

iNAT-4C/SLx

Precise MEMS Based Inertial Navigation System with Battery Pack, 3 Spare Controllers for Custom Application and Dedicated Interfaces for Swarm Control

The **iNAT-4C/SLx** is a device family with integrated up to 3 simultaneously operated dissimilar MEMS based inertial sensor clusters and an GNSS engine, a highly sophisticated data fusion by incorporating also information from wheel sensor, Radar, Lidar or stereo cameras for precise positioning as well as for environmental perception and collision avoidance. Furthermore, the device contains 4 independent controllers (CPU and memory), also useable for custom applications, and it is powered via two hot-swappable rechargeable battery packs for up to ½ hour of operation time while external power supply might be interrupted.

iNAT-4C/SLx is used for advanced navigation and vehicle control tasks like swarm control, where safety requirements can be covered by an architecture allowing operation of dissimilar signal processing.

Swarm Control is a most important application for highly and fully automated driving vehicles. All controlled vehicles have to operate in real-time within a shared space, a joined task has to be fulfilled and therefore the trajectory control of each swarm member is as mandatory as communication is between every member and - if desired - also with a dedicated control center (see **iSWACO-ARGUS**).

Optionally iNAT-4C/SLx can be equipped with a powerful communication module for LTE/ GSM / WLAN and/or with iMAR's **iDMN** Dynamic Mesh Network, to be able to interact with all other swarm members in the neighborhood as well as with an upper level **iARGUS-CC** control center.

- INS/GNSS with up to L1L2 GPS/GLONASS/GALILEO RTK and dual-antenna capability for true heading even without motion
- Accurate roll, pitch, heading, WGS84 or UTM position, velocity, rates, acceleration and standard deviations
- Integrated odometer input (A/B quadrature signals)
- lowest data latency (< 3 ms) and data jitter (< 1 ms) makes it also the best choice for real-time vehicle control applications
- communication I/F for external LTE, GSM, WLAN and iDMN
- Capable to use iMAR's iDMN Dynamic Mesh Network
- CAN, UART RS232 & RS422 / Ethernet / WLAN / GP-I/O / USB interfaces to every controller; PPS output for time sync.
- Three internal controllers available for custom applications; capability to operate three dissimilar MEMS IMUs simultaneously, e.g. in **safety relevant application**
- Hot swappable power supply, two battery packs
- L1L2 GNSS antennas with ground plane and vacuum fixation for vehicle roof mounting available as option
- Power supply 9...26 V DC, reverse and over-voltage protection up to 35 V
- Size LxWxH: 250x155x100 mm (W with connectors: ≈200 mm)
- [iXCOM-CMD](#) GUI for operation, visualization, configuration

Due to today's missing interface standardization, nearly each autonomous operating platform comes with it's individual actuator interface. Therefore, iNAT-4C provides three ARM based processors dedicated to custom



applications, where one of them may perform a platform control (incl. a vehicle's kinematic model) to achieve best trajectory performance with smallest errors in position, speed or regarding dynamic behaviour, depending on the user's priorities.

The iNAT-4C/SLx series is one of the most powerful MEMS based INS/GNSS inertial navigation, measurement, surveying and control systems on the market, in a modular design for swarm control applications for autonomous marine vessels, unmanned airborne vehicles, highly or fully automated road vehicles etc. It provides all kinematic measurements like acceleration, angular rate, attitude, true heading, velocity and position of the target vehicle in real-time as well as the actuator control outputs (engine's torque, steering and braking information etc.) with a data update rate of up to 500 Hz.



The iNAT-4C/SLx is a robust and easy to handle ensemble. The INS/GNSS solution and all communication equipment are mounted together on a single carrier. This light weight small carrier contains also mounting brackets and grasps for easy handling. The size of the carrier base is approx. 450 mm x 210 mm.

The INS/GNSS performance specification of the iNAT-4C/SLx is given in the dedicated product datasheets of iNAT-M200/SLN, iNAT-M200/SLC and iNAT-M200/SLI. To meet higher performance requirements as well, the modular architecture of iNAT-4C/SLx also allows to connect any other of iMAR's higher performance iNAT INS/GNSS systems (fiber optic / ring laser / hemispherical resonator gyro based).

The key technical data of the external available standard communication interface are as follows (additionally the iDMN Dynamic Mesh Network is available as option):

- LTE up to 100 Mbps DL and 50 Mbps UL
- DC-HSPA+ up to 42 Mbps DL and 5.73 Mbps UL
- Multiple LTE FDD bands
- Quadband UMTS and GSM
- IEEE 802.11b/g/n WiFi with 2x2 MIMO up to 300 Mbps
- IEEE 802.3 and IEEE 802.3u standards
- Four Ethernet ports (3 x LAN, 1 x WAN)
- External antennas
- Dual SIM
- Temperature range -40... +75 °C operating

Contact iMAR sales team for further information or customized solutions.

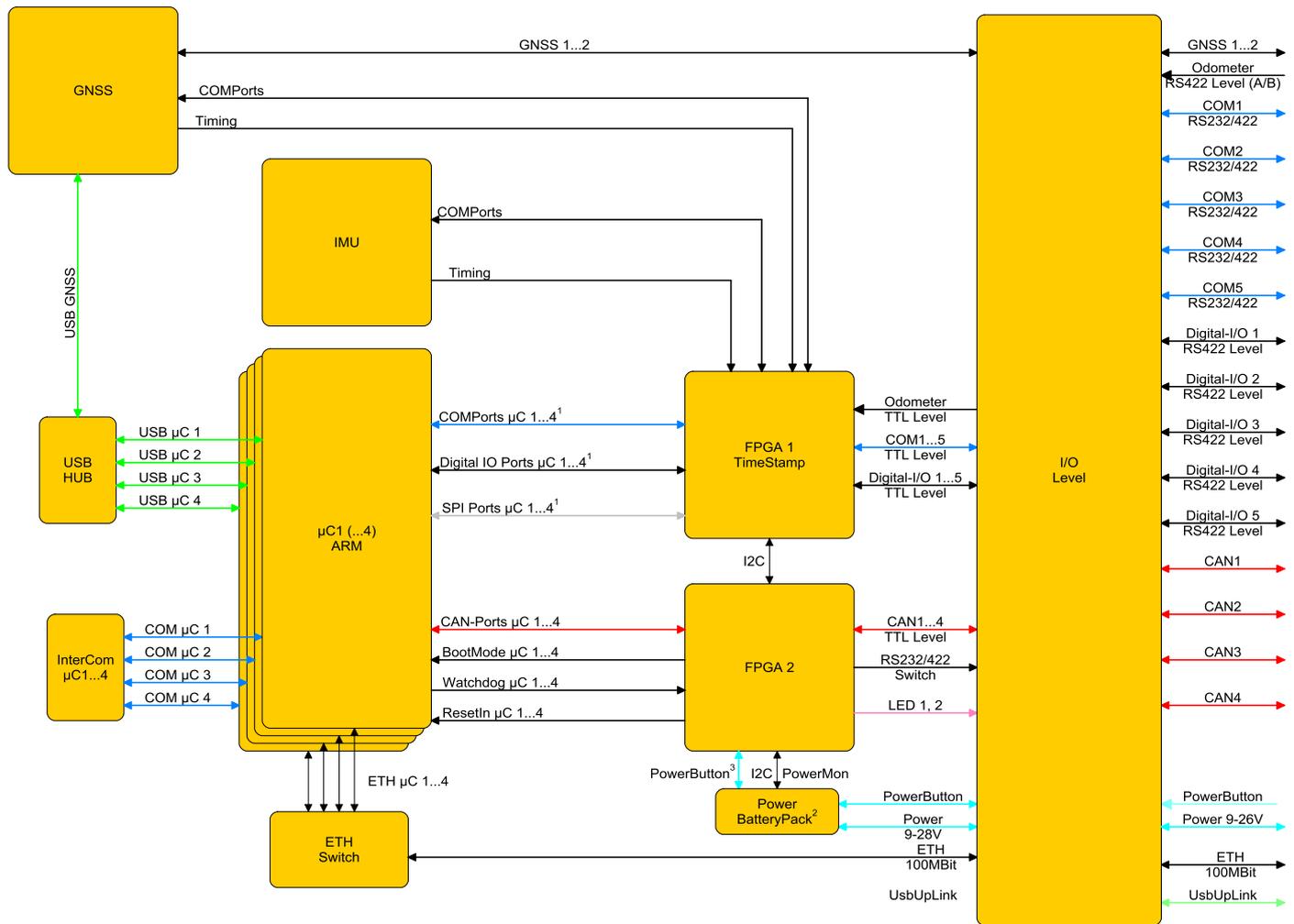
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System Architecture Diagram iNAT-4C/SLx:



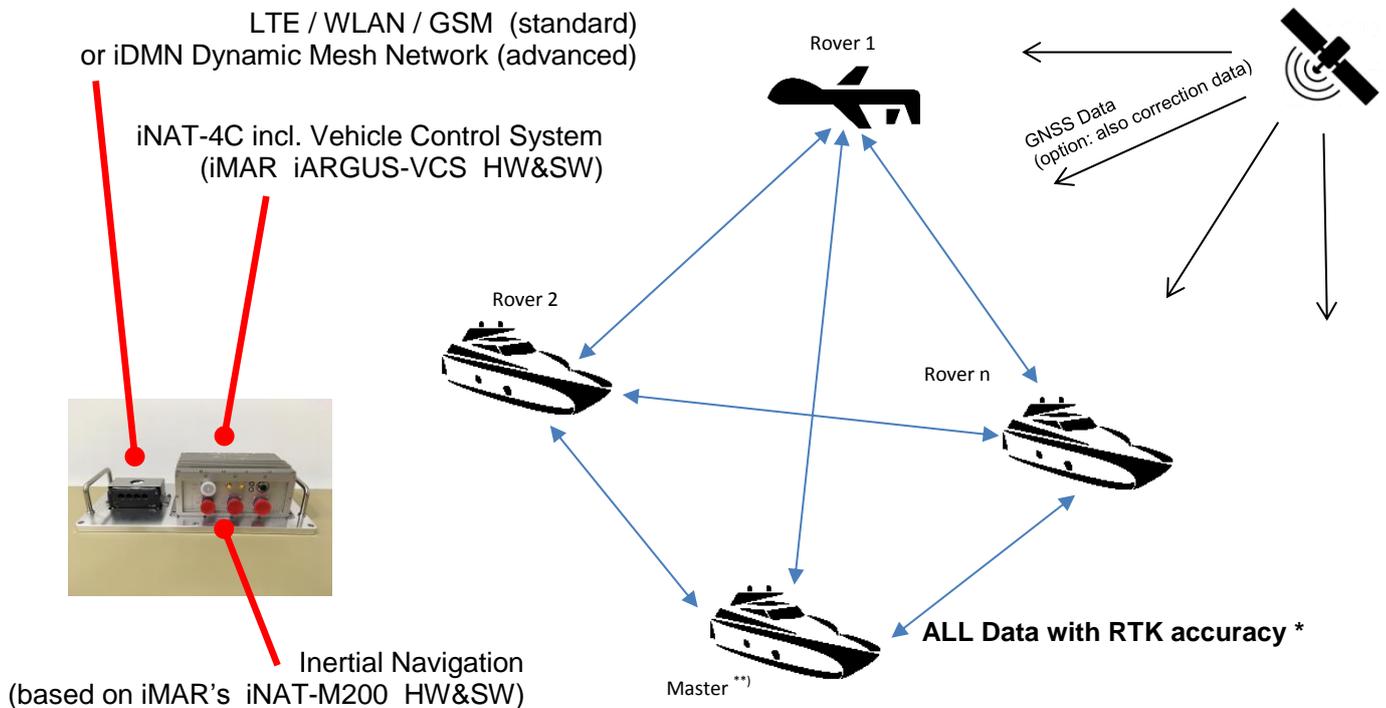
Inter-System Communication Capability and Architecture:

- Each of the four μ Controllers has a direct dedicated UART link to each other μ Controller.
- Each of the four μ Controllers is connected to the USB hub.
- Each μ Controller is monitored via a dedicated WatchDog line.
- Each μ Controller can access to the IMU and the GNSS engine as well as to the odometer counts.¹
- All μ Controllers are connected via an Ethernet switch to each other and to the outside.
- Safety relevant concepts like "Voter architecture with dissimilar software execution on separate μ Controllers" or "Operation of multiple simultaneous dissimilar MEMS IMUs" can be implemented on the iNAT-4C/SLx architecture.

¹ For IMU and GNSS the configuration interface is exclusive to μ C1. The data sent from IMU and GNSS are available to all μ Controllers.

Examples for Swarm Control Applications:

a) Naval Vessel Control with Airborne Support

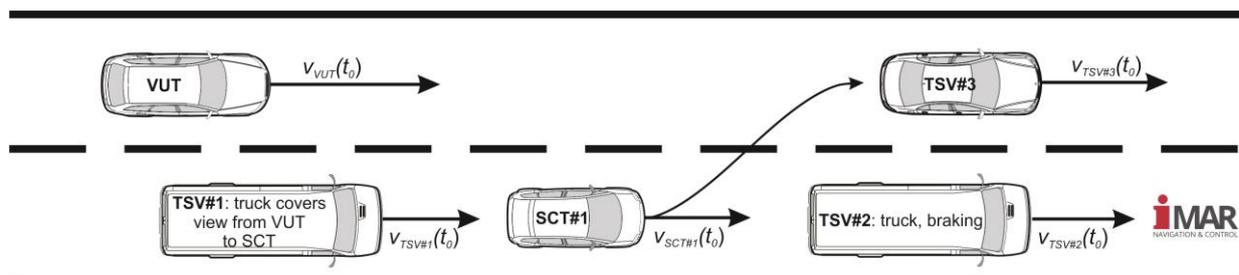


Explanations:

For each vehicle the GUI software **iXCOM-CMD** (under Linux and MS Windows and as SDK available) assists the on-board or remote working operator by providing visualization, communication, trajectory planning, monitoring, health reporting and optionally also remote access capability, on request via a secured communication channel.

- *) Absolute sub-decimeter accuracy with external GNSS Correction Data, but **relative sub-decimeter accuracy also without any availability of GNSS correction data!**
- ***) The "Master" role can be moved via command from one object to another object, e.g. in case of a loss of one object

b) Automotive Testing of partially / highly / fully automated driving (PAD / HAD / FAD) vehicles within a real emulated traffic scenario on a proving ground (see also iSWACO-ARGUS)



Same explanations as given above – see also [YouTube Video about Vehicle Swarm Control](#)

