V2X Hub Functional Test

Items Needed
Computer w/ V2X Hub
Traffic Signal Controller
Network Switch
RSU
Test Laptop
Ethernet Cable (4)

V2X Hub + SPAT Plugin
All the devices above must be connected to the Network Switch and all IP addresses must be set to the same network configurations. Instructions on how to change the IP address for the RSU is found in its document. Other instructions are written below.

1. Once the test laptop is plugged into the network switch, change its Ethernet IPv4 to:
   a. IP address: 192.168.0.100
   b. Subnet mask: 255.255.255.0
   c. Gateway: 192.168.0.1
2. Using the test laptop, open an internet browser and go to:
   a. http://192.168.0.146/
   b. The screen will be in a continual loading phase. Open a new tab and go to:
      i. https://192.168.0.146:19760/
      ii. Accept the credentials on the page. They may be under an **advanced** option
   c. Return to the first tab. You will have to change the IP address in the text box to:
      i. 192.168.0.146
      ii. Default is 127.0.0.1 if logging in from the computer running V2X Hub
      iii. Refer to Figure 1 for the text box
3. Login using:
   a. Username: v2xadmin
   b. Password: V2xHub#321
   c. Refer to Figure 1
4. Computer Admin Login:
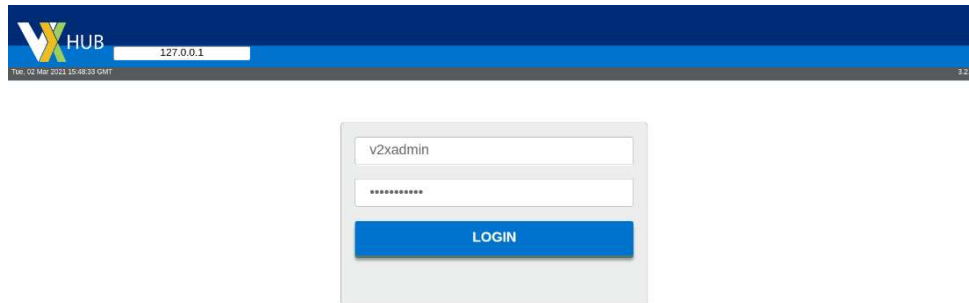   a. Username: v2xhub
   b. Password: St0l2019

Figure 1. V2X Hub Login

5. Once logged in, **Enable** the **SPAT** plugin if it is not already enabled. Refer to Figure 2
   a. If SPAT is not listed as below, the Enabled, Disabled, and External filters may be toggled on or off to show/hide plugins
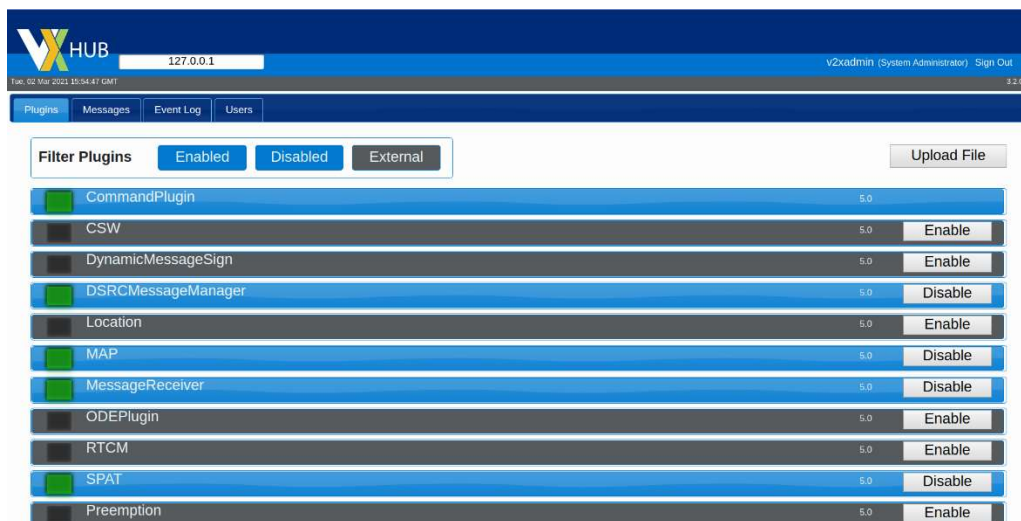   b. Check "Enable SPaT Application" in acceptance checklist

Figure 2. Plugins with Enabled and Disabled Filters ON

6. Click on the **SPAT** row to expand it
   a. Expand the **Configuration** row and ensure the values match Figure 3
   b. The **SignalGroupMapping** section is valid for any standard 4-way intersection
      i. It must otherwise be changed to match your intersection's SPaT settings

Figure 3. SPAT Plugin Settings

7. Select the **Messages** tab at the top to view the messages being received
   a. The **SPAT-P** Subtype will eventually reach a 100 Average Interval
   b. Refer to Figure 4

Figure 4. Messages Received

Traffic Signal Controller

The following steps show which Traffic Signal Controller settings have to be changed at a minimum. Every intersection has a different setup. Therefore, some settings are only examples.

1. The **network configuration settings** must be changed to communicate with the V2X Hub
   a. Address: 192.168.0.92
   b. Net Mask: 255.255.255.0
   c. Gateway: 192.168.0.1
   d. Ping Server: 192.168.0.146
   e. Refer to Figure 5
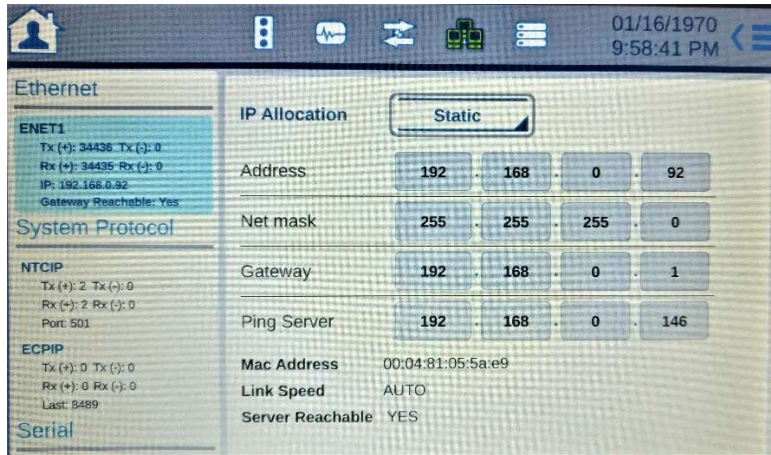
Figure 5. TSC Network Configuration

2. The **Phase Order** settings can be found on the home page. Select the symbol and adjust to match your intersection's phase order
   a. Barriers separate active phases
   b. Tap on a phase symbol or empty box to view edit menu
   c. Refer to example in Figure 6

Figure 6. Example Phase Order Settings

3. In the **Timing Plans** settings, all the separate tabs, seen in Figure 7, can be changed to match your desired signal timing

Figure 7. Timing Settings

4. There are many other settings available to be changed. Not all need to be adjusted, but can be to reflect your desired SPaT messages
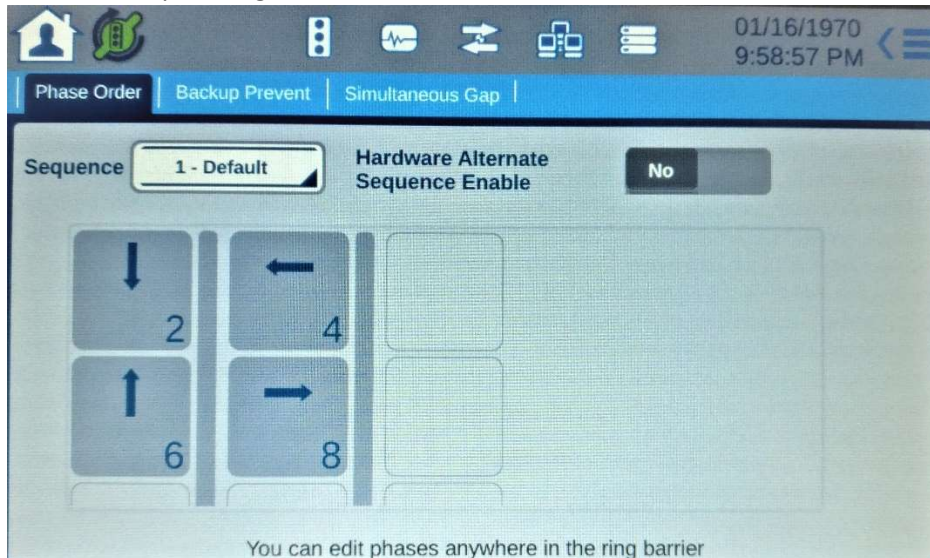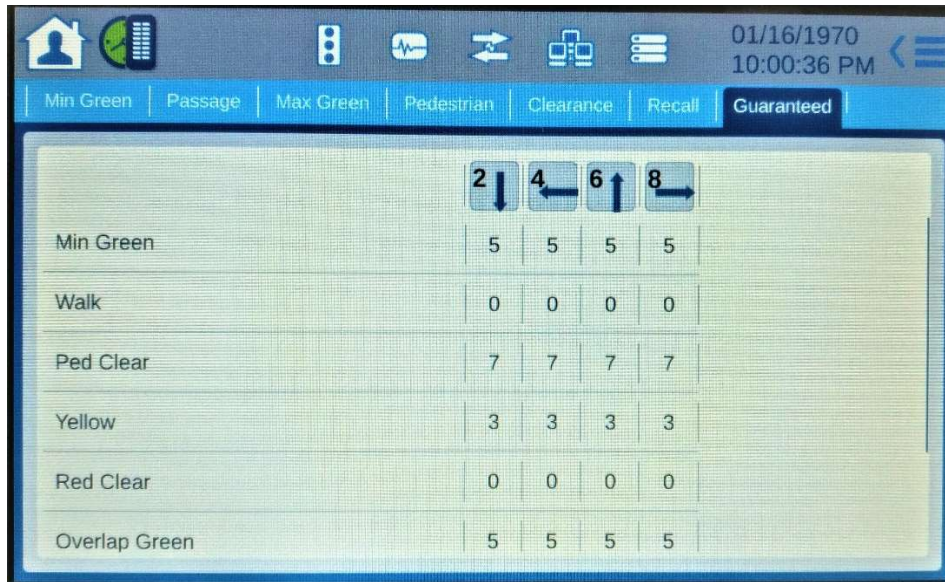
MAP Plugin

To use the MAP plugin in V2X Hub, a map file must be saved in the V2X Hub file path. The map file is an UPER string saved as a .txt file.

1. Following the **ISD Message Creator** tool instructions, encode an **UPER** Hex string from your Child Map using:
    a. Message Type: Map
    b. Node Offsets: Tight
2. Copy and Paste the UPER Hex string into a text editor and save it as a **.txt** file
3. Open a terminal and navigate to the location where the file was saved
4. Save the .txt file to the V2X Hub computer in the V2X Hub MAP folder:
    a. To copy from the test laptop to the NanoPi:
        i. `scp file_name pi@192.168.0.146:/tmp`
    b. To copy from test laptop to Winsys:
        i. `scp file_name v2xhub@192.168.0.146:/tmp`
    c. To copy from the temporary folder to the final location on a NanoPi:
    d. `cp /tmp/file_name /home/pi/V2X-Hub/configuration/arm64/MAP/`
    e. To copy from the temporary folder to the final location on a WinSYS:
    f. `cp /tmp/file_name /var/www/plugins/MAP/`
5. Return to the Plugins tab in V2X Hub and ENABLE the MAP plugin if it is not already enabled
    a. Check "Enable MAP Application" in acceptance checklist
6. Click on the MAP row to expand it
7. Expand the Configuration row and ensure the values match Figure 8

a. Change the file name in the *Value* section to match the location of your .txt file
  i. If the text box refuses to update, delete the entire text and hit <Enter>
    1. Once box is cleared, copy + paste the default value into a text editor
    2. Edit the File Path section to the location where your MAP file is located
  ii. Refer to Figure 8

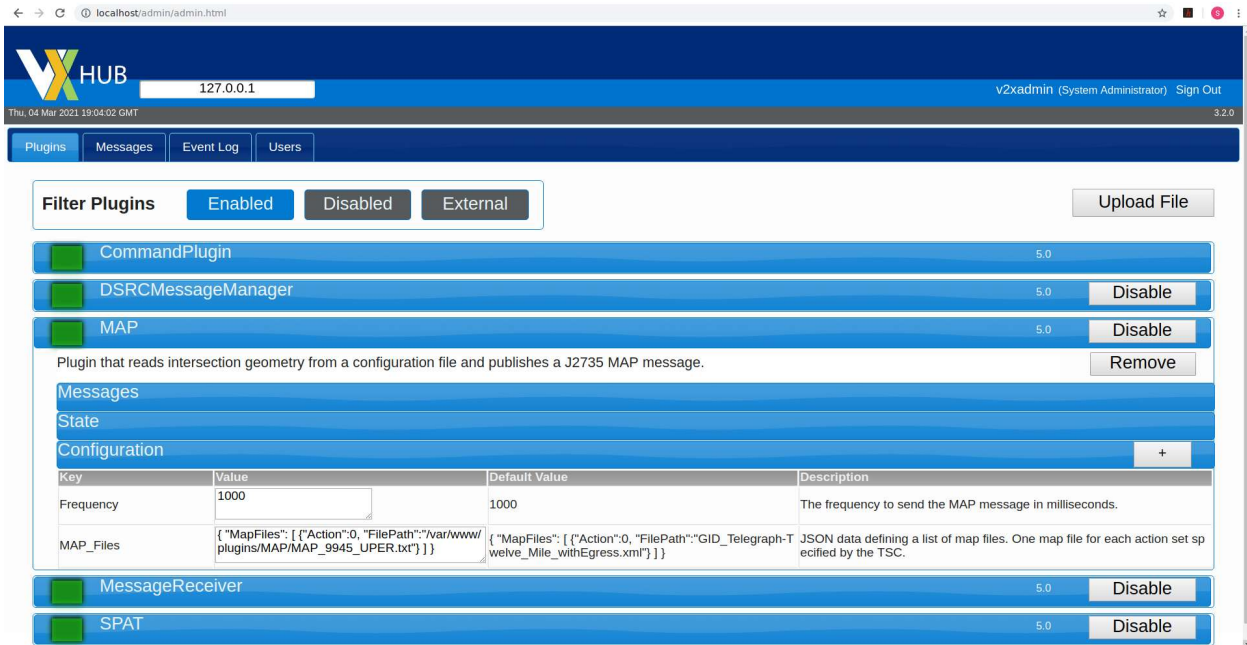
Figure 8. MAP Plugin Settings

8. Select the Messages tab at the top to view the messages being received
  a. The MAP-P Subtype will eventually reach a 1000 Average Interval
  b. Refer to Figure 4 above

Forward to RSU

The DSRCMessageManager forwards both DSRC and CV2X messages, despite its name. The Destination_1 settings can be changed to match the RSU IP address and port number that are set up to receive messages.

1. Expand the plugin and expand the Configuration tab
  a. In the Value section, change the IP and port to match your RSU's settings. Port 1516 is generally set used on Cohda RSUs
  b. All other configurations can be left at default, unless a specific message type and ID are desired. Those settings can be added in the Messages_Destination_1 row
  c. Refer to Figure 9

Figure 9. DSRCMessageManager Configurations

2. Disable and re-Enable the DSRCMessageManager plugin after changes are made. Refer to Figure 10

Figure 10. DSRCMessageManager Plugin Enabled

BSM

To ensure BSMs are being received by V2X Hub, transmission from the OBU is first tested. Refer to your OBU documentation.

1. Once BSM transmission is verified, click on the MessageReceiver plugin to expand it
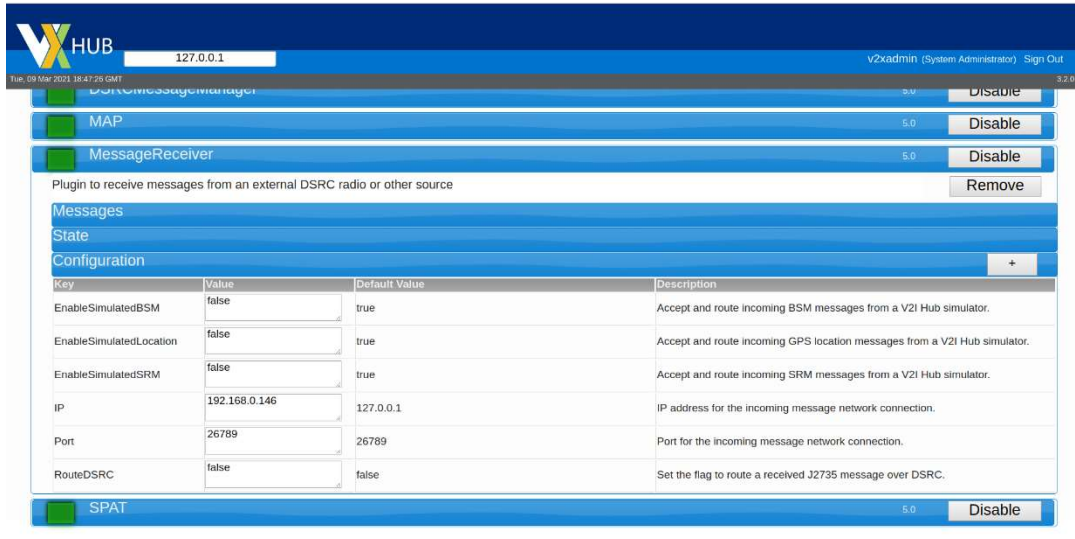   a. Expand the Configuration row and ensure the values match Figure 11

Figure 11. MessageReceiver Configuration

2. Navigate to the Messages Tab and verify that BSMs are being received
    a. The BSM subtype will eventually reach 100 average interval
    b. Refer to Figure 12
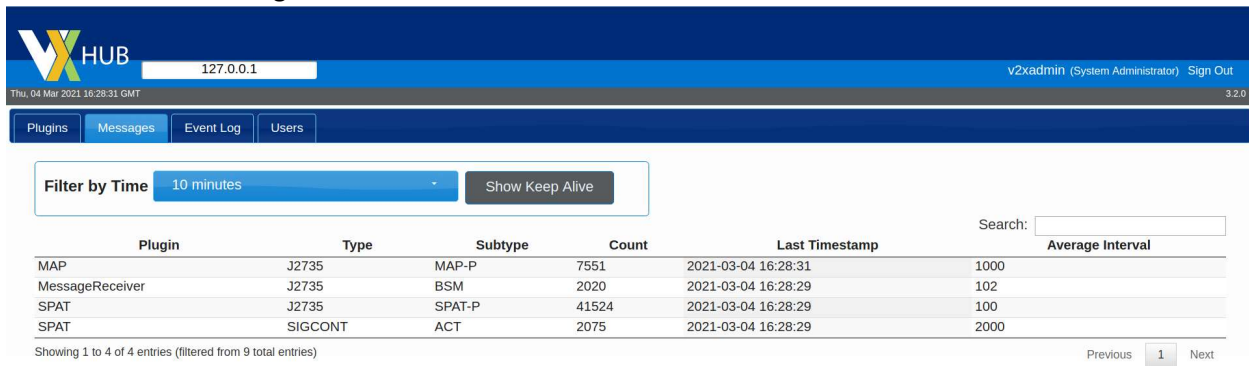

Plugin	Type	Subtype	Count	Last Timestamp	Average Interval
MAP	J2735	MAP-P	7551	2021-03-04 16:28:31	1000
MessageReceiver	J2735	BSM	2020	2021-03-04 16:28:29	102
SPAT	J2735	SPAT-P	41524	2021-03-04 16:28:29	100
SPAT	SIGCONT	ACT	2075	2021-03-04 16:28:29	2000

Showing 1 to 4 of 4 entries (filtered from 9 total entries)

Figure 12\. BSM Messages Received