
LMU-3x40

CalAmp LMU-3x40 Training Guide



CALIFORNIA PROPOSITION 65



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1. Scope

This document provides an overview of CalAmp's Telematics EdgeCore platform, referred as EdgeCore hereafter, the associated products, its highlights and major features. It also serves as a training manual on 'how-to' get started with an EdgeCore device (e.g. LMU-3040). Lastly, this document serves to describe the major differences between EdgeCore and the LMU32 predecessor platforms.

1.1 Platform Introduction

CalAmp's next-generation EdgeCore platform features a new embedded architecture and revamped hardware featuring significant advanced capability, reliability, and security. EdgeCore is agnostic to operating system (OS) and Hardware underneath. This section highlights the major features and benefits of the new platform.

1.2 Highlights and Features

- A new embedded architecture & framework designed to be adapted on new technologies, hardware chipsets, and operating systems
- 3rd party custom application capability in a Linux API rich environment ("EdgeApp")
- Advanced & robust security capability (TLS security built on CalAmp's IOT PKI)
- Enhanced OBD capability that allows for future support of:
 - Simultaneous Protocol Support
 - Light & Heavy Duty Support
 - Complete migration to VE Cloud service (i.e. no more OBD DB file)
- Support of Next-Generation PEG2 scripting environment
- Power Management down to sub-milliamp levels during sleep
- Wi-Fi Hotspot capability if the HW supports it. LMU-3240 is a WiFi Cat 4 OBD dongle.
- BLE Asset Tag scanner and aggregator
- 3 axis - Accelerometer (MEMS) and 3 axis Gyroscope
- Extensive RAM/Flash memory space to avoid code space constraints.
- Delta file upgrade capability

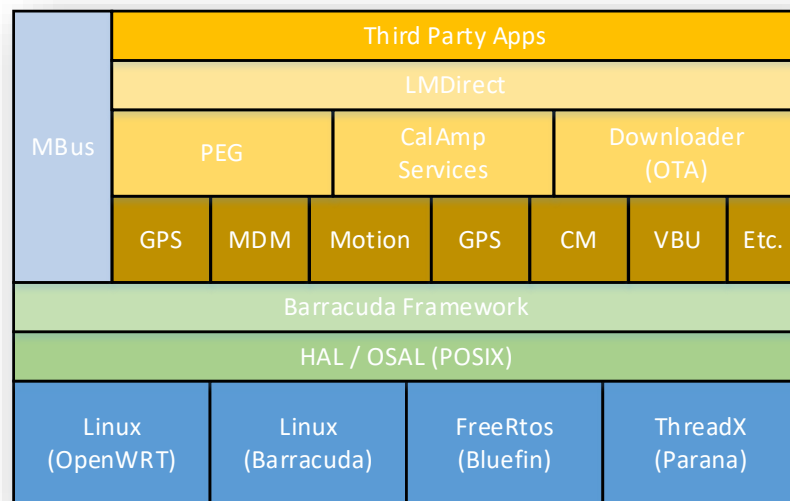
1.3 Embedded Software Architecture

The new software architecture deployed on the EdgeCore platform moves the CalAmp LMU application functionality into a multi-threaded/multi-tasking environment. While the initial deployment for this architecture is in a Linux environment, the architecture is specifically designed to be portable across many other multi-tasking environments.

The fundamental goal of this architecture is to not only achieve a powerful and extensible software platform, but also a platform that easily supports for scalability across other hardware designs in order to meet different market segments. This is achieved by re-using common code built on a common framework that can be ported onto different operating systems and hardware chipsets by leveraging the use of abstraction layers.

The design and architecture of this software platform achieve the intended benefits by following these principles:

1. Modularity and compactness of system. One module envelops one concept and/or task.
2. Commonality across modules to allow more efficient methods to understand code across different platforms and developers.
3. Adaptability to allow for easier changes within the product or platform, with the goal that one module is applicable to other modules.
4. Portability that allows for streamlined ports of application code base on different operating systems and hardware chipsets using both OS and Hardware abstraction layers.

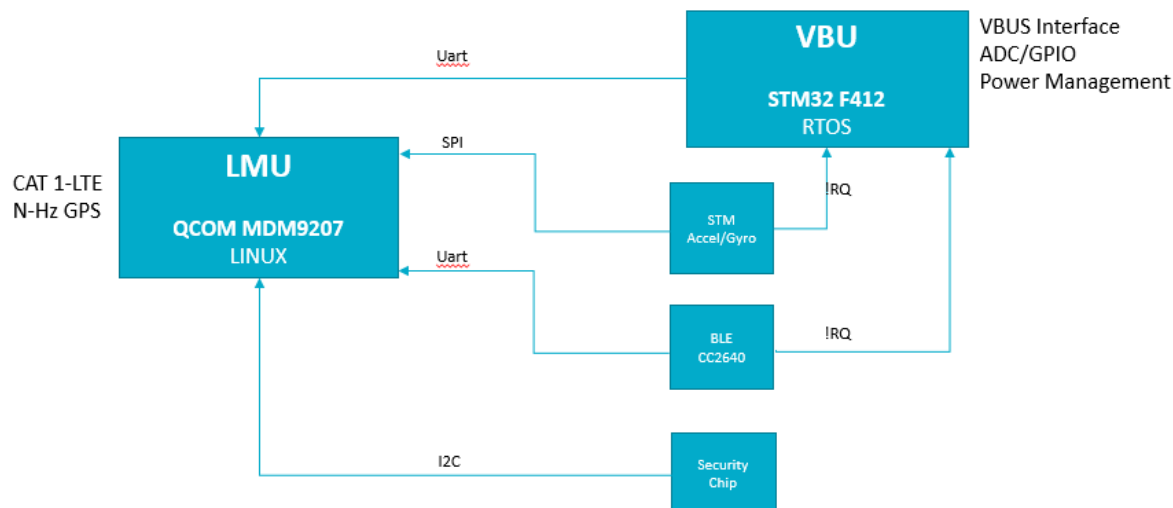


1.4 3040 & 3240 Hardware Platform

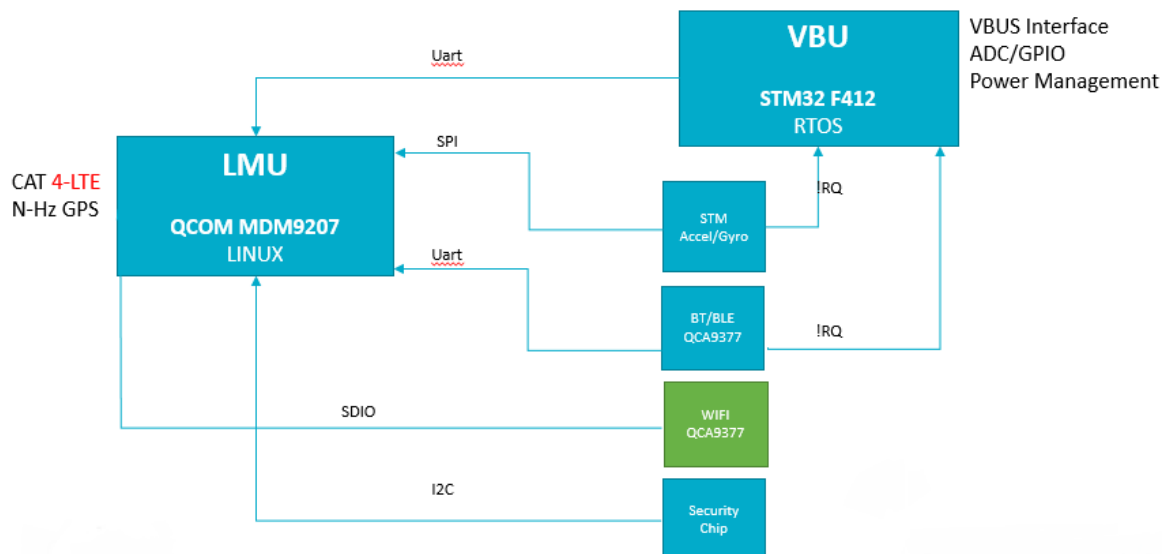
LMU-3040 and LMU-3240 are the first EdgeCore platform devices. They are very similar in form, fit, and function, with the following differences:

Feature	LMU-3040	LMU-3240
LTE Speed	CAT-1	CAT-4
Wi-Fi Capable?	No	Yes
BLE Capable?	Yes	Yes
BT Classic Capable?	No	Yes
Hardware		
Modem/GPS Chip	QCOM MDM9207	QCOM MDM9207
BLE	CC2640	-
BT/BLE/Wi-Fi	-	QCA9377
VBU	STM32F412	STM32F412
Mems/Gyro	LSM6DSL	LSM6DSL
Security Chip (opt)	STSafe-A100	STSafe-A100

1.4.1 LMU-3040 Hardware Architecture:



1.4.2 LMU-3240 Hardware Architecture:



2. LMU-3040 Hardware Specifications

Cellular/Network

North American Variant I (ATT):

LTE Cat 1: 1900 (B2)/AWS 1700 (B4)/850 (B5)/700 (B12) MHz

HSPA/UMTS+: 850 (V)/1900 (II) MHz

North American Variant II (VZW):

LTE Cat 1: AWS 1700 (B4)/700 (B13) MHz

LMU3240LAW

North America Variant I (ATT):

LTE Cat 4: 1900 (B2)/AWS 1700 (B4)/850 (B5)/700 (B12) MHz

HSPA/UMTS+: 850 (V)/1900 (II) MHz

Data Support

SMS, UDP Packet Data, TCP, TLS, CalAmp Telematics Cloud API

Satellite Location (GNSS)

Constellation Support: Hybrid GPS, GLONASS, SBAS Engine (WAAS, EGNOS, MSAS)

Channels: 55

Tracking Sensitivity: -167 dBm

Acquisition Sensitivity: -157 dBm (hot start) -148 dBm (cold start)

Location Accuracy: ~2.0m CEP Open Sky (GPS SBAS 24 hours static)

Location Update Rate: Up to 5 Hz

AGPS Location assistance capable

Comprehensive I/O

OBD-II Interface: J1850 PWM, J1850 VPW, ISO-9141-2, ISO-14230 KWP 2000,

ISO-15765 CAN, SW-CAN

Serial Port: USB serial interface

Bluetooth: Bluetooth Low Energy (BLE)

Status LEDs: Programmable dual color (OBD, cellular, GPS)

Buzzer: Integrated buzzer for audible alert applications

Sensors: Gyroscope: Triple-axis, tilt, yaw, roll detection

Accelerometer: Triple-axis, impact, motion sense

Certifications:

Industry Certifications: FCC, IC, PTCRB, Applicable Carriers

Device Management

PULS™: Monitor, manage, upgrade firmware, configure and troubleshoot devices remotely

Embedded Intelligence Engine

PEGII™: Update device functionality or develop new on the edge applications

Geo-Fences: 32 built-in

Buffered Messages: 20,000

Electrical

Operating Voltage: 12-24 VDC Vehicle Systems

9-30 VDC (start-up, operating)

7-32 VDC (momentary)

Power Consumption: Typical 500 uA @ 12V (deep sleep)

Typical 2 mA @ 12V (sleep on active network)

Typical 70 mA @ 12V (active tracking with GPS and cell enabled)

Battery

Battery Capacity: 180 mAH

Battery Technology: Lithium-Ion

Charging Temperature: 0° to +45° C

Certifications: IEEE 1725-2011, UL 1624, UN 38.3

Environmental:

Temperature: -30° to +60° C (connected to primary power)

-10° to +60° C (operating on internal battery)

-20° to +25° C ≤ 6 months (long term storage)

Humidity: 95% RH @ 50° C non-condensing

Shock and Vibration: U.S. Military Standards 202G, 810F SAEJ1455

ESD: IEC 61000-4-2 (4KV Test)

Physical/Design

Dimensions: 1.88 x 2.50 x 1.14" (48 x 63.25 x 29 mm)

Weight: 2.54 oz. (72 g)

Connectors/SIM Access

GPS Antenna Internal

Cellular Antenna Internal

SIM Access Internal (4FF SIM)

BLE Antenna Internal

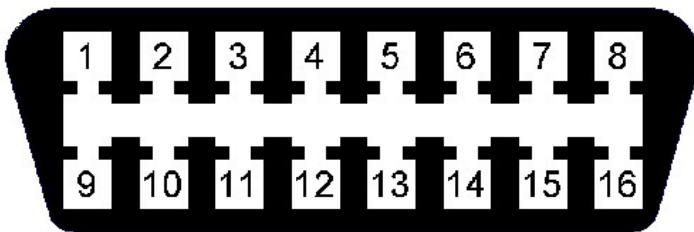
3. LMU-3040™ Connectors

3.1 Primary Connector

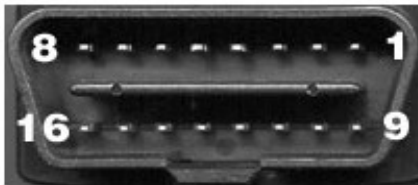
The LMU-3040 equips a 16-Pin J1962 Compliant OBD-II Plug that also supports the following OBD-II physical layer interfaces:

1. ISO 15765 CAN
2. ISO 9141-2 K-Line
3. ISO 14230 KWP2000]
4. J1850 PWM
5. J1850 VPW

Connector on Vehicle side



Connector on LMU-3040 side



Pin	Signal Name	Description
1	Make/Model Specific	Vendor Option

2	Bus+ Line	SAE-J1850 PWM and SAE-1850 VPW
3	Make/Model Specific	Vendor Option
4	Chassis Ground	Ground
5	Signal Ground	Ground
6	Can High	ISO 15765-4 and SAE-J2284
7	K line	ISO 9141-2 and ISO 14230-4
8	Make/Model Specific	Vendor Option
10	Bus- Line	SAE-J1850 PWM and SAE-1850 VPW
11	Make/Model Specific	Vendor Option
14	Can Low	ISO 15765-4 and SAE-J2284
15	L line	ISO 9141-2 and ISO 14230-4
16	Battery Power	Power

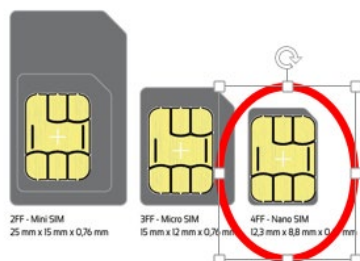
4. Getting Started

With any new platform, there are some changes in the form, fit, and function when compared to the predecessor product line. This section highlights pertinent changes compared to the LMU32 platform to help users get started with an EdgeCore device:

4.1 The Basics

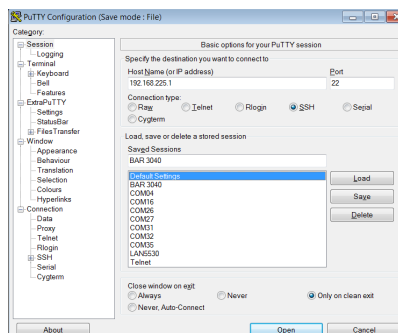
4.1.1 SIM Card

The LMU-3x40 product line is the first LMU to use a 4FF (nano) SIM card, as opposed to the common 2FF (mini) SIM card that is required for other LMUs.



4.1.2 SSH Client

LMU-3x40 has a micro USB port in place of a RS-232/TTL UART serial interface. To physically access the device through the USB connector, the device utilizes a Secure Shell protocol or “SSH”. A SSH client (e.g. Putty) is required to login and access the device.



4.1.3 USB Cable

LMU-3x40 does not require a serial adapter cable, but rather a stand-alone USB cable. The required cable type is a MICRO USB B cable (male). Example: *StarTech P/N: UUSBHAUB3*



4.1.4 File Transfer

LMU-3x40 requires Secure Copy Protocol (SCP) to transfer files from a laptop or PC onto the device. A common SCP tool to perform this task with Windows is the WIN SCP. SCP only allows for transfer of a file. Programming or flashing of a certain file type is a different step as explained in Section [4.8](#).



4.2 SSH Credentials

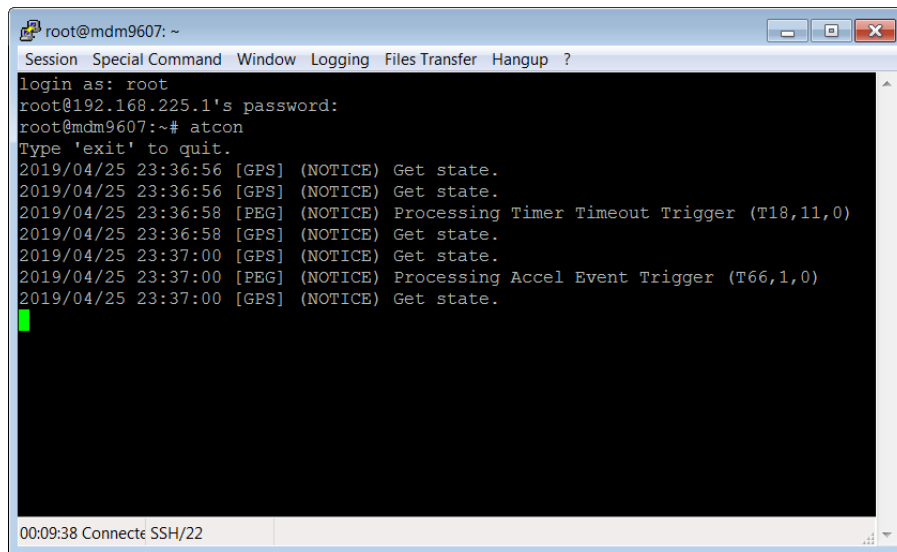
A set of default credentials is required for access to the device. If your application requires root access or if you would like to change the default settings of the credentials, please contact Calamp Support.

- Host IP: 192.168.225.1
- Port: 22
- User: calamp
- Password: <*Please contact Calamp Support*>

4.3 Interactive “AT Console”

With the Linux operating system on the EdgeCore platforms, you are no longer in a traditional AT command environment as with the LMU32 architecture. Rather, you are using a Linux Console with access to the file system as with other traditional operating systems. A Linux script, ATCON, has been developed to emulate the traditional LMU device interface in terms of LMU logs and AT interaction.

Within the Linux Console, enter: **‘ATCON’**. This brings you to the AT Interactive console. The script emulates the AT command parser. You will see debug information like below:



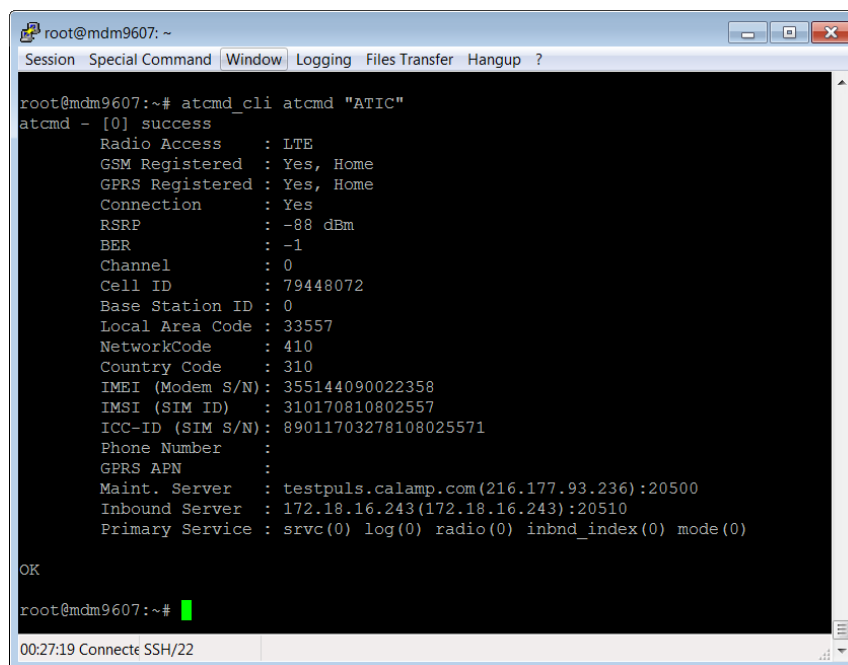
```
root@mdm9607: ~
Session Special Command Window Logging Files Transfer Hangup ?
login as: root
root@192.168.225.1's password:
root@mdm9607:~# atcon
Type 'exit' to quit.
2019/04/25 23:36:56 [GPS] (NOTICE) Get state.
2019/04/25 23:36:56 [GPS] (NOTICE) Get state.
2019/04/25 23:36:58 [PEG] (NOTICE) Processing Timer Timeout Trigger (T18,11,0)
2019/04/25 23:36:58 [GPS] (NOTICE) Get state.
2019/04/25 23:37:00 [GPS] (NOTICE) Get state.
2019/04/25 23:37:00 [PEG] (NOTICE) Processing Accel Event Trigger (T66,1,0)
2019/04/25 23:37:00 [GPS] (NOTICE) Get state.
```

4.4 Command Line Interface (CLI)

From the Linux Console you can send 'AT' commands to retrieve traditional LMU Application responses. The format of this command is the following:

- `atcmd_cli atcmd "AT command"`
- Quotes are required

Below is an example of how to send 'ATIC' directly from Linux:



```
root@mdm9607: ~
Session Special Command Window Logging Files Transfer Hangup ?
root@mdm9607:~# atcmd_cli atcmd "ATIC"
atcmd - [0] success
Radio Access      : LTE
GSM Registered    : Yes, Home
GPRS Registered   : Yes, Home
Connection        : Yes
RSRP              : -88 dBm
BER               : -1
Channel           : 0
Cell ID           : 79448072
Base Station ID   : 0
Local Area Code   : 33557
NetworkCode       : 410
Country Code      : 310
IMEI (Modem S/N)  : 355144090022358
IMSI (SIM ID)     : 310170810802557
ICC-ID (SIM S/N)  : 89011703278108025571
Phone Number      :
GPRS APN          :
Maint. Server     : testpuls.calamp.com(216.177.93.236):20500
Inbound Server    : 172.18.16.243(172.18.16.243):20510
Primary Service   : srvc(0) log(0) radio(0) inbnd_index(0) mode(0)

OK
root@mdm9607:~#
```

4.5 Log File

Engineering and LMU logs can be found in the Linux file system. You can find the most recent log file in a specific `/var/log/` directory, in a file named **messages**

If you would like to view new information that is written to this log file, Linux offers a way to do this through the command line.

- Enter: **tail -F /var/log/messages**

This command will open the messages file and display the latest written lines of the file. It will continue to display the most updated lines you quit.

Helpful Tip: Linux allows the option to create multiple instances of SSH windows so you can have one SSH session viewing a log while the other is being used to send AT commands. Other Linux options such as parsing specific debug using a grep command can also be utilized. For example, the command: **tail -F /var/log/messages | grep VBU** will display lines in the log that have VBU in the string.

Important Note: The log file stored in 'messages' gets overwritten on every device wake-up.

4.6 Backup Logs

There is a method to store a current log file into a backup directory. This can be programmed in the PEG Script by using **PEG Action 144**.

- PEG Action 144 modifier 1 will save the current log into the `/data/backup/` folder
- PEG Action 144 modifier 2 will save the current log and also send it to the set remote debug server defined in param 2328.

Important Note: Only one backup file can be stored at a time

4.7 File Components

Devices have several components on the EdgeCore platform that are provisioned at the factory. These components are described below:

File	Description	~Size
LMU Delta Image	This image includes Modem and GPS software in addition to Application software. On the LMU-3240, this file also packages Bluetooth and Wi-Fi images.	12-18Mb
VBU Firmware	Also known as "OBD firmware" which contains the software that handles vehicle bus protocol and message handling	500Kb
PEG2 Script	This file controls and defines all the business logic and configuration settings on the device. PEG2 script file sizes will vary from application to application	50-150Kb (avg)
BLE Image	The BLE image for the LMU-3040 is separate from the LMU delta image.	150Kb

All file sizes are subject to change.

Important Note: Data plans may be impacted due to the larger size of FW delta files.

4.8 Software & Script Updates

All of these files can be updated Over-The-Air if subscribed to Calamp's Device Management Service (PULS).

These files can also be updated with physical access to the device as well. Below are the steps and options below:

1. Transfer Firmware/Script (e.g. WINScp, ADB Push) to **/data/configs/files** directory. See section [4.1.4](#).
2. Option 1: Using Linux CLI Commands (Device Type, File Type)

First, change directory to /data/configs/files directory.

Enter command: **cd /data/configs/files/**

- a) PEG2: **dnld_cli prog_file 0 22 <PEG2 File>.pg2**
 - b) LMU: **dnld_cli prog_file 0 0 >LMU Binary>.bin**
 - c) VBU: **dnld_cli prog_file 25 0 <VBU Binary File>.bin**
 - d) BLE (3040 only): **dnld_cli prog_file 26 0 <BLE Binary File>.bin**
3. Option 2: Using AT Console: Change the file name to update to "ota_file.bin"
- a) PEG2: **at\$app fprog 0 22**
 - b) LMU: **at\$app fprog 0 0**
 - c) VBU: **at\$app fprog 25 0**
 - d) BLE (3040 only): **at\$app fprog 26 0**

5. PEG2

PEG2 is the next-generation scripting environment with enhancements that allow you to build more efficient scripts with easier maintenance and unrestricted feature growth. These benefits are made possible by features such as:

- Multiple Triggers, Conditions and Actions per line
- Expanded modifier fields
- Complex boolean Condition logic
- Labels for Jumps and Calls (i.e. PEG line indexing will not change no matter where a line is added)

- In-line comments

5.2 PEG2 File

In next generation devices supporting PEG2, the file containing the PEG script and the configurations parameters has an updated format. The new file has the following characteristics:

- Format
 - Header - Time/Date, Signature, ID
 - Configuration Parameters - same format as existing Config Param file (File Type 1)
 - PEG2 Script - ASCII Text Lines delimited with <CR><LF>
 - End-Of-File marker
 - CRC - Usual 2-byte CRC is appended to the file by PULS or file generation tool
- Configuration Parameter section (if present) is merged with configuration parameters on target device
- Script section (if present) overwrites script on target device.
- New File Type: 22
- File Extension: 'PG2'

The sections [5.1.1](#) through [5.1.4](#) below describe the content of each file section. Tags are used to identify the start of each section.

5.2.1 Header

TAG Definition	Example
!TD: UTC Date and Time the file was generated or uploaded to the maintenance server (PULS)	!TD:10:47:38 12-27-2018
!SIG: File Signature is a MD-5 Hash generated from the file contents (anything after the signature). This is generated by LMU Manager and PULS during upload.	!SIG:2a944f7d34857d99e4b39ce50069dcf0
!ID: User defined identification field. Up to 60 characters allowed. This field is displayed on PULS.	!ID:v10.41_12_27_18_FAEPilot3040TestScript

5.2.2 Configuration Parameters

TAG Definition	Example
!CP: Following this tag, this is where all the Config Parameters start until the PEG2 script section starts or the EOF is detected. Important Notes: - Config Parameters use the same format as in a PEG1 file - Config Parameters are still a union of the file contents and what already resides on the target device	!CP: 256,0,00 256,1,01 256,2,00 256,3,00 257,0,15D4 259,3,00 260,0,00 260,1,00

5.2.3 Script Section

TAG Definition	Example
!SCR: Script Section starts here. This section must immediately follow the Configuration Parameter (!CP) section. - PEG Lines are no longer parameterized. !SCR will overwrite the entire PEG2 script on the device (no longer a union of PEG lines) - You can delete the PEG2 script on the target device by including the !SCR tag without any lines following. - The generic line number references can be replaced with custom names or named sub-routines	!SCR: L512000;T1,0;A51,512225 L512001;T2,0;A51,512225 L512002;T3,0;C39,7;A51,512185 L512003;T5,2;A51,512185 L512004;T11,0;C17,15;A31,15 L512005;T18,5;C17,15;A31,15 L512006;T48,0;C16,15;^C17,16;A31,16 L512007;T5,2;C8,0;^C16,16;A32,16 L512008;T12,0;A124,28 L512009;T12,0;A125,29 LCustomLabel;T5,2;!C44,0;A51,512195

5.2.4 End of File (EOF) and CRC

TAG Definition	Example
!EOF: End-of-file marker (this tag) must be included !CRC: Following EOF marker, a 2-byte binary CRC value must be appended to validate integrity of file during transit. This is needed for OTA and Serial transfers Important Note: If !SIG or !CRC is incorrect, PULS will re-calculate upon upload. However, this means while the file has been corrected for OTA, your original file will not be valid or usable for serial updates until fixed.	... L514014;T18,35;A112,0,0 L514015;T15,0;A112,0,0 L514250;T0,0;A0,0 !EOF: %P

5.3 PEG2 TAG Definitions

Definitions of the PEG2 Tag Characters with examples are listed below:

Tag Char	Name	Description	Example
L	Label	Defines a unique label to be used as a “virtual line”. Used as reference for Jump & Call PEG Actions	L514013
T	Trigger	Define one or more Triggers on the same line. T<TrigCode>,<Mod0>,T<TrigCode>,<Mod0>	T18,0;T17;A8,4
C	Condition	Define one or more Conditions on the same line. C<CondCode>,<Mod0>, C<CondCode>,<Mod0>	T13;C16,11;^C16,10;!+!C16,12;A1,24
A	Action	Defines one or more PEG Actions. Actions executed in order of appearance. A<ActionCode>,<Mod0>,A<ActionCode>,<Mod0>	T13;C16,11;^C16,10;!+!C16,12;A1,24

:	Comment	The comment tag ':' is immediately followed by free text and is only terminated by the end-of-line delimiter (<CR>)	T18,0;T17;A8,4;:This is a comment
+	OR	Boolean operator that combines result with next Condition results using 'OR' operation	
^	AND	Boolean operator that combines result with next Condition results using 'AND' operation	
!	NOT	Boolean operator that inverts results of following Condition or previous Boolean state depending on placement.	

5.4 Multiple Modifiers

PEG2 offers the ability to use multiple modifiers for specific Triggers, Conditions or Actions. This makes it easier to use some existing PEG actions where there was a need to bit mask one modifier, or use two PEG actions to satisfy one function (like copy accumulator). See below for a few examples of how multiple modifiers can be utilized in a PEG2 script.

Trigger/Cond/Action	Definition	Modifier 0	Modifier 1
Update End Trigger (Code 61)	An update has completed. PEG1 single modifier mapping: Bits 0-3=File Type, bits 4-7 = Device Type	Device Type	File Type
Zone State Condition (Code 40)	True when current location is inside (0) or outside (1) the Zone identified by Zone# and the Zone is enabled. PEG1 single modifier mapping: Inside (bit7 of is 0), Outside (bit7 is 1), Zone Identifier (bits 0-6).	Current Location (inside/outside Zone)	Zone#
Copy Accumulator Action (103)	Copies value in Accum Source into Accum Destination	Source Accum	Destination Accum

	PEG1 single modifier mapping: Upper 4 bits = Source, Lower 4 bits = Destination		
--	---	--	--

Example: "I want to copy Accumulator 10 into Accumulator 22 every second"

PEG1	PEG2 Example
Not possible using PEG Action 103 (Copy Accum). Limited to 4 bits (accum 0-15)	Possible with this PEG2 line: T18,5;A103,10,22
Using PEG Action 124 (Select Dest.) & 125 (Copy to Dest.): 120500007C160000 120500007D0A0000	Possible with one PEG2 line: T18,5;A103,10,22

5.5 PEG1 -> PEG2 Conversion

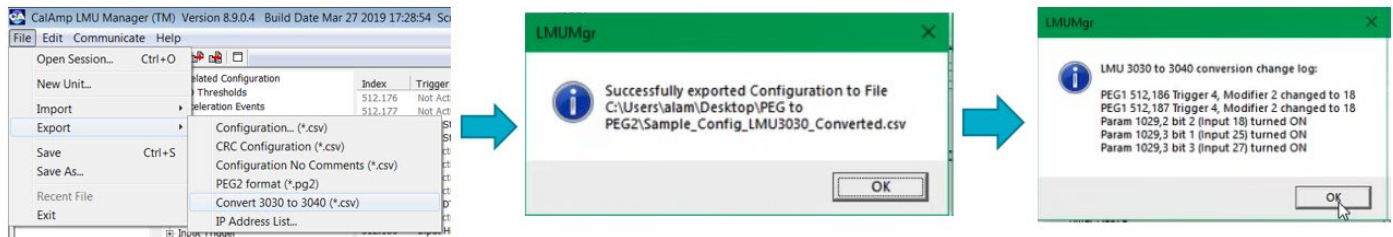
The latest version of LMU Manager offers a PEG1-PEG2 conversion export feature so that an existing LMU-3030 PEG1 script can be easily converted into a PEG2 script to avoid the need of re-writing an existing script.

Note: A PEG1->PEG2 conversation does not optimize how PEG resources would be used if the script were to be written natively in PEG2. For example, the ability to have a complex set of conditions on one PEG2 line is not able to be leveraged unless done manually by the script writer. As a result, no PEG lines are being saved during the conversion.

Converting from PEG1 to PEG2, it is a two-step process.

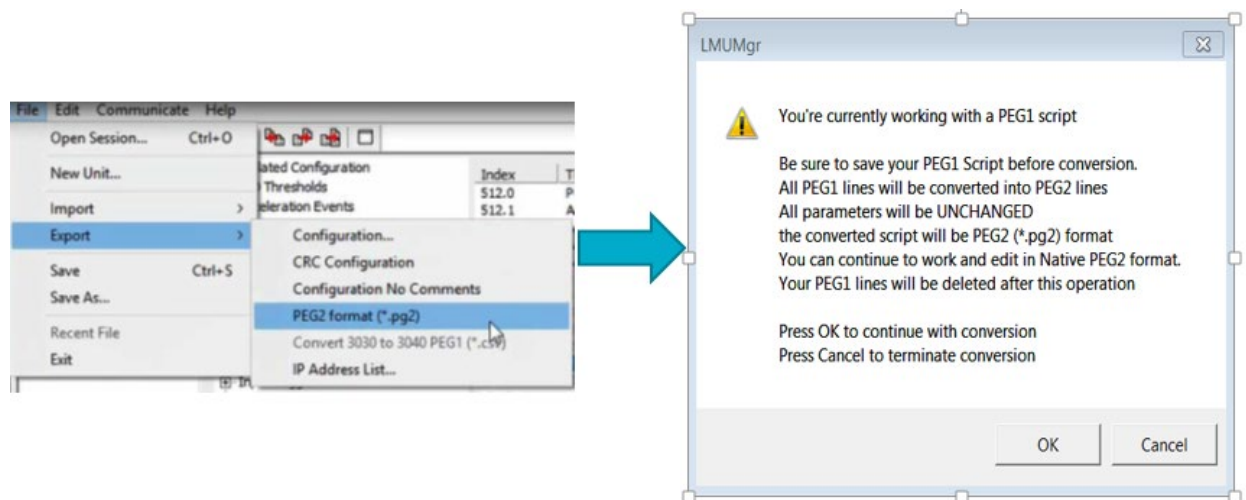
Step1: Convert LMU-3030 PEG1 script file to an LMU-3x40 PEG1 script file:

- Open Session with App ID that supports PEG2 (e.g. 1001, 1002, 1011, 1012)
- Load 3030 PEG1 Script to Convert
- Select "Export" -> "Convert 3030 to 3x40 (*.csv)" selection
- Press OK on dialog boxes and Save File as CSV



Step2: Convert an LMU-3x40 PEG1 script file into an LMU-3x40 PEG2 script file

- Load 3x40 PEG1 script to convert (from Step 1)
- Select “Export” -> “PEG2 format (*.pg2)” selection
- Press OK and Save File



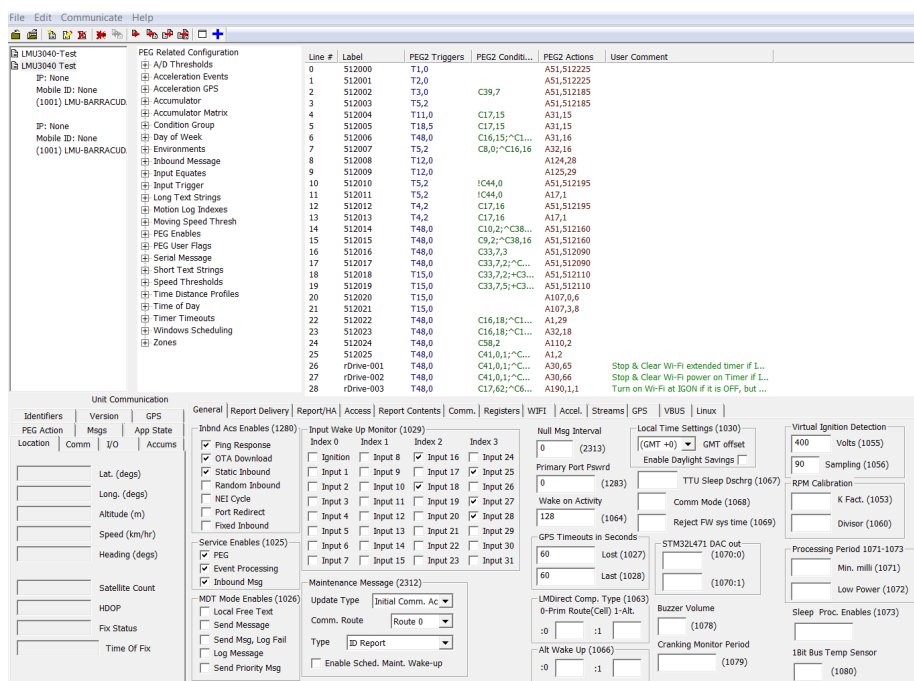
Note: A more detailed step-by-step PEG1->PEG2 conversion user guide can be made available

5.6 PEG2 Native Editor

The latest LMU Manager also offers a way to create or edit PEG2 files natively, without requiring a PEG1 to PEG2 conversion. High level features are introduced below:

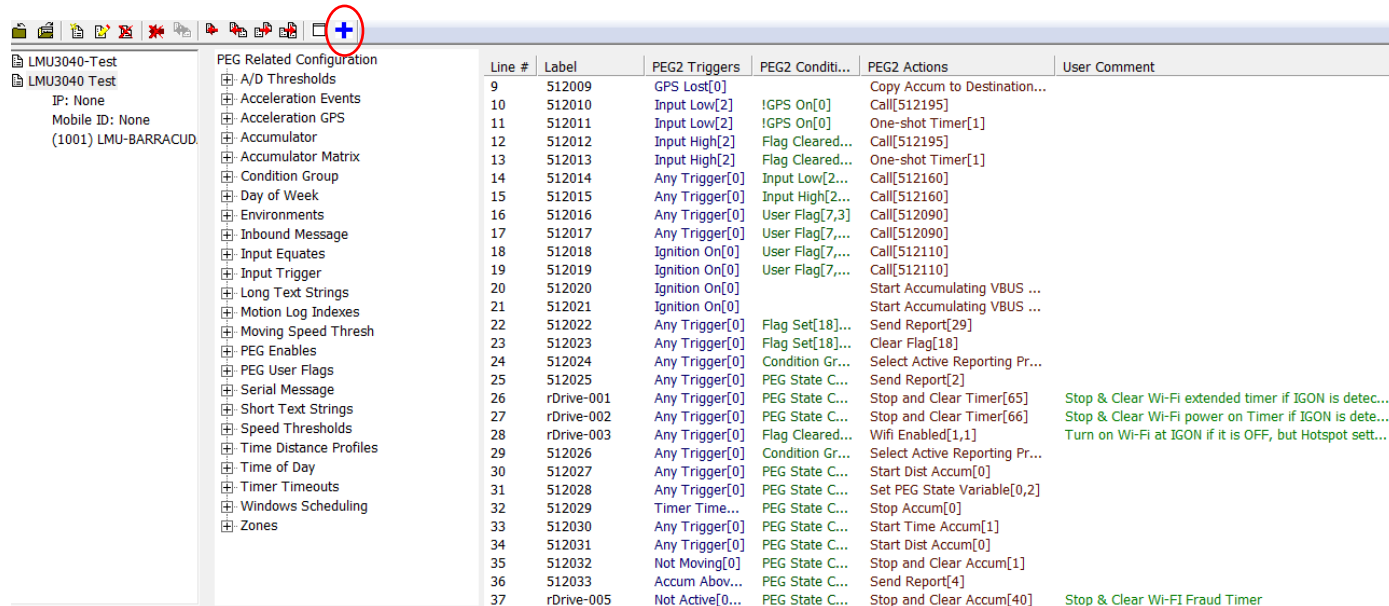
5.6.1 Load PEG2 file:

In LMU Manager, go to **FILE -> IMPORT -> PEG2 (.pg2)** or start from a blank script with any App ID that supports PEG2 (e.g. 1001, 1002, 1011, 1012):



5.6.2 PEG2 Readable Text

To switch from PEG2 ASCII to readable text, you can toggle the **blue cross bar** icon on top left.



5.6.3 Single Line Editor

Double click on any line to open the Single Line Editor screen to add, edit, delete or insert a PEG2

6. LMU32 vs EdgeCore Platform Differences

6.1 I/O Mapping & Wake-Up Sources

Inputs 0-4 and Input 14 are mapped the same on the LMU-3040 as they are on the LMU-3030.

However, on the LMU-3x40 platform, these same enumerated inputs are NOT used as wake-up sources.

Monitoring the status of these inputs within a PEG Script is the same as on the LMU-3040, however, to set these inputs **as a wake-up source** requires setting a different input in param 1029. This also means that the settings for Input 0-4 or Input 14 on a LMU-3040 will have no effect on the device.

For example, in order to wake-up on Power State on the LMU-3x40, you will need to set Input 18 via Param 1029 (i.e. Param 1029, Index 2, Bit 2) in the PEG Config. Below, in bold, are the possible wake-up sources for the LMU-3x40 that can be set or cleared in Param 1029.

I/O	LMU-3030	LMU-3040	LMU-3240
Input-0	Ignition	Ignition	Ignition
Input-1	Motion Wake	Motion	Motion
Input-2	Pwr State Wake	Pwr State	Pwr State
Input-3	Vbatt Low Wake	Vbatt Low	Vbatt Low
Input-4	Batt Virt Ign	Batt Virt Ign	Batt Virt Ign
Input-5			
Input-6			
Input-5			
Input-6			
Input-7			

Input-8			
Input-9			
Input-10			
Input-11			
Input-12			
Input-13			
Input-14	Pure Virt Ign	Pure Virt Ign	Pure Virt Ign
Input-15			
Input-16	N/A	Motion Wake	Motion Wake
Input-17			
Input-18	N/A	Power State Wake	Power State Wake
Input-19			
Input-20			
Input-21			
Input-22			
Input-23	N/A	Radio Active Wake	Radio Active Wake
Input-24	N/A	BLE Wake	BLE Wake
Input-25	N/A	VBUS Wake	VBUS Wake
Input-26			
Input-27	N/A	Crank Detect Wake	Crank Detect Wake
Input-28	N/A	RTC Wake	RTC Wake

6.1.1 3-Axis Accelerometer + 3-Axis Gyroscope

The LMU-3040™ supports an internal 3 Axis Precision Accelerometer as one of its discreet inputs. When the LMU is moved in any direction, the associated input will be in the High state. If the LMU's accelerometer does not detect motion, then the input will be in the Low state. No external connections are required for this functionality to be operational.

Accelerometer

Acquisition rate: >1600Hz
 Sampling rate - output data rate: 100, 200, 400 Hz
 Resolution: <= 0.01G
 Full Scale: 15-24G

Gyroscope

Acquisition rate: >1600Hz
 Sampling rate - output data rate: 100, 200, 400 Hz
 Resolution: <= 0.01G
 Full Scale: 15-24G

6.2 LMU Firmware Updates (Delta Files)

The LMU firmware on an LMU-3040 or LMU-3240 is a Linux based image that utilizes the concept of "Delta Images" while managing firmware updates.

A Delta Image is defined as an update file for a device that contains only that code that has changed from one specific (known) version already deployed on the device to the new target version. Thus, a delta image is unique, based off: the current firmware on the device AND the desired target firmware.

For example: if a fleet of 100 units is on 3 different firmware versions (v1.10.1, 1.10.4, and 1.11.4), to get all 100 units on to the same target firmware (1.12.0) requires 3 unique delta images:

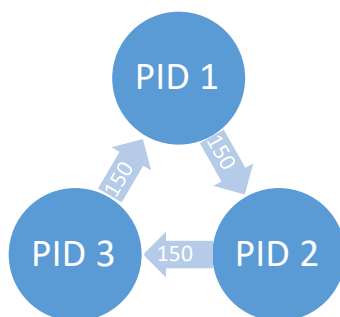
- Delta Image1: 1.10.1 -> 1.12.0
- Delta Image2: 1.10.4 -> 1.12.0
- Delta Image3: 1.11.4 -> 1.12.0

If there is no Delta Image available to get to the target firmware directly, a multi-step update would be required. For example, if Delta Image 1 did not exist on the Device Management platform, then the user would have to hop from 1.10.1 to 1.10.4 and then to 1.12.0.

6.3 Vehicle Bus PID Polling Rate

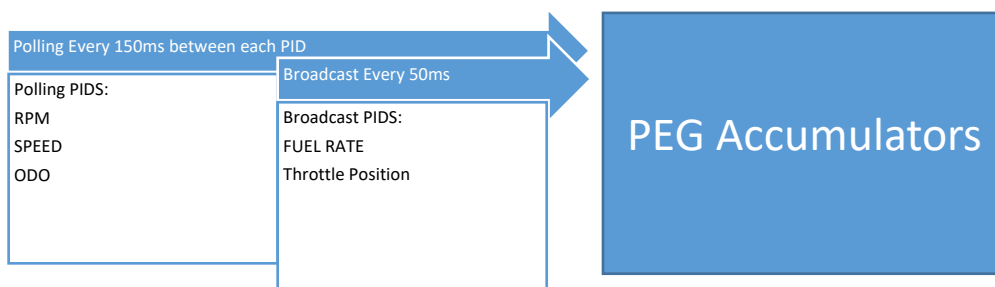
Unlike on the LMU-3030, the polling rate between each PID is a fixed. It is set to 150ms.

Additionally, the LMU-3040 and LMU-3240 no longer gives priority polling precedence to Speed and RPM PIDs. For example, if there are three registered non-broadcast parameters, each individual parameter is polled every 450ms



The LMU-3030 is different in that in-between each registered (non-broadcast) PID, the device polls for SPEED and RPM, increasing the polling interval between each polled PID by a factor of three.

On the LMU-3x40, Broadcast PIDs, if available and registered on the specific YMME installed, do not add to the polling interval. Below is an illustration of this;



6.4 PEG2 “Lines”

As stated in section [5.1.3](#) above, PEG2 lines are no longer considered “parameters”. A PEG2 “line” is only a virtual line, but in reality they are not enumerated the same way as in a PEG1 script.

The Script (!SCR) section of a PEG2 file is one whole section that requires either deleting or updating the whole section at once. No individual “line” can be updated.

The following differences should be noted from the LMU32/PEG1 environment:

- Individual PEG “lines” cannot be updated via Param Write or SMS.
- When updating a PEG2 script section, you must provide the complete script.

Note: Configuration Parameters (!CP section) can still be updated as individual parameters via Param Write or SMS.

6.5 Event Index Field

The LMDirect protocol defines the Event Index field as the PEG1 Config Parameter index number of the event that generated the report.

Since this field is limited to 1-byte in the LMDirect protocol and the LMU-3x40 uses PEG2 which can have an indefinite amount of PEG “Lines”, this field has a slightly new definition. The table below indicates the differences:

PEG1 Event Index	PEG2 Event Index
• Values should range from 0-249. • 255 representing a Real Time PEG Action request.	• Values should range from 0-253. • 254 representing any PEG line number exceeding 253. • 255 still representing a Real Time PEG Action request

6.6 Remote Debug PEG Action

Unlike the LMU32 platforms, EdgeCore (LMU-3x40) is always logging at a default level. There is no need to “start capturing” data using Peg Action 144, Modifier 1. To use this PEG Action on the EdgeCore there is a different definition of the modifiers as shown in the following table.

LMU-3030: PEG Action 144 Definition	LMU-3x40: PEG Action 144 Definition
Peg Action 144 0 - Stop capturing the LMU debug in SPI Flash Peg Action 144 1 - Start capturing the LMU debug into SPI Flash. Peg Action 144 2 - Stop capturing and send the debug captured so far as a file to the server	Peg Action 144 0 - Save log files in a tar ball in /data/backup/. This is useful for someone at the AT Console to save logs when desired. Peg Action 144 1 - Upload the existing saved log if the URL specified by Param 2328 is present.

Peg Action 144 2 - Save log files in a tar ball in /data/backup/ and upload the file. This is good for timer or event based log saving.

6.7 Modem/GPS Reset

The LMU-3x40 hardware architecture does not support rebooting the modem and/or GPS, since both are on the same chip, they both use the same power rail. A complete system reboot is required to reboot either function. This does not apply to the BLE and Wi-Fi functions.

6.8 SIM Form Factor

All previous legacy Calamp devices utilize a 2FF Micro SIM. The LMU-3x40 device uses a 4ff nano SIM. See section [4.1.1](#) above for size details.

6.9 Boot Reason

There are some boot reasons that are no longer supported on the EdgeCore platform and some new ones that are only supported on EdgeCore. The table below defines the boot reasons supported on each product type:

Boot Reason	LMU-3030	LMU-3040/3240
Boot Reason 0 (Cold Boot/Normal Power Up)	Yes	Yes
Boot Reason 1 (Power On - Factory Boot)	Yes	No
Boot Reason 2 (Reset Due to OTA Download Complete)	Yes	Yes
Boot Reason 3 (Reset Due to Radio Power Up)	Yes	No
Boot Reason 4 (Wake Due to I/O Activity)	Yes	Yes
Boot Reason 5 (Wake Due To Timer)	Yes	Yes
Boot Reason 6 (Wake Due to An Incoming SMS Message)	Yes	Yes
Boot Reason 7 (Wake Due to Application Restart)	Yes	Yes
Boot Reason 11 (Reset Due to Hosted App OTA Download Complete)	N/A	No
Boot Reason 12 (Wakeup from receive line activity on serial port)	N/A	No
Boot Reason 14 (BOOT_WDOG - lmu watchdog reboot)	No	Yes
Boot Reason 15 (BOOT_VBU_WDOG - vbu watchdog reboot)	No	Yes
Boot Reason 16 (BOOT_LMU_HARD_RESET - linux hard crash/kernel panic)	No	Yes

6.10 Peg Resources

The LMU-3040 and LMU-3240 offer a significant amount of PEG resources for PEG2 scripting and accumulator storage. The table below highlights the PEG resource differences between the product types.

	LMU-3030	LMU-3040	LMU-3240
PEG Accumulators	32	254	254
PEG Timers	32	254	254
PEG Condition Groups	8	32	32
PEG TimeDate Masks	8	10	10
PEG Event Lines/Pages	500/2	Peg2 Script	Peg2 Script
PEG Zones	32	32	32

6.11 GPS

Some of the notable differences between GPS operation are indicated in the following table.

	LMU-3030	LMU-3040/LMU-3240
GPS Sample Rate	4hz	5hz
Differential GPS	Available	Not Available
SBAS	Available	Available
Assisted GPS	Available (UBLOX)	Available (QCOM) URL: http://xtrapath1.izatcloud.net/xtra3grc.bin

Important Note: If you are using private data plans, it is important to open a tunnel to ensure the GPS Assist URLs can be resolved.

6.12 Motion Logs (4hz vs 5hz GPS Sample Rate)

Since there is a difference in the GPS update rate (4Hz vs. 5Hz) between the LMU32 and EdgeCore products, there is an impact on the sampling in some of the pre-defined motion logs.

On an EdgeCore platform the Short Motion Log types 0-4 samples at a fixed interval of 200mS while on the LMU-3030 the sample interval is 250mS. This causes the motion log buffer to fill up faster.

The Short Motion Logs Types are defined on Calamp's wiki site:

[https://puls.calamp.com/wiki/Accelerometer App Note#Long Type 0 .28Record Type 1.29](https://puls.calamp.com/wiki/Accelerometer_App_Note#Long_Type_0_.28Record_Type_1.29)

6.13 Time Sync Precedence

The possible time sources for syncing the system clock is slightly different between the product types. Both are listed below in order of precedence.

LMU-3030	LMU-3040/3240
GPS 3D Fix (highest priority)	GPS 3D Fix (highest priority)
Real Time Clock (RTC)	Real Time Clock (RTC)
GPS Fix (2D-Fix)	N/A
Time Server	N/A
Network Time	Network Time
No Time Sync Available	No Time Sync Available

6.14 Version String in ID Reports

The EdgeCore platform sends and displays the version string in a different format.

6.14.1 ID Reports:

The firmware version of the LMU-3x40, can be obtained from the LMDirect ID Report, Extension String field. In that field, there is a new Key-Value pair in the "LMUAPP" extension string. See the definition below.

LMU Application Info

LMUAPP:< DeviceID>,< HW-ID>,< SerialNumber>[,< FileType>,< Version>[,< FileType>,< Version>[...]]]

Example:

LMUAPP:0,Rev11,,0,1.5.0.2.0.2aaf159,22,,11,,18,

Highlighted above is an example of file type '0' which denotes the firmware file paired with the version string. In this example the version of firmware file type is '1.5.0.2.2aaf159'. The version string is 1.5.0.2 and the rest of the string ('2aaf159') is a build number. Please note, other files can be loaded in this field as an array of FileType, Version key-pair values.

6.14.2 Vehicle BUS ID Reports

Similar to the ID Report above, the VBUS Firmware version can be obtained utilizing the existing field in the Extension String. The LMU-3x40 uses a VBU3 (25) as a device type. See the definition below.

When Vbus DeviceType is 25 (VBU3):

VBUS:<DeviceType>,< VbuAppID>,< VbuSerialNumber>[,< FileType>,< Version>[,< FileType>,< Version>[...]]]

Example:

VBUS:25,101,001480123336510831333431,0,1.5.0.2.0.5b555a6

6.15 Firmware Revision Convention

The Firmware Revision Convention is defined as

follows: **MAJOR.MINOR.RELEASE.CANDIDATE.REVISION.HASH[M]**

Below is the breakdown:

- MAJOR.MINOR.RELEASE** is the external facing official Version. (e.g. 1.5.4)
- CANDIDATE** is used to address bugs and minor changes. Also external facing (1.5.4.9)
- REVISION** number displays the amount of commits and is used by the development team. Customers can ignore this field.
- HASH** is used by the development team. Customers can ignore this field.

6.16 Status LEDs

The LMU-3040 and LMU-3240 have single dual color LED on the board, green and red. The device firmware has individual controls for each color and can program each color individually or together to generate green, red or amber. Currently the devices only display a solid amber light to indicate if the device is powered on or off. There is no blinking pattern defined to indicate GPS/Cell status or Vehicle Installation status.

6.16.1 Status LED Behavior

The LMU-3040™ contains one programmable dual-color status LED (amber and green). Please note that there are PEG configuration parameters that can change the factory default behavior of all LEDs. LED behavior detail can be reviewed in the table below:

LED Definitions and Behavior

	Condition	Order	LED Color	LED Frequency
	Power On	1	Amber/Green	Fast
	GPS On	2	Green	Slow blinking
	GPS Time Sync	2	Green	Fast blinking
	GPS Fix	2	Green	Solid for 10 s
	Comms On & Searching	3	Amber	Slow blinking
	Network Available	3	Amber	Fast blinking
	Registered but no inbound acknowledgement	3	Amber	Solid & Fast Blink every 1 s
	Registered and received inbound acknowledgement	3	Amber	Solid for 10 s
	Vehicle Not Compatible	4	Amber/Green	Slow
	Install Successful	5	Green	Solid

6.17 Dual APN Mode

LMU-3240 supports DUAL APNs. One can be dedicated for Telematics data while the other can be dedicated for a Wi-Fi hotspot. This is optional.

Note: When using DUAL APN Mode, Param 2306 must be programmed so the secondary APN can establish a data connection. Because of this, it is always recommended to program PARAM 2306 for the AT&T SKU.

6.18 Version Reports (App Message 111)

Since the firmware versions strings are quite different between the LMU32 and EdgeCore platforms, it is possible that the processing of LMDirect App Message 111 (Version Reports) would require updating in order to properly parse the firmware version.

7. Installation Verification

In many cases it is desirable to verify that an installed LMU-3040™ is working properly. That is, installers should verify that the GPS and communications functions of the LMU-3040™ are working properly before departing the installation site. In more robust cases, some key configuration settings such as the Inbound Address and URL should also be verified.

Note that these processes are all based on issuing AT Commands to the LMU-3040™. It is expected that installers will have access to a serial port expansion cable and a laptop or PDA capable of a terminal connection. Alternatively, an SMS message can be sent to an LMU-3040™ to obtain its current status.

7.1 Comm Verification

Installers should first verify that the LMU-3040™ has been acquired and has registered to the wireless network.

Comm may be verified using an AT Command:

ATIC

Depending on the wireless network being used something similar to what is shown below will be displayed. It is important to verify that 'Yes' values are displayed at the top for Data and Network registration and the correct APN is displayed.

Radio Access	: LTE	
GSM Registered	:Yes, Home	GPRS Registered :Yes, Home

```
Connection : Yes
RSSI      : -97 dBm
BER       : 99
Channel   : 737
Cell ID    : 3441
Base Station ID : 40
Local Area Code : 31003
Network Code : 410
Country Code : 310
IMEI (Modem S/N): 351802055396182
IMSI (SIM ID) : 310410202524377 ICC-ID (SIM S/N):
89014102212025243778
Phone Number :
GPRS APN : ISP.CINGULAR Maint. Server :
maint.vehiclelocation.com(216.177.93.246):20500
Inbound Server : (0.0.0.0):20500
Primary Service : srvc(0) log(0) radio(0) inbnd_index(0) mode(0)

OK
```

If any of the responses return Not-Acquired or Not-Registered (and the APN is correct), the wireless network operator should be contacted for further troubleshooting.

Please note that it may take several seconds (or longer) for the LMU-3040™ to communicate with the modem and acquire the wireless network.

7.2 GPS Verification

The next step is to verify that the GPS receiver is seeing enough satellites to obtain a valid GPS position. Again, installers have two choices on how to perform this verification. First, like the Comm Verification, there is a GPS status LED (i.e., the one closest to the SMA connector). If this LED is solid, then the LMU has found GPS service.

If the LED is not visible then GPS service may be verified using an AT Command:

AT\$APP GPS?

The response should be similar to:

```
Lat=3304713, Lon=-11727730, Alt=0  
Hdg=113 Spd=0 3D-RTIME HDOP=130 nSats=7
```

Installers are looking for the 3D-RTIME setting along with a valid Lat, Long pair (i.e. something other than 0). If the GPS receiver does not have a valid lock within 2-3 minutes, for further troubleshooting, installers should contact CalAmp Support (productsupport@CalAmp.com)

7.3 Inbound Verification

The last item to verify is that the LMU-3040™ is sending data to the correct server. In general, this is a two-step process that will need the aid of an observer on the back end. That is, a technician will have to be logged in so they can monitor data coming into the backend mapping/vehicle management application.

First, verify that the LMU-3040™ is using the correct Inbound IP address by using:

```
ATIS
```

The response should be similar to:

```
PUBLIC SERVICES 4  
svrc(0) log(0:0) radio(0) mode(0:0) inb(0) ddd.ddd.ddd.ddd:<ppppp>  
svrc(1) log(1:0) radio(0) mode(0:0) inb(1) 0.0.0.0:20500  
svrc(2) log(2:0) radio(0) mode(0:0) inb(2) 0.0.0.0:20500  
svrc(3) log(3:0) radio(0) mode(0:0) inb(3) 0.0.0.0:20500  
PRIVATE SERVICES 1  
svrc(0) log(0:0) radio(0) mode(0:0) inb(0) 0.0.0.0:20500  
  
OK
```

The installer will need to verify with a backend technician that the IP address (ddd.ddd.ddd.ddd) and port (<ppppp>) are correct.

The second step is to verify that the LMU-3040™ is sending data. The best way to do this is to force the LMU-

3040™ to send in an unacknowledged Event Report (i.e., its current GPS location) with the following command:

```
AT$APP PEG ACTION 44 255
```

The LMU-3040™ will respond with: OK

The backend monitor must then be contacted to confirm that they received an Event Report with Event Code 255.

Assuming that all three sections have passed, the installation can be considered to be complete.

7.4 Verification via SMS

The current Comm, GPS and Inbound status of a LMU can be obtained via SMS provided you have access to an SMS capable phone or PDA.

Using your handset, send the following SMS Message to the LMU:

!RO

Within a few minutes, the LMU should return a response in the following format:

```
APP: <App ID> <Firmware Version>
COM:<RSSI> [./d/D][./a/A][./L][IP address] [<APN>]
GPS:[Antenna <Short/Open/Off>] | [No Time Sync] | [<FixStatus> <Sat
Count>]
INP:<inputs states> <vehicle voltage>
MID:<mobile ID> <mobile ID type>
INB:<inbound IP address>:<inbound port> <Inbound Protocol (LMD/LMX)>
```

□

APP: o

<App ID>:

The Application ID value of the LMU indicating the host platform and the wireless networking technology of the LMU.

o <Firmware Version>:

The current firmware version in use by the LMU

□ COM:

o <RSSI>:

This is the signal strength the wireless modem sees from the network. In general the LMU is at least scanning for the network if the RSSI is not -113.

o [./d/D]:

If the character 'D' is present, it indicates the LMU had a data session established when it responded to the status request. For the 8-Bit product line an upper case 'D' indicates both the Inbound and Maintenance sockets are ready. The lower case 'd' indicates that only the Maintenance socket is ready. A '.' indicates no sockets are ready.

- o [./a/A]:

This field indicates if the LMU has received an Acknowledgement from the Inbound server. This field will be empty if the LMU has never received an ACK. The lower case 'a' will be present if it has received an ACK since the last cold boot (i.e. power cycle) but not the last warm boot (App Restart or Sleep). The upper case 'A' will be present if the LMU has received an ACK since the last warm boot. A '.' Indicates no acknowledgement has been received.

- o [./L]:

This field indicates if the LMU's log is currently active. An 'L' indicates that the log is currently in use (i.e. one or more records have been stored) where a '.' indicates the log is inactive.

- o [IP Address]:

This is an optional field if and is only present if the LMU has established a valid data session. This field will contain the current IP address of the LMU as assigned by the wireless network. Note that if you see a value of 192.168.0.0, this is an indication that the LMU has not been able to establish a data session.

- o [<APN>]

The current Access Point Name in use by a GSM LMU.

- GPS:

- o [Antenna <Short/Open/Off>]:

This field, if present, indicates a problem with the LMU's GPS antenna. A value of Short indicates that the antenna cable has likely been crushed. A value of Open indicates that the antenna cable is either cut or disconnected. A value of Off indicates that the LMU's GPS receiver is off.

- o [No Time Sync]:

If this field is present, it indicates that the LMU's GPS receiver has not been able to find even a single GPS satellite. This would likely been seen in conjunction with the above antenna error, or if the LMU GPS antenna is otherwise blocked.

- o [<FixStatus> <Sat Count>]:

If these fields are present it indicates that the LMU has, or had a valid GPS solution. The <Sat Count> field indicates how many GPS satellites are currently in use by the LMU. The <FixStatus> field indicates the type of fix. The Fix Status types are detailed in the [LM Direct Reference Guide](#).

☐ INP:

o <input states>:

This field details the current state of each of the LMU's discreet inputs. This field is always 8 characters long. The left most character represents the state of input 7 where the right most represents the state of input 0 (i.e. the ignition). A value of 1 indicates the input is currently in the high state. A value of 0 indicates it is currently in the low state.

o <vehicle voltage>:

This field will contain the current reading of the LMU's internal A/D. This will be the supply voltage provided to the LMU in mV.

☐ MID:

o <mobile ID>:

This will be the current mobile ID in use by the LMU.

o <mobile ID type>:

This will be the type of Mobile ID in use by the LMU. The available types are, Off, ESN, IMEI, IMSI, USER, MIN and IP ADDRESS.

☐ INB:

o <inbound IP address>:

This is the current IP address in use by the LMU. This value should match the IP address of your LM Direct™ server.

o <inbound port>:

This is the current UDP port the LMU will use to deliver its LM Direct™ data. This value should match UDP port you are using on your LM Direct™ server. It is typically 20500.

o <Inbound Protocol (LMD/LMX)>:

This is the current UDP/IP messaging protocol in use by the LMU. In general it should be LMD.

Example Response

```
APP:1001 10a
COM:0
GPS:No Time Sync
INP:11100111 13.7V
MID:4141000100 ESN
INB:207.7.101.227:20500 LMD
```

8. Regulatory Information

Human Exposure Compliance Statement Pursuant to 47 CFR § 24.52 of the FCC Rules and Regulations, personal communications services (PCS) equipment is subject to the radio frequency radiation exposure requirements specified in § 1.1307(b), § 2.1091 and § 2.1093, as appropriate.

CalAmp Wireless Networks Inc. certifies that it has determined that the LMU3x40™ complies with the RF hazard requirements applicable to broadband PCS equipment operating under the authority of 47 CFR Part 24, Subpart E of the FCC Rules and Regulations. This determination is dependent upon installation, operation and use of the equipment in accordance with all instructions provided.

The LMU3x40™ is designed for and intended to be used in fixed and mobile applications. “Fixed” means that the device is physically secured at one location and is not able to be easily moved to another location. “Mobile” means that the device is designed to be used in other than fixed locations and generally in such a way that a separation distance of at least 20 cm is normally maintained between the transmitter’s antenna and the body of the user or nearby persons. The LMU3x40™ is not designed for or intended to be used in mobile applications (within 20 cm of the body of the user) and such uses are strictly prohibited.

To ensure that the LMU3x40™ complies with current FCC regulations limiting both maximum RF output power and human exposure to radio frequency radiation, a separation distance of at least 20 cm must be maintained between the unit’s antenna and the body of the user and any nearby persons at all times and in all applications and uses. Additionally, in mobile applications, maximum antenna gain must not exceed 3.2 dBi.

FCC Rules and Industry Canada (IC) regulatory information Compliance Statement (Part 15.19)

The equipment device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received including interference that may cause undesired operation. Warning (Part 15.21)

Changes or modifications not expressly approved by TransCore Amtech Systems could void the user’s authority to operate the equipment. Manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment.

Compliance Statement (Part 15.105(b))

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Class B digital device notice

“CAN ICES-3 (B)/NMB-3(B)”

RF Radiation Exposure Statement

This equipment complies with the FCC/IC radiation exposure limits set fourth for mobile transmitting devices operation in an uncontrolled environment. End users must follow the specific operating instructions to satisfy RF exposure compliance.

The equipment should only be used where there is normally at least 20cm separation between the antenna and

all
person/user.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or

transmitter, except tested built-in radios.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement

non contrôlé

é. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

Cet appareil et son antenne ne doivent pas être situés ou fonctionner en conjonction avec une autre antenne ou un autre émetteur, exception faites des radios intégrées qui ont été testées.