Integrated Vehicle-to-Infrastructure
Prototype (IVP)

Draft V2I Hub Troubleshooting Guide

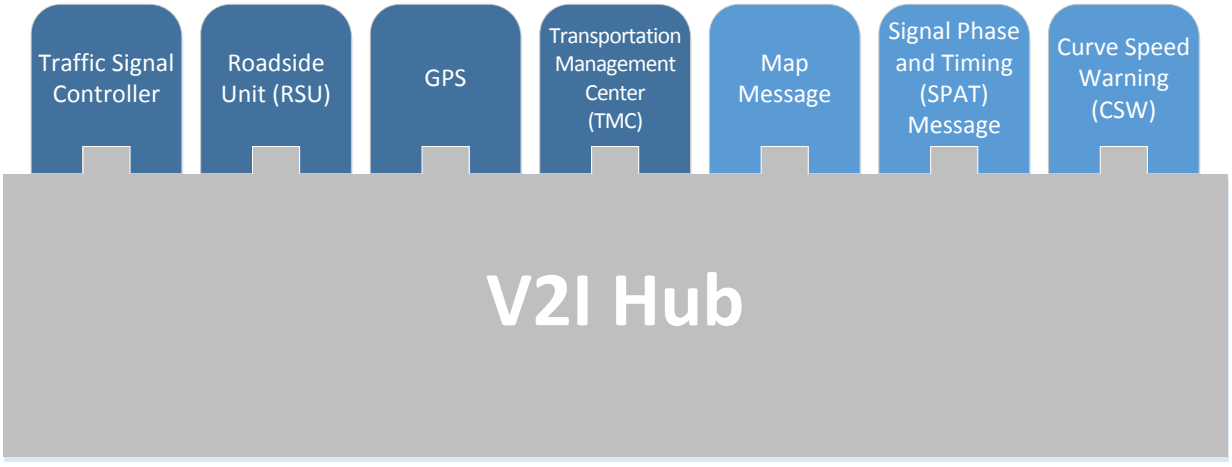
Prepared by:

Battelle
505 King Avenue
Columbus, Ohio 43201

Submitted to: U.S. Department of Transportation

Client: FHWA Office of Operations Research and Development
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101

Date: September 2016



Battelle
The Business of Innovation

Table of Contents

Page

Chapter 1. Troubleshooting 1
1.1 ASSUMPTIONS 1
1.2 SUPPORT DOCUMENTS 1
1.3 ISSUES 1
Appendix A - Abbreviations and Descriptions A-1

List of Tables

Page

Table 1. Issues and Resolutions 1
Table A-1. Abbreviations and Descriptions A-1

Chapter 1. Troubleshooting

1.1 ASSUMPTIONS

This Troubleshooting Guide is part of U.S. Department Of Transportation's (U.S. DOT) Integrated Vehicle-to-Infrastructure Prototype (IVP) Development project and has been developed based on deploying V2I Hub in limited scenarios with an Econolite ASC/3 traffic signal controller and an Arada LocoMate Commando Roadside Unit (RSU). Although it does not provide information on all potential V2I Hub issues, it does provide a starting place for identifying issues and options for resolution.

1.2 SUPPORT DOCUMENTS

The documents listed below provide information on the development, setup, and deployment of V2I Hub.

- V2I Hub Design, Battelle, May 2016
- V2I Hub Versions, Battelle, July 2016
- V2I Hub Plugin Creation Manual, Battelle, July 2016
- V2I Hub Sample Setup Guide, Battelle, September 2016
- V2I Hub Florida Deployment Report, Battelle, September 2016

1.3 ISSUES

Table 1 contains common issues with the execution of the V2I Hub system and possible resolutions to those issues. Descriptions for abbreviations are included in Appendix A.

Table 1. Issues and Resolutions

Issue	Resolution
Roadside Unit (RSU) Not Broadcasting	• For the Arada Commando RSU, if logging is turned on, check the last logs in /tmp/usb/ModelDeploymentCaptures/. Logs are written every 10 minutes, so if there is a log from 10 minutes ago, then the RSU was transmitting. • For the Arada RSU, check to see if all three lights are either solid or blinking. If not, then reboot the RSU by unplugging the Power over Ethernet unit for a minute then plugging it back in. • Check the Arada RSU to see if the correct applications are running and configured correctly. For more information, refer to the *V2I Hub Sample Setup Guide* or the *Arada RSU User Guide*. • Consult the *V2I Hub Sample Setup Guide* for information on configuring the RSU. • Consult Arada's *LocoMate Installation Guide* for guidance on the equipment and installation.
Can't connect to V2I Hub unit with Maintenance Computer	• Confirm the local network Ethernet cable is plugged into the LAN Port on the V2I Hub unit. • Double check that the accessing computer has an IP address on the same local network (e.g., 192.168.25.*). • If it's a managed switch, confirm the ports used are on the same local network without communication restrictions.

Issue	Resolution
	• Some organizations use connection security software, such as Cisco AnyConnect, that may be blocking access to the V2I Hub unit. Disabling or using a maintenance computer without the software may be required. Alternatively, it may be possible to access the V2I Hub unit's Admin Web Portal by entering the IP address of the V2I Hub unit into the web browser of a computer on the same network.
V2 Hub unit can't communicate with the RSU	• Arada RSU needs to have three solid or blinking lights. • Check network cabling. The Ethernet cable should be plugged into the same switch as the V2I Hub unit. • Check the IP address of the RSU and confirm that it matches the RSU IP address in the DSRC Message Manager Plugin of the V2I Hub Admin Web Portal (System Admin Menu → Installed Plugins → DSRC Message Manager). Additional information is provided in the *V2I Hub Sample Setup Guide*. • If it's a managed switch, confirm the ports used are on the same local network without communication restrictions. • Use an Ethernet cable tester to verify the Ethernet cable is working (e.g., not damaged during installation) and that the RJ45 connectors are installed correctly.
Data not being sent out the RSU for specific plugins	Check the configurations described below. The *V2I Hub Sample Setup Guide* provides additional information on configuration: • Check that the plugin in question is enabled via the V2I Hub Admin Web Portal. • Verify that the plugin output count is incrementing in the V2I Hub Admin Web Portal. • Check that the plugin is configured correctly via the V2I Hub Admin Web Portal. • Check that the RSU is configured correctly. • Check that the DSRC Message Manager plugin is enabled and configured correctly.

SPaT Plugin not generating SPaT message	• Check configuration of the SPaT plugin for the correct IP address and port information for the traffic signal controller.
	• Check that traffic signal controller network connection is plugged into the same network switch as the V2I Hub unit's local network connection (LAN).
	• Consult the *V2I Hub Sample Setup Guide* for the correct configuration.
	• Check the boot, firmware, and telemetry version on the signal controller. On the Econolite signal controller, select Menu → 8 → 7 to see the currently-installed software version. Econolite controllers must meet the following specifications:
	  ○ Firmware version 2.54 or greater
	  ○ Boot version 1.14.03 or greater
	  ○ Telemetry version 1.00.00
	• Power cycle traffic signal controller after software updates to complete their installation and incorporation.

Issue	Resolution
RTCM Plugin not generating RTCM messages	• Check correct configuration parameters for IP address, port, username and password via the V2I Hub Admin Web Portal. The *V2I Hub Sample Setup Guide* provides additional information on configuration. • Check internet connectivity on V2I Hub unit and that the Internet network cable is plugged into the WAN port. Checking internet connectivity can be done by pinning a known website, like espn.com. • Check network configuration for firewall rules preventing the V2I Hub unit from connecting to the NTRIP network. This may require coordination with IT personnel managing the network.
Plugin fails to upload with “Error 1”	• This is due to a malformed manifest file. Run manifest file through a JSON validator to verify it.
MAP Plugin not generating MAP message	• Check that the map plugin has the correct MAP files in its configuration. The *V2I Hub Sample Setup Guide* provides additional information on configuration. • Check that that the MAP files in the configuration exist in the MAP plugin directory on the V2I Hub unit.
Unable to receive or interpret incoming messages	• Make sure that broadcasting and receiving devices are configured to send and receive messages according to the same standardized formats (i.e., SAE J2735-2016). • Verify that the broadcasting device is sending messages signed with valid security certificates and that the receiving device is enabled to validate signed messages according to the SCMS • Verify that the broadcasting device has not been ‘blacklisted’ by the SCMS or that the security certificates haven’t expired.

Appendix A - Abbreviations and Descriptions

Table A-1. Abbreviations and Descriptions

Abbreviation	Name	Description
DHCP	Dynamic Host Configuration Protocol	The Dynamic Host Configuration Protocol (DHCP) is a standardized network protocol used on Internet Protocol (IP) networks for dynamically distributing network configuration parameters, such as IP addresses for interfaces and services.
DSRC	Dedicated Short Range Communications	DSRC is a two-way short- to- medium-range wireless communications protocol that supports vehicle-to-vehicle, vehicle-to-roadside, and roadside-to-vehicle communication.
IP	Internet Protocol	A numerical label assigned to device in an computer network that is used for communication.
IPv4	Internet Protocol version 4	Internet Protocol version 4 (IPv4) is the fourth version of the Internet Protocol (IP).
IPv6	Internet Protocol version 6	Internet Protocol version 6 (IPv6) is the most recent version of the Internet Protocol (IP), the communications protocol that provides an identification and location system for computers on networks and routes traffic across the Internet.
IT	Information Technology	Describes the technology that uses systems for storing, receiving and sending information.
IVP	Integrated Vehicle-to-infrastructure Prototype	A USDOT project to develop an Integrated Vehicle-to-Infrastructure (V2I) Prototype System that brings results from mapping, positioning, communications research, and Signal Phase and Timing (SPaT) and related message set development into a single operating environment that supports V2I communications-based connected vehicle applications.
J2735	Society of Automotive Engineers (SAE) Standard J2735	The SAE standard J2735 DSRC Message Set.
JSON	JavaScript Object Notation	Describes a lightweight data-interchange format.
LAN	Local Area Network	A computer network that interconnects computers within a limited area.
MAP	Map Data	Describes the static physical geometry of one or more intersections; i.e., lane geometries and the allowable vehicle movements for each lane, and introduces the idea of “intersection data frame” which describes barriers, pedestrian walkways, shared roadways and rail lines that may affect vehicle movements.
NIC	Network Interface Controller	A network interface controller (also known as a network interface card, network adapter, LAN adapter or physical network interface, and by similar terms) is a computer hardware component that connects a computer to a computer network.

Abbreviation	Name	Description
NTCIP	National Transportation Communications for Intelligent Transportation Systems Protocol	A family of standard protocols for allowing traffic management systems to talk to intelligent transportations systems field devices such as: dynamic message signs, CCTV cameras, vehicle detection sensors, traffic signals, Road weather information stations (RWIS), along with many other types for roadway devices.
NTRIP	Network Transport of RTCM via Internet Protocol	A protocol for streaming differential GPS data over the Internet in accordance with specifications published by RTCM.
PoE	Power over Ethernet	Describes any of several standardized or ad-hoc systems which pass electrical power along with data on Ethernet cabling.
PuTTY	PuTTY	A free and open-source terminal emulator, serial console and network file transfer application that supports several network protocols, including Secure Copy (SCP), Secure Shell (SSH), Telnet, rlogin, and raw socket connection.
RSU	Road-Side Unit	DSRC communication unit that is located aside a road that provides connectivity support to passing vehicles
RTCM	Radio Technical Commission for Maritime Services	Is an international standards organization that provides specifications for global positioning system (GPS) position correction.
RTCM Plugin	Position Correction Plugin	The Position Correction Plugin supplies V2I Hub with real time differential GPS correction data in Radio Technical Commission for Maritime Services (RTCM) format. This is done by communicating with a Networked Transport of RTCM via Internet Protocol (NTRIP) client to receive the differential GPS data over the internet.
SCMS	Security Credential Management System	Provides security to Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications at current production levels.
SNMP	Simple Network Management Protocol	Is an Internet-standard protocol for collecting and organizing information about managed devices on IP networks and for modifying that information to change device behavior.
SPaT	Signal Phase and Timing data	Real-time provision of traffic signal phase and timing information to vehicles approaching signalized intersections. Describes the signal state of the intersection and how long this state will persist for each approach and lane that is active. The SPaT message sends the current state of each phase, with all-red intervals not transmitted. Movements are given to specific lanes and approaches by use of the lane numbers present in the message.
V2I	Vehicle-to-Infrastructure	Defines the communication between vehicles and infrastructure via DSRC and other wireless communications.
V2V	Vehicle-to-Vehicle	Defines the communication between vehicles via DSRC and other wireless communications.