System Requirements Specifications for

Navistar Telematics Module

OTA BCM S-Record Update

Version 1.0

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# Feature Scope

This document captures the business requirements derived for software development on the Navistar Telematics module for OTA BCM S-Record Update feature, herein called “the system”. When known, the sources are listed. This document covers the system requirements only. This document is provided on a RESTRICTED basis and is not to be used in any way detrimental to the interests of Navistar.

The scope of this document is limited to the controllers which take part in the programming event and is limited to Navistar Telematics module, Body Control Module, Electronic Instrument Cluster, and interfaces with OCC.

## Physical Description

The implementation of the OTA BCM S-Record Update system consists of the Body Control Module (BCM), Electronic Gauge Cluster (EGC), Navistar Telematics Module, On Command Connection (OCC) and HMI (Human Machine Interaction)

Please refer below words and their detailed descriptions:

* [Key ON Event / Key is in ON position]: This refers to the Vehicle startup when IGN and ACC grids are ON.
* Highlighted text in this document should be treated as open points.
* Commented texts in this document needs a confirmation from stakeholders.

# System Architecture

## Block Diagram

### Navistar Telematics device shall program the BCM s-record package from Navistar cloud. Navistar Telematics device shall program s-record to BCM and send status to Navistar cloud which shall then make it available in OCC.

## Process Flow

### This diagram depicts the end to end process for OTA BCM S-record updates and roles involved in the process.

## User Roles

### These are the roles that shall be involved in the OTA BCM S-Record update process.

## Boundary Diagram

### This diagram shows which interaction requirements are captured in this document. Highlighted in blue rectangle is out of scope of this document.

# On Command Connection Requirements

Note: These system requirements are covered under separate document.

# Navistar Telematic OTA Update Requirements Decomposition

## Generate BCM S-record file and perform checksum

### Every time Navistar Telematics device is turned ON and there are no BCM s-records present on the device memory:

#### Navistar Telematics device shall request BCM to send current BCM s-record information as below (software identification and ECU identification request).

* *HW Revision / Part Number*
* *OP Version*
* *CF Version*
* *PP Version*

#### Navistar Telematics device shall request Cluster to send cluster information as below (software identification and ECU identification request).

* *Software identification*
* *ECU identification*

#### BCM shall transmit requested information to Navistar Telematic device.

#### Cluster shall transmit requested information to Navistar Telematic device.

#### Navistar Telematic device shall transmit current BCM and cluster information to OCC module to compare and generate s-record file.

#### Navistar Telematic device shall send VIN, ESN and calibration ID information to OCC.

#### OCC shall interact with Hyperion and receives s-record file in .zip folder.

#### OCC shall perform checksum validation on zip folder and decide to send zip folder to Navistar Telematic device or delete it.

Note: Please refer ‘xyz.dox’ for OCC interface requirements with Hyperion to generate S-record file and transmit it to Navistar Telematic module.

#### OCC shall push the s-record zip folder to OTA backend along with folder size and CRC checksum.

#### OTA backend shall send zip folder to Navistar Telematic device memory along with file path.

#### Navistar Telematic device shall receive folder size and CRC checksum in Navistar Telematic memory and shall initiate zip folder download process from OTA backend.

#### Navistar Telematic device shall store the contents of a zip folder into a temporary buffer (RAM memory) while downloading the zip folder from OTA backend.

#### Navistar Telematic device shall check the file size and CRC checksum while the zip folder still resides in temporary buffer.

Notes: This step is required to make sure downloading process in buffer does not hinder the folder integrity before it creates physical file in Navistar Telematic device.

##### Navistar Telematic device shall store zip folder into a physical file in Navistar Telematic memory, once the folder integrity checks (File size and CRC checksum) passes.

##### Navistar Telematic device shall not create a zip folder in Navistar Telematic memory and shall ignore the buffer if zip folder integrity check fails.

##### Navistar Telematic device shall attempt to re-download the zip folder from OTA backend in next Key ON event.

#### Navistar Telematic device shall perform integrity check on downloaded s-record zip folder (File size and CRC checksum).

Notes: This step is required to make sure zip folder is intact when it has transformed into physical file from buffer.

##### Navistar Telematic device shall unzip the folder and retrieve individual s-record files if zip folder integrity check passes.

##### Navistar Telematic device shall delete the zip folder from Navistar Telematic memory if zip folder integrity check fails.

###### Navistar Telematic device shall attempt to re-download the zip folder from OTA backend in next Key ON event.

#### Navistar Telematic device shall send status as ‘Downloaded’ to OTA backend systems once individual s-record is retrieved in Navistar Telematic device and wait for next Key ON to start programming sequence.

### Navistar Telematic device shall follow section 4.1.3 once BCM-s-record is present in Navistar Telematic memory at key ON event.

### Sanity checks on the individual s-record file in Navistar Telematics device memory before programming event.

#### Navistar Telematics device shall request BCM to send current BCM s-record information as below (software identification and ECU identification request).

* *HW Revision / Part Number*
* *OP Version*
* *CF Version*
* *PP Version*

#### BCM shall transmit requested information to Navistar Telematic device.

#### Navistar Telematics device shall perform s-record file sanity checks before programming event, to avoid programming failure.

Notes: Refer BCM bootloader document (EED-Z3-2335 BCM VCM Configuration Loader (Bootloader)) to perform these checks.

##### S-record sanity check involves:

###### S-record version checks (encryption and decryption or header file checks)

###### S-record file dependency checks

Navistar Telematics device shall check CF and PP s-record file availability if it detects OP s-record file.

Navistar Telematics device shall check PP s-record file availability if it detects OP and CF s-record file.

##### Navistar Telematics device shall calculate estimated time required to complete BCM programming based on number of s-record to be programmed.

###### This estimated time shall account for successful attempt (best case timing) and additional 3 retry attempts, if BCM programming is failed (worst case timing).

##### Navistar Telematic device shall follow section 4.2 once all s-record version check passes.

##### Navistar Telematic device shall delete all s-record files if sanity check fails on either of the s-record.

###### Navistar Telematic device shall send status as ‘s-record file check failed’ to OCC.

## Check display pre-conditions and get Driver’s consent for programming

### Vehicle state message

#### Navistar Telematic device shall monitor the vehicle state message on J1939 to detect vehicle startup. Vehicle startup can be defined as the transition of IGN and ACC grids are turned ON, while not in Auto start/stop mode.

### Display pre-conditions

#### Navistar Telematic device shall check below pre-conditions before sending any message to cluster

##### Individual s-record files are available in Navistar Telematic device from last key cycle.

##### Wheel based vehicle speed = 0 rpm

##### Battery voltage >= Calibratable Threshold Volts

Note: Please refer ESI 2068-xx for calibration threshold

##### Parking brake is Set.

##### Physical Key is in ON position (through PGN 65096 and SPN 1865)

#### Navistar Telematic device shall not display any message on cluster, if either display pre-conditions are not met and abort the update process until the next key ON.

#### Navistar Telematic device shall initiate first s-record update notification on cluster, if all the display pre-conditions are met.

### Operator consent: First notification

#### Navistar Telematic device shall send a message to the cluster and request for Operator consent to start BCM programming.

##### Message contents: “Vehicle performance update available, X minutes to complete”, Query option: ‘Start/Later’.

#### Operator can Accept/Reject the first notification through cluster screen.

##### Navistar Telematic device shall send second notification to cluster and request operator’s consent for safe location if operator accepts first notification (refer section 4.2.4).

##### Navistar Telematic device shall remove the notification from cluster and send reject count to OCC as a status ‘Driver Rejected[x]’, where [x] stands for number of rejections if operator rejects first notification. Notification can be rejected by:

* *Choosing ‘Later/Cancel’ option*
* *Pressing back button (if available)*
* *Moving vehicle*
* *Wait for 5 minutes, notification will auto-reject.*

### Operator consent: second notification

#### Navistar Telematic device shall display second update notification on cluster when first update notification is accepted.

##### Message contents: “Confirm vehicle is in safe location”, Query option: ‘OK/Cancel’

#### Operator can Accept/Reject the second notification through cluster screen.

##### Navistar Telematic device shall send third notification to cluster if operator accepts second notification and request operator’s consent to turn physical key into ON position (refer section 4.2.5).

##### Navistar Telematic device shall remove the notification from cluster If operator rejects second notification and send reject count to OCC as a status ‘Driver Rejected[x]’, where [x] stands for number of rejections. Notification can be rejected by:

* *Choosing ‘OK/Cancel’ option*
* *Pressing back button (if available)*
* *Moving vehicle*
* *Wait for 5 minutes, notification will auto-reject*

### Operator consent: Third notification

#### Navistar Telematic shall display third update notification on cluster when second update notification is accepted.

##### Message contents (Example): “Confirm Key is in ON Position”, Query option: ‘Yes/Cancel’

#### Operator can Accept/Reject the third notification through cluster screen.

##### Navistar Telematic device shall check programming pre-conditions before initiating s-record update process if operator accepts third notification (refer section 4.3).

##### Navistar Telematic device shall remove the notification from cluster if operator rejects third notification and send reject count to OCC as a status ‘Driver Rejected[x]’, where [x] stands for number of rejections. Notification can be rejected by:

* *Choosing ‘Yes/Cancel’ option*
* *Pressing back button (If possible)*
* *Moving vehicle*
* *Wait for 5 minutes, notification will auto-reject*

## Programming pre-condition checks

### Navistar Telematic device shall check all below pre-conditions to start programming event

#### Engine RPM = 0

#### Parking Brake = Set

#### Key is ON/Engine OFF (IGN and ACC grids are ON)

#### Auto Start/Stop = Disabled

#### Battery Voltage >= Calibratable Threshold Volts

### Navistar Telematic Device shall send appropriate notification to cluster to ensure operator satisfies all programming pre-conditions. The below programming pre-conditions are checked in order and messages are also displayed in below order:

#### Battery voltage < Calibratable Threshold Volts

##### Display timed message (30 secs) on cluster screen “Battery Voltage is too low to update performance package” and abort update process till next key cycle.

#### Engine Speed > 0 RPM

##### Display message (example) ‘Turn OFF Engine and Move Key in ON position’.

##### Navistar Telematic device shall abort update process till next key ON If Engine Speed is not equal to 0 rpm within 30 sec.

##### Navistar Telematic device shall remove popup if Engine speed = 0 rpm within 30 sec and check next pre-conditions.

#### Parking Brake is NOT Set

##### Display message ‘Set Parking Brake’.

##### Navistar Telematics device shall abort update process till next key cycle if Parking Brake is not Set within 30 sec.

##### Navistar Telematic device shall remove popup if Parking Brake is Set within 30 sec and check next pre-conditions.

#### Auto Start/Stop Active

##### Display message ‘Deactivate Auto Start/Stop mode’

##### Navistar Telematics device shall abort update process till next key cycle if Auto Start/Stop is not deactivated within 30 sec.

##### Navistar Telematic shall remove popup if Auto Start/Stop is deactivated within 30 sec and check next pre-conditions.

### Navistar Telematic device shall initiate secure diagnostic mode request with BCM module once all programming pre-conditions are met.

Note: for secure diagnostic mode, refer CSD0006\_SW\_S\_BCM cybersecurity requirements

## Programming Initialization Request

### Navistar Telematic device shall send programming initialization request to BCM module and receives response

#### Navistar Telematic device shall send programming initialization request along with ‘Crank Inhibit Request’ to BCM module.

#### Navistar Telematic device shall abort update process until next key ON, if BCM rejects programming initialization request (Interlock Not Met / Programming not-allowed).

##### Navistar Telematics device shall attempt to request 3 times before aborting the update process when Navistar Telematic device does not receive any response from BCM for programming initialization.

##### While aborting, Navistar Telematic shall display timed message (10 seconds) on cluster: ‘Could not initiate. Try Later’.

#### Navistar Telematic shall check for all flashing pre-conditions before starting an update process once BCM approves Navistar Telematic device’s programming initialization requests (Programming allowed).

### Navistar Telematic Device shall check flashing pre-conditions once programming initialization request is approved

#### Navistar Telematic device shall check all below flashing pre-conditions

##### Engine RPM = 0

##### Parking Brake = Set

##### Key is ON/Engine OFF (IGN and ACC grids are ON)

##### Auto Start/Stop = Disabled

##### Battery Voltage >= Calibratable Threshold Volts

##### Wheel based vehicle speed = 0

#### Navistar Telematic Device shall start programming event mentioned in section 4.6 once all flashing pre-conditions are satisfied, if not Navistar Telematics device shall send appropriate notification to cluster to ensure operator satisfies all pre-conditions.

## Programming Event

### Navistar Telematic device shall send total programming time needed to complete performance update (as calculated in 4.1.3.3.2 section) to cluster before it initiates programming event.

#### Instrument cluster shall start programming timer on screen once it receives message from Navistar Telematics device.

##### Message contents (Example): ‘BCM Performance update is in progress. It will take X mins of time to complete. Please keep Key switch in ON position’.

##### Cluster shall display programming % and timer on screen.

##### Cluster shall give priority to programming message and timer display once BCM programming is initiated.

#### Navistar Telematics device shall send the “In Progress” status to OTA backend systems to indicate s-record update is in progress.

### Navistar Telematic device shall check available s-record file once programming timer message sent to cluster and start update process in below order.

#### Kernel Update (OP Programming)

##### Kernel s-record programming takes priority over other s-record programming.

##### Navistar Telematic device shall skip kernel s-record update and perform configuration s-record and PP s-record programming respectively if kernel version is up to date.

#### Configuration Update (CF Programming)

##### Configuration s-record programming takes second priority if kernel s-record update is to be programmed.

##### Configuration s-record programming shall take priority over PP s-record update if Kernel s-record update is up to date.

#### Programmable Parameter Update (PP Programming)

##### PP s-record programming takes least priority

##### Navistar Telematic device shall perform pp s-record programming if kernel s-record and configuration s-record is up to date.

### Navistar Telematic device shall initiate Kernel Update and check programming status.

#### Navistar Telematic device shall initiate Kernel update and shall request programming status message from BCM once kernel s-record programming is completed.

#### BCM bootloader shall send programming status through software identification message and Navistar Telematic device shall decide if re-programming is required.

##### Navistar Telematic device shall re-program Kernel update without secure diagnostic mode, when BCM Kernel update is failed.

###### Navistar Telematic device shall retry 3 programming attempts, when kernel update is failed.

###### Navistar Telematics shall notify OCC about failed status as ‘Failed (x) where x stands for number of failed attempts. Failure of all recovery attempts is counted as one failure.

###### Navistar Telematic device shall not attempt CF update and PP Update if Kernel update is failed.

##### Navistar Telematic device shall store the success result and initiate configuration update, when BCM Kernel update is successful.

### Navistar Telematic device shall initiate Configuration Update and check programming status.

#### Navistar Telematic device shall initiate Configuration update and shall request programming status message from BCM once configuration s-record programming is completed.

#### BCM bootloader shall send programming status through software identification message and Navistar Telematic device shall decide if re-programming is required.

##### Navistar Telematic device shall re-program configuration update without secure diagnostic mode if BCM configuration update is failed.

###### Navistar Telematic device shall retry 3 programming attempts, when kernel update is failed.

###### Navistar Telematics shall notify OCC about failed status as ‘Failed (x) where x stands for number of failed attempts. Failure of all recovery attempts is counted as one failure.

###### Navistar Telematic device shall not attempt Programming Parameter Update if configuration update is failed.

##### Navistar Telematic device shall store the success result and initiate programming parameter update if BCM configuration update is successful.

### Navistar Telematic device shall initiate Programming Parameter Update and check programming status.

#### Navistar Telematic device shall initiate Programming Parameter update and shall request programming status message from BCM, once Programming Parameter s-record programming is completed.

#### BCM bootloader shall send programming status through software identification message and Navistar Telematic device shall decide if re-programming is required.

##### Navistar Telematic device shall re-program Programming Parameter update without secure diagnostic mode if BCM Programming Parameter update is failed.

###### Navistar Telematic device shall retry 3 programming attempts, when kernel update is failed.

###### Navistar Telematics shall notify OCC about failed status as ‘Failed (x) where x stands for number of failed attempts. Failure of all recovery attempts is counted as one failure.

##### Navistar Telematic device shall store the success result if BCM configuration update is successful.

### Navistar Telematic device shall update cluster and OCC, when all s-records are successfully programmed.

#### Navistar Telematic device shall send a timed notification to cluster (15 seconds) as ‘Performance update successful’.

##### Cluster shall abort the programming timer once it receives a timed notification as ‘Performance update successful’ from Navistar Telematics device.

#### Navistar Telematic device shall send BCM s-record update status as ‘Current’ to OTA backend systems.

### Navistar Telematics device shall **abort** BCM programming event if either of the below conditions occurs:

* All 3 retry attempts are failed
* Operators perform Key OFF

Note: During BCM programming event, if operator turn OFF Key switch, BCM will be non-operable even if operator move Key to ON position afterword. In this case, Navistar Telematics device will not wake up till it sees Vehicle State message. So, Telematics device won’t be able to reinitiate the programming event if ongoing programming is aborted by turning Key OFF.

#### Cluster shall display below timed message if it does not receive communication from Navistar Telematics device within timer duration with Key switch is not in OFF State.

##### Cluster shall abort the programming timer in case Operator performs Key OFF.

##### Cluster shall display message (Example): “Could not complete Performance Update. Drive Vehicle to nearest service center for programming update”.

### Navistar Telematics device shall continue programming event if operator crank the engine and move the vehicle.

#### Cluster shall continue with programming timer.

#### Navistar Telematics device shall send a timed notification to cluster (15 seconds) as ‘Performance update successful’ once programming is successful.

##### Cluster shall abort the programming timer once it receives a timed notification as ‘Performance update successful’ from Navistar Telematics device.

#### Navistar Telematics device shall retry 3 programming attempts if programming is unsuccessful.

##### Cluster shall display below timed message if it does not receive communication from Navistar Telematics device within timer duration

##### Cluster shall display message (Example): “Could not complete Performance Update. Drive Vehicle to nearest service center for programming update”.

#### All requirements from section 4.5.7 applies in this case too.

# System Failures

## Fault Conditions and system Actions

|  |  |  |
| --- | --- | --- |
| # | **Fault Conditions** | **System Reaction** |
|  | Navistar Telematic loose power during zip folder transfer from OCC to Navistar Telematic (circuit failure) | * If failure is recovered, OCC shall retry transfer process in next key cycle. |
|  | ~~OCC Communication failed during zip file transfer Hyperion to OCC~~ | * ~~Covered in OCC interface document.~~ |
|  | OCC Communication failed during programming event | * Navistar Telematics device shall store the programming status and send out latest status to OCC once communication between OCC and telematics device is established. |
|  | Navistar Telematic to BCM secure diagnostic mode is not established. | * Navistar Telematics device shall abort the update process and wait for next key cycle. |
|  | Failure to meet programming pre-conditions after secure diagnostic mode has established between Navistar Telematic and BCM module. | * Navistar Telematics device shall abort the update process and wait for next key cycle to start update. |
|  | Cluster Failure (loose power grids) before programming event | * Navistar Telematics device received approval (operator consent) for programming event. No impact for now. |
|  | Cluster Loose power during programming event | * Operator should see blank cluster and should drive truck to nearby service center. |
|  | Operators try to crank the engine after operator consent and before programming | * Navistar Telematics device shall abort the update process and wait for next key cycle to start update. |
|  | Operators try to crank the engine during programming event | * Navistar Telematics device shall abort the update process and wait for next key cycle to start update. * Talk with program team for appropriate action. * Include in FMEA |
|  | Auto Start/Stop is activated during programming event. | * Auto start/stop will only active during Key OFF scenario. Not a valid failure. |
|  | Operators try to turn OFF vehicle during programming event. | * Navistar Telematics device shall abort the update process and wait for next key cycle to start update. * BCM programming will be started, only when we receive consent from driver for the physical Key switch. BCM programming should be done with Key switch in ON position. * Talk with program team for appropriate action. * Include in FMEA |
|  | Park brake is released during programming event | * No impact on programming. Parking brake can be read in next key cycle only. * Currently, we don’t have any means to inform driver to set park break, as BCM is under programming event. |
|  | Service tool is connected in the middle of programming event | * Ignore service tool. Complete programming event. |
|  | ~~Any fault condition occurred after programming completion~~ | * ~~Functional Requirement.~~ |
|  | BCM is non-operational after all programming retries and failed | * Discuss with program team as next scope. (Currently we don’t have any measure to indicate BCM programming is failed on cluster. Ideally, we should inform driver about the failure and next action.) |
|  | Battery voltage dropped while programming or while retry attempts | * Navistar Telematics device shall abort the update process and wait for next key cycle to perform pre-condition check again. |
|  | Bad internet connection during programming | * Does not impact on programming event |
|  | Operator is not in the vehicle and programming failed | * Drivers need to turn ON the truck and drive to nearest service center or location where, service tool is accessible to program BCM. |
|  | BCM programming failed and BCM is inoperable | * Driver’s action * Drivers need to turn ON the truck and drive to nearest service center or location where, service tool is accessible to program BCM. |

# References

## Navistar Documents

### DR101138 Gen 4 Instrument Cluster

### DR101281 On Command Link Module

### CSD0006\_SW\_S\_BCM Cybersecurity Phase 1 Requirements

### EEARCH-14 CA 2.x Proprietary SPN Assignments

### EPS-148 Information Symbols and Displays for Products

### ESI 2068-xx ESI Over the Air programming

### EED-Z3-2335 BCM VCM Configuration Loader (Bootloader)

# Revision History

This section shall include the date of revision release, the Navistar USERID, a detailed account of the changes and the release version number. In the case where detailed revision information is captured in the changed section only a reference to that section need be contained in the Description field. This may happen when significant changes are the result of a negotiation and the details of the agreement are directly captured with the affected requirements.

|  |  |  |  |
| --- | --- | --- | --- |
| Date | Revised By | Description | Version |
| 15-Dec-2021 | Kiran Thorat | Initial Release | 1.0 |

# Feature Design Team

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