

VEHICLE INFRASTRUCTURE INTEGRATION (VII)

WEATHER INFORMATION POC APPLICATION REQUIREMENTS



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1 Introduction

The scope of this VII POC Weather Information application is to collect vehicle-based probe data (as available) and use this data to estimate atmospheric and pavement conditions.

The goals of the POC Weather Information application are focused on testing the feasibility of using vehicle probe data to determine weather characteristics as well as enabling weather service providers to provide enhanced traveler weather advisories. In particular, this application will demonstrate how vehicle probe data would be useful in determining ground-level atmospheric conditions and pavement surface conditions. In addition, the Weather Information application will enable the weather community to understand how vehicle-based atmospheric and pavement data are compared to in-situ observations and climatological outliers. It will provide the weather community with some knowledge of the latency issues involved with vehicle probe data collection and processing. Finally, this application will improve the weather community's ability to quantify the meteorological state variables based on vehicle probe data.

2 Requirements Guide

2.1 Precedence And Criticality Of Requirements

The following terms are used to qualify the requirements (shall), expectations (should) and assumptions (will) contained in this document and are based on RFC 2119.

WORD	MEANING
SHALL	This word means that the definition is an absolute requirement of the application.
SHOULD	This word means that valid reasons may exist for not meeting the specific expectation, but the full implications of this must be understood carefully.
WILL	This word indicates functionality that the operational environment surrounding the application is to provide.

2.2 Requirements Identification

All articles in this document will be categorized as follows:

- Assumption – assumption about the operation of entities external to the application
- Constraint – constraint specifies behaviors or characteristics levied on the application by external entities.
- Functional Requirements – functional requirements specify actionable behaviors of the application.
- Security Requirements – security requirements specify mechanisms to prevent the application from compromising connected resources.
- Performance Requirements – performance requirements specify quantifiable characteristics of application operations.
- Performance Expectations – end-to-end performance expected for each application.
- External Interface Requirements – external interface requirements define application interfaces with VII and non-VII Systems.

All articles in this document are identified by a tag of the form: **ST-Category-Number**. The definitions for the tags are listed below:

“S” stands for **Scope**, single character in the 1st position with the following value list

“A”	for Application
”V”	for VII System
“X”	for External Entity

“**T**” stands for **Type**, a single character in the 2nd position with the following value list

“A”	for “Assumptions”
“C”	for “Constraint”
“F”	for “Functional Requirement”
“S”	for “Security Requirement”
“P”	for “Performance Requirement”
“X”	for “External Application Interface Requirement”
“N”	for “End-to-End Performance Expectation”

Category is a variable length text string, usually a defined VII acronym, which will identify a specific application.

“TI”	for Traveler Information
“WI”	for Weather Information
“CMLB”	for Corridor Management Load Balancing
“CMPA”	for Corridor Management Planning Assistance
“STO”	for Signal Timing Optimization
“RM”	for Ramp Metering
“PD”	for Pothole Detection

Number is a two digit numerical value which identifies the specific requirement. Child requirements are numbered using a hierarchical decimal system of numerical values.

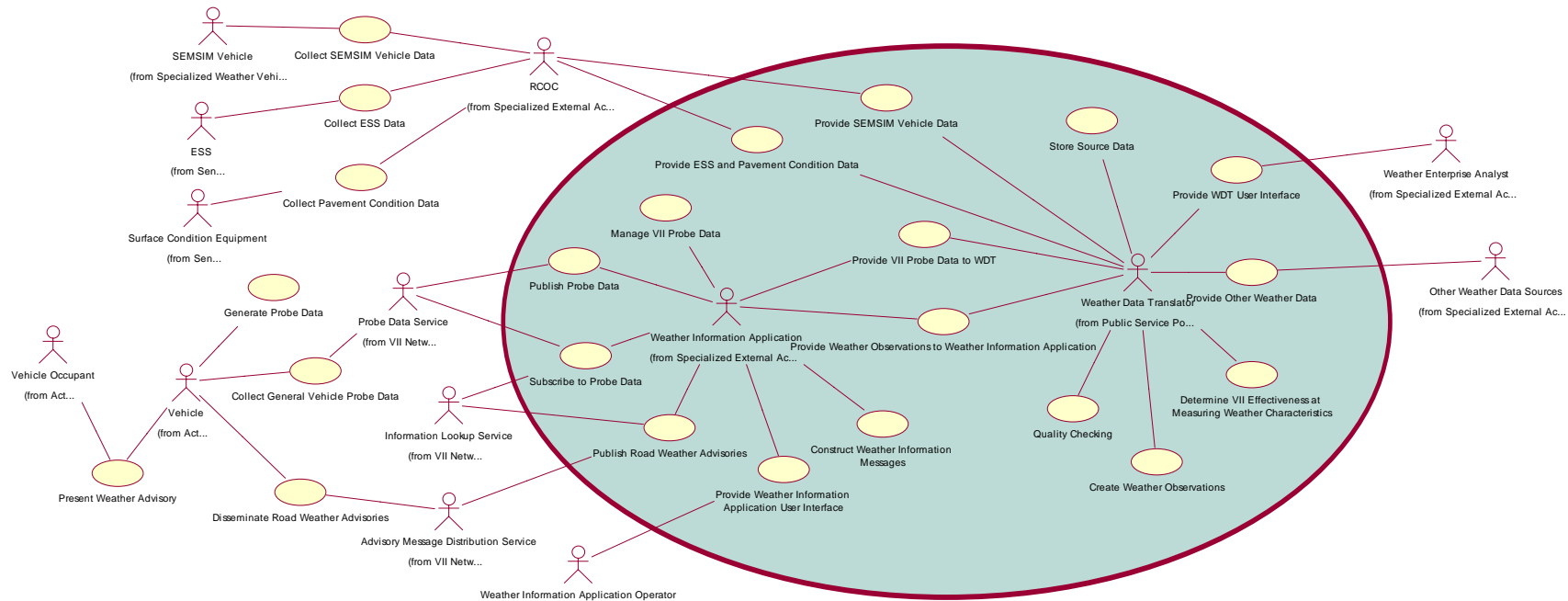
2.3 Requirements Relationship

The requirements have been developed as “parent-child” requirements and should be tested as such. In other words, verification of all “child” requirements automatically implies verification of their “parent” requirement.

3 Application Boundary Definition

The following POC use case diagram identifies the actors and basic functions involved in implementing the Weather Information Application. This diagram was taken from the VII POC Applications Concept of Operations document version 1.4¹. The shaded portion of the diagram represents the boundary of the Weather Information Application for POC.

Figure 3.1 – POC Weather Information Application Use Case Diagram



¹ This is the most recent version of the Weather Information POC Use Case diagram. Version 1.4 of the VII Applications Concept of Operations will eventually be updated with this edition of the diagram. The changes included in this diagram are critical to the writing of the functional requirements for the Weather Information application, as they better identify the role of the Weather Data Translator than the officially published version.

The following table maps the actors in the use case to the VII System boundary, as defined within the VII National System Requirements.

Table 3.1 – Weather Information Application Actors

Actor	VII System Architecture Entities
Vehicle Occupant	Vehicle External Entity
Vehicle	Vehicle
SEMSIM Vehicle	Network User External Entity
ESS	Network User External Entity
Surface Condition Equipment (SCE)	Network User External Entity
RCOC	Network User External Entity
Other Weather Data Sources	Network User External Entity
Weather Information Application	Network User
Advisory Message Distribution Service	VII System
Probe Data Service	VII System
Information Lookup Service	VII System
Weather Data Translator	Network User
Weather Information Application Operator	Network User External Entity
Weather Enterprise Analyst	Network User External Entity

As shown in the above table, the Weather Information Application “lives” on the Network User side, outside of the VII System. However, in order for the application to function as intended, it requires all the other actors identified in the use case to perform appropriate actions.

The requirements in the following sections are developed around the basic functions identified within the shaded portion of the use case diagram. The actors in the use case diagram are used as “nouns” to describe the requirements. These requirements are levied on the POC implementation only, and may or may not apply to the Day-1 Weather Information Applications.

4 Assumptions and Constraints

4.1 Assumptions

Identifier	VII System Assumptions
VA-WI-01	The Vehicle will generate probe data snapshots in accordance with SAE J2735 version 15 and the POC Additions and Exceptions to J2735 (APP190-02).
VA-WI-01.1	All probe data snapshots generated by the Vehicle will include latitude and longitude of the vehicle location.
VA-WI-01.2	All probe data snapshots generated by the Vehicle will include elevation of the vehicle location.
VA-WI-01.3	All probe data snapshots generated by the Vehicle will include time (hour, minute and seconds) that the snapshot was generated.
VA-WI-01.4	All probe data snapshots generated by the Vehicle will include date (month, day, year) that the snapshot was generated.
VA-WI-01.5	All probe data snapshots generated by the Vehicle will include vehicle heading.
VA-WI-01.6	All probe data snapshots generated by the Vehicle will include vehicle speed.
VA-WI-01.7	All probe data snapshots generated by the Vehicle will include the probe segment number.
VA-WI-01.8	The Vehicle's probe snapshot generation parameters will be configurable within the vehicle.
VA-WI-01.9	All probe data snapshots generated by the vehicle will include the wiper status (i.e., not equipped, off, intermittent, low, high and automatic wiper equipped).
VA-WI-01.10	All probe data snapshots generated by the vehicle will include the exterior air temperature.
VA-WI-01.11	All probe data snapshots generated by the vehicle will include the headlight status.
VA-WI-01.12	All probe data snapshots generated by the vehicle will include the atmospheric pressure.
VA-WI-01.13	All probe data snapshots generated by the vehicle will include the ABS status.
VA-WI-01.14	All probe data snapshots generated by the vehicle will include the traction control status.
VA-WI-01.15	All probe data snapshots generated by the vehicle will include the stability control status.
VA-WI-02	The Vehicle will buffer probe data snapshots in accordance with SAE J2735 version 15 and the POC Additions and Exceptions to J2735 (APP190-02).
VA-WI-02.1	The Vehicle's probe snapshot buffering parameters will be configurable within the vehicle.
VA-WI-03	The Vehicle will provide probe data snapshots to the Probe Data Service, when available, as part of Probe Data Messages in accordance with the process outlined in SAE J2735 version 15 and the POC Additions and Exceptions to J2735 (APP190-02).

Identifier	VII System Assumptions
VA-WI-04	The Vehicle will log information related to probe data generation and Probe Data Service interactions.
VA-WI-04.1	The Vehicle will log all probe data snapshots generated within the previous 24-hour period using extended storage in the vehicle.
VA-WI-04.1.1	For each snapshot logged by the Vehicle, the snapshot type (periodic, start, stop, or event including the event trigger) will be recorded.
VA-WI-04.1.2	For each snapshot logged by the Vehicle, the time and type of buffer state changes will be recorded.
VA-WI-04.1.3	For each snapshot logged by the Vehicle, the probe data management scheme at time of each snapshot generation will be recorded.
VA-WI-04.1.4	Each snapshot logged by the Vehicle will be uniquely identifiable.
VA-WI-04.2	The Vehicle will log all of the locations and times at which the probe segment number changes.
VA-WI-04.3	The Vehicle will log the location and times at which the snapshot buffer overflows.
VA-WI-04.4	The Vehicle will log the times at which the vehicle location information is not available.
VA-WI-04.5	The Vehicle will log the location and times at which the vehicle operational data used for probe data generation is not available.
VA-WI-04.6	The Vehicle will log probe messages provided to the Probe Data Service within the previous 24-hour period.
VA-WI-04.6.1	For each message logged, the Vehicle will record information necessary to identify the specific probe snapshots included in each message.
VA-WI-04.6.2	For each message logged, the Vehicle will record the location and time of transmission of the message to the Probe Data Service.
VA-WI-04.6.3	For each message logged, the Vehicle will record information necessary to identify which infrastructure component (i.e. which RSE) of the Probe Data Service the message was transmitted to.
VA-WI-04.6.4	For each message logged, the Vehicle will record the probe data management scheme at the time the message was transmitted to the Probe Data Service.
VA-WI-05	The Probe Data Service will accept a subscription from the Weather Information Application as specified in Network User to Service Delivery Node (SDN) Subsystem Software Interface Requirements Specification - Version 1.1 (or latest), using the X-031 interface.
VA-WI-06	The Probe Data Service will attempt to deliver all Probe Data Snapshots received from Vehicles to the Weather Information Application, if the snapshot parameters meet the Weather Information Application's probe data subscription profile.
VA-WI-07	The Advisory Message Distribution Service will accept advisory message delivery requests from the Weather Information Application as specified in Network User to Service Delivery Node (SDN) Subsystem Software Interface Requirements Specification - Version 1.1 (or latest), using the X-032 interface.
VA-WI-08	The Advisory Message Distribution Service will forward the

Identifier	VII System Assumptions
	Weather Information Application provided advisory messages to vehicles, as specified in SDN to RSE Subsystem Software Interface Requirements Specification - Version 1.1 (or latest) and RSE to OBE Subsystem Software Interface Requirements Specification.
VA-WI-09	The Vehicle will present the Weather Information Application provided advisory messages to the Vehicle Occupant, as specified in APP110-01 POC In-Vehicle Signage Application SFPR – Version 1.0.
VA-WI-10	The Information Lookup Service will respond to a request from the Weather Information Application with the information necessary for the Weather Information Application to subscribe to probe data within a specified geographic boundary.
VA-WI-11	The Information Lookup Service will respond to a request from the Weather Information Application with the information necessary for the Weather Information Application to deliver an advisory message within a specified geographic boundary.
VA-WI-12	The Advisory Message Distribution Service will allow for creating, modifying, deleting, and querying advisory message delivery requests by the Weather Information Application.
VA-WI-13	The Information Lookup Service will respond to a request from the Weather Information Application with the information necessary for the Weather Information Application to submit advisory messages within a specified geographic boundary.
VA-WI-14	The Advisory Message Distribution Service will accept advisory messages from the Weather Information Application, as specified in Network User to Service Delivery Node (SDN) Subsystem Software Interface Requirements Specification - Version 1.1 (or latest), using the X-032 interface.

Identifier	Non-VII External Entity Assumptions
XA-WI-01	Other Weather Data Sources will provide Doppler radar data, satellite data, AWOS (Automated Weather Observing System) and ASOS (Automated Surface Observing System) data and their associated metadata to the Weather Information Application.
XA-WI-02	The RCOC will provide environmental condition data from the SEMSIM Vehicles to the Weather Information Application.
XA-WI-02.1	The environmental condition data from the SEMSIM Vehicles will include the latitude and longitude location.
XA-WI-02.2	The environmental condition data from the SEMSIM Vehicles will include the elevation.
XA-WI-02.3	The environmental condition data from the SEMSIM Vehicles will include the time (hour, minute and seconds).
XA-WI-02.4	The environmental condition data from the SEMSIM Vehicles will include the date (year, month, day).
XA-WI-02.5	The environmental condition data from the SEMSIM Vehicles will include the exterior air temperature.
XA-WI-02.6	The environmental condition data from the SEMSIM Vehicles will include the vehicle speed.

Identifier	Non-VII External Entity Assumptions
XA-WI-02.7	The environmental condition data from the SEMSIM Vehicles will include the vehicle heading.
XA-WI-02.8	The environmental condition data from the SEMSIM Vehicles will include the pavement temperature.
XA-WI-03	The RCOC will provide environmental sensor station data from the ESS equipment to the Weather Information Application.
XA-WI-03.1	The environmental condition data from the ESS equipment will include the latitude and longitude location.
XA-WI-03.2	The environmental condition data from the ESS equipment will include the elevation.
XA-WI-03.3	The environmental condition data from the ESS equipment will include the time (hour, minute and seconds).
XA-WI-03.4	The environmental condition data from the ESS equipment will include the date (year, month, day).
XA-WI-03.5	The environmental condition data from the ESS equipment will include the air temperature.
XA-WI-03.6	The environmental condition data from the ESS equipment will include the precipitation type.
XA-WI-03.7	The environmental condition data from the ESS equipment will include the precipitation rate.
XA-WI-03.8	The environmental condition data from the ESS equipment will include the wind speed.
XA-WI-03.9	The environmental condition data from the ESS equipment will include the wind direction.
XA-WI-03.10	The environmental condition data from the ESS equipment will include the relative humidity.
XA-WI-03.11	The environmental condition data from the ESS equipment will include the dewpoint.
XA-WI-03.12	The environmental condition data from the ESS equipment will include the visibility.
XA-WI-03.13	The environmental condition data from the ESS equipment will include the atmospheric pressure.
XA-WI-04	The RCOC will provide surface condition data from the SCE to the Weather Information Application.
XA-WI-04.1	The surface condition data from the SCE will include the latitude and longitude location.
XA-WI-04.2	The surface condition data from the SCE will include the elevation.
XA-WI-04.3	The surface condition data from the SCE will include the time (hour, minute and seconds).
XA-WI-04.4	The surface condition data from the SCE will include the date (month, day, year).
XA-WI-04.5	The surface condition data from the SCE will include the surface temperature.
XA-WI-04.6	The surface condition data from the SCE will include the precipitation characteristics, including: wet, dry, frost, and frozen.
XA-WI-04.7	The surface condition data from the SCE will include the amounts of de-icing agent(s) on the surface.

4.2 Constraints

Identifier	Constraints
AC-WI-01	The geographic extent of the Weather Information Application is limited to the Detroit POC Development and Test Environment.
AC-WI-02	Only a limited number of POC vehicles will produce probe data snapshots that contain stability control status.
AC-WI-03	Only a limited number of POC vehicles will produce probe data snapshots that contain the atmospheric pressure.
AC-WI-04	Only a limited number of POC vehicles will produce probe data snapshots that contain ABS status.
AC-WI-05	Only a limited number of POC vehicles will produce probe data snapshots that contain traction control status.

5 Functional Requirements

5.1 Subscribe to Probe Data

Identifier	Functional Requirements
AF-WI-01	The Weather Information Application shall subscribe to probe data from the Probe Data Service.
AF-WI-01.1	The Weather Information Application shall have the ability to obtain information about the availability of Probe Data Service.
AF-WI-01.1.1	The Weather Information Application shall send a Probe Data Service availability lookup request to the Information Lookup Service, when directed by the Weather Information Application Operator.
AF-WI-01.1.2	The Weather Information Application shall receive information from the Information Lookup Service about the availability of the Probe Data Service.
AF-WI-01.2	The Weather Information Application shall include a probe data subscription profile.
AF-WI-01.2.1	The Weather Information Application's probe data subscription profile shall include a geographic boundary defined by the Weather Information Application Operator.
AF-WI-01.2.2	The Weather Information Application's probe data subscription profile shall include a start time (month, day, year, hour, and minute) of the subscription defined by the Weather Information Application Operator.
AF-WI-01.2.3	The Weather Information Application's probe data subscription profile shall include an end time (month, day, year, hour, and minute) of the subscription defined by the Weather Information Application Operator.
AF-WI-01.2.4	The Weather Information Application's probe data subscription profile shall include probe data elements defined by the Weather Information Application Operator.
AF-WI-01.3	The Weather Information Application shall update the probe data subscription profile when directed by the Weather Information Application Operator.
AF-WI-01.4	The Weather Information Application shall send a subscription request based on the subscription profile to the Probe Data Service, when directed by the Weather Information Application Operator.
AF-WI-01.5	The Weather Information Application shall cancel a subscription to the Probe Data Service when directed by the Weather Information Application Operator.

5.2 Publish Probe Data

Identifier	Functional Requirements
AF-WI-02	The Weather Information Application shall receive probe data snapshots from the Probe Data Service.

5.3 Manage VII Probe Data

Identifier	Functional Requirements
AF-WI-03	The Weather Information Application shall manage probe data snapshots received from the Probe Data Service..
AF-WI-03.1	The Weather Information Application shall store all probe data snapshots received from the Probe Data Service.
AF-WI-03.1.1	The Weather Information Application shall store all probe data snapshots received form the Probe Data Service, in received form.
AF-WI-03.1.2	The Weather Information Application shall store the time the snapshot was received by the Weather Information Application, for all probe data snapshots received from the Probe Data Service.
AF-WI-03.1.3	The Weather Information Application shall have a mechanism to access stored probe data snapshots, based on the value of any parameter included within the snapshots.
AF-WI-03.2	The Weather Information Application shall verify the contents of probe data snapshots received from the Probe Data Service.
AF-WI-03.2.1	The Weather Information Application shall verify that the contents of probe data snapshots received from the Probe Data Service match with the corresponding subscription requests.
AF-WI-03.2.2	The Weather Information Application shall store the result of the verification for all probe data snapshots.

5.4 Provide VII Probe Data to WDT

Identifier	Functional Requirements
AF-WI-04	The Weather Information Application shall provide probe data to the Weather Data Translator.
AF-WI-04.1	The Weather Information Application shall provide a mechanism whereby the stored probe data is accessible to the Weather Data Translator.
AF-WI-04.2	The Weather Data Translator shall obtain stored probe data from the Weather Information Application.

5.5 Provide SEMSIM Vehicle Data

Identifier	Functional Requirements
AF-WI-05	The Weather Information Application shall have the ability to receive environmental condition data from RCOC.

5.6 Provide ESS and Pavement Condition Data

Identifier	Functional Requirements
AF-WI-06	The Weather Information Application shall have the ability to receive environmental and surface condition data from RCOC.

5.7 Provide Other Weather Data

Identifier	Functional Requirements
AF-WI-07	The Weather Information Application shall have the ability to receive Doppler radar data, satellite data, AWOS and ASOS data and their associated metadata from Other Weather Data Sources.

5.8 Store Source Data

Identifier	Functional Requirements
AF-WI-08	The Weather Data Translator shall store source data received from the Weather Information Application, RCOC, and Other Weather Data Sources.
AF-WI-08.1	The Weather Data Translator shall store probe data received from the Weather Information Application, in received form.
AF-WI-08.1.1	The Weather Data Translator shall store the time the snapshot was received by the Weather Data Translator, for all probe data snapshots received from the Weather Information Application.
AF-WI-08.1.2	The Weather Data Translator shall have a mechanism to access stored probe data snapshots based on the value of any parameter included within the snapshots.
AF-WI-08.2	The Weather Data Translator shall store environmental and surface condition data received from RCOC, in received form.
AF-WI-08.2.1	The Weather Data Translator shall store the time the environmental and surface condition data was received by the Weather Data Translator, for all environmental and surface condition data received from RCOC.
AF-WI-08.2.2	The Weather Data Translator shall have a mechanism to access stored environmental and surface condition data based on the value of any parameter included within the environmental and surface condition data.
AF-WI-08.3	The Weather Data Translator shall store Doppler radar data, satellite data, AWOS and ASOS data and their associated metadata received from Other Weather Data Sources, in received form.
AF-WI-08.3.1	The Weather Data Translator shall store the time the Doppler radar data, satellite data, AWOS and ASOS data was received by the Weather Data Translator, for all Doppler radar data, satellite data, AWOS and ASOS data received from Other Weather Data Sources.
AF-WI-08.3.2	The Weather Data Translator shall have a mechanism to access stored Doppler radar data, satellite data, AWOS and ASOS data based on the value of any parameter included within the Doppler radar data, satellite data, AWOS and ASOS data.

5.9 Quality Checking

Identifier	Functional Requirements
AF-WI-09	The Weather Data Translator shall perform quality checking on the source data.
AF-WI-09.1	The Weather Data Translator shall flag probe data elements and data from RCOC and Other Weather Data Sources when the data elements are not within configurable threshold values.
AF-WI-09.2	The Weather Data Translator shall flag probe data elements and data from RCOC and Other Weather Data Sources when the data elements are not within the thresholds of the Doppler radar data.
AF-WI-09.3	The Weather Data Translator shall flag probe data elements and data from RCOC and Other Weather Data Sources when the data elements are not within the climate boundaries.
AF-WI-09.4	The Weather Data Translator shall flag probe data elements and data from RCOC and Other Weather Data Sources when the data elements are not within the physical boundaries.
AF-WI-09.5	The Weather Data Translator shall flag probe data elements and data from RCOC and Other Weather Data Sources when the data elements are not within the trend and bias analysis envelopes.
AF-WI-09.6	The Weather Data Translator shall flag probe data elements and data from RCOC and Other Weather Data Sources when the data elements do not meet spatial testing criteria.

5.10 Create Weather Observations

Identifier	Functional Requirements
AF-WI-10	The Weather Data Translator shall create weather and surface condition observations.
AF-WI-10.1	The Weather Data Translator shall determine exterior air temperature.
AF-WI-10.1.1	When enabled by the Weather Enterprise Analyst, the Weather Data Translator shall utilize quality-checked probe data and data from RCOC and Other Weather Data Sources and determine exterior air temperature.
AF-WI-10.1.2	The Weather Data Translator shall geo-locate all exterior air temperature observations.
AF-WI-10.1.3	The Weather Data Translator shall store all exterior air temperature observations.
AF-WI-10.1.4	The Weather Data Translator shall verify that all exterior air temperature observations are within threshold values defined by the Weather Enterprise Analyst.
AF-WI-10.1.5	The Weather Data Translator shall store the result of the verification for all exterior air temperature observations.
AF-WI-10.2	The Weather Data Translator shall determine possible precipitation occurrence, intensity and type.
AF-WI-10.2.1	When enabled by the Weather Enterprise Analyst, the Weather Data Translator shall utilize quality-checked probe data and data from RCOC and Other Weather Data Sources and determine

Identifier	Functional Requirements
	possible precipitation occurrence, intensity and type.
AF-WI-10.2.2	The Weather Data Translator shall geo-locate all precipitation observations.
AF-WI-10.2.3	The Weather Data Translator shall store all precipitation observations.
AF-WI-10.2.4	The Weather Data Translator shall verify that all precipitation observations are within threshold values defined by the Weather Enterprise Analyst.
AF-WI-10.2.5	The Weather Data Translator shall store the result of the verification for all precipitation observations.
AF-WI-10.3	The Weather Data Translator shall determine atmospheric pressure.
AF-WI-10.3.1	When enabled by the Weather Enterprise Analyst, the Weather Data Translator shall utilize quality-checked probe data and data from RCOC and Other Weather Data Sources and determine atmospheric pressure.
AF-WI-10.3.2	The Weather Data Translator shall geo-locate all atmospheric pressure observations.
AF-WI-10.3.3	The Weather Data Translator shall store all atmospheric pressure observations.
AF-WI-10.3.4	The Weather Data Translator shall verify that all atmospheric pressure observations are within threshold values defined by the Weather Enterprise Analyst.
AF-WI-10.3.5	The Weather Data Translator shall store the result of the verification for all atmospheric pressure observations.
AF-WI-10.4	The Weather Data Translator shall determine mobility index value.
AF-WI-10.4.1	When enabled by the Weather Enterprise Analyst, the Weather Data Translator shall utilize quality-checked probe data and data from RCOC and Other Weather Data Sources and determine mobility index value indicating roadway slipperiness.
AF-WI-10.4.2	The Weather Data Translator shall geo-locate all mobility index values.
AF-WI-10.4.3	The Weather Data Translator shall store all mobility index values.
AF-WI-10.4.4	The Weather Data Translator shall verify that all mobility index values are within threshold values defined by the Weather Enterprise Analyst.
AF-WI-10.4.5	The Weather Data Translator shall store the result of the verification for all mobility index values.

5.11 Determine VII Effectiveness at Measuring Weather Characteristics

Identifier	Functional Requirements
AF-WI-11	The Weather Data Translator shall provide access to the stored weather and surface condition observations for analysis by the Weather Enterprise Analyst to determine the effectiveness of

Identifier	Functional Requirements
	probe data-assisted roadway weather measurement.

5.12 Provide Weather Observations to Weather Information Application

Identifier	Functional Requirements
AF-WI-12	The Weather Data Translator shall provide weather and surface condition observations to the Weather Information Application.
AF-WI-12.1	The Weather Data Translator shall provide a mechanism whereby either all or only verified weather and surface condition observations are accessible to the Weather Information Application, as determined by the Weather Enterprise Analyst.
AF-WI-12.2	The Weather Information Application shall obtain weather and surface condition observations from the Weather Data Translator.
AF-WI-12.3	The Weather Information Application shall store weather and surface condition observations obtained from the Weather Data Translator.

5.13 Construct Weather Information Messages

Identifier	Functional Requirements
AF-WI-13	The Weather Information Application shall construct weather information messages.
AF-WI-13.1	The Weather Information Application shall construct weather information messages for icy roadway and icy bridge conditions, using the Traffic Advisory Message format specified in APP190-02 POC Additions and Exceptions to the POC Version of SAE J2735.
AF-WI-13.2	The Weather Information Application shall have up-to-date geographic information data covering the geographic extent of the Weather Information Application, to geo-locate weather information messages.
AF-WI-13.3	The Weather Information Application shall define the freeways and arterials included in the geographic information data into weather information reporting links.
AF-WI-13.4	The Weather Information Application shall define the start and end points of the weather information reporting links using freeway interchanges, arterial intersections, bridges, or pre-defined landmarks.
AF-WI-13.5	The Weather Information Application shall utilize Weather Data Translator-provided weather and surface condition observations (i.e. mobility index values), along with the weather information reporting links, to construct weather information messages.
AF-WI-13.6	The Weather Information Application shall store constructed weather information messages.

5.14 Publish Road Weather Advisories

Identifier	Functional Requirements
AF-WI-14	The Weather Information Application shall provide weather information messages to the Advisory Message Distribution Service.
AF-WI-14.1	The Weather Information Application shall have the ability to obtain information about the availability of Advisory Message Distribution Service.
AF-WI-14.1.1	The Weather Information Application shall send a Advisory Message Distribution Service availability lookup request to the Information Lookup Service, when directed by the Weather Information Application Operator.
AF-WI-14.1.2	The Weather Information Application shall receive information from the Information Lookup Service about the availability of the Advisory Message Distribution Service.
AF-WI-14.2	The Weather Information Application shall provide the Weather Information Application Operator the ability to construct broadcast strategies which identify the distribution parameters of weather information messages.
AF-WI-14.2.1	The Weather Information Application broadcast strategies shall be for any given combination of weather information message type, location, duration, and priority.
AF-WI-14.2.2	The Weather Information Application broadcast strategies shall include the distribution parameters specified in Network User to Service Delivery Node (SDN) Subsystem Software Interface Requirements Specification - Version 1.1 (or latest), using the X-032 interface.
AF-WI-14.2.3	The Weather Information Application shall store broadcast strategies.
AF-WI-14.3	The Weather Information Application shall generate advisory message delivery requests.
AF-WI-14.3.1	The Weather Information Application shall generate an advisory message delivery request when a new weather information message is constructed.
AF-WI-14.3.2	The Weather Information Application shall include in the advisory message delivery request, a broadcast strategy based on the newly constructed advisory message type, location, duration, and priority.
AF-WI-14.3.3	The Weather Information Application shall include, as part of the advisory message delivery request, the newly constructed advisory message.
AF-WI-14.4	The Weather Information Application shall send advisory message delivery requests to the Advisory Message Distribution Service.
AF-WI-14.5	The Weather Information Application shall store advisory message delivery requests.
AF-WI-14.6	The Weather Information Application shall cancel advisory message delivery requests to the Advisory Message Distribution

Identifier	Functional Requirements
	Service, when directed by the Weather Information Application Operator.

5.15 Provide Weather Information Application User Interface

Identifier	Functional Requirements
AF-WI-15	The Weather Information Application shall provide a User Interface (UI) for the Weather Information Application Operator to manage the Weather Information Application.
AF-WI-15.1	The Weather Information Application shall provide a User Interface (UI) for the Weather Information Application Operator to manage the probe data subscription.
AF-WI-15.1.1	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to add and modify the probe data elements of the probe data subscription profile.
AF-WI-15.1.2	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to add and modify the geographic boundary of the probe data subscription profile.
AF-WI-15.1.3	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to add and modify the start and end times of the probe data subscription profile.
AF-WI-15.1.4	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to send a probe data subscription request.
AF-WI-15.1.5	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to cancel a probe data subscription request.
AF-WI-15.2	The Weather Information Application shall provide a UI for the Weather Information Application Operator to manage probe data.
AF-WI-15.2.1	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to view, in a tabular form, probe data stored by the Weather Information Application.
AF-WI-15.2.2	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to select a subset of stored probe data for viewing, based on the value of any parameter of the probe data snapshot.
AF-WI-15.2.3	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to select a subset of stored probe data for viewing, based on the time the probe data snapshot was received from the Probe Data Service.
AF-WI-15.2.4	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to view the most recently received probe data snapshots.
AF-WI-15.2.5	The Weather Information Application UI shall provide the

Identifier	Functional Requirements
	Weather Information Application Operator the ability to view any probe data verification errors generated by the Weather Information Application.
AF-WI-15.3	The Weather Information Application shall provide a UI for the Weather Information Application Operator to manage weather information messages.
AF-WI-15.3.1	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to define the active regions (i.e. region within which a link weather information message gets presented to the Vehicle Occupant) for each weather information reporting link.
AF-WI-15.3.2	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to view weather information messages in a tabular format, using one row for each pre-defined weather information reporting link.
AF-WI-15.3.3	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to view the most recently generated weather information messages.
AF-WI-15.3.4	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to view any weather information related errors generated by the Weather Information Application.
AF-WI-15.4	The Weather Information Application shall provide a UI for the Weather Information Application Operator to define weather information reporting links.
AF-WI-15.5	The Weather Information Application shall provide a UI for the Weather Information Application Operator to view in tabular form weather and surface condition observations stored by the Weather Information Application.
AF-WI-15.6	The Weather Information Application shall provide a UI for the Weather Information Application Operator to view advisory message delivery requests.
AF-WI-15.6.1	The Weather Information Application shall provide a UI for the Weather Information Application Operator to view the active, scheduled, and expired advisory message delivery requests in a tabular format, using one row for each delivery request.
AF-WI-15.6.2	The Weather Information Application UI shall update the view with the latest advisory message delivery requests generated by the Weather Information Application.
AF-WI-15.6.3	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to view any delivery request related errors reported by the Advisory Message Distribution Service.
AF-WI-15.7	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to cancel an advisory message delivery request.
AF-WI-15.8	The Weather Information Application shall provide a UI for the Weather Information Application Operator to view errors generated by the Weather Information Application related to

Identifier	Functional Requirements
	Weather Data Translator-provided data.
AF-WI-15.9	The Weather Information Application shall provide a UI for the Weather Information Application Operator to create, view, modify, and delete broadcast strategies for broadcasting weather information messages at various RSEs within geographic extent of the Weather Information Application.
AF-WI-15.10	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to create lookup requests to the Information Lookup Service about information on VII System managed entities (i.e. RSEs, Probe Data Service availability, and Advisory Message Distribution Service availability).
AF-WI-15.11	The Weather Information Application UI shall provide the Weather Information Application Operator the ability to view information about VII System managed entities (i.e. RSEs, Probe Data Service availability, and Advisory Message Distribution Service availability).

5.16 Provide Weather Data Translator User Interface

Identifier	Functional Requirements
AF-WI-16	The Weather Data Translator shall provide a User Interface (UI) for the Weather Enterprise Analyst to manage the Weather Data Translator.
AF-WI-16.1	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to extract stored weather observations for manual analysis of the effectiveness of probe data-assisted roadway weather measurement.
AF-WI-16.2	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to define the threshold values for the mobility index, atmospheric pressure, precipitation, and exterior air temperature, to create weather observations.
AF-WI-16.3	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to set what data and metadata (i.e. data received from the Weather Information Application, RCOC, and Other Weather Data Sources) are stored by the Weather Data Translator.
AF-WI-16.4	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to configure quality checking thresholds.
AF-WI-16.5	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to configure quality checking climate boundaries.
AF-WI-16.6	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to configure quality checking physical boundaries.
AF-WI-16.7	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to configure quality checking trend and bias analysis envelopes.

Identifier	Functional Requirements
AF-WI-16.8	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to configure quality checking spatial testing criteria.
AF-WI-16.9	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to set parameters for the algorithms used to determine mobility index value, atmospheric pressure, precipitation, and exterior air temperature.
AF-WI-16.10	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to choose to provide to the Weather Information Application either all weather and surface condition observations, or only those that have been verified.
AF-WI-16.11	The Weather Data Translator shall provide a UI for the Weather Enterprise Analyst to enable or disable, either separately or together, the analysis of source data for determine mobility index value, atmospheric pressure, precipitation, and exterior air temperature.

6 Security Requirements

Identifier	Security Requirements
AS-WI-01	The Weather Information Application shall be coded to ensure that adequate security measures are in place to prevent it from compromising connected system resources both within the host computing and VII infrastructure environments.
AS-WI-02	The Weather Information Application shall be subject to a code security assessment to ensure it complies with safe coding practices.
AS-WI-03	The Weather Information Application shall validate all user input to prevent maliciously entered data from being accepted.
AS-WI-04	The Weather Information Application shall enforce access policies associated with specific user roles.
AS-WI-05	Upon detection of any security event, the Weather Information Application shall isolate the compromised component in order to render it harmless to the rest of the network.
AS-WI-06	The Weather Information Application shall prevent known message-based attacks from inbound XML formatted data.
AS-WI-07	The Weather Information Application shall only use FIPS 140-2 compliant crypto algorithms wherever encryption is needed.
AS-WI-08	The Weather Information Application shall encrypt a user's ID and password while performing authentication.
AS-WI-09	The Weather Information Application shall encrypt it's own user ID and password used to establish connectivity to the DBMS.
AS-WI-10	The Weather Information Application shall store all user ID's and password's in the DBMS in either encrypted or hashed format.
AS-WI-11	The Weather Information Application shall be designed with user roles which employ the concept of least privileges.
AS-WI-12	The Weather Information Application shall be designed to connect to the DBMS with an account that is consistent with the concept of least privileges.
AS-WI-13	The Weather Information Application shall only communicate with the VII CA Subsystem via a private, or virtual private communications link.
AS-WI-14	The Weather Information Application shall only communicate with Managed Entities via a private, or virtual private communications link.

7 External Interface Requirements

Identifier	External Interface Requirements
AX-WI-01	The Weather Information Application shall utilize the X-034 interface, as defined in the Network User to Service Delivery Node (SDN) Subsystem Software Interface Requirements Specification - Version 1.1 (or latest), when communicating with the Information Lookup Service.
AX-WI-02	The Weather Information Application shall utilize the X-031 interface, as defined in the Network User to Service Delivery Node (SDN) Subsystem Software Interface Requirements Specification - Version 1.1 (or latest), when communicating with the Probe Data Service.
AX-WI-03	The Weather Information Application shall utilize the X-032 interface, as defined in the Network User to Service Delivery Node (SDN) Subsystem Software Interface Requirements Specification - Version 1.1 (or latest), when communicating with the Advisory Message Distribution Service.
AX-WI-04	The Weather Data Translator shall receive SEMSIM, ESS, and SCE data, using an interface specified by RCOG.
AX-WI-05	The Weather Data Translator shall receive Doppler radar data, satellite data, AWOS (Automated Weather Observing System) and ASOS (Automated Surface Observing System) data and their associated metadata, using an interface specified by the Other Weather Data Sources.

8 Performance Requirements

Identifier	Performance Requirements
AP-WI-01	It shall take no longer than five (5) seconds for the Weather Information Application to obtain all stored weather observations for a fifteen (15) minute period.
AP-WI-02	The Weather Information Application shall generate a weather information message (icy road, icy bridge) within two (2) minutes of obtaining weather observations from the Weather Data Translator.

9 End-to-End Performance Expectations

Identifier	Performance Expectations
AN-WI-01	The Weather Data Translator generated weather observations should be within ten percent (10%) of field collected measures.
VN-WI-02	Vehicle snapshots provided to the Weather Data Translator should be of sufficient frequency and accuracy to allow the determination of road weather observations.
VN-WI-03	Latitude and Longitude included in Probe Data Snapshots should be accurate to determine a vehicle's horizontal position to within one (1) meter.
VN-WI-04	Elevation included in Probe Data Snapshots should be sufficiently accurate to determine a vehicle's vertical position within three (3) meters.
VN-WI-05	Time associated with Vehicle position included in Probe Data Snapshots should be accurate to within one (1) second.
VN-WI-06	Speed associated with a Vehicle position included in Probe Data Snapshots should be accurate to within two (2) kph.
VN-WI-07	Vehicle atmospheric pressure included in Probe Data Snapshots should be accurate to within a resolution of 2 hPa (hectopascal) with values ranging from 580-1090 hPas.
VN-WI-08	Vehicle external temperature included in Probe Data Snapshots should be accurate to within 1 degree C with values ranging from minus-40 to 150 degrees C.
VN-WI-09	Vehicle snapshots should be provided to the Weather Information Application within fifteen (15) minutes of their transmission by the Vehicle.
VN-WI-10	The Probe Data Service should provide probe data snapshots within one (1) minute of the subscription start time, if probe data snapshots are available and meet the subscription profile.
VN-WI-11	The Advisory Message Distribution Service should commence distribution of weather advisory messages within one (1) minute of the advisory message broadcast start time, for all advisory message delivery requests received from the Weather Information Application.

Appendix A. List of Acronyms

AAM	Alliance of Automobile Manufacturers
AASHTO	American Association of State and Highway Transportation Officials
ABS	Antilock Braking System
AMDS	Advisory Message Distribution Service
AMI-C	Automotive Multimedia Interface Collaboration
ASOS	Automated Surface Observing System
ASTM	American Society for Testing and Materials
AWOS	Automated Weather Observing System
CA	Certification Authority
CAMP	Crash Collision Avoidance Metrics Partnership
CICAS	Cooperative Intersection Collision Avoidance Systems
CSP	Content Service Provider
DIC	DSRC Industry Consortium
DiD	Defense In Depth
DOT	Departments of Transportation
DSRC	Dedicated Short Range Communications
DTE	Development and Test Environment
EDMap	Enhanced Digital Map
ENOC	Enterprise Network Operations Center
ENS	Event Notification System
ESS	Environmental Sensor Stations
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FTA	Federal Transit Administration
GHz	Gigahertz
GPS	Global Positioning System
GSA	General Services Administration
HMI	Human Machine Interface
IdAM	Identity and Access Management
IEEE	Institute of Electrical and Electronic Engineers
ILS	Information Lookup Service
ISTEA	Intermodal Surface Transportation Efficiency Act
IT	Information Technology
ITIL	Information Technology Infrastructure Library
ITS	Intelligent Transportation System
ITSM	Information Technology Service Management
IVHS	Intelligent Vehicle Highway Systems
IVI	Intelligent Vehicle Initiative
LBS	Location Based Services
MDSS	Maintenance Decision Support System
MPO	Metropolitan Planning Organization
NAP	Network Access Point
NHS	National Highway System

NHTSA	National Highway Traffic Safety Administration
NMS	Network Management System
NOC	Network Operations Center
NWS	National Weather Service
O&M	Operations and Maintenance
OBE	On Board Equipment
OBU	On Board Unit
OEM	Original Equipment Manufacturer
OSI	Open Systems Interconnection
PATH	Partners for Advanced Transit and Highways
PDS	Probe Data Service
PSAP	Public Service Answering Point
QoS	Quality of Service
RCOC	Road Commission of Oakland County
RSE	Road Side Equipment
RSU	Road Side Unit
RWIS	Road Weather Information System
SAE	Society of Automotive Engineers
SDLC	System Development Life Cycle
SDN	Service Delivery Node
SEMSIM	Southeastern Michigan Snow and Ice Removal
SNMP	Simple Network Management Protocol
SOC	Security Operations Center
SSL	Secure Sockets Layer
TEA-21	Transportation Equity Act for the 21 st Century
TMC	Traffic Management Center
TOC	Traffic Operations Center
VII	Vehicle Infrastructure Integration
VPN	Virtual Private Network
VSC	Vehicle Safety Communications
U.S. DOT	U.S. Department of Transportation

Appendix B. References

REF #	REFERENCE	VERSION
1	VII POC Applications Concept of Operations	Version 1.4
2	VII National System Requirements	Version 1.2.1
3	Road Side Equipment (RSE) Subsystem Specification	Version 1.0
4	Enterprise Network Operations Center (ENOC) Subsystem Specification	Version 1.1
5	Certificate Authority (CA) Subsystem Specification	Version 1.1
6	ENOC to Administrative User Subsystem Software IRS [X-011]	Version 1.1
7	Network User to SDN Subsystem Software IRS [X-031, X-032, X-033]	Version 1.1
8	ENOC to Managed Entity Subsystem Software IRS	Version 1.1
9	ENOC to Managed Network Element Software IRS	Version 1.1
10	SDN to RSE Subsystem Software IRS [I-06]	Version 1.1
11	ENOC to CA Subsystem Software IRS [I-13]	Version 1.1
12	ENOC to SDN Subsystem Software IRS [I-11]	Version 1.1
13	VII USDOT Day-1 Use Case Descriptions (May 2006)	Version 1.0
14	Network Subsystem Specification	Version 1.0
15	VII Concept of Operations	Draft 1.2
16	VII Systems Security Plan	Version 2.1
17	SDN Subsystem Specification (SSS)	Version 1.1
18	VII Infrastructure Lexicon	Version 1.0
19	Draft SAE J2735 Dedicated Short Range Communications (DSRC) Message Set Dictionary	Rev. 15
20	APP190-02 POC Additions & Exceptions to the POC Version of SAE J2735	R00
21	VII x.509 Certificate Authority Certificate Practice Statement (CPS)	TBD