ITS Heartland Multistate Corridor Operations and Management Program Grant

System Requirements Specification

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Executive Summary

The Intelligent Transportation Society Heartland (ITSH) Chapter, an official chapter of ITS America, was recently awarded a grant, herein called the "Multistate Corridor Operations and Management Program (MCOMP) Grant", by the Federal Highway Administration (FHWA) to fund one or more projects aimed at providing greater information sharing between the five ITSH state transportation agencies (Missouri, Iowa, Nebraska, Kansas and Oklahoma) and their respective customers.

This System Requirements Specification (SRS) consists of an introduction describing the objectives of both the MCOMP and the SRS itself; a general description of MCOMP distilled from the Concept of Operations (ConOps); and requirements for addressing the purposes and needs identified in the ConOps. As described in the ConOps, stakeholders have determined that the preferred approach is building an integrated data warehouse (IDW) to aggregate information from the five Heartland States while enabling the agencies and third-party information service providers to access the information for their own user interfaces.

1 Introduction

1.1 Background

The Intelligent Transportation Society Heartland (ITSH) Chapter, an official chapter of ITS America, was recently awarded a grant, herein called the "Multistate Corridor Operations and Management Program (MCOMP) Grant", by the Federal Highway Administration (FHWA) to fund two projects aimed at providing greater information sharing between the five ITSH state transportation agencies (Missouri, Iowa, Nebraska, Kansas and Oklahoma) and their respective customers. The scope and objectives of the grant were proposed in the MCOMP Grant Application prepared and submitted to FHWA by the ITSH Corridor Coalition (ITSHCC) member agencies. The scope and terms of the Grant Award are described in the ITS Partnership Agreement between the FHWA and the Missouri Highways and Transportation Commission, acting by and through the Missouri Department of Transportation on behalf of the ITSHCC member agencies.

The ITSH MCOMP Grant Application was submitted to FHWA as a means of obtaining support for improved corridor operation throughout the ITSH States. As stated in the MCOMP Grant Application, "As this group has matured over the past six years, they have desired to bring corridor operations to a new level within the region through the programming of projects that benefit all of the states in the Coalition as well as private business and travelers who live, work or pass through this region. Their goals are to improve the movement of commercial vehicles, provide better traveler information systems, and cooperatively plan operations throughout the region." The Grant Application then goes on to identify three operational goals and two strategies for achieving each goal to which the MCOMP grant funds might be applied.

The FHWA award for the MCOMP grant identified two of the MCOMP Grant Application projects as the basis of its award:

A. **Provide Real-Time Traveler Information on Rural Freeways:**
   a. Completion of a feasibility study in which adequate data sources and data dissemination opportunities are identified;
   b. Integration of real-time data feeds into existing agency tools for disseminating information to external customers;
   c. Publication of a final project evaluation report.

B. **Develop a Regional Data Aggregation and Data Warehouse Service:**
   a. Completion of a feasibility study to investigate which data is most beneficial for internal sharing, identify options for integrating the data into one location, and identify any necessary performance reports needed for sufficient data analysis;
   b. Integration of the identified datasets into the central data warehouse;
   c. Development of specialized performance reports for the data, if identified;
   d. Publication of a final project evaluation report.

The ITSH Chapter Board of Directors therefore established an MCOMP Grant Executive Committee charged with making decisions regarding the grant. The Committee consists of six members: the current ITSH Board Vice President along with a representative from each ITSH state member agency.

1.2 Purpose

As described in the MCOMP *Concept of Operations* (ConOps), the purpose of the project is to fulfill the intent of MCOMP grant in demonstrating the feasibility of, developing, and evaluating the integration and sharing of system management and operations data across the Heartland States. The program is structured around the FHWA's Systems Engineering (SE) process for Intelligent Transportation Systems. The program is divided into a Grant Administration effort to assist ITSH in program administration and systems engineering tasks, and development efforts to be completed by implementation contractors.

The purpose of this System Requirements Specification (SRS) is to establish the fundamental requirements for effective development and operations of an integrated data warehouse (IDW) for sharing data among the ITSH States and with their stakeholders. The requirements will specify what the program will do, but will not describe how the program is to be implemented. As such, the requirements form a basis for system design and testing.

1.3 Scope

The scope of intelligent transportation systems (ITS) deployments in the Heartland States encompasses ITS assets collecting data, providing operations decision support, and providing traveler information in metropolitan areas and along the interstate corridors. In that respect, the scope is similar to that needed to meet the intent of the FHWA's Office of Operations Real-Time System Management Information Program (RTSMIP) derived from Section 1201 of the SAFETEA-LU legislation. Complying with the Section 1201 Rule requires acquiring and managing roadway weather condition information, information on incidents blocking roadway lanes, information on construction activities with closures, and travel time information on interstate highways and limited-access routes of significance.

1.4 Document Overview

The structure of this document is generally consistent with the outline of a System or Software Requirements Specification defined in ISO/IEC/IEEE Standard 29148-2011. Some sections herein have been somewhat enhanced to accommodate more detailed content than are described in the standard. Titles of some sections have been edited to more specifically capture that enhancement.

Section 2 provides a general description of the system, its function, its users, significant constraints on its development and operations, and specific assumptions and dependencies. It is largely a summary of material described in more detail in the Concept of Operations.

Section 3 documents the system requirements.

2 Referenced Documents

1. Olsson Associates *ITS Heartland Multistate Corridor Operations and Management Program Grant Concept of Operations*

2. Institute of Transportation Engineers *Traffic Management Data Dictionary (TMDD) Standard for the Center to Center Communications - Volume I: Concept of Operations and Requirements v3.03* http://www.ite.org/standards/tmdd/3.03.asp, accessed 2016.09.22

3. Institute of Transportation Engineers *Traffic Management Data Dictionary (TMDD) Standard for the Center to Center Communications - Volume II: Design Content v3.03* http://www.ite.org/standards/tmdd/3.03.asp, accessed 2016.09.22

3 General Description

3.1 System Perspective

ITSH member states have been actively deploying ITS for over 15 years. As described in the MCOMP Grant Application, these deployments were begun, as in most parts of the U.S., in urban metropolitan areas. Heartland States have continued, however, to deploy along interurban corridors to provide data collection, operations support and traveler information across their expansive rural areas. Operations support for these ITS assets is provided by a mix of the urban/metropolitan and regional transportation management centers (TMCs). Traveler information systems have similarly expanded from coverage of metropolitan areas to virtual statewide coverage in each of the Heartland States.

Traffic and weather, however, do not respect jurisdictional boundaries. Weather systems moving across the plains and prairies of the Heartland States can quickly degrade travel and traffic conditions across the entire region. Transportation systems management and operations need to similarly have access to road, traffic and weather information across the region and to be able to inform the public of what to expect as they travel across the region. To that end, the goals of the ITSHCC as described in the MCOMP Grant Application are to “improve the movement of commercial vehicles, provide better traveler information systems, and cooperatively plan operations throughout the region.” For the MCOMP Grant Application, the focus of these goals is on the network of interstate corridors that tie the region together.

The ITSH MCOMP Grant identifies two project goals to be developed and deployed. The first of these two, providing Real-Time Information on Rural Freeways, is to some extent being addressed in parallel to the MCOMP Grant effort by the ITSH member States in their continuing deployment of ITS assets to support ongoing statewide operations. The second project goal, developing a Regional Data Aggregation and Data Warehouse Service, begins in large part with recognizing the existing deployments of metropolitan and regional TMCs that are already aggregating traffic, road, and weather condition data.

3.2 System Functions

As described in the ConOps, stakeholders have determined that the preferred approach is building an IDW to aggregate information from the five Heartland States while enabling the agencies and third-party information service providers to access the information for their own user interfaces. In this scheme, each agency will share its real-time road and weather condition information with the IDW. The agencies will have the option to collect the other agencies’ information from the IDW and share it on its own interface. Other users such as information providers and research institutions will have access to the IDW for real-time and archived weather and road data.

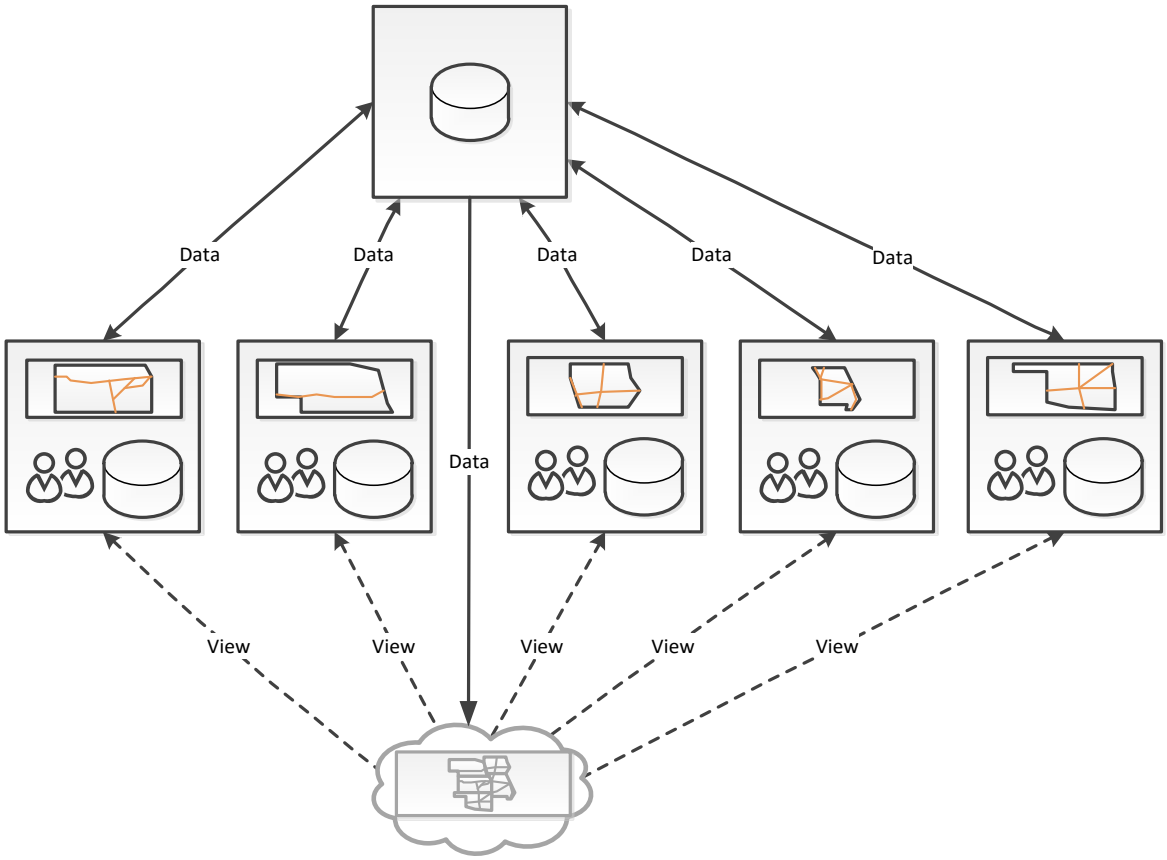

Figure 1 - Preferred System Concept[1]

The IDW will collect road and weather data from the Heartland States' transportation management and traveler information systems. The data will be processed and converted, if necessary, to ensure consistency across the region. The information collected will be stored in the IDW for access by the Heartland States and other third-party information services. The IDW will enable the TMCs in the region to integrate operations data at their discretion, when it becomes operationally advantageous and fiscally prudent.

Relative to the original goals of the ITSHCC grant award, the IDW will provide collected data to other systems for application-specific processing and presentation. The information collected in the IDW will include traffic, road, and weather conditions for pre-trip planning and for updates during trips at critical route decision-making points. The data would then be accessed as appropriate by agency TMC systems and third-party information services to create actionable information for traffic operations, commercial vehicle operations, and traveler information systems. The IDW will furthermore archive the real-time data collected, which will be available for use by stakeholders such as the Heartland agencies, universities and other research institutions. The archive will provide consistent data over time to aid in performance management and transportation systems research.

[1] Source: Olsson Associates *ITS Heartland Multistate Corridor Operations and Management Program Grant Concept of Operations*

3.3 Stakeholder Characteristics

3.3.1 General Considerations

Transportation system stakeholders need access to road and weather condition information within and beyond their jurisdictional boundaries in order to make appropriate travel and traffic management decisions. Weather systems move from one state to the next in the Heartland States and create transportation challenges across the region. It is crucial for users to have road and weather condition information along the entire length of their travels throughout the Heartland region.

The data collected and stored in the IDW will facilitate better communication, corridor operations and performance measurement among the Heartland States. The integrated road and weather condition information will be consistent across the region to make viewing the data easier and to aid in the decision-making process.

With the projected increasing volumes of commercial vehicle movement in the Heartland region, the ITSHCC needs better management and operational technologies to help bridge the gap between the demand and capacity for accommodating the region's expanding commercial vehicle movement needs. The IDW to be created in this project will support and feed those technological enhancements.

3.3.2 Transportation Operations

Transportation operations personnel monitor traffic and roadway conditions, manage traffic controls, respond to incidents, and provide traveler information throughout a road network, typically through systems provided in a TMC by an advanced transportation management system (ATMS). Operators work with roadway maintenance personnel to identify maintenance needs, manage traffic and provide traveler information during maintenance events, and with public safety and emergency response units during incidents. Operators monitor weather conditions and forecasts for their potential impacts on safety and mobility. Operations personnel may use traffic simulations to support assessment of operations strategies.

Transportation operations personnel currently have access to road condition information such as traffic flow, construction zones and weather conditions within their operational boundaries based on the information collected using system field devices, third-party information services, or even from social media. The IDW will enable operators to access data from outside their area from the IDW to improve their understanding of the road conditions within their own boundaries as well as alert travelers of potential issues. Standardization of the data in the IDW will reduce or minimize the effort necessary to interpret the data feed for presentation.

The ITSH agencies will be able to extend interfaces for operator viewing across the region based on the IDW created using the MCOMP Grant. Operators will use the interfaces for viewing and assessing risks and enacting appropriate traffic controls. They will also be able to enable interventions and respond to events through dispatch of emergency services and maintenance operations.

3.3.3 Information Service Providers

Information service providers can gather real-time data as needed from each of the state agencies to share on applications and websites. They use the real-time information such as traffic flow, construction zones, and weather conditions to create dynamic routing and quick navigation for their users. Services such as Google Maps, Waze, and INRIX enable users to have access to the real-time traffic information in their area so they can best navigate travel.

They often use the data they receive from multiple sources, including state agencies, to give travelers instant access to the best route for their trip and access to the current conditions of their daily commute.

With the proposed system, information providers can gather information from all of the Heartland States through the IDW for traffic condition presentation and routing algorithms. The aggregation and standardization of the data reduces the investment needed to access and interpret the information, which may also encourage additional service providers to find new applications.

3.3.4 Travelers

Travelers are able to view road and weather condition information data in the Heartland region on both agency and third-party information service provider websites and mobile applications. They are able to plan any travel in the area whether it is a daily commute or a recreational trip across the region. Travelers can better utilize their time by having a clearer understanding of the conditions they may encounter along the way.

The IDW will aid the Heartland States in presenting traveler information to commercial vehicle operators and travelers through existing interfaces. Travelers will no longer need to move from interface to interface as they cross state boundaries. The information collected in the IDW will include traffic, road, and weather conditions for pre-trip planning and for updates during trips at critical route decision-making points.

3.3.5 Universities and Research Institutions

Universities and other institutions researching transportation systems and operations need past traffic and weather information upon which to base their research. The IDW will archive the real-time information it collects from each of the Heartland States and store the data for future use by organizations such as research institutions. Consistent information across the states will be collected, so the same type of data for each state is available for use. This body of normalized, consistent data provides a unique resource for researchers needing a broad data perspective over a long time period.

3.4 User Needs

User needs are typically focused on the functional needs of a system's human users as described in scenarios and use cases. For the development of the IDW, however, systems operated by Heartland agencies and third parties will act as the users of the system. The systems operated by agencies and third parties will retrieve data from the IDW for use in other traffic management and traveler information systems. Direct human interactions with the IDW will be limited to system administration, data analysis and development of operations reports.

In spite of the limitations on direct human interaction, the system has indirect institutional user needs representing the interests of the ITSH member agencies and their partners:

- ITSHCC members need to share traffic and operations data across the boundaries of their jurisdictions. Having information on traffic conditions before it enters or after it leaves their states would enable them to make better operational decisions in anticipation of changing conditions.
- Agencies benefit from sharing traveler information with each other and with other information providers. Incident information and electronic messages posted to roadside variable/dynamic message signs are useful across jurisdictional boundaries.

- Camera images may be useful across agency borders, especially for illustrating incoming traffic and weather conditions.
- ITSHCC members may need to share traffic control status near the borders of their jurisdictions. For example, Oklahoma needs to know if Kansas is shutting down I-35 northbound.
- ITSHCC members need to share operationally significant road weather information.
- Agencies would benefit from sharing commercial vehicle height, weight, and profile/wind restrictions that might affect alternative routing through multiple jurisdictions.

3.5 General Constraints

The five Heartland States have a diverse set of data management, publication and sharing perspectives. As shown in Table 1, the States have numerous statewide and metro ATMS and advanced traveler information systems (ATIS). All of them provide traveler information to the public (Table 2), but the types of information and even the target traveler demographics vary among the states. This diversity is more pronounced when providing interfaces through which other parties can access traveler information data feeds (Table 3). Some of the states do not provide any third-party data feeds, and some provide open access. The purposes and reasons behind these patterns of access seem to be equally diverse, depending on multiple policy, financial and technical factors.

Sharing of access to data for operations is much less diverse among the states. Information sharing generally occurs between operations personnel in different agencies on an as-needed basis and does not flow directly between systems. Unusual and extreme events like the 2011 Missouri River flooding that affected Iowa, Nebraska and Missouri require and lead to significant cross-border operations coordination.

The KC Scout situation is inherently different because Scout system monitors conditions across the Kansas City metropolitan area, and operations in Scout have to cross the state line. The Scout TMC operators support both KDOT and MODOT, even to the extent of monitoring I-70 operations from the St. Louis metro border to the Kansas-Colorado state line. The differentiating factor in this cooperation is primarily that the information is captured in a single system that is accessed by both states.

Table 1 – ITSH ATMS and ATIS[2]

ATMS/ATIS							
State (Region)	**ATMS Software**	**ATIS Name**		**ATIS Website Name**		**ATIS Vendor/Maintainer**	
Iowa	TransSuite	CARS		511ia.org		Castle Rock	
Kansas (Wichita)	MIST	WHICHway		www.WHICHway.org		DTS	
Kansas (Statewide)		KanDrive		www.kandrive.org			
Missouri (Kansas City)	TransSuite	Kansas City Scout	MoDOT Traveler Info. Website	kcscout.net	traveler.modot.org/map	TransCore	MoDOT
Missouri (St. Louis)		Gateway Guide		gatewayguide.com		Vector Communications	
Missouri (Springfield)		Ozarks Traffic		ozarkstraffic.com		Americaneagle.com	
Nebraska	IRIS	CARS		hb.511.nebraska.gov		Castle Rock	
Oklahoma	Developed in-house	N/A		oktraffic.org		ODOT	

Table 2 - Traveler Information Provided in Each State[3]

		Traveler Information Provided				
		States				
		Iowa	**Kansas**	**Missouri**	**Nebraska**	**Oklahoma**
All Travelers	Speeds	X	X	X	X	X
	Incidents	X	X	X	X	X
	Winter Road Conditions	X	X	X	X	X
	Cameras	X	X	X	X	X
	Electronic Signs	X	X	X	X	X
	Road Work Activities	X	X	X	X	
	Rest Areas	X				
	Restrictions	X	X		X	
Commercial Vehicle Specific	Height/Weight restrictions	X	X	X		
	Winter Road Conditions	X	X	X		
	Weigh Stations	X				
	Towing Prohibited Areas	X				
	Routing Information		X	X		

[2] Source: Olsson Associates *ITS Heartland Multistate Corridor Operations and Management Program Grant Concept of Operations*
[3] Source: Olsson Associates *ITS Heartland Multistate Corridor Operations and Management Program Grant Concept of Operations*

Table 3 - Outbound Data Feeds in Each State[4]

Outbound Data Feeds					
	States				
	Iowa	Kansas	Missouri	Nebraska	Oklahoma
Entities receiving data	Many (+100)	Publicly Available	HERE	INRIX, SpeedInfo, Google	None
Data Provided					
Speeds	X		X	X	
Incidents	X			X	
Winter Road Conditions	X	X		X	
Cameras	X				
Road Work Activities	X	X			
Restrictions	X	X		X	

3.6 Assumptions and Dependencies

Traffic Management Data Dictionary

The Traffic Management Data Dictionary (TMDD) Standard for Traffic Management Center-to-Center (C2C) Communications describes the requirements for traffic management centers (TMC) providing services to external centers (EC). The document is presented in two volumes and follows a systems engineering process (SEP).

Volume 1 is the Concept of Operations and Requirements. It addresses user needs and functional requirements related to the standard. Other topics related to the standard, such as terms and definitions, acronyms, references, conformance to the standard, extensions to the standard and backwards compatibility of this version of the standard with previous versions, are also included in Volume 1.[5]

Volume 2 describes the Design Content which includes dialogs, message sets, data frames and data elements. This volume describes the message exchanges needed for communications between a TMC and an EC. The data concepts that fulfill the TMDD requirements are also defined in Volume 2 and a table is provided that lists the data concepts needed to fulfill each requirement. Based on the TMDD standard, a system interface can be created for exchanging information between centers. The interface implementation is defined by a variety of protocol-specific application profiles that are related to the TMDD standard.[6]

[4] Source: Olsson Associates *ITS Heartland Multistate Corridor Operations and Management Program Grant Concept of Operations*
[5] Source: Institute of Transportation Engineers *Traffic Management Data Dictionary (TMDD) Standard for the Center to Center Communications - Volume I: Concept of Operations and Requirements v3.03,* available at http://www.ite.org/standards/tmdd/3.03.asp, accessed 2016.09.22
[6] Source: Institute of Transportation Engineers *Traffic Management Data Dictionary (TMDD) Standard for the Center to Center Communications - Volume II: Design Content v3.03,* available at http://www.ite.org/standards/tmdd/3.03.asp, accessed 2016.09.22

All of the data types currently available from and being shared by the Heartland States are described in the TMDD. As such, it provides a neutral, normative reference for exchange of data that covers the existing (and any likely future) IDW needs. As such, the TMDD will be referenced where appropriate in requirements for the IDW.

Third Party Data Usage

Aside from its own traditional fixed detector data collection, each of the five states in the Heartland region has acquired third-party probe data for use in its operations and in providing traveler information. As describe in the ConOps, Heartland States are currently getting those data from HERE or INRIX. Each State has its own contracts with those data providers, and each contract contains its own data sharing provisions that may restrict the redistribution of the third-party data.

Due to these restrictions, probe data that might otherwise be useful in the IDW will not be collected directly from HERE or INRIX. The IDW may collect data derived from HERE and INRIX data through the ATMS or ATIS for each jurisdiction, as constrained by the data sharing provisions for those ATMS/ATIS, as part of its integration of data across the region as a whole.

Data Cleansing

The data stored in the IDW needs to be consistent and accurate for information from across the Heartland region to be integrated for downstream applications. It is assumed here that the data contributed to the IDW will be quality checked and cleansed by the contributing system prior to entering the system. The IDW itself will not attempt to quality check, interpolate, or smooth the incoming ATMS/ATIS data. The data will be normalized—made consistent in format and units—as part of the data collection process.

IDW Data Access to Agency Data

The IDW must have access to the data needed from each of the TMCs through their ATIS and ATMS in order to collect the data. While getting access to this data could require a formal statement of permission or a data sharing agreement with the agency operating the TMC, the implicit agreement of the five Heartland states is presumed in the issuance of this requirements specification. Formal agreements would be obtained and managed outside the system at such time as identified as being required by individual contributing agencies.

It is therefore assumed in derivation of the requirements that the IDW will need to be able to access and collect the data from all of the contributing TMCs in the Heartland Region. All types of data listed in the Collect Data portion of the requirements will be presumed to be available from the TMCs and accessible by the IDW.

IDW User Access

The intent of the IDW design concept is that systems operated by Heartland States and other information service providers, rather than people, will be the end users of the IDW. The Heartland States currently have differing practices as to what other systems and users can receive outbound data feeds from their ATMS/ATIS. While at this point in the system development process there are no specific requirements as to enabling or disabling system access, it may become necessary in the future to limit access to data based on type or source for particular user classes. For example, data purchased from third-party traffic information

service providers might be accessible to other agency systems, but inaccessible to other similar information service providers.

As such, the requirements will address a general capability to identify user systems and track accesses of the IDW data. Identifying and tracking user activity then also implies a need for managing the records of user identity ("accounts").

IDW User Interfaces

The requirements do not describe any human end-user interfaces, which are presumed in the design concept to be provided by those other user systems. Nonetheless, the IDW will itself need to be managed and maintained. IDW administrators will need system interfaces to monitor and maintain its connections to other systems and its data repository. The working assumption is that these functions will be performed by administrators using standard software and database administration tools rather than needing a custom IDW interface.

There is still a need, however, for an interface by which the contributing Heartland States are able to monitor the system's use and measure performance across the system. This function provides a common view of the IDW operations, but does not necessarily subsume or replace any performance measures that individual Heartland States might want to apply to IDW-derived data within their own operational contexts. For example, the IDW might derive a travel time delay statistic for the I-35 corridor from the Minnesota-Iowa state line to the Oklahoma-Texas state line. This would supplement, rather than replace, similar statistics within Kansas for I-35 travel. An interface providing these kinds of IDW measures (a "dashboard") is described in the requirements.

Requirements Definition

The requirements specified in this document are requirements for the IDW being created and are not inclusive of all the *project* requirements. Project requirements, such as system deployment sites and maintenance intervals, will be described in the MCOMP procurement documentation. The requirements described in the SRS also do not prescribe a particular system implementation, but rather the requirements that must be fulfilled by the implemented system. The requirements describe what the system must do, but not how it should be implemented.

4 Specific Requirements

Requirements are assigned unique identifications to assure traceability. Notes as to the basis for the requirement may be provided if they offer additional information that clarifies the intent.

Requirement types may be:

- F: Functional
- I: Interface
- P: Performance
- S: Security
- D: Data
- R: Reliability

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
1xx		**Collect Data**		
101	F	The system shall be able to configure collection of particular operations data types from particular data interfaces.	ITSH agencies may have particular data types and restrictions on their particular system interfaces. For example, an agency might decline to make still camera images available for collection.	
111	F	The system shall collect operations data including link speeds.	Tables 2 and 3	101
112	F	The system shall collect operations data including incident data.	Tables 2 and 3	101
113	F	The system shall collect operations data including winter road conditions.	Tables 2 and 3	101
114	F	The system shall collect operations data including still camera images (“snapshots”).	Tables 2 and 3; not video	101

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
115	F	The system shall collect operations data including messages posted to electronic signs.	Tables 2 and 3	101
116	F	The system shall collect operations data including road work and construction activities.	Tables 2 and 3	101
117	F	The system shall collect operations data including commercial vehicle restrictions.	Tables 2 and 3	101
118	F	The system shall be able to configure collection of other operations data types.	New data types may become available from ITSH agency systems over the lifetime of the IDW. The IDW should not be constrained to only those types available during its initial development.	101
141	F	The system shall collect operations data from the Iowa statewide TransSuite data interface.	Table 1	101
142	F	The system shall collect operations data from the Iowa statewide CARS data interface.	Table 1	101
143	F	The system shall collect operations data from the Nebraska statewide IRIS data interface.	Table 1	101
144	F	The system shall collect operations data from the Nebraska statewide CARS data interface.	Table 1	101

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
145	F	The system shall collect operations data from the Topeka MIST data interface.	Table 1	101
146	F	The system shall collect operations data from the Wichita MIST data interface.	Table 1	101
147	F	The system shall collect operations data (road conditions and work zone/construction) from the KanDrive data interface.	Table 1	101
148	F	The system shall collect operations data from the Kansas City TransSuite data interface.	Table 1	101
149	F	The system shall collect operations data from the St. Louis TransSuite data interface.	Table 1	101
150	F	The system shall collect operations data from the Springfield TransSuite data interface.	Table 1	101
151	F	The system shall collect operations data from the ODOT ATMS data interface.	Table 1	101
161	F	The system shall be able to configure collection of operations data types from other data interfaces.	ITSH agencies may develop and enable new system interfaces from which data would be collected over the lifetime of the IDW.	101

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
171	F	The system shall be able to associate user access restrictions with data collected through particular data interfaces.	For example, an agency may need to restrict downstream access to data provided to the agency by a third-party information service provider (for example, INRIX or HERE) to only other agencies and not to other providers. The data would need to come to the IDW through an interface that identified the data to be restricted.	
172	F	The system shall enable the collection schedule to be independently specified for each source.		101
173	F	The system shall retry a failed collection attempt on a configurable interval until the next scheduled collection.	For example, a collection might be scheduled hourly at one minute past the hour. If the initial attempt failed, it could be reattempted every five minutes (at, for example, :06, :11, etc.) until the next scheduled collection at :01.	171
174	F	The system shall keep a log of successful and failed collection attempts.		171
2xx		**Store Data**		
201	F	The system shall store all collected operations data.		

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
211	P	The system shall store operations data, except still camera images ("snapshots"), for a minimum of five (5) years.	Identifies the minimum data retention interval for collected data.	201
212	P	The system shall store still camera images ("snapshots") for a minimum of thirty (30) days.	Identifies the minimum data retention interval for still camera images.	201
221	D	The system shall store data using data definitions consistent with the Traffic Management Data Dictionary (TMDD) version 3.03.[7]		201
231	D	The system shall index the stored data by geographical region and time.	A "geographical region" in this context could be a State or a jurisdiction represented by a TMC/ATMS from which the data were collected.	201
3xx		**Measure IDW Performance**		
301	F	The system shall maintain a record of the total number of records in the system for each operations data type.		
302	F	The system shall maintain a record of the total volume (bytes) of data stored in the system.		
303	F	The system shall maintain records of data collection attempts from each data source.		

[7] Documents are available at http://www.ite.org/standards/tmdd/3.03.asp, downloaded 2016.09.16.

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
304	F	The system shall maintain records of data collection successes from each data source.		
305	F	The system shall maintain records of system user requests for operations data from each unique system user.		
306	F	The system shall maintain records of responses to system user requests for operations data from each unique system user.		
35x		**Measure System Performance**		
351	F	The system shall enable administrators to configure routes for which performance measures are to be computed.		
352	F	The system shall compute congestion hours along its configured routes.	Example computations are described in the Iowa DOT *Mobility Report for the Years 2013-2015*.[8]	351
353	F	The system shall compute travel time reliability along its configured routes.		351
354	F	The system shall compute speed performance along its configured routes.		351

[8] *Mobility Report for the Years 2013-2015*, Iowa DOT Office of Traffic Operations.

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
4xx		**Distribute Data**		
401	F	The system shall provide an interface for requesting operations data.	"Operations data" in this context includes performance measures as well as the underlying mobility data.	
402	F	The system interface shall require identification from the requesting system user.	"System user" in this context may be and most likely is another system.	401
403	F	The system interface shall require authentication from the requesting system user.		401
404	F	The system interface shall enable specific types of operations data to be requested.	For example, a system might only want link speed data from the IDW.	401
405	F	The system interface shall enable operations data to be requested for a particular geographic region.		401
406	F	The system interface shall enable the most recent operations data to be requested.	"Most recent" operations data in this context means the last data stored in the system from any particular source. This function stands in for a "real-time" data feed.	401
407	F	The system interface shall enable operations data to be requested for a particular time range.	This function enables users and other systems to get archived and recent data.	401

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
408	F	The system interface shall enable operations data to be requested for particular combinations of time, geographic region and operations data type.		401
409	F	The system interface shall provide operations data in response to a request, subject to restrictions on access to the requested data for the requesting system user.		401
410	F	The system interface shall provide operations data in compliance with the TMDD v3.03.	The TMDD specifies the particulars of Center-to-Center (C2C) message exchanges.	401
411	I	The system interface shall provide operations data using the TMDD v3.03 XML message formats.	The TMDD specifies the particulars of and options for C2C message content.	401
412	I	The system interface shall use the Hypertext Transport Protocol - Secure (HTTPS).		401
421	F	The system shall provide an interface for monitoring roadway system and IDW performance (a “dashboard”).		
422	I	The system dashboard shall provide roadway system performance parameters in a graphical user interface.		421
423	I	The system dashboard shall provide IDW performance parameters in a graphical user interface.		421

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
424	I	The system dashboard shall use the Hypertext Transport Protocol - Secure (HTTPS).		421
425	I	The system dashboard shall enable displayed roadway system performance parameters to be configured.		421
426	I	The system dashboard shall enable displayed IDW performance parameters to be configured.		421
5xx		**Back-up**		
501	F	The system shall keep a weekly full back-up copy of the stored operations data.		
502	F	The system shall keep daily incremental back-up copies of the stored operations data.		
6xx		**System Access**		
601	F	The system shall enable system users to identify themselves.	Some system interfaces (for example, the dashboard) may be open to all users without identification. Some features or data sets (for example, those restricted to certain users (or user classes) may require that users identify themselves in order to get access.	

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
602	F	The system shall associate a system user identity with a name.		
603	F	The system shall associate a system user identity with an organization.		
604	F	The system shall provide a means of authenticating user identity.	Authentication could be implemented as, for example, a password or other “shared secret”.	
605	F	The system shall require identified system users to authenticate themselves.		
606	F	The system shall be able to provide “terms of use” to system users.		
607	F	The system shall require acknowledgment of the “terms of use” prior to establishing a system user identity.		
608	F	The system shall enable users who have authenticated themselves to the system to edit their identifying data.		
609	F	The system shall enable users who have authenticated themselves to the system to edit their name.		
610	F	The system shall enable users who have authenticated themselves to the system to edit their organization.		

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
611	F	The system shall enable users who have authenticated themselves to the system to edit their means of authentication.	For example, to change their password.	
7xx		**Reporting**		
701	F	The system shall publish monthly reports of system metrics.	This and its related requirements in this section are related to those in Section 30x that define the measurement of the IDW system performance.	
702	I	The system monthly metrics reports shall include counts of records added for each operations data type.		701
703	I	The system monthly metrics reports shall include counts of the total number of records in the system for each operations data type.		701
704	I	The system monthly metrics reports shall include the total volume (bytes) of data stored in the system.		701
705	I	The system monthly metrics reports shall include counts of data collection attempts from each data source.		701

Req. ID	Req. Type	Requirement	Basis/Notes	Related Req. ID
706	I	The system monthly metrics reports shall include counts of data collection successes from each data source.		701
707	I	The system monthly metrics reports shall include counts of system user requests for operations data from each unique system user.		701
708	I	The system monthly metrics reports shall include counts of responses to system user requests for operations data from each unique system user.		701
8xx		**IDW Performance**		
801	P	The system shall be able to complete each of its data collections prior to the next scheduled collection from the same source.		
802	P	The system shall be able to service at least seven simultaneous data requests.	The seven requests represent one from each ITSH state, with two additional requestors.	
803	R	The system shall be out of service for no more than one hour per month.	One hour per month is roughly equivalent to 99.9% availability.	

APPENDIX A

List of Acronyms

ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic/Transportation Management System
C2C	Center-to-Center
CCTV	Closed Circuit Television
ConOps	Concept of Operations
DMS	Dynamic Message Sign
DOT	Department of Transportation
EC	External Centers
FHWA	Federal Highway Administration
GLRTOC	Great Lakes Regional Traffic Operations Coalition
IDW	Integrated Data Warehouse
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization of Standards
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
ITSH	Intelligent Transportation Society Heartland
ITSHCC	Intelligent Transportation Society Heartland Corridor Coalition
MAASTO	Mid America Association of State Transportation Officials
MCOMP	Multistate Corridor Operations and Management Program
OTIIS	Operations and Travel Information Integration Sharing
RITIS	Regional Integrated Transportation Information System
RTSMIP	Real-Time System Management Information Program
RWIS	Road Weather Information System
SE	Systems Engineering
SEP	Systems Engineering Process
SRS	System Requirements Specification
TMC	Transportation Management Center
TMDD	Traffic Management Data Dictionary
XML	EXtensible Markup Language