REQUEST FOR PROPOSAL
REVISED PROPOSAL DUE DATE

The Michigan Department of Transportation is seeking professional services for the project contained in the attached Research Problem Statement.

The prime consultant/vendor is responsible for the successful completion of the service and is expected to perform at least 40 percent of the services, by dollar value, not including direct costs required on the service, unless otherwise specified in the RFP.

If your organization is interested in providing services, please indicate your interest by submitting a proposal following the research guidelines near the top of MDOT's Request for Proposals Web page at http://www.michigan.gov/mdot/0,1607,7-151-9625_32842---,00.html.

RFP SPECIFIC INFORMATION

Problem Title: Advanced Applications of IntelliDrive[SM] Data Use Analysis and Processing 2 (DUAP 2) Project
ORBP Number: OR10-044

This is Best Value Selection which means the budget amount submitted with the proposal is a component of the proposal score, not the determining factor of the selection.

PROPOSAL SUBMITTAL INFORMATION

REQUIRED NUMBER OF COPIES FOR PROJECT MANAGER	PROPOSAL DUE DATE	TIME DUE
8	**1/21/2011**	**5:00 PM, EST**

PROPOSAL AND BID SHEET MAILING ADDRESSES

Mail the multiple proposal package to:

☒ Calvin Roberts, P.E., Engineer of Research and Best Practices

First Class Mailing Address
Michigan Department of Transportation
Office of Research and Best Practices
P.O. Box 30050
Lansing, Michigan 48909

OR

Overnight/Express Services Address
Michigan Department of Transportation
Office of Research and Best Practices
425 West Ottawa
Lansing, Michigan 48933

Mail one additional copy of the proposal to the Contracting Office indicated below:

☒ First Class Mail:
ORBP Contract Administrator
Contract Services Division
Michigan Department of Transportation
P.O. Box 30050
Lansing, Michigan 48909

OR

Lansing Overnight Mail:
ORBP Contract Administrator
Contract Services Division
Michigan Department of Transportation
425 West Ottawa
Lansing, Michigan 48933

BUDGET

☐ Tier I ($25,000 - $99,999)

☐ Tier II ($100,000 - $250,000)

☒ Tier III (>$250,000)

GENERAL INFORMATION

Any questions relative to the Research Problem Statement must be submitted by e-mail to: mdot-research@michigan.gov. Questions must be received by **January 14, 2011 at 5:00 p.m. EST.** All questions and answers will be placed on the MDOT RFP Web site as soon as possible after receipt of the questions and at least three (3) days prior to the due date listed above. The names of organizations submitting questions will not be disclosed.

MDOT is an equal opportunity employer and MDOT DBE firms are encouraged to apply. The participating DBE firm, as currently certified by MDOT's Office of Equal Opportunity, shall be listed in the Proposal.

MDOT AND ORBP FORMS REQUIRED AS PART OF PROPOSAL SUBMISSION:

5100D – Request for Proposal Cover Sheet
5100G – Certification of Key Personnel
5100I – Conflict of Interest Statement
ORBP Research Proposal Budget Form Worksheet
ORBP Schedule of Research Activities Form
ORBP Deliverables Table
ORBP Implementation Project Recommendation Form

Michigan Department
Of Transportation
5308-10 (03/10)

OFFICE OF RESEARCH & BEST PRACTICES
MDOT RESEARCH PROGRAM
2010 PROBLEM STATEMENT

PROBLEM TITLE
Advanced Applications of IntelliDrive^{SM} Data Use Analysis and Processing 2 (DUAP 2) Project

ORBP NO.	STRATEGIC PRIORITY NO.	CRITICAL ISSUE CODE	MDOT PROJECT CATEGORY
OR10-044			

PROBLEM TO ADDRESS

BRIEFLY DESCRIBE THE PROBLEM TO BE ADDRESSED AND WHY IT IS AN ISSUE FOR MDOT

Some data collection systems within MDOT are outdated, redundant, inefficient, departmentalized, and partly disjointed. These inadequate systems are not best-suited to serve MDOT, due to the limitations of current technologies and resources in use. This proposed research project (DUAP 2) will:

-Define specific user needs through refined systems engineering process based on the original DUAP project.

- Develop and deploy new approaches to collect, manage, analyze and process data for maintenance, operation management and planning purposes. MDOT needs to have a more efficient and effective means of accessing, storing, and disseminating purposeful data when planning, managing, and operating Michigan's transportation infrastructure system.

- Significantly expand the range of partner organizations and sources from which probe data are drawn.

- Research and demonstrate how data from applications currently collected like US weather data sources can be used for mass scale data comingling and convergence to add value to current operations of a Transportation Management Center and maintenance garage.

- Develop and evaluate new types of technology and data from sensors not available in the original DUAP.

- Research and demonstrate how DUAP data compares to current collection practices of asset management, MDOT's Transportation Management System and how this data can be used to support current data sources used for asset management and planning purposes.

-Develop and evaluate applications for mileage and congestion based charging schemes, fuel efficiency and emissions monitoring and commercial vehicle operations.

-Research and demonstrate how economies of scale can be achieved by collecting and processing vehicle probe data for a Transportation Management System

RESEARCH OBJECTIVES AND TASKS

LIST THE RESEARCH OBJECTIVE(S) TO BE ACCOMPLISHED

1. Use vehicle probe data to more efficiently and effectively collect, manage, analyze and process data for safety, mobility, maintenance, operations management , planning and asset management purposes.

2. Grow the number of partner organizations and sources that MDOT's probe data collection/usage is drawn from.

3. Research/study multiple data use cases that better address key stakeholder needs and determine the best ways to meet these needs.

4. To sustain MDOT's business operations the research must demonstrate full functionality/applicability of the new systems to fulfill scenarios prescribed in the updated Concept of Operations. Develop a plan for MDOT's use for training and other efforts necessary for MDOT to mainstream into its business processes. Converge vehicle probe data to meet MDOT's end user needs.

LIST THE MAJOR TASKS TO ACCOMPLISH THE RESEARCH OBJECTIVES: ESTIMATED PERSON HOURS

1. Task 1 - Concept Review and Refinement: This research task revisits and updates the DUAP Concept of Operations based on the experience and lessons-learned in the earlier research. The updated Concept of Operations will provide a broad and easily understandable view of the ways in which IntelliDriveSM will help make MDOT business processes more efficient and effective. This task is an essential step for engaging all MDOT stakeholders in a meaningful discussion of their needs.

2. Task 2 - IntelliDriveSM User Needs Development: This research task involves interacting with planning, maintenance, construction, MDTMB, TOC, design, etc. crews to determine their individual user needs. The Consultant and Project Manager will work together to present the type of data they decide will meet the needs of each group. The Consultant will then work with each group to get user feedback as to how the data set should change to meet each of the groups needs. Once these needs are determined, data sets that determine the types of sensors that will collect the data for the DUAP 2 project will be established, and defined use cases around these needs will be developed. These use cases will support data applications that vehicles will be collecting, and will then be documented in the modified versions of the original DUAP Concept of Operations and Requirements.

3. Task 3 - Design and Development: Research/study multiple data use cases that better address key stakeholder needs and determine how best to incorporate these practices to benefit MDOT's operations. This research task will enable the system developers to create the design for DUAP 2 that will satisfy the user needs. This task provides an opportunity to design and develop the applications identified in Task 1 and 2. The selected vendor will be required to work with a steering committee to develop the overall functional requirements for the IntelliDriveSM data-use program. This process shall follow the traditional systems engineering process used by US DOT and others.

4. Task 4 - Implementation, Testing and Evaluation: In this research task, the system developers will work with testers to assure that the system being built meets all of the documented system requirements and delivers the user needs. At this point, the system will be a tool for users to assess their own particular applications. Consistent with earlier DUAP work, this task will implement, test, and evaluate the various new applications as they become available. As with the focus of DUAP 2, this research task will also seek to enhance all of the implemented applications with richer, more comprehensive data sets when this will improve their quality and usefulness to

state and local transportation agencies. This task will also explore new ways to retrieve a sufficient amount of real data to conduct suitable evaluations.

5. Task 5 - Procure and Deploy Data Sources: The true value of IntelliDriveSM is the ability to provide types and volumes of data that are otherwise unavailable or too expensive to routinely gather. This research task will involve equipping MDOT and other public fleets with new types of aftermarket devices that will generate the specific data elements needed to power the users' individual applications.

6. Task 6 - Data Management and Distribution Design: In this research task the Consultant will demonstrate the management, distribution and display of data in an efficient and scaleable manner. As the prototype being developed will be used by MDOT and its IntelliDriveSM partners beyond the anticipated end of this contract, the prototype must be able to demonstrate scalability, redundancy upgradeability, and be compatible with the Michigan Department of Technology, Management and Budget's (MDTMB) current and future platforms, operating systems, software tools, development software and database software.

7. Task 7 - Data Collection Method Comparison and Exploration: In this research task, the Consultant will identify specific applications for which there are likely to be significant operational advantages, and will specify needs and evaluation success criteria for each application of interest. The Consultant will also compare and contrast how DUAP data compares to current data collection practices for asset management and Michigan's transportation management system, and how this data can be used to support current data sources used for asset management and planning, and enhance the current methods of data collection. Emphasis will also be placed on identifying the best set of performance measures for MDOT's overall needs, and evaluating the capabilities of the system to report those measures.

8. Task 8 - Application Convergence and Sustained Operations: The research comes full circle in this task with demonstrating that the new DUAP 2 applications collectively fulfill the scenarios presented in the updated Concept of Operations. Through training and other efforts beyond this research project, DUAP 2 will begin mainstreaming into MDOT's business processes. This research task will also explore the convergence and integration of applications. It is intended to identify opportunities where applications that are driven by IntelliDriveSM and ITS data can be logically packaged together. For example, one set of integrated applications could be intended to support operations in a traffic management center; another might be best suited to winter maintenance personnel; while a third could be developed for long-range planners.

9. Task 9 - Outreach and Awareness: The ultimate success of the research of DUAP 2 depends on acceptance and routine use of the system department-wide to the greatest extent possible. This research task provides for continuing efforts during research to ensure key agency stakeholders remain aware and informed of progress and have opportunities to provide input to the system development and operation. With the rapid pace and broad range of IntelliDriveSM research activity, sharing of information and lessons learned is crucial to advancing research initiatives, reducing duplication of effort, and ultimately reaching a deployment decision that is informed by and accepted across industries and geographic boundaries. The purpose of this task is to share ideas, research, and lessons learned with interests around the world in the hopes that others can learn and further build off of the Michigan IntelliDriveSM experience.

ESTIMATED COST AND TIMELINE

ESTIMATE THE COST OF THIS RESEARCH STUDY (Please provide a cost range [min. and max.] associated with the person hours by task above)

PROVIDE A PROPOSED TIMELINE FOR THE PROJECT (At minimum, the expected duration of the project)
3/15/2011 to 3/15/2014

REQUIRED COMPLETION DATE (At minimum, the date by which results are needed to be applicable)
3/15/2014

BUDGET INFORMATION

(For each FY, list suggested minimum and maximum budgets as targets. Indirect Cost Rate is for ORBP use only.)

TOTAL BUDGET (BY FY)	FY1	FY2	FY3	FY4	INDIRECT COST RATE

DELIVERABLES

WHAT DELIVERABLES SHOULD BE RECEIVED AT THE END OF THIS PROJECT? (e.g., usable technical product, design method, techniques, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tools, etc.)
The respondents to the DUAP 2 RFP will include a planned list of expanded deliverables to add to the suggested lists below.

Task 1:
- **Revised and expanded Concept of Operations**
- **List of prototype applications vendor plans to develop for program**

Task 2:
- **Determination of stakeholder individual user needs**
- **List of defined use-cases to support data applications**
- **Revised and expanded Concept of Operations and Requirements**

Task 3:
- **Revised and expanded System Architecture**
- **System Requirements**
- **System Design documentation**

Task 4: • **System Test Plans and Reports**
• **Software Distribution Kits**
• **System Evaluations**
• **Structural Testing Data Evaluation**
• **Prepare data and interface specifications**
Task 5: • **Vehicles equipped with new OBE type devices for data colllection and communication**
Task 6: • **A prototype which meets all requirements and standards**
Task 7: • **Comparison of DUAP and current data collection practices**
• **Specification of needs and evaluation success criteria for each application of interest**
Task 8: • **Training materials**
• **Application procedures**
• **System evaluation and operation**
Task 9: • **Presentation materials**
• **Research papers**

MDOT INVOLVEMENT (What will MDOT provide for this project and when)
MDOT will provide data information from the original DUAP project. Data collection sources being used for the original DUAP project, and any system engineering included in original DUAP. These will be provided upon execution of the contract award.

URGENCY, PAYOFF POTENTIAL AND IMPLEMENTATION

HOW URGENT IS THIS RESEARCH? IS IT IMPORTANT THAT IT BE DONE SOON? IF SO, WHY?
To avoid any gaps in data collection or pre-mature application terminations, DUAP- I project's completion should dovetail into the DUAP 2 project by July 31, 2011. The DUAP 2 project activities/tasks should parallel future IntelliDrive initatives by the USDOT and Michigan is expected to be an important stakeholder with regard to the development of those initiatives and their parallel with the DUAP 2 research project.

DESCRIBE HOW THE PROPOSED RESULTS OF THIS PROJECT CAN BE IMPLEMENTED AT MDOT
The prototypes developed in DUAP 2 from data collected will be used to compliment the divisions of planning, design, maintenance, and the Transportation Operation Center. These prototypes will be used to support and enhance the current methods for decision support systems.

DESCRIBE HOW MDOT WILL BENEFIT FROM THE IMPLEMENTATION OF THIS PROJECT AND WHO THE BENEFICIARIES WILL BE. INCLUDE A DISCUSSION OF HOW MDOT DIVISIONS, OTHER THAN THAT OF THE PROBLEM SUBMITTER, WILL BENEFIT AND HOW.
MDOT will benefit from the implementation of DUAP 2 by becoming more efficient and effective. For example, efficiency and effectiveness will be realized in the maintenance division due to more accurate information about when and where to supply salt. Safety and mobility will also be improved when drivers are informed of slippery conditions. Another important example benefits the planning division. When DUAP 2 data is used to retrieve more pavement performance data, this data will help to support and enhance existing data collections for asset management purposes. The selected vendor will coordinate all work with MDOT task groups and committees that define department needs.

POSSIBLE INVESTIGATOR(S)

DESIRED QUALIFICATIONS IN AN INVESTIGATOR
- Experience in Intelligent Transportation Systems (ITS)
- Developing and producing System Engineering Documents
- Background in data collection and analysis
- Background in IntelliDriveSM applications
- Experience working with government agencies

POTENTIAL OBSTACLES

WHAT RISKS OR OBSTACLES MAY MAKE CARRYING OUT THIS PROJECT DIFFICULT? WHAT STRATEGIES WILL YOU USE TO OVERCOME THEM?

Potential obstacles include:
-Acquiring a sufficient amount of data needed to develop prototypes and applications.
- Finding partners willing to cooperate with data sharing.
- Securing correct data sets to develop prototypes and applications needed for project completion.

Strategies used to overcome obstacles:
Identify needs early on in the project and have open forum discussions with selected partners to acquire data needs

ADVANCED APPLICATIONS OF INTELLIDRIVE^{SM} DATA USE ANALYSIS AND PROCESSING 2 (DUAP 2) PROJECT
REQUEST FOR PROPOSAL
Supplemental Information

The Michigan Department of Transportation (MDOT) is seeking professional services for the project contained in the preceding problem statement and following scope of services:

SCOPE OF SERVICES

PROJECT DESCRIPTION/PROJECT MANAGER DESIGNATION:

C.S. J.N. 84900-

C.S. J.N. 84900-111941
Work completed and related to Task number 9, Outreach, shall be charged to control section and job number 84900-111941. Work completed and related to Task 1 through 8 shall be charged to control section 84900-

Project Location: Statewide

Project Type of Work: Services to evaluate the uses and benefits of IntelliDrive^{SM} related data to determine how the IntelliDrive^{SM} program will impact how state and local departments of transportation, specifically MDOT, do business as a result of the significant quantity of additional data on all major (and eventually minor) roads. This information is anticipated to permit MDOT and MDOT's partners to more efficiently and effectively manage traffic on all facilities in the region, manage assets and road conditions, and respond to safety concerns.

I Primary Prequalification Classification:

None

II Secondary Prequalification Classification:

None

The anticipated start date of the service is March 15, 2011.

The anticipated completion date for the service is March 15, 2014.

DBE Requirement: N/A

MDOT Project Manager: Steven J. Cook, P.E.
Operations Division
Construction and Technology

8885 Ricks Rd.
P.O. Box 30049
Lansing, MI 48909
cooksj@michigan.gov
(517) 636-4094

The Consultant shall contact the Project Manager (PM) prior to beginning any work on the project.

PRE-PROPOSAL MEETING

There is no pre-proposal meeting schedule or planned for this project.

ORAL PRESENTATIONS

Responders who submit proposals may be required to make oral presentations of their proposals to MDOT. These presentations provide an opportunity for the consultants to clarify the proposals through mutual understanding. MDOT will schedule these presentations, if required.

GENERAL:

The Consultant shall furnish all services and labor necessary to conduct and complete the services described herein. The Consultant shall also furnish all materials, equipment, supplies and incidentals necessary to perform the Services (other than those designated in writing to be furnished by the Department), and check and/or test the materials, equipment, supplies and incidentals necessary in carrying out this work. The Services shall be performed to the satisfaction of the Department consistent with applicable professional standards.

The Services described herein are financed with public funds. The Consultant shall comply with all applicable Federal and State laws, rules, and regulations. The Consultant shall perform field operations in accordance with MIOSHA regulation and accepted safety practices. The consultant staff shall conduct themselves with professionalism in carrying out their duties.

The Consultant will notify the Project Manager, in writing, prior to any personnel changes from those specified in the Consultant's original approved proposal. Any personnel substitutions are subject to review and approval of the Project Manager.

At the request of the Department, the Consultant, during the progress of the Services, shall furnish information or data relating to the Services described herein that may be required by the Department to enable it to carry out or to proceed with related phases of the Project not described herein, or which may be necessary to enable the Department to furnish information to the Consultant upon which to proceed with further Services.

Introduction

The IntelliDrive^{SM} DUAP program began in FY 2007 (DUAP-1) provided the first evaluation of the uses and benefits of IntelliDrive^{SM} related data to Michigan transportation agencies. DUAP-1 was the first significant demonstration in the U.S. of the opportunities available to operate transporation agencies from the collection, analysis, and processing of probe data from IntelliDrive^{SM} equipped non-agency vehicles.

This DUAP 2 project builds on the original DUAP-1 success by significantly expanding the range of partner organizations and sources from which probe data are drawn; evaluating new types of data from sensors not available in DUAP-1, identifying and acquiring non-probe data sources for correlation and data quality checking, developing new algorithms to synthesize performance measures, evaluating applications for mileage- and congestion-based charging schemes, fuel efficiency and emissions monitoring, commercial vehicle operations, rural areas and facilitating industry and public awareness of the opportunities and benefits of IntelliDrive^{SM}.

Key changes from the DUAP-1 project are going to be implemented in the DUAP-2 project. The first is that this project will focus on honing in on specific customer needs, and developing data sets based on those needs. The second change concerns the absence of a sufficient amount of real IntelliDrive^{SM} data to conduct suitable system evaluations and prototypes, and exploring ways to retrieve this data. First, new methods and technology to collect data from the infrastructure will be researched, investigated, developed, integrated, and deployed using probe vehicles and sensor technologies. Second, research and development for vehicle probe data collection field operation testing will be executed as needed to meet user needs. In the event both of these methods lack important data sets to fully research and develop algorithms, system evaluation and prototype development and testing, simulation may be implemented as determined by the Project Manager. The method of simulation involves generating synthetic IntelliDrive^{SM} data and gap-filling this data to compensate for possible limitations of the real-time data. Simulation will not be considered as a main source of data collection.

Background

The Michigan Department of Transportation and our partners have been working diligently to reduce both the number and severity of crashes on our roadways, as well as to reduce the impacts of congestion on personal travel and the movement of goods and services. One area identified as a means of solving both of these issues is the integration of the vehicle and the roadway. As these two components are integrated, it is possible to prevent vehicles from colliding with one another, running red lights or running off the road. Likewise, the collection of data for location, speed and other vehicle information, in addition to the ability to process and share that information with drivers, in-vehicle, has the potential to reduce secondary crashes and congestion. Providing drivers with sufficient, accurate information on congestion allows them to intelligently select alternate routes or trip departure times.

In 2002, 1,279 people lost their lives on Michigan roadways, and although that shows a decrease of almost 17% from 1995, it still amounts to 3.5 people per day being killed on Michigan roadways. The IntelliDrive^{SM} text bed section had 474 crashes, resulting in 2 fatalities and 6 incapacitation injuries from 2002 to 2004. With respect to traffic congestion, the 2005 Urban Mobility Report prepared by the Texas Transportation Institute, shows that in 2002, the average

commuter in Detroit spent 57 hours stuck in traffic congestion. This delay resulted in approximately 120 million hours of delay and 73 million gallons of excess fuel consumed, at an annual cost of over 2 billion dollars due to lost time and increased fuel consumption.

Although the IntelliDrive^{SM} program shows promise in reducing all of these factors, it is still in its infancy. Work needs to be done to support this program by both the public and private sectors. The private sector needs to develop applications and components, both for in the vehicle and along the roadway, including the research, development, testing and evaluation. The public sector needs to support the efforts of the private sector by providing infrastructure on the roadside, coordinating activities, and funding some of the less commercially viable yet operationally critical components, such as the safety and mobility applications.

Likewise, the IntelliDrive^{SM} program will begin to provide a significant amount of data that MDOT and MDOT's partners (USDOT, FHWA, Local Agencies, MPO's, etc.) can use in real-time and near real-time as well as future uses. Examples would include active crash avoidance, detection of slippery surface conditions, and enhanced evaluation of crash patterns, congestion, asset management and maintenance needs.

Purpose

The intent of this Request for Proposals (RFP) is to evaluate the data being received by MDOT and MDOT's partners through the IntelliDrive^{SM} program for its day-to-day applications within a Department of Transportation. Key sub-tasks are going to be the development of functional requirements, development of algorithms, and development of a prototype data processing, storage and management utility, in addition to user interfaces that demonstrate various uses of IntelliDrive^{SM} data and technologies on a department of transportations management and operations of transportation infrastructure. These cases require the integration, storage, processing, utilization and dissemination of real time vehicle data from a variety of sources detailed in the background of this proposal, and others as they may become available. It is the ultimate intent of this project to research and demonstrate the impact of IntelliDrive^{SM} data on the safety, mobility, and efficiency of the transportation system generated as a result of the IntelliDrive^{SM} program. The intent of this project is not the development of the production-level applications. The applications that are anticipated to be developed for this project are intended to be prototypes that aid in the processing of large amounts of data and how they can be displayed and used by the end user. The development of production-level applications will be considered and researched as to how these applications can be mainstreamed into a DOT's day to day production applications for mobility, asset management, maintenance and TOC needs. This project will research, develop and deploy full circle IntelliDrive^{SM} data applications starting with user needs, using vehicles and sensors/devices needed to collect data to meet user needs, and research and develop how the data from many sources can be used to support and enhance a current Transportation Data Management System.

Key Tasks

Research and evaluate the potential uses of IntelliDrive^{SM} data in the day-to-day operations of a DOT and how that data can support and enhance existing data collection systems. The selected vendor will be required to develop a set of prototype back-room applications. However, prior to

developing prototype applications, the selected vendor will be required to develop functional requirements through partnering sessions, and the development and review of algorithms and systems (and sub systems) for the processing of the IntelliDrive^{SM} data. The respondents to this RFP should include a planned list of expanded deliverables to add to the suggested lists below. The following elements detail the main areas of interest. Due to the iterative nature of this program, they are presented in as logical an order as possible. The proposals should address, through the systems engineering process, how best to organize these elements to ensure that the final product has that greatest chances of success.

Task 1 – Concept Review and Refinement

The current DUAP-1 project has followed a disciplined systems engineering approach, moving from user needs documented in a Concept of Operations through requirements specification, architecture development, design, implementation, and testing. This has resulted in a detailed plan by which specific data applications are being researched, developed and deployed.

Task 1 will review the DUAP-1 systems engineering process and development timelines, and identify any expanded opportunities for prototype application development and implementation that are afforded through integration with other IntelliDrive^{SM} field test sites or ITS applications with the potential to provide and use vehicle probe data. The successful vendor will be required to develop these prototype applications that will process and archive the raw data based on input and feedback from MDOT user needs. These applications shall include, but are not limited to:

- Traffic Information (Real-Time)
    - Link Travel Times
    - Link Speeds
    - Integrated corridor management decision support information
    - Crash notification
    - Others?
- Historic Traffic Information
    - Time of Day
    - Day of Week
    - Travel Time
    - Average Stops
    - Vehicle operation characteristics at “high crash” locations
    - Identification of locations where there are potential crashes due to data anomalies (anti-lock brake activations, traction control activations, vehicle stability, etc.)
    - Others?
- Performance Measure Calculations
    - Time of Day
    - Day of Week
    - Travel Time
    - Stops
    - Air quality estimations
    - Others?
- Congestion Mitigation and Air Quality
    - Link and corridor travel times

    - Identify Stops
    - Identify "problem corridors" and "hot spots"
    - Develop air quality and emissions calculations
    - Others?
- Weather Traffic Impacts
    - Track storm progress through probe data
    - Tie probe data regarding weather to other information sources, such as the National Weather Service, CLARUS, etc. and demonstrate how probe weather data could interact with those sources to improve the maintenance decision support system (including a potential tie-in to the Southeast Michigan Snow and Ice Management (SEMSIM) system)
    - Identify storm and visibility impacts on traffic operations
    - Identify maintenance needs though ABS and traction control activations
    - Integrate with CLARUS data
    - Others?
- Asset Management
    - Identify rough road segments based on probe data, accelerometer XY&Z, (potholes, cracks, etc.)
    - Develop a prototype maintenance decision support system (work with the US DOT and other public sector entities who have existing decision support systems that can be integrated into a prototype IntelliDrive^{SM} system)
    - DOT fleet vehicle data collection system to manage and process fleet use and maintenance.
    - Determine cost-benefit for asset management purposes by using vehicle probe data collection systems.
    - Others?
- Traffic Signal Operations
    - Weather Impacts
    - Signal retiming impacts (before and after studies; evaluate the effectiveness of changes; etc.)
        - Main Street
        - Cross Street
        - Directional
    - Turning Movements
    - Origin and Destination Data
    - Others?
- Predictive Traffic Impacts
    - Compare current traffic to historic traffic
    - Broadcast an unusual congestion alarm or alert
    - Others?

The list of applications is provided as information for the potential vendors. The proposal should include a list of the prototype applications that the vendor plans to develop as part of this program. The proposal should also include information regarding the data processing, management, distribution and user interfaces that will be developed as part of this program.

The successful team should include team members with experience in traffic management, operations, highway asset management, and Systems Engineering development to ensure that the program being developed meets the needs of a DOT.

For the applications listed above, the successful proposer will be expected to develop algorithms that use the available data to calculate or derive the desired values and provide displays to end users that clearly define their needs based on data collected.

The proposal should include any experience the proposing team has with the development of traffic and transportation-related applications.

Deliverables:

- Revised and expanded Concept of Operations from DUAP-1
- List of prototype applications vendor plans to develop for the program
- Others?

Task 2 – IntelliDrive^{SM} User Needs Development

This task involves interacting with planning, maintenance, construction, MDTMB, Transportation Operation Centers (TOC), design, etc., department planning tasks groups and committees to determine their individual user needs. The Consultant and Project Manager will work together to present the specific type of data they decide will meet the needs of each group. The Consultant will then work with each group to get user feedback as to how the data set should change to meet each of the groups needs. Once these needs are determined, data sets that determine the types of vehicle sensors that will collect the data for the DUAP-2 project will be established, and defined use cases around these needs will be developed. These use cases will support data applications that vehicles will be collecting, and will then be documented in the modified versions of the original DUAP Concept of Operations and Requirements.

Deliverables:

- Determination of stakeholder individual user needs
- List of defined use-cases to support user needs and data applications
- Revised and expanded Concept of Operations and Requirements
- Others?

Task 3 – Design and Development

This task provides an opportunity to design and develop the applications identified in Task 1. The selected vendor will be required to work with a steering committee to develop the overall functional requirements for the IntelliDrive^{SM} data-use program. This process shall follow the traditional systems engineering process used by US DOT and others.

Following the development of the functional requirements, the selected vendor shall develop and submit for approval system mock-ups that include the data to be used, algorithms associated with

the data, and other key components. This will also include a design of the prototype hardware and software that selected vendor deems necessary for use in this program.

Deliverables:

- Revised and expanded System Architecture
- System Requirements
- System Design documentation
- Others?

Task 4 – Implementation, Testing and Evaluation

Consistent with earlier DUAP work, this task will implement, test, and evaluate the various new applications as they become available. As with the focus of DUAP 2, this task will also seek to enhance all of the implemented applications with richer, more comprehensive data sets when this will improve their quality and usefulness to state and local transportation agencies.

Concerning the absence of a sufficient amount of real data to conduct suitable evaluations, new ways to retrieve this data will be explored. First, new methods and technology to collect data from the infrastructure will need to be investigated. Field Operation Testing will need to be executed using vehicles, sensors, and telecommunications systems. Field Operation Testing protocols will be used to produce data that focuses on the needs of specific groups within a DOT organization as defined in the tasks above and the refined Systems Engineering process. A demonstration of how the data collected using Field Operation Testing can better utilize the way resources are used and administrated will be implemented.

Simulation is not to be used as a primer means for data collection, delivery, analysis, and use. It will only be used to fill data gaps and bridge data holes that probe vehicles/sensors, and field operation testing can not provide. The use and amount of simulation will be determined by the Project Manager.

Deliverables:

- System Test Plans and Reports
- Software Distribution Kits
- System Evaluations
- Field Operational Testing Data Planning and Evaluation
- Prepare data and interface specifications
- Others?

Task 5 – Procure and Deploy Data Sources

The Consultant will configure specifications for on board equipment/communication procurement with existing systems in Michigan (ex. MDOT access points and test beds), installation of sensors/devices and test vehicles ready for data collection to DUAP 2. Coordinate collection of data from multiple sources. Selected vendor will coordinate all necessary communication systems between the vehicles and access points with organizations managing and operating those devices (IP addresses, etc,).

Deliverables:

- Provide data collection from multiple project and applications.
- Demonstrate various data applications for use by a DOT
- Others?

Task 6 – Data Management and Distribution Design

One of the objectives of the IntelliDrive^{SM} program is the ability to demonstrate the management, distribution and display of data in an efficient and scaleable manner. As the prototype being developed will be used by MDOT and its IntelliDrive^{SM} partners beyond the anticipated end of this contract, the prototype must be able to demonstrate scalability, redundancy upgradeability, and be compatible with the Michigan Department of Technology, Management and Budget's (MDTMB) current and future platforms, operating systems, software tools, development software and database software. The proposal should briefly address experience with this type of design and implementation.

The proposal should document experience in using data from multiple sources, in multiple formats, in terms of data normalization, processing and display.

Deliverables:

- A prototype which meets all requirements and standards

Task 7 – Data Collection Method Comparison and Exploration

In this task, the Consultant will identify specific applications for which there are likely to be significant operational advantages, and will specify needs and evaluation success criteria for each application of interest. The Consultant will also compare and contrast how DUAP data compares to current data collection practices for asset management and Michigan's transportation management system, and how this data can be used to support current data sources used for asset management and planning, and enhance the current methods of data collection. The consultant will be responsible for integrating and coordinating current and proposed MDOT IntelliDrive^{SM} projects with DUAP-2 for data collection, analysis and processing proposes. These project and existing/new projects as a result of partnerships that are formed will require the consultant to coordinate data collection efforts with other MDOT IntelliDrive^{SM} initiatives as determined by the Project Manager. Some specific IntelliDrive^{SM} data collection projects to be integrated into DUAP-2 will include but are not limited to the list below:

- Developing and deploying actual vehicle probe data collection platforms as part of this RFP.
- Current data collection sources from DUAP-1.
- Slippery Roads: Determine how the use of probe vehicle data can be used to monitor road surface conditions to evaluate safety, mobility, and asset management and planning.
- Vehicle-base Information and Data Acquisition System (VIDAS): Determine how IntelliDrive^{SM} data can be converted into useful information for asset management, planning, maintenance, Transportation Management Centers, etc. Example: DOTs collect International Roughness Index (IRI) data using a profilometer. From this data

DUAP-2 will determine how IntelliDrive^{SM} can give a DOT useful information that can replicate the International Roughness Index (IRI) readings to support and enhance current data collection systems like a Transportation Management System and pavement management systems.

- Infrastructure: Determine how the use of sensors installed on bridges and roads can be used to collect data to monitoring infrastructure behavior and to evaluate safety, mobility, asset management and planning.
- Pavement Condition Monitoring: Demonstrate the ability to provide pavement condition indicators for appropriately instrumented fleet vehicles through IntelliDrive^{SM} type communication and data services. Testing will compare DUAP-derived pavement condition indicators to those collected by MDOT profilometry vans on specific highway test sections.
- Generation of Origin-Destination Data: Demonstrate the ability to generate trip origin-destination data from appropriately instrumented vehicles through IntelliDrive^{SM} type communications and data services. Testing will compare the ability to generate useful and accurate trip data from DUAP records to actual vehicle trip logs.

Deliverables:

- Comparison of DUAP and current data collection practices
- Specification of needs and evaluation success criteria for each application of interest
- Others?

Task 8 – Application Convergence and Sustained Operations

This task will explore the convergence and integration of applications. It is intended to identify opportunities where applications that are driven by IntelliDrive^{SM} and ITS data can be logically packaged together. For example, one set of integrated applications could be intended to support operations in a TOC; another might be best suited to winter maintenance personnel; while a third could be developed for long-range planners and asset management needs.

Consistent with the overall DUAP concept, these groupings would draw from the same IntelliDrive^{SM} and ITS data sets, albeit with potentially different temporal dimensions, and would draw from common algorithms and applications. Distinctions between the sets would likely include different user interfaces and software tools, such as decision support systems, acting as wrappers around the grouped applications.

At this point, the applications can become a core component of Michigan's various transportation management system and operational activities.

Deliverables:

- Training materials
- Application procedures
- System evaluation and operation
- Others?

Task 9 – Outreach and Awareness

With the rapid pace and broad range of IntelliDrive^{SM} research activity, sharing of information and lessons learned is crucial to advancing research initiatives, reducing duplication of effort, and ultimately reaching a deployment decision that is informed by and accepted across industries and geographic boundaries. The purpose of this task is to share ideas, research, and lessons learned with interests around the world in the hopes that others can learn and further build off of the Michigan IntelliDrive^{SM} experience.

Deliverables:

- Presentation materials
- Research papers
- Others?

Project Documentation

This project is considered research by the Michigan Department of Transportation, and as such, the results, conclusions and lessons learned from this project need to be documented and disseminated. The selected vendor will be required to prepare a significant amount of documentation for each task, as well as close coordination with MDOT's review and evaluation team. The selected firm shall provide general description of work completed, findings, conclusions, recommendations, and lessons learned for each project task/phase.

All software shall include a "user's manual" for future reference.

In addition to the requirements above, final project documentation will include an executive summary, description of work, specific findings, recommendations for future research efforts regarding the use of IntelliDrive^{SM} data within a DOT, how IntelliDrive^{SM} data would be integrated into current DOT collection processes, and how IntelliDrive^{SM} data would come together with existing DOT data management systems to increase the effectiveness and efficiencies of those systems while satisfying end user needs. Lessons learned from the research will also be documented.

Notes to Vendor

The selected vendor shall provide all necessary project management services, including monthly, quarterly and annual progress reports, developing and maintaining a project schedule, and providing invoices in a timely manner.

The selected vendor will be required to prepare a formal schedule, defining all deliverables based on days following NTP (see draft schedule below).

1. All computer hardware, software, racks and other miscellaneous equipment purchased for DUAP-1 will be delivered to the vendor selected for this RFP. The vendor is responsible for coordinating all computer and communication systems from the consultant managing DUAP-1 so that a seamless transition is made from DUAP-1 to DUAP-2 with regards to current and future data collection, use, analysis and processing efforts. The consultant

shall ensure all current data is secure so that no data is lost in the transfer and little or no down time is experienced for current data collection processes. A detail itemized list of equipment will be provided to the consultant if requested. However, the following defines the bulk of equipment needed for transfer:

Cisco, ASA 5510 Firewall	250 VPN Peers, SMARTnet 8x5xNBD Support
Sun, Sun Fire X4150 Server	2 x Quad-Core Intel Xeon X5355 2.66 GHz processors, 16 GB RAM (8 x 2GB PC2-5300 667 MHz ECC fully buffered DDR2 DIMMs), 2 x 146GB 10K RPM 2.5" SAS disk drives, 1 x DVD+/-RW , slide rail kit
Sun, SPARC Enterprise 5120 Server	1 x 8 Core 1.2GHz UltraSPARC T2 processor, 16GB (8 x 2GB FBDIMMs), 2 x 146GB 10K RPM SAS disks, 1 x DVD+/-RW, slide rail kit

2. Any computer hardware, software, and miscellaneous purchases needed to support and/or expand the current DUAP data management and processing system will be coordinated and approved by the Project Manager.
3. Vehicles proposed for this project (tasks 4 and 5) shall be owned, operated (including providing drivers, gas, maintenance, etc.), and insured by the consultant, sub-vendor and/or proposed supplier of the vehicles. The consultant will be responsible for all liability associated with the use of the vehicles for the duration of the project. Equipment installed on the vehicles will be the property of MDOT. The Consultant shall coordinate with the Project Manager where this equipment should be sent after project completion. Ensure all equipment is in good operating order and all software and hardware needed to operate the devices are documented for future vehicle use. These devices may be installed on other vehicles once this project is complete.
4. The consultant shall propose to the Project Manager the proposed numbers of vehicles needs for the project to ensure sufficient data collection needs are met. Also, recommended schedules of driver, routes driven (trunkline vs. secondary Michigan routes), and miles per month.
5. The data sources for this project will be provided by a variety of sources and processes. Some of the data providers and processors have built proprietary information and systems around their data and data management. Likewise, some of the data provided to the successful vendor will be proprietary or of a nature as to impact the competitive nature of the partner in the IntelliDrive^{SM} program. As such, these companies/organizations have required MDOT to enter into Non-Disclosure Agreements (NDA). It is anticipated that the successful vendor will be required to enter into a number of NDA's prior to receiving data or discussing data formats with MDOT's partners. The successful vendor should be prepared to sign multiple NDA's with the partners on this project and at multiple times throughout the project as more partners join the Michigan IntelliDrive^{SM} team.
6. The successful vendor is responsible for collecting current data from current suppliers and coordinating all MDOT projects with DUAP 2.
7. At the digression of the Project Manager, the successful vendor will provide a system that allows the sharing of data to other organizations as needed.
8. Software developed by the vendor prior to this contract or during this contract at the successful vendor's expense, and all commercial-off-the-shelf contract required for this project shall be supplied to MDOT as part of the project. MDOT shall be provided a

license to use this software feely, including all updates and upgrades, for three years after the end of the project. The vendor shall provide a preliminary listing of all software that in the proposal and a final listing as part of the formal scope of services developed following selection. The vendor shall notify the project manager immediately (within 1-week) of any changes to that list as they occur, prior to the use of the proprietary or COTS software package.

9. The successful vendor will be required to coordinate the retrieval (see 1 above), install, maintain, and operate all necessary computer hardware, including, but not limited to, servers, workstations, monitors, and racks. The proposal shall indicate that the successful vendor has experience with this task. The final scope of services shall include a final listing of all hardware necessary for the successful completion of this project. All hardware, software, instruction manual, etc. shall be turned over to MDOT with warrantee (minimum 3 years) that takes effect following completion of the project.
10. The Michigan IntelliDrive^{SM} laboratory is located in the MDOT Construction and Technology (C&T) facility in Lansing. Any servers may be located at the Michigan Department of Technology and Management and Budget (MDTMB) server farms/facilities in Michigan as detemined by the Project Manager.
11. The selected vendor shall use the Systems Engineering approach from DUAP-1 to the planning, design, implementation of the software. The MDOT will provide Systems Engineering approach from DUAP-1 to the selection vendor for DUAP-2. Systems Engineering process will, at a minimum, include:
    1. Concept of Operations
    2. Functional Requirements
    3. High Level Design
    4. Detailed Design
    5. Documented Code
    6. System Validation
    7. System Verification
    8. Test Plan and Procedures
    9. Test Results

    Where the Systems Engineering process concluded in the DUAP-1 project, the successful vendor shall continue with the full systems operation approach for prototype applications, system validation, system verification, testing, and procedural documentation in DUAP-2.
12. The successful vendor shall use standard database software and a format that is compatible with existing database formats used by MDOT/MDTMB, and be prepared to document and justify differences between the two.
13. The proposal shall include the operating system that is to be used. If that operating system is not Microsoft Windows, justification needs to be provided to justify the decision/recommendation.
14. Although this is intended as a prototype development effort, a web interface is desired to permit users to access the system and data remotely. The web interface must be developed using JAVA and IBM's Websphere or Microsoft's .NET.
15. The prototype will include the development of data interfaces to exchange data between the MDOT DUAP project and other IntelliDrive^{SM} activities.

16. The proposals shall include a listing of all proposed sub-consultants or vendors, including their specific roles/tasks and an estimate of the percentage of the total contract for which each vendor will be responsible. All sub-consultants/vendors listed in the proposal are anticipated to participate in the project unless it is mutually agreed upon by the MDOT project manager and the prime contractor project manager during the final project scoping and negotiations.
17. Planned partnering sessions provided to design user needs will be coordinated by the selected vendor. These sessions will typically be 1 day and will include a working lunch catered by the vendor.

Schedule

The successful vendor shall submit a schedule and draft work plan as part of the proposal documents. A formal schedule will be required within 5 days of Notice to Proceed (NTP). The project is anticipated to last 36 months. In general, the following outlined draft frame is expected following NTP. The selected vendor will work with the Project Manager to refine this as needed:

- Formal Schedule – 5 Days
- Refined Concept of Operations – 45 Days
- Refined Functional Requirements – 45 Days
- Refined Detailed Design – 60 Days
- 1st Preliminary Suite of Prototype Applications (short list of applications to be determined following selection) – 120 Days
- 2nd Preliminary Suite of Prototype Applications (short list of applications to be determined following selection) – 210 Days
- Full Suite of Prototype Application – 365 Days
- Final Suite of Prototype Applications – 450 Days
- Final Documentation and Reports – 640 Days