Final Project Report

Municipality of Anchorage
GIS Integrated Transportation Network (Roadnet)
Federal Project #ITS-9902(4)

September 26, 2008
MOA Integrated GIS Transportation Network (Roadnet) Final Report
September 26, 2008

Project Location: Anchorage, Alaska

FY 2002 ITS Earmark: $158,000
Other Federal Match: 98,400
State of Alaska Match: 10,000
Municipality Match: 53,200
Total Funds: $316,000

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Completion Date: Consultant Contract Expired: November 2006
GIS Road Network Integration into MOA Geodatabase Completed by
MOA IT GIS Division: March 2008

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Overview

The Municipality of Anchorage (MOA) initiated a project in July, 2002, to integrate various existing GIS databases for roads information into a single data layer to serve as the roads layer of the MOA Land Information System (LIS) project, then under development (see Appendix A, Land Information System). The LIS is designed as a centralized land information and GIS database usable by all MOA Departments.

In 2002, existing deficiencies in the MOA GIS transportation data limited its usefulness and accessibility. Different layers of roads data, in varying degrees of accuracy and completeness, were being used and maintained by many different users. Many departments within MOA, as well as key stakeholders external to MOA, rely on MOA GIS data and were interested in a project to improve the GIS Transportation Network Data (Roadnet). A project was conceived to develop a single source of roads data that would be usable by a broad base of users.

The Alaska Department of Transportation and Public Facilities (ADOT&PF) was keenly interested in this project with the ultimate goal of facilitating inter-agency data sharing. ADOT&PF pledged its support through recommending approval of a federal ITS (Intelligent Transportation Systems) earmark, and by generously providing the cash match in other federal and state funds. The ITS Earmark was secured at the end of 2002.

ADOT&PF and MOA together signed a Memorandum of Agreement in April, 2003, and signed a Partnership Agreement in May, 2003, for the project. A consultant was contracted to do the work outlined in the Partnership Agreement. The new roads layer was published March 3, 2008 for use by various departments within the MOA and by the public (see Appendices H and I).

Project Timeline

ITS Earmark Secured..........................................................December 2002

MOU signed between MOA & ADOT&PF....................... April 2003

Partnership Agreement signed between MOA & ADOT&PF.....May 2003
Contract signed between MOA and Cambridge Systematics, Inc. (CSI) .........................September 2004

Project Kickoff Meeting with Stakeholders .................. September 13, 2004

User Needs Interviews .................................................. October 2004

Data Inventory ............................................................. November 2004

User Needs Assessment .................................................. December 2004

Project Report: Conformance with FHWA Final Rule
(includes ITS Standards Plan) ........................................... January 13, 2005

Roadnet Geodatabase Design Discussions and
Linear Referencing System Workshop ......................... February 2005

Alaska Surveying and Mapping Conference Presentation
by CSI .......................................................... February 2005

Database and Application Design Initiated ................. March 2005

Letter of Approval signed by FHWA for
ITS Standards Plan .................................................. January 2006

Testing .............................................................................. 2006-2007

Consultant Contract Expired ........................................ November 2006

MOA Roadnet Completion Strategy Developed ............ April 2007

Production of Roadnet Upgrade for GIS Users ............. March 3, 2008

Final Project Report to FHWA and ADOT&PF ............... September 2008
Stakeholder Involvement

Broad outreach for this project culminated with identification of seventeen stakeholder groups to be interviewed for the user needs analysis (see Appendix B), with 75 representatives from various agencies participating in the interviews. Stakeholders were invited to participate in the project Kickoff meeting, and a project team was established early in the process to provide project oversight. That team consisted of representatives from MOA IT Department GIS Division, Public Works Technical Services GIS Division, Public Transportation Department, Traffic Department, Anchorage Fire Department, and Anchorage Police Department. The project team enthusiastically participated in regularly scheduled bi-weekly meetings and teleconferences with the consultant for approximately one year. Later, due to unforesen technical and other difficulties, the project manager often needed to cancel meetings, and the original project team did not meet again after June, 2005.

Following the appointment of a new IT Department Director, major re-organization of MOA GIS staff, and the expiration of the consultant contract in 2006, a new project manager was appointed to complete the project in January, 2007. A technical team was created principally from GIS staff and Planning Department staff responsible for editing the Roadnet layer. The primary goal at this point was to complete the project as quickly as possible and provide a usable product to MOA staff and to the public, which was accomplished on March 3, 2008. Follow-up with the original key stakeholders is also planned for fall 2008.

Goals and Objectives Achieved / Benefits

The MOA goals for this project as included in the Partnership Agreement between MOA and ADOT&PF were the following:

- Assess transportation information needs in the Municipality for incorporation into a single data model and GIS layer called “Roadnet” usable by multiple agencies

- Accelerate the integration and interoperability of Intelligent Transportation Systems (ITS) technologies that may improve the accuracy of the data, transportation efficiency, promote safety, increase traffic flow
• Reduce emission of air pollutants, improve traveler information, enhance alternate transportation modes
• Build on the existing ITS projects, and promote tourism. In addition, certain aspects may enhance the secure operation of commercial motor vehicles and enhance their productivity.

All of these project goals have been met in varying degrees. An in-depth user needs analysis was conducted through interviews with seventeen stakeholder groups from MOA, ADOT&PF, and Elmendorf Air Force Base, who represented a wide range of users. Appendix B provides a list of stakeholder groups who were contacted and interviewed. Appendix C is the survey instrument used during stakeholder interviews. Results from the interviews were used to compile a detailed data inventory, and to evaluate and prioritize functionality in developing the first phase of the data model. The next project phase will include a review and assessment of remaining user needs that have not yet been addressed.

Integration and interoperability of ITS technologies was promoted through the use of ITS Standards in developing the new roads data layer. (ITS Standards are discussed in the next section of this report.) The new mapping layer will serve as the base mapping layer for planned ITS deployments such as real-time traffic system monitoring and data collection, real-time driver information to include incident information and road conditions, asset management, transit vehicle management, highway/rail intersection warning, and materials usage for street maintenance, when implemented in the future. An immediate public safety benefit of the improved roads network is the delivery of continually updated and refreshed mapping data to support fire and police dispatch, and related e-911 functions (addressing).

The data structure of Roadnet has been re-architected into a normalized structure and transitioned from the former ESRI (Environmental Systems Research Institute, Inc.) coverage format to the new SDE (Spatial Data Engine) geodatabase in a Relational Data Base Management System, or RDBMS, format. Integrating the new roads data layer into the MOA geodatabase infrastructure allows for improved functionality, simplified workflows, and increases data accuracy, while reducing data entry and redundancy. It provides for integration flexibility, concurrent editing, and one-source data access.

With completion of this project, all enterprise data layers are now integrated into the Municipality’s SDE geodatabase. The ease of integration was proven recently
by the speed of implementing the new AMATS (Anchorage Metropolitan Area Transportation Solutions) Transportation Improvement Program (TIP) on-line project, with the added benefit of non-GIS editors being able to update the traffic feature class.

Data upgrades have been implemented to better support the on-line public information “My Neighborhood” application (http://neighborhood.muni.org/) and the new Traffic Data Management System. Fire and Police Computer-Aided Dispatch systems rely on accurate street connectivity and over 20 attributes such as address ranges to support their functions, including Automatic Vehicle Locations (AVL) and live routing. This system is now the single source of road data which will ensure that 911 dispatch services are seeing the same road data as paper map books and other sources of road MOA information, thus eliminating confusion from responders referring to different maps, which helps to reduce driving errors and response times.

The new GIS roads layer is also planned for use as the base mapping layer of MOA roads within the State of Alaska 511 travel information system. Currently, the State is using the Conditions Acquisition and Reporting System (CARS), an internet-based travel information reporting system. The information is then automatically sent to the 511 Web site (http://511.alaska.gov) and telephone. CARS is not designed to accept GIS-based maps. The State is now evaluating other options as it plans for the next generation travel information system so that CARS or a new system can integrate GIS-based maps directly from its ESRI geo-database and from the MOA geo-database for Roadnet. The MOA will work with ADOT&PF as it plans for the next generation for its travel information system to ensure that Roadnet will be included.

When CARS/511 was being developed, one feature that was envisioned was a secure Internet site to serve ADOT&PF Division of Measurement Standards and Commercial Vehicle Enforcement (DMS/CVE) on-line permitting function and provide real-time mapping and routing for commercial vehicle permits, and to support real-time HAZMAT vehicle tracking. However, the ADOT&PF contractor for CARS/511 was unable to provide this service, and DMS/CVE developed their own on-line permit system that is not tied into CARS/511.

ADOT&PF, a major stakeholder in the MOA Integrated GIS Roadnet project, was concurrently developing an integrated GIS database for state roads data, and had expressed interest in ultimately being able to share SDE data between ADOT&PF and MOA. Now that Phase I of the MOA project is complete, MOA has initiated
discussions with ADOT&PF to determine how such data exchanges may be effected.

**ITS Requirements, Concept of Operations, and ITS Standards**

This project was funded with federal ITS funds. A primary federal requirement was that the project demonstrate conformance with the FHWA Final Rule for Intelligent Transportation Systems (ITS), Section 940.11, Project Implementation Requirements. Conformance with the Final Rule requirements is demonstrated in the project report entitled *Conformance with FHWA ITS Final Rule, January 13, 2005*, which was provided to ADOT&PF for review, and to FHWA for review and approval of the ITS Standards Plan, as required by the Partnership Agreement.

High-level functional requirements for the new geodatabase are addressed in Section 4.2 of the ITS Conformance Report. This section of the ITS Conformance Report includes a Concept of Operations that outlines the process specifications to integrate the Roadnet geodatabase with the ITS subsystems (Archive Data User Service 7.1). Figure 4.1, below, is taken from the ITS Conformance Report, and illustrates the ITS Concept of Operations for this project.

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**Figure 4.1 Roadnet Geodatabase/ITS Concept of Operations**

[Diagram showing the Roadnet Geodatabase and ITS Subsystems]

- Other Routes (e.g., snow plow)
- Transit Routes
- Roadnet Reference Network
- Other GIS data, coverages, and geodatabases
  - Traffic Data
  - Stormnet
  - ADOT&PF Highway Network
- Location Referencing
- MOA Attribute Data
- RDBMs
- ITS Subsystems
- Geodatabase Archive
- Metadata

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September 26, 2008
An ITS Standards Plan is included in the FHWA ITS Conformance Report, Chapter 6, and is included with this project Final Report in Appendix D, with a copy of the FHWA approval letter. A discussion of how ITS Standards were implemented is provided below.

GIS database technology has evolved very rapidly over the past ten years -turning over approximately every three years. The result is that if GIS standards take three years to get developed and approved they are completely obsolete by the time they get approved. Some of the ITS standards are obsolete by more than two generations of technology. In this project MOA attempted to strike a balance between existing standards and using better technologies that became available after the standards were envisioned. Specific standards are addressed below.

Location Referencing Message Specification (LRMS)

Industry wide, this was a major problem with past technologies because geographic features were located in reference to various control networks with varying degrees of precision. The precision was frequently inadequate when trying to geographically relate features identified by different surveys. Attempts were made to relate features by character keys but this caused more problems than solutions. The problem still exists with data collected with previous technologies but it seems clear that the solution is to relate geographic data geographically with high precision GPS being the answer to precision problems. MOA has elected to use geodetic location as the geographical identifier storing the location data using the high precision available in ArcGIS 9.2 and later. This format enables the data to be accurately addressed in many different geographic formats and projections.

Linear Referencing

While the Partnership Agreement and consultant contract specified that linear referencing would be incorporated into the project, this step did not fit within time and budget constraints for this phase. The ultimate goal of this phase was to get as much functionality into a usable state as was feasible with available resources, while maintaining dependent critical systems such as police and fire Computer Automated Dispatch (CAD) systems. Linear referencing was not necessary to accomplish what has been accomplished to date. Implementation of linear referencing could not have begun without the work that was completed and placed into production in March 2008. There would have been no advantage to delaying the implementation waiting for linear referencing opportunities to be put into practice. The design that has been implemented assumes linear referencing will be added at some point in the future, probably in the next phase.
Data Dictionaries

MOA has stored the metadata as an integral part of the geodatabase in the standard ESRI format. This is the most stable format and can be exported to a variety of other formats.

NTCIP 1405 Transit Communications Interface Profiles (TCIP) Spatial Representation Business Area Standard

As discussed in 6.2, MOA has elected to use a high precision geographic representation of the location of geographic features. This method is independent of all technologies and datums and does not need any additional interface.

SAE J1663 Truth in Labeling for Navigation Map Databases

This section was not incorporated in the current version of Roadnet.

SAE J2529, Rules for Standardizing Street Names and Route Identifications

When the Roadnet integration project began, this standard was being transferred to the ATIS (Advanced Transportation Information Systems) Committee, and was in development. The approach taken by the project consultant was to work with standards and practices established within the Municipality. As this standard becomes developed and refined, the MOA will review it for its impact on route naming conventions and identifiers and the representation of street names.

Roadnet ITS Standards Test Plan

For the features implemented in this phase the testing accommodated the specifications of this section and much more. A significant effort was put into auditing the data and correcting problems detected whether issues with ITS standards or otherwise.

Project Deliverables

A power point presentation summarizing the contractor results and deliverables is provided in Appendix E. A matrix showing all contract deliverables by task,
with relevant MOA documents for project completion, is provided in Appendix F. The final MOA Relational Geodatabase Model with Business Tables and Domains, and Daily Maintenance Flowchart, are provided in Appendix G. The MOA IT GIS Department announcement publishing the final product for all MOA GIS users is provided in Appendix H, and a copy of the MOA IT GIS Internet Web page showing the new Street Segments data layer available to the public for free download is provided in Appendix I.

Lessons Learned

Technical

Initially the complexity and amount of time required were greatly underestimated for the following tasks:

- **Developing interfaces with existing systems:** This prevented the system from being put into use until these very complex interfaces were developed and tested.

- **Upgrading the data content:** The previous system had less stringent data demands and the data was not adequate for the new database. A considerable effort of auditing and manually restructuring and improving the data was required before it could be converted to the new system.

At first, the conversion was envisioned as an *ad hoc*, power user operation. This proved to be inadequate for an upgrade of a system that was driving critical 911 applications. To do the conversion, IT GIS needed to develop a software program that would be completely reproducible. They also needed to be able to test the conversion and make refinements until the converted data was able to support the project goals and objectives. A requirement was to know that the results of the final conversion would be identical to the test conversions. Uninterrupted operation of the 911 applications and other enterprise applications could be assured when the new system was put into production.

Institutional
The risk of underestimating the time required for some tasks (identified in the Technical section above) is that the institutional “window of opportunity” of support for a project can change with changes in management over time. Over the life of this project, MOA experienced changes in executive administration, changes in key management positions within the IT Department, a major re-organization of key offices including the MOA GIS staff, and turnover of project champions and project managers.

None of these changes was foreseen when this project was begun, but together they resulted in unavoidable project delays. When the consultant contract expired, there was still much work left to do to provide a usable product. It is to the credit of the IT Department and GIS staff that commitment to the project remained strong to the end. The final production team focused their efforts and worked together to achieve the primary goal of creating a single, usable roads data layer within the new relational geodatabase. The streets layer of the new MOA Land Information System (LIS) geodatabase was originally anticipated to be the first layer of the new geodatabase to be completed; instead, due to unforeseen complications, the streets layer ultimately was the last layer that was completed, more than five years after project funding was secured.

Although the MOA IT GIS Department has created and made available to all MOA GIS users a single-source roads mapping layer that is continually updated, it is technically feasible for users to create and use stand-alone snap-shot data files (shapefiles, other exchange formats, etc.) that may not be updated with the most current data. It is ultimately the responsibility of individual MOA departments to establish business rules for ensuring that the most current data is used for critical functions.

**Phase II**

Funding for Phase II of the Anchorage Integrated Roadnet project was approved in June, 2007, and the project was scheduled for implementation from 2007-09 through the AMATS Transportation Improvement Program (TIP). Phase II will refine work accomplished during Phase I, by adding linear referencing, routing, and integrating with the recently upgraded ADOT&PF road data model. Work has not yet begun on Phase II.
APPENDIX A
MUNICIPALITY OF ANCHORAGE
LAND INFORMATION SYSTEM
Land Information System: Sequence of Development

- Water lines
- Zoning
- Roads
- Grid
- Land Use
- Parcels
- Subdivisions
- Address

Legend:
- Core GIS Layers
- Process
- CAMA and GIS Data
- AWWU geodatabases
- ITS Transportation

Integration

AWWU

Roadnet

LIS—Final Integration

LIS—Phase 1

SQL Server Database

- Parcels
- Subdivisions
- Address
APPENDIX B
MOA INTEGRATED GIS ROADNET PROJECT
LIST OF STAKEHOLDER GROUPS
### MUNICIPALITY OF ANCHORAGE

### INTEGRATED GIS ROADNET KEY STAKEHOLDER GROUPS

**Interviews/Participants**

<table>
<thead>
<tr>
<th>Department / Division</th>
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<tbody>
<tr>
<td>1. Public Works – Street Maintenance</td>
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<tr>
<td>2. Traffic – Engineering, Signals, Planning and Safety</td>
</tr>
<tr>
<td>3. Anchorage Police Department (APD)</td>
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<tr>
<td>4. DOT Permitting – Commercial Vehicle</td>
</tr>
<tr>
<td>5. Public Works – Planning/GIS</td>
</tr>
<tr>
<td>6. Public Works – PME (Project Management &amp; Engineering) &amp; Trails</td>
</tr>
<tr>
<td>7. Anchorage Fire Department</td>
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<tr>
<td>8. DOT – Planning Highway Data &amp; M&amp;O Road Maintenance</td>
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<tr>
<td>9. Municipality – ITD (IT Department)</td>
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<td>10. Public Transportation, Transit</td>
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<tr>
<td>11. Municipality – Department of Health and Human Services (DHHS)</td>
</tr>
<tr>
<td>12. Office of Emergency Management (OEM)</td>
</tr>
<tr>
<td>13. DOT – Pavement Management System, Planning AMATS, &amp; ROW</td>
</tr>
<tr>
<td>14. DOT - HPMS</td>
</tr>
<tr>
<td>15. Port of Anchorage</td>
</tr>
<tr>
<td>16. Elmendorf Air Force Base</td>
</tr>
<tr>
<td>17. ADOT&amp;PF – Statewide Planning (Highway Data Management, GIS and ITS)</td>
</tr>
</tbody>
</table>
APPENDIX C
USER NEEDS SURVEY INSTRUMENT AND DISCUSSION GUIDE
Roadnet Stakeholder Interviews Discussion Guide

1. **Interview Objectives:**
   - For the stakeholder to articulate your information needs and data flow business issues with respect to an Integrated Transportation Network
   - For the consultant team to understand business issues and user needs in order to design an Integrated Transportation Network that appeals to your needs

2. **Interview Approach:**
   Each interview will last 30 - 60 minutes. The overall procedure of the interviews is:
   - Review your current business process related to the utilization of Roadnet in its current format, and discuss issues or problems with the current process
   - Discuss your perceived needs for an Integrated Transportation Network, and discuss potential issues or problems as they relate to your business area

3. **Discussion Guide:**
   1. Business Process Overview (10 to 15 minutes)
      - High-level description of your business area, how you conduct your work, and how you utilize Roadnet in its current form
      - Identify key issues for this interview and for the project
   2. Issues/Problem Identification (10 to 15 minutes)
      - Discuss your information needs and data compatibility issues with Roadnet and other transportation related GIS
      - Identify specific problems with using Roadnet. Are these problems chronic or acute? Please provide examples.
      - How do you presently overcome the problems as described?
   3. Needs Assessment (15 to 20 minutes)
      - Discuss what GIS data that you currently have should be included in the Integrated Transportation Network. Identify data sources, evaluate data accuracy and currency. Identify other business units that may be interested in accessing these data items.
      - Discuss what GIS data that you currently do not have, but would like to have them included in the Integrated Transportation Network.
Network. Identify the business units that own or manages these data items.

- Identify any changes in business processes that you intend to implement that may impact the development of the Integrated Transportation Network; this should also include any new data requirements

- Discuss how you would like to access, analyze, and display data in the Integrated Transportation Network.

- Identify changes to the transportation GIS that would help you perform your functions better

- Staffing or training needs: what and who?

4. Wrap-up: Summary and Follow-Up Action Items (5 to 10 minutes)

- Are there any other issues that need to be identified related to the development of an integrated transportation network?

- Summarize discussion and identify follow-up action items and priorities

- Identify key contact person(s) and provide a list of existing transportation GIS information

- Identify any documents or other sources of information that should be analyzed in the project. If available, please bring these to the interview.
APPENDIX D
ROADNET ITS STANDARDS PLAN
GIS Integrated Transportation Network (Roadnet) Conformance with FHWA ITS Final Rule, January 13, 2005, Chapter 6
And
FHWA Approval Letter, January 17, 2006
6.0 Roadnet ITS Standards
6.0 Roadnet ITS Standards

There are two ITS standards that are especially relevant to the Roadnet project, plus four others that have some relevance and may be applicable depending upon the type of ITS subsystems that Roadnet will support. The two most important standards are:

1. ADUS; and
2. LRMS, Standard J2266.

These are discussed below.

6.1 Archived Data User Service

The Anchorage Regional Architecture identifies the role of GIS and geodata services as falling under the ADMS subsystem, which includes two market packages for archiving and retrieving ITS data, namely the Data Archive (User Service 7.6) and ITS Community Interface (User Service 7.6.1). The data archive houses operational, planning, and asset management data collected and owned by a single agency (e.g., the MOA). The source agency can contribute these data to a regional data warehouse, or provide a general query and report access to regional archive data users. In either case, it is critical that a common spatial referencing system (GIS) be used to ensure common understanding and usability of the data mart capabilities. In line with the concept of operations outlined in Section 4.0, the Roadnet geodatabase is envisioned as a data mart (User Service 7.4, or AD1 in the National ITS Architecture) with tools to access or integrate spatially referenced data in other agencies (e.g., ADOT&PF).

The purpose of ADMS is to enable transportation agencies to retain ITS-generated data and make them available for analysis. ADMS or ADUS is one of 32 user services defined in the National ITS Architecture. Each user service addresses a particular user need and defines the following:

- Subsystems or locations applicable to satisfying the need;
- Data flows between the subsystems; and
- Functions enabled by the data flows.

The earlier sections in this report have described these capabilities in the ADMS subsystem that hosts the Roadnet geodatabase.

ADUS major functions include:

- Operational data control for data integrity;
- Data import and verification;
- Automatic data historical archive to store the data permanently;
• Data warehouse distribution to provide data to the planning, safety, operations, and research communities; and

• ITS community interface.

The MOA ADMS hosts the ADUS functions described in the Anchorage Regional ITS Architecture (ADMS User Service 7.1), which conform to the National ITS Architecture. The Roadnet geodatabase is a component of this subsystem and will comply with the ADUS requirements, where appropriate. For example, the geodatabase will verify the integrity of spatially referenced data, but cannot verify the quality or accuracy of attributes associated with the spatial data.

Within the ADUS framework, a number of standards are currently under development. The first ADUS standard (ASTM E2259-03, Standard Guide for Archiving and Retrieving ITS-Generated Data) has been published by the American Society for Testing and Materials (ASTM). ASTM E2259-03 is general in scope; it does not strictly specify formats and processes, which means that it can accommodate the GIS formats proposed for the geodatabase, so long as these meet the ADUS guidelines. The ADOT&PF is using this standard to develop protocols for collecting, managing, and disseminating data collected by their weigh-in-motion (WIM) stations. This protocol could serve as a template for other traffic data collected by the State and in the MOA. The contact person at ADOT&PF is Maryann Dierckman.

The current status of the ADUS standards development is summarized in Table 6.1.

### Table 6.1 ADUS Standards Development

<table>
<thead>
<tr>
<th>Standard</th>
<th>Document Title</th>
<th>Description</th>
<th>Status</th>
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<tbody>
<tr>
<td>ASTM E2259-03</td>
<td>Standard Guide for Archiving and Retrieving ITS-Generated Data</td>
<td>Provides guiding principles for ADMS development</td>
<td>Published June 2003</td>
</tr>
<tr>
<td>ASTM Task Group E17.54.02.1</td>
<td>Standard Specification for Metadata Content for ITS-Generated Data</td>
<td>Specifies how to annotate data for subsequent uses</td>
<td>In development; draft expected 2004</td>
</tr>
<tr>
<td>ASTM Task Group E17.54.02.2</td>
<td>Standard Specification for Archiving ITS-Related Traffic Monitoring Data</td>
<td>Specifies a data dictionary for archiving traffic data</td>
<td>In development; draft expected 2004</td>
</tr>
</tbody>
</table>

In the future, ASTM Committee E17.54 plans to address standard specifications for additional data types of ITS-generated data, including incident/safety, transit, and commercial vehicles operation/freight. As these become available, the data dictionary in Roadnet can be updated to the standard definitions.
6.2 LOCATION REFERENCING MESSAGE SPECIFICATION

The LRMS standardizes location referencing for ITS applications that require the communication of spatial data references between databases. It is a core standard for accomplishing the ITS-Community Interface User Service 7.1.6 in the Anchorage Regional ITS Architecture. ITS databases may reside in central sites, in vehicles, or in devices on or off transportation links. The LRMS is applicable to both homogeneous (same database) and mixed database environments that may be implemented on wireless or landline networks. Many location referencing methods have been described and used for transportation. Since different kinds of location referencing methods must be supported for ITS applications, a variety of location referencing data concepts are provided within the LRMS.

The LRMS standard (Society of Automotive Engineers (SAE) J2266) is an extension of the LRMs Revision C, originally developed by the Oak Ridge National Laboratory (ORNL). In 1999, LRMS Revision C was incorporated in an SAE Information Report, J2374, also called the Location Referencing Message Specification. J2266 supersedes the Information Report.

The original LRMS approach had been to develop a set of location "profiles," which are sets of primitive data elements that, when taken together, describe a location according to a particular location referencing method or combination of methods. The location described might be a point, a segment of road, a house, a building, a city, or some arbitrary area on the face of the earth. Examples of referencing methods used to convey locations are complete addresses, geographic coordinates, and offsets along known roads or links (linear referencing).

SAE J2266 maintains the profile concept, but exposes previously lower-level referencing structures as profiles. For example, point, line, and area structures (and others) were contained within the geometry profile of the former LRMS versions. In J2266, these structures are broken out as profiles. A pointLocation becomes a general term that can be specified by many LRMS profiles, and, vice-versa, many profiles rely on the concept of a pointLocation.

6.2.1 LRMS Structure

A location reference is the highest level (root) of the LRMS. The LocationReference data frame is a sequence of optional profiles used to describe a location. The profiles can be organized by category (Table 6.2). The 17 LRMS profiles in a location reference are listed alphabetically in Table 6.3.
Table 6.2 LRMS Profiles by Category

<table>
<thead>
<tr>
<th>Categories</th>
<th>Profiles</th>
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<tbody>
<tr>
<td>Spatial Object</td>
<td>PointLocation</td>
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<td>LinkLocation</td>
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<td>Transition</td>
</tr>
<tr>
<td></td>
<td>GroupLocation</td>
</tr>
<tr>
<td></td>
<td>RouteLocation</td>
</tr>
<tr>
<td>Location Referencing Method (LRM)-based</td>
<td>LinearReference</td>
</tr>
<tr>
<td></td>
<td>CrossStreets</td>
</tr>
<tr>
<td></td>
<td>Address</td>
</tr>
<tr>
<td></td>
<td>PreCoded</td>
</tr>
<tr>
<td></td>
<td>PublicGrid</td>
</tr>
<tr>
<td>Collections (useful historically)</td>
<td>Geometry</td>
</tr>
<tr>
<td></td>
<td>GeoCoord</td>
</tr>
<tr>
<td></td>
<td>Grid</td>
</tr>
<tr>
<td>Data Support</td>
<td>Node Attribute</td>
</tr>
<tr>
<td></td>
<td>Spatial Object</td>
</tr>
</tbody>
</table>

The LocationReference schema representations are coded in ASN.1 and XML. An ITS location reference using the LocationReference data frame may use a single profile, or several profiles. A location reference may, therefore, be as simple as one of the other optional elements — locationName or externalID — or even of locationID only, which is an attribute in the XML Schema. In shortest form, once any profile is used to bind a location ID with a location, a complete location reference could be by ID alone, for example:

```xml
<locationReference locationID = "3333" /></locationReference>
```

Examples of more complete and complex XML profiles are provided in the J2266 LRMS standard. LRMS data concepts are included in other ITS standards, notably the Advanced Traveler Information System (ATIS) standard (SAE J2354 — Message Sets for ATIS, June 2003) and the Transit Communications Interface Profiles standard (American Public Transportation Association (APTA), under development).
Table 6.3 Top-Level LRMS Profiles and Subprofiles

<table>
<thead>
<tr>
<th>Profiles</th>
<th>Subprofiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>• AddressPoint</td>
</tr>
<tr>
<td></td>
<td>• AddressLink</td>
</tr>
<tr>
<td>AreaLocation</td>
<td></td>
</tr>
<tr>
<td>Chain</td>
<td></td>
</tr>
<tr>
<td>CrossStreets</td>
<td>• CrossStreetsLink</td>
</tr>
<tr>
<td></td>
<td>• CrossStreetsPoint</td>
</tr>
<tr>
<td>GeographicCoordinate</td>
<td>• GeoLocationDelta</td>
</tr>
<tr>
<td></td>
<td>• GeoLocationLink</td>
</tr>
<tr>
<td></td>
<td>• PolarCoordinates</td>
</tr>
<tr>
<td>Geometry</td>
<td></td>
</tr>
<tr>
<td>Grid</td>
<td>• GridArray</td>
</tr>
<tr>
<td></td>
<td>• GridBox</td>
</tr>
<tr>
<td></td>
<td>• GridPoint</td>
</tr>
<tr>
<td></td>
<td>• GridPointPair</td>
</tr>
<tr>
<td></td>
<td>• GridPointSequence</td>
</tr>
<tr>
<td>GroupLocation</td>
<td></td>
</tr>
<tr>
<td>LinearReference</td>
<td></td>
</tr>
<tr>
<td>LinkLocation</td>
<td>• LinkGeneral</td>
</tr>
<tr>
<td>NodeAttribute</td>
<td></td>
</tr>
<tr>
<td>PointLocation</td>
<td>• PointOffset</td>
</tr>
<tr>
<td>PreCoarea</td>
<td></td>
</tr>
<tr>
<td>PublicGrid</td>
<td>• PublicGridLocalReference</td>
</tr>
<tr>
<td></td>
<td>• PublicGridStatePlane</td>
</tr>
<tr>
<td></td>
<td>• PublicGridUSNG</td>
</tr>
<tr>
<td>RouteLocation</td>
<td></td>
</tr>
<tr>
<td>SpatialObject</td>
<td></td>
</tr>
<tr>
<td>Transition</td>
<td></td>
</tr>
<tr>
<td>OtherData Frames</td>
<td>AdminAreaGroup</td>
</tr>
<tr>
<td></td>
<td>Angle</td>
</tr>
<tr>
<td></td>
<td>AttributesDistance</td>
</tr>
<tr>
<td></td>
<td>GeoLocation</td>
</tr>
<tr>
<td></td>
<td>Height</td>
</tr>
<tr>
<td></td>
<td>IdType</td>
</tr>
<tr>
<td></td>
<td>Polygon</td>
</tr>
<tr>
<td></td>
<td>StreetInfo</td>
</tr>
</tbody>
</table>
The LRMS is an interface standard. It does not define how application communities use LRMS data concepts. It does not specify implementation software, and is independent of specific communication protocols or underlying positioning technologies. ITS messages are at the "logical" level, and are temporally static, but ITS applications will use the messages and other data concepts within temporal sequences. As has been noted in the Mitretek Systems White Paper, Integration Issues Related to the ITS Standards Program, ITS program efforts to develop data dictionary and message set standards are not in themselves sufficient to ensure interoperable ITS systems; there is a further need for standardized sequences of data interactions between system components, called dialogs. The Roadnet interface dialog shall comprise a collection of data elements and/or data frames which contain the substantial data to be exchanged. Messages and the data concepts they contain can be viewed as the alphabet and basic grammar for ITS. Dialogs define the sentences and paragraphs that tell the ITS application story.

The absence of defined dialogs for ITS is particularly relevant to spatial data interoperability problems and the development of the Roadnet geodatabase. During the last few years, technical developments have altered the spatial data interchange and interoperability landscape (e.g., cellular phones with built-in GPS and information standards such as XML). XML supports wireless transactions using base standards and technologies developed for the Internet, thus leveraging software and products from that field into ITS.

These developments, along with the increased importance being given by industry to location-dependent telematics services beyond navigation, commonly called Location Based Services (LBS), have two major implications for ITS standards. First, the client-server model demands that sequences of data interactions between servers and clients be standardized in order for interoperability (any client, any server) to be achieved. Second, the model makes non-ITS spatial data standards activities, such as those of the OGC and ISO TC211 (GIS), more relevant to ITS than was justifiable a few years ago, and therefore increases the need for standards coordination between ITS and non-ITS activities. The OGC has developed standards for Web Map Standards (WMS) and Web Feature Standards (WFS) that are relevant to this issue (These may not be fully compatible with LRMS, even though XML based.). Similarly, the TC211 Committee is developing standards for linear referencing to enable interoperability between software platforms, and which incorporate more robust methods of linear referencing, such as allowing lateral offset from centerline measures. The intent is also to make LRS compatible with Geographic Data File (GDF) for spatial data management. These standards are supported by ESRI in the GIS platforms, but may require custom applications and Application Programming Interfaces (APIs) to configure these functions to the ITS applications.

In practice, applications will use LRMS data concepts within the context of application dialogs. Dialogs are usually defined by applications based on specific operational needs, but it should be noted that LRMS-specific dialogs can be designed to allow location referencing messages to be sent in sequences for more accurate location referencing or to perform other spatial data functions. LRMS
provides the data concept language to support user dialogs. It also implies dialogs and services of its own. The Roadnet geodatabase may need to develop its own dialog to import/export the LRMS profiles from other GIS or non-GIS devices. The development of these dialogs is not included in the current scope of work for this project, and these dialog(s) will need developing in collaboration with the ITS subsystems that the ADMS will interface with.

The LRMS User's Guide\textsuperscript{5} discusses application dialogs using LRMS concepts in the examples, and also provides, in an Appendix, a first cut at LRMS-specific services that may be of interest to non-ITS spatial data standards activities, as well as to ITS users. This provides a useful starting point for the development of the Roadnet dialog to ITS services.

Given that ITS applications are currently evolving, it is expected that the LRMS will itself evolve. One expected revision is to accommodate the international location referencing standard under development by ISO TC204 Working Group 3 for the navigation industry. This standard, in particular the dynamic profile for on-the-fly referencing, will be finalized following testing of algorithms currently underway in Europe in real-word traffic and data situations. While algorithm based, rather than a pure interface standard, it is expected to be used by the vehicle navigation community within ITS and may be included in a future J2266 revision as a new profile.

6.3 OTHER ITS STANDARDS

There are four other ITS standards that are somewhat relevant to the Roadnet project, and these are briefly reviewed below.

6.3.1 IEEE Std 1489 - 1999, Standard for Data Dictionaries for ITS

This standard provides the rules for developing and defining data concepts used in the ITS functional area data dictionaries. These data dictionaries allow unambiguous data transfer between and among the various ITS functional areas (e.g., traffic management, traveler information, and transit management). They also enable the reuse of data concepts developed by a single functional area by all other ITS functional areas.

There are three types of data dictionaries defined in this standard: 1) application-specific data dictionaries, 2) functional area data dictionaries, and 3) the ITS data registry. The data registry is a single repository for all ITS data concepts developed by the other data dictionaries with the purpose of encouraging unambiguous data interchange and reuse among the ITS functional subsystems via their specific application systems.

This standard specifies a common set of data concepts and meta-attributes for ITS data dictionaries, as well as associated conventions and schemes, which enable the description, standardization, and management of all ITS data. Through consistent use of these common structures and associated conventions and schemes, data and information can be unambiguously defined. Other ITS standards define such issues as how data elements are combined into messages; how messages are exchanged over specific communications interfaces (e.g., LRMS); what groups of data should coexist within a given system; and the requirements for an ITS data registry. Through the implementation of this family of standards, data can be unambiguously interchanged and reused among the various ITS functional subsystems via their specific application systems.

The Roadnet geodatabase will include metadata and data dictionaries that will comply with this standard for ITS-generated data (User Service Data Archive 7.1).

Related Standards J2266, LRMS

6.3.2 NTCIP 1405 Transit Communications Interface Profiles (TCIP) Spatial Representation Business Area Standard

The Transit Communications Interface Profiles (TCIP) is a family of standards that specifies the rules and terms for the automated exchange of information in transit applications, such as operations, maintenance, planning, management, and customer services. TCIP standards define the information and information-transfer requirements among public transportation vehicles (PTVs), transit management centers (TrMCs), other transit facilities; and ITS centers. TCIP standards also identify mechanical and electrical interfaces (physical layer) and methods for ensuring data integrity (data-link layer), specify required message sets, and provide a common set of conformance requirements.

This standard defines the spatial representation data elements (called "objects") for the TCIP. The ability to transfer information about the location of transit resources, such as vehicles, facilities, passenger stops, etc., is essential to the operation of any transit agency. The spatial reference methodology described in this standard represents the location of fixed and mobile objects.

The spatial representation business area provides other transit business areas with the vocabulary and format for representing common attributes for referencing spatial transit data elements, or "objects." For example, a route is generally identified by a route identifier and its physical representation. A route pattern may be represented by a sequence of timepoints, nodes, and links; or by a series of intersections. Spatial features are composed of three primitive types: 1) zero-, 2) one-, and 3) two-dimensional objects; or point, line, and polygon,

5 Only those related standards relevant to the Roadnet project are listed here. The full list of all related standards is contained in each standards document available on the ITS Standards web site: http://www.its.dot.gov/Doc_info.html#AEP.
respectively. In addition, transit data elements make significant use of complex spatial objects, such as linked lines or traversals, which are referred to in this standard as "routes." These four classes of spatial elements (point, line, polygon, and route) cover most of this business area's location-referencing needs. These classes may be further specialized into various "layers": topological, geographic, etc. Generally, for referencing data elements, TCIP business areas use geographic, topological, and combined (geographic and topological) representations. Each layer of the representation has various referencing methods. Translation from one layer to another is accomplished by indexing (or calibrating) key data elements between two or more layers. Definitions or guidelines of data structures that ensure interoperability among location referencing methods are not within the scope of this standard. However, data elements that can accomplish the translation are contained in the standard.

This standard provides a list of objects (data elements) and messages necessary for conducting control center or transit management operations. It must be used in conjunction with the TCIP Framework Standard (NTCIP 1400), which organizes the information and data transfer requirements among public transportation vehicles, transit management centers, transit facilities, and other ITS centers. The Framework Standard also identifies physical and data link communication requirements, develops required message sets, and establishes a liaison between the Institute of Transportation Engineers (ITE) and other standards development organizations (SDOs).

The ESRI GIS platforms that are used in the Roadnet project broadly provide the types of data objects specified in this standard, and these will be included in the geodatabase data model. It should also be noted that this standard is currently being revised under the auspices of APTA, who has taken over the role of TCIP standards development. Applies to User Service 7.1.6, ITS-Community Interface.

Related Standards: SAE J2266 - LRMS

6.3.3 SAE J1663 Truth in Labeling for Navigation Map Databases

This standard provides a consistent method for describing the quality and content of navigation-capable map databases, along with consistent definitions of terminology and concepts. It defines the metrics and tests for describing the quality and content of such databases. The standard does not prescribe the quality that a map database must achieve; quality requirements will vary significantly from one application to another. Rather, the use of the standard allows application developers to compare databases from different vendors and select one that corresponds to their requirements.

This standard is an aid to the evaluation of the content and quality of navigation map databases. It is intended primarily for use by developers of passenger vehicle navigation products, automobile manufacturers, and suppliers of automobile equipment. Database vendors may use the standard to construct a descriptive label to attach to their database product. Application developers may use the
standard to help them select a database that is most appropriate for the application they are developing.

As the Roadnet database and spatial data are being developed in-house by MOA, this standard is less relevant. However, it may provide a useful checklist of features that need to be included in the geometric network that will be developed to support routing and vehicle navigation capabilities. Applies to Data Archive User Service 7.1.

6.3.4 J2529 Rules for Standardizing Street Names and Route Identities

This document was originally prepared by the SAE Map Database Committee, now inactive; and the work will now be transferred to the ATIS Committee. The SAE web site indicates that this standard development is in process. This could have an impact on the Roadnet geodatabase development, especially with respect to route naming conventions and identifiers, and also the representation of street names. Until this standard is adopted, the Roadnet development will continue to work with standards and practices established in MOA. This could apply in future to User Services 7.1, Data Archive, and 7.1.6, ITS-Community Interface.
Jack Stickel, Transportation Planner
Alaska Department of Transportation and Public Facilities
3132 Channel Drive
Juneau, AK 99801

SUBJECT: ITS 9902(4), Integrated GIS Transportation Network

Dear Mr. Stickel:

The standards plan for the Integrated GIS Transportation Network that was submitted to our office has been approved.

For more information, please contact Al Fletcher, Safety / Operations Engineer, of our office at 907-586-7245.

Sincerely,

For,
David C. Miller
Division Administrator

cc: Vivian Underwood, Senior Transportation Planner, Municipality of Anchorage
Charles Barnwell, GIS Manager, Municipality of Anchorage
APPENDIX E

GIS INTEGRATED TRANSPORTATION NETWORK SUMMARY OF RESULTS AND DELIVERABLES POWER POINT PRESENTATION
CAMEBRIDGE SYSTEMATICS, INC., JULY 19, 2005
GIS Integrated Transportation Network
Summary of Results and Deliverables

presented to
Municipality of Anchorage

presented by
John Sutton and Yushuang Zhou
Cambridge Systematics, Inc.

July 19, 2005

Transportation leadership you can trust.

Agenda

- Project Scope and Objectives
- Deliverables
- Roadnet Implementation
Project Scope and Objectives

Objectives

✓ Assess transportation information needs in the MOA;

✓ Create an integrated transportation network that will meet the needs of MOA stakeholders and link many of the statewide and MOA’s ITS initiatives;

✓ Consolidate and integrate various transportation GIS layers into an integrated geodatabase system that will provide efficient means to store transportation related data elements;

✓ Provide tools for updating GIS data in the geodatabase to allow interoperability for ITS maintainers and users;

✓ Assist in the development of a secure web access to the geodatabase, and make Roadnet the foundation for managing, accessing and retrieving information needed to address transportation planning issues and to improve surface transportation system operations.
### Project Tasks and Deliverables

<table>
<thead>
<tr>
<th>Task</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITS Standards Review</td>
<td>√ ITS Compliance Report</td>
</tr>
<tr>
<td>Stakeholder Interviews</td>
<td>√ Data Assessment</td>
</tr>
<tr>
<td>User Requirements</td>
<td>√ System Capacity Plan</td>
</tr>
<tr>
<td>Database Design</td>
<td>√ Data Model Implementation Plan &amp; Geodatabase Design</td>
</tr>
<tr>
<td>Data Migration &amp; Testing</td>
<td>√ Geodatabase Development, Data Migration and Testing</td>
</tr>
<tr>
<td>Application Tools</td>
<td>√ Database Maintenance and Data Extraction Applications</td>
</tr>
<tr>
<td>Final Testing &amp; Deployment</td>
<td>√ Geodatabase and Applications Documentation</td>
</tr>
<tr>
<td></td>
<td>√ Web-GIS Implementation Plan</td>
</tr>
</tbody>
</table>

**Deliverables**
Geodatabase/ITS Concept of Operations

- Other Routes e.g. snow plow
- Transit Routes
- Roadnet Reference Network

Roadnet Geodatabase

MOA Attribute Data

Metadata

Geodatabase Archive

ITS Sub-systems

- Traffic Data
  - Stormnet
  - ADOT&PF Highway Network

Other GIS data, coverages and geodatabases

MOA Integrated GIS Transportation Network (Roadnet) Final Report
September 26, 2008

User Needs Analysis

- Interviewed more than 30 stakeholders in MOA, ADOT&PF and other agencies
- Developed Use Cases to analyze business processes and information flows
- User Needs Analysis defines data needs and functional requirements for the Roadnet Geodatabase
Use Case Example
*Transportation Planning and Management*

- **Point Events**
- **Line Events**
- **Routes**
- **Reference Networks**
- **Base Maps**
- **Digital Orthophotos**

Thematic Layers (Proposed)
Linear Reference System (LRS)

- A common underlying geometry for all transportation users
- Represented as a Geometric Network

Reference Network

- Route
  - Linear Reference System (LRS)
  - Route
    - Location
      - Jurisdictional Boundaries
    - Transportation Feature Classes
      - LRM Measures
        - Routes
          - Point Events
          - Line Events
          - Area Events
      - Other Events
    - Area Events
      - Other Lines
      - Bridges
      - Guardrails
      - Pavement
      - Bus Stops
      - Signs
      - Cross-Sections
    - Other Points
  - LRS System
    - Location
      - Jurisdictional Boundaries
      - Transportation Feature Classes
      - LRM Measures
        - Routes
          - Point Events
          - Line Events
          - Area Events
      - Other Events
    - Area Events
      - Other Lines
      - Bridges
      - Guardrails
      - Pavement
      - Bus Stops
      - Signs
      - Cross-Sections
    - Other Points

Note: Data for these junction types might not be available
Geometric Network

- One-dimensional nonplanar logical network composed of a set of edges (lines) and junctions (points).
- Topologically connected, with navigation properties such as travel direction.
- Rules can be established between junctions and edges in geometric networks.
- Allows for Routing!

Linear Referencing Illustration

- Linear Referencing Systems (LRS)
Roadnet Routes

- 183 out of 16883 Edges have no street information (1%)
- 4060 routes defined based on Street Name
- 4862 routes total when added Street Prefix/Suffix, Direction and Street Type

Roadnet Route Example
Correspondence between ADOT and MOA Networks

Rule: For the beginning and ending nodes of any CDS route on the State network, find the corresponding nodes on Roadnet.
Mapping ADOT&PF Data in GIS

Maintenance Application

Navigation Tool
Maintenance Application
Street Features and Attributes Editing Tool

Data Extraction Tools

MOA Integrated GIS Transportation Network (Roadnet) Final Report
September 26, 2008
Vision for Roadnet

- “Intelligent” network to serve multiple uses
  - Planning
  - Operations
  - Emergency services

- What is an “intelligent” network?
  - Uses location to manage different types of transportation data
    - Spatial Intelligence – manages geometry (points, lines and polygons)
    - Images
    - GPS
    - Street addresses, milepoints
GIS Integrated Transportation Network
Long-Term Vision: Technology Convergence

Applications
Wireless
Web Access
GIS Spatial/LRS
MOA Business Data
Database
PDA
Map Interface

Questions and Answers
Transportation leadership you can trust.
APPENDIX F
PROJECT DELIVERABLES MATRIX
<table>
<thead>
<tr>
<th>Task</th>
<th>Deliverable</th>
<th>Status /Comments</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td><strong>Project management and systems engineering activities</strong> commensurate with Federal and State Requirements and Agreements</td>
<td>Completed by Cambridge Systematic, Inc. (CSI)</td>
<td><em>Project Kick-Off Meeting (Power Point 9-13-04)</em>&lt;br&gt;<em>ITS Component (Power Point 11-17-04)</em></td>
</tr>
<tr>
<td>1 b</td>
<td><strong>ITS standards plan and acceptance test plan</strong></td>
<td>Completed by CSI</td>
<td><em>GIS Integrated Transportation Network (Roadnet) Conformance with FHWA ITS Final Rule, January 13, 2005, Chapter 6</em>&lt;br&gt;<em>FHWA Approval Letter 1-17-06</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The ITS Standards Plan was approved by FHWA, as required in the MOA/ADOT&amp;PF Partnership Agreement</td>
<td></td>
</tr>
<tr>
<td>1 c</td>
<td><strong>Submission of project plan, general implementation flow, status reports, budget reporting, etc., as required in the TORA and Federal FY02 ITS Integration Program Guidelines</strong></td>
<td>Completed by CSI. These items were provided with the invoices submitted by Cambridge, and were used by MOA IT GIS staff to generate the</td>
<td>Quarterly Reports (submitted between 2004 and 2007)</td>
</tr>
<tr>
<td>2</td>
<td>a</td>
<td>Needs Analysis and Data assessment report, including: 1.) A complete list of existing transportation GIS data, data dictionaries and data accuracy evaluation; 2.) Use cases of key business processes; and 3.) User needs/user requirements analysis.</td>
<td>Completed by CSI Draft Report by CSI submitted 2-15-05 incorporated the first round of user comments. No final report was submitted. This version was presumed to be final.</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>Data extract report that lays out the key steps and the critical path to the configuration of the geodatabase that will function to meet the short-term and long-term needs of existing and prospective users.</td>
<td>Completed by CSI Draft Excel Spreadsheets submitted by CSI 12-3-04. No final report was submitted. This version was presumed to be final.</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>System capacity plan for current implementation and future expansion.</td>
<td>Completed by CSI</td>
</tr>
<tr>
<td>3</td>
<td>a</td>
<td>Data Model and Standards Documentation including: Logical GIS data model design (Visio UML) and a technical memorandum that describes the data model structure along with a data dictionary</td>
<td>Draft Excel Spreadsheet submitted by CSI 8-14-06. No final report was submitted. This version was presumed to be final. The Capacity Plan was done at a very high level because the MOA did not have the resources in place to support this project.</td>
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<tr>
<td></td>
<td></td>
<td>Completed by CSI</td>
<td>Roadnet Geodatabase Design: Technical Discussions (Power Point 2-10-05)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Database &amp; Application Design: Technical Discussions (Power Point 3-23-05)</td>
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</tr>
<tr>
<td>b</td>
<td>Data model implementation plan including: 1) An LRS work plan, 2) A data development plan, 3) Historical data storage plans and 4) A metadata plan.</td>
<td>Draft Report Submitted 6-05. No final report was submitted. This version was presumed to be final.</td>
<td></td>
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<tr>
<td></td>
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<td>Roadnet Geodatabase Design and Documentation (6-05)</td>
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<td>Linear Referencing System (LRS) Workshop (Power Point 2-22-05)</td>
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<td></td>
<td></td>
<td>Linear Referencing Work Plan (Power Point 2-06, and undated Word file “LRS Work Plan”)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>a</td>
<td>Geodatabase Development including: Physical Data Model documentation including: data model documents, and a prototype geodatabase containing appropriate GIS and related data meeting user requirements and needs, and passes MOA testing.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Draft deliverables were provided by CSI. Testing by MOA revealed the final work products (geodatabase prototype and related data) were not immediately usable, and would need further validation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Roadnet Implementation Technical Topics, Structured Database Design, Undated Power Point</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>Pre-production geodatabase with corresponding FGDC compliant metadata.</td>
<td>Draft provided by CSI and upgraded by MOA IT GIS staff: Metadata (in xml file)</td>
<td>editmetadata_FGDC.xml file (undated)</td>
</tr>
</tbody>
</table>
|   | 5a  | Data Maintenance Application and Data Extraction Application. ArcGIS applications | Completed by CSI. These reports also served as the training manuals (see 5b) and were submitted as drafts. No final reports were submitted. These versions were presumed to be final. | MOA Roadnet Maintenance Tool User Guide (7-15-05)  
Roadnet Database Extraction Tool User Guide (7-15-05) |
|   | 5b  | Procedures manuals and user training | Completed by CSI  
Training manuals were provided under 5a, above. | Training Sessions (3) with Power Point Presentations (7-15-05):  
1) Building the Roadnet Geodatabase  
2) Data Extraction Application  
3) Network Maintenance Application |
|   | 6a  | Assist the MOA in the design and implementation plan for developing an internet server and applications. | Completed by CSI  
This report was submitted as a draft. No final report was submitted. This version was presumed to be final. | Implementation Plan For Developing an Internet Server and Applications for Roadnet (10-6-05) |
<p>|   | 6b  | Web-GIS application for internet access (CS team to provide technical assistance) | Completed by CSI | No document provided; technical assistance only |</p>
<table>
<thead>
<tr>
<th>7</th>
<th>a <strong>Testing and Final Deployment</strong>: includes accuracy analysis, comparison of old and new roadnet, scenario modeling, and application testing.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CSI Contract ended 11-06</td>
</tr>
<tr>
<td></td>
<td>The project was completed by MOA IT GIS 3-08</td>
</tr>
<tr>
<td></td>
<td>MOA produced a usable geodatabase streets layer which was published for GIS users on the public MOA IT GIS Internet Web page as “Street Segments” on 3-3-08.</td>
</tr>
<tr>
<td></td>
<td>MOA IT GIS staff produced draft final phase Metadata for ITS.Street_Segments as “Frequently Anticipated Questions” format. After final quality control review, the Metadata will be published for GIS users on the MOA GIS Web site.</td>
</tr>
<tr>
<td></td>
<td>CSI Final Summary of Results and Deliverables (Power Point 7-19-05)</td>
</tr>
<tr>
<td></td>
<td>Final MOA relational database model of ITS.Street_Segments (Business Tables and Domains) &amp; Daily Maintenance Flowchart</td>
</tr>
<tr>
<td></td>
<td>MOA Production Announcement of ITS.Street_Segments (e-mail sent to GIS Users 3-3-08)</td>
</tr>
<tr>
<td></td>
<td>Copy of MOA Download GIS Data public Internet Web page with Streets Segments highlighted. Link to web site: <a href="http://munimaps.muni.org/moagis/download.htm">http://munimaps.muni.org/moagis/download.htm</a></td>
</tr>
<tr>
<td></td>
<td>DRAFT ITS.Street_Segments FAQ’s (not available, still undergoing internal review)</td>
</tr>
</tbody>
</table>
APPENDIX G
FINAL MOA Relational Geodatabase Model of ITS.Street_Segments
(Business Tables and Domains) & Daily Maintenance Flowchart
APPENDIX H
MOA GIS UPDATE (ROADNET AND ITS.STREET_SEGMENTS)
ANNOUNCEMENT TO GIS USERS
From: Howard, Susan J.
Sent: Thursday, February 28, 2008 5:03 PM
To: GIS Users
Subject: GIS update: Changes to Roadnet & Street_Segment

The upgrade to the GIS map layer “Roadnet” has been completed. On Monday, March 3, GDBO.Roadnet will be replaced with a new feature class called ITS.STREET_SEGMENTS. Please make sure your mapping applications that utilized Roadnet are now pointing to the new ITS.STREET_SEGMENTS layer. If you’re not sure if you’re using the right data, or how to switch to the new data if there is road data missing from your applications, please let us know and we will assist you in getting re-connected to the new data source.

For a short while, the old Roadnet layer will still be accessible, but please note as of last week it is no longer being updated.

We are also slightly changing a few names of the new feature classes, in order to adhere to our own naming standards. We originally called this new feature class ITS.STREET_SEGMENT – but we are renaming it to ITS.STREET_SEGMENTS (note the “S” at the end). This will affect this feature class on both Rock (geoprod) and Hardy (georep) servers. We will also change the names of the views from ITS.STREET_SEGMENT_VIEW and ITS.STREET_SEGMENT_EXISTING_VIEW to ITS.STREET_SEGMENTS_VW and ITS.STREET_SEGMENTS_EXISTING_VW.

These changes will be in place Monday morning March 3rd.

We will keep the ITS.STREET_SEGMENT_VIEW and the ITS.STREET_SEGMENT_EXISTING_VIEW on Hardy (georep) through Friday March 7th, to allow time to move applications to the new naming convention.

If you have any questions or concerns about this action, please feel free to let me know.

Susan J. Howard
GIS Supervisor
Municipality of Anchorage
Information Technology, GIS Services
(907) 343-8255
APPENDIX I

PUBLIC MOA IT DEPARTMENT INTERNET WEB PAGE:
GIS DATA DOWNLOADS (STREET SEGMENTS HIGHLIGHTED)
http://munimaps.muni.org/moagis/download.htm
MOA GIS
DOWNLOAD GIS DATA

To download a GIS data file simply click on the underlined link for the file you wish to download. A window will pop up asking if you wish to "Open" or "Save" the file. Select "Save" and then enter the path on your PC to where you wish to store the data you selected.

SHAPEFILE FORMAT (.shp)

- Address Points (5610 KB)
- Assembly Districts (195 KB)
- Avalanche (448 KB)
- Buildings (foot prints) (295 KB)
- Census Block Groups (554 KB)
- Chugach National Forest (8 KB)
- Chugach State Park (36 KB)
- Community Councils (301 KB)
- Community Borders (19 KB)
- Easements (1442 KB)
- Geology (2092 KB)
- 100 Scale MOA Grid (216 KB)
- 500 Scale MOA Grid (25 KB)
- House District (189 KB)
- Senate District (132 KB)
- Lakes (195 KB)
- Landuse (40291 KB)
- Marine (land/water 1622 KB)
- Military (31 KB)
- MOA Boundary (3 KB)
- MOA Parks (385 KB)
- Precincts (212 KB)
- Parcels (26330 KB)
- Railroad (92 KB)
- Street Segments (4167 KB)
- Seismic (430 KB)
- Streams (520 KB)
- Legacy Streams (883 KB)
- Subdivisions (3595 KB)
- Trails (913 KB)

Oracle SDE (GDB) Export Format

- Address Points (11204 KB)
- Building Footprints (166 KB)
- Easements (755 KB)
- Flood Limits (2940 KB)
- Landuse (19947 KB)
- Parcels (15968 KB)
- Street Segments (2894 KB)
- Subdivisions (1759 KB)
- Wetlands (677 KB)
- Zoning (604 KB)
- Street Lights (506 KB)

CAMA (property information)

For CAMA data we recommend using the Municipal Appraisals's web site http://propertytax.muni.org/propappraisal/public.html. If further information is needed, please contact, Property Appraisal at 907-343-6770