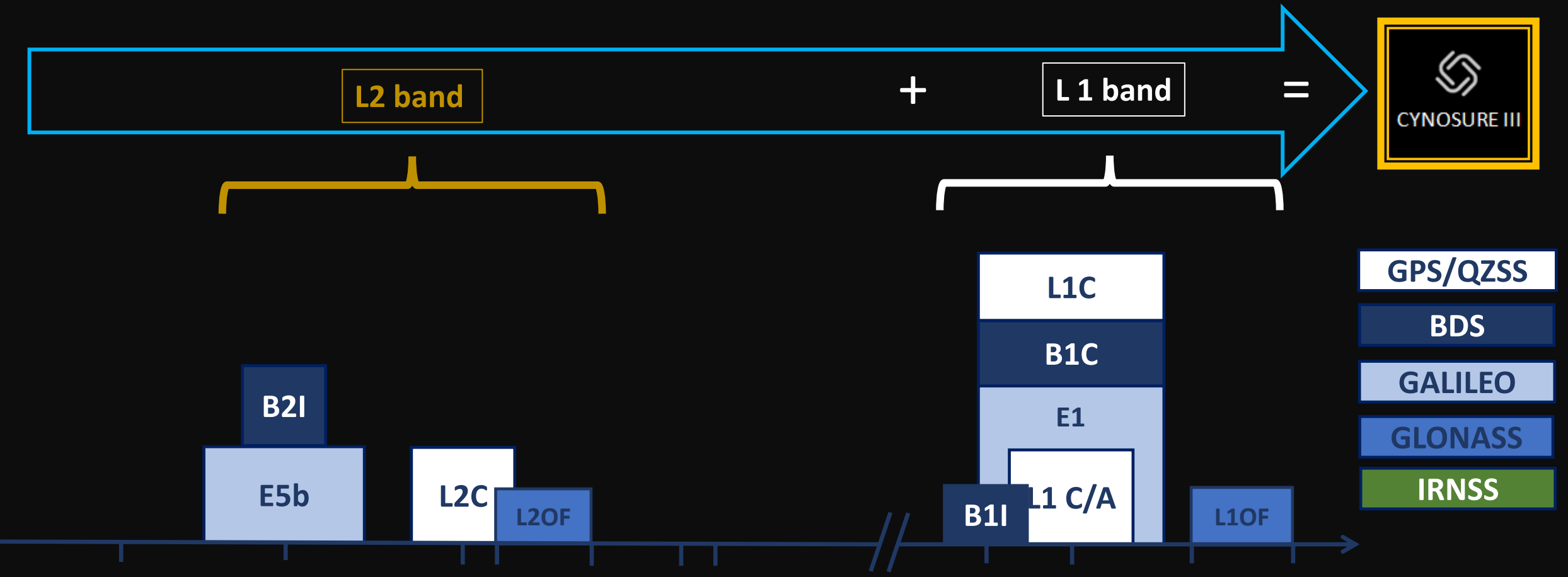
Option A :

- **supports : GPS L1/L5 , QZS L1/L5 , BDS B1/B2a, GAL E1/E5a, GLO L1OF and IRNSS**



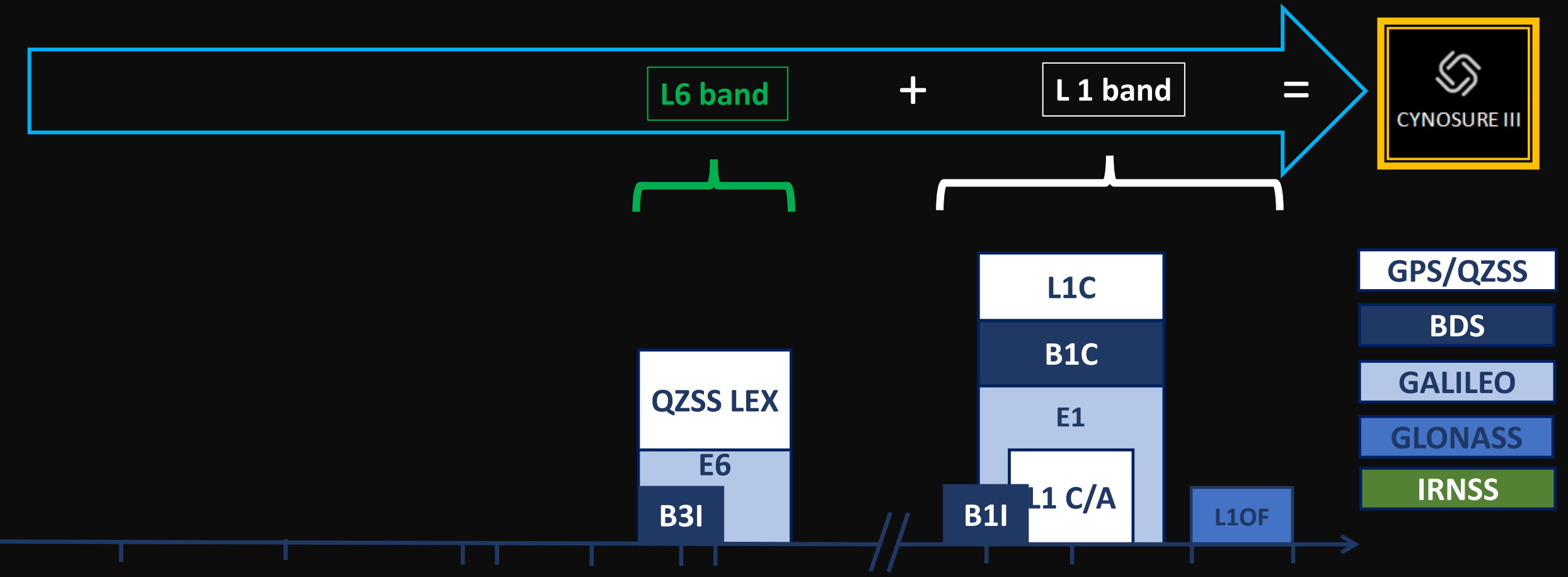
Option B :

- **supports : GPS L1/L2 , QZS L1/L2 , BDS B1/B2, GAL E1/E5b, GLO L1OF/L2OF**

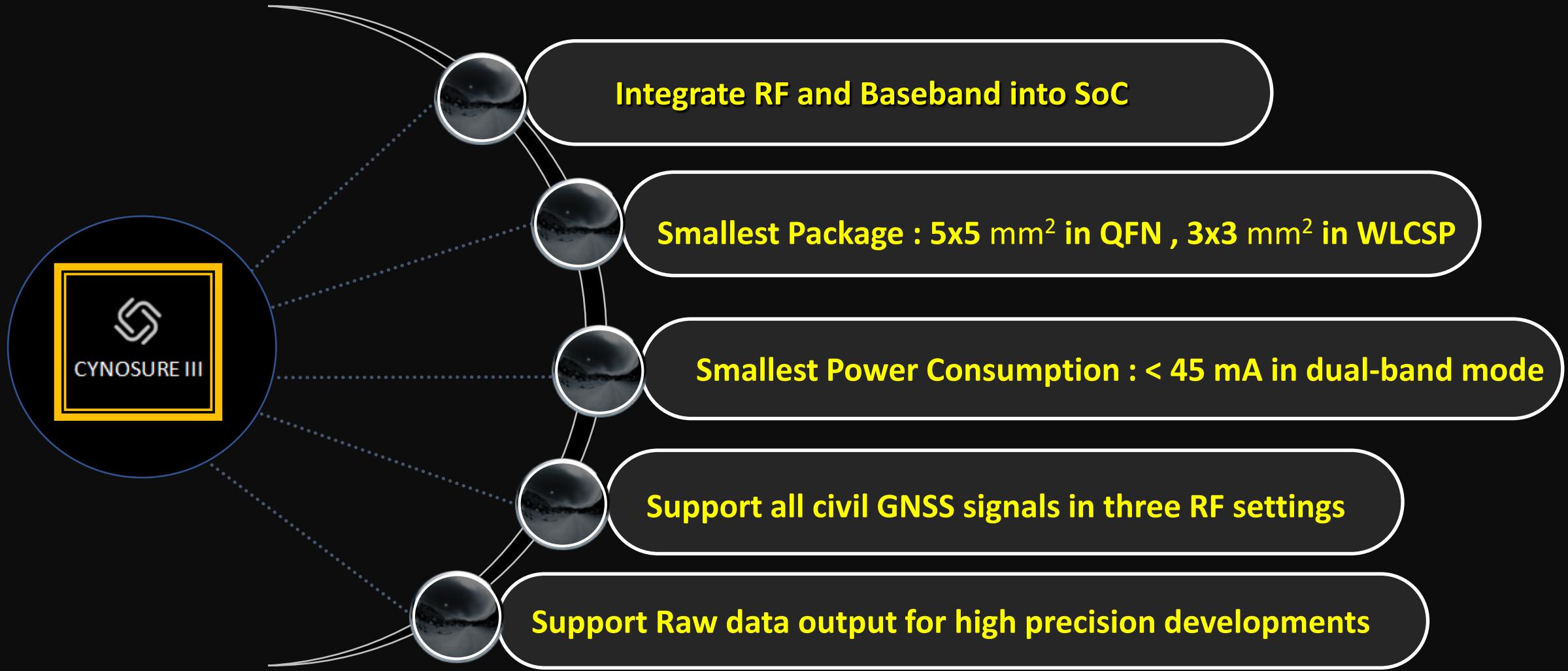


Option C :

- **supports : GPSL1, QZS L1/L6 , BDS B1/B3I, GAL E1/E6, GLO L1OF**

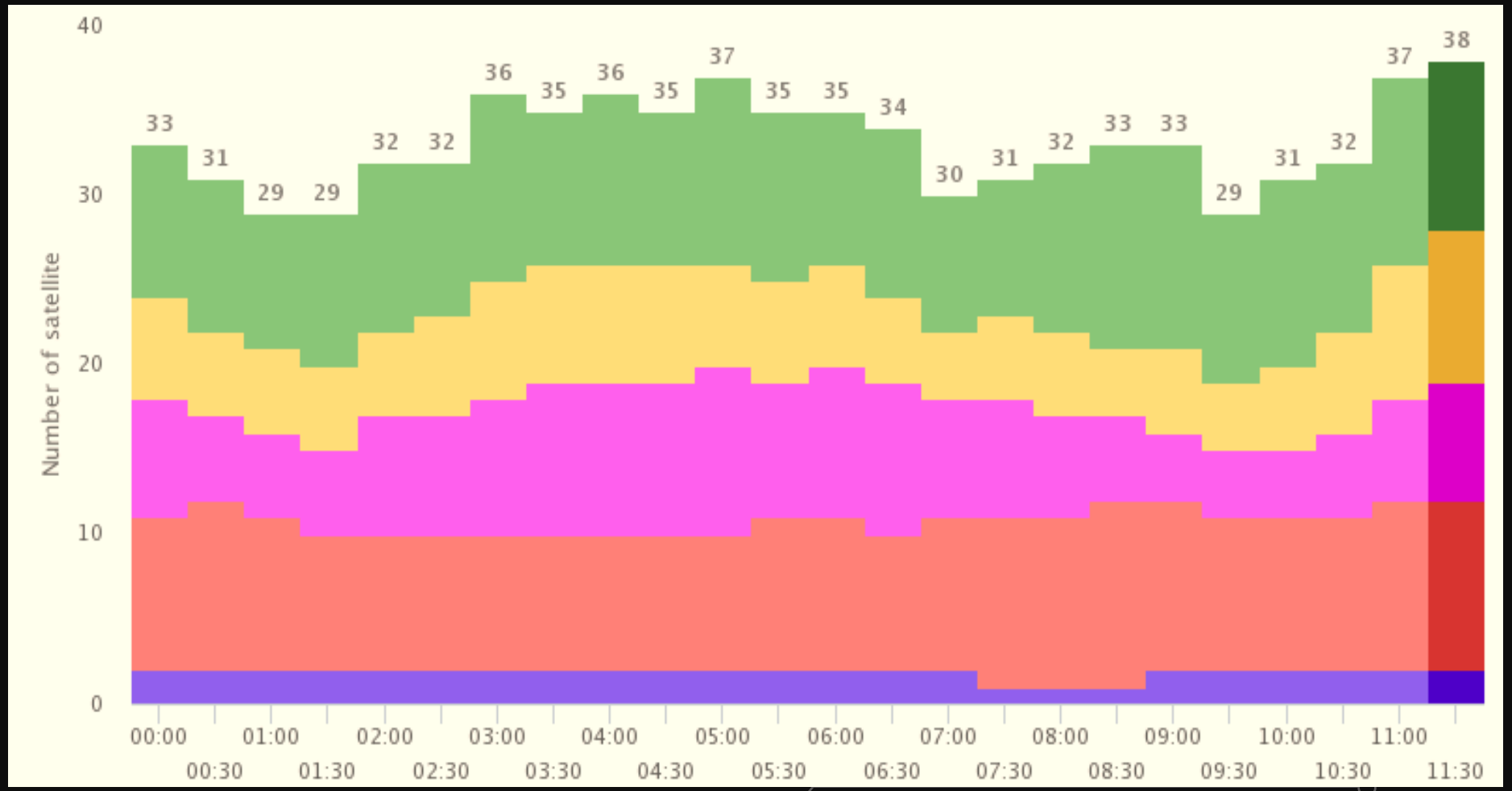


Highlights of CYNOSURE III GNSS SoC(1/2)



Highlights of CYNOSURE III GNSS SoC(2/2)

Receiving 5 systems (GPS+QZS+BDS+GAL+GLO) at the same time to maximize satellites visibility



CYNOSURE III

Output Protocol

- Standardization
- Compatibility
- Feasibility

- NMEA 0183 4.1 version (PVT solution)
- RTCM Standard 3.x
  - Multi-band Multi-system GNSS Raw
    e.g. Pseudo range, Phase range, SNR, Doppler
- Proprietary Binary Messages
  - IRNSS raw data , QZSS L6 raw data

Standard RTCM 3 Protocol (GNSS Raw Data)

Message type	Intended Application
MSM1	Conventional and advanced DGNSS
MSM2	Conventional RTK modes
MSM3	
MSM4	
MSM5	Storing data in a complete set of RINEX observables
MSM6	RTK with extended resolution. Real time Network data streaming.
MSM7	Transmission of a complete set of RINEX observations with extended resolution

RTCM STANDARD 10403.3

DIFFERENTIAL GNSS (GLOBAL NAVIGATION SATELLITE SYSTEMS) SERVICES – VERSION 3

System	MSM4	MSM7
GPS	L1 / L2 / L5	L1 / L2 / L5
BDS	B1 / B2 / B3	B1 / B2 / B3
GAL	E1 / E5	E1 / E5
GLO	L1 / L2	L1 / L2
QZS	L1 / L2 / L5	L1 / L2 / L5
SBS	*	*
IRNSS	-	-

CYNOSURE III support MSM table (I/O)

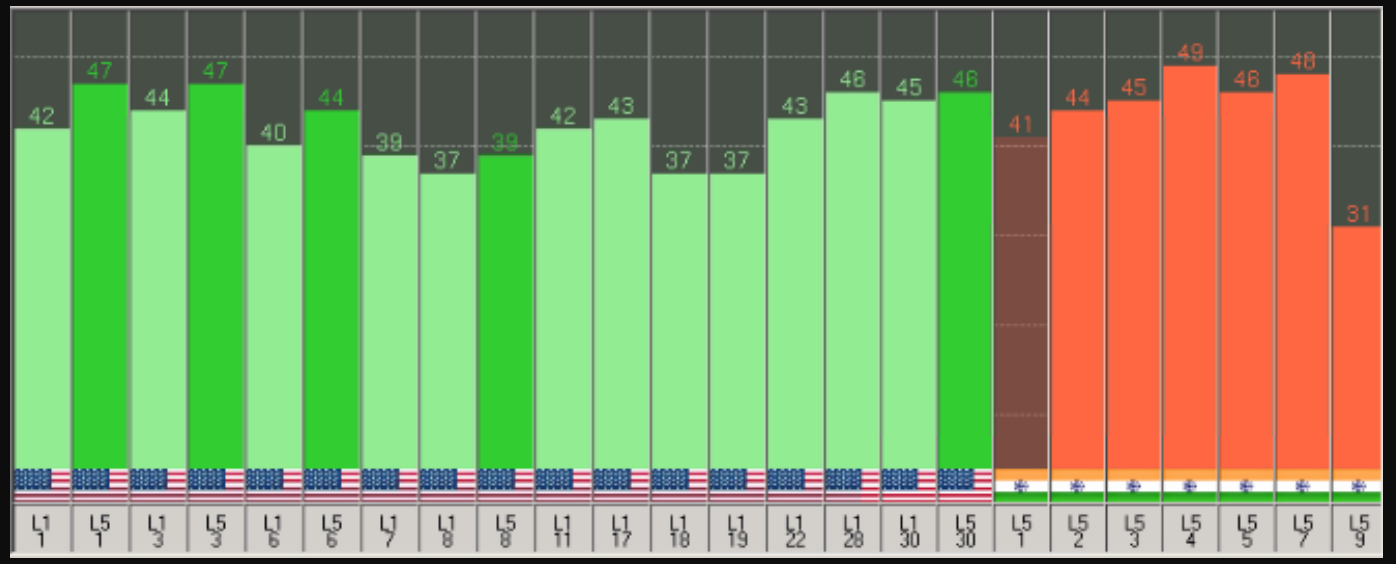
System	Ephemeris
GPS	MSG 1019
BDS	MSG 1042
GAL	MSG 1045 / MSG 1046
GLO	MSG 1020
QZS	MSG 1044
SBS	-
IRNSS	-

CYNOSURE III support Navigation MSG Table (O)

NAVIC sub frame data output

- There is no standard RTCM protocol to support NAVIC yet.
- Allystar supports proprietary binary messages of NAVIC sub frame output.

  $PIRNSF, ...




```
$PIRNSF,1,4,8B,49,8D,79,15,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,55,04,CF,F0,5C,0*09
$PIRNSF,2,2,8B,49,8D,0B,53,89,79,4D,B8,AC,04,8B,A7,F7,2B,A9,62,C4,36,B6,93,F2,05,17,AF,8B,FF,8F,F1,4D,C0,C8,C1,69,A1,0C,0*08
$PIRNSF,4,2,8B,49,8D,0B,BB,57,F4,25,B3,F0,04,AE,07,2B,2B,A8,8D,C0,37,01,DF,72,04,8C,B1,03,FF,91,01,4C,B9,A3,72,11,82,04,0*03
$PIRNSF,5,2,8B,49,8D,09,C0,BE,5B,75,B3,F0,03,AD,03,27,2B,B0,8C,5E,34,00,90,C2,02,30,CC,17,FF,99,51,4D,6D,C0,80,4C,A5,DC,0*07
$PIRNSF,7,2,8B,49,8D,08,4E,6F,53,BD,B8,AC,01,4B,BC,B7,2B,AA,05,A3,C3,BD,FC,F6,50,D2,D1,97,FD,5D,90,1F,45,15,13,4A,19,54,0*0A
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$PIRNSF,3,2,8B,49,8D,0A,6A,9B,CC,85,B8,AC,03,C3,E1,0B,2B,AD,69,A7,61,B1,AF,50,12,F5,7F,2B,FB,A7,10,15,E1,EB,22,58,4D,34,0*0E
```

unit: byte

QZSS L6 Raw Data Output (1/2)

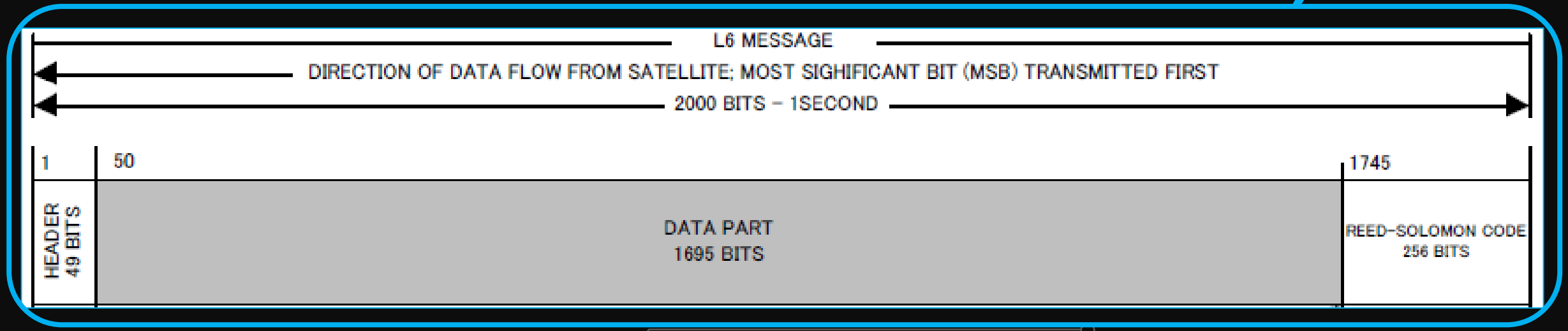
Original:

Sync word (2)	Class ID(1)	Message ID (1)	payload length(2)	SVN(2)	Freq ID(1)	data length(1), value = N	data (N*4)	checksum(2)

New:

Sync word (2)	Class ID(1)	Message ID (1)	payload length(2)	SVN(2)	Freq ID(1)	data length(1), value = N + 2	GPS Week Number(2)	GPS Time of week in ms(4)	SNR (1)	Flag(1)	data (N*4)	checksum(2)

Extend data: big endian
Others: little endian



unit: byte

QZSS L6 Raw Data Output (2/2)

Original:

Sync word (2)	Class ID(1)	Message ID (1)	payload length(2)	SVN(2)	Freq ID(1)	data length(1), value = N	data (N*4)	checksum(2)

New:

Sync word (2)	Class ID(1)	Message ID (1)	payload length(2)	SVN(2)	Freq ID(1)	data length(1), value = N + 2	GPS Week Number(2)	GPS Time of week in ms(4)	SNR (1)	Flag(1)	data (N*4)	checksum(2)

Extend data: big endian
Others: little endian

Flag definition:

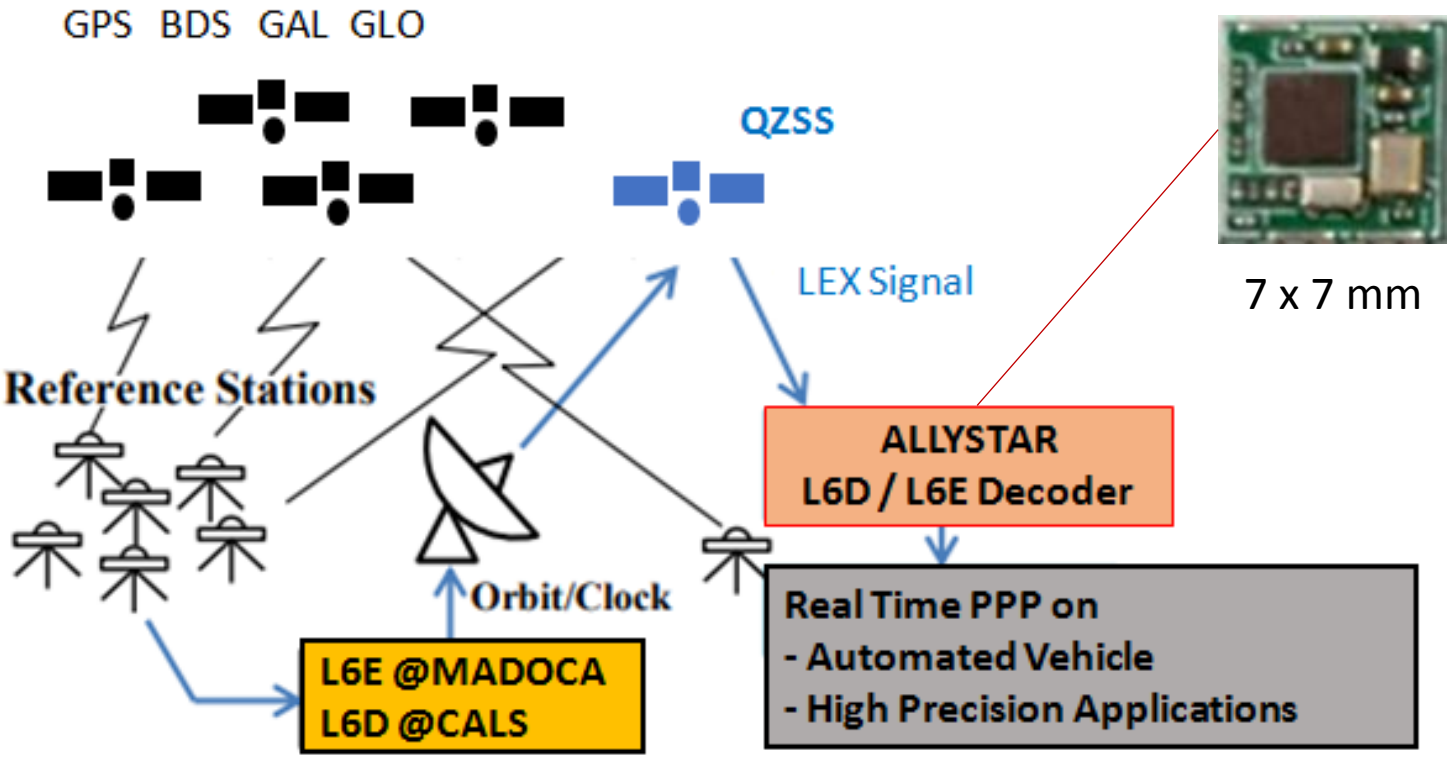
```
// QZSS L6 raw data flag, there is 8 bit can be used.
enum{
  QZSL6_ALL_GOOD = 0x0,
  QZSL6_RS_FAILED = 0x1,
  QZSL6_WEEK_NOT_CONFIRM = 0x2,
  QZSL6_TOW_NOT_CONFIRM = 0x4,
};
```

Header Description:

Sync word	0xF1D9
Class ID	0x2
Message ID	0x10
SVN	Follow the NMEA format, QZSS L6 SVN is "prn +700"
Freq ID	0
Data length	Word size

Flexible channels to track L6D and L6E

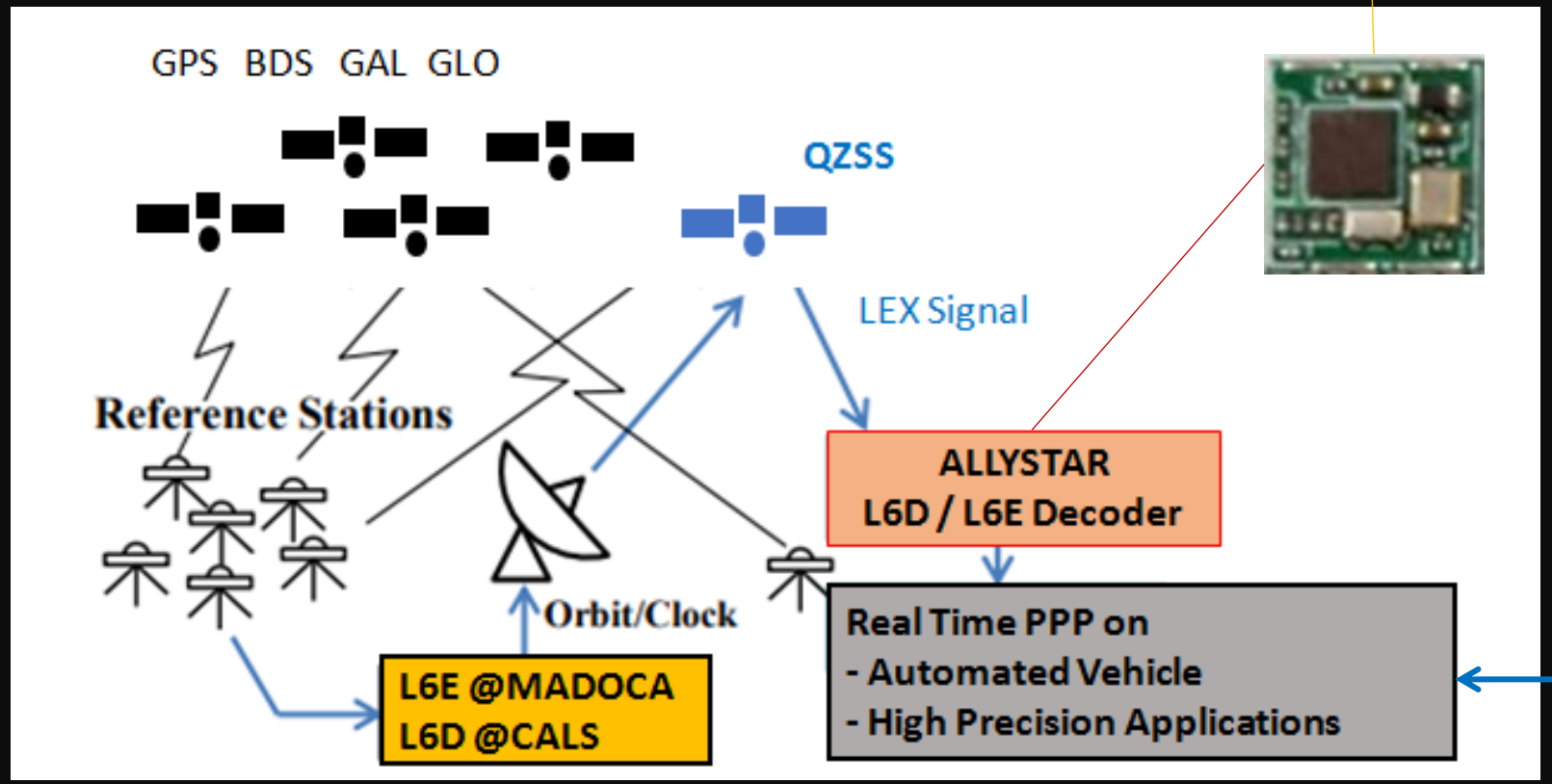
- Tracking L6D and L6E at the same time (max. 8 dedicated channels)
- Standard RTCM SSR-Type output
- Lowest Power consumption : 38 mA
- Smallest module size : 7.6mm x 7.6mm x 1.9mm

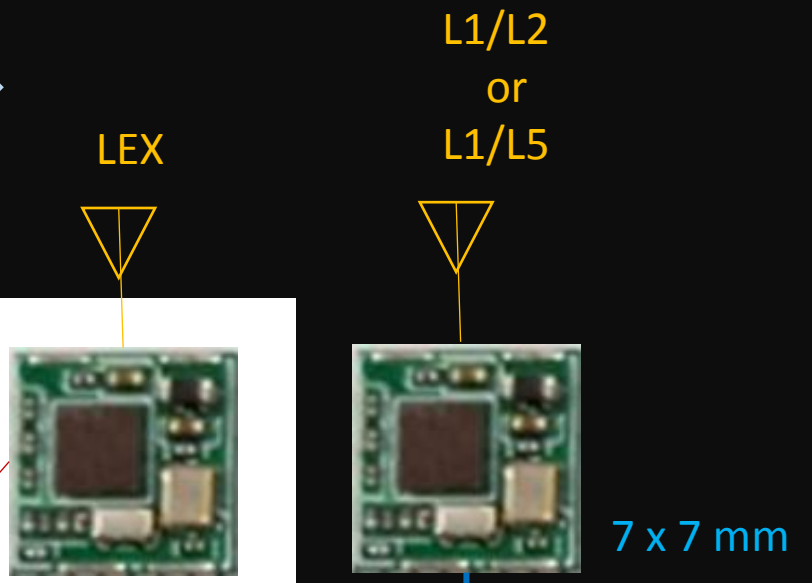


7 x 7 mm

QZSS L6 Application Note :

- One module to access L1/L5(Option A) or L1/L2(Option B)
- One module to access QZS LEX signal (Option C)
- Over all power consumption is < 90 mA
- Over all size is about 7mm x 14 mm





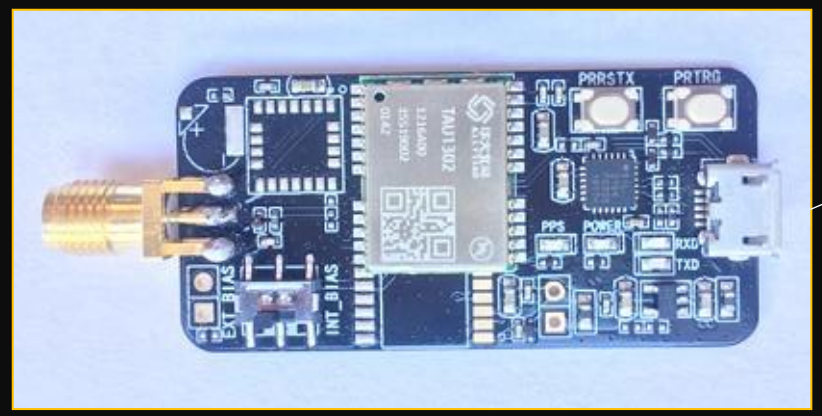
PART 3 Demonstration

- RF Option A : L1 & L5 band
- RF Option B : L1 & L2 band
- RF Option C : L1 & L6 band

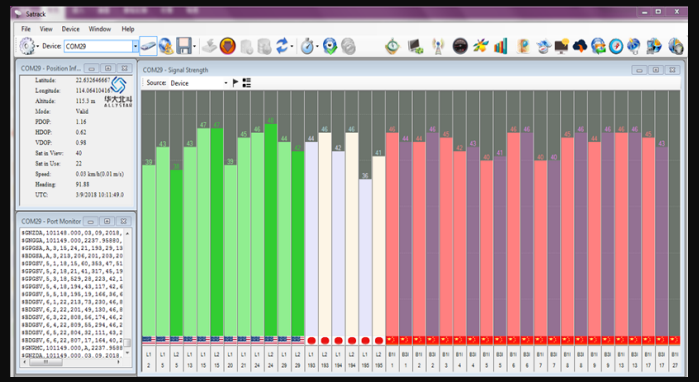
Tools

FTP server

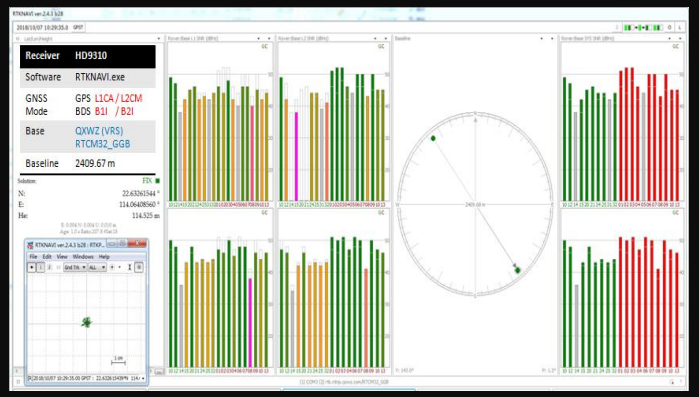
Address : fcd.allystar.com
user : hd_cynosure3
password : hd_cynosure3@0929



- EVB
- √ Driver
- √ GUI program
  - Satrack.exe
  - RTKLIB
- √ Firmware



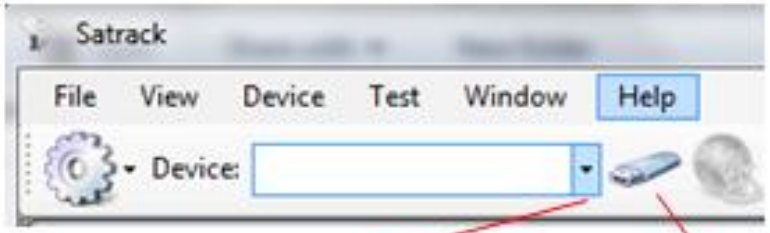
(Allystar GUI Tool – Satrack.exe)



RTCM Protocol compatible with RTKLIB
(Open source tool, Author : T. Takasu)

Steps to access GNSS signal via Satrack and EVB

Step 1 : connect EVB to PC
Step 2 : open Satrack.exe
Step 3 : choose com port & connect
Step 4 : monitor GNSS signal



Choose com port

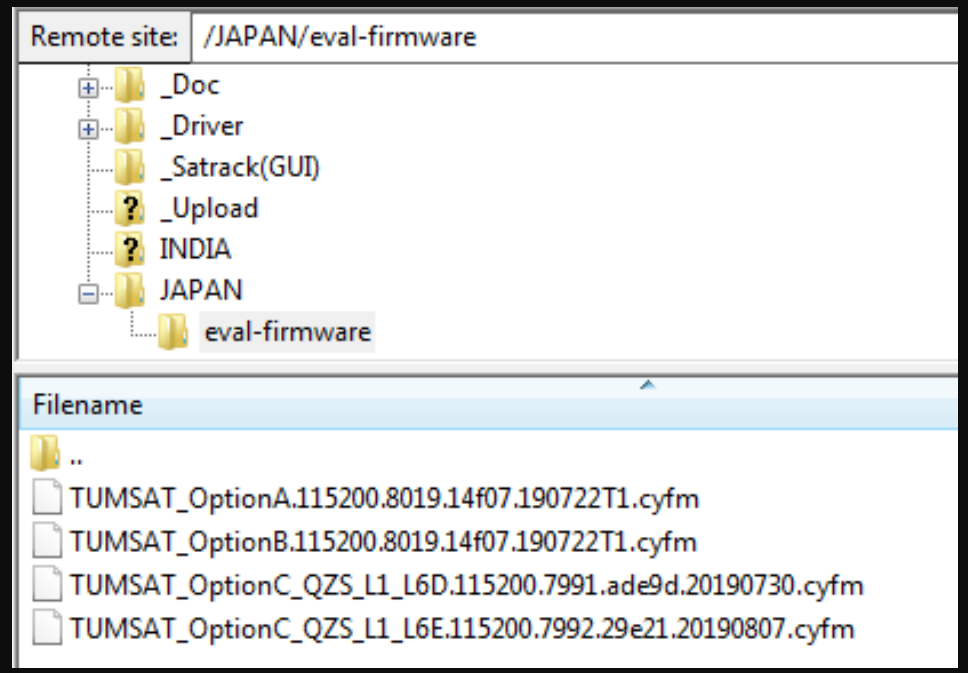
Connect

External Active GNSS Antenna

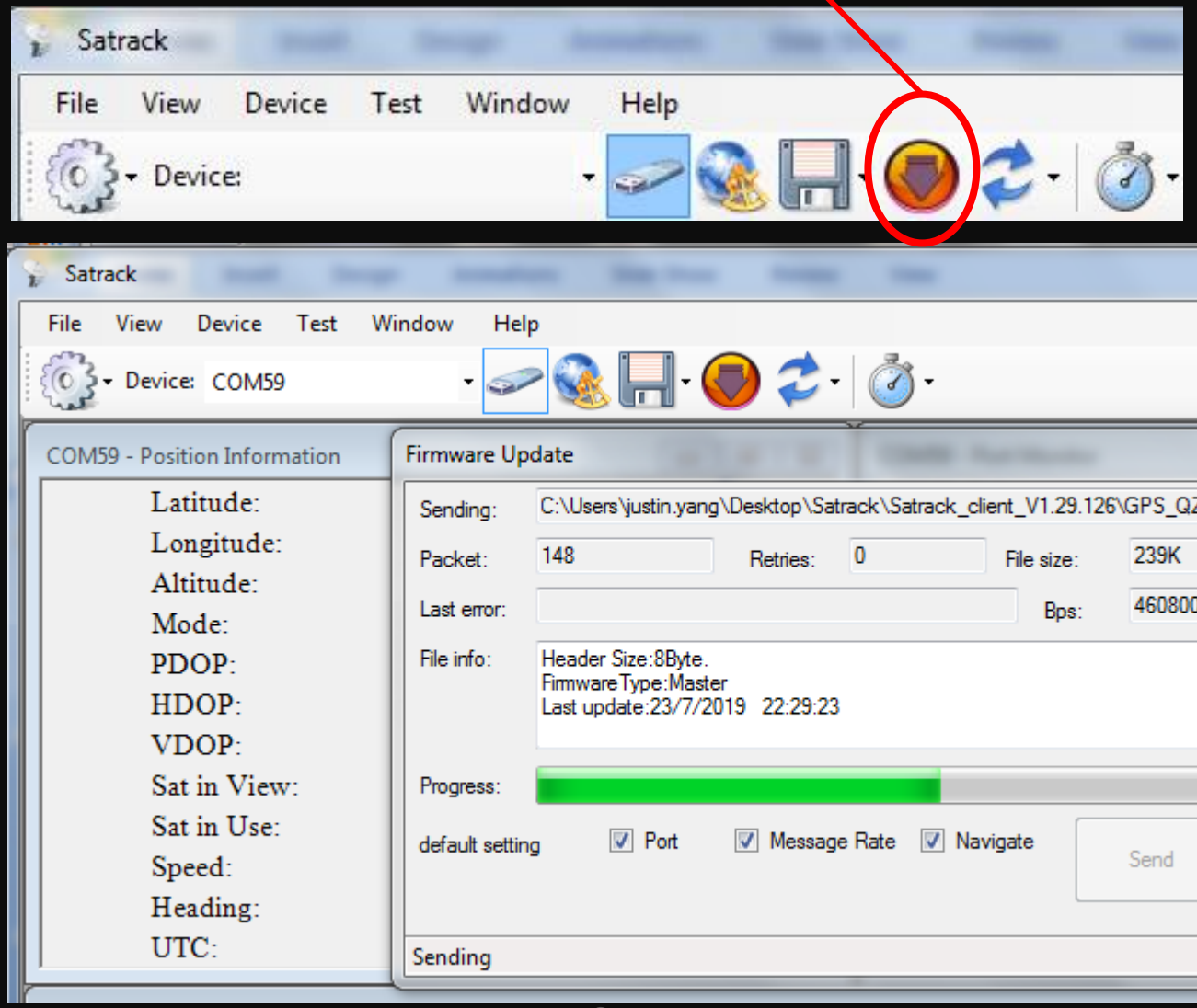
Change Firmware

FTP server

Address : fcd.allystar.com
user : hd_cynosure3
password : hd_cynosure3@0929



Choose specific firmware to update



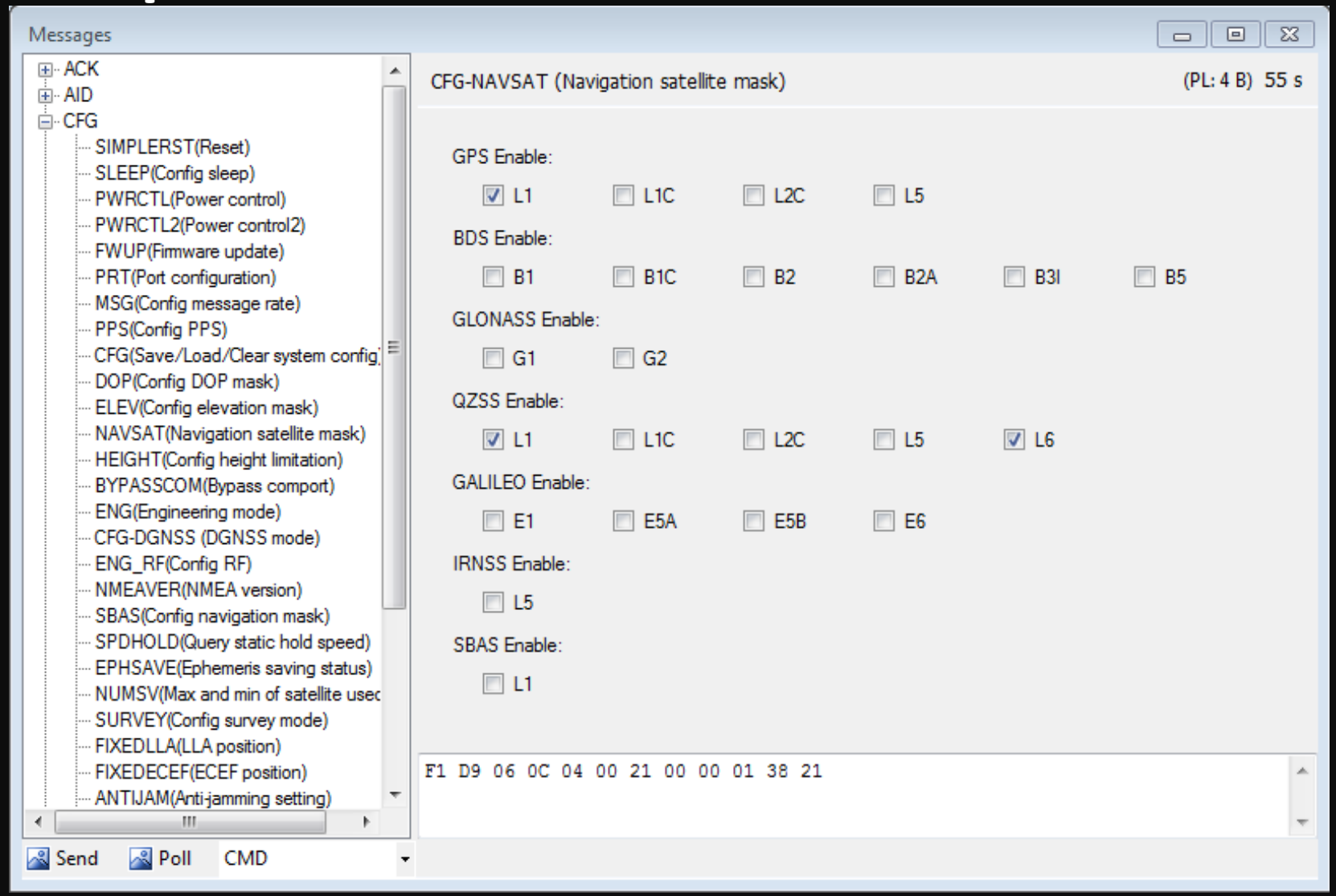
Configure the GNSS receptions and bands

- Cynosure III SoC
  has only 40 tracking channels

- Flexible command to choose
  specific Reception and frequency

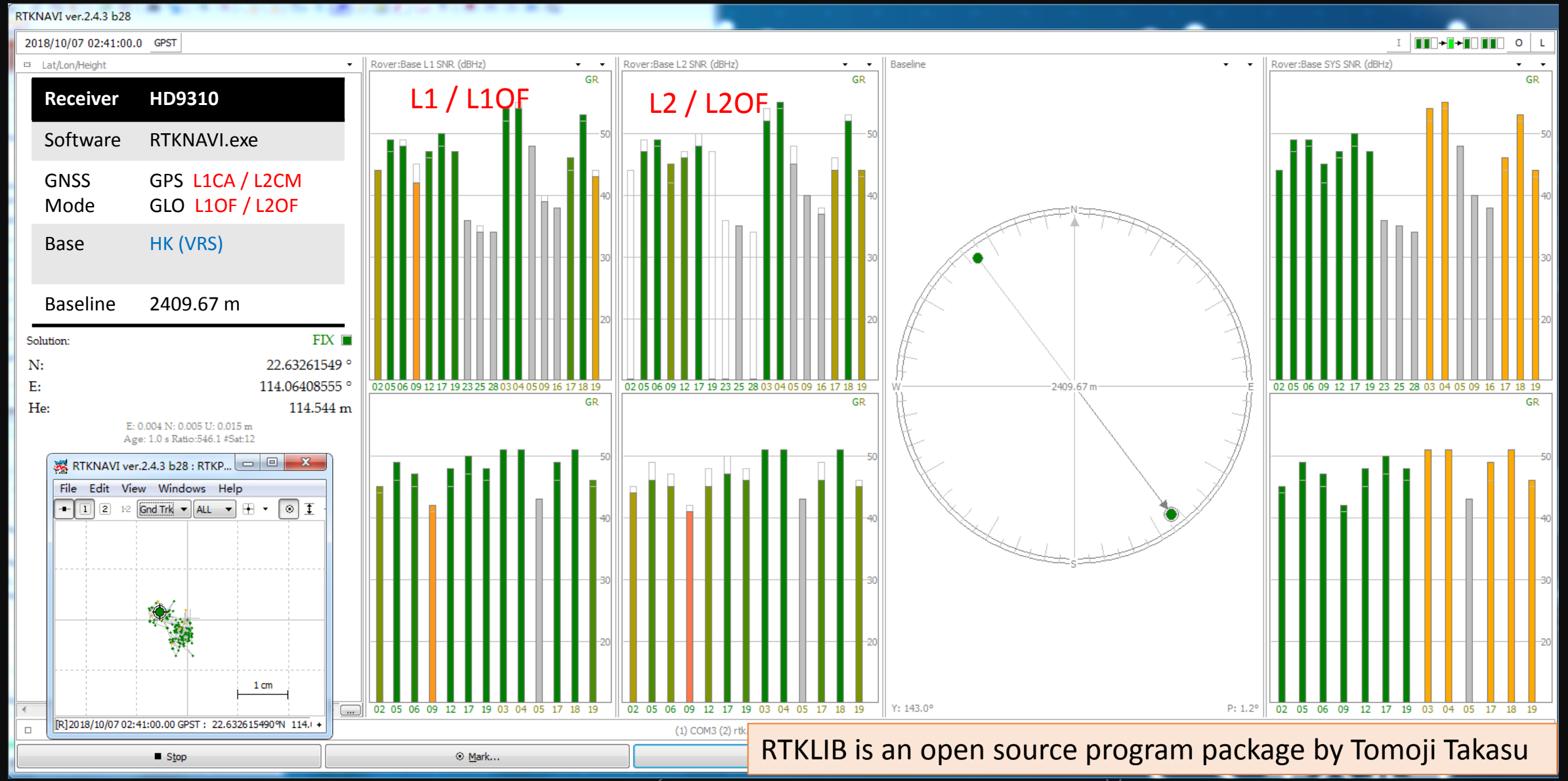
Satrack.exe :

- View
- AS Messages
- CFG
- NAVSAT
  - Choose frequencies
  - Send



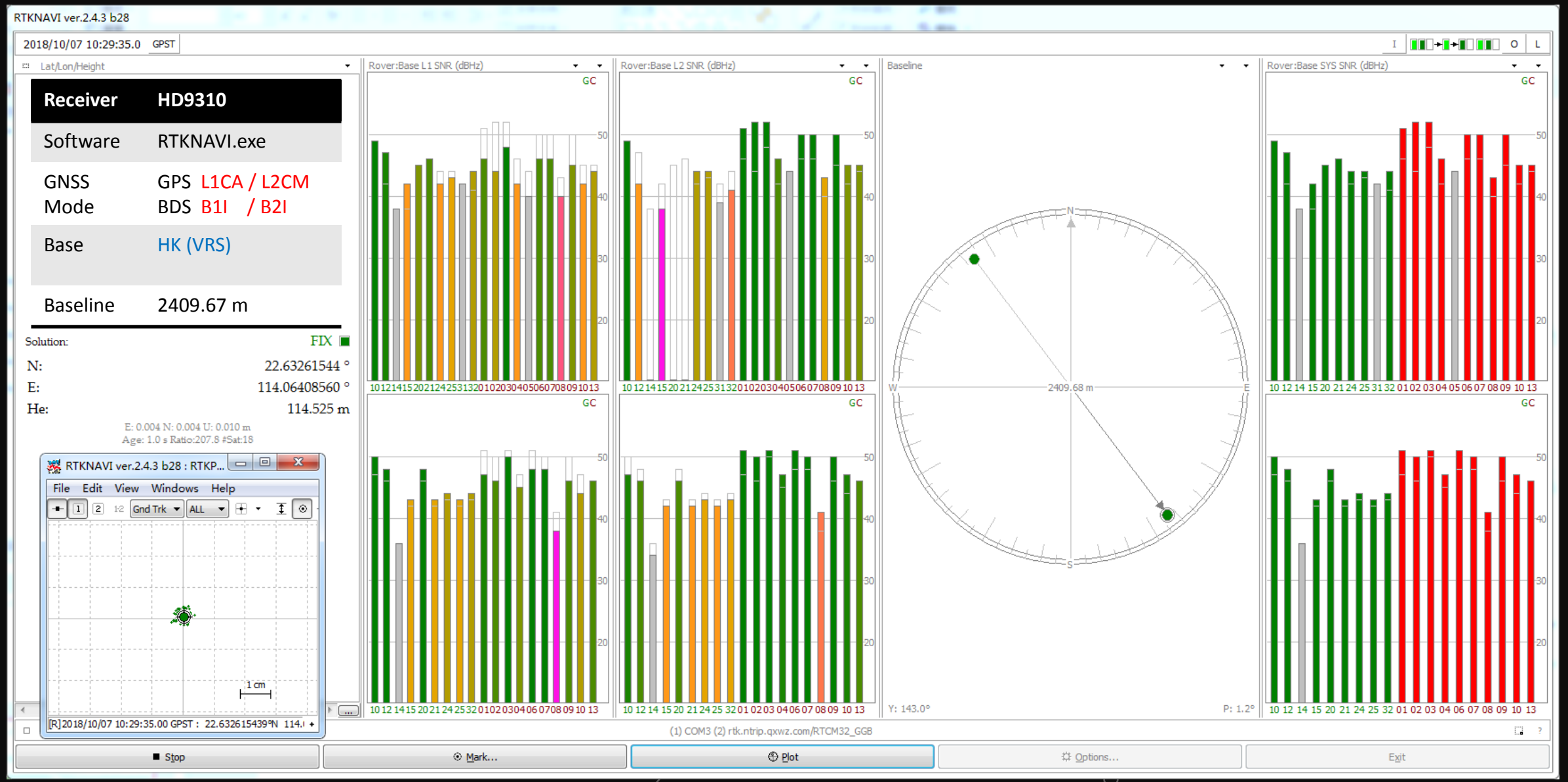
Relevant commands , please refer to PI-4-1712-Satrack V1.29-User Manual.pdf

Demo via RTKLIB (1/2)



RTKLIB is an open source program package by Tomoji Takasu

Demo via RTKLIB (2/2)



PART 4 Competitive Solutions

- TAU module series
- Compatible antennas

Advantages based on CYNOSURE III Technology

Can easily design competitive multi-band multi-GNSS solutions with smallest size and lowest power consumption

Down size

75 %

Down Power

50 %

1 cm

7x 7 mm2
(w/o LNA)

Power < 45 mA

10 x 10 mm2
(w/ LNA inside)

Power < 45 mA

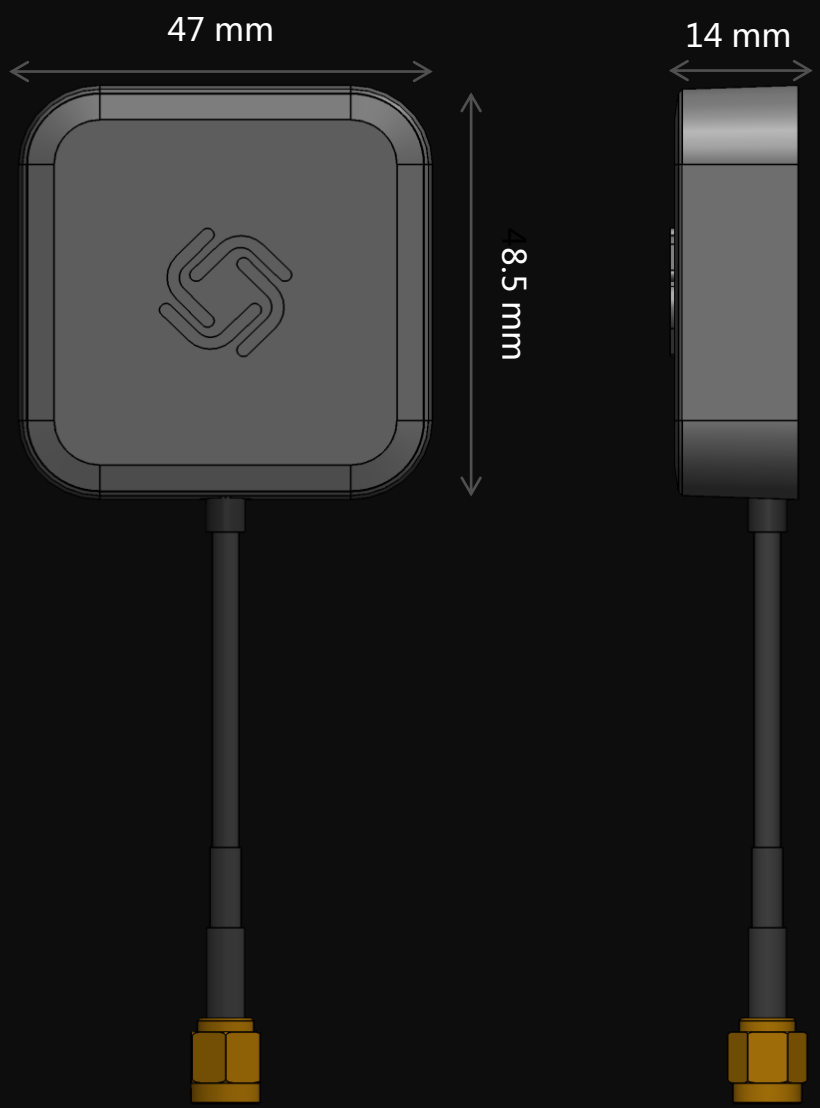
Other competitors

12 x 16 mm2

Power > 85 mA

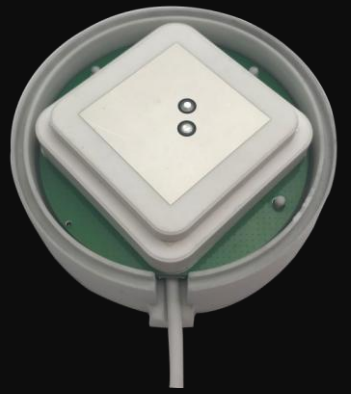
L1 Band GNSS Antenna – AGR6301

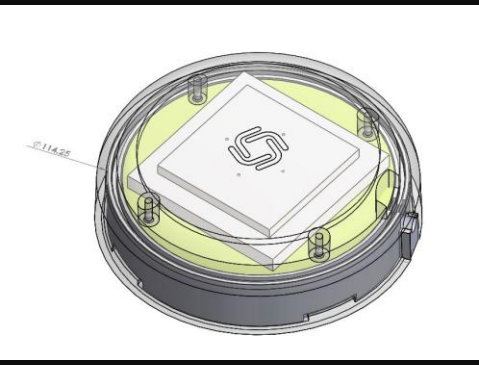
GNSS Reception	GPS/QZS L1, BDS B1, GAL L1OF, GAL E1, SBAS
Specifications	Architecture : Dual Feed Network Axial Ratio : < 2dB Gain : 3~5dBi Polarization : RHCP LNA gain : 25dB typ. Noise Figure : < 2dB Output SWR : < 1.5 Output Impedance : 50 Ohm Out-band rejection : > 1640Mhz (>40dB) Support Voltage : 1.8~5.5 V Power consumption : 7.5mA(3.3V typ.)
Mechanicals	Size : L45.8 x W47 x H14mm Interface : SMA-M-M Mounting : Magnet mount Water Proof : IP67



L1 / L2 band GNSS Antenna – AGR6302

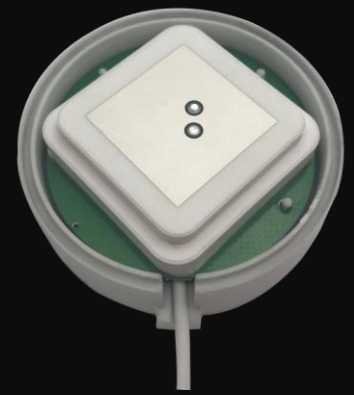
GNSS Reception	GPS/QZS L1 L2, BDS B1 B2I, GLO L1OF, GAL E1 E5b, SBAS
Specifications	Architecture : Quad Feed Network Axial Ratio : < 2dB Gain : 3~5dBi Polarization : RHCP LNA gain : 31dB typ. Noise Figure : < 2dB Output SWR : < 2 Output Impedance : 50 Ohm Out-band rejection : In-Band +- 80Mhz (>35dB) Support Voltage : 2.5~5.5 V Power consumption : 22mA(3.3V typ.)
Mechanicals	Size : D79 x H24mm Interface : SMA-M-M Mounting : Magnet mount Water Proof : IP67

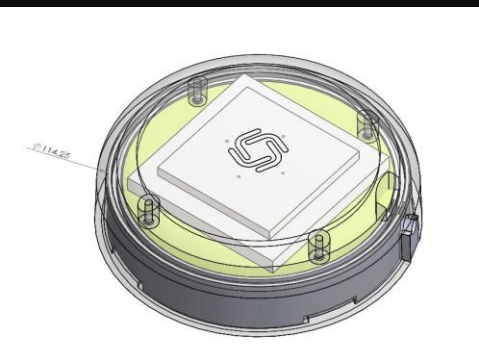




L1 / L5 band GNSS Antenna – AGR6303

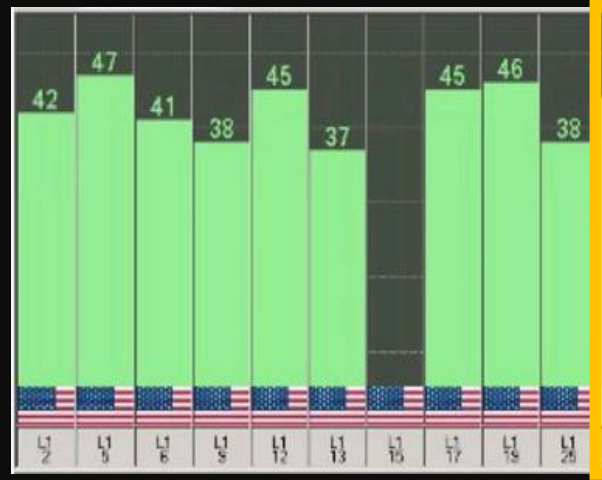
GNSS Reception	GPS/QZS L1 L5, BDS B1 B2a, GLO L1OF, GAL E1 E5a, SBAS
Specifications	Architecture : Quad Feed Network Axial Ratio : < 2dB Gain : 3~5dBi Polarization : RHCP LNA gain : 31dB typ. Noise Figure : < 2dB Output SWR : < 2 Output Impedance : 50 Ohm Out-band rejection : In-Band +- 80Mhz (>35dB) Support Voltage : 2.5~5.5 V Power consumption : 22mA(3.3V typ.)
Mechanicals	Size : D79 x H24mm Interface : SMA-M-M Mounting : Magnet mount Water Proof : IP67

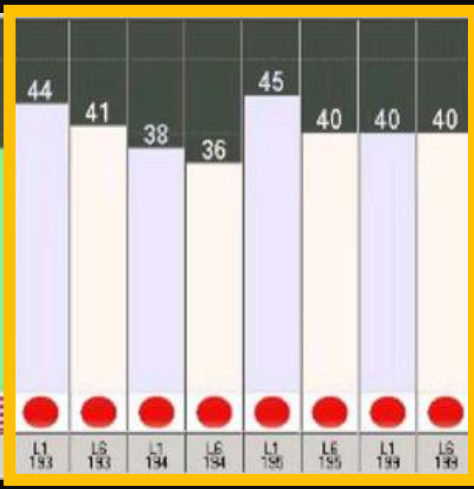




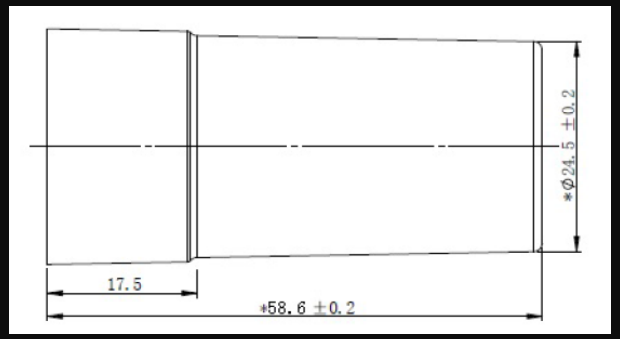
L1 / L6 band GNSS Helix Antenna

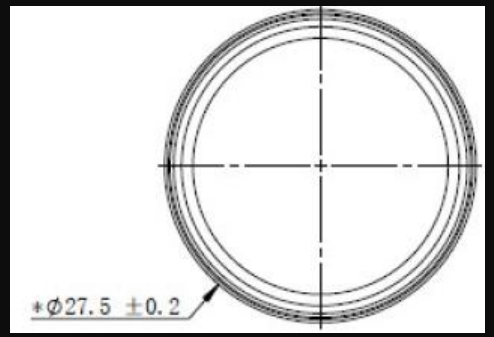
GNSS Reception	GPS/QZS L1 L6
Specifications	Architecture : Helix Gain : L1 > 1.5 dBi ; L6 > 2.0 dBi Polarization : RHCP LNA gain : 31dB typ. Noise Figure : < 2dB Output SWR : < 2 Output Impedance : 50 Ohm Out-band rejection : In-Band +- 80Mhz (>35dB) Support Voltage : 3~5 V Power consumption : < 40mA(3.3V typ.)
Mechanicals	Size : D27.5 x H58.6mm Interface : SMA-J





QZS # PRN 193 : L1 L6
QZS # PRN 194 : L1 L6
QZS # PRN 195 : L1 L6
QZS # PRN 199 : L1 L6
(2019.06.01 Hong Kong)





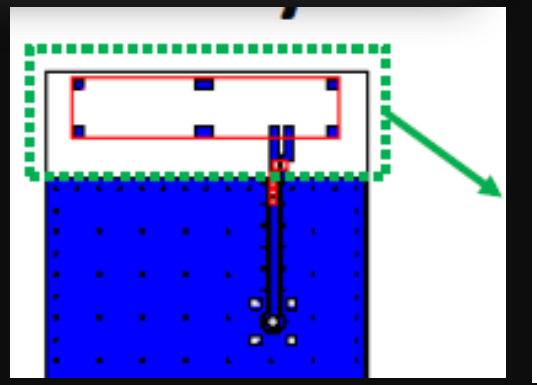
Low Cost L1 / L5 Passive Patch Antennas

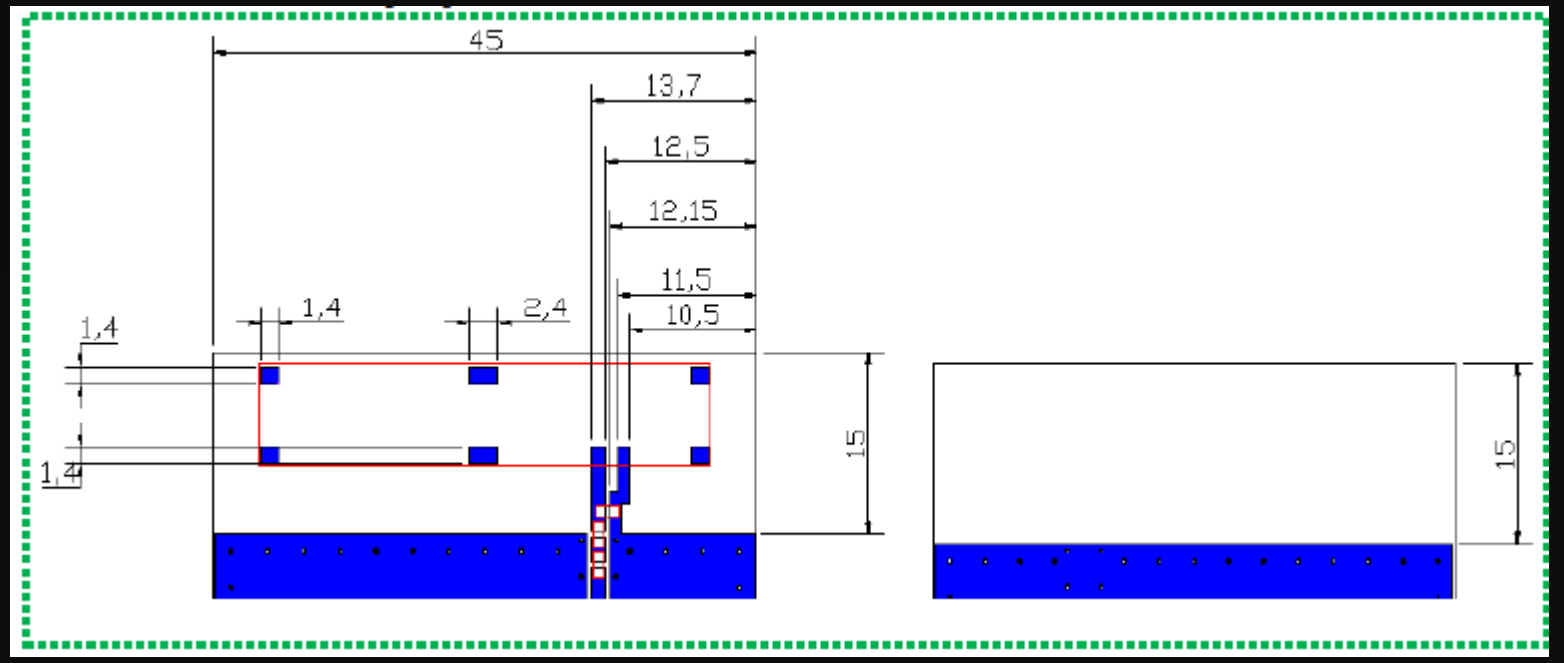
GNSS Reception	GPS/QZS L1 L5, BDS B1 B2a, GLO L1OF, GAL E1 E5a, NAVIC, SBAS
Specifications	Architecture : Single Feed Stack Axial Ratio : L1 < 4dB ; L5 < 13dB Gain : 3~5dBi Polarization : RHCP Output SWR : < 2 Output Impedance : 50 Ohm
Mechanicals	Size : Type A (35x35mm + 25x25mm) Type B (25x25mm + 15x15mm)

Type A Type B

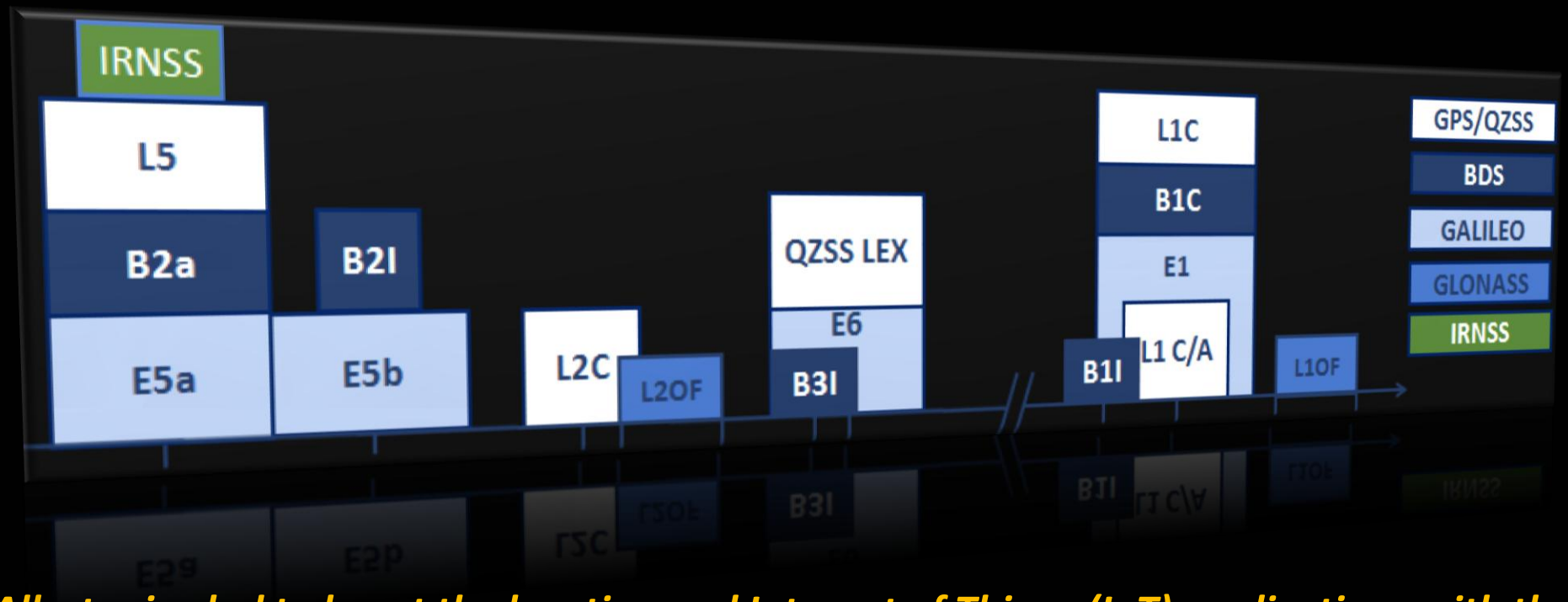
Low Cost L1 / L5 Band Linear antenna

Frequency	GNSS		
	Peak Gain (dB)	Average gain (dBi)	Efficiency (%)
1176.45MHz	1.65	-3.15	48.45%
1227MHz	2.28	-1.87	64.98%
1575.42MHz	3.48	-1.31	73.94%

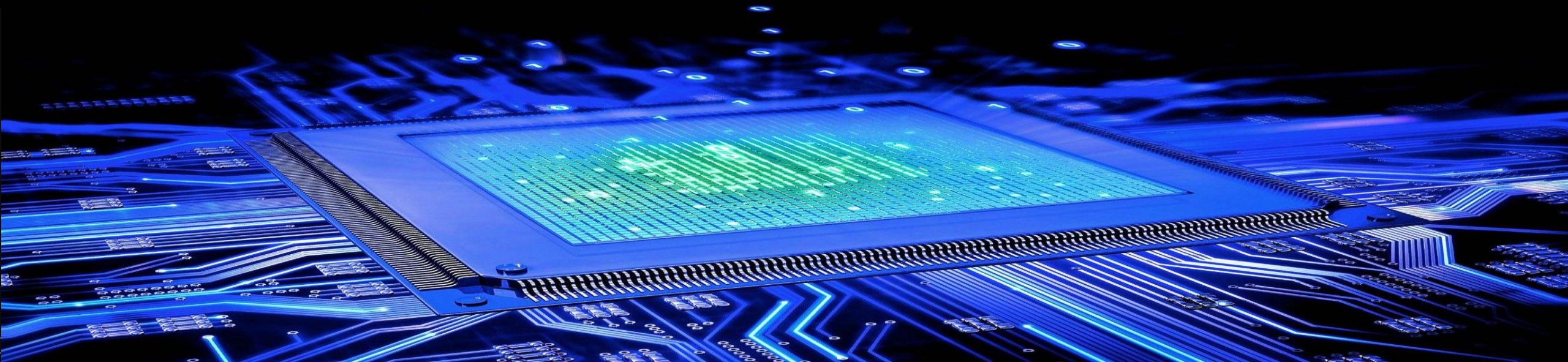




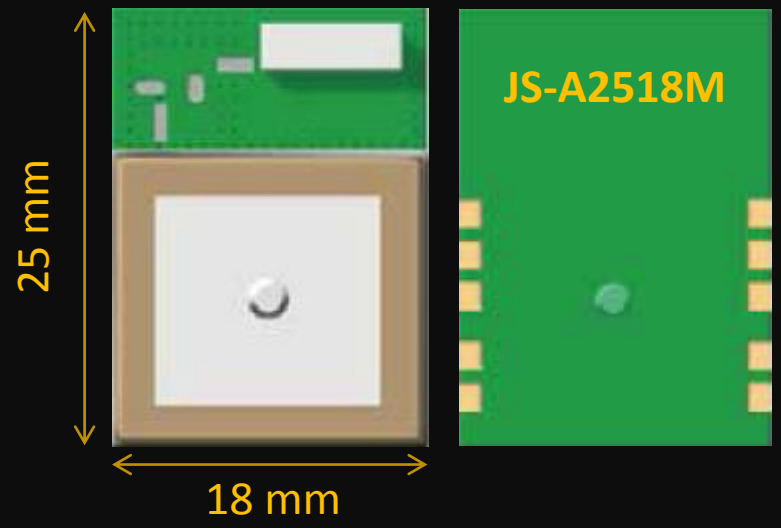
THANK YOU

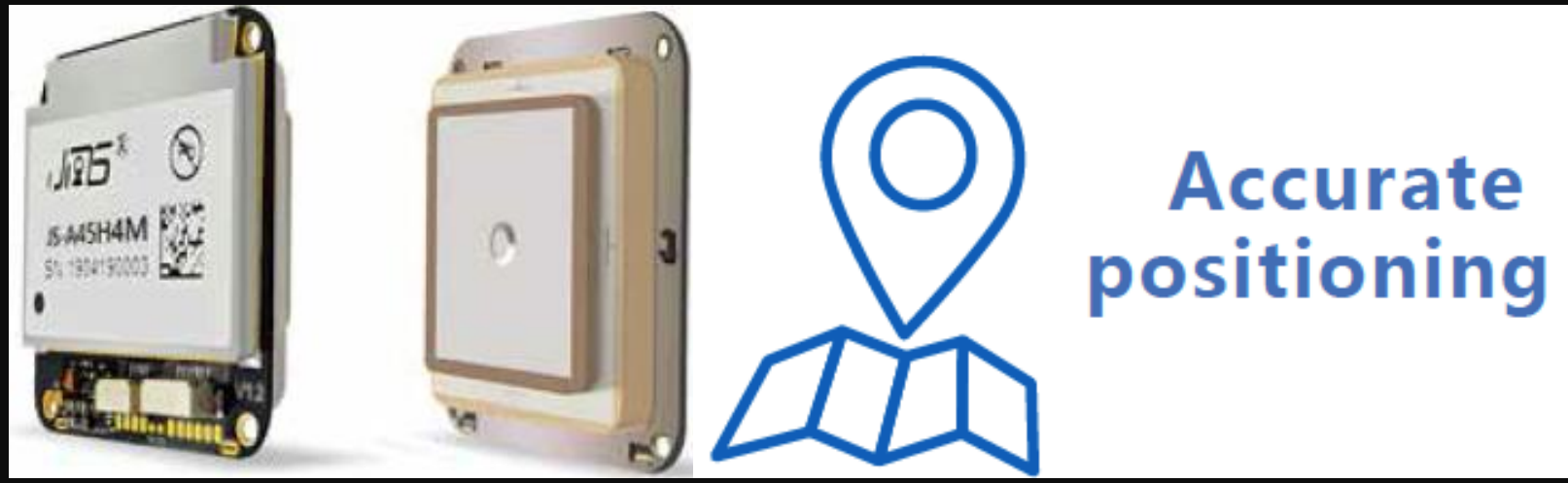


Allystar is glad to boost the location and Internet of Things (IoT) applications with the latest multi-frequency GNSS SoC (system on chip) technology

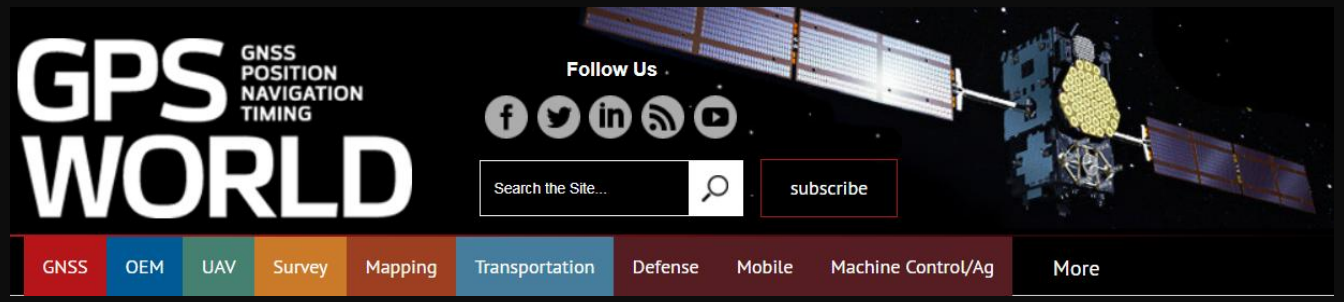


L1 / L5 band design applications





Realizing in smart phone



The latest Lenovo smart phone offers dual-frequency GNSS capable of tracking
GPS L1 , L5
BDS B1 , B2a
GAL E1 , E5a
GLO L1OF,
IRNSS (HD8041D only),
the Z6 SE, using an Allystar chipset.