

12-22-17 Posting Date
VAR-STW SEA AV/CV, Data System Analysis
PID No. 106875
Preliminary Notification Concerning Request for Letters of Interest

On January 16, 2018, the Department will post a request for letters of interest to perform and document the statewide Systems Engineering Analysis for Autonomous/Connected Vehicle (SEA AV/CV) projects in conformance with 23 CFR 940 and Section 1300 of the Traffic Engineering Manual. Included with this effort will be a review, and recommendations of necessary updates, to the existing statewide and MPO Regional ITS Architectures to ensure consistency with the developed SEA AV/CV document.

The goal of this effort is to create the statewide framework to guide current and future AV/CV deployments. The requirements of 23 CFR 940 will be handled at the program level to the extent possible via this effort rather than on a project-by-project basis.

The preliminary scope of services document is included below.

The Request for Letters of Interest will be posted to the Consultant Services page of the ODOT's website at the following address:

<http://www.dot.state.oh.us/divisions/Engineering/consultant/Pages/default.aspx>

Selection Procedures

The Department will use a two-step selection process including the initial submittal of a Letter of Interest, and a second step consisting of formal presentations/interviews with approximately 3 short listed firms. The initial submittal will utilize ODOT's electronic Letter of Interest (LoI) system.

Tentative Selection Schedule

Preliminary Notification	12/22/2017
Website Posting - Request for Letter of Interest	01/16/2018
Deadline to Submit Questions	01/29/2018
Answers Provided (No later than)	02/05/2018
Letter of Interest Response Due Date	02/12/2018
Short List Published	02/26/2018
Presentations/Interviews	03/09/2018
Tentative Authorization to Proceed	April 2018

The Department reserves the right to amend the Selection Schedule.

Prequalification Requirements

Prequalification with the Department will not be required for this agreement. However the consultant must have a certificate issued by the Ohio Secretary of State indicating that the firm is authorized to do business in Ohio.

DBE and EDGE Goals

This agreement will not include a DBE or EDGE Goal.

Scope of Services

General

The Department is seeking services to provide numerous deliverables related to Autonomous Vehicle/Connected Vehicle (AV/CV) deployments in Ohio.

The goal of this effort is the creation of Ohio's initial AV/CV planning documents that will:

- Provide specific recommendations for AV/CV data storage, management, and security; and
- Create a Business Plan to prioritize future AV/CV deployments; and
- Create the master plan for AV/CV data communication infrastructure in Ohio; and
- Highlight Public Private Partnership (P3) opportunities to support AV/CV in Ohio; and
- Create the statewide framework to guide current and future AV/CV application deployments complying with the Systems Engineering Analysis (SEA) requirements of 23 CFR 940. The product of this effort will be the SEA-AV/CV; and
- Create software requirements for an Ohio Integrated Data Exchange (if authorized)

Responsive proposals shall demonstrate knowledge and experience with, but not limited to:

1. 23 CFR 940; and
2. ARC-IT 8.0; and
3. Section 1300 of the Traffic Engineering Manual; and
4. Relevant U.S. DOT Standards;
5. AV/CV Messaging (BSM, SPaT, MAP, SSM, SRM, etc.); and
6. All applicable Industry Standards including but not limited to IEEE, ISO/TS, ASTM, ITE, NTCIP and most current SAE Standards (including J2945/x and J2735); and
7. U.S. Department of Transportation Systems Engineering Analysis (i.e., "Vee" Diagram); and
8. SAE requirements for Security Certificate Management System for Connected Vehicles; and
9. Data communication, storage, management and security

AV/CV Applications

It is expected that the consultant will have extensive knowledge and expertise related to the below applications. An initial delivery of this project will be an assessment of the maturity by the Technical Readiness Level for Highway Research (TRL-H)

(https://www.fhwa.dot.gov/advancedresearch/trl_h.cfm) scale of the below listed applications.

ODOT will use this assessment to determine if a listed application will be included in this SEA-AV/CV. Additional applications not listed that the consultant deems to be mature and

deployment ready (or will soon be ready) should also be highlighted to ODOT for consideration of inclusion in the SEA-AV/CV.

V2I Safety

- Red Light Violation Warning
- Curve Speed Warning
- Stop Sign Gap Assist
- Stop Sign Violation Warning
- Spot Weather Impact Warning
- Traction Control Warning
- Reduced Speed/Work Zone Warning
- Pedestrian in Signalized Crosswalk Warning (Transit)
- Wrong Way Vehicle Detection
- Collision Avoidance

V2V Safety

- Emergency Electronic Brake Lights (EEBL)
- Forward Collision Warning (FCW)
- Intersection Movement Assist (IMA)
- Left Turn Assist (LTA)
- Blind Spot/Lane Change Warning (BSW/LCW)
- Do Not Pass Warning (DNPW)
- Vehicle Turning Right in Front of Bus Warning (Transit)

Agency Data

- Probe-based Pavement Maintenance
- Probe-enabled Traffic Monitoring
- Vehicle Classification-based Traffic Studies
- CV-enabled Turning Movement & Intersection Analysis
- CV-enabled Origin-Destination Studies
- Work Zone Traveler Information

Mobility

- Advanced Traveler Information System
- Intelligent Traffic Signal System (I-SIG)
- Signal Priority (transit, freight)
- Mobile Accessible Pedestrian Signal System (PED-SIG)
- Emergency Vehicle Preemption (PREEMPT)
- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Cooperative Adaptive Cruise Control (CACC)

SEA – AV/CV

As noted above, the consultant will evaluate the listed AV/CV applications and ODOT will determine which applications will be included in the SEA-AV/CV. The SEA-AV/CV will provide at the statewide level the Systems Engineering Analysis per 23 CFR 940 for those applications to the extent possible. The goal is to identify classes of common applications or projects that can be covered by a common SEA documentation effort. It is understood that multiple Systems

Engineering Analysis documentation efforts may be required to cover all the included applications or groups of common applications.

The SEA-AV/CV will provide the Systems Engineering Analysis documentation for AV/CV applications at the statewide level to the extent possible. With each application(s) SEA the consultant, in concurrence with ODOT & FHWA, will determine the extent of how much of the Systems Engineering Analysis can be appropriately be performed at the statewide level via the SEA-AV/CV versus at the project level.

For a given application or group of common applications the consultant will provide specific guidance highlighting what portions, if any, of the Systems Engineering Analysis would be more appropriately handled at the project level. This project level documentation would be supplementary and in addition the documentation provided by the SEA-AV/CV and together would fully cover the requirements of 23 CFR940 for that application(s).

The deliverable of this effort will be the SEA-AV/CV that provides the statewide documentation for the included applications or groups of common applications along with guidance on the necessary project level documentation requirements specifically for each application or group of common applications. It is expected that the necessary project level documentation requirements will vary for applications based upon the ability of the SEA-AV/CV to provide the necessary documentation for that application at the statewide level.

The SEA-AV/CV will support the deployment of interoperable AV/CV projects in Ohio.

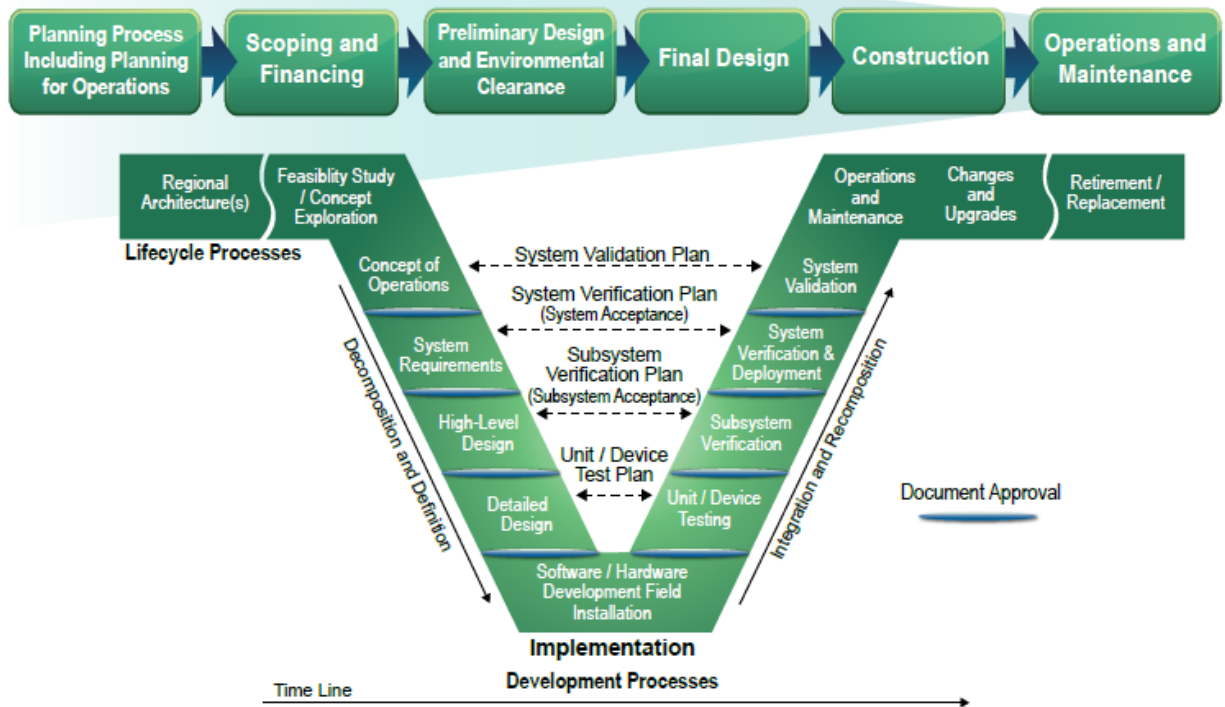
Deployment Example - City "X" is proposing to deploy a connected traffic signal application (V2I). That project would provide the necessary project level documentation (if any) and document which parts of the SEA-AV/CV, relevant ITS architectures (Statewide or Regional) & Traffic Authorized Product (TAP) list approved devices that apply to that project. The SEA-CV/AV will ensure interoperability while potentially reducing the need for lengthy project specific Systems Engineering Analysis so long as the proposed project conforms to the statewide document. Equipment used in the project would typically be listed on the ODOT pre-approved equipment list and be obtained via competitive bidding whenever possible.

Systems Engineering Analysis (SEA) Development

It is understood that a Statewide SEA-AV/CV may be somewhat different than a traditional ITS project and that there may be inconsistencies in application of the Vee diagram concepts to this project as compared to a more traditional ITS project. Deviation from the traditional Systems Engineering Analysis approach may be necessary in some phases of the project scope. In these cases the consultant in conjunction with ODOT and FHWA will determine how to address these application inconsistencies.

The SEA development for applications or groups of common applications will follow the process defined by the traditional "Vee" diagram as follows:

1. **Architectures** – this will consist of a review of the existing statewide architecture, the national ITS architecture and regional architectures to determine their adequacy to support statewide operation of AV/CV deployments that are interoperable regionally, statewide and nationally. Significant work exists to incorporate AV/CV architecture elements into the Statewide ITS Architecture for AV/CV applications that should be used in this SEA-AV/CV effort.



This may be an iterative process requiring subsequent updates to the architectures as the SEA is developed and finalized. The output of this effort will include:

- a. List of project stakeholders and roles and responsibilities;
- b. List of inventory elements included in or affected by the project;
- c. List of requirements the proposed systems must meet;
- d. List of interfaces and the information to be exchanged or shared by the systems (information flows)
- e. List of relevant standards

2. **Feasibility/Concept Exploration** – this will establish the projects purpose and need. Project concept will be established including the rational for selection over other concepts. The output of this effort will include:

- a. A description of the problems and opportunities addressed by AV/CV deployments;
- b. An economic and risk analysis;
- c. Project objectives that must be achieved for success;
- d. A description of the selected alternative including major system features and resources that will be used.

This effort will include significant exploration of feasible data communication mediums and architectures, bandwidth requirements, necessity of real-time (home-run) data transmission versus batched aggregated transmission, data storage, data management, data security and privacy. Feasible alternatives will be provided with recommendations along with supporting rational for those recommendations.

3. **Concept of Operations** – this will include a high-level identification of user needs and system capabilities. Output from this effort will include:

- a. A concept of operations plan including a description of stakeholder needs and constraints.
 - b. Key performance measures and a system validation plan.
4. **System Requirements** – this will develop system requirements that meet stakeholder needs based upon the concept of operations, functional requirements, standards and constraints. Output from this effort will include:
- a. System requirements document;
 - b. System verification plan;
 - c. Traceability matrix;
 - d. System acceptance plan

It should be noted that it is ODOT's intention to utilize commercially available off-the-shelf equipment to the extent possible during AV/CV deployments. This equipment will be tested and verified by ODOT and placed on an approved products list (TAP). This approach will effect several aspects of the System Requirements documentation.

5. **System Design (High Level)** – this will produce a high level design that meets systems requirements and defines key interfaces that facilitate development, integration and future maintenance and upgrades. Based upon the:
- a. Concept of Operations;
 - b. System Requirements;
 - c. Availability of Commercial Off-the-Shelf (COTS) equipment;
 - d. Applicable Standards
 - e. Test Documentation following IEEE-829-2008

The high level system design will:

- a) Provide an assessment of viable COTS equipment;
 - b) Provide a high level (architectural) design;
 - c) Detailed design specifications for hardware/software. These specifications would be used both at the program level (pre-approval of products) and at the project level.
 - d) Provide specific system design information to be used in future AV/CV deployments (ex. RSU installation & spacing, connected signal typical/standard drawings, etc.). These will be the basis of providing design guidance for future AV/CV deployments.
 - e) Defined system interfaces;
 - f) Analysis of communication and data bandwidth requirements including high level communication system design
6. **Software Development** –This effort will provide the rational and recommendation how Ohio will handle AV/CV data storage and management based upon:
- a. System and subsystem requirements;
 - b. Updated Integration plans
 - c. System design;
 - d. Availability of COTS equipment;
 - e. Industry standards;
 - f. Unit/Device test plans

The deliverable of this effort will be an assessment of Ohio's AV/CV data storage and management alternatives. Specifically, an assessment of potential AV/CV data management and storage / retention options including recommendations to:

- a. Create an Ohio Statewide Integrated Data Exchange (IDE); or
 - b. Utilize and/or expand the City of Columbus Smart City IDE for statewide use; or
 - c. Contract with a private data storage and management company for these services; or
 - d. Utilize a regional / national AV/CV data warehouse/IDE; or
 - e. Utilize and/or expand Smart City IDE for statewide use
7. **Verification Plan** – will provide verification plans for project deployments of the cited AV/CV applications. These verification plans would be used at the program level (pre-approval of COTS equipment) and at the project level as AV/CV projects are deployed.

Systems Engineering Analysis (SEA) Deliverables

- Assessment of the maturity and state of development of the listed applications. ODOT will use this assessment to determine if a listed application should be included in this SEA-AV/CV;
- Based upon the included applications, the Consultant will recommend what data is available from AV/CV applications and what data should be retained/stored. It should be noted that a state wide data working group is currently addressing this issue and the efforts will need to be coordinated. This task shall include an assessment of what data could potentially be made available to the private sector via API's in order to support value added application development. The task shall also include recommendations for how the data may be made available, while maintaining privacy / anonymity of the motoring public.
- Completion and Documentation of the SEA described above including:
 - Architectures;
 - Feasibility/Concept Exploration;
 - Concept of Operations
 - System Requirements;
 - System Design (High Level);
 - Software Development;
 - Verification Plan
- Specific project level documentation requirements not covered by the SEA-AV/CV for included application(s).
- Specific system design information that would be applicable at the project level in future AV/CV deployments (ex. RSU installation details & spacing requirements, connected signal typical/standard drawings, etc.). These will be provided by ODOT as design guidance for future AV/CV deployments.
- An assessment of currently available and viable commercial off the shelf products to support AV/CV operations.

Communications Plan Deliverables

This deliverable is an assessment of AV/CV bandwidth requirements and communication system design details and guidance. This communications plan should consider the specific communication needs (ex. bandwidth, latency, etc.) of the various applications, the required supporting communication medium (fiber, wireless, DSRC/WAVE, 4G/5G LTE, satellite, etc.). The assessment should include consideration of private communication opportunities (P3) as opposed to focusing exclusively on publicly owned/maintained communication infrastructure.

This deliverable will serve as the master communication planning and design document for AV/CV deployments in Ohio.

P3 Deliverables

This task and deliverable will identify potential P3 opportunities to support the deployment, operations or maintenance of AV/CV in Ohio. The rationale and supporting justification for proposed P3 opportunities will be provided showing that the potential P3 opportunities:

1. Creates opportunities for Ohio to use AV/CV applications and data to improve safety or operational capabilities; or
2. Provides cost savings or cost sharing; or
3. Provides revenue generation; or
4. Provides efficiencies in deployment, operations or maintenance; or
5. Expedites AV/CV deployments. This includes deployment of existing commercially available and viable products and systems;
6. Provides efficiencies in data storage, analytics, management or security;

It is understood that the data from AV/CV deployments has an inherent value. P3 opportunities shall be evaluated to maximize the public value (safety, mobility, commerce, economic development, monetary) of this data.

Program Plan Deliverable

This deliverable will provide specific recommendations and an evaluation process to prioritize AV/CV deployments based upon factors such as:

1. Maturity of applications;
2. Safety & mobility benefits;
3. Benefit/cost;
4. Logistic and economic development benefits;
5. Regulatory restrictions/risks;
6. P3 opportunities;
7. Deployment time frame;

The Program Plan will provide Ohio with specific information to begin the short and long term planning of AV/CV deployments and should be application as well as location/facility specific.

Software Functional Requirements Deliverable

This is an "if authorized" task to provide the necessary information and detailed software development requirements based on the SEA-AV/CV for the potential scoping of a separate software development project to create an Ohio Integrated Data Exchange (IDE).

An Ohio IDE would manage cloud stored AV/CV data obtained from autonomous and connected vehicles.

Additional Information

1. There are a number of AV/CV projects in various stages of development and deployment in Ohio (Union County Council of Governments; Ohio Turnpike and Infrastructure Commission; US-33 Smart Corridor; Columbus Smart City; Smart Cincinnati). Creation of the SEA-AV/CV will require coordination with these projects, as well as the 3 USDOT CV Pilot projects (New York, Wyoming, and Tampa) to:
 - a. Take advantage of previously completed work that can be leveraged to develop the SEA-AV/CV including System Engineering Analysis and IDE development

from the Columbus Smart City Project – (SCOS – Smart Columbus Operating System); and

- b. To identify aspects in these projects that would not be in compliance with the SEA-AV/CV.
2. It is ODOT's intention to create and maintain approved AV/CV equipment lists via the TAP (Traffic Authorized Products). Individual projects would be required to utilize equipment from the TAP via competitive bidding whenever possible. This procurement approach is relevant to multiple SEA requirements (ex. From the TEM - SEA Item #6 - Procurement Method; SEA Item # 8 – Testing Procedures; SEA Item # 9 – Traceability Matrix);
3. AV/CV data is expected be hosted in a TBD Cloud Environment;
4. The Consultant is expected to synthesize and use guidance from the USDOT Joint Programs Office (JPO) and any relevant work from national AV/CV demonstration deployments in the formulation of the SEA-AV/CV. Existing available guidance, architectures, etc. shall be used to the extent possible in order to not replicate existing work and to ensure interoperability.