Cummins Inc.

NGDI File Upload Process

SDK – Specifications & Requirements

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NGDI File Upload Process (v1.1.1)

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II. PURPOSE

This document explains the process for uploading a data file to Cummins Connected Solutions, providing both Specifications and Requirements for the process.

A. Overview

The NGDI file upload process should be used by telematics providers who need to send data files to Cummins Connected Solutions. **In general, NGDI file upload is the preferred method of transmitting data to Cummins Connected Solutions.** Use cases where the NGDI file upload process is preferred include:

1. Data to be transmitted has already been saved in file format.
2. Over-the-air connection is sporadic. In this case, it may be preferred for the telematics device to compile data into a file, and then upload the file when it has an over-the-air connection.

B. Terminology

In the context of this document, there are notable terms that have specific, special meanings:

- **Provider**
  Telematics and real-time data integration solution providers.

- **Customer**
  The end user, or whomever is delegated to represent the customer.

- **Fleet Manager**
  A type of customer role; one who manages a fleet of vehicles.

- **Operator**
  A type of customer role; one who operates a vehicle in a fleet.

- **Calibration**
  The complete file to be loaded into the ECM, which includes software code, factory-set parameters, and tool-adjustable parameters (also known as “Trims”).

- **Tool-adjustable Parameters**
  ECM software parameters that can be adjusted using a service tool (in this

document, a telematics device acting as a service tool).

- **Buffering**
  Transferring the new calibration or parameter write package from telematics device to the ECM memory.

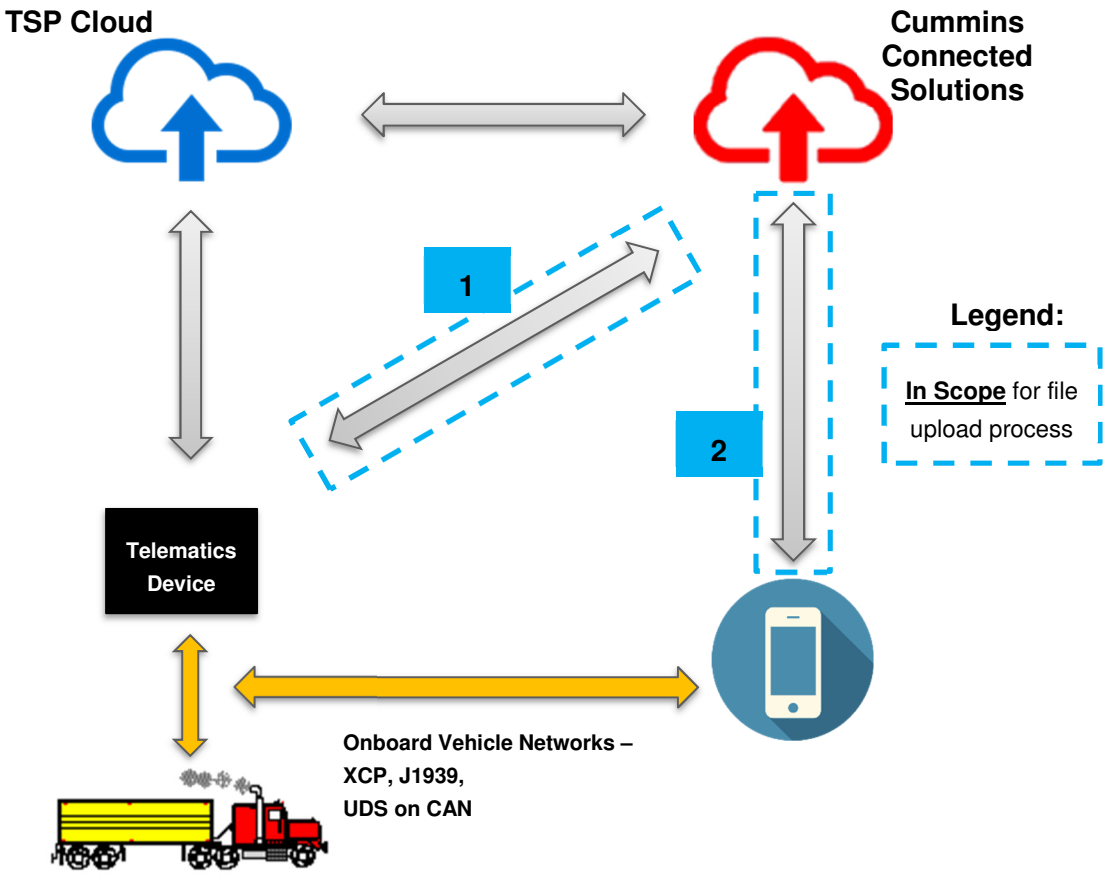
- **HMI**
  Human Machine Interface

- **UDS**
  Unified Diagnostic Services

III. SPECIFICATIONS

A. NGDI File Upload Process Details

The diagram below illustrates a high-level representation of the overall system and application of the NGDI file upload process:



The "In Scope for file upload process" (blue dotted boxed) arrows represent data file upload between Cummins Connected Solutions and:

1. TSP telematics devices
2. "BYOD" telematics devices, such as a cell phone

The NGDI file upload process is identical for both of these paths. (Data file upload between TSP cloud and TSP telematics devices is, of course, at the TSP's discretion.)

NOTE:

This document does not go into detail regarding the specifications and requirements for the “Onboard Vehicle Networks” (gold arrows in the diagram above). They are outside the scope of this document.

IV. REQUIREMENTS

The requirements that follow in this section must be satisfied by the parties concerned, in order to ensure proper system functionality.

A. Compiling and Preparing a Data File for Upload

The telematics device must meet several requirements related to compiling data into a file and preparing it for upload to Cummins Connected Solutions. These requirements vary by the type of data being collected.

Several types of data are currently supported for upload to Cummins Connected Solutions. Detailed requirements for each type are documented below. This document includes common requirements that apply to **all** data types, followed by requirements that are specific by data type.

1. Common requirements
2. Public data (e.g. J1939)
3. Proprietary data (e.g. UDS)
4. Engineering data (requires Engineering Access Level (EAL))
5. Trip data (also requires EAL)

1. Common Requirements

The telematics device collects data from the ECM in different ways for different data types. See the “Next Gen Data Ingestion Interface” SDK document for details. The following requirements apply regardless of the type of data being collected.

Global Settings to Manage Wireless Data Usage

In recognition that there are different cellular data cost structures, the following settings are available to help manage cost. These settings must be configurable. They are global (e.g. they cannot be set on a parameter-by-parameter basis).

1.1 Connection Preference: “WiFi + Cellular” and “WiFi Only”.

1.2 Data Latency Time: The amount of calendar time that must elapse between data collection and possible file upload via cellular (see below for more details).

Data Storage Management by Priority

In addition to the global settings, the data being collected has a Priority setting. See the "Next Gen Data Ingestion Interface" SDK document for details of how Priority is set. Data that accumulates during a period without wireless connection should be managed as follows (per Priority):

1.3 High: "Real-time" data that should be compiled into a file and uploaded as soon as the appropriate type of connection is established. Must be uploaded before Normal and Low Priority data.
1.4 Normal: "Latent" data that can wait for a WiFi connection (to reduce cellular data costs). Must be uploaded before Low Priority data.
1.5 Low: "Latent" data that can wait for a WiFi connection (to reduce cellular data costs).

If the storage space becomes full, the following rules apply:

1.6 The lowest priority data must be overwritten first.
1.7 Within a priority, the oldest data must be overwritten first (a "FIFO rolling buffer").
1.8 When data of different priorities is being collected, the lowest priority data collection must be stopped when the highest priority data needs its storage space.

Example 1: If only one priority of data is being collected, begin a "FIFO rolling buffer".

Example 2: If Normal and/or High Priority data are being collected, stop collecting Low Priority data and begin to overwrite it with the highest priority incoming data (FIFO).

Example 3: If Normal **and** High Priority data are being collected, begin overwriting the Low Priority data with the incoming High Priority data (FIFO). Also begin a FIFO rolling buffer for the Normal Priority data. Then, if all the Low Priority data is overwritten, stop collecting Normal Priority data and begin overwriting the Normal Priority data with the incoming High Priority data (FIFO). Finally, if all the Normal Priority data is overwritten, begin a FIFO rolling buffer for the High Priority data.

When to Prepare Accumulated Data for Upload

The following table explains when to prepare data files for upload:

NOTE: Data file uploads shall be performed when the lowest cost data transmission path is available, unless the below requirements will not be fulfilled (e.g. use WiFi as default).		
Connection Preference	**Data Priority**	**Prepare the data file to upload (in Priority order)…**
WiFi + Cellular	Normal / Low	by WiFi as soon as connection is made or until Data Latency Time elapses, then by whichever connects first, WiFi or cellular
WiFi + Cellular	High	as soon as either WiFi or cellular connection is made
WiFi only	Normal / Low	by WiFi as soon as connection is made
WiFi only	High	by WiFi as soon as connection is made or until Data Latency Time elapses, then by whichever connects first, WiFi or cellular

The telematics device shall perform the following steps to prepare each data file to upload (in Priority order):

1.9 Save the data file.
- 1.9.1 Filename shall be according to the data type-specific requirements.
- 1.9.2 File structure shall be in .csv format, as specified in “Example Data File.csv” for all data types **except Trip data**. (Trip data file structure is plain text, as specified in the Trip Data Files section below.)
  - 1.9.2.1 The first eight rows of the file are a fixed header.
    - 1.9.2.1.1 The rows “startingEventDateTimestamps” and “endingEventDateTimestamps” shall be populated as follows:
      - 1.9.2.1.1.1 For event-based data sampling, these shall be populated with the DateTimestamps of each instance of the starting event and ending event. If no ending event is specified, both rows shall be populated with the DateTimestamp(s) of the starting event(s).
      - 1.9.2.1.1.2 For periodic data sampling, these shall be populated with the DateTimestamp of the creation and closing of the data file.
  - 1.9.2.2 <empty row>
  - 1.9.2.3 The next section of the file is a “metadata table”. All the data to populate the table is specified in the “singleSampleParameters” section of the Data Content Specification. See the “Next Gen Data Ingestion

Interface" SDK document for details. Each row shall include a DateTimestamp (in ISO 8601 format) and the corresponding data.
NOTE: This section should be omitted when there are no "singleSampleParameters" specified.

1.9.2.4 <empty row>

1.9.2.5 The final section of the file is a "data table". All the data to populate the table is specified in the "allSampleParameters" section of the Data Content Specification. See the "Next Gen Data Ingestion Interface" SDK document for details. Each row shall include a DateTimestamp (in ISO 8601 format) and the corresponding data.

1.10 Compress (Zip) the data file.

1.11 Initiate the file upload sequence (see File Upload Sequence section below).

NOTE: The above section ("Common Requirements") describes how to manage data and file uploads upon establishing wireless connection(s). While wireless connection(s) are stably connected, the telematics device shall follow the "maxTransmitPeriod" and "maxSetSize" logic to prepare data files for upload, as specified in the Data Sampling Specification. See the "Next Gen Data Ingestion Interface" SDK document for details.

2. Public Data Files

The telematics device receives public data broadcasts from the ECM and requests public data from the ECM using protocol-defined parameter IDs. For J1939, this would be the SPN. In the case of Manufacturer Defined PGNs, the PGN is used instead of the SPN, preceded by 'P'. Example: P65479. The parameter IDs are used as data column headers in the data file.

Public data also includes some "special" parameters: ActiveFaultCodes, InactiveFaultCodes, and PendingFaultCodes. If any of these are included in the Data Content Specification, the telematics device shall include in the data file either:

1) The entire converted list of applicable fault codes by SPN, FMI, and Occurrence Count as shown in "Example Data File.csv". For fault codes that have only one identifier, use the SPN field.
2) The entire list of applicable fault codes as a raw hex string (as received from the source/ECM).

Filename shall be as follows: **<TSPName, e.g. EDGE>_<BoxID>_<ESN>_SCxxxx _<FileCloseDateTimestamp_in_ISO8601_format>.csv**

3. Proprietary Data Files

The telematics device also requests proprietary data from the ECM using protocol-defined parameter IDs. For UDS, this would be the UDS ID. The parameter IDs are used as data column headers in the data file.

Proprietary data may also include the same "special" parameters listed in the Public Data Files section above. If any of these are included in the Data Content Specification, the telematics device shall include them in the data file as described in the Public Data Files section above.

Filename shall be as follows: **<TSPName, e.g. EDGE>_<BoxID>_<ESN>_SCxxxx _<FileCloseDateTimestamp_in_ISO8601_format>.csv**

4. Engineering Data Files

The telematics device requests engineering data from the ECM using a Dynamically Defined Data Identifier (DDID). See the "Next Gen Data Ingestion Interface" SDK document for details. The telematics device may request data from more than one DDID. **The data from each DDID must be compiled into a separate data file.**

Filename shall be as follows: **<TSPName, e.g. EDGE>_<BoxID>_<ESN>_SCxxxx _<FileCloseDateTimestamp_in_ISO8601_format>_DDID.csv**

Note: The "metadata table" section will typically be omitted from engineering data files, because there will typically be no "singleSampleParameters" specified in the Data Content Specification. See the "Next Gen Data Ingestion Interface" SDK document for details.

5. Trip Data Files

The telematics device retrieves trip data from the ECM one block at a time by repeatedly calling the RoutineControl service. See the "Next Gen Data Ingestion Interface" SDK document for details. **The telematics device must upload each data block as a separate data file.**

Filename shall be as follows: **<BoxID>-<TSPName, e.g. EDGE>-<FileCloseDatestamp_in_YYYYMMDD>-<FileCloseTimestamp_in_HHMMSSsss>.txt**

YYYY = Year

MM = Month
DD = Day
HH = Hour (24-hour)
MM = Minute
SSsss = Second + milliseconds

Note: As mentioned in the Common Requirements section above, the trip data file does not follow the "Example Data File.csv" data file structure. Instead, the telematics device must upload the data block retrieved from the ECM as a text file.

B. File Upload Sequence for AWS IoT

The NGDI file upload process follows the below sequence diagram. "AWS IoT" and "AWS S3" represent different portions of Cummins Connected Solutions:

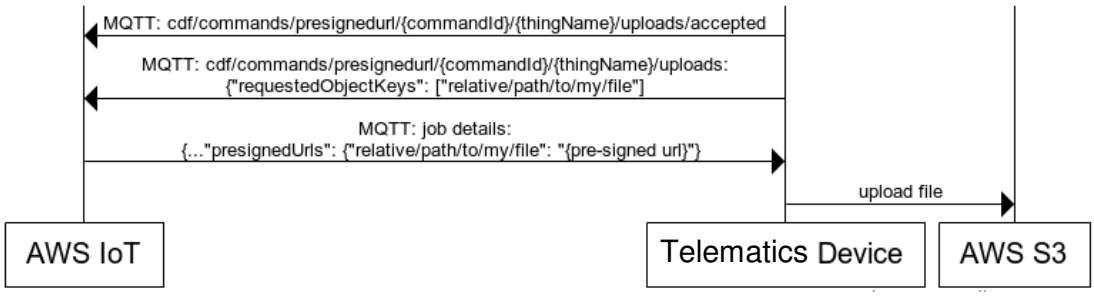


Figure 1: File Upload Sequence Diagram

The file upload sequence consists of four steps (as shown above). The sequence is initiated by the telematics device, which interfaces with two different portions of Cummins Connected Solutions – AWS IoT and AWS S3.

The four steps are (from top to bottom):
1. Subscribe to upload request topic
2. Publish file path
3. Receive pre-signed URL
4. Upload file

1. Subscribe to Upload Request Topic

At any time before attempting to upload a file, the telematics device shall subscribe to the topic shown in the top-most arrow of Figure 1: File Upload Sequence Diagram.

2. Publish File Path

When the telematics device has prepared a data file to upload, it shall publish an MQTT message to the topic shown in the second arrow of Figure 1: File Upload Sequence Diagram. This tells AWS IoT the path to the data file to be uploaded.

3. Receive Pre-signed URL

AWS IoT shall respond with an MQTT message containing a pre-signed URL, which enables the telematics device to upload the data file to AWS S3. This step is shown in the third arrow of Figure 1: File Upload Sequence Diagram.

4. Upload File

Finally, the telematics device shall upload the data file to AWS S3 via the pre-signed URL it received. This step is shown in the last arrow of Figure 1: File Upload Sequence Diagram.

V. DOCUMENT UPDATES

Version Number	Change Date	Modified By	Reviewed By	Changes Made
1.1.1	May 17, 2019	Michael F. Mattern		• Updated data file format
1.0.1	March 5, 2019	Michael F. Mattern		• Updated data file format

1.0.0	January 30, 2019	Michael F. Mattern		• Document created

VI. REQUIRED FILES

The following items are essential supplementary documents, APIs, schema, additional data, miscellaneous necessary files, etc.

Document Name	Description	Item Type
Example Data File_Rev2019-05-08.csv	Example .csv file showing the required format for data files to be uploaded to Cummins Connected Solutions by the telematics device in support of the NGDI file upload process	Comma-separated values (.csv) file