

**Research & Vehicle Technology**

**“Infotainment Systems Product Development”**

**Feature – Location Service**

**APIM Infotainment Subsystem Part Specific Specification (SPSS)**

Version 1.10

**UNCONTROLLED COPY IF PRINTED**

**Version Date: July 10, 2019**

**FORD CONFIDENTIALF**

**Revision History**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Date** | **Version** | **Notes** | | | |
| **May 31, 2013** | **1.0** | **Initial Release** | | |  |
|  | | | | | |
| **October 23, 2013** | **1.1** | **Sorris1: Function & Requirement Updates** | | | |
|  | FAS-LOCATN-GFUN-304495-Configuration Parameters | | | | sorris1: New Function (Gen 3.2) |
|  | FAS-LOCATN-GREQ-304494-Configuration | | | | sorris1: New Requirement |
|  | FAS-LOCATN-GFUN-304498-Diagnostics | | | | sorris1: New Function (Gen 3.2) |
|  | FAS-LOCATN-GREQ-304497-Diagnostics | | | | sorris1: New Requirement |
|  | | | | | |
| **December 2, 2013** | **1.2** | **Sorris1: Interface Updates** | | | |
|  | GpsLatLong\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null removed). |
|  | GpsHeading\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null removed). |
|  | GpsDateTime\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null & Faulty removed). |
|  | GpsSatNumber\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null removed). |
|  | GpsAltitude\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null removed). |
|  | GpsSpeed\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null removed). |
|  | Gps3dEstimatedError\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null removed). |
|  | GpsDilutionOfPrecision\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null removed). |
|  | GpsCompassDirection\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Faulty removed). |
|  | GpsSensorCalibration\_St | | | | sorris1: Encoding updated to match up with pending CAN database (None change to Null). |
|  | GpsSatInfo\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null changed to Inactive). |
|  | VehicleDynamics\_St | | | | sorris1: Encoding updated to match up with pending CAN database (Null removed). |
|  | GpsDataAvailable | | | | sorris1: New Method Description to align with pending CAN database release. |
|  | | | | | |
| **March 12, 2014** | **1.3** | **SPSS Updates** | | | |
|  | LOCATN-CLD-REQ-022480/B-Location Service(TcSE ROIN-294362) | | | | sorris1: Changed labeling of GPS to GNSS or location engine to clarify meanings and specified WGS84 coordinates instead of the generic GPS |
|  | MD-REQ-022483/B-GPSBFault\_St(TcSE ROIN-221027-1) | | | | Changed labeling of GPS to GNSS or location engine to clarify meanings and specified WGS84 coordinates instead of the generic GPS |
|  | MD-REQ-022484/B-GPSDimension\_St(TcSE ROIN-221028-1) | | | | sorris1: Changed labeling of GPS to GNSS or location engine to clarify meanings and specified WGS84 coordinates instead of the generic GPS |
|  | MD-REQ-022486/B-GPSLocation\_St(TcSE ROIN-221031-1) | | | | sorris1: Changed labeling of GPS to GNSS or location engine to clarify meanings and specified WGS84 coordinates instead of the generic GPS |
|  | MD-REQ-022487/B-GPSSpeed\_St(TcSE ROIN-221118-1) | | | | sorris1: Changed labeling of GPS to GNSS or location engine to clarify meanings and specified WGS84 coordinates instead of the generic GPS |
|  | MD-REQ-022489/B-GPSDilutionOfPrecision\_St(TcSE ROIN-294409) | | | | sorris1: Changed labeling of GPS to GNSS or location engine to clarify meanings and specified WGS84 coordinates instead of the generic GPS |
|  | MD-REQ-022490/B-GPSSatNumInView\_St(TcSE ROIN-294417) | | | | sorris1: Changed labeling of GPS to GNSS or location engine to clarify meanings and specified WGS84 coordinates instead of the generic GPS |
|  | LOCATN-IIR-REQ-022491/B-LocationService\_Tx(TcSE ROIN-297354) | | | | sorris1: The LocationService\_Tx interface requirement has been redesigned to be a protocol. All previous method descriptions (GpsLatLong\_St, GpsHeading\_St, GpsFault\_St, GpsDateTime\_St, GpsSatNumber\_St, etc.) have been removed and replaced by the Global Navigation Satellite System (GNSS) protocol and associated message type descriptions. |
|  | MD-REQ-051835/A-MetaDataTime | | | | sorris1: New method description for GNSS protocol. |
|  | MD-REQ-051836/A-Location1 | | | | sorris1: New method description for GNSS protocol. |
|  | MD-REQ-051837/A-Location2 | | | | sorris1: New method description for GNSS protocol. |
|  | MD-REQ-051838/A-LocationQuality | | | | sorris1: New method description for GNSS protocol. |
|  | MD-REQ-051839/A-SensorQuality | | | | sorris1: New method description for GNSS protocol. |
|  | MD-REQ-051840/A-SkyView | | | | sorris1: New method description for GNSS protocol. |
|  | 112568/A-Data Interpretation Example | | | |  |
|  | LOCATN-REQ-022427/B-GPS Receiver Hardware Requirements(TcSE ROIN-294201) | | | | sorris1: Included Compass/Bediou and Galileo as required when regulated |
|  | LOCATN-UC-REQ-022432/B-Driving on Road – Clear Sky(TcSE ROIN-292579) | | | | sorris1: Clarified WIFI usage as if licensed |
|  | LOCATN-UC-REQ-022436/B-WIFI Fault(TcSE ROIN-292583) | | | | sorris1: Clarified WIFI usage as if licensed |
|  | LOCATN-UC-REQ-022437/B-WIFI Positioning Data Not Available(TcSE ROIN-292584) | | | | sorris1: Clarified WIFI usage as if licensed |
|  | LOCATN-UC-REQ-022438/B-Driving on Road – Urban Canyon(TcSE ROIN-292585) | | | | sorris1: Clarified WIFI usage as if licensed |
|  | LOCATN-UC-REQ-022441/B-Driving on Road – Multi-leveled Roads(TcSE ROIN-292588) | | | | sorris1: Clarified WIFI usage as if licensed |
|  | LOCATN-UC-REQ-022442/B-Driving Off Road – Entering Parking Lot(TcSE ROIN-292589) | | | | sorris1: Clarified WIFI usage as if licensed |
|  | LOCATN-UC-REQ-022443/B-Driving off Road – Exiting Underground Parking Lot(TcSE ROIN-292590) | | | | sorris1: Clarified WIFI usage as if licensed |
|  | LOCATN-REQ-022450/B-Playback(TcSE ROIN-294174) | | | | sorris1: Added text to clarifiy playback functionality via USB stick. |
|  | LOCATN-REQ-022451/B-Shunting(TcSE ROIN-294175) | | | | sorris1: Clarified WIFI usage as if licensed |
|  | LOCATN-REQ-022459/B-Wheel Tick Failure(TcSE ROIN-294197) | | | | sorris1: Updated requirement for clarity. |
|  | LOCATN-REQ-022464/B-WIFI(TcSE ROIN-294203) | | | | sorris1: Clarified WIFI usage as if licensed |
|  | LOCATN-REQ-022476/B-Configuration(TcSE ROIN-304494) | | | | sorris1: Added usage of driveline type to determine which wheel to use as primary for dead reckoning |
|  | LOCATN-REQ-022478/B-Diagnostics(TcSE ROIN-304497) | | | | sorris1: Accepted changes from last release. |
|  | | | | | |
| July 18, 2014 | 1.4 | **SPSS Updates** | | | |
|  | MD-REQ-022482/B-GPSActualVsInferredPosition\_St (TcSE ROIN-221139-1) | | | | Added clarification as to what these signals actually mean and how to use them |
|  | MD-REQ-022484/C-GPSDimension\_St (TcSE ROIN-221028-1) | | | | Accepted Changes from previous release. No content changed. |
|  | MD-REQ-022487/C-GPSSpeed\_St (TcSE ROIN-221118-1) | | | | Clarification as to which velocity to use in this field |
|  | MD-REQ-051839/B-SensorQuality | | | | Added not measured states for noise detection |
|  | STR-069713/B-Use Cases (TcSE ROIN-292764) | | | | Added use cases |
|  | LOCATN-UC-REQ-022434/B-Sensor Fault – Gyro / Wheel Tick Issue (TcSE ROIN-292581) | | | | Corrected post conditions to point to the requirements dealing with this |
|  | LOCATN-REQ-022450/C-Playback (TcSE ROIN-294174) | | | | Added initializing playback engine with configuration from the playback file instead of using ECU configs |
|  | LOCATN-REQ-022451/C-Shunting (TcSE ROIN-294175) | | | | Clarified shunting of velocity during playback |
|  | LOCATN-REQ-022457/B-Wheel Tick Calibration (TcSE ROIN-294195) | | | | Added ability to supersede the requirements based on limitations of a chosen location solution |
|  | LOCATN-REQ-022460/B-3D Gyro/Accelerometer Initialization (TcSE ROIN-294198) | | | | added requirements for clean data for bias determination at key up |
|  | LOCATN-REQ-022462/B-3D Gyro/Accelerometer Failure (TcSE ROIN-294200) | | | | corrected from 4 wheel to differential wheel tick mode |
|  | LOCATN-REQ-022468/B-Navigation Map Matched Position Feedback (TcSE ROIN-294189) | | | | clarified elements of the feedback methodology to match implementation |
|  | | | | | |
| **August 13, 2014** | **1.5** | **SPSS Updates** | | | |
|  | STR-069740/B-Location Service Interface (TcSE ROIN-294368) | | | | rpaquet2 - added internal interface. |
|  | MD-REQ-051835/B-MetaDataTime | | | | rpaquet2 - Updated bit field Day and fault bit mask. |
|  | MD-REQ-051837/B-Location2 | | | | rpaquet2 - Added Fix Type parameter per Dave Herman direction. |
|  | 112568/B-Data Interpretation Example | | | | rpaquet2 - Update Byte 7 example hex for fault bit. |
|  | LOCATN-UC-REQ-022433/B-GPS Fault – Antenna Issue (TcSE ROIN-292580) | | | | rpaquet2 - update text in scenario to state HMI dependency. |
|  | LOCATN-REQ-022463/B-GPS Receiver Failure (TcSE ROIN-294202) | | | | rpaquet2 - Rev to B accidently no change to requirement. |
|  | | | | | |
| **September 3, 2014** | **1.6** | **rpaquet1: Added use cases and method description** | | | |
|  | MD-REQ-051840/B-SkyView | | | | rpaquet2 - per direction from Dave H. added text talking about making sky view configurable |
|  | LOCATN-UC-REQ-094992/A-Startup - Boot with Vehicle in Motion | | | | rpaquet2 - added use case for Dave H. |
|  | LOCATN-UC-REQ-094994/A-Startup – System Crashes / Watchdog Forces Reboot | | | | rpaquet2 - added use case for Dave H. |
|  | | | | | |
| **March 2, 2015** | **1.7** |  | | | |
|  | STR-069740/C-Location Service Interface (TcSE ROIN-294368) | | | | rpaquet2 - Added Location Service\_Ephemeris for Dave Herman |
|  | LOCATN-IIR-REQ-022491/C-LocationService\_Tx (TcSE ROIN-297354) | | | | rpaquet2 - Added Location3 requirement for China shifting and Location 4 and 5. |
|  | MD-REQ-051840/B-SkyView | | | | rpaquet2 - per direction from Dave H. added text talking about making sky view configurable |
|  | MD-REQ-132696/A-DownloadedEphemeris | | | | rpaquet2 - per direction from Dave H. added text for Downloaded Ephemeris |
|  | MD-REQ-132697/A-CalculatedEphemeris | | | | rpaquet2 - per direction from Dave H. added text for Calculated Ephemeris |
|  | STR-069713/C-Use Cases (TcSE ROIN-292764) | | | | Added use cases |
|  | LOCATN-UC-REQ-094992/A-Startup - Boot with Vehicle in Motion | | | | rpaquet2 - added use case for Dave H. |
|  | LOCATN-UC-REQ-094994/A-Startup – System Crashes / Watchdog Forces Reboot | | | | rpaquet2 - added use case for Dave H. |
|  | LOCATN-REQ-022459/C-Wheel Tick Failure (TcSE ROIN-294197) | | | | rpaquet2 - Added text to requirement per Dave Herman. |
|  | LOCATN-REQ-022476/C-Configuration (TcSE ROIN-304494) | | | | rpaquet2 - Added new row to table for wheel tick time separation per Dave Herman. |
|  | LOCATN-REQ-022478/C-Diagnostics (TcSE ROIN-304497) | | | | rpaquet2 - Updated text to add 1 second of data. |
|  | | | | | |
| **June 16, 2015** | **1.8** |  | | | |
|  | LOCATN-REQ-022431/B-Position Accuracy (TcSE ROIN-294206) | | | | kturne20 - Added positioning accuracy values to support overall system performance for location. |
|  | | | | | |
| **July 19, 2018** | **1.9** | |  | | |
|  | LOCATN-CLD-REQ-022480/C-Location Service (TcSE ROIN-294362) | | | | rpaquet2 - revised per feature owner |
|  | LOCATN-IIR-REQ-022481/B-LocationServiceLegacy\_Tx (TcSE ROIN-294359) | | | | rpaquet2 - revised per feature owner |
|  | LOCATN-IIR-REQ-022491/D-LocationService\_Tx (TcSE ROIN-297354)+ | | | | rpaquet2 - Added" All items in this subsection apply to an ECU that is a Localization Master." |
|  | LOCATN-IIR-REQ-022491/E-LocationService\_Tx (TcSE ROIN-297354) | | | | rpaquet2 - Added the ArbId for when message is sent from the TCU and clarified the ArbID note for when the APIM sends the data. |
|  | MD-REQ-051835/C-MetaDataTime | | | | rpaquet2 - Update the Description for Fault Bit Mask |
|  | LOCATN-IIR-REQ-091628/B-Internal | | | | rpaquet2 - Updated per feature owner request |
|  | LOCATN-REQ-022426/B-Architecture (TcSE ROIN-294207) | | | | rpaquet2- Updated Text |
|  | LOCATN-REQ-022429/B-GPS Fixes (TcSE ROIN-296600) | | | | rpaquet2 - Updated per feature owner |
|  | STR-069712/B-Requirements (TcSE ROIN-294224) | | | | rpaquet2 - Added Reference Coordinate System requirement |
|  | LOCATN-REQ-022431/C-Position Accuracy (TcSE ROIN-294206) | | | | rpaquet2- updated per feature owner |
|  | LOCATN-REQ-283027/A-Reference Coordinate System | | | | rpaquet2- updated per feature owner |
|  | LOCATN-UC-REQ-022432/C-Driving on Road – Clear Sky (TcSE ROIN-292579) | | | | rpaquet2 - Update use case per feature owner |
|  | LOCATN-UC-REQ-022433/C-GPS Fault – Antenna Issue (TcSE ROIN-292580) | | | | rpaquet2 - Updated use case per feature owner |
|  | LOCATN-UC-REQ-022434/C-Sensor Fault – Gyro / Wheel Tick Issue (TcSE ROIN-292581) | | | | rpaquet2 - Updated use case per feature owner |
|  | LOCATN-UC-REQ-022435/B-Sensor Reset – Wheel Tick Issue (TcSE ROIN-292582) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-022438/C-Driving on Road – Urban Canyon (TcSE ROIN-292585) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-022439/B-Map Data Not Available (TcSE ROIN-292586) | | | | rpaquet2 - Update per featue owner |
|  | LOCATN-UC-REQ-022440/B-Navigation Application is Not Running (If Equipped) (TcSE ROIN-292587) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-022441/C-Driving on Road – Multi-leveled Roads (TcSE ROIN-292588) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-022442/C-Driving Off Road – Entering Parking Lot (TcSE ROIN-292589) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-022443/C-Driving off Road – Exiting Underground Parking Lot (TcSE ROIN-292590) | | | | rpaquet2 - Update per feature owner |
|  | LOCATN-UC-REQ-091631/B-CAN Bus Wakeup (Generic) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-091639/B-CAN Bus Wakeup - Tracking Location Request | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-091657/B-Prior Location not Stored | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-091658/B-Startup – Customer sitting in vehicle | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-091659/B-Startup – Customer sitting in vehicle rolling start | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-091701/B-Battery Removal | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-094992/B-Startup - Boot with Vehicle in Motion | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-094994/B-Startup – System Crashes / Watchdog Forces Reboot | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-022446/B-Data Logging (TcSE ROIN-292591) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-022447/B-Data Logging File System Full (TcSE ROIN-292592) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-022448/B-Data Logging File System Not Writeable (TcSE ROIN-292593) | | | | rpaquet2 – Updated per feature owner |
|  | LOCATN-REQ-022450/D-Playback (TcSE ROIN-294174) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-REQ-022451/D-Shunting (TcSE ROIN-294175) | | | | rpaquet2 - Updated per feature owner |
|  | LOCATN-UC-REQ-022452/B-Navigation Data Playback (TcSE ROIN-292594) | | | | rpaquet2- Updated per feature owner |
|  | LOCATN-UC-REQ-022453/B-Data Playback File Corrupt (TcSE ROIN-292595) | | | | rpaquet2 - Updated per feature owner |
|  | STR-069718/B-Requirements (TcSE ROIN-294222) | | | | rpaquet2 - Added 289991 |
|  | LOCATN-REQ-022459/D-Wheel Tick Failure (TcSE ROIN-294197) | | | | rpaquet2 - Updated per feature owner |
|  | STR-069722/B-Requirements (TcSE ROIN-304496) | | | | rpaquet2 - Added new requirement for Autoconfiguration |
|  | LOCATN-REQ-318210/A-Auto Configuration for Determining Message Set to Read | | | | rpaquet2 - Added requirement for receving modules to be able to Auto config based on which module is transmitting the Locaiton data |
|  | LOCATN-REQ-022474/C-Performance (TcSE ROIN-294177) | | | | rpaquet2 - updated per feature owner |
|  | LOCATN-REQ-022478/D-Diagnostics (TcSE ROIN-304497) | | | | rpaquet 2- Updated per feature owner |
|  | | | | | |
| **July 10, 2019** | **1.10** | | |  | |
|  | MD-REQ-051838/B-LocationQuality | | | | rpaquet2 - Added Speed Accuracy approximation |
|  | MD-REQ-051838/C-LocationQuality | | | | rpaquet2 - Fixed a format issue in the v1.10 version of spec |

**Table of Contents**

[Revision History 2](#_Toc13658816)

[1 Architectural Design 8](#_Toc13658817)

[1.1 LOCATN-CLD-REQ-022480/C-Location Service (TcSE ROIN-294362) 8](#_Toc13658818)

[1.2 Location Service Interface 8](#_Toc13658819)

[1.2.1 LOCATN-IIR-REQ-022481/B-LocationServiceLegacy\_Tx (TcSE ROIN-294359) 8](#_Toc13658820)

[1.2.2 LOCATN-IIR-REQ-022491/E-LocationService\_Tx (TcSE ROIN-297354) 13](#_Toc13658821)

[1.2.3 LOCATN-IIR-REQ-091628/B-Internal 26](#_Toc13658822)

[1.2.4 LOCATN-IIR-REQ-132695/A-LocationService\_Ephemeris 26](#_Toc13658823)

[2 Functional Definition 27](#_Toc13658824)

[2.1 LOCATN-FUN-REQ-022425/A-Physical Architecture (TcSE ROIN-294216) 27](#_Toc13658825)

[2.1.1 Requirements 27](#_Toc13658826)

[2.2 LOCATN-FUN-REQ-022430/A-Position (TcSE ROIN-292763) 28](#_Toc13658827)

[2.2.1 Requirements 28](#_Toc13658828)

[2.2.2 Use Cases 30](#_Toc13658829)

[2.3 LOCATN-FUN-REQ-022444/A-Data Logging (TcSE ROIN-294214) 38](#_Toc13658830)

[2.3.1 Requirements 38](#_Toc13658831)

[2.3.2 Use Cases 38](#_Toc13658832)

[2.4 LOCATN-FUN-REQ-022449/A-Data Playback (TcSE ROIN-294209) 39](#_Toc13658833)

[2.4.1 Requirements 39](#_Toc13658834)

[2.4.2 Use Cases 40](#_Toc13658835)

[2.5 LOCATN-FUN-REQ-022454/A-Sensor Inputs (TcSE ROIN-294213) 40](#_Toc13658836)

[2.5.1 Requirements 40](#_Toc13658837)

[2.6 LOCATN-FUN-REQ-022465/A-System Inputs (TcSE ROIN-294212) 42](#_Toc13658838)

[2.6.1 Requirements 42](#_Toc13658839)

[2.7 LOCATN-FUN-REQ-022475/A-Configuration Parameters (TcSE ROIN-304495) 42](#_Toc13658840)

[2.7.1 Requirements 42](#_Toc13658841)

[2.8 LOCATN-FUN-REQ-022471/A-Power State (TcSE ROIN-294210) 43](#_Toc13658842)

[2.8.1 Requirements 43](#_Toc13658843)

[2.9 LOCATN-FUN-REQ-022473/A-Performance (TcSE ROIN-294211) 44](#_Toc13658844)

[2.9.1 Requirements 44](#_Toc13658845)

[2.10 LOCATN-FUN-REQ-022477/A-Diagnostics (TcSE ROIN-304498) 44](#_Toc13658846)

[2.10.1 Requirements 44](#_Toc13658847)

[3 Appendix: Reference Documents 47](#_Toc13658848)

# Architectural Design

## LOCATN-CLD-REQ-022480/C-Location Service (TcSE ROIN-294362)

Responsibility:

(Internal) The Location Service shall provide an accurate positioning solution to feed various applications.

(External – if ECU is Localization Master for Vehicle) The Location Service shall transmit GNSS data to the vehicle system interface for use by other vehicle systems.

## Location Service Interface

### LOCATN-IIR-REQ-022481/B-LocationServiceLegacy\_Tx (TcSE ROIN-294359)

All items in this subsection apply to an ECU that is a Localization Master.

These "Legacy" signals are used for backward compatibility as provided by a Localization Master. They shall be maintained until all vehicle systems that utilize them are updated to incorporate the change to the upgraded signals in LOCATN-GIF-297354-LocationService\_Tx.

#### MD-REQ-022482/B-GPSActualVsInferredPosition\_St (TcSE ROIN-221139-1)

Message Type: Status

Status used to indicate if the data in the signal is actual or inferred.

Actual means that sky is used in the current location solution. Inferred is DR only

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Signal to indicate if data is actual or inferred.  Unit:SED  Resolution:1  Offset:0 |
|  | ActualPosition | 0x0 |  |
|  | InferredPosition | 0x1 |  |

#### MD-REQ-022483/B-GPSBFault\_St (TcSE ROIN-221027-1)

Message Type: Status

Status used to indicate a fault of the location engine.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Used to indicate a GPS fault.  Unit:SED  Resolution:1  Offset:0 |
|  | No | 0x0 |  |
|  | Yes | 0x1 |  |

#### MD-REQ-022484/C-GPSDimension\_St (TcSE ROIN-221028-1)

Message Type: Status

Status used to indicate the GNSS Solution Dimension.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Used to indicate GPS Dimension.  Unit:SED  Resolution:1  Offset:0 |
|  | NoFix | 0x0 |  |
|  | TwoDimensional | 0x1 |  |
|  | ThreeDimensional | 0x2 |  |

#### MD-REQ-022485/A-GPSDirection\_St (TcSE ROIN-221029-1)

Message Type : Status

Represents the Direction and Heading.

Status used to indicate which direction the vehicle is heading or facing.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Compass | - | - | Direction of vehicle.  Unit:SED  Resolution:1  Offset:0 |
|  | North | 0x0 |  |
|  | NorthEast | 0x1 |  |
|  | East | 0x2 |  |
|  | SouthEast | 0x3 |  |
|  | South | 0x4 |  |
|  | SouthWest | 0x5 |  |
|  | West | 0x6 |  |
|  | NorthWest | 0x7 |  |
| Heading | - | - | Heading in degrees of current vehicle.  Unit:Degrees  Resolution:0.01  Offset:0 |
|  | degrees | 0x0 to 0x8C9f |  |
|  | Unknown | 0xFFFE |  |
|  | Fault | 0xFFFF |  |

#### MD-REQ-022486/B-GPSLocation\_St (TcSE ROIN-221031-1)

Message Type: Status

Status used to indicate Latitude, Longitude, Hemisphere and Altitude information. As the Legacy messages have no method to account for negative minutes, hemispheres are used to represent this condition. The expectation is that hemispheres are always populated correctly and encoding of a 0 degree, negative minute is accomplished with that. All published locations (Lat / Long) are DR'd Solution (output of location engine in WGS84 coordinates)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Literals** | | **Value** | **Description** |
| LatitudeDegrees | - | - | | Indicates the WGS84 Latitude Degrees information.  Unit:Degrees  Resolution:1  Offset:-89 |
|  | Degrees | 0x0 To 0xB2 | |  |
|  | Unknown | 0xFE | |  |
|  | Invalid | 0xFF | |  |
| LatitudeMinutes | - | - | | Indicates the WGS84 Latitude Minutes information.  Unit:Minutes  Resolution:1  Offset:0 |
|  | Minutes | 0x0 To 0x3B | |  |
|  | Unknown | 0x3E | |  |
|  | Fault | 0x3F | |  |
| LatitudeMinutesDecimal | - | - | | Indicates the WGS84 Latitude Minutes Decimal information.  Unit:Minutes  Resolution:0.0001  Offset:0 |
|  | Minutes | 0x0 To 0x270F | |  |
|  | Unknown | 0x3FFE | |  |
|  | Invalid | 0x3FFF | |  |
| HemisphereLongitudeEastern | - | - | | Indicates the WGS84 Hemisphere Longitude Eastern information.  Unit:SED  Resolution:1  Offset:0 |
|  | Invalid | 0x0 | |  |
|  | Eastern | 0x1 | |  |
|  | Western | 0x2 | |  |
|  | Fault | 0x3 | |  |
| HemisphereLatitudeSouthern | - | - | | Indicates the WGS84 Hemisphere Latitude Southern information.  Unit:SED  Resolution:1  Offset:0 |
|  | Invalid | 0x0 | |  |
|  | Southern | 0x1 | |  |
|  | Northern | 0x2 | |  |
|  | Fault | 0x3 | |  |
| LongitudeDegrees | - | - | | Indicates the WGS84 Longitude Degrees information.  Unit:Degrees  Resolution:1  Offset:-179 |
|  | Degrees | 0x0 To 0x166 | |  |
|  | Unknown | 0x1FE | |  |
|  | Fault | 0x1FF | |  |
| LongitudeMinutes | - | - | | Indicates the WGS84 Longitude Minutes information.  Unit:Minutes  Resolution:1  Offset:0 |
|  | Minutes | 0x0 To 0x3B | |  |
|  | Unknown | 0x3E | |  |
|  | Fault | 0x3F | |  |
| LongitudeMinutesDecimal | - | - | | Indicates the WGS84 Longitude Minutes Decimal information.  Unit:Minutes  Resolution:0.0001  Offset:0 |
|  | Minutes | 0x0 To 0x270F | |  |
|  | Unknown | 0x3FFE | |  |
|  | Invalid | 0x3FFF | |  |
| MSLAltitude | - | - | | Indicates the WGS84 MSL Altitude information.  Unit:Feet  Resolution:10  Offset:-20460 |
|  | Feet | 0x0 To 0xFFC | |  |
|  | Unknown | 0xFFE | |  |
|  | Fault | 0xFFF | |  |

#### MD-REQ-022487/C-GPSSpeed\_St (TcSE ROIN-221118-1)

Message Type: Status

Represents the current GPS Speed.

Status used to indicate current speed as calculated by the location engine. If dead reckoning is compromised (wheel tick failure) then using speed from the GPS chipset would be allowed

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Type | - | - | Indicates the current Location Engine measured Speed.  Unit:MPH  Resolution:1  Offset:0 |
|  | MPH | 0x0 to 0xFD |  |
|  | Unknown | 0xFE |  |
|  | Invalid | 0xFF |  |

#### MD-REQ-022488/A-GPSUTCDateTime\_St (TcSE ROIN-221119-1)

Message Type: Status

Status used to indicate current GPS Date and Time.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| UTCDay | - | - | Indicates the current UTC day.  Unit:Day  Resolution:1  Offset:1 |
|  | Day | 0x0 To 0x1E |  |
|  | Fault | 0x1F |  |
| UTCMonth | - | - | Indicates the current UTC month.  Unit:Month  Resolution:1  Offset:1 |
|  | Month | 0x0 To 0xB |  |
|  | Fault | 0xF |  |
| UTCYear | - | - | Indicates the current UTC year.  Unit:Year  Resolution:1  Offset:1 |
|  | Year | 0x0 To 0x1E |  |
|  | Fault | 0x1F |  |
| UTCHours | - | - | Indicates the current UTC hour.  Unit:Hour  Resolution:1  Offset:0 |
|  | Hours | 0x0 To 0x17 |  |
|  | Unknown | 0x1E |  |
|  | Fault | 0x1F |  |
| UTCMinutes | - | - | Indicates the current UTC minute.  Unit:Minutes  Resolution:1  Offset:0 |
|  | Minutes | 0x0 To 0x3B |  |
|  | Unknown | 0x3E |  |
|  | Fault | 0x3F |  |
| UTCSeconds | - | - | Indicates the current UTC second.  Unit:Seconds  Resolution:1  Offset:0 |
|  | Seconds | 0x0 To 0x3B |  |
|  | Unknown | 0x3E |  |
|  | Fault | 0x3F |  |

#### MD-REQ-022489/B-GPSDilutionOfPrecision\_St (TcSE ROIN-294409)

Message Type: Status

Status used to indicate the Dilution of Precision (DOP) of the current GPS data.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| PositionalDop | - | - | This field is in reality 3D estimated error from the location engineUnit:Value  Resolution:0.2  Offset:0 |
|  | Value | 0x0 To 0x1D |  |
|  | Unknown | 0x1E |  |
|  | Invalid | 0x1F |  |
| HorizontalDop | - | - | Indicates the current horiztonal dilution of precision.  Unit:Value  Resolution:0.2  Offset:0 |
|  | Value | 0x0 To 0x1D |  |
|  | Unknown | 0x1E |  |
|  | Invalid | 0x1F |  |
| VerticalDop | - | - | Indicates the current vertical dilution of precision.  Unit:Value  Resolution:0.2  Offset:0 |
|  | Value | 0x0 To 0x1D |  |
|  | Unknown | 0x1E |  |
|  | Invalid | 0x1F |  |

#### MD-REQ-022490/B-GPSSatNumInView\_St (TcSE ROIN-294417)

Message Type: Status

Status used to indicate the number of GNSS satellites currently in solution.

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Literals** | **Value** | **Description** |
| Number | - | - | Indicates the number of GNSS satellites in the solution.  Unit:Integer  Resolution:1  Offset:0 |
|  | 0 | 0x0 |  |
|  | 1 | 0x1 |  |
|  | 2 | 0x2 |  |
|  | … |  |  |
|  | 29 | 0x1D |  |
|  | Unknown | 0x1E |  |
|  | Invalid | 0x1F |  |

### LOCATN-IIR-REQ-022491/E-LocationService\_Tx (TcSE ROIN-297354)

All items in this subsection apply to an ECU that is a Localization Master.

The Location Service shall utilize a Global Navigation Satellite System (GNSS) multi-plex messaging protocol as defined below. The GNSS protocol shall utilize one or more data messages on the vehicle system interface that consists of 8 bytes of data. Each 8 byte block of data will represent one of 6 different messages:

1. Meta Data/Time
2. Location 1
3. Location 2
4. Location Quality
5. Sensor Quality
6. Sky View
7. Location 3 (same as Location 1, but with shifted coordinates for China – only for China)
8. Location 4 (RAW GNSS from Chipset)
9. Location 5 (Map Match Feedback from embedded nav, if equipped)

Each of these 6 messages consists of several fields of data within the 8 byte blocks. The first field of data in every message is an 8 bit block called “Message Type” that indicates what fields of data are present in the remaining 60 bits of data. The *Message Type Definition Table* below defines the “Message Type” field used by all 6 messages.

|  |  |  |
| --- | --- | --- |
| **Message Type** | **Message** | **Broadcast In** |
| 0 | MetaDataTime | LocationServices\_Data1 |
| 1 | Location1 | LocationServices\_Data1 |
| 2 | Location2 | LocationServices\_Data1 |
| 3 | LocationQuality | LocationServices\_Data1 |
| 4 | SensorQuality | LocationServices\_Data1 |
| 5 | SkyView | LocationServices\_Data2 |
| 6 | Location3 | LocationServices\_Data1 |
| 7 | Location4 | LocationServices\_Data1 |
| 8 | Location5 | LocationServices\_Data1 |

LocationServices\_data1 is currently defined as ArbID 0x45E transmitted by APIM/CHR/CTR on HS3. LocationServices\_data2 is currently defined as ArbID 0x45F transmitted by APIM/CHR/CTR on HS3. In addition, message $45F is only for Engineering development testing. It will not be active in production vehicles.

LocationServices\_3 is currently defined as ArbID 0x21E transmitted by TCU on HS4.

Please see database file for ArbID’s reassigned across the gateway.

#### MD-REQ-051835/C-MetaDataTime

GNSS Message Type: Meta Data/Time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Field** | **Length**  **(bits)** | **Value**  **Range** | **Literals** | **Value** | **Description** |
| Message Type | 4 | 0 | MetaDataTime | 0x0 | See *Message Type Definition Table.* |
| Protocol Version | 3 | 0 - 7 | Version1 | 0x0 | Any additional updates to the GNSS protocol will increment the protocol version. The Protocol Version data field will indicate which version is in use. |
| Version2 | 0x1 |
| … | … |
| Version8 | 0x7 |
| Data Good To Use | 1 | 0 - 1 | DataUnreliable | 0x0 | Indicates whether the data is reliable or not. |
| DataReliable | 0x1 |
| UTC Time Hours | 5 | 0 - 23 | 0 | 0x00 | Indicates the hour portion of the GPS time. |
| 1 | 0x01 |
| … | … |
| 23 | 0x17 |
| UTC Time Minutes | 6 | 0 - 59 | 0 | 0x00 | Indicates the minute portion of the GPS time. |
| 1 | 0x01 |
| … | … |
| 59 | 0x3B |
| UTC Time Seconds | 6 | 0 - 59 | 0 | 0x00 | Indicates the second portion of the GPS time. |
| 1 | 0x01 |
| … | … |
| 59 | 0x3B |
| Fault Bit Mask | 4 | Bit0 (lsb) | 0 | False | Indicates a Wheel Tick fault where True = Fault Active. |
| 1 | True |
| Bit1 | 0 | False | Indicates a Gyro fault where  True = Fault Active. |
| 1 | True |
| Bit2 | 0 | False | Indicates an Accelerometer fault Or GNSS receiver internal fault or both where True = Fault Active. |
| 1 | True |
| Bit3 (msb) | 0 | False | Indicates an Antenna fault where True = Fault Active. |
| 1 | True |
| UTC Time Day | 5 | 1 - 31 | 1 | 0x01 | Indicates the day portion of the GPS date, where 0 is reserved. |
| 2 | 0x02 |
| … | … |
| 31 | 0x1F |
| UTC Month | 4 | 1 - 12 | 1 | 0x1 | Indicates the month portion of the GPS date where 0 is reserved, 1 = January, 2 = February, etc. |
| 2 | 0x2 |
| … | … |
| 12 | 0xC |
| UTC Year | 6 | 2014 - 2077 | 2014 | 0x00 | Indicates the year portion of the GPS date. |
| 2015 | 0x01 |
| … | … |
| 2077 | 0x3F |

Note: All values outside the defined range above shall remain reserved.

The physical bit/byte position layout of the MetaDataTime message is as follows:



#### MD-REQ-051836/A-Location1

GNSS Message Type: Location 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Field** | **Length**  **(bits)** | **Value**  **Range** | **Literals** | **Value** | **Description** |
| Message Type | 4 | 1 | Location1 | 0x1 | See *Message Type Definition Table.* |
| Latitude Degrees Integer | 7 | 0 - 89 | 0 | 0x00 | Indicates the WGS84 Latitude integer portion in degrees. |
| 1 | 0x01 |
| … | … |
| 89 | 0x59 |
| Latitude Sign | 1 | 0 - 1 | Negative | 0x0 | Indicates the sign of the WGS84 Latitude Integer in degrees. |
| Positive | 0x1 |
| Latitude Degrees Fractional | 20 | 0.000001 - 0.999999 | 0 | 0x00000 | Indicates the WGS84 Latitude fractional portion in degrees. |
| 0.000001 | 0x00001 |
| … | … |
| 0.999999 | 0xF423F |
| Longitude Degrees Integer | 8 | 0 - 179 | 0 | 0x00 | Indicates the WGS84 Longitude integer portion in degrees. |
| 1 | 0x01 |
| … | … |
| 59 | 0xB3 |
| Longitude Degrees Fractional | 20 | 0.000001 - 0.999999 | 0 | 0x00000 | Indicates the WGS84 Latitude fractional portion in degrees. |
| 0.000001 | 0x00001 |
| … | … |
| 0.999999 | 0xF423F |
| Longitude Sign | 1 | 0 - 1 | Negative | 0x0 | Indicates the sign of the WGS84 Longitude Integer in degrees. |
| Positive | 0x1 |

Notes:

1. All values outside the defined range above shall remain reserved.

2. Latitude and Longitude values are a derived solution from the output of the location engine in WGS84 coordinates.

The physical bit/byte position layout of the Location1 message is as follows:



#### MD-REQ-051837/B-Location2

GNSS Message Type: Location 2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Field** | **Length**  **(bits)** | **Value**  **Range** | **Literals** | **Value** | **Description** |
| Message Type | 4 | 2 | Location2 | 0x2 | See *Message Type Definition Table.* |
| Heading | 12 | 0 – 359.9 | 0 | 0x000 | Indicates the WGS84 Heading in degrees. |
| 0.1 | 0x001 |
| … | … |
| 359.9 | 0xE0F |
| Mean Sea Level (MSL) Altitude | 11 | -1000 - 9000 | -1000 | 0x000 | Indicates the WGS84 altitude in meters. |
| -995 | 0x001 |
| … | … |
| -5 | 0x0C7 |
| 0 | 0x0C8 |
| 5 | 0x0C9 |
| … | … |
| 9000 | 0x7D0 |
| Velocity | 12 | 0.1 - 409.5 | 0 | 0x000 | Indicates the WGS84 velocity in kilometers per hour (kph). |
| 0.1 | 0x001 |
| … | … |
| 409.5 | 0xFFF |
| Compass Direction | 4 | N/A | Null (Unknown) | 0x00 | Indicates compass direction. |
| North | 0x01 |
| NorthEast | 0x02 |
| East | 0x03 |
| SouthEast | 0x04 |
| South | 0x05 |
| SouthWest | 0x06 |
| West | 0x07 |
| NorthWest | 0x08 |
| GPS Satellites In Solution | 4 | 0 - 15 | 0 | 0x00 | Indicates the number of GPS satellites in solution. |
| 1 | 0x01 |
| … | … |
| 15 (or more) | 0xFF |
| GLONASS Satellites In Solution | 4 | 0 - 15 | 0 | 0x00 | Indicates the number of GLONASS satellites in solution. |
| 1 | 0x01 |
| … | … |
| 15 (or more) | 0xFF |
| Galileo Satellites In Solution | 4 | 0 - 15 | 0 | 0x00 | Indicates the number of Galileo satellites in solution. |
| 1 | 0x01 |
| … | … |
| 15 (or more) | 0xFF |
| Compass Satellites In Solution | 4 | 0 - 15 | 0 | 0x00 | Indicates the number of Compass satellites in solution. |
| 1 | 0x01 |
| … | … |
| 15 (or more) | 0xFF |
| Fix Type | 3 | N/A | Sensors Uncalibrated with no Fix (DR Off) | 0x0 | Indicates Fix type |
| Sensors Calibrated with no Fix (DR On) | 0x1 |
| 2D Fix | 0x2 |
| 3D Fix (DR Uncalibrated) | 0x3 |
| 3D Fix DR Blended (DR Calibrated) | 0x4 |
| 3D Fix DR Bleneded w DGPS (DR Calibrated) | 0x5 |

Note: All values outside the defined range above shall remain reserved.

The physical bit/byte position layout of the Location2 message is as follows:



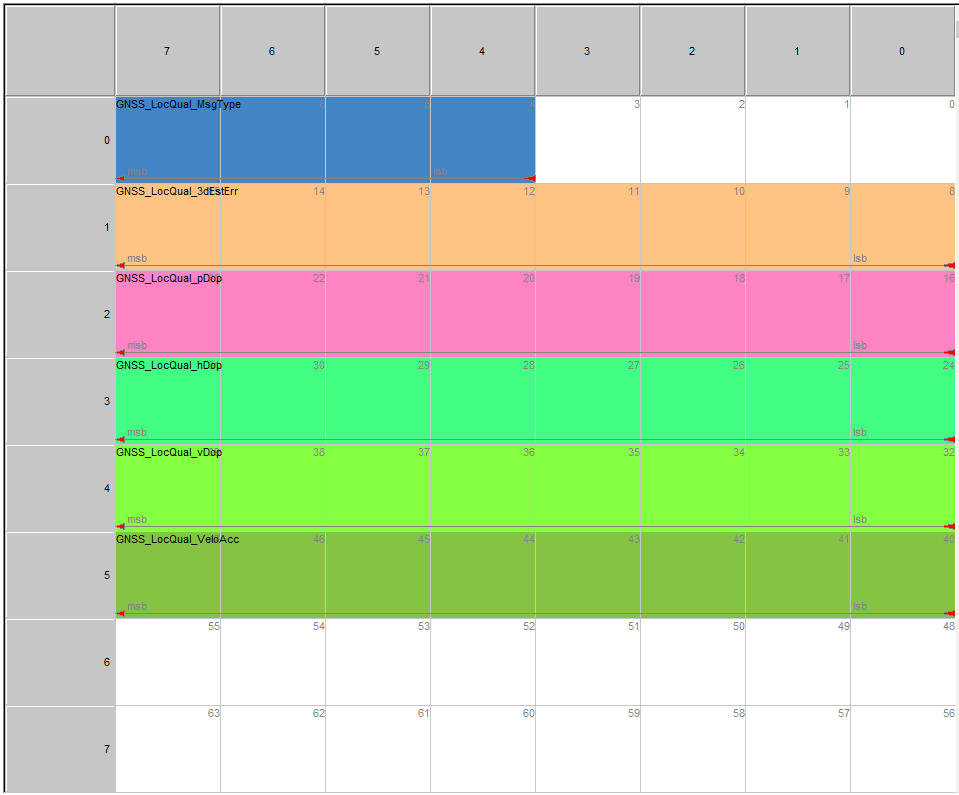
#### MD-REQ-051838/C-LocationQuality

GNSS Message Type: Location Quality

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Field** | **Length**  **(bits)** | **Value**  **Range** | **Literals** | **Value** | **Description** |
| Message Type | 4 | 3 | LocationQuality | 0x3 | See *Message Type Definition Table.* |
| 3D Estimated Error | 8 | 0 – 255 | 0 | 0x00 | Indicates the three dimensional error in meters of the location solution. |
| 1 | 0x01 |
| … | … |
| 255 | 0xFF |
| Positional Dilution Of Precision (pDop) | 8 | 0.1 - 25.5 | 0 | 0x00 | Indicates the current positional dilution of precision. |
| 0.1 | 0x01 |
| … | … |
| 25.5 | 0xFF |
| Horizontal Dilution Of Precision (hDop) | 4 | 0.1 - 25.5 | 0 | 0x00 | Indicates the current horizontal dilution of precision. |
| 0.1 | 0x01 |
| … | … |
| 25.5 | 0xFF |
| Vertical Dilution Of Precision (vDop) | 4 | 0.1 - 25.5 | 0 | 0x00 | Indicates the current vertical dilution of precision. |
| 0.1 | 0x01 |
| … | … |
| 25.5 | 0xFF |
| Speed accuracy approximation (VeloAcc) | 8 | 0.00 – 2.54 | 0 | 0x00 | Indicates the current speed accuracy approximation in m/s.  Corresponding to Velocity. (see Location2) |
| 0.01 | 0x01 |
| … | … |
| 2.54 | 0xFE |
| Over 2.54 / not supported | 0xFF |

Note: All values outside the defined range above shall remain reserved.

The physical bit/byte position layout of the LocationQuality message is as follows:



#### MD-REQ-051839/B-SensorQuality

GNSS Message Type: Sensor Quality

Note: All values outside the defined range above shall remain reserved.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Field** | **Length**  **(bits)** | **Value**  **Range** | **Literals** | **Value** | **Description** |
| Message Type | 4 | 4 | SensorQuality | 0x4 | See *Message Type Definition Table.* |
| Accelerometer Calibration Status | 3 | N/A | NotCalibrated | 0x0 |  |
| RoughCal | 0x1 | Calibration in process |
| GoodCal | 0x2 | Calibration in process |
| Reserved | 0x3 - 0x5 |  |
| GyroNotPresent | 0x6 |  |
| CalFault | 0x7 | Calibration Fault |
| Wheel Tick Calibration Status | 2 | N/A | NotCalibrated | 0x00 |  |
| RoughCal | 0x01 | Calibration in process |
| GoodCal | … | Calibration in process |
| CalFault | 0xFF | Calibration Fault |
| Gyro Calibration Status | 3 | N/A | NotCalibrated | 0x0 |  |
| RoughCal | 0x1 | Calibration in process |
| GoodCal | 0x2 | Calibration in process |
| Reserved | 0x3 - 0x5 |  |
| GyroNotPresent | 0x6 |  |
| CalFault | 0x7 | Calibration Fault |
| Wheel Circumference | 12 | 1000 - 5000 | 1000 | 0x000 | Indicates the computed circumference of the wheel in millimeters. |
| 1001 | 0x001 |
| … | … |
| 5000 | 0xFA0 |
| Jamming Detection | 2 | Bit0 (lsb) | 0 | False | Indicates Narrow Band Detection where True = Narrow Band Detected. |
| 1 | True |
| Bit1 (msb) | 0 | False | Indicates Wide Band Detection where True = Wide Band Detected. |
| 1 | True |
| Active Gain Control (AGC) | 10 | 0 - 100 | 0 | 0x000 | Indicates the active gain control level in percentage. |
| 0.1 | 0x001 |
| … | … |
| 100.0 | 0x3E8 |
| Narrow Band Noise Level | 12 | 0 - 409.5 | 0 | 0x000 | Indicates the level of Narrow Band noise in db. |
| 0.1 | 0x001 |
| … | … |
| 409.4 | 0xFFE |
| Not Measured | 0xFFF |
| Wide Band Noise Level | 12 | 0 - 409.5 | 0 | 0x000 | Indicates the level of Wide Band noise in db. |
| 0.1 | 0x001 |
| … | … |
| 409.4 | 0xFFE |
| Not Measured | 0xFFF |

The physical bit/byte position layout of the Location1 message is as follows:



#### MD-REQ-051840/B-SkyView

Sky View Message shall be configurable on/off and only to be used for development. The bus load for this is extreme and could destabilize the intended platform.

GNSS Message Type: Sky View

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Field** | **Length**  **(bits)** | **Value**  **Range** | **Literals** | **Value** | **Description** |
| Message Type | 4 | 5 | SkyView | 0x5 | See *Message Type Definition Table.* |
| Rolling Counter | 4 | 0 - 15 | 0 | 0x00 | Indicates the GNSS Satellite Rolling Counter. |
| 0.1 | 0x01 |
| … | … |
| 25.5 | 0xFF |
| Satellite Channel | 8 | 0 - 255 | 0 | 0x00 | Indicates the GNSS Satellite Channel of the identified satellite. |
| 1 | 0x01 |
| … | … |
| 255 | 0xFF |
| Satellite PRN ID | 8 | 0 - 255 | 0 | 0x00 | Indicates the GNSS Satellite PRN ID of the identified satellite. |
| 1 | 0x01 |
| … | … |
| 255 | 0xFF |
| Satellite Carrier To Noise | 8 | 0 - 255 | 0 | 0x00 | Indicates the GNSS Satellite Carrier to Noise Ratio (CN0) in dbHz of the identified satellite. |
| 1 | 0x01 |
| … | … |
| 255 | 0xFF |
| Satellite Elevation | 8 | 0 - 255 | 0 | 0x00 | Indicates the GNSS Satellite Elevation in degrees of the identified satellite. |
| 1 | 0x01 |
| … | … |
| 255 | 0xFF |
| Satellite Azimuth | 8 | 0 - 255 | 0 | 0x00 | Indicates the GNSS Satellite Azimuth in degrees of the identified satellite. |
| 1 | 0x01 |
| Satellite Signal Quality | 3 | N/A | Idle | 0x0 | This channel is idle |
| Searching | 0x1 | This channel is searching |
| Acquired | 0x2 | Signal Acquired |
| Unstable | 0x3 | Signal is detected but unstable |
| CodeLock | 0x4 | Code lock on signal |
| CodeCarrierLock1 | 0x5 | Code and carrier locked |
| CodeCarrierLock2 | 0x6 | Code and carrier locked |
| CodeCarrierLock3 | 0x7 | Code and carrier locked |
| Satellite Status Bit Mask | 7 | Bit0  (lsb) | 0 | False | Indicates the identified Space Vehicle (SV) is used for Navigation when True. |
| 1 | True |
| Bit1 | 0 | False | Indicates differential correction data of the identified satellite is available for this SV when True. |
| 1 | True |
| Bit2 | 0 | False | Indicates orbit information of the identified satellite is available for this SV (Ephemeris or Almanach) when True. |
| 1 | True |
| Bit3 | 0 | False | Indicates orbit information of the identified satellite is Ephemeris when True. |
| 1 | True |
| Bit4 | 0 | False | Indicates the identified Space Vehicle (SV) is unhealthy/shall not be used when True. |
| 1 | True |
| Bit5 | 0 | False | Indicates orbit information of the identified satellite is Almanac Plus when True. |
| 1 | True |
| Bit6 (msb) | 0 | False | Indicates orbit information of the identified satellite is Autonomous Orbit Prediction when True. |
| 1 | True |

Notes:

1. All values outside the defined range above shall remain reserved.

2. The above set of data is broadcast one message per satellite seen in the sky (per epoch).

3. The entire set of data above shall be tied to the same “rolling counter”.

The physical bit/byte position layout of the Location1 message is as follows:



#### MD-REQ-130083/A-Location3

GNSS Message Type: Location 3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Field** | **Length**  **(bits)** | **Value**  **Range** | **Literals** | **Value** | **Description** |
| Message Type | 4 | 1 | Location1 | 0x1 | See *Message Type Definition Table.* |
| Latitude Degrees Integer | 7 | 0 - 89 | 0 | 0x00 | Indicates the China Shifted Latitude integer portion in degrees. |
| 1 | 0x01 |
| … | … |
| 89 | 0x59 |
| Latitude Sign | 1 | 0 - 1 | Negative | 0x0 | Indicates the sign of the China Shifted Latitude Integer in degrees. |
| Positive | 0x1 |
| Latitude Degrees Fractional | 20 | 0.000001 - 0.999999 | 0 | 0x00000 | Indicates the China Shifted Latitude fractional portion in degrees. |
| 0.000001 | 0x00001 |
| … | … |
| 0.999999 | 0xF423F |
| Longitude Degrees Integer | 8 | 0 - 179 | 0 | 0x00 | Indicates the China Shifted Longitude integer portion in degrees. |
| 1 | 0x01 |
| … | … |
| 59 | 0xB3 |
| Longitude Degrees Fractional | 20 | 0.000001 - 0.999999 | 0 | 0x00000 | Indicates the China Shifted Latitude fractional portion in degrees. |
| 0.000001 | 0x00001 |
| … | … |
| 0.999999 | 0xF423F |
| Longitude Sign | 1 | 0 - 1 | Negative | 0x0 | Indicates the sign of the China Shifted Longitude Integer in degrees. |
| Positive | 0x1 |

Notes:

1. All values outside the defined range above shall remain reserved.

2. China Shifted Latitude and Longitude values are a derived solution from the output of the location engine (which is output in WGS84 coordinates).. The algorithm to shift the data is to be procured by the tier 1 supplier of the system from the Chinese Government

The physical bit/byte position layout of the Location 3 message is identical to location 1.

#### MD-REQ-133270/A-Location4

GNSS Message Type: Location 4 Raw GNSS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Field** | **Length**  **(bits)** | **Value**  **Range** | **Literals** | **Value** | **Description** |
| Message Type | 4 | 1 | Location4 | 0x7 | See *Message Type Definition Table.* |
| Latitude Degrees Integer | 7 | 0 - 89 | 0 | 0x00 | Indicates the Raw GNSS Latitude integer portion in degrees. |
| 1 | 0x01 |
| … | … |
| 89 | 0x59 |
| Latitude Sign | 1 | 0 - 1 | Negative | 0x0 | Indicates the sign of the Raw GNSS Latitude Integer in degrees. |
| Positive | 0x1 |
| Latitude Degrees Fractional | 20 | 0.000001 - 0.999999 | 0 | 0x00000 | Indicates the Raw GNSS Latitude fractional portion in degrees. |
| 0.000001 | 0x00001 |
| … | … |
| 0.999999 | 0xF423F |
| Longitude Degrees Integer | 8 | 0 - 179 | 0 | 0x00 | Indicates the Raw GNSS Longitude integer portion in degrees. |
| 1 | 0x01 |
| … | … |
| 59 | 0xB3 |
| Longitude Degrees Fractional | 20 | 0.000001 - 0.999999 | 0 | 0x00000 | Indicates the Raw GNSS Latitude fractional portion in degrees. |
| 0.000001 | 0x00001 |
| … | … |
| 0.999999 | 0xF423F |
| Longitude Sign | 1 | 0 - 1 | Negative | 0x0 | Indicates the sign of the Raw GNSS Longitude Integer in degrees. |
| Positive | 0x1 |

Notes:

1. All values outside the defined range above shall remain reserved.

2. This message is for the Raw GNSS Location fed by the GNSS Chipset.

The physical bit/byte position layout of the Location 4 message is identical to location 1.

#### MD-REQ-133599/A-Location5

GNSS Message Type: Location 5 – Map Match

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Field** | **Length**  **(bits)** | **Value**  **Range** | **Literals** | **Value** | **Description** |
| Message Type | 4 | 1 | Location5 | 0x8 | See *Message Type Definition Table.* |
| Latitude Degrees Integer | 7 | 0 - 89 | 0 | 0x00 | Indicates the Map Matched Latitude integer portion in degrees. |
| 1 | 0x01 |
| … | … |
| 89 | 0x59 |
| Latitude Sign | 1 | 0 - 1 | Negative | 0x0 | Indicates the sign of the Map Matched Latitude Integer in degrees. |
| Positive | 0x1 |
| Latitude Degrees Fractional | 20 | 0.000001 - 0.999999 | 0 | 0x00000 | Indicates the Map Matched Latitude fractional portion in degrees. |
| 0.000001 | 0x00001 |
| … | … |
| 0.999999 | 0xF423F |
| Longitude Degrees Integer | 8 | 0 - 179 | 0 | 0x00 | Indicates the Map Matched Longitude integer portion in degrees. |
| 1 | 0x01 |
| … | … |
| 59 | 0xB3 |
| Longitude Degrees Fractional | 20 | 0.000001 - 0.999999 | 0 | 0x00000 | Indicates the Map Matched Latitude fractional portion in degrees. |
| 0.000001 | 0x00001 |
| … | … |
| 0.999999 | 0xF423F |
| Longitude Sign | 1 | 0 - 1 | Negative | 0x0 | Indicates the sign of the Map Matched Longitude Integer in degrees. |
| Positive | 0x1 |

Notes:

1. All values outside the defined range above shall remain reserved.

2. This message is only if an embedded navigation product is installed.

3. Map Match value from the Embedded navigation product shall feed this message

4. If no map match is provided, do not publish

The physical bit/byte position layout of the Location 5 message is identical to location 1.

#### Data Interpretation Example

Conditions:

MsgType = MetaDataTime (0x0)

ProtVer = Version 3 (0x2)

DataGoodToUse = Data Reliable (0x1)

HTC Hour = 1

HTC Min =2

HTC Sec =3

HTC Day =4

HTC Month =5

HTC Year =2020 (0x6),

Fault Indication:

Bit3: Antenna Fault = False (0)

Bit2: Accelerometer Fault = False (0)

Bit1: Gyro Fault = True (1)

Bit0: Wheel Tick Fault = True (1)

Resulting Data:

Byte0 = 0000 0101 🡪 Hex 05

Byte1 = 0000 0001 🡪 Hex 01

Byte2 = 0000 0010 🡪 Hex 02

Byte3 = 0000 0011 🡪 Hex 03

Byte4 = 0000 0100 🡪 Hex 04

Byte5 = 0000 0101 🡪 Hex 05

Byte6 = 0000 0110 🡪 Hex 06

Byte7 = 0000 0011 🡪 Hex 03

CAN Frame = 05 01 02 03 04 05 06 03

### LOCATN-IIR-REQ-091628/B-Internal

The location service will be responsible for providing the following data elements as available to client applications inside the host micro processing operating system:

System timestamp (microseconds) for the solution

2D DR Elements

Lattitude and longitude in WGS84 with 6 decimals of precision of degree

Heading with two decimals of precision

Calibration status

Estimate of 67%ile spherical position error (in cm)

Estimate of 67%ile heading error (in degrees)

Error States (RF, CAN, IMU, etc.)

if supported by localization provider - 3D DR Elements:

Altitude filter (g-sensor): status flags

Altitude filter (g-sensor): cumulative delta-distance (m)

Altitude filter (g-sensor): cumulative delta-altitude (m)

Altitude filter (g-sensor): noise component independent of distance travelled

Altitude filter (g-sensor): noise component to multiply by distance travelled

### LOCATN-IIR-REQ-132695/A-LocationService\_Ephemeris

As specified in section *LOCATN-REQ-022427/B-GPS Receiver Hardware Requirements (TcSE ROIN-294201), autoephemeris support is expected*

A position fix using any satellite cannot be calculated until the receiver has an accurate and complete copy of that satellite's ephemeris data. If the signal from a satellite is lost while its ephemeris data is being acquired, the receiver must discard that data and start again. Ephemeris information is highly detailed and considered valid for no more than four hours.

In order to give customers the best possible experience between commute cycles, a hot start is preferable for these occurrences. For a hot start to work, ephemeris must be up to date. As Such, two methods exists in order to facilitate increasing the validity time of the ephemeris data. The first is downloaded extended ephemeris information and the second being self-generated predicted ephemeris.

#### MD-REQ-132696/A-DownloadedEphemeris

If Ford establishes via its cloud infrastructure a method for downloading an off board ephemeris (via TCU, WIFI or Applink), then system shall support downloading said data and using internally. . If a download is incomplete prior to a key cycle, the prior file shall be maintained (assuming file is still valid). Valid files shall not be deleted until new download is complete.

#### MD-REQ-132697/A-CalculatedEphemeris

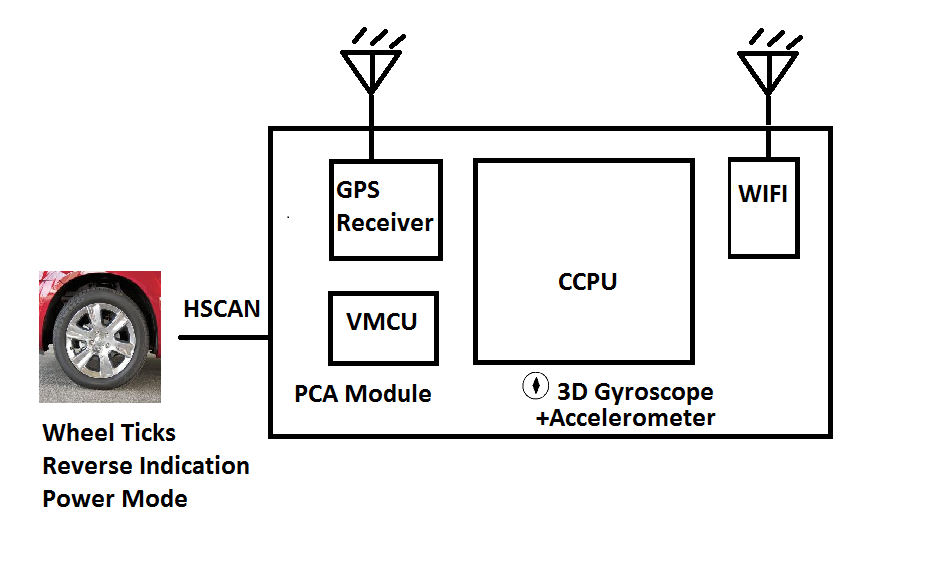
Location engine shall calculate (maintain) at a minimum a 24 hour predicted ephemeris at all times . If a calculation is incomplete prior to a key cycle, the prior calculation shall be maintained (assuming file is still valid). Valid files shall not be deleted until new calculation is complete.

# Functional Definition

## LOCATN-FUN-REQ-022425/A-Physical Architecture (TcSE ROIN-294216)

### Requirements

#### LOCATN-REQ-022426/B-Architecture (TcSE ROIN-294207)



There are 2 Architecture Potentials for the Location features.

1. Smart GPS Receiver with built in dead reckoning (with a second location engine augmenting the GPS receiver in the Host Micro)

2. Dumb GPS receiver with entire location engine running in Host Micro

#### LOCATN-REQ-022427/B-GPS Receiver Hardware Requirements (TcSE ROIN-294201)

The GPS Receiver shall be selected from Ford approved vendors only. It shall provide the following features in it’s chipset (independent of smart/dumb delineation)

Support of a minimum of both GPS and GLONASS constellations. Galileo and Compass/Beidou must be supported when regulations require them.

Auto-ephemeris calculation for a minimum 24 hour period

Jamming Detection, with real time reporting and internal mitigation

#### LOCATN-REQ-022428/A-GPS Chipset Tuning (TcSE ROIN-296599)

GPS Chipset shall be tuned such that errant fixes (leading to position flyways) after periods of poor reception will not occur.  All GPS chipset settings shall be reviewed with both Ford and the Chipset vendor prior to implementation.

#### LOCATN-REQ-022429/B-GPS Fixes (TcSE ROIN-296600)

Any fix with less than 4 satellites and/or lacking a 3D fix designation shall default to the use of the Dead Reckoning engine.

## LOCATN-FUN-REQ-022430/A-Position (TcSE ROIN-292763)

### Requirements

#### LOCATN-REQ-022431/C-Position Accuracy (TcSE ROIN-294206)

Positioning shall always be accurate.

System accuracy shall be calculated via the following method:

A drive cycle of 500 hours consisting of 50% Urban Canyon, 30% Open Sky and 20% Dense Foliage shall be driven with data collected.

A high resolution ground truth (RTK or PPP based) system shall be utilized and recorded with the same time domain (UTC Seconds, and publishing at the same epoch integer)

Each point shall be measured relative to each other and a distance calculated

An analysis shall be performed on the dataset such that a 98% confidence value (largest distance in achieving 98% of the points in 2 Dimensions).

System performance shall be:

High resolution (>100hz) Acceleromoter+Gyro+Wheel Ticks 10m or less

Low resolution (<20hz) Acceleromoter+Gyro+Wheel Ticks 13m or less

Differential Wheel Ticks (4 wheel input) 15m or less

Pure Open Sky performance shall be 1.5m for all solutions

The following edge cases must be verified to work error free:

* Slight bi-furcation deviation in a tunnel (if a map is available for map-match)

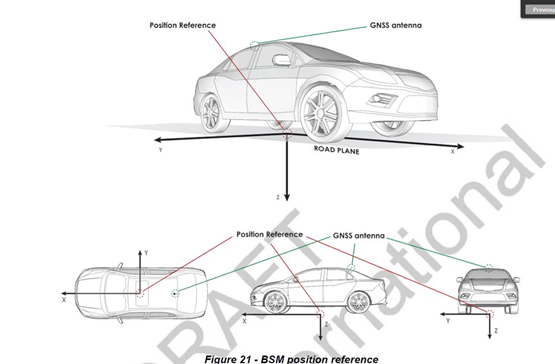




* Exiting Parking Garage (valet at Palmer House Chicago Example) (if a map is available for map-match)
* Multi-leveled roads (Upper/lower/Service level Wacker Dr in Chicago / Randolph st in Chicago) (if a map is available for map-match)
* Parking Lot / Off road handling (if a map is available for map-match)
* Express lane vs Service drive vs freeway (if a map is available for map-match)
* Startup in dense foliage (after 24 hour soak – autoephemeris expired)
* Startup in Complicated Airport Parking deck (after 24 hour soak – autoepemeris expired)
* US/Canada Tunnel in Detroit/Windsor (if a map is available for map-match)
* Multipath Mitigation (Downtown Chicago Test Route)
* Big Dig in Boston (if a map is available for map-match)

#### LOCATN-REQ-283027/A-Reference Coordinate System

Localization engine shall provide a solution based on Center point of vehicle at ground altitude. Appropriate transformations shall be applied such that the solution matches that for each vehicle variant. This shall be verified in clear sky conditions with a high resolution GNSS system as ground truth.



### Use Cases

#### LOCATN-UC-REQ-022432/C-Driving on Road – Clear Sky (TcSE ROIN-292579)

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | The current location is available.  A navigation route is not active. |
| **Scenario Description** | The customer is driving on a road. |
| **Post-conditions** | The current location is correctly identified (position of vehicle on road).  The position data (Lat/Long/Heading/ Satellite constellation information /etc) is output on the vehicle data bus if the ECU is the localization master.  The position is provided for internal consumption. |
| **List of Exception Use Cases** | E1 – GPS Fault – Antenna Issue  E2 – Sensor Fault – Gyro / Wheel Tick Issue E3 – Sensor Reset – Wheel Tick Issue  E4 – WIFI Fault (if licensed by Ford)  E5 – WIFI Positioning Data Not Available (if licensed by Ford) |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal IMU)  Wheel Ticks (via Vehicle Data bus) |

#### LOCATN-UC-REQ-022433/C-GPS Fault – Antenna Issue (TcSE ROIN-292580)

**Linked Elements**

LOCATN-UC-REQ-022432/C-Driving on Road – Clear Sky (TcSE ROIN-292579)

LOCATN-UC-REQ-022441/C-Driving on Road – Multi-leveled Roads (TcSE ROIN-292588)

LOCATN-UC-REQ-022443/C-Driving off Road – Exiting Underground Parking Lot (TcSE ROIN-292590)

LOCATN-UC-REQ-022442/C-Driving Off Road – Entering Parking Lot (TcSE ROIN-292589)

LOCATN-UC-REQ-022438/C-Driving on Road – Urban Canyon (TcSE ROIN-292585)

|  |  |
| --- | --- |
| **Actors** | Host Vehicle |
| **Pre-conditions** | Same as Normal Usage Use Case |
| **Scenario Description** | An RF Path failure |
| **Post-conditions** | No map will be displayed by the infotainment system (if equipped AND if HMI is in agreement with this requirement).  The last know position is broadcast on the vehicle data bus with relevant quality factors set (localization master).  The last know position is provided for internal consumption (localization master) and an internal failure flag is set.  An error message is displayed to the customer (if HMI is in agreement with this requirement – if consumption of data is limited only to V2V features, this is covered by the V2V malfunction warning).  A vehicle Diagnostic Trouble Code (DTC) is set. |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI (IF EQUIPPED) |

#### LOCATN-UC-REQ-022434/C-Sensor Fault – Gyro / Wheel Tick Issue (TcSE ROIN-292581)

**Linked Elements**

LOCATN-UC-REQ-022432/C-Driving on Road – Clear Sky (TcSE ROIN-292579)

LOCATN-UC-REQ-022441/C-Driving on Road – Multi-leveled Roads (TcSE ROIN-292588)

LOCATN-UC-REQ-022443/C-Driving off Road – Exiting Underground Parking Lot (TcSE ROIN-292590)

LOCATN-UC-REQ-022442/C-Driving Off Road – Entering Parking Lot (TcSE ROIN-292589)

LOCATN-UC-REQ-022438/C-Driving on Road – Urban Canyon (TcSE ROIN-292585)

|  |  |
| --- | --- |
| **Actors** | Host Vehicle |
| **Pre-conditions** | Same as Normal Usage Use Case |
| **Scenario Description** | The customer is driving on a road and there is a sensor malfunction or sensor data is not received via vehicle data bus. |
| **Post-conditions** | See the following requirements for specific behaviors  LOCATN-REQ-022459/B-Wheel Tick Failure(TcSE ROIN-294197)  LOCATN-REQ-022462/A-3D Gyro/Accelerometer Failure(TcSE ROIN-294200)  Degraded location performance |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI (IF EQUIPPED) |

#### LOCATN-UC-REQ-022435/B-Sensor Reset – Wheel Tick Issue (TcSE ROIN-292582)

**Linked Elements**

LOCATN-UC-REQ-022432/C-Driving on Road – Clear Sky (TcSE ROIN-292579)

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Same as Normal Usage Use Case |
| **Scenario Description** | The customer is driving on a road and the wheel tick sensor resets back to a zero count. (data is received via vehicle data bus) |
| **Post-conditions** | The ECU correctly identifies the reset and no noticeable position error is present. |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI (IF EQUIPPED) |

#### LOCATN-UC-REQ-022436/B-WIFI Fault (TcSE ROIN-292583)

**Linked Elements**

LOCATN-UC-REQ-022432/C-Driving on Road – Clear Sky (TcSE ROIN-292579)

LOCATN-UC-REQ-022441/C-Driving on Road – Multi-leveled Roads (TcSE ROIN-292588)

LOCATN-UC-REQ-022442/C-Driving Off Road – Entering Parking Lot (TcSE ROIN-292589)

LOCATN-UC-REQ-022443/C-Driving off Road – Exiting Underground Parking Lot (TcSE ROIN-292590)

LOCATN-UC-REQ-022438/C-Driving on Road – Urban Canyon (TcSE ROIN-292585)

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | WIFI (if licensed by Ford) is unable to provide SSID data to the location core. |
| **Scenario Description** | WIFI assistance is not available for position enhancement. |
| **Post-conditions** | The vehicle position may be compromised.  An error message may be displayed. A vehicle Diagnostic Trouble Code (DTC) is set. |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI |

#### LOCATN-UC-REQ-022437/B-WIFI Positioning Data Not Available (TcSE ROIN-292584)

**Linked Elements**

LOCATN-UC-REQ-022432/C-Driving on Road – Clear Sky (TcSE ROIN-292579)

LOCATN-UC-REQ-022441/C-Driving on Road – Multi-leveled Roads (TcSE ROIN-292588)

LOCATN-UC-REQ-022443/C-Driving off Road – Exiting Underground Parking Lot (TcSE ROIN-292590)

LOCATN-UC-REQ-022442/C-Driving Off Road – Entering Parking Lot (TcSE ROIN-292589)

LOCATN-UC-REQ-022438/C-Driving on Road – Urban Canyon (TcSE ROIN-292585)

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Underlying Data for WIFI Positioning (if licensed by Ford) is not available. |
| **Scenario Description** | WIFI assistance is not available for position enhancement. |
| **Post-conditions** | The vehicle position may be compromised.  An error message may be displayed. A vehicle Diagnostic Trouble Code (DTC) is set. |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI |

#### LOCATN-UC-REQ-022438/C-Driving on Road – Urban Canyon (TcSE ROIN-292585)

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | The current location is available.  Navigation data is available.  A navigation route is not active. |
| **Scenario Description** | The customer is driving on a road in an urban canyon. |
| **Post-conditions** | The current location is correctly identified (position of vehicle on road) by the ECU.  The position data (Lat/Long/Heading/ Satellite constellation information /etc) is output on the vehicle data bus if the ECU is the Localization Master.  The position is provided for internal consumption.  The navigation application feeds back a map matched candidate to the localization engine (if equipped). |
| **List of Exception Use Cases** | E1 – [GPS Fault – Antenna Issue](http://ivs02.pd3.ford.com:8080/tcr/controller/ObjLauncher?wolf_objectid=19.0.80964030&LID=19.0.80964030&tcr_symbolic_target_id=19.0.80964030&tcr_symbolic_property_id=4.0.54206017)  E2 – [Sensor Fault – Gyro / Wheel Tick Issue](http://ivs02.pd3.ford.com:8080/tcr/controller/ObjLauncher?wolf_objectid=19.0.80964097&LID=19.0.80964097&tcr_symbolic_target_id=19.0.80964097&tcr_symbolic_property_id=4.0.54206017)  E3 – [WIFI Fault](http://ivs02.pd3.ford.com:8080/tcr/controller/ObjLauncher?wolf_objectid=19.0.80964231&LID=19.0.80964231&tcr_symbolic_target_id=19.0.80964231&tcr_symbolic_property_id=4.0.54206017) (if licensed by Ford)  E4 – [WIFI Positioning Data Not Available](http://ivs02.pd3.ford.com:8080/tcr/controller/ObjLauncher?wolf_objectid=19.0.80964298&LID=19.0.80964298&tcr_symbolic_target_id=19.0.80964298&tcr_symbolic_property_id=4.0.54206017) (if licensed by Ford)  E5 – [Map Data Not Available](http://ivs02.pd3.ford.com:8080/tcr/controller/ObjLauncher?wolf_objectid=19.0.80964432&LID=19.0.80964432&tcr_symbolic_target_id=19.0.80964432&tcr_symbolic_property_id=4.0.54206017)  E6 – [Navigation Application is Not Running](http://ivs02.pd3.ford.com:8080/tcr/controller/ObjLauncher?wolf_objectid=19.0.80964499&LID=19.0.80964499&tcr_symbolic_target_id=19.0.80964499&tcr_symbolic_property_id=4.0.54206017) |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus) |

#### LOCATN-UC-REQ-022439/B-Map Data Not Available (TcSE ROIN-292586)

**Linked Elements**

LOCATN-UC-REQ-022438/C-Driving on Road – Urban Canyon (TcSE ROIN-292585)

LOCATN-UC-REQ-022441/C-Driving on Road – Multi-leveled Roads (TcSE ROIN-292588)

LOCATN-UC-REQ-022443/C-Driving off Road – Exiting Underground Parking Lot (TcSE ROIN-292590)

LOCATN-UC-REQ-022442/C-Driving Off Road – Entering Parking Lot (TcSE ROIN-292589)

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Same as Normal Usage Use Case |
| **Scenario Description** | The map data for the current vehicle market does not support the road the customer is driving on. Without a map (corresponding to current location), map matching is not possible. |
| **Post-conditions** | No map will be displayed by the infotainment system.  The best location solution possible is output to the vehicle data bus. |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI (IF EQUIPPED) |

#### LOCATN-UC-REQ-022440/B-Navigation Application is Not Running (If Equipped) (TcSE ROIN-292587)

**Linked Elements**

LOCATN-UC-REQ-022438/C-Driving on Road – Urban Canyon (TcSE ROIN-292585)

LOCATN-UC-REQ-022441/C-Driving on Road – Multi-leveled Roads (TcSE ROIN-292588)

LOCATN-UC-REQ-022442/C-Driving Off Road – Entering Parking Lot (TcSE ROIN-292589)

LOCATN-UC-REQ-022443/C-Driving off Road – Exiting Underground Parking Lot (TcSE ROIN-292590)

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | The navigation application is not running (if equipped). |
| **Scenario Description** | The customer is driving on a road without clear sky access (urban canyon, multi- level road, covered parking garage, etc.) while the navigation application is not running (for whatever reason). Without the navigation application running map matching is not possible. |
| **Post-conditions** | No map will be displayed by the infotainment system.  The best location solution possible is output to the vehicle data bus. |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI (IF EQUIPPED) |

#### LOCATN-UC-REQ-022441/C-Driving on Road – Multi-leveled Roads (TcSE ROIN-292588)

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | The current location is available.  Navigation data is available (if equipped).  A navigation route is not active. |
| **Scenario Description** | The customer is driving on a road with multiple levels (Example: Wacker Dr in Chicago – 3 levels). |
| **Post-conditions** | The current location is correctly identified by the ECU= including vehicle altitude.  The position data (Lat/Long/Heading/ Satellite constellation information /etc) is output on the vehicle data bus if ECU is Location Master.  The position is provided for internal consumption.  The navigation application feeds back a map matched candidate for the location engine. |
| **List of Exception Use Cases** | E1 – GPS Fault – Antenna Issue  E2 – Sensor Fault – Gyro / Wheel Tick Issue  E3 – WIFI Fault (if licensed by Ford)  E4 – WIFI Positioning Data Not Available (if licensed by Ford)  E5 – Map Data Not Available  E6 – Navigation Application is Not Running |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus) |

#### LOCATN-UC-REQ-022442/C-Driving Off Road – Entering Parking Lot (TcSE ROIN-292589)

|  |  |
| --- | --- |
| **Actors** | Host Vehicle |
| **Pre-conditions** | The current location is available. Navigation data is available (if equipped).  A navigation route is not active (if equipped). |
| **Scenario Description** | The customer is driving off Road entering a parking Lot. |
| **Post-conditions** | The current location (position of vehicle off-road) is correctly identified by the ECU.  The position data (Lat/Long/Heading/ Satellite constellation information /etc) is output on the vehicle data bus if the ECU is the Location Master.  The position is provided to Navigation Application for Display (if equipped).  The navigation application feeds back a map matched candidate for the location engine (if equipped).  The position data is shared for internal consumption. |
| **List of Exception Use Cases** | E1 – GPS Fault – Antenna Issue  E2 – Sensor Fault – Gyro / Wheel Tick Issue  E3 – WIFI Fault (if licensed by Ford)  E4 – WIFI Positioning Data Not Available (if licensed by Ford)  E5 – Map Data Not Available (if equipped)  E6 – Navigation Application is Not Running (if equipped) |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus) |

#### LOCATN-UC-REQ-022443/C-Driving off Road – Exiting Underground Parking Lot (TcSE ROIN-292590)

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | The current location is available.  Navigation data is available.  A navigation route is not active. |
| **Scenario Description** | The customer is driving off Road exiting an underground Parking Lot (Example: Palmer House Hotel in Chicago). |
| **Post-conditions** | The current location (position of vehicle off-road) is correctly identified by the ECU.  The position data (Lat/Long/Heading/ Satellite constellation information /etc) is output on the vehicle data bus if the ECU is the Location Master.  The position is provided to Navigation Application for Display (if equipped).  The navigation application feeds back a map matched candidate for the location engine (if equipped).  Position data is shared for internal consumption. |
| **List of Exception Use Cases** | E1 – GPS Fault – Antenna Issue  E2 – Sensor Fault – Gyro / Wheel Tick Issue  E3 – WIFI Fault (if licensed by Ford)  E4 – WIFI Positioning Data Not Available (if licensed by Ford)  E5 – Map Data Not Available (if equipped)  E6 – Navigation Application is Not Running (if equipped) |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus) |

#### LOCATN-UC-REQ-091631/B-CAN Bus Wakeup (Generic)

|  |  |
| --- | --- |
| **Actors** | ECU on CAN Bus |
| **Pre-conditions** | Prior location is stored |
| **Scenario Description** | Vehicle is sitting in a garage or other parking area. An ECU wakes up the CAN Bus |
| **Post-conditions** | The last known location is correctly identified (position of vehicle on road) by the ECU.  The position data (Lat/Long/Heading/ Satellite constellation information /etc) is output on the vehicle data bus if the ECU is the Location Master. The data for the various location quality factors should be set to unknown and #of satellites should be 0. GPS\_dimension should be 0 (no fix). The Correct (actual) UTC Date/Time is to be transmitted on the can bus. Once the Localization Engine is up and running, an updated location shall be published. |
| **List of Exception Use Cases** | E10 – Prior Location not stored |
| **Interfaces** | CAN Bus |

#### LOCATN-UC-REQ-091639/B-CAN Bus Wakeup - Tracking Location Request

|  |  |
| --- | --- |
| **Actors** | ECU on CAN Bus |
| **Pre-conditions** | Prior location stored |
| **Scenario Description** | Vehicle has been stolen. The consumer requests a vehicle location through the MyFordMobile app. |
| **Post-conditions** | The last known location is correctly identified (position of vehicle on road) by the ECU.  If the ECU is the Location Master, for this function, the following applies:  The position data (Lat/Long/Heading/ Satellite constellation information /etc) is output on the vehicle data bus. The data for the various location quality factors should be set to unknown and #of satellites should be 0. GPS\_dimension should be 0 (no fix). The Correct (actual) UTC Date/Time is to be transmitted on the can bus until a location can be found from the GNSS Chipset  At the same time, if in a multi-microcontroller solution (See APIM Gen3), the Vehicle facing microcontroller (VMCU) must power up the Consumer microcontroller (CCPU) with direction to not enable the display and not to boot the HMI. Only bring up location, get a quick GNSS fix, stay up for 30 seconds and then power down |
| **List of Exception Use Cases** | E10 – No Prior location stored |
| **Interfaces** |  |

#### LOCATN-UC-REQ-091657/B-Prior Location not Stored

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Prior location is not stored in the system |
| **Scenario Description** | System has had a file system error or is in a virginal state and has no prior location data. |
| **Post-conditions** | If the ECU is the Location Master, System shall use the default location of Ford World Head Quarters in Dearborn, mi as the prior location  For other GNSS ECUs (non Location Master) the post condition is application specific. Please consult application specific specification . |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI (IF EQUIPPED) |

#### LOCATN-UC-REQ-091658/B-Startup – Customer sitting in vehicle

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Customer is sitting in vehicle for an extended period with CAN bus off |
| **Scenario Description** | Given the pre-soak described in the above line, customer starts vehicle and drives off quickly |
| **Post-conditions** | Location engine initialized correctly |
| **List of Exception Use Cases** | E1 – GPS Fault – Antenna Issue  E2 – Sensor Fault – Gyro / Wheel Tick Issue  E3 – Sensor Reset – Wheel Tick Issue  E4 – WIFI Fault (if licensed by Ford)  E5 – WIFI Positioning Data Not Available (if licensed by Ford) |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus) |

#### LOCATN-UC-REQ-091659/B-Startup – Customer sitting in vehicle rolling start

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Customer is in vehicle for an extended period (With can bus off)  Vehicle is a manual Transmission |
| **Scenario Description** | Customer starts vehicle via popping the clutch and leaves very quickly |
| **Post-conditions** | Location engine initializes correctly |
| **List of Exception Use Cases** | E1 – GPS Fault – Antenna Issue  E2 – Sensor Fault – Gyro / Wheel Tick Issue  E3 – Sensor Reset – Wheel Tick Issue  E4 – WIFI Fault (if licensed by Ford)  E5 – WIFI Positioning Data Not Available (if licensed by Ford) |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus) |

#### LOCATN-UC-REQ-091701/B-Battery Removal

|  |  |
| --- | --- |
| **Actors** | Vehicle Operator or Dealership |
| **Pre-conditions** | Battery Disconnected (or module unplugged) |
| **Scenario Description** | Given a standard repair cycle to the vehicle (after reconnection of Battery or ECU), system shall initialize with last known data from prior key cycle (if available) |
| **Post-conditions** | The last known location is correctly identified (position of vehicle on road) by the ECU.  The position data (Lat/Long/Heading/ Satellite constellation information /etc) is output on the vehicle data bus if the ECU is the Location Master for the vehicle. The data for the various location quality factors should be set to unknown and #of satellites should be 0. GPS\_dimension should be 0 (no fix). The Correct (actual) UTC Date/Time is to be transmitted on the can bus.  Once a new location solution is available it is published via the various interfaces |
| **List of Exception Use Cases** | EX (11) No Prior Location stored in system |
| **Interfaces** |  |

#### LOCATN-UC-REQ-094992/B-Startup - Boot with Vehicle in Motion

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Vehicle is in motion |
| **Scenario Description** | Either 1) System reboots due to crash (or key cycle)  2) System boot is after vehicle is in motion |
| **Post-conditions** | 1. Center map on last known position (NO GPS Icon is illuminated) (if equipped) 2. Wait for a 3D Fix 3. initialize location with that fix 4. If wheels are spinning at this time, wait for a standstill to initialize the DR engine –or- use prior saved calibration data (if available)   Lack of map movement will be considered acceptable until a 3D fix is achieved (if equipped) |
| **List of Exception Use Cases** | E1 – GPS Fault – Antenna Issue  E2 – Sensor Fault – Gyro / Wheel Tick Issue E3 – Sensor Reset – Wheel Tick Issue  E4 – WIFI Fault (if licensed by Ford)  E5 – WIFI Positioning Data Not Available (if licensed by Ford) |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus) |

#### LOCATN-UC-REQ-094994/B-Startup – System Crashes / Watchdog Forces Reboot

|  |  |
| --- | --- |
| **Actors** | Vehicle Occupant |
| **Pre-conditions** | Vehicle is in motion |
| **Scenario Description** | Either 1) System reboots due to crash  2) System watchdog forces an immediate reboot |
| **Post-conditions** | Location engine state and calibration information is saved |
| **List of Exception Use Cases** | E1 – GPS Fault – Antenna Issue  E2 – Sensor Fault – Gyro / Wheel Tick Issue  E3 – Sensor Reset – Wheel Tick Issue  E4 – WIFI Fault (if licensed by Ford)  E5 – WIFI Positioning Data Not Available (if licensed by Ford) |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus) |

## LOCATN-FUN-REQ-022444/A-Data Logging (TcSE ROIN-294214)

### Requirements

#### LOCATN-REQ-022445/A-Logging (TcSE ROIN-294204)

There shall be 2 logging modes. The first shall be active at all times and logged into stdout (devlog). Contents shall support the following stdout messages.

Location: RAW GPS [Lat, Long, Heading, Altitude], Display Candidate [Lat, Long, Heading, Altitude, last Feature ID], DR Candidate [Lat, Long, Heading, Altitude]

Sensor [Gyro]: Sample rate xx Hz, Current Bias X,Y,Z, Calibration Status, FAULT State

Sensor [Accelerometer]: Sample rate xx Hz, Current Bias X,Y,Z, Calibration Status, FAULT State

Sensor [Wheel Ticks]: Sample rate xx Hz,Ticks per Meter xx,  Calibration Status, FAULT State

Location Loop Timing Blockage > 200ms xxx ms blocked

Calibration Status shall be:

Not Calibrated  
 Coarse Calibration  
 Fine Calibration

Fault State shall be:

Faulted  
 Not Faulted

The second method will log all inputs to the location engine to the internal (or external) filesystem given logging mode enabled.

### Use Cases

#### LOCATN-UC-REQ-022446/B-Data Logging (TcSE ROIN-292591)

|  |  |
| --- | --- |
| **Actors** | Development Engineer |
| **Pre-conditions** | The current location is available. Navigation data is available. (if equipped)  A navigation route is or is not active. (if equipped) A USB stick may/may not be inserted. Logging mode is engaged. |
| **Scenario Description** | The development engineer enters logging mode, which enables logging of all raw sensor data (inputs into the Location engine) to allow for fault case reproduction / regression testing.  If a USB stick is inserted, logging is to USB stick. (if equipped)  Otherwise, logging is into internal file system (with a method to extract). |
| **Post-conditions** | A data logging file is saved to the USB stick or internal file system. |
| **List of Exception Use Cases** | E1 – Data Logging File System Full  E2 – Data Logging File System Not Writeable |
| **Interfaces** | G-HMI (If Equipped)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus)  WIFI  RAW GPS Data  File System |

#### LOCATN-UC-REQ-022447/B-Data Logging File System Full (TcSE ROIN-292592)

**Linked Elements**

LOCATN-UC-REQ-022446/B-Data Logging (TcSE ROIN-292591)

|  |  |
| --- | --- |
| **Actors** | Development Engineer |
| **Pre-conditions** | Same as normal usage use case. |
| **Scenario Description** | The development engineer enters logging mode while the file system in which the Location application logs data is full. |
| **Post-conditions** | The ECU removes the oldest log data (FIFO behavior) as needed. |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI (IF EQUIPPED) |

#### LOCATN-UC-REQ-022448/B-Data Logging File System Not Writeable (TcSE ROIN-292593)

**Linked Elements**

LOCATN-UC-REQ-022446/B-Data Logging (TcSE ROIN-292591)

|  |  |
| --- | --- |
| **Actors** | Development Engineer |
| **Pre-conditions** | Same as normal usage use case. |
| **Scenario Description** | The development engineer enters logging mode while the file system in which the Location application logs data is not writeable. |
| **Post-conditions** | ECU provides a notification to the user that logging is not possible. |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI (IF EQUIPPED) |

## LOCATN-FUN-REQ-022449/A-Data Playback (TcSE ROIN-294209)

### Requirements

#### LOCATN-REQ-022450/D-Playback (TcSE ROIN-294174)

Data from Logging shall be usable to playback as inputs into location engine (with a shunting of external/internal inputs). Input file shall be accessible from external storage. Playback function shall have a clean failover behavior when usb stick (if equipped) is removed. Playback function shall play multiple files in alphabetic order. Playback function shall restart the playback from the beginning if the media is removed and replaced. Configuration shall be utilized from the playback file for initialization of the location engine.

#### LOCATN-REQ-022451/D-Shunting (TcSE ROIN-294175)

* Applicable to Host-Micro Localization Engines, not ‘Smart Chip’ architecture: The Location engine shall allow the selectable shunting of various inputs to allow for playback.
* Selectable inputs shall be: GPS Data,Wifi Data (if licensed by Ford), Vehicle data {Powermode, reverse indication, wheel ticks, vehicle speed}, Gyro/accelerometer Data
* Date/Time shunting shall allow adjusting system clock (date/time) to a new start time (any valid date/time ) separated from the GPS data. This will allow time (and/or date) restricted road / speed limit validation
* When shunting is active there will be no GPS time syncing with the master clock time as GPS data is in test mode.
* During playback, any velocity feeds to other functions in the system shall utilize the playback data in place of real time velocity data

### Use Cases

#### LOCATN-UC-REQ-022452/B-Navigation Data Playback (TcSE ROIN-292594)

|  |  |
| --- | --- |
| **Actors** | Development Engineer |
| **Pre-conditions** | Playback Sensor Data is available.  Navigation data is available.  A navigation route is or is not active.  Playback mode is engaged. |
| **Scenario Description** | The development engineer enters playback mode, which enables playback of all raw sensor data (inputs into location engine) to allow for fault case reproduction / regression testing. |
| **Post-conditions** | Internal Sensor data is shunted (and replaced with playback data). |
| **List of Exception Use Cases** | E1 – Data Playback File Corrupt |
| **Interfaces** | G-HMI (IF EQUIPPED)  Sensors (Internal Gyro)  Wheel Ticks (via Vehicle Data bus) WIFI  RAW GPS Data Filesystem |

#### LOCATN-UC-REQ-022453/B-Data Playback File Corrupt (TcSE ROIN-292595)

**Linked Elements**

LOCATN-UC-REQ-022452/B-Navigation Data Playback (TcSE ROIN-292594)

|  |  |
| --- | --- |
| **Actors** | Development Engineer |
| **Pre-conditions** | Same as normal usage use case. |
| **Scenario Description** | The development engineer enters playback mode but the file selected for navigation data playback is corrupt. |
| **Post-conditions** | ECU provides a notification to the user that navigation data playback is not possible from the selected file. |
| **List of Exception Use Cases** | NA |
| **Interfaces** | G-HMI (IF EQUIPPED) |

## LOCATN-FUN-REQ-022454/A-Sensor Inputs (TcSE ROIN-294213)

### Requirements

#### LOCATN-REQ-022455/A-Wheel Ticks (TcSE ROIN-294193)

Wheel Tick performance is documented in AN-0234.

#### LOCATN-REQ-022456/A-Wheel Tick Initialization (TcSE ROIN-294194)

System shall use rear left wheel (non-driven) as first wheel tick input. Prior ignition cycle calibration to be maintained

#### LOCATN-REQ-022457/B-Wheel Tick Calibration (TcSE ROIN-294195)

Location service shall calibrate the distance per tick ratio within 5 miles of open sky driving. Location service will have a default ratio of 0.0762 per tick. This value must be maintained from key cycle to key cycle and not be lost on battery removal. System shall detect tire size changes and shall replace calibration values automatically. This may be superseded by limitations of the chosen location engine and performance must be agreed to by Ford

#### LOCATN-REQ-022458/A-Wheel Tick Counter Resets (TcSE ROIN-294196)

Location service shall be resilient to resets of the wheel tick signal. If a tick to tick delta greater than 8 m/s2 is observed it shall be considered a reset. Monitoring Ignition status transitions might help mitigate some resets.

#### LOCATN-REQ-022459/D-Wheel Tick Failure (TcSE ROIN-294197)

Location service will utilize the fault state of a given wheel’s direction (if available upon the can bus in signal WhlDiryx\_D\_Actl). A fault is determined if the aforementioned signals has a state of **Failed (0x3)**

Wheel Fallback strategy should follow:

Undriven Left (see configuration Drive\_Type to determine) Undriven Right

Driven Left

Driven Right

If all 4 sensors are faulted, the limp mode Popup message and GPS Failsafe mode shall be engaged as required by the application specific implementation of HMI – please reference application specific requirements. A DTC IS REQUIRED. At the next key cycle, the fault state shall be reset and Undriven Left Wheel is utilized as the monitored wheel.

If location engine is axle based (average of both wheels on an axle), then if one sensor fails, move to the driven axle (as the initial axle is undriven). If failures occur on one wheel of each axle, then behavior is to be implemented based on the strategy of the location supplier. If all wheels are failed, fall back to non-Dead reckoned as specified above.

#### LOCATN-REQ-022460/B-3D Gyro/Accelerometer Initialization (TcSE ROIN-294198)

Gyro/Accelerometer shall re-zero upon every ignition cycle. In order to support a clean calibration, 4 seconds of sensor data shall be samples prior to the vehicle moving.

#### LOCATN-REQ-022461/B-3D Gyro/Accelerometer Calibration (TcSE ROIN-294199)

Location service shall calibrate the bias of the gyro and accelerometers within 5 miles of open sky driving. These values must be maintained from key cycle to key cycle and not be lost on battery removal. Temperature compensation algorithms are expected. This may be superseded by limitations of the chosen location engine and performance must be agreed to by Ford.

#### LOCATN-REQ-022462/B-3D Gyro/Accelerometer Failure (TcSE ROIN-294200)

If the Internal Gyro fails, then the system shall set the appropriate DTC and then fallback into differential wheel tick Dead Reckoning mode

#### LOCATN-REQ-022463/B-GPS Receiver Failure (TcSE ROIN-294202)

If the GPS Receiver fails, then the system shall notify the user and set the appropriate DTC

#### LOCATN-REQ-022464/B-WIFI (TcSE ROIN-294203)

WIFI data (SSID and signal strength) shall be used as inputs into a third party WIFI positioning engine and utilized as a feedback into the location engine for position augmentation (if licensed by Ford).

#### LOCATN-REQ-289991/A-WRTX/RKX/PPP

Localization correction shall be provided by cellular (or other) interfaces and utilized by the localization engine in order to improve the solution (if licensed)

## LOCATN-FUN-REQ-022465/A-System Inputs (TcSE ROIN-294212)

### Requirements

#### LOCATN-REQ-022466/A-Powermode (TcSE ROIN-294187)

Powermode shall be utilized from the can bus to assist in the debounce of wheel tick resets

#### LOCATN-REQ-022467/A-Reverse Indication (TcSE ROIN-294188)

Reverse indication shall be provided to the location engine

#### LOCATN-REQ-022468/B-Navigation Map Matched Position Feedback (TcSE ROIN-294189)

Location engine shall provide a methodology to allow the navigation application (if equipped) to provide a map matched location (system timestamp representing which fix the map match is against, lat,long,altitude, heading) to be used as part of fusion solution. Confidence values for the lat/long and heading (separate values) should be provided to tell the location engine how confident the match is. Additionally, right hand drive market indication, one way road, lane width and number of lanes must also be provided in order to prevent a center line map match pulling location over from the far right lane into the left lane. Additional items that could be provided include:

Distance to last bi-furcation, Route Active flag, and Altitude,

#### LOCATN-REQ-022469/A-Camera Detected lane (TcSE ROIN-294190)

If available, camera based lane recognition data shall be provided to location/navigation engine to offer lane level guidance

#### LOCATN-REQ-022470/A-Steering Wheel Angle (TcSE ROIN-294191)

If available, steering wheel angle shall be fed into the location engine to augment turn detection

#### Can Bus Internal Interface Rqmts

Can Bus Internal Interface Rqmts

##### LOCATN-REQ-091661/A-Timestamping

CAN data (as applicable) shall be time stamped upon receipt and fed to the location engine. The timestamping shall have no jitter greater than 10% of the delta time between updates of that signal.

##### LOCATN-REQ-091662/A-DataLoss Mitigation

CAN Bus interface will be verified to never drop data. This testing shall be done under worst case system load

##### LOCATN-REQ-091663/A-Data Over Buffering

CAN Bus interface will insure that spacing between consecutive messages is representative of the actual inputs. If typical seperation is 20ms, having 1ms between messages is unacceptable.

## LOCATN-FUN-REQ-022475/A-Configuration Parameters (TcSE ROIN-304495)

### Requirements

#### LOCATN-REQ-022476/C-Configuration (TcSE ROIN-304494)

The system shall obtain the following configuration from the ECU end of line configuration as specified in the Infotainment Diagnostic Specification (IDS).

|  |  |  |
| --- | --- | --- |
| Parameter | Units | Usage |
| Install angle of Apim for Accelerometer (X) | 0 -> 393.21 degrees | Needed for quicker calibration of sensors |
| Install angle of Apim for Accelerometer (Y) | 0 -> 393.21 degrees | Needed for quicker calibration of sensors |
| Install angle of Apim for Accelerometer (Z) | 0 -> 393.21 degrees | Needed for quicker calibration of sensors |
| Wheel ticks to revolution front | 40->100 | Needed for quicker calibration of sensors |
| Wheel ticks to revolution rear | 40->100 | Needed for quicker calibration of sensors |
| Tire Circumference as built | 100 -> 455 cm | Needed for quicker calibration of sensors |
| distance from IP to rear axle | 100 -> 65735 cm | Needed for quicker calibration of sensors |
| Antenna Type | Harada; Laird (0-255 table) | Used for Tuning GNSS Driver to the patch's unique pattern |
| Front Track | 0->655.35 inches | Needed for quicker calibration of sensors |
| Rear Track | 0->655.35 inches | Needed for quicker calibration of sensors |
| Wheel Base | 0->655.35 inches | Needed for quicker calibration of sensors |
| Drive\_Type | 00 – FWD  01 – RWD  02 – AWD  03 – 4WD  04 – Dually 2WD  05 – Dually 4WD  06-FF - Reserved | This is used for selecting which wheel to use as primary for dead reckoning  If FWD, send rear left  If RWD, send front left  if AWD or 4wd send front left  04 or 05 = RWD, so send front left if 06-FF send front left |
| Time Seperation between wheel tick messages | 0x00 – 20ms  0x01 – 30ms  0x02 – 40ms  0x03 – 50ms  0x04 – 60ms  0x05 – 70ms  0x06 – 80ms  0x07 - Reserved | Vehicle specific timing for periodicity of wheel tick messages (work around for non-realtime/timestamped wheel ticks from Can interface) |

#### LOCATN-REQ-318210/A-Auto Configuration for Determining Message Set to Read

On bus wake up the potential Location Service modules will send their respective messages 45E and 21E once and the value will be defaulted to zero.  Once the module that is providing the actual data starts writing to the signal the value will no longer be zero. The module that is not providing the actual data will no longer send the message on the bus after the initial messsage is sent.

The client will initially receive messages 0x45E and 0x21E on bus wake up (initialization) due to the Network initialization attribute being set to Yes.  The client shall monitor bits 4 through 7 of each message as they contain the Message Type parameter which will be used for auto configuration within the client.  When the Message Type is equal to 0x2 (Location2) the client shall use the CAN ID that transmitted the 0x2 as the Location Services data provider.

For FNV2 architecture the LocationServiceLegacy\_Tx interfaces (0x465, 0x466 and 0x467) will not be sent in all configurations. LocationService \_Tx (45E or 21E) shall be used for all location data needs.

## LOCATN-FUN-REQ-022471/A-Power State (TcSE ROIN-294210)

### Requirements

#### LOCATN-REQ-022472/A-Power State (TcSE ROIN-294176)

The system is expected to start calculating location as soon as the bus wakes up. Any vehicle movement shall be captured and reflected in the position solution

## LOCATN-FUN-REQ-022473/A-Performance (TcSE ROIN-294211)

### Requirements

#### LOCATN-REQ-022474/C-Performance (TcSE ROIN-294177)

Localization engine shall meet experience requirments as follows:  
If supporting Navigation functions the Location engine is required to publish a solution at 10hz to support smooth map rendering (if equipped). The Navigation supplier and Tier 1 system supplier may require a higher solution rate and must be provided as part of a RFI process and added to the implementation guide for that product. Expectation is Rendering is at two times the location solution output rate.

If supporting Racing computer applications, a 10hz minimum rate is expected

Location master ECU shall provide Can bus output of position shall be at 1hz (or as specified by dbc) .

Logging shall be at 1hz or a specified rate

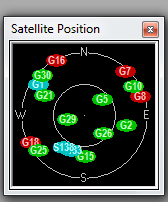
## LOCATN-FUN-REQ-022477/A-Diagnostics (TcSE ROIN-304498)

### Requirements

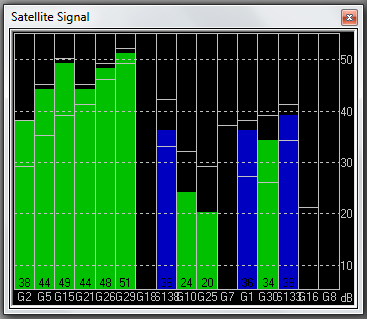
#### LOCATN-REQ-022478/D-Diagnostics (TcSE ROIN-304497)

Localization engine shall provide a method to perform functions below (via external interfaces if not via HMI).

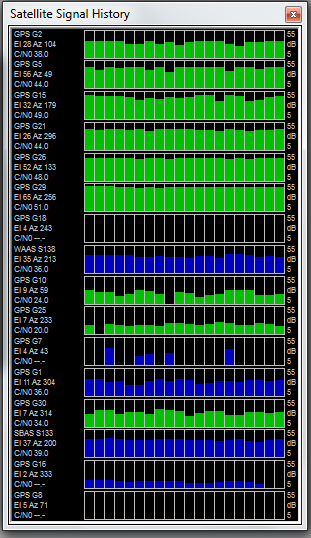
If equipped, System HMI shall provide the following widgets via Bezel Diagnostics and via external tools (with a 1hz update rate).



This shows the distribution of satellites around the vehicle. Inner Circle represents directly above vehicle to 45 degrees down, out circle represents +/- 45 degrees to horizon



This shows real time satellite constellation status and CNO Levels



This widget shows the data from above widget, but over time. With last 30 seconds displayed as a histogram. If 30 seconds not available start with 1 second of data.

Final Widget provides textual data for the following data elements:

Lat/Long/Heading/Altitude/Hdop/Pdop/Vdop/2d Accuracy/3d Accuracy/Vehicle speed/number of satellites (used in solution/seen [which may/may not be used in solution])

Fix Mode/Time To First Fix/Jamming Active/AGC level/Noise Level/Sensor Calibration Status [Wheels/Gyro]/UTC Date/UTC Time/

# Appendix: Reference Documents

|  |  |
| --- | --- |
| Reference # | Document Title |
| 1 | Chicago GPS Drive Test 2013 |
| 2 | WHEEL SPEED/DISTANCE/DIRECTION INFORMATION SHARING (AN-0234) |
| 3 |  |
| 4 |  |
| 5 |  |