

SCHEDULE A

**NYSDOT Commercial Vehicle
Infrastructure Integration Project
Contract #C030588**

SCOPE OF SERVICES

Overview

This statement of work (SOW) summarizes the Volvo team's overall approach for undertaking and managing the New York State Commercial Vehicle Infrastructure Integration (CVII) program, and includes the approach for addressing each task.

The SOW herein identifies and details the tasks to be completed and the deliverables to be provided under this program. It is recognized by all involved parties, however, that this is a research and development project involving complex and evolving technologies and that the SOW may be modified by NYSDOT as a result of findings during the advancement of the program. In addition, the parties recognize that the first substantial task to be completed will be to develop a detailed Program Plan subject to approval by NYSDOT, as reflected in Task 1 that provides for enhanced descriptions of deliverables including equipment, hardware and software to be developed under the program, detailed milestones and specific payments schedules including partial payments.

Task 1 - CVII Program Plan

The following are key issues that shall be addressed with NYSDOT as part of this first task, developing a CVII Program Plan:

- High-level human (driver) – vehicle interface design guidelines (HVI design);
- Selection of the radio platform around which to build the OBE.
- Definition of the type of general “public sector” commercial vehicle friendly information (e.g., traffic, weather, incidents, roadwork, etc.) that will be broadcast by the VII network and that therefore must be received and displayed by the vehicle. In other words, the specific “public sector” applications to be demonstrated (Task 2) will be solidified
- Definition of the type of general “public sector” vehicle information to be transmitted to the RSE including at a minimum the location and speed of the commercial vehicle.
- Definition and details of “commercial vehicle specific” information to be transmitted from the OBE to the RSE. This information may include, but not be limited to, the VIN, CDL#, Position and Speed.
- Overview of processes and technology solutions for positively identifying and verifying the driver of a commercial vehicle and electronically linking the driver ID with other vehicle data for subsequent transfer of a “safety data message set” to the infrastructure. In other words, the specific applications to be demonstrated (Task 3) will be solidified.
- Overview of processes and technology solutions for transfer of “safety data message sets” involving vehicle and carrier identification and safety equipment status from the commercial vehicle to the infrastructure. In other words, the specific applications to be demonstrated (Task 4) will be solidified.
- Outline of CVII final demonstration task including procedures, requirements and expectations for the final demonstration of all of the CVII functionalities along at least one of the VII corridors in NYS.

Task 1 Deliverables

The Volvo Team will provide the following deliverables:

Deliverable 1.1: Procurement Cost Estimate – An estimate of the upfront outlays that will be needed to solicit quotes and place purchase orders in order to secure a timely delivery of the various hardware and equipment that is needed for the project.

Deliverable 1.2: CVII Program Plan - The Task 1 deliverable will include a CVII Program Plan that documents all of the key issues, milestones, roles and responsibilities, detailed payment schedule including partial payments, deliverables and all other pertinent information including:

Scope Statement - A high level summary of the scope of the Project that reflects the team's understanding of the scope of the project and key deliverables. This would be a one page or less summary that describes goals, methods, outcomes, stakeholders, and overall schedule for the project.

Work Breakdown Structure - Documentation of tasks, key activities, milestones, as well as roles and responsibilities of team members, NYSDOT, and/or vendors.

Program Schedule - A Gant Chart, or similar, which reflects the start, duration and completion of each key phase of the project to research, design, install, test, and demonstrate the CVII OBE system. The associated key milestones and deliverables shall be reflected in the CVII Program Plan's schedule information consistent with the Work Breakdown Structure described in Deliverable 1.2 above. The Volvo team shall develop, document and deliver a Program Schedule that includes a listing of each significant activity and its estimated duration in days.

High Level Design - The Volvo team shall develop, document and deliver a high level design as part of the initial activities of the CVII Program Plan. This would include a high level design of the proposed OBE solution, driver interface, driver identification solution, as well as Safety Data Message Set (SDMS) content and format. The high level design would also list the other "public sector" applications that would be demonstrated, the scope of those applications, and any assumptions related to the infrastructure requirements needed to demonstrate the applications (including VII network (roadside) hardware/software as well as off-board application software. Vehicle design and development activities will be performed and completed at Volvo's North America headquarters in Greensboro, North Carolina.

Test Plan - The Volvo team shall develop a test plan including a system acceptance process. The Test Plan shall reflect component and system performance measurements including those that address reliability and accuracy (such as latency, packet error rates, data loss, coverage, and security related performance). The Test Plan shall outline the test procedures that, evaluate the reliability and accuracy of the

communication and system functionalities, of the OBE HVI, sensor and detection systems, on-board applications, and VII network interfaces. The Test Plan shall reflect a process that reasonably proves the OBE system is accurately and reliably transmitting and receiving the specified standard message sets and information. The Test Plan shall designate roles and responsibilities for both the Volvo team and NYSDOT staff. NYSDOT will make available appropriate staff members as needed to participate in, at a minimum, the system acceptance process. The Volvo team shall conduct system acceptance testing of the developed CVII hardware, software and systems in accordance with the process developed in the Test Plan, including complete "end-to-end" testing. Results shall be submitted to NYSDOT in a summary report prior to the formal and final demonstration of the system along a NYS VII Corridor as provided by NYSDOT. The Test Plan shall reflect and ensure that the tests are conducted using VII compliant RSE and network equipment. All testing will be conducted in Greensboro, NC. The Volvo team shall provide NYSDOT with the recommended support and resource requirements in advance of the actual testing activities. Any NYSDOT personnel costs associated with the development and testing activities of this CVII Program will be the responsibility of NYSDOT.

Demonstration Plan - The Volvo team shall develop a Demonstration Plan which will reflect a formal and final demonstration of the CVII systems and equipment. It will be conducted along one or more of the following three NYS VII compliant corridors as determined by NYSDOT:

- NYSTA's I-87 Spring Valley VII Corridor
- NYSDOT's I-490 Long Island Expressway VII Corridor
- NYCDOT's Manhattan VII Grid

Note: All VII compliant RSE and network requirements will be provided and supported by the NYS agencies responsible for the operations and maintenance of the NYS VII corridors. *It was required in the RFP that the formal and final demonstration event shall include a minimum of three business days of at least 8 hours per day of operation and demonstration of the commercial vehicles delivered under this task. However, given the research nature of this project, if the efforts and experience learned during the execution of the project warrant a different duration and schedule of the demonstration, NYSDOT is willing to alter this schedule.*

Demonstration of the CVII system will occur in accordance with the CVII Demonstration Plan developed under this task.

Staffing Plan - The Volvo team shall include a staffing plan that lists key individual's roles and responsibilities including identification of a Program Manager who shall serve as the key and primary representative

of the team's overall effort. Volvo will record and document all key communications, meetings and other activities required by NYSDOT to efficiently and effectively manage and advance the CVII Program.

Task 2 - VII Compliant On-Board Communication Equipment (OBE)

In this task the Volvo team will research, develop, test and demonstrate VII compliant on-board communication equipment (OBE) in a commercial vehicle provided by the Volvo team.

The team will utilize a VII radio platform from TechnoCom that is compliant with IEEE P1609 WAVE standards and fully compatible with USDOT's National VII program.

The vehicle system integration work will be completed at Volvo's North American headquarters in Greensboro, North Carolina. A minimum of two MCNU-based RSEs will be installed at Volvo's facilities, which will allow testing on Volvo's test track, as well as one additional RSE on Interstate 40, which is located within 50 meters of Volvo's facilities.

The baseline plan will utilize a TechnoCom Multiband Configurable Networking Unit (MCNU) R1500 as the platform for the Commercial Vehicle Infrastructure Integration (CVII) On-Board Equipment (OBE). This platform is fully compliant with New York State Department of Transportation (NYSDOT) OBE requirements for size, performance, and security. However, during Task 1, we will explore, with NYSDOT, the potential for utilizing a newly developed embedded WAVE VII radio device being developed by TechnoCom that promises to significantly reduce the size, complexity, and most importantly the cost of an OBE. Key OBE integration tasks will include: 1) providing an interface to the J1939 network as well as other peripherals (e.g., driver identification apparatus, EOBR) to be detailed during the design phase; 2) linking the OBE with the HVI display and driver interface device; 3) loading and testing all operating and security systems software; and, 4) positioning the OBE within the cab and providing power and antenna connections.

The Volvo Team will draw from the extensive experience of its members in producing a detailed plan for this effort as part of the Program Plan of Task 1.

The test plan will include provisions for documenting performance of the vehicle-to-infrastructure communications using relevant metrics such as range, latency, error-rates and data loss for all transmissions

Task 2 Deliverables

The Volvo Team will provide the following deliverables:

Deliverable 2.1: HVI Research Report - The Volvo team shall provide an initial report on existing research involving HVI. The report shall recommend an approach that most effectively communicates information

to the driver with minimal distraction to the driver, and which holds the most promise for industry acceptance.

Deliverable 2.2: OBE SYSTEM - The Volvo team shall, after approval of NYSDOT, undertake the procurement, development, installation and testing of the basic commercial vehicle OBE system required to provide communication to and from a compliant VII RSE.

Deliverable 2.2: CV VII OBE to VII RSE - Upon successful integration of the OBE in the cab, the Volvo team will develop and test the capability of transmitting general “public sector” vehicle information to the RSE installed at the test track. This data will include, but not necessarily limited to, vehicle speed, vehicle location, vehicle heading and vehicle identification number (VIN). Data to be utilized includes elements and/or message sets already defined in the SAE J2735 standard, or, as necessary, creation of new messages that adhere to the structure and syntax defined by J2735.

Deliverable 2.3: VII RSE to CV VII OBE - In this task, the Volvo team will research, develop and demonstrate on-board applications that allow the OBE to receive and display a variety of general “public sector” commercial vehicle friendly information messages.

Deliverable 2.4: Human-Vehicle Interface (HVI) - In this task, Volvo will develop a driver display and interface that compliments VII’s capabilities for receiving information from the roadside and other vehicles. The work will focus on developing a driver vehicle interface that delivers messages at the appropriate time, location, and circumstances, and in a manner that minimizes driver distraction.

Deliverable 2.5: Testing - The Volvo team shall successfully complete the testing of a VII compliant commercial vehicle(s) with installed OBE including HVI capable of transmitting standard VII system data and information to a VII compliant 5.9GHz DSRC roadside infrastructure and capable of receiving standard VII system data and information from a VII compliant 5.9GHz DSRC roadside infrastructure. Testing of vehicle-to-infrastructure communications will be completed at Volvo’s test track, as well as along I-40 in Greensboro, NC. The I-40 activities will include testing of the vehicle-to-infrastructure communication link at highway speeds, in different lanes, and under varying traffic and environmental conditions. The test matrix will include roadside-to-vehicle and vehicle-to-roadside communications, and will demonstrate communications using both the Wave Short Message (WSM) and IPV6 communication paths/protocols.

Deliverable 2.6: Final Task Report - The Volvo team shall deliver a Final Task Report that includes all final documentation including high

level design, detailed design, schematics, plans, equipment list and costs, and any other information required to completely reflect all aspects of the CVII OBE system including the HVI.

Task 3 - Wireless Driver Identification and Verification

In this task, the team will develop and test a solution for verifying and authenticating the driver's identification by using an off-board validation process when in range of an RSE. The Volvo Team will research a variety of technologies and concepts for meeting NYSDOT requirements, and will leverage the lessons learned including those from Volvo's Wireless Inspection project for the I-95 Corridor Coalition that involved using biometrics and a simulated Transportation Workers Identification Credential (TWIC) card to positively identify the driver.

Our preliminary concept includes a real-time off-board validation process when the vehicle is in range of an RSE. When not in range, a previously downloaded "authorized list" of CDL numbers could be used to control vehicle access and privileges. If the driver's CDL is inactive, revoked, or suspended, the test will demonstrate that the driver is unable to start the commercial vehicle. If the driver's CDL status is active and without revocation or suspension, the test will demonstrate that the commercial vehicle will be able to start and operate normally. This operation is limited to the Volvo and MACK vehicles due to the fact that the Volvo Team does not have access to the proprietary systems of other OEMs needed to control such action. For any other manufacturer's commercial vehicle a message could be provided to the driver via the HVI indicating that there is a problem with his/her CDL.

The test plan will include provisions for documenting performance vehicle-to-infrastructure communications using relevant metrics such as range, latency, and error rates, and data loss for all transmissions.

Task 3 Deliverables

The Volvo Team will provide the following deliverables:

Deliverable 3.1: Initial Report - The Volvo team shall provide an initial report on existing research involving wireless communication of commercial vehicle driver identification and verification. The report shall recommend an approach that maximizes the benefits of this capability and holds the most promise for industry and government acceptance.

Deliverable 3.2: Driver Identification/Verification System – The Volvo team shall, after approval of NYSDOT, undertake the procurement, development, installation and testing of the driver identification and verification process and functionality consistent with the plan developed under Task 1 above. Volvo shall provide a successfully tested VII compliant commercial vehicle(s), delivered in Task 2 above with installed

OBE including HVI, capable of accurately and reliably transmitting driver identification and verification data and information to a VII compliant 5.9GHz DSRC roadside infrastructure and network, and verify that it is capable of accurately and reliably receiving driver ID authentication/verification from the VII RSE thereby allowing for, or preventing, operation of the vehicle as appropriate. This operation will be limited to the Volvo and MACK vehicles. For any other manufacturer's vehicle, a message will be provided to the driver via the HVI indicating that there is a problem with his/her CD

Deliverable 3.3: Final Task Report – The Volvo Team shall provide a final report for Task 3 that documents and/or includes the high level design, detailed design, schematics, plans, equipment list and costs, and other documentation required to reflect all aspects of this commercial vehicle driver identification and verification OBE system including any information required to allow successful replication of the system and process using appropriate commercial vehicles.

Task 4 – Develop and Test and Demonstrate a Wireless Inspection Application

In this task, the Volvo team shall utilize prior research in wireless commercial vehicle safety inspections, as well as solicit input from the NYS project management, in order to detail the requirements and design concepts for a wireless inspection application. In this task, the Volvo team will develop an on-board wireless inspection application that:

- Assembles an SDMS to include safety related information such as: vehicle, driver, and carrier identification data; safety information collected from the J1939 network; as well as data that might be collected from auxiliary equipment (e.g., driver identification apparatus).
- Transmits the SDMS to an RSE that has first requested such information from the truck (through a WAVE Service Announcement (WSA) message);
- Include a simplified (and possibly simulated) off-board application that would:
- Parse, validate and analyze the SDMS,
- Link the data with other information that might normally reside in state and/or federal databases (e.g., vehicle credential status, carrier out-of-service order); and
- Transmit back to the truck an automated and/or “manual” response that adheres to VII and J2735 protocols. Such messages will include warnings, instructions, or other advisory messages.

The test plan will include provisions for documenting performance of vehicle-to-infrastructure communications using relevant metrics such as range, latency, and error rates, and data loss for all transmissions.

Task 4 Deliverables

The Volvo Team will provide the following deliverables:

Deliverable 4.1: Initial Report - The Volvo team shall provide a report on existing research on wireless communication of commercial vehicle safety information including the ongoing Wireless Roadside Information program being advanced by the Federal Motor Carrier Safety Administration. The report shall recommend and detail the best approach to be used, including recommendations for the standard data message sets, that maximizes the benefits of this capability and holds the most promise for industry and government acceptance.

Deliverable 4.2: Wireless Safety Information system - The Volvo team, after approval by NYSDOT, shall undertake the development, installation and testing of the VII compliant commercial vehicle (delivered in Task 2 above) utilizing the wireless vehicle safety information data exchange system and process, and demonstrate that it is capable of accurately and reliably *transmitting* vehicle safety information to a VII compliant roadside infrastructure and capable of accurately and reliably *receiving* vehicle safety information back from the VII RSE.

Deliverable 4.3: Final Task Report - The Volvo team shall provide final documentation for the design, installation, operation, maintenance and other pertinent information including detailed designs, schematics, plans, equipment lists, and other information required to reflect all aspects of this task. The documentation shall include information required to allow replication, installation, operation, and maintenance of the OBE and wireless vehicle safety information data exchange system and process using appropriate commercial vehicles.

Task 5 - Install and Test VII Compliant OBE's in NYS Maintenance Vehicles

In this task, the Volvo team will assemble OBE "kits" based on the hardware, software and designs that were developed and tested for commercial vehicles in Task 2. The OBE kits will be installed in two Mack and two International maintenance vehicles provided by NYS. The final stage of this work involving the installation and testing will occur at a facility in NYS, after as much as possible of the work has been done in Greensboro, NC.

Testing and validation of the VII OBE "kits" for the maintenance vehicles will be completed in Greensboro, NC as well as New York State, and will adhere to the

test plan developed in Task 1. The test plan will include provisions for documenting performance of both vehicle-to-infrastructure and vehicle-to-vehicle communications using relevant metrics such as range, latency, and error rates, and data loss for all transmissions.

Task 5 Deliverables

The Volvo Team will provide the following deliverables:

Deliverable 5.1: Initial Report - The Volvo team shall provide an initial report to NYSDOT documenting the proposed schedule for the OBE installation and testing of the VII compliant NYS maintenance vehicles based on discussions with the appropriate NYS managers of the maintenance vehicles to ensure coordination of activities and equipment availability. The report shall also recommend the specific maintenance vehicle information (parameters) to be communicated (via the VII system) which provides the most benefit to transportation operations management.

Deliverable 5.2: Maintenance Vehicle OBE - The Volvo team shall, after approval by NYSDOT, procure, install and test the four NYS maintenance vehicle's VII compliant OBE:s in the presence of appropriate transportation personnel at a location determined by NYSDOT. The Volvo team shall conduct the installation and testing activities in a manner which will allow multiple personnel to become familiar with the required activities in order to allow those personnel to replicate the OBE systems for other identical maintenance vehicles including all required installation, operation and maintenance activities. The Volvo team shall ensure to NYSDOT the successfully tested and accepted OBE integration and operation of the VII compliant NYS maintenance vehicles with the installed OBE with HVI capable of communication of the standard message sets with a VII RSE developed under this Task and capable of communication of the standard message sets with the commercial vehicle VII compliant OBE developed under Tasks 2 - 4 above

Deliverable 5.3: Final Task Report - The Volvo team shall provide a final task report which includes all final documentation including the high level design, detailed design, schematics, plans, equipment list and costs, and other information required to reflect all aspects of this Task. The documentation shall include any information addressing procurement, installation, operation and maintenance information required to allow successful replication by NYSDOT of the NYS maintenance vehicle VII compliant OBE system including the HVI and of any information data exchange system and processes, using appropriate commercial or maintenance vehicles.

Task 6 - Final Demonstration of CVII OBE Systems

In this task, the Volvo team will perform a final demonstration of the VII vehicles including the Volvo commercial vehicle and the four NYS provided maintenance vehicles along at least one of the VII corridors in NYS as chosen by NYSDOT. During this time, all of the required vehicle-to-infrastructure and vehicle-to-vehicle applications will be demonstrated as reflected by Tasks 2-5.

Task 6 Deliverables

The Volvo Team will provide the following deliverables:

Deliverable 6.1: Final CVII Demonstration – The Volvo Team will conduct the final demonstration along at least one of the NYS VII corridors as approved by NYSDOT. This deliverable shall be considered complete upon the successful demonstration of the CVII OBE systems, associated functionalities and successfully tested applications previously developed under Tasks 2-5.

Task 7 - Project Management

The Program Plan developed in Task 1 will lay the foundation for managing the project and will be kept up-to-date over the life of the project. The Volvo team will provide monthly updates on the project's status; quarterly reports based on the federal fiscal year; and will participate in monthly project management meetings throughout the life of the project. The team also will produce a final report at the conclusion of the project summarizing the outcomes of the project and work completed over the life of the project.

Task 7 Deliverables

The Volvo Team will provide the following deliverables:

Deliverable 7.1: Monthly Reports - The Volvo team shall develop and deliver monthly reports on the status of the overall CVII Program to NYSDOT reflecting progress, accomplishments, anticipated activities for the following month, problems, and any other pertinent information needed to professionally manage this CVII Program as determined by NYSDOT. These monthly reports shall be delivered to the NYSDOT project manager within seven business days of the end of each month for the program's duration.

Deliverable 7.2: Quarterly Reports - The Volvo team shall produce a quarterly report based on the federal fiscal year. The quarterly reports shall be delivered to NYSDOT in electronic format within seven business days of the end of each federal fiscal year quarter.

Deliverable 7.3: Monthly Program Management Meetings - The Volvo team shall perform typical project management activities including but not limited to a minimum of one project management meeting with NYSDOT per month of the CVII Program's duration. The Volvo team will provide minutes of all meetings within 5 business days of the date of the meeting.

Deliverable 7.4: Final CVII Report - The Volvo team will produce a final report after successful completion of all Tasks including the final demonstration. The Final CVII Report will summarize all of the results of the project, including all tasks and deliverables.

Task 8 - Public Outreach Program

For this task, the Volvo team shall develop promotional materials including: a CVII Program Overview document suitable for publication on NYSDOT's website; a two-page "slick sheet" (printed on front and back of a single sheet) that summarizes project vision, goals, concept of operation; technology and programmatic highlights; and project participants; and a 15-minute promotional video that can include footage of test hardware and early demonstrations.

Task 8 Deliverables

The Volvo Team will provide the following deliverables:

Deliverable 8.1: Outreach Support - The Volvo team shall attend and/or present information about the CVII Program at up to six transportation related events, forums, conferences, workshops or similar functions around the United States as determined by the NYSDOT.

Deliverable 8.2: Information/Outreach Documents - The Volvo team shall develop a multi-colored information document, in an Adobe PDF format or equivalent as determined by NYSDOT capable of reproduction which outlines and describes the key activities involved in the CVII Program. All aspects of this project information document shall be determined and approved by the NYSDOT with the Volvo team providing including conceptual, preliminary and final drafts to NYSDOT.

Deliverable 8.3: Information Video - The Volvo team shall be required to produce an information video lasting at least 15 minutes on the CVII Program including information on the research, development, testing, and demonstration activities. This video is intended for use as an informational resource at various transportation related events.