Savari S-50 Operations, Administration, Maintenance & Provisioning (OAM&P) Guide for Transcore Application

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Version Information

S.No	Document Version	Date	Reason for Change
1	0.1	Dec 8, 2014	Initial Version
2	0.2	Jan 20, 2015	Corrections based on internal review
3.	0.3	Jan 22, 2015	Added LED Table and FCC info.
4.	0.4	Feb 5, 2015	Added FCC Para

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1 Introduction

The Savari S-50 is a purpose built On-Board Unit (OBU) for interoperability with a Transcore LMU-TC (also known as ROVR in this document) and a Savari StreetWAVE™. The OBU communicates with the LMU-TC and receives GPS breadcrumb information. The OBU stores this data in persistent memory until it is able to upload it to the specific RSE. The communication between the LMU-TC and the OBU is over aproprietary 2.4 GHz link whereas the communication to the RSE is over a DSRC 5.9 GHz link. The S-50 OBU has been built as a plug and play device without needing any user intervention. However, the S-50 OBU has been equipped with a provisioning interface that can receive and load new versions of software, new configurations and instructions to perform logging functions and download log messages to an external device.

Figure 1: StreetWAVE™

Figure 2: Savari S-50

2 Abbreviations

The following are the abbreviations used throughout this document:

Abbreviation	Expansion
DSRC	Dedicated Short Range Communication
GPS	Global Positioning System
ITS	Intelligent Transportation Systems
ITIS	International Traveler Information Systems
IP	Internet Protocol
LED	Light Emitting Diode
OBE/OBU	On-Board Equipment/On-Board Unit
PSC	Provider Service Context
RFC	Request for Comments
RSE/RSU	Roadside Equipment/Roadside Unit
RX	Receive
SSH	Secure Shell
TCP	Transmission Control Protocol
TX	Transmit
WAVE	Wireless Access in Vehicular Environments
WSA	WAVE Service Advertisement

3 Savari S50 Features

This chapter explains the salient features of the Savari S-50 (alternatively known as OBU in this document).

3.1 Radio

Each S-50 unit consists of two radios:

- A high-powered 5.9 GHz DSRC radio
- A 2.4 GHz radio that operates on a proprietary protocol

Both radios feature an internal antenna.

3.2 IPv4 and IPv6 Networking

Each S-50 unit consists of one Ethernet interface (eth0) and one wireless interface (ath0). The S-50 provides support for IPv4 on its Ethernet interface and IPv6 networking on its DSRC interface. The latter functionality is seamless to the user and does not require any configuration. The Ethernet interface is accessed using the mini USB connector on the S-50. A corresponding USB to Ethernet adaptor will be required. The default IPv4 address is 192.168.40.40.

3.3 Transcore Application

The specific application has two parts: A downstream communication with the LMU-TC and an upstream communication to the Savari RSE.

3.3.1 Transcore Application

The Savari S-50 is a small form factor purpose-built DSRC OBU that is capable of 2.4G wireless communications with a Transcore LMU-TC and receiveing GPS breadcrumb data in a proprietary format. The S-50 resides in the taxi and is connected to vehicle power using a 2 pin custom cable. See Appendix A for details on the power connectivity.

The RSE transmits a DSRC Wave Service Advertisement (WSA) with a specific Provider Service Context (PSC) String (defaulted to ‘tsf0’). The WSA is transmitted every 100 ms from the RSE. The WSA message contains many parameters and instructions that are interpreted

by all S-50s. The information within the WSA can be user configured by accessing the Savari RSE. Among other information, the information in the WSA enables the following:

1. Transmission of an RSSI threshold – Upon receipt of the WSA, The S-50 configures its minimum RSSI threshold value. The breadcrumbs are then uploaded only when the measured RSSI is greater than the minimum threshold value.

2. Logging – The S-50 will enable or disable logging as per the instructions within the WSA. It also uploads an indicated number of records to the RSE along with the breadcrumb information. This capability will be useful for on-field debugging as it allows the receipt of some information (although minimal) without the need for manual intervention on the S-50. The size of the logging can also be specified within the WSA messages.

   Note: The instructions/parameters sent by WSA will be common to all S-50s in listening distance.

Receipt of a WSA by the S-50 is an indication of the availability of an RSE that provides this specific 'Transcore' Application. The WSA consists of sufficient information to differentiate and uniquely identify this specific RSE with another generic DSRC RSE. The S-50 configures itself with the received RSSI threshold value (received in the WSA). It then uses its own measured RSSI value (of the RSE signal) to perform a comparison. If the received value is higher than the configured value, the S-50 enters into a communication transaction to upload all data to the RSE. Only S-50 units that are configured with the same PSC (as the RSE) respond. Hence, if desired, it is possible to have multiple S-50s communicate with specific RSEs. Multiple breadcrumbs are packed into a single DSRC packet (up to 1500 bytes). The S-50 stores a maximum of 100 breadcrumbs. The specific sequence of breadcrumbs stored is based on an algorithm specified by Transcore. Up to 5 DSRC packets of data may be required to transfer all stored breadcrumbs (5 DSRC packets for 100 breadcrumbs).

3.3.2 LED Behavior

The S-50 uses a dual color (red and green) LED to indicate functional status.

RED LED

After Power ON, the RED LED will be lit for roughly 10-12 seconds till the kernel boots. The RED LED is then turned OFF. After another 7-9 seconds, the RED is lit once for 200 ms indicating that the OBU is fully functional. If the RED LED is continuously lit for greater than 20 seconds, it is unlikely to be functioning correctly and a corrective action might be needed. Any

intermittent blink (200 ms) of the RED LED indicates receipt of a breadcrumb/message from the Transcore LMU-TC.

Note: The figure of 10-12 seconds and 7-9 seconds is for a rough estimate and is not meant to be used as an exact number. In reality, the actual time may vary by a couple of seconds. The table below for troubleshooting takes into consideration the outer boundary to provide a definite indication of behavior.

GREEN LED

After the OBU boots and is in a fully functional state, the Green LED is lit for 200 ms once every 5 seconds (also termed as heartbeat) to indicate that the system is functioning correctly. During an upload to the RSE the Green LED is blinked at a rate of 100 ms ON and 100 ms OFF for a period of 2 seconds. This action is used to visually indicate a successful upload of data from an OBE to an RSE.

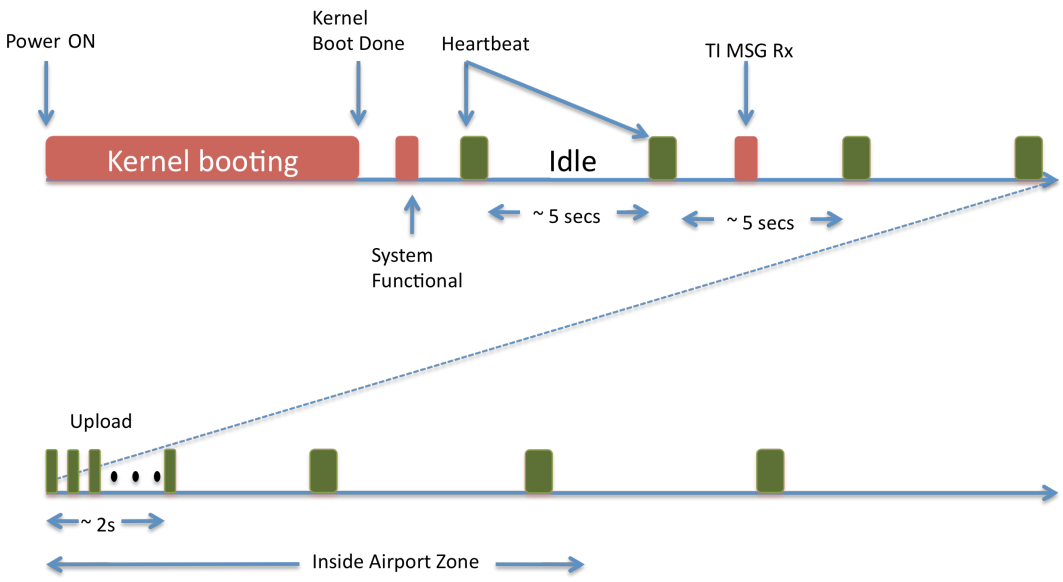


Figure 3 S50 LED Sequence

LED BEHAVIOR FOR TROUBLESHOOTING

The behavior of the LEDs is described below in a tabular form.

LED	Visual Behavior	Indication

RED	Continuously Lit for greater than 15 sec at anytime	Boot-up sequence / functionality failed. Retry after a power cycle.
RED	Continuously Lit for up to 10 sec	Power ON boot sequence in progress (during initial bootup).
RED	Single flash of 200ms	OBU ready (signifying successful boot-up) OR receipt of breadcrumb from LMU-TC (after successful boot-up)
GREEN	Single flash of 200ms every ~5 sec	Indication of OBU in an operative state and (only valid after boot-up sequence is complete)
GREEN	Continuous ON/OFF for 100ms each for 2 seconds	Indication of successful data upload to the RSE (only valid after boot-up sequence is complete)
GREEN & RED	Both continuously off for > 6 sec	Device not functioning correctly. Check power connectivity and retry

4 Hardware Components

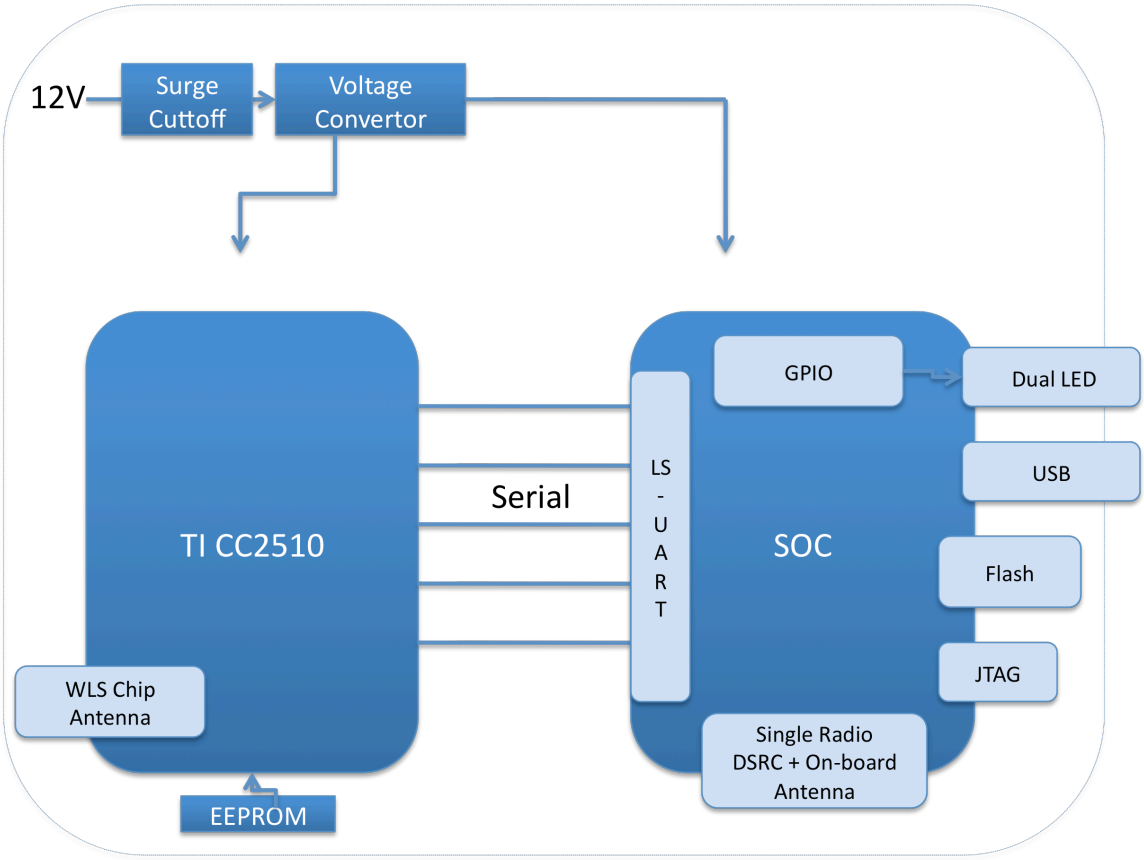


Figure 4 S-50 HW Block Diagram

4.1 Power

The S-50 is powered by the vehicle switched battery power (see Appendix A). Surge and low voltage cutoff is provided for within the OBE.

4.2 DSRC 5.9 GHz Radio

A single DSRC radio supports 802.11p in the hardware and uses an on-board antenna.

4.3 Wireless 2.4 GHz Radio

A single wireless 2.4 GHz radio provides the communication mechanism with the Transcore LMU-TC. It uses an on-board antenna.

4.4 Storage

The S-50 incorporates an on-board FLASH for storing the breadcrumbs as well as other log data. The log data is only required in case advanced troubleshooting is required.

Note: The S-50 supports tftp utility to make it easier for retrieving the log data to an external platform for off-board analysis.

4.5 LEDs

S-50 unit is installed with a dual LED on the enclosure to indicate power and device operation state.

4.6 Mini-USB (Ethernet)

S-50 consists of one Ethernet port (eth0) but accessed via the mini USB port.

4.7 FCC

FCC ID: OUP020300101, Please refer to FCC Part 95

5 S-50 Getting Started

This section describes the procedures to get the S-50 started after installation and power up.

5.1 Getting Started Using the CLI

This section describes the procedures to get the S-50 started using the CLI.

To Access using Telnet

telnet <Default/Configured IP Address>

The default IP address is 192.168.40.40

Password: As given in the ***Default Configuration (CLI)*** section.

5.1.1 Default Configuration (CLI)

The S-50 has the following default configuration:

Username: root

Password: 5up

Ethernet (eth0)

IPv4 Address: *192.168.40.40 (if using default)*

5.2 Visual Status Indicators

See “LED Behavior” (Sec 3.3.2) for more details.

6 Using the Command Line Interface (CLI)

This chapter describes the operations that you can perform using S-50 CLI commands. The S-50 comes pre-configured as described in the ***Default Configuration (CLI)*** section..

Caution: Only advanced users should use the instructions given below. Incorrect modification of the following parameters may make the S-50 inoperable or inaccessible.

Note: All configuration changes will only be applied once the device is power rebooted.

6.1 Network configuration

6.1.1 IP Address configuration

The IP address of the USB-Ethernet interface is factory set to 192.168.40.40. The IP address can be changed if needed by the following command

1. **#cfg –a USB2ETH_IPADDR=a.b.c.d**
2. **#cfg –c**
3. Power cycle the OBU

The change is not persistent across FW upgrades.

6.2 Changing the Password

The password for the ‘root’ user can be changed using the following command.

1. **#passwd root**
2. When prompted, provide the new password.

The change is not persistent across FW upgrades.

6.3 Transcore Application (TransApp)

The S-50 has been designed to be a plug and play device. It is recommended that the CLI be used for any required operations, administration, maintenance and provisioning by an advanced user only.

The S-50 TransApp application requires the '**obe_conf**' configuration file located at **/tmp/rw/obe_conf.**

Parameter	Value	Range	Description
ProviderServiceContext	tsf0		Some unique string. Provider service context. This string needs to match the PSC string on the RSE. Default: tsf0
logfilesize	5000	5 KB to 10 KB	Size of the log file on the OBE in Bytes. Default: 5 KB
maxretry	5	1 to 10	Maximum retry from OBE to RSE. Do not modify, this is a test only parameter
retry_mechanism	0	0 or 1	type of retry mechanism. Do not modify, this is a test only parameter

uplobelog	0	0 to 10	Upload number of records of the OBE log set by the RSE WSA message. 0 indicates that upload is disabled 0 < value < 11 indicates the number of records to upload.

The above parameter changes will take effect after a power cycle of the OBE.

7 Firmware Upgrade Procedure Using the CLI

The following is the procedure to upgrade the OBE firmware using the CLI:

1. Connect a local PC to the S-50 via Ethernet to mini-USB adaptor.
2. Assign the IP address to the PC to be in the same subnet of the S-50, preferably 192.168.40.1.
3. Download the image to be upgraded from the Savari FTP site to the PC.
4. Copy the image to the tftp server directory of the PC. Image should be names as “Timage.tgz”. Ensure that the tftp server is running on the PC.
5. Login to the OBE using telnet and issue the following commands
6. **#cfg –a TFTP_SERVER=192.168.40.1**
7. **#cfg –c**
8. **#/etc/upgrade.sh**
9. Power cycle the OBU when the upgrade process has completed (an “**upgrade done**” message is displayed).

8 CLI Commands

The S-50 OS is based on the Linux Operating System (OS). All well-known Linux commands are supported.

The following are the key commands and their descriptions:

Command	Description
reboot	This command reboots the device.
passwd ***#passwd root***	This command allows the user to change the password. Executing the command will
ifconfig	To view and modify the interface status (UP/DOWN) and IP address configuration without changing the persistent configuration.

9 Appendix A: S-50 Power Installation

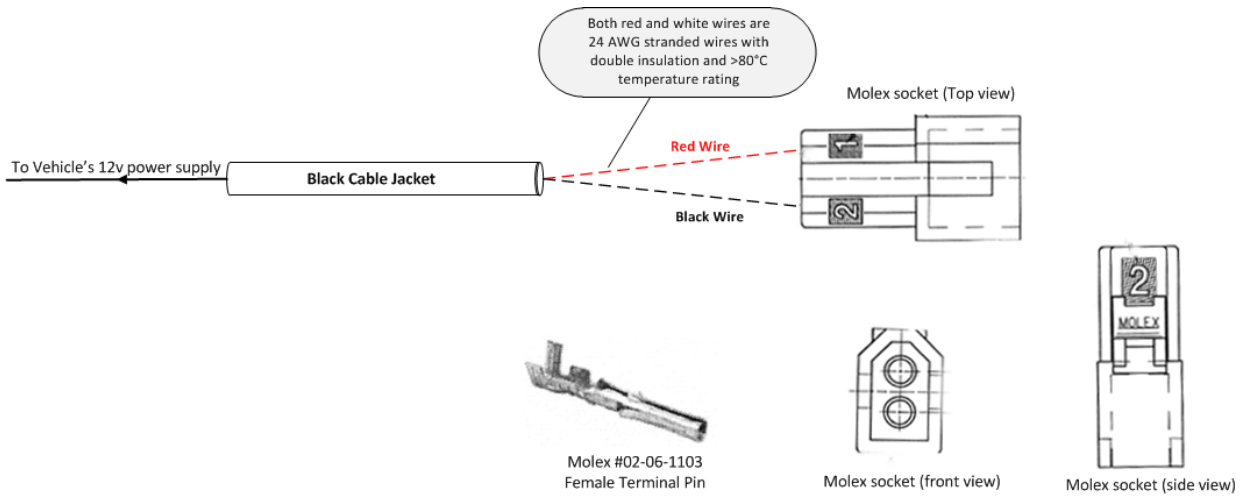
This chapter contains diagrams depicting the In-vehicle and OBU cables that are a part of the Transcore OBU setup. The OBU will ship with a two-conductor, one-foot length cable terminated by a Molex connector (details below).

9.1 Transcore OBU Cable Diagrams

9.1.1 In-vehicle (Taxi) Cable

The installer is expected to use the required length of cable with a mating Female Molex socket using the wiring diagram given in this section.

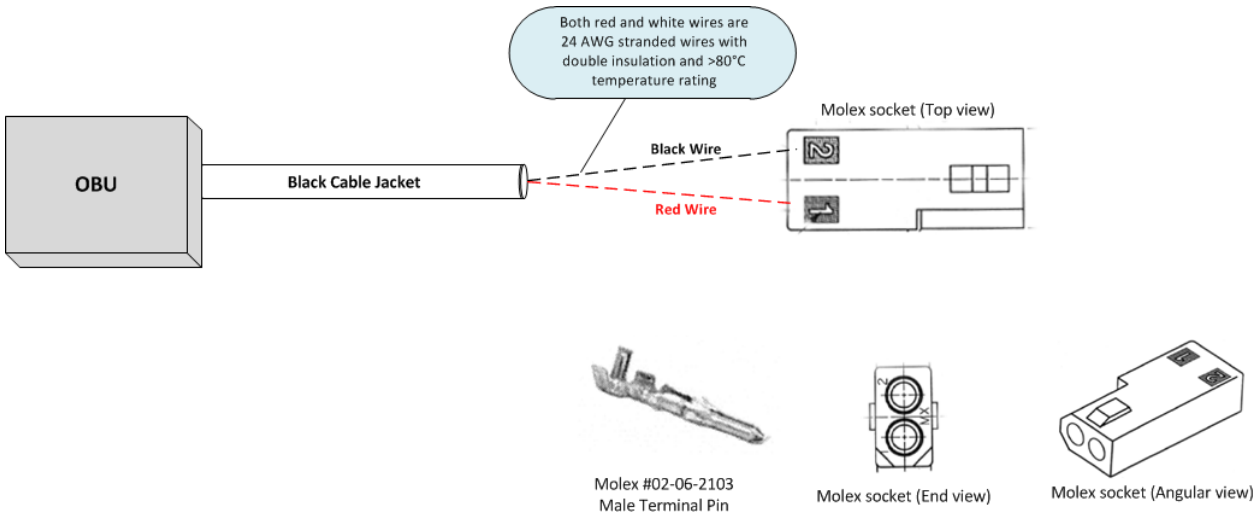
The In-vehicle Cable diagram below shows how one end of the black cable jacket is connected to a Molex socket #03-06-2023 using red and black wires (crimped with crimp pins Molex # 02-06-1103, 2 per socket). The other end of the cable is connected to the 12V power supply of the vehicle, with red connected to the +12 V and black connected to Gnd (0v). It also shows front and side views of the Molex socket used and a Molex #02-06-1103 female terminal pin.



In-vehicle Cable Diagram

9.2 OBU Cable

The OBU Cable diagram below shows how the OBU is connected to the Male Molex connector using red and black wires, with red connected to +12v and black connected to Gnd (0v). It also shows angular and end views of the Molex connector used and a Molex #02-06-2103 male terminal pin. Note that the part number of the Molex socket used is '03-06-1023'. The socket must be crimped with crimp pins Molex # 02-06-2103 (2 per socket).



OBU Cable Diagram

Note: For information on how to strip and connect the wires, refer to the "*Molex Application Tooling Specification Sheet* (Order No. 63819-1300)".

FCC

IMPORTANT NOTE: FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination. The firmware setting is not accessible by the end user.

Wireless 5 GHz Band Statements:
This module could only been operated at 5850-5925 MHz frequency band.