External Connected Vehicle Systems Interface Requirements

The Project shall integrate with the Data Exchange Platform (DEP) as detailed in the following requirements:

1. Connected Vehicle equipment shall be OmniAir certified.
2. RSUs shall be capable of forwarding received messages, filtered by channel and/or PSID, each to multiple target destination IP/port (UDP) combinations.
    a. Shall include configurable options to include the IEEE 1609.3 frame, IEEE 1609.2 frame, and the SAE J2735 formatted message payload.
3. Provide a system to support Connected Vehicle field data aggregation:
    a. Provide software (and dedicated hardware if necessary) to support aggregation of messages received from field devices (RSUs) which will then be sent to one or more target destination IP/port (UDP) combinations. The software/hardware should support multiple-input/multiple-output configurations. i.e. Messages received with a specified PSID may be sent to multiple destination targets; multiple messages received with different PSIDs may be sent to the same destination target. Message forwarding should occur in near-real-time. No long-term storage of messages is necessary.
    b. Aggregation software shall include configurable options to include the mac address of the source RSU ethernet port, IEEE 1609.3 frame, IEEE 1609.2 frame, and the SAE J2735 message payload in each message.
4. Provide a system capable of sending MAP and SPAT messages (in a SAE J2735 compliant format) to multiple target destination IP addresses and ports.
5. Provide Connected Vehicle messages using appropriate SAE/IEEE standards.
    a. Basic Safety Messages will comply with SAE J2945/1 or SAE J3161/1 for performance/accuracy requirements.
    b. Personal Safety Messages will comply with SAE J2945/9 for performance/accuracy requirements.
    c. SPAT/MAP/SSM/SRM/TIM/RSM messages will comply with the appropriate standards as applicable and available (including, but not limited to CTI 4501 for connected intersections).
        i. MAP messages sent to the DEP shall provide:
            1. The corresponding buffer values for a given MapData.intersections[*].laneSet[*].laneAttributes.laneType CHOICE
                a. For example, if MapData.intersections[*].laneSet[*].laneAttributes.laneType CHOICE is “LaneAttributes-Vehicle”, the “vehicle” buffer should be populated.
                b. Note this is already required by J2735, but the US DOT tool to build MAPs does not set it.
        ii. SPaT messages sent to the DEP:
            1. shall set the following optional fields:
                a. SPAT.timeStamp
                b. SPAT.intersections[*].moy
                c. SPAT.intersections[*].timeStamp
            2. shall be sent over UDP as J2735 UPER.

3. may optionally be contained within an Immediate Forward message with J2735 UPER as ASCII hexadecimal payload in the format specified by USDOT RSU v4.1 (https://rosap.ntl.bts.gov/view/dot/3600).

iii. TIM messages sent the DEP shall set the following optional fields:

1. TIM.packetID
    a. This is used by the platform and other systems to track changes to the same message over time.
    b. This value should be unique for each TIM, but subsequent updates to the same TIM should use the same value as the original TIM revision.

d. It is recommended that an 8-byte DEP-specific header be prepended to support localization functionality for J2735 UPER sent to the DEP described as follows.

i. The prefix shall begin with a fixed sentinel value of hexadecimal 0x80000000 to indicate the header is present followed by a decimal encoding of the IPv4 source (i.e. RSU IP address or other unique source address).

ii. For example, for BSM messages received from an RSU with IPv4 address 10.20.40.80, the prefix would be 0x800000000a142850.

1. MAP and SPAT similarly would include a signal controller device IP address.
2. Messages such as TIM, which are broadcasted via one or more devices, should include the IPv4 address of the system used to send the message.

iii. If the J2735 UPER is contained within an RSU v4.1 Immediate Forward Payload, then the prefix shall be inserted after "Payload=" and before the DSRC message in ASCII hexadecimal representation.

e. A collection of one or more MAP messages may be provided via ZIP archive.

i. The zip file shall be named with fields separated by underscores with a ".zip" suffix. The fields are the name of the entity providing the file (e.g. agency, agency division (i.e. district), and/or project name) and date of revision formatted as YYYYMMDD (e.g. "FDOT-District5- I4FRAME_20230131.zip").

ii. The following are recommendations on directory structure, but the platform will accept any directory format.

1. The directories immediately inside the zip archive shall be named for the primary route of the MAP location. (e.g. "US441", "IH75").
2. Within each primary route directory, a subdirectory shall be created for each Map. This subdirectory should/shall be named for an applicable cross street, landmark, or floating-point mile marker along the primary route. A two-letter abbreviation for direction of travel may be included. Direction of travel may be abbreviated "NB", "EB", "SB", or "WB". No additional directories shall be included.

iii. MAP files shall have a file name with ".hex" extension and contain the encoded MAP. Additional files may be included but will be ignored.

1. Each MAP ".hex" file provided in this manner shall contain a single ASCII line of J2735 UPER-encoded hex string terminated by a UNIX style new line character.

6. Configure all equipment and the aggregation system to forward Connected Vehicle messages to the V2X DEP and support integration testing with the V2X DEP project team.