VEHICLE INFRASTRUCTURE INTEGRATION (VII)

CORRIDOR MANAGEMENT PLANNING ASSISTANCE
POC APPLICATION REQUIREMENTS

Research and Innovative Technology Administration

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VERSION 1.2

Booz | Allen | Hamilton

REVISION HISTORY

Date	Version	Description
March 1, 2007	1.0	Draft for Review
March 26, 2007	1.1	Revised per Comments and SRR
April 11, 2007	1.2	Revised per additional comments

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1 Introduction

Planning for new roads and road improvements requires the collection of travel data, so that planners can characterize trip volumes from point to point. Traditionally this is done through surveys and fixed-point volume counts that can require specialized installations. The VII concept provides the possibility for directly gathering this information from vehicles, eliminating the need to establish data collection locations and increasing both the speed and flexibility with which planning data can be acquired.

The Corridor Management Planning Assistance application is geared toward proving the viability of using VII to support capital planning activities. The POC efforts concentrate on determining what traffic measures with potential applicability to planning can reliably be determined from VII probe data, and demonstrating the use of an opt-in application to collect trip path 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"
"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.

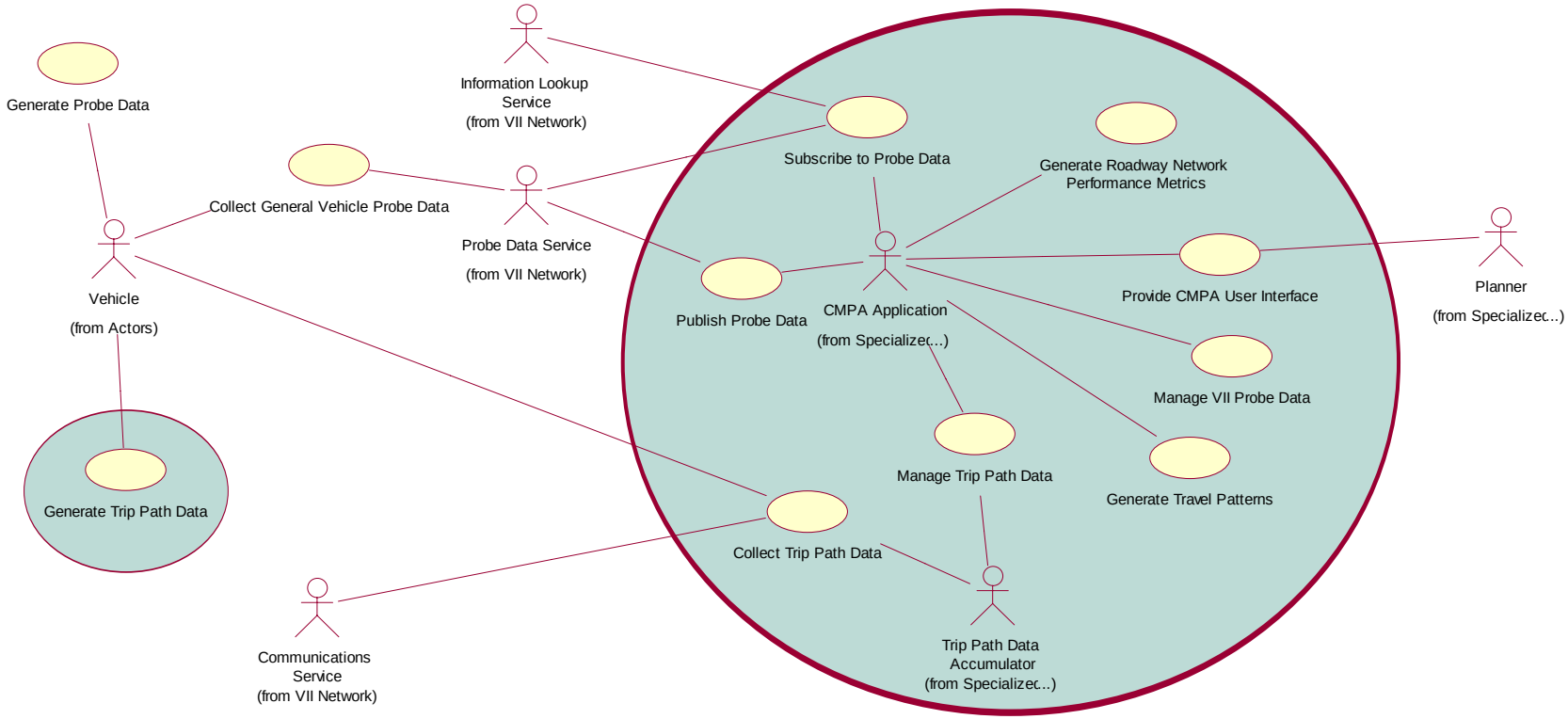
2.3 Requirements Relationship

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 functions involved in implementing the Corridor Management Planning Assistance Application. This diagram was taken from the VII POC Applications Concept of Operations document version 1.4[1]. The shaded portion of the diagram represents the boundary of the Corridor Management Planning Assistance Application for POC.

Figure 3.1 – POC Corridor Management Planning Assistance Application Use Case Diagram



[1] This is the most recent version of the Corridor Management Planning Assistance 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 Corridor Management Planning Assistance application, as they better identify the role of the Planner and the Vehicle than the officially published version.

The following table maps the actors in the use case to the VII System Architecture, as defined within the VII National System Requirements v1.2.1.

Table 3-1 - POC Corridor Management Planning Assistance Actor Context

Actor	VII System Architecture Entities
Vehicle	Vehicle
Probe Data Service	VII System
Information Lookup Service	VII System
Communications Service	VII System
Corridor Management Planning Assistance Application	Network User
Trip Path Data Accumulator	Network User
Planner	Network User External Entity

As shown in the above table, the Corridor Management Planning Assistance 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 Corridor Management Planning Assistance Application.

4 Assumptions and Constraints

4.1 Assumptions

Identifier	VII System Assumptions
VA-CMPA-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-CMPA-01.1	All probe data snapshots generated by the Vehicle will include latitude and longitude of the vehicle location.
VA-CMPA-01.2	All probe data snapshots generated by the Vehicle will include elevation of the vehicle location.
VA-CMPA-01.3	All probe data snapshots generated by the Vehicle will include time (hour, minute and seconds) that the snapshot was generated.
VA-CMPA-01.4	All probe data snapshots generated by the Vehicle will include date (month, day, year) that the snapshot was generated.
VA-CMPA-01.5	All probe data snapshots generated by the Vehicle will include vehicle heading.
VA-CMPA-01.6	All probe data snapshots generated by the Vehicle will include vehicle speed.
VA-CMPA-01.7	All probe data snapshots generated by the Vehicle will include the probe segment number.
VA-CMPA-01.8	The Vehicle's probe snapshot generation parameters will be configurable within the vehicle.
VA-CMPA-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-CMPA-02.1	The Vehicle's probe snapshot buffering parameters will be configurable within the vehicle.
VA-CMPA-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).
VA-CMPA-04	The Vehicle will log information related to probe data generation and Probe Data Service interactions.
VA-CMPA-04.1	The Vehicle will log all probe data snapshots generated within the previous 24-hour period.
VA-CMPA-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-CMPA-04.1.2	For each snapshot logged by the Vehicle, the time and type of buffer state changes will be recorded.
VA-CMPA-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-CMPA-04.1.4	Each snapshot logged by the Vehicle will be uniquely identifiable.
VA-CMPA-04.2	The Vehicle will log all of the locations and times at which the probe segment number changes.

Identifier	VII System Assumptions
VA-CMPA-04.3	The Vehicle will log the location and times at which the snapshot buffer overflows.
VA-CMPA-04.4	The Vehicle will log the times at which the vehicle location information is not available.
VA-CMPA-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-CMPA-04.6	The Vehicle will log probe messages provided to the Probe Data Service within the previous 24-hour period.
VA-CMPA-04.6.1	For each message logged, the Vehicle will record information necessary to identify the specific probe snapshots included in each message.
VA-CMPA-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-CMPA-04.6.3	For each message logged, the Vehicle will record information necessary to identify which RSE of the Probe Data Service the message was transmitted to.
VA-CMPA-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-CMPA-05	The Probe Data Service will accept a subscription from the Corridor Management Planning Assistance 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-CMPA-06	The Probe Data Service will attempt to deliver all Probe Data Snapshots received from Vehicles to the Corridor Management Planning Assistance Application, if the snapshot parameters meet the Corridor Management Planning Assistance Application's probe data subscription profile.
VA-CMPA-07	The Information Lookup Service will respond to a request from the Corridor Management Planning Assistance Application with the information necessary for the Corridor Management Planning Assistance Application to subscribe to probe data within a specified geographic boundary.
VA-CMPA-08	The Vehicle will log messages provided to the Communications Service.
VA-CMPA-08.1	The Vehicle will log its latitude and longitude location, elevation, time (hour, minute, seconds), date (month, day, year), heading and speed when it sends trip path information using the Communications Service.
VA-CMPA-08.2	The Vehicle will log the RSE and Trip Path Data Accumulator destination addresses when it sends trip path information to the Trip Path Data Accumulator using the Communications Service.
VA-CMPA-08.3	The Vehicle will log its latitude and longitude location, elevation, time (hour, minute, seconds), date (month, day, year), heading, speed, RSE in communication, and the acknowledgement receipt when it receives an acknowledgement receipt from the Trip Path Data Accumulator.

Identifier	Non-VII External Entity Assumptions
XA-CMPA-01	Noblis, as part of USDOT's "VII Data Characteristics for Traffic Management" study, will provide algorithms for calculating travel times using probe data.
XA-CMPA-02	Noblis, as part of USDOT's "VII Data Characteristics for Traffic Management" study, will provide algorithms for calculating volumes using probe data.

4.2 Constraints

Identifier	Constraints
AC-CMPA-01	The geographic extent of the Corridor Management Planning Assistance Application is limited to the Detroit POC Development and Test Environment.

5 Functional Requirements

5.1 Subscribe to Probe Data

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

5.2 Publish Probe Data

Identifier	Functional Requirements
AF-CMPA-02	The Corridor Management Planning Assistance Application shall have the ability to receive probe data snapshots from the Probe Data Service.

5.3 Manage VII Probe Data

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

5.4 Generate Roadway Network Performance Metrics

Identifier	Functional Requirements
AF-CMPA-04	The Corridor Management Planning Assistance Application shall analyze probe data to compute roadway performance metrics for freeways and arterials within the geographic extent of the Corridor Management Planning Assistance application.
AF-CMPA-04.1	The Corridor Management Planning Assistance Application shall compute link travel times on freeways and arterials.
AF-CMPA-04.1.1	The Corridor Management Planning Assistance Application shall have up-to-date geographic information data covering the geographic extent of the Corridor Management Planning Assistance Application, to geo-locate travel times.
AF-CMPA-04.1.2	The Corridor Management Planning Assistance Application shall define the freeways and arterials included in the geographic information data into travel time estimation links.
AF-CMPA-04.1.3	The Corridor Management Planning Assistance geographic information data shall define the start and end points of the travel time estimation links using freeway interchanges, arterial intersections, or pre-defined landmarks.
AF-CMPA-04.1.4	The Corridor Management Planning Assistance Application shall

Identifier	Functional Requirements
	utilize stored probe data to compute link travel times on freeways and arterials using algorithms developed by Noblis as part of USDOT's "VII Data Characteristics for Traffic Management" study.
AF-CMPA-04.1.5	The Corridor Management Planning Assistance Application shall store computed link travel times.
AF-CMPA-04.1.6	The Corridor Management Planning Assistance Application shall verify that the computed link travel times are within threshold values defined by the Planner.
AF-CMPA-04.1.7	The Corridor Management Planning Assistance Application shall store the result of the verification for all computed link travel times
AF-CMPA-04.2	The Corridor Management Planning Assistance Application shall compute trip paths on freeways and arterials.
AF-CMPA-04.2.1	The Corridor Management Planning Assistance Application shall have up-to-date geographic information data covering the geographic extent of the Corridor Management Planning Assistance Application, to geo-locate trip paths.
AF-CMPA-04.2.2	The Corridor Management Planning Assistance Application shall define the freeways and arterials included in the geographic information data into trip path estimation links.
AF-CMPA-04.2.3	The Corridor Management Planning Assistance geographic information data shall define the start and end points of the trip path estimation links using freeway interchanges, arterial intersections, or pre-defined landmarks.
AF-CMPA-04.2.4	The Corridor Management Planning Assistance Application shall utilize stored probe data to compute trip paths on freeways and arterials.
AF-CMPA-04.2.5	The Corridor Management Planning Assistance Application shall store computed trip paths.
AF-CMPA-04.2.6	The Corridor Management Planning Assistance Application shall verify that the computed trip paths are within threshold values defined by the Planner.
AF-CMPA-04.2.7	The Corridor Management Planning Assistance Application shall store the result of the verification for all computed trip paths.
AF-CMPA-04.3	The Corridor Management Planning Assistance Application shall compute volumes on freeways and arterials.
AF-CMPA-04.3.1	The Corridor Management Planning Assistance Application shall have up-to-date geographic information data covering the geographic extent of the Corridor Management Planning Assistance Application, to geo-locate volumes.
AF-CMPA-04.3.2	The Corridor Management Planning Assistance Application shall define the freeways and arterials included in the geographic information data into volume estimation links.
AF-CMPA-04.3.3	The Corridor Management Planning Assistance geographic information data shall define the start and end points of the volume estimation links using freeway interchanges, arterial intersections, or pre-defined landmarks.
AF-CMPA-04.3.4	The Corridor Management Planning Assistance Application shall utilize stored probe data to compute volumes from probe data using algorithms developed by Noblis as part of USDOT's "VII

Identifier	Functional Requirements
	Data Characteristics for Traffic Management" study.
AF-CMPA-04.3.5	The Corridor Management Planning Assistance Application shall store computed volumes.
AF-CMPA-04.3.6	The Corridor Management Planning Assistance Application shall verify that the computed volumes are within threshold values defined by the Planner.
AF-CMPA-04.3.7	The Corridor Management Planning Assistance Application shall store the result of the verification for all computed volumes.

5.5 Generate Trip Path Data

Identifier	Functional Requirements
VF-CMPA-05	The Vehicle shall record trip path information.
VF-CMPA-05.1	The Vehicle shall record trip path information describing its route from ignition on to ignition off.
VF-CMPA-05.2	The Vehicle shall record trip path information as data points generated at configurable time and distance intervals.
VF-CMPA-05.3	The Vehicle shall record trip path data points only after the vehicle has traversed a configurable distance from the vehicle's ignition on location.
VF-CMPA-05.4	The Vehicle shall discard trip path data points generated within a configurable distance of the vehicle's ignition off location.
VF-CMPA-05.5	The Vehicle shall assign a unique identifier to all trip path data points which is constant for the duration of the trip.
VF-CMPA-05.6	All trip path data points generated by the Vehicle shall include latitude and longitude of the vehicle location.
VF-CMPA-05.7	All trip path data points generated by the Vehicle shall include elevation of the vehicle location.
VF-CMPA-05.8	All trip path data points generated by the Vehicle shall include time (hour, minute and seconds) at which the data point was generated.
VF-CMPA-05.9	All trip path data points generated by the Vehicle shall include date (month, day and year) at which the data point was generated.
VF-CMPA-05.10	All trip path data points generated by the Vehicle shall include vehicle speed.
VF-CMPA-05.11	All trip path data points generated by the Vehicle shall include vehicle heading.

5.6 Collect Trip Path Data

Identifier	Functional Requirements
VF-CMPA-06	The Vehicle shall provide trip path information to the Trip Path Data Accumulator.
VF-CMPA-06.1	The Vehicle shall utilize the Communications Service after the completion of a trip to provide the trip's path information to the Trip Path Data Accumulator.
VF-CMPA-06.2	The Vehicle shall store all generated trip path information until it

Identifier	Functional Requirements
	has provided it to the Trip Path Data Accumulator and the Vehicle receives a receipt acknowledgement from the Trip Path Data Accumulator.
VF-CMPA-06.3	The Vehicle shall provide trip path information in order, so that all trip path information describing a particular trip is provided to the Trip Path Data Accumulator before another trip's information is provided.
AF-CMPA-06.4	The Trip Path Data Accumulator shall have receive trip path information from the Vehicle using the Communications Service.

5.7 Manage Trip Path Data

Identifier	Functional Requirements
AF-CMPA-07	The Trip Path Data Accumulator shall manage trip path information.
AF-CMPA-07.1	Upon receipt of trip path information from a Vehicle, the Trip Path Data Accumulator shall send the Vehicle an acknowledge receipt of the trip path information using the Communications Service.
AF-CMPA-07.2	The Trip Path Data Accumulator shall store all trip path information received from Vehicles.
AF-CMPA-07.3	The Trip Path Data Accumulator shall store all trip path information received from Vehicles, in received form.
AF-CMPA-07.4	The Trip Path Data Accumulator shall store the time the trip path information was received by the Trip Path Data Accumulator , for all trip path information.
AF-CMPA-07.5	The Trip Path Data Accumulator shall provide a mechanism whereby the stored trip path information is accessible from the Corridor Management Planning Assistance application.
AF-CMPA-07.6	The Corridor Management Planning Assistance Application shall have a mechanism to access stored trip path information based on the value of any parameter included within the trip path information.

5.8 Generate Travel Patterns

Identifier	Functional Requirements
AF-CMPA-08	The Corridor Management Planning Assistance Application shall analyze trip path information to compute travel patterns and associated performance metrics.
AF-CMPA-08.1	The Corridor Management Planning Assistance Application shall compute the number of trips originating from predefined areas.
AF-CMPA-08.1.1	The Corridor Management Planning Assistance Application shall have up-to-date geographic information data covering the geographic extent of the Corridor Management Planning Assistance Application, to geo-locate trip origins (defined as the first data point of a given trip path).
AF-CMPA-08.1.2	The Corridor Management Planning Assistance Application geographic information data shall include information describing

Identifier	Functional Requirements
	the geographic boundaries of each predefined origin area.
AF-CMPA-08.1.3	The Corridor Management Planning Assistance Application shall utilize stored trip path information to compute the number of trips originating from each predefined origin area.
AF-CMPA-08.1.4	The Corridor Management Planning Assistance Application shall store the number of trip origins per origin area.
AF-CMPA-08.2	The Corridor Management Planning Assistance Application shall compute the number of trips terminating in predefined areas.
AF-CMPA-08.2.1	The Corridor Management Planning Assistance Application shall have up-to-date geographic information data covering the geographic extent of the Corridor Management Planning Assistance Application, to geo-locate trip destinations (defined as the last data point of a given trip path).
AF-CMPA-08.2.2	The Corridor Management Planning Assistance Application geographic information data shall include information describing the geographic boundaries of each predefined destination area.
AF-CMPA-08.2.3	The Corridor Management Planning Assistance Application shall utilize stored trip path information to compute the number of trips terminating in each predefined destination area.
AF-CMPA-08.2.4	The Corridor Management Planning Assistance Application shall store the number of trip destinations per destination area.
AF-CMPA-08.3	The Corridor Management Planning Assistance Application shall compute the number of trips on each roadway link.
AF-CMPA-08.3.1	The Corridor Management Planning Assistance Application shall have up-to-date geographic information data covering the geographic extent of the Corridor Management Planning Assistance Application, to geo-locate trips.
AF-CMPA-08.3.2	The Corridor Management Planning Assistance Application shall define the freeways and arterials covered within the geographic extent of the Corridor Management Planning Assistance Application into trip estimation links
AF-CMPA-08.3.3	The Corridor Management Planning Assistance Application shall define the trip estimation links using specific start and end points
AF-CMPA-08.3.4	The Corridor Management Planning Assistance Application shall define the start and end points of trip estimation links using freeway interchanges, arterial intersections, or pre-defined landmarks.
AF-CMPA-08.3.5	The Corridor Management Planning Assistance Application shall utilize stored trip path information to compute the number of trips on each trip estimation link.
AF-CMPA-08.3.6	The Corridor Management Planning Assistance Application shall store the computed number of roadway trips on each link.
AF-CMPA-08.4	The Corridor Management Planning Assistance Application shall compute the number of trips using the same route.
AF-CMPA-08.4.1	The Corridor Management Planning Assistance Application shall have up-to-date geographic information data covering the geographic extent of the Corridor Management Planning Assistance Application, to geo-locate trip routes.
AF-CMPA-08.4.2	The Corridor Management Planning Assistance Application shall

Identifier	Functional Requirements
	define the freeways and arterials covered within the geographic extent of the Corridor Management Planning Assistance Application into routes (defined as a series of connected links between predefined origin and destination area pairs)..
AF-CMPA-08.4.3	The Corridor Management Planning Assistance Application shall utilize stored trip path information to compute the number of trips using the same route.
AF-CMPA-08.4.4	The Corridor Management Planning Assistance Application shall store the computed number of trips using each route.
AF-CMPA-08.5	The Corridor Management Planning Assistance Application shall compute the average travel time and travel time variance of trips using the same route.
AF-CMPA-08.5.1	The Corridor Management Planning Assistance Application shall have up-to-date geographic information data covering the geographic extent of the Corridor Management Planning Assistance Application, to geo-locate trip routes.
AF-CMPA-08.5.2	The Corridor Management Planning Assistance Application shall define the freeways and arterials covered within the geographic extent of the Corridor Management Planning Assistance Application into routes (defined as a series of connected links between predefined origin and destination area pairs)..
AF-CMPA-08.5.3	The Corridor Management Planning Assistance Application shall utilize stored trip path information to compute the average travel time and travel time variance of trips using the same route.
AF-CMPA-08.5.4	The Corridor Management Planning Assistance Application shall store the computed average travel time and travel time variance of trips using each route.
AF-CMPA-08.6	The Corridor Management Planning Assistance Application shall compute the number of trips originating and terminating in predefined origin and destination area pairs.
AF-CMPA-08.6.1	The Corridor Management Planning Assistance Application shall have up-to-date geographic information data covering the geographic extent of the Corridor Management Planning Assistance Application, to geo-locate trip origins and destinations.
AF-CMPA-08.6.2	The Corridor Management Planning Assistance Application geographic information data shall include information describing the geographic boundaries of each predefined origin and destination area.
AF-CMPA-08.6.3	The Corridor Management Planning Assistance Application shall utilize stored trip path information to compute the number of trips originating and terminating in predefined origin and destination area pairs over a configurable time period.
AF-CMPA-08.6.4	The Corridor Management Planning Assistance Application shall store the number of trips originating and terminating in each origin and destination pair.

5.9 Provide Corridor Management Planning Assistance Application User Interface

Identifier	Functional Requirements
AF-CMPA-09	The Corridor Management Planning Assistance Application shall provide a User Interface (UI) for the Planner to manage the Corridor Management Planning Assistance Application.
AF-CMPA-09.1	The Corridor Management Planning Assistance Application shall provide a User Interface (UI) for the Planner to manage the probe data subscription.
AF-CMPA-09.1.1	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to add and modify the probe data elements of the probe data subscription profile.
AF-CMPA-09.1.2	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to add and modify the geographic boundary of the probe data subscription profile.
AF-CMPA-09.1.3	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to add and modify the start and end times of the probe data subscription profile.
AF-CMPA-09.1.4	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to send a probe data subscription request
AF-CMPA-09.1.5	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to cancel a probe data subscription request
AF-CMPA-09.2	The Corridor Management Planning Assistance Application shall provide a UI for the Planner to manage probe data.
AF-CMPA-09.2.1	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to view, in a tabular form, probe data stored by the Corridor Management Planning Assistance Application.
AF-CMPA-09.2.2	The Corridor Management Planning Assistance Application UI shall provide the Planner 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-CMPA-09.2.3	The Corridor Management Planning Assistance Application UI shall provide the Planner 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-CMPA-09.2.4	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to view the most recently received probe data snapshots.
AF-CMPA-09.2.5	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to view any probe data verification errors generated by the Corridor Management Planning Assistance Application.
AF-CMPA-09.3	The Corridor Management Planning Assistance Application shall provide a UI to allow the Planner to set parameters for the algorithms used to compute travel times per link, trip paths and volumes from probe data.

Identifier	Functional Requirements
AF-CMPA-09.4	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to specify the geographic boundaries of the ramp, freeway, and arterials within the geographic extent of the Corridor Management Planning Assistance Application.
AF-CMPA-09.5	The Corridor Management Planning Assistance Application UI shall provide the ability to display travel times per link, trip paths and volumes computed based on probe data.
AF-CMPA-09.6	The Corridor Management Planning Assistance Application UI shall provide the ability to set threshold values for travel times per link, trip paths and volumes.
AF-CMPA-09.7	The Corridor Management Planning Assistance Application shall provide a UI to allow the Planner to set parameters for the algorithms used to compute number of trip origins, number of trip destinations, number trips on each link, number of trips on each route, and average route travel time and travel time variance based on trip path information.
AF-CMPA-09.8	The Corridor Management Planning Assistance Application UI shall provide the ability to display computed trip origins, trip destinations, trips on each roadway segment, trip paths, mean travel time and travel time variance computed based on trip path information.
AF-CMPA-09.9	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to define and modify the geographic boundaries of origin and destination areas.
AF-CMPA-09.10	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to configure the time periods for computing the number of trips originating and terminating in predefined origin and destination area pairs.
AF-CMPA-09.11	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to create lookup requests to the Information Lookup Service about VII System managed entities (i.e., RSEs, Probe Data Service Availability, and Communications Service availability).
AF-CMPA-09.12	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to view information about VII System managed entities (i.e., RSEs, Probe Data Service Availability, and Communications Service availability).
AF-CMPA-09.13	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to enable or disable, either separately or together, the analysis of probe data for computing the number of trip origins, number of trip destinations, number trips on each link, number of trips on each route, and average route travel time and travel time variance based on trip path information.
AF-CMPA-09.14	The Corridor Management Planning Assistance Application UI shall provide the Planner the ability to enable or disable, either separately or together, the analysis of probe data for computing travel times per link, trip paths and volumes from probe data.

6 Security Requirements

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

7 External Interface Requirements

Identifier	External Interface Requirements
AX-CMPA-01	The Corridor Management Planning Assistance 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-CMPA-02	The Corridor Management Planning Assistance 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-CMPA-03	The Trip Path Data Accumulator shall utilize the X-033 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 Vehicles over the Communications Service.
AX-CMPA-04	The Vehicle shall utilize the I-03 and X-033 interfaces when communicating with the Trip Path Data Accumulator over the Communications Service.

8 Performance Requirements

Identifier	Performance Requirement
AP-CMPA-01	The Corridor Management Planning Assistance Application shall take no longer than one minute to retrieve all of the probe data snapshots over a fifteen (15) minute period.
AP-CMPA-02	The Corridor Management Planning Assistance Application shall take no longer than five (5) minutes to produce the roadway network performance metrics over a one (1) hour period.
AP-CMPA-03	The Corridor Management Planning Assistance Application shall take no longer than fifteen (15) minutes to produce the travel patterns and associated performance metrics over a one (1) day period.

9 End-to-End Performance Expectations

Identifier	Expectation
VN-CMPA-01	Latitude and longitude included in trip path information should be sufficiently accurate to determine a vehicle's horizontal position within five (5) meters.
VN-CMPA-02	Elevation included in trip path information should be sufficiently accurate to determine a vehicle's vertical position within three (3) meters.
VN-CMPA-03	Download of trip path data from the Vehicle should complete within the third interaction of Vehicle with an RSE after key-on.
VN-CMPA-04	Heading associated with a vehicle position included in Probe Data Snapshots should be sufficiently accurate to determine a vehicle's heading within twenty (20) degrees.
VN-CMPA-05	Speed associated with a vehicle position included in Probe Data Snapshots should be accurate to within five (5) kph.
VN-CMPA-06	Latitude and longitude included in Probe Data Snapshots should be sufficiently accurate to determine a vehicle's horizontal position within five (5) meters.
VN-CMPA-07	Elevation included in Probe Data Snapshots should be sufficiently accurate to determine a vehicle's vertical position within three (3) meters.
VN-CMPA-08	The Corridor Management Planning Assistance Application's subscription to probe data should commence distribution of probe data snapshots within five (5) minutes of subscription.

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
ASTM	American Society for Testing and Materials
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
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
SNMP	Simple Network Management Protocol
SOC	Security Operations Center
SSL	Secure Sockets Layer
TEA-21	Transportation Equity Act for the 21st 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