Infotainment Business Unit
STA8090 SDK release note

1 Introduction

This document shows the changelog of Teseo3 GNSS standard application updated to release 2.3.0. For each version a description of what is changed is reported, together to the high level module that is affected.

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3 Document Management

3.1 Revision History

Rev	Date	Author	Notes
2.0.0a	2014-06-05	F. Boggia	First release
2.0.1a		F. Boggia	Aligned to GNSS rel 8.4.0.1 beta
2.0.2a	2014-10-07	F. Boggia	Updated to SDK 2.0.2a
2.1.1b	2015-04-27	A.Di Girolamo	Updated to SDK 2.1.1b
2.1.2b	2015-05-15	A.Di Girolamo	Updated to SDK 2.1.2b
2.1.3b	2015-07-31	A.Di Girolamo	Updated to SDK 2.1.3b
2.1.4b	2015-10-30	A.Di Girolamo	Updated to SDK 2.1.4b
2.1.5	2015-12-18	F. Boggia	Updated to SDK 2.1.5
2.1.6	2016-04-29	F. Boggia	Updated to SDK 2.1.6
2.2.1	2016-07-29	F. Boggia	Updated to SDK 2.2.1
2.3.0	2016-12-16	F. Boggia	Updated to SDK 2.3.0

Table 1: Revision history

3.2 Acronyms

Keyword	Definition

Table 2. Acronyms

3.3 Reference Documents

None

4 Features included

4.1 GNSS library:

- GPS, Glonass, Galileo, Beidou, SBAS/EGNOS/SBAS tracking capability;
- Single-core, dual-channel acquisition engine;
- Up to 24 channels to track.

4.2 OS20 real time operative system.

4.3 LLD drivers library

Currently available:

- ADC
- CAN
- EFT
- FSMC (SRAM, NOR)
- GPIO
- I2C
- MSP
- MTU
- RTC/RTT
- SDI
- SSP
- UART
- USB
- VIC
- WDG
- Teseo3 specific IP (PRCC)

4.4 Services implemented

- Communication services:

  - UART
  - SSP (SPI and Microwire, master only, protocols)
  - MSP (SPI and I2S, master only, protocols)
  - SDI (FATFS for FAT/FAT32 file system handling (open source, for manual and details see http://elm-chan.org/fsw/ff/00index_e.html).
  - I2C (master only)
  - CAN
  - USB (VCOM)
- Memory services
  - FSMC
  - SQI
- System services
  - GPIO
  - MCU
  - MTU
  - FSW

4.5 Application development tools

SDK 2.3.0 for STA8090 has been built and tested using:

- IDE:
  - Eclipse IDE Neon.1 (for both ARM and GCC targets)
- Compilers:
  - ARM RVCT 5.04 build 5040049;
  - GCC for ARM embedded 4.7 2014q2;
- Debuggers
  - Lauterbach PowerDebug ICD for ARM and Trace32.
  - Segger J-link probe and Ozone debugger.

5 Changelog

5.1 Version: 2.3.0

Tagged: 2016-12-16

GNSS Library

- Improved satellite tracking sensitivity.
- Introduced RTC calibration to improve time accuracy at startup in hot start conditions.
- Removed RTC counter initialization to default time or to last saved time in case the RTC time is lost. The RTC counter is written only when the time is updated and accurate.
- Improved LMS first fix accuracy in cold start conditions
- Removed speed limitation at 128m/s. The speed is now evaluated up to 600m/s.

DR Library (if DR plugin is used)

- Introduced sensors sampling rate configurability. The user can select the sampling rate for the on board sensors
- Introduced the real time sensors data reporting over NMEA. The sensor's samples are sent over NMEA as soon as they have been captured. This feature can be enabled using firmware configuration.
- Added new DR calibration state parameter in $PSTMDRCAL message
- Restored raw sensor data NMEA messages for 3DGyro and 3DAccelerometer. It needs to be enabled in the firmware configuration
- Introduced the DR status saving during the system suspend sequence. If a controlled power down sequence is implemented by the host micro (the system is suspended by command before the power supply is removed), the DR status is saved by the command execution and so the DR status auto-saving feature must be disabled to avoid extra data saving in the backup memory. The DR status auto-saving feature can be disabled in the DRAW firmware configuration
- Increased the backup space reserved for the DR status saving. When DR status auto-saving feature is enabled, the increased memory space will reduce the number of required flash erases
- Improved gyro sensitivity calibration algorithm
- Improved odometer scale calibration algorithm for speed-based operating modes
- Fixed a bug on speed reporting when fix rate > 1 Hz
- GNSS filtering parameters tuneable by configuration (only for advanced users)

Drivers

- Added support for ISSI IS25LQ SQI memory
- Implemented the flash memory (SQI) status register restoring in case of corruptions detected at system power ON. Such feature implements the restoring of default status register bits and applies the flash write protection configuration which is configured in the factory setting. NOTE: configuration of flash write protection parameters (CDB-ID 249 and CDB-ID 250) is no more supported via NMEA commands. Only factory setting, which is configured before firmware flashing (e.g. using fwconfig62 tool), can be used to change the flash write protection configuration.

Application

- Introduced new NMEA proprietary message ($PSTMFEDATA) to report the current value of the RF front end registers including the Automatic Gain Control (AGC) for both RF paths (GPS+GALILEO, GLONASS or BEIDOU)
- Updated NMEA GNS message extending the mode indicator field to GALILEO and BEIDOU constellations
- Introduced shutdown triggering via GPIO to stop the firmware execution from the host micro. It is intended to be as a critical shutdown trigger event that stops immediately the CPU processing without performing the GNSS suspend sequence. It cannot be used as normal shutdown. The feature needs to be enabled and configured to select the pin to be used.
- Added external RTC oscillator support. This feature needs to be enabled in the firmware configuration. When enabled, the internal RTC oscillator in not used and the RTC clock must be provided by an external oscillator on the xtal_in pin.
- Fixed command interface stuck condition if $PSTMGPSRESTART command was sent before than $PSTMGPSSUSPEND.
- Low power modes (GPS only): Periodic, Active Periodic, fix on demand (= always hot start) fully qualified.
- Updated FreeRTOS version to v9.0.0.
- Optimized CPU usage.
- Reworked projects structure. Projects building is now available as makefiles, they can be built as targets inside Eclipse, and there is no need to use a specific Eclipse version anymore.
- Added support for Segger Ozone debugger. Segger plugin for Teseo products has been discontinued.

Notes: This firmware should be considered as BETA version for GALILEO constellation.

The adaptive low power management is not supported for Beidou constellation

6 Axis MEMS Sensors (LSMDS3 and ASM330) are supported by firmware configuration but they have been not yet fully qualified in terms of DR performances.

The flash write protection feature is ENABLED by default. It is configured to protect the code area for the internal STA8089/STA8090 SQI memory. If the firmware is used with external SQI memories, make sure to apply the correct configuration in accordance with the SQI

memory in use (please refer to the flash protection application note for details about configurations for supported memories). Before flashing the firmware in the product, make sure to have the right tool versions which are able to support firmware upgrade on protected memories. To have a full operative flash protection capability also the boot code must be updated on the HW. NOTE: usage of "_UPG.bin" image doesn't update the boot code. Flash protection feature is supported starting from boot code v2.0.
Configuration of flash write protection parameters (CDB-ID 249 and CDB-ID 250) is no more supported via NMEA commands. Only factory setting, which is configured before firmware flashing (e.g. using fwconfig62 tool), can be used to change the flash write protection configuration.

5.2 Version: 2.2.1

Tagged: 2016-07-29

GNSS Library

- Improved usage of BEIDOU GEO satellites in the position solution
- Fixed usage of BEIDOU differential corrections when SBAS feature is disabled
- BEIDOU almanac downloading improvements
- Improved first fix position accuracy in cold start conditions
- Optimized gnss_get_sat_visible() API
- Introduced multipath mitigation at tracking channel level.
- Improved the EHPE algorithm to provide a better estimation of the horizontal position error
- Fixed error ellipse evaluation which was returning not expected zero values.
- Introduced periodic low power modes (disabled by default in the software configuration). This feature must be considered as BETA version.

DR Library (if DR plugin is used)

- Extended the DR speed update during position extrapolation with sensor data
- Fixed CAN initialization failure when gyro initialization was failing
- Fixed CAN gyro data decoding
- Added MEMS gyro + CAN DWS operating mode
- Improved estimation of device installation angle
- Extended support for LSM6DSM sensor
- Improved slope detection algorithm using gyro and accelerometer sensors

- Implemented light sensor calibration (output position is affected by sensor data even if the full calibration is not yet achieved). This feature is disabled by default and it can be enabled using FW configuratio

Services

- Improved I2C initialization to reset pending communications after reset.
- Fixed double data creation in CAN service.
- Fixed NOR reset procedure when erase was suspended before a reset.
- Added frequency switching (FSW) service.
- Fixed USB VCOM when used in FreeRTOS environment.

Drivers

- Added support to cut BC and BD for LLD_PRCC_GetHWBootStatus.
- Reworked LLD_PRCC_GetRingOscFreq to avoid deadlock if Ring if off.

Application

- Low power periodic mode
- Fixed NMEA $PSTMFORCESTANDBY command
- Fixed NMEA FW Upgrade command which was not working properly on latest silicon versions
- Disabled internal pull-up on ADC inputs to ensure correct input value reading
- Reduced debug messages during the system startup phase
- Low Voltage Detector (LVD) management to stop CPU processing in case of voltage drops (safe shutdowns to prevent flash write accesses when the voltage is outside the memory specification).
- Reworked Eclipse projects structure. Targets divided in specific projects

Notes: This firmware should be considered as BETA version for GALILEO constellation.

The acquisition stage is never turned OFF if GALILEO is used

The adaptive low power management is not supported for Beidou constellation

6 Axis MEMS Sensors (LSMDS3 and ASM330) are supported by firmware configuration but they have been not yet fully qualified in terms of DR performances.

The flash write protection feature is ENABLED by default. It is configured to protect the code area for the internal STA8089/STA8090 SQI memory. If the firmware is used with external SQI memories, make sure to apply the correct configuration in accordance with the SQI memory in use (please refer to the flash protection application note for details about configurations for supported memories). Before flashing the firmware in the product, make

sure to have the right tool versions which are able to support firmware upgrade on protected memories. To have a full operative flash protection capability also the boot code must be updated on the HW. NOTE: usage of "_UPG.bin" image doesn't update the boot code. Flash protection feature is supported starting from boot code v2.0

5.3 Version: 2.1.6

Tagged: 2016-04-15

GNSS Library

- Added auto-dynamic mode setting in the satellite tracking engine.
- Improved multipath rejection in the satellite tracking stage
- Improved Beidou satellites acquisition
- Improved Beidou satellites tracking (fixed long term satellite tracking issue)
- Improved position accuracy when Beidou constellation is enabled
- Improved integrity verification for Beidou almanacs and ephemeris
- Added multi-constellation time integrity check and recovery
- Improved Glonass timemark management in reacquisition phase.
- Added Weighted Least Square (WLS) algorithm to improve the LMS position fix accuracy
- Added position filter configuration to allow different settings according to the application requirements.

DR Library (if DR plugin is used)

- Sensor data integrity improvements
- Sensor calibration improvements
- Added IMU configuration
- Added pressure sensor sampling
- Added dual NMEA port capability for DR messages
- Added DR messages enabling/disabling in the NMEA message list mask.
- Changed default configuration
- Fixed DR fix status wrongly reported also on GSA NMEA message

Services

- Added new API to SSP service to permit more configurability of SSP port.

- Added support of status interrupts in CAN service.

LLD

- Added support for MX25R3235F memory
- Fixed software hang condition when RTC crystal is not present

Application

- Enabled Flash write protections by default (the code area is configured to be write protected)
- Changed default constellation setting from GPS+Beidou to GPS+Glonass
- Added configuration of decimal digits for speed and course values in the NMEA messages
- Fixed KNOTS to m/s conversion in the NMEA module
- Fixed wrong position reporting when datum is selected
- Added antenna sensing functionality using the ADC
- Fixed antenna sensing management for TCXO frequency different than 26MHz
- Added not filtered position (LMS position) on $PSTMPVRAW NMEA message
- Disabled debug messages by default

Notes: This firmware should be considered as BETA version for GALILEO constellation.

The acquisition stage is never turned OFF if GALILEO is used

The adaptive low power management is not supported for Beidou constellation

6 Axis MEMS Sensors (LSMDS3 and ASM330) are supported by firmware configuration but they have been not yet fully qualified in terms of DR performances.

The flash write protection feature is ENABLED by default. It is configured to protect the code area for the internal STA8089/STA8090 SQI memory. If the firmware is used with external SQI memories, make sure to apply the correct configuration in accordance with the SQI memory in use (please refer to the flash protection application note for details about configurations for supported memories). Before flashing the firmware in the product, make sure to have the right tool versions which are able to support firmware upgrade on protected memories. To have a full operative flash protection capability also the boot code must be updated on the HW. NOTE: usage of "_UPG.bin" image doesn't update the boot code. Flash protection feature is supported starting from boot code v2.0

5.4 Version: 2.1.5

Tagged: 2015-12-18

GNSS Library

- Improved Beidou host start sensitivity
- Improved Beidou acquisition management
- Improved Beidou satellites reacquisition
- Implemented time transfer from GPS to Beidou constellation
- Extended Galileo satellites PRN range
- Notch filter thresholds tuning

DR Library (if DR plugin is used)

- Added Map Matching Feedback (MMFB) weighting. The MMFB weight can be provided to the DR library through the NMEA command.

Services

- Added new API to I2C service to use a custom speed mode.
- Added new API to MSP service to create a com with more parameters.

LLD

- Fixed registers memory map for FSMC.
- Added high speed mode support to I2C.

Application

- Reviewed debuggers scripts to proper handle specific memory (NOR/RAM) parts.
- Added DR targets to FreeRTOS project.

Notes: This firmware should be considered as BETA version for GALILEO constellation.

The acquisition stage is never turned OFF if GALILEO is used

The adaptive low power management is not supported for Beidou constellation

6 Axis MEMS Sensors (LSMDS3 and ASM330) are supported by firmware configuration but they have been not yet fully qualified in terms of DR performances.

5.5 Version: 2.1.4b

Tagged: 2015-10-30

GNSS Library

- Improved satellite prediction module to increase satellite reacquisition capabilities
- Optimized acquisition to tracking stage hand-over for Galileo constellation

- Improved reacquisition of Beidou GEO satellites
- Improved cross-correlation and RFI detection for Beidou GEO satellites
- Introduced a satellites weighted LMS algorithm for velocity evaluation
- Reduced time to download UTC correction data for PPS synchronization
- Improved first fix position accuracy for Beidou constellation in Cold start mode
- Improved first fix position accuracy for Beidou constellation in Warm start mode
- Improved Beidou satellites tracking performances
- Improved Beidou MEO satellites acquisition sensitivity in cold and hot start conditions
- Introduced GNSS library support to report the satellites which have been excluded in the positioning stage by the RAIM or FDE algorithms
- Improved Beidou GEO satellites acquisition
- Introduced the RTC test at GNSS lib startup to disable the RTC HW usage in case the HW is broken (e.g. not working 32kHz crystal)
- Improved PPS long term time accuracy stability
- Fixed leap second update issue. The leap second update event is now performed on time at midnight when the leap second updated event is scheduled
- Improved accuracy of Beidou satellites predictions

DR Library (if DR plugin is used)

- Free mount 3D DR (See notes below).
- Fixed wrong default value for CPU speed in the DR firmware
- Improved GNSS quality acceptance logic in DR algorithm to avoid wrong DR position jumps to not accurate GNSS position
- Improved DR position covariance calculation
- Fixed wrong NO FIX status occurrence in high fix rate configuration (>1Hz)
- Turned off the built-in temperature compensation algorithm supported by the ASM330LHX sensor. The temperature compensation is supported directly by the DR algorithm.
- Improved slope estimation accuracy
- Added support for high sampling rates of MEMS sensors (up to 50Hz)
- Fixed datum application issue when Dead Reckoning is enabled

Application

- Added DTM nmea message to the supported NMEA message list
- Fixed the SQI driver issue which was causing firmware startup failures on Micron SQI memory.
- Added support for 55MHz TCXO (NOTE: 55MHz TCXO support is designed for applications where the GNSS frequency clock scheme can inject RF interferers into the FM radio band. The correct configuration for FM radio interferer mitigation includes also the CPU speed to be set at 55MHz)
- Added $PSTMALM, $PSTMEPHEM, $PSTMIONO and $PSTMBIAS into the standard NMEA message list configurability
- Added GBS NMEA message
- Improved robustness of NMEA command parsing. A hole in the parsing logic was causing that partial command strings were recognized as valid commands.
- Fixed the GPIO Hi/Low status configuration. The SW configuration facility was not properly handling the GPIO operating modes to set the desired hi or low level value on the GPIO. The issue was present only if the GPIO status configuration facility was used (configuration parameters CDB-ID 206-209) was used.
- Fixed computation of TTFF value reported in the PSTMTTFF message
- Added configuration to enable/disable the deep standby capability (also called stop mode)
- Fixed CRC evaluation in the PSTMTIM nmea message
- Extended to 512kB size the SQI memory area that can be accessed (read, write, erase) using the NMEA command interface.
- Fixed I2C clock speed configuration in normal and fast modes
- updated FreeRTOs version to v8.2.1
- Set max CPU speed as default for all FreeRTOS and GCC targets
- Improved watchdog low level driver
- Peripherals initialization (e.g. I2C and SPI) have been moved after the final system clock configuration (see gnssapp_gnss_service_start() in the gnssapp.c module)
- Fixed wrong read/write access to backup registers of PRCC peripheral (changes have been applied in the LLD library to solve the LVD enabling issue and the watch dog status reporting issue).

Notes: This firmware should be considered as BETA version for GALILEO constellation.

The acquisition stage is never turned OFF if GALILEO is used

The adaptive low power management is not supported for Beidou constellation

6 Axis MEMS Sensors (LSMDS3 and ASM330) are supported by firmware configuration but they have been not yet fully qualified in terms of DR performances.

5.6 Version: 2.1.3b

Tagged: 2015-07-30

GNSS Library

- Overall GNSS software CPU usage optimization
- Improved overall stability for both GPS and GLONASS constellations
- Improved Beidou tracking performances against cross-correlation and auto-correlation issues
- Improved subframe buffering for Beidou navigation message decoding
- Fixed Beidout UTC delta time decoding
- Improved Galileo satellite tracking sensitivity

STAGPS Library

- Reduced NVM size used by STAGPS data storage.

Application

- Fixed string decoding on $PSTMSETPAR command for CDB-ID 500 when checksum is not sent by the host processor.
- Added NMEA command to put the GNSS module in standby mode.
- Optimized the NMEA output processing
- Fixed wrong reporting of Beidou satellites into $GAGSV NMEA message
- Fixed USB detect functionality
- Fixed missing NMEA messages. The NMEA message flow is now continuous with no time jumps due to the missing set of sentences.
- Default hard coded UTC delta time moved to 17s.
- Improved the NVM driver flash erase time
- Fixed antenna sensing enable issue
- Restored the RTCM functionality
- Fixed PZ90.11 datum evaluation

Notes: This firmware should be considered as BETA version for GALILEO constellation.

BEIDOU tracking sensitivity degradation caused by auto-correlation and cross-correlations filters.

PPS long term stability and accuracy are not guaranteed

The acquisition stage is never turned OFF if GALILEO is used

The adaptive low power management is not supported for Beidou constellation

5.7 Version: 2.1.2b

Tagged: 2015-05-15

GNSS library:

- Fixed position and velocity covariance estimation for DR.

Services

- Fixed SD Card initialization.

Application:

- Fixed I2C and SPI initialization for DR sensor reading

Notes: This is a beta version intended for evaluation.

CPU usage is not yet optimal

10Hz GNSS fix rate is not properly supported (NMEA message lost are present)

RTCM doesn't work properly

PPS long term stability and accuracy are not guaranteed

The acquisition stage is never turned OFF if GALILEO is used

The adaptive low power management is not working if Beidou is enabled

The duty-cycle mode is not supported if Beidou is used

5.8 Version: 2.1.1b

Tagged: 2015-04-27

GNSS library:

- Improved overall positioning accuracy
- Improved acquisition engine performance at high CN0
- Improved Beidou HOT start performance

STAGPS library:

- RAM memory space optimization
- Extended GPS autonomous predictions to 6 days
- Fixed occasional positioning and time to first fix outliers

LLD

- Added USB LLD
- Fixed I2C peripheral configuration

OS20

- Changed APIs using generic OS prefix “gpOS”.

Services

- Added USB service
- Added to SSP service the possibility to manage SPI devices with different configurations.

Application:

- Added ADC sampling over NMEA messages
- Fixed 30ms time error in the NMEA message timestamps
- Fixed erase-resume issue at start up (SQI targets)
- Added support for 48Mhz TCXO

Notes: *This is a beta version intended for evaluation.*

CPU usage is not yet optimal

10Hz GNSS fix rate is not properly supported (NMEA message lost are present)

RTCM doesn’t work properly

PPS long term stability and accuracy are not guaranteed

The acquisition stage is never turned OFF if GALILEO is used

The adaptive low power management is not working if Beidou is enabled

The duty-cycle mode is not supported if Beidou is used

5.9 Version: 2.0.2a

Tagged: 2014-10-07

GNSS library:

- Aligned to GNSS library 8.4.1.3 beta.
- Added antenna sensing feature (using RF).

LLD

- Added ADC LLD

OS20

- Reduced interrupt and supervisor calls latencies.

Services

- Improved I2C service to avoid missing communication with some peripherals.

Application:

- Added support for FreeRTOS to GNSS application
- Reduction of 80% of MISRA compliancy violations.

Note: This is an alpha version intended for evaluation.

5.10 Version: 2.0.1a

Tagged: 2014-07-28

GNSS library:

- Aligned to GNSS library 8.4.0.1 beta.

Note: This is an alpha version intended for evaluation.

5.11 Version: 2.0.0a

Tagged: 2014-02-03

Note: This is an alpha version intended for evaluation.

6 Disclaimer

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