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Attachment 1 – Proposed ITS Deployment Map
EXECUTIVE SUMMARY

The City of Dubuque is a leader in the use of traffic signal systems and field hardware to manage and operate a sophisticated and advanced signal network that benefits the road-users that live within, that work within, visit within or just pass through the Dubuque region. These devices have served to reduce delay and improve safety for these road-users. This includes adjusting signal timings based on the traditional study of traffic conditions. Staff has used the camera system to support Dubuque Police in identifying wrong way traffic or other crash information. Much of this effort is placed upon a small number of traffic engineers and technicians within the City. With the advent of new technology and integration, with terms like: advanced analytics, “deep learning”, smart cities, artificial intelligence throughout our society and within the transportation industry, the opportunity to “do more with our technology” was discussed and planned for in the Dubuque region. Area leaders, planners and administrators came together to describe a future smart traffic signal system that leverages the advances in technology. The vision is to create the next generation of integrated traffic signal system that includes rapid simulation of future traffic conditions based on real-time data collection. It also includes communicating the modeled changes to road-users before they leave and in route to balance delay and reduce congestion. The dynamic rerouting of traffic to balance road-user delay is also expected to have safety benefits with a reduction in crashes and pollutants. The interaction of sub-system components is illustrated in Executive Summary (ES) Figure 1.

This future enhanced smart traffic system for the Dubuque region has been given that name: Smart Traffic Routing with Efficient & Effective Traffic System (STREETS).

ES Figure 1 – STREETS Components Interaction

The Dubuque STREETS project has taken the next step from a future project described within the Dubuque Metropolitan Area Transportation Study (DMATS) to the completion of system engineering
documents that are consistent with Federal Highway Administration (FHWA) processes and guidelines for the deployment of Intelligent Transportation System (ITS) projects. The documents include:

- System Engineering Management Plan (SEMP)
- Concept of Operations (Con Ops)
- Preliminary Requirements and Verification Plan

These documents provide the required planning and design as the project moves towards future design phases and ultimately deployment. These documents will provide the supporting materials for the lead agency to submit the STREETS project for additional grants and funding opportunities. There is no guarantee of funding but the System Engineering documents satisfy Federal Requirements to be able to submit the applications.

The East Central Intergovernmental Association (ECIA), City of Dubuque, Dubuque Metropolitan Area Transportation Study (DMATS) and the Iowa Department of Transportation (Iowa DOT) partnered together to develop the Smart Traffic Routing with Efficient & Effective Traffic System (STREETS) project. The goal of the STREETS project is to develop a smart, next generation, traffic management and control system, **ES Figure 2** Shows the expected flow of data through the STREETS system. In addition to providing sound information to the stakeholders, this project will serve as a framework, nationally, for deployment of similar systems in small urban areas with populations under 100,000.

The STREETS project will use traffic control strategies to enable dynamic traffic routing to maximize the use of existing roadway capacities in the Dubuque metropolitan area. The ultimate deployment of STREETS will cover nine (9) corridors with 57 signalized intersections within the City of Dubuque. The STREETS project will use advanced traffic control strategies to enable dynamic traffic routing to maximize the use of existing roadway capacities in the Dubuque metropolitan area. Some benefits from implementation of the STREETS includes:

- Reducing wear and tear on major corridors
- Reduced congestion
• Improved travel times
• Improved safety
• Reduced emissions
• Enhanced system monitoring capabilities

The proposed STREETS project is expected to dynamically react to congestion detected/predicted by the Micro-simulation model, and proactively change signal timing based on predicted traffic flow data while disseminating congestion and alternate route information for motorists. This requires existing signal system and ITS infrastructure to be improved to meet the operational requirements of STREETS. **ES Figure 3** shows the intersections by Stage and locations where existing travel-time and data collection devices are present.

**ES Figure 3 – STREETS Deployment Stages**

Opinion of Probable Cost (OPC) was also developed to summarize the estimated costs to construct the STREETS based what has been identified by the stakeholders. Looking at potential funding the project was broken into two deployment stages. Stage 1 will include the integration and deployment
of the STREETS software, servers, camera analytics and traffic signal enhancements at 33 intersections. Stage 2 would expand the system to adding another 24 intersections. The estimated cost of Stage I is slightly more than $3,365,000, with an overall project estimate $5,060,000. This includes estimated engineering services to support the development of the final RFP and appropriate plan packages for signal enhancements. It also includes a 15% contingency at this time due to the unknown sub-system component costs.

The completion of Phase 1 of the System Engineering Process, which serves as a guide for future phases of the project by defining the roles and responsibilities of the stakeholders involved, as well as the requirements of the system. The project now moves into the next phase, which is the completion of additional design of the system and preparation of a Request for Proposal (RFP). Based on the current status of the industry, the design team recommends completing a Request for Information (RFI) before finalizing requirements and preparing the RFP. Although sub-system components are mature, the rapid micro-simulation modeling of real-time traffic characteristics with camera analytics and other decision-making has not been completed within the signal system industry. The RFI will allow signal system vendors to team up with micro-simulation, with camera analytics and advanced traveler information systems to present preliminary solutions and project specific challenges for the ultimate deployment of the STREETS project. The result of the RFI will allow the design team to improve the project requirements and RFP resulting in a better final project.
STREETS FINAL REPORT

1 Introduction
2 STREETS Planning Process
3 STREETS Opinion of Probable Cost
4 Next Steps
1 INTRODUCTION

The City of Dubuque, Dubuque Metropolitan Area Transportation Study (DMATS) and the Iowa Department of Transportation (Iowa DOT) partnered together to develop the Smart Traffic Routing with Efficient & Effective Traffic System (STREETS) project. The goal of the STREETS project is to develop a smart, next generation, traffic management and control system. The STREETS project will use traffic control strategies to enable dynamic traffic routing to maximize the use of existing roadway capacities in the Dubuque metropolitan area.

The initial deployment of STREETS covers nine (9) corridors with 57 signalized intersections within the City of Dubuque. The STREETS project will use advanced traffic control strategies to enable dynamic traffic routing to maximize the use of existing roadway capacities in the Dubuque metropolitan area. The STREETS project seeks to employ Active Transportation and Demand Management (ATDM) strategies which will require a suite of modeling tools and methods that will enable the City of Dubuque to evaluate the potential benefits of implementing ATDM strategies in a dynamic and proactive fashion using both real-time and historic data.

The STREETS includes the following major components: 1) Travel Demand Model (TDM); 2) Microsimulation Traffic Model (MTM); 3) Adaptive Signal Control Technology (ASCT); 4) Decision Support System (DSS). The STREETS will also interface with other components include, but not limited to, Advanced Traffic Management System (ATMS), Advanced Traveler Information System (ATIS), and third-party data source (i.e., Waze). The TDM will be utilized to estimate the origin/destination (O/D) and other necessary data for the microsimulation traffic model. The MTM is to represent the current roadway network and be capable of executing traffic assignment (dynamic traffic routing) based on estimated/measured traffic impedances of the network links. The ASCT will develop optimized signal timing in real time after changes of traffic conditions are determined by STREETS. The DSS is to function as a core model which communicates with TDM, MTM, ASCT and other components, provide data exchange, dynamic routing strategy generation and integrate all components into a complete STREETS. The interaction of these components is illustrated in Figure 1.

Figure 2 – STREETS Components Interaction
The City of Dubuque expects the STREETS will facilitate dynamic routing of traffic to maximize the use of existing roadway capacities in the project area. Some benefits from implementation of the STREETS includes:

- Reducing wear and tear on major corridors
- Reduced congestion
- Improved travel times
- Improved safety
- Enhanced system monitoring capabilities

Based on the goals, a set of objectives, in the context of addressing the City of Dubuque’s issue, is established as shown in Table 1.

**Table 1 – STREETS Goals and Objectives**

<table>
<thead>
<tr>
<th>GOALS</th>
<th>OBJECTIVES</th>
</tr>
</thead>
</table>
| Improve Mobility | • Reduce travel time for commuters within the corridor  
| | • Increase person and vehicle throughput on the corridor  
| | • Reduce delay time for corridor travel on the corridor’s networks  
| | • Detour/reroute traffic among corridors to balance the capacity usage |
| Reduce Congestion | • Improve intersection operation  
| | • Reduce delay at intersections  
| | • Reduce incident detection time |
| Improve Safety | • Reduce incident rate  
| | • Reduce injury rate  
| | • Reduce fatality rate  
| | • Reduce roadway hazards |
| Information for Travelers | • Improve collection and dissemination of road network information  
| | • Collect and process data on the operational condition/status of all corridor networks, including  
| | o Comparative travel times between major origins and destinations  
| | o Construction, detours, and other planned road work  
| | o Occurrence and location of incidents  
| | o Expected delays  
| | • Disseminate comprehensive, real-time, and accurate information to travelers within the corridor by means of multiple media (e.g., phone, computer, PDA/Blackberry, CMSs, 511 App)  
| | • Make available archived historical data to travelers |

Currently, the City of Dubuque operates all traffic signals and other ITS devices within City limits (including state highways). The current signal system in Dubuque includes 115 traffic signals. Most of the signal controllers are M50 Siemens controller with EPAC firmware and some are EPAC 300. The signal cabinets are NEMA TS-1 or TS-2. Approximately 80% of the system is connected to a fiber optic
communication system which is comprised of a minimum of 24 multi-mode and 48 single mode fibers. The City currently uses Siemens’ TACTICS central management software to communicate with the traffic signal system. The City currently uses various types of vehicle detection, including Wavetronix and inductive loop. The City has a small number of travel-time measurement systems. Currently the City has 31 Acyclica devices installed throughout the City, which is expected to grow. The City has an extensive network of CCTV and the video detection cameras which are both used for traffic surveillance and post-event investigation of the events that affect safety and security of the travelers. In addition to the existing ITS devices, the City has undertaken an aggressive program to expand ITS deployment within the City including fiber optic conduit, fiber Optic Loop, Dynamic Message Sign (DMS), Smart Sensor, Traffic Camera, and wireless communication. All these will become part of future STREETS and play roles in dynamic routing. The STREETS project intends to deliver an automatic system that gives the City staff the ability to monitor traffic operations and intervene as necessary but does not require constant or significant manual operations.

Built on the existing and near future ITS to be deployed, implementation of the STREETS may require City investment in other physical infrastructure such as data collection and performance measurement systems, processing and dissemination systems, control algorithms, and signal systems that will provide the following upgraded systems and equipment:

- A high speed, reliable communications system
- A highly accurate, reliable detection system
- Improved traffic signal controllers
- A high speed, reliable series of servers and databases
- An automated process to transfer data
- An automated process to analyze traffic conditions
- An automated, highly accurate means to communicate traffic conditions to the traveling public.

1.1 Document Overview

The STREETS Final Report provides a high-level overview of the System Engineering documents that have been completed to date. This Final Report summarizes Phase 1 of the Systems Engineering Process, as illustrated in Figure 1. The System Engineering documents produced as part of Phase 1 will guide the STREETS project from conception to operations and maintenance in a systematic way.

The Systems Engineering for the STREETS project worked through the identification of stakeholder needs, project requirements, and verification procedures. Following the FHWA Systems Engineering process (V Diagram in Figure 2), the Systems Engineering Management Plan (SEMP), Concept of Operations (ConOps), System Requirements and Verification Plan are key deliverables that are part of the systems engineering work for STREETS. These System Engineering documents are evolving documents that will need to be updated as the STREETS project progresses through the phases of the System Engineering Process.
The Final Report contains the following sections:

2.0 STREETS Planning Process
   2.1 Systems Engineering Master Plan (SEMP)
   2.2 Concept of Operations (ConOps)
   2.3 Requirements and Verification Plan
3.0 STREETS OPC Costs
4.0 Next Steps

Section 2.0 STREETS Planning Process provides a high-level summary, as well as the recommendations, of the three system engineering documents listed above as the subsections within Section 2.0. Section 3.0 STREETS OPC Costs summarizes the estimated OPC Costs to construct the STREETS based on what has been identified from the planning processes that have been completed as part of Phase 1 of the System Engineering Process. The final section, 4.0 Next Steps, summarizes the recommendations and actions that should be taken next as identified from Phase 1 of the System Engineering Process, as well as provides an overview of what Phase 2 of the process will include.

![Figure 2 – Systems Engineering Process “V” Diagram](image-url)
2 STREETS PLANNING PROCESS

The following sections provide a high level overview and summary of the System Engineering documents that have been produced as part of Phase 1 of the System Engineering Process for the STREETS project.

2.1 Systems Engineering Management Plan (SEMP)

2.1.1 SEMP Overview
The Systems Engineering Management Plan (SEMP) for the STREETS project provides a high-level plan for the management of Systems Engineering in compliance with the Federal Highway Administration (FHWA) Federal Rule 23 CFR 940.11 and Systems Engineering Guidelines. At this stage of the systems engineering the process is evolving, this SEMP will need to be revisited again at key milestones as the project progresses through procurement, deployment, integration, and testing.

2.1.2 SEMP Summary
SEMP details the technical tasks and systems engineering processes that should be followed to develop and implement a next-generation traffic management system in the Dubuque metro area. The SEMP identifies project elements that must be designed, procured, integrated, verified and maintained as the deployment occurs. The SEMP also identifies a realistic project schedule so that consistent expectations are developed early-on among project stakeholders with regard to deployment of the system. Development of the SEMP considered the region’s planning process and other project technical needs and dependencies that could impact the planning, design and deployment schedule for the system. Key details defined in the SEMP include:

- Project Management and Control
- Traceability and Technical Review
  - Procurement Management
  - Change Management
  - Quality Management
  - System Acceptance
  - Operations, Maintenance, Upgrade and Retirement

For more detailed information about the above, refer to the Smart Traffic Routing with Efficient & Effective Traffic System (STREETS) Systems Engineering Management Plan (SEMP) document.

The System Engineering Process and deliverables that will be completed as part of the STREETS project, as identified in the SEMP, are shown in Table 2. These contain important descriptions of stakeholders, systems, and operational practices that support the systems engineering for the STREETS project.
Table 2 – City of Dubuque STREETS Process Documentation

<table>
<thead>
<tr>
<th>SYSTEMS ENGINEERING PROCESSES</th>
<th>STATUS</th>
<th>DESCRIPTION</th>
<th>DELIVERABLES</th>
</tr>
</thead>
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<tr>
<td>Systems Engineering Management Plan</td>
<td>Complete; update as needed during future phases.</td>
<td>The Systems Engineering Management Plan provides project managers and stakeholders an overview of how the systems engineering activities and the subsequent components of the STREETS will follow and be integrated with the systems engineering processes.</td>
<td>Draft and Final Systems Engineering Management Plan</td>
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<tr>
<td>Concept of Operations</td>
<td>Completed.</td>
<td>The Concept of Operations identifies the needs as well as roles and responsibilities of all stakeholders identified in the SEMP as it relates to the STREETS. The Concept of Operations defines what the STREETS will look like and how it will operate based on discussion of operational scenarios and alternative concepts.</td>
<td>Draft and Final Concept of Operations</td>
</tr>
<tr>
<td>Requirements</td>
<td>Preliminary Completed.</td>
<td>This document describes what needs to be achieved by the proposed STREETS. The requirements will be traced back to the stakeholder needs that were identified in the Concept of Operations. Each need will have at least one requirement. The requirements will be either mandatory or secondary based on the stakeholder needs. The System Requirements determine what the system must do. A Verification Plan will be prepared as part of this project that addresses the expected process to determine that the requirements are satisfied during the deployment of the STREETS components.</td>
<td>Preliminary, Revised and Final Requirements</td>
</tr>
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## Systems Engineering Processes

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<th>DESCRIPTION</th>
<th>DELIVERABLES</th>
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</thead>
<tbody>
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<td>Verification Plan</td>
<td>Draft Completed</td>
<td>This document describes how the system will be tested, ensuring that the mandatory and possibly desirable requirements are satisfied. It will lay out a template plan for the vendor &amp; City to conduct the verification effort.</td>
<td>Draft and Final Verification Report</td>
</tr>
<tr>
<td>Travel Demand Forecast Model (Enhanced Existing or New)</td>
<td>Not started. To be started in the next phase of the project.</td>
<td>The existing Travel Demand Forecast Model will be evaluated to determine how well it can perform in estimating the O/D and other necessary data for the microsimulation traffic model. If the existing Travel Demand Forecast Model cannot perform satisfactorily, then either it may be enhanced or a new model may need to be procured in the next phase of the project.</td>
<td>The draft and final requirements related to the Travel Demand Forecast Model. In the next phase of the project, either the model may need to be enhanced or a new model may need to be procured.</td>
</tr>
<tr>
<td>Microsimulation Traffic Model’ – Data (New)</td>
<td>Not started. To be started in the next phase of the project.</td>
<td>Based on the system requirements, the existing microsimulation model will be evaluated to determine whether it can satisfy the data requirements. If the existing model cannot satisfy the requirement, then either it may be enhanced or a new microsimulation traffic model representing the existing traffic conditions in the Dubuque metro area may need to be procured. In the next phase of the project.</td>
<td>The draft and final requirements related to the microsimulation model. In the next phase of the project, either the existing model may need to be enhanced or a new model may need to be procured.</td>
</tr>
<tr>
<td>Adaptive Signal Control Technology (ASCT) (New)</td>
<td>Not Started. To be completed in the next phase of the project.</td>
<td>An adaptive signal control technology system will be procured in the next phase of the project. The ASCT system will be selected based on the system requirements.</td>
<td>The draft and final requirements related to the ASCT system. In the future phases of the project, the ASCT system will be procured.</td>
</tr>
<tr>
<td>SYSTEMS ENGINEERING PROCESSES</td>
<td>STATUS</td>
<td>DESCRIPTION</td>
<td>DELIVERABLES</td>
</tr>
<tr>
<td>-------------------------------</td>
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</tr>
<tr>
<td>System Integration</td>
<td>Not started. To be completed in the next phase of the project.</td>
<td>In future phases of the project, a detailed plan of integrating the existing data sources to the STREETS will be developed. The plan will identify the available data sources, indicate which data sources will be utilized as input to the microsimulation model, which data sources will be used for model calibration and validation, provide the approach of handling missing data and identify necessary tools and features such as third party Speed Data Collection/Performance Management system to monitor the STREETS.</td>
<td>The draft and final data requirements related to data sharing and integration. In a future phase of the project, the system integration plan identifying how to meet the data requirements will be developed. The high level data requirements will be included in the requirements in this phase of the project.</td>
</tr>
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The most significant objective of the SEMP was to ensure that a deployment strategy is identified that meets the Region’s short- and long-term needs in a logical, sequential manner. Adherence to the defined process will ensure that all relevant concerns have been included in the overall design process. The SEMP serves as a guide the STREETS project from conception to operations to maintenance in a systematic way. The SEMP is an evolving document that will be updated as the STREETS project progresses through future phases.

2.2 Concept of Operations (ConOps)

2.2.1 ConOps Overview

The Concept of Operations (ConOps) is a document that describes the expected operations of the system from the user’s viewpoint and provides documentation in compliance with FHWA Rule 23 CFR 940.11 and Systems Engineering Guidelines. The objective of this task was to develop a ConOps for a traffic management solution in the Dubuque metro area that identifies (confirms) project stakeholders, defines system needs and expectations, explores the adaptive/dynamic environment that is envisioned (including user and/or operational scenarios) develops high-level requirements and identifies institutional issues or constraints that would impact project design, deployment, operations or maintenance. Key aspects of the ConOps included the needs assessment, review of current systems, defining roles and responsibilities of the project stakeholders and necessary resources for the operations and maintenance of the desired traffic management system. This task explored the
necessary integration that must exist between system components (signal system, communications, field devices, microsimulation models, performance measurement platform, etc.) to provide the desired STREETS functionality. The ConOps answers the following set of core questions:

- **Why**: Justification for the system, identifying what the corridors currently lack, and what the system will provide
- **What**: Currently known elements and the high-level capabilities of the system
- **Where**: Geographical and physical extents of the system
- **Who**: Stakeholders involved with the system and their respective responsibilities
- **When**: Time sequence of activities that will be performed
- **How**: Resources needed to design, build, operate, and maintain the system

### 2.2.2 ConOps Summary

The ConOps is the second document of the various systems engineering deliverables identified for this project. The purpose of the ConOps document is to communicate overall qualitative system characteristics to the City of Dubuque and other involved stakeholders. The ConOps document lays out the STREETS concept, explains how things are expected to work once it is in operation, and identifies the roles and responsibilities of the various stakeholders to make this happen. The Concept of Operations documents, at a high-level, the expected plan for:

- **Operations** – This includes a high-level summary of the staffing needs to operate the STREETS and the roles and responsibilities for the selected system operation, management, information sharing and reporting.
- **Maintenance** – This included the staffing needed to maintain system software, hardware and communications.
- **Upgrade** – This will include opportunities to upgrade hardware, software and communications. The City of Dubuque and DMATS will use potential upgrade options to develop a strategy for budgeting and performing system upgrades.
- **Retirement** – This will include estimates for software, hardware and communications replacement. This will be based on industry trends and the City of Dubuque and DMATS’ vision for future systems.

The plan for the operations, maintenance, upgrade and retirement of the STREETS and its components was documented in the ConOps. The details for these plans were summarized in the following sections of the ConOps:

- Operational Needs
- Proposed Operations
- Operational Scenarios
- Summary of Impact
- Next Steps
For more detailed information about the above, refer to the *Smart Traffic Routing with Efficient & Effective Traffic System (STREETS) Concept of Operations (ConOps)* document.

The operational needs assessment process was conducted to identify the stakeholder needs, based on the proposed operations, which must be satisfied in order for the City of Dubuque to meet its goals and objectives relative to developing the STREETS. This process included a Needs Assessment Workshop with stakeholders, as well as additional follow-up meetings with key stakeholders, that included various operational scenarios to identify stakeholder roles and responsibilities, equipment (such as hardware, software, and communications), staffing, and traffic management needs for both existing and future conditions. This process resulted in the identification of eight needs, which included:

1. Data Collection
2. Performance Measurement System
3. Traffic Modeling
4. Decision Support System
5. Traffic Signal System
6. Communication System
7. ATIS
8. Operations and Maintenance

Through discussion and further evaluation of the needs identified during stakeholder workshops, more detailed needs were identified based on various operational scenarios. After the needs were defined, a preliminary list of performance measures was identified to support the evaluation of the goals and objectives by defining the system requirements. These needs and associated requirements are further documented and traced in the requirements and verification plan.

### 2.3 Requirements and Verification Plan

#### 2.3.1 Requirements and Verification Plan Overview

The Requirements and verification Plan will be used to guide the City of Dubuque staff and the System Vendors through different components of the STREETS during the deployment. The Requirements and Verification Plan traceability from each requirement to the original needs identified in the ConOps, as well as to the testing and acceptance procedures identified in the Verification Plan. The verification plan will serve as the foundation for the creation of a detailed acceptance test plan for the STREETS.

#### 2.3.2 Requirements and Verification Plan Summary

The requirements are based on user needs determined in the Concept of Operations document. These needs were gathered directly through meetings with stakeholders and walking-through various operational scenarios. The STREETS requirements and verification are discussed in detail in the following sections of the Requirements and Verification Plan:

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Iteris, Inc. | 10
• Verification Approach
• Verification Review and Testing
• System Requirements.

For more detailed information about the specific details of the Requirements and Verification Plan, refer to the *Smart Traffic Routing with Efficient & Effective Traffic System (STREETS) Requirements and Verification Plan* document.

A preliminary set of detailed requirements were evaluated and determined to be Mandatory or Secondary. Secondary requirements are features that provide benefit but are not mandatory, as the execution of the project deployment can be accomplished without these STREETS requirements. As an example, the selected ASCT system of STREETS does not need the ability to access and modify settings on an adjacent controller at a near-by intersection. The City might consider this a favorable solution but not a solution at the expense of other mandatory requirements. Therefore, it is written as a Secondary requirement.

The Final verification procedures will be developed by the System Vendors of the STREETS project based on actual sub-systems selected and the materials provided in the RFP. These acceptance procedures will require the approval from lead agency and the City of Dubuque traffic engineering staff. All verifications shall be conducted in the presence of the City of Dubuque staff. Final verification and formal system acceptance will be provided by the City of Dubuque’s Project Manager. The Project Manager will control the schedule and acceptance of the tests, but will also work with the System Vendors to clarify the verification procedures and acceptance tests.

The verification and acceptance testing will be accomplished at approved City of Dubuque locations and at specific field locations within the City. All acceptance test procedures shall conform to the approved acceptance test plans. These tests will be completed and documented by the System Vendors and supervised by the City of Dubuque Project Manager. Operational documentation of the field components is expected to be completed with a laptop, internet connection and associated cabling. The System Vendors will need to provide multiple staff in the field and at the TOC to document certain acceptance tests.
3 STREETS OPINION OF PROBABLE COST

As part the Phase 1 of the STREETS project, an Opinion of Probable Cost (OPC) was developed for the STREETS components, as well as the annual support and fine-tuning. The items that were included in the OPC were identified throughout the project, including during the stakeholder workshops, as being necessary to obtain the required system functionality needed to obtain the proposed operations. The OPC was separated into two stages. Stage 1 is the cost required to equip the primary corridor intersections and one primary alternate route. It also includes the majority of the software, central network and integration. Stage 2 is the completion of the system and additional of the remaining alternate routes. Figure 3 shows the intersection locations by Stage and locations where existing travel-time and data collection devices are present.

Figure 3 – STREETS Deployment Stages
Stage 1 includes 33 intersections with the purchase, development and integration of the necessary sub-systems to meet the project requirements and operational goals. The construction is expected to include integration of:

- Camera Analytics
- Acyclica Travel-Time Data
- 3rd Party Travel-Time Data
- Advanced Traffic Management System (ATMS) Enhancements
- Adaptive Signal Control Technology (ASCT)
- Additional Detection
- Micro-Simulation
- Signal Performance Measures (SPM)
- Decision Support System (DSS)
- Dynamic Message Signs (DMS)
- Advanced Traveler Information Systems (ATIS)

The software and central network will be sized for the future build-out and additional stages such that the effort to expand the system will require field hardware such as controller, detection and communication upgrades. The DSS system will likely need expansion as new corridors are monitored and available for dynamic rerouting. For planning purposes the project is broken into two Stages to support funding, deployment and acceptance testing. The component and support costs for Stage 1, Stage 2 and the Total of both phases is shown in Table 3, while the detailed OPC for each of the phases is located in Appendix A.

**Table 3 – Opinion of Probable Cost (OPC) for the STREETS Project**

<table>
<thead>
<tr>
<th>STAGE</th>
<th>COMPONENTS COST</th>
<th>SUPPORT COSTS</th>
<th>TOTAL COSTS</th>
</tr>
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<tbody>
<tr>
<td>Stage 1</td>
<td>$3,366,250</td>
<td>$101,200</td>
<td>$3,467,450</td>
</tr>
<tr>
<td>Stage 2</td>
<td>$1,696,250</td>
<td>$101,200</td>
<td>$1,797,450</td>
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<tr>
<td>Total</td>
<td>$5,062,500</td>
<td>$202,400</td>
<td>$5,264,900</td>
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</table>
4 NEXT STEPS

With the completion of Phase 1 of the System Engineering Process, which serves as a guide for future phases of the project by defining the roles and responsibilities of the stakeholders involved, as well as the requirements of the system, the project now moves into Phase 2 of the Design Process, which will include the detailed design, revision of requirements and then preparation of an RFP to select the STREETS Vendor.

As of the spring of 2018, numerous components of the STREETS can be described by the industry as “in development.” It is anticipated that multiple vendors will need to team together to provide a STREETS solution. To better refine the requirements for this system, an RFI is recommended to have vendors organize teams and describe potential solutions. Through this process the agencies will gather additional information to expand the requirements and move the project closer to procurement.

The agencies have discussed the selection process that would likely consist of one RFP and include all components for deployment including field hardware, video analytics, simulation models, the ASCT system, the DSS and the ATIS systems as necessary to meet the requirements. Such a selection process would help reduce the potential finger-pointing of multiple contracts and extended project support.

Staged deployment is recommended for this project to support funding, to manage construction, configure and test the system.
APPENDIX A – DETAILED STREETS OPC BY STAGE