

ISR LTE GPS NMEA Streaming

For All Verizon Wireless LTE Services

Revision 1.0

June 2014

Overview

4G wireless and the accompanying network devices provide flexible connectivity for devices and applications in buildings, automobiles, trains, buses, trucks, and movable machinery at construction and utilities sites. In addition, valuable information can be gathered across the 4G wireless network regarding the location, state, and radio conditions for those devices. This can assist in improving analytics (e.g. where the asset is and was, length of time at locations, radio conditions at those locations, and availability of the applications).

Related documents for GPS, LTE antenna selection/placement, configuration and troubleshooting can be found under “Verizon LTE Deployment Guides for Cisco 4G LTE ISR 819/1900/2900/3900 and CGR2010” by visiting www.cisco.com/go/4g and clicking on the “Configuration and Deployment Guides” link.

Cisco ISRs and CGRs can provide information regarding GPS location and radio reception conditions in multiple ways including: SNMP MIBs, SMS, command line interface via console, Telnet or SSH, HTTP/HTTPS, and NMEA for GPS location. In the guides mentioned above, there are examples of using these interfaces. This guide focuses on the ISR with 4G LTE providing data over an IP network in NMEA format. Streaming data via NMEA allows for a cloud based application to display the location and path for multiple devices.

EEM (embedded event manager) is a feature available on ISR and CGR routers that allows for automation, self-recovery and communication to management systems or applications. Actions can be triggered in various ways, such as ISR log message, test messages, specific or recurring date/time, status/change of an interface or available route, a probe failure, etc.

This ISR sample application (referred to hereafter as the “app”) uses EEM to stream NMEA formatted location data in UDP packets (with configurable port number) to a defined target. The script can be modified to do more or different functions; other EEM scripts available show examples of additional location and radio signal applications. Please see the Router Best Practices for LTE Guide “Real World Examples” section for other EEM scripts.

www.cisco.com/c/dam/en/us/td/docs/routers/access/interfaces/software/deployment/guide/lte_access_011414.pdf

To obtain the EEM TCL script, click on the link below:

<https://supportforums.cisco.com/document/12239371/gps-nmea-streaming-over-udp>

Details

NMEA (National Marine Electronics Association) has developed a data format standard for PVT (position, velocity, time) location-based reporting. The information is formatted as a single ascii text line, which is sent once every reporting period. This standard has become popular for real-time location-based reporting and is also commonly used for land-based systems.

This ISR app sends location information with timestamp in NMEA format once per second. The information is sent in a UDP packet to an IP address and port number that are configured via two required variables. The app is triggered by the ISR cellular interface coming up (active), and then it continuously sends the location information to the server. To use the app, install the small tcl file, enable GPS NMEA, and enable the EEM application in the ISR configuration (show below).

The following is an example of the data sent:

```
09:51:23.303475260 108.16.125.2 60646: 65 $GPRMC,134858.0,A,4006.152961,N,07507.354396,W,0.0,,180614,,,A*5A
```

Considerations:

- Existing systems integrators offer services or products to receive NMEA streams and provide mapping, reporting and analytics. The app should allow an ISR with LTE eHWIC or 819 with LTE to work with these products and services.
- As the location information is acquired from GPS, a supported GPS antenna with direct line of sight to the sky needs to be connected to the ISR.
- If line of sight to the sky is lost, or the GPS antenna is disconnected, the ISR will continue to send location data to the server. NMEA packets will still be received with latitude/longitude GPS coordinates of 0,0,0 (degrees, minutes, seconds).

Requirements

- ISR G2 with an LTE eHWIC, or an 819 series ISR with embedded LTE and a minimum IOS level of 15.3(3)M2
- An active SIM inserted with appropriate IOS configuration, and (optionally) knowledge of the phone number where text messages are to be sent
- The NMEA Streaming tcl script loaded onto ISR flash and configured (as shown below), and the EEM applet defined in the IOS configuration.
- Both main and diversity LTE antennas appropriately connected.
- A GPS antenna connected to the ISR GPS port, with line-of-sight to the sky. This can be the dedicated Cisco GPS antenna (GPS-ACT-ANTM-SMA) or the Cisco single outdoor LTE/GPS antenna (SKU to be available summer 2014).

Installation

- 1) Ensure that the ISR is operational (enabled SIM installed, appropriate IOS version, configured, LTE antennas installed with at least one extension cable, and GPS antenna installed).
 - a. Guidance for the above is available via the documents located here:
www.cisco.com/c/en/us/support/interfaces-modules/high-speed-wan-interface-cards/products-installation-and-configuration-guides-list.html
- 2) Enable NMEA GPS function on ISR (IOS configuration mode).
controller cellular 0/X (where X is the LTE eHWIC slot number, or cellular 0 for 819)
lte gps mode standalone
lte gps nmea
- 3) Enable AAA on ISR to allow the NMEA app access to ISR enable commands (IOS configuration mode).
aaa new-model
aaa authentication login nologin none
aaa authorization exec nologin none
- 4) Download the stream_NMEA2.tcl script from
<https://supportforums.cisco.com/document/12239371/gps-nmea-streaming-over-udp>
- 5) Copy **stream_NMEA2.tcl** script onto the ISR flash via USB drive, TFTP, FTP, etc. (IOS enable mode)
- 6) Define the destination IP address and port number, default tcl location, and tcl script (IOS configuration mode).
event manager environment server "a.b.c.d" (with quotes where a.b.c.d is an IPv4 address)
event manager environment port "X" (with quotes where X is an integer, not a well-known port)
event manager directory user policy "flash:/"
event manager policy stream_NMEA2.tcl type user
- 7) Define the EEM applet that calls the tcl script above (IOS configuration mode).
event manager applet NMEA
event syslog pattern "LINEPROTO-5-UPDOWN: Line protocol on Interface Cellular[0-9\]/+, changed state to up" maxrun 31536000
action 010 cli command "enable"
action 020 syslog msg "NMEA streaming starting now"
action 030 cli command "tclsh flash:stream_NMEA2.tcl \$server \$udp_port"
- 8) Reset the LTE interface via configuration shut/no shut, LTE modem power cycle, or ISR reload during planned maintenance (IOS configuration mode).
 - a. IOS commands from enable mode: **configure terminal**, **interface cell 0/x/0** (where x is the ISR slot number for 1900/2900/3900, or cell 0 for 819), **shut** (wait 5 seconds), **no shut**, **end**. (Operational in a few seconds)
 - i. Requires ISR terminal access other than through the LTE interface

- b. IOS commands from enable mode: `configure terminal`, `service internal`, `end`, `test cellular 0/x/0 modem-power-cycle` (where x is the ISR slot number for 1900/2900/3900, or cell 0 for 819) (IOS configuration and enable modes)
 - i. Can be done over LTE, but takes 1 minute to return to operation

Sample Installation and operation

Check IOS version:

```
C1921_pod4#sh ver | i IOS
Cisco IOS Software, C1900 Software (C1900-UNIVERSALK9-M), Version 15.3(3)M3, RELEASE SOFTWARE (fc1)
...
```

Copy the script to the ISR:

```
C1921_pod4#copy usbflash1:stream_NMEA2.tcl flash:
Destination filename [stream_NMEA2.tcl]?
Copy in progress...C
3145 bytes copied in 0.516 secs (6095 bytes/sec)
C1921_pod4#dir flash: | i tcl
 245  -rw-          3145  Jun 18 2014 12:46:30 +00:00  stream_NMEA2.tcl
C1921_pod4#
...
```

Enable AAA for the NMEA app:

```
C1921_pod4#conf t
Enter configuration commands, one per line. End with CNTL/Z.
C1921_pod4(config)#aaa new-model
C1921_pod4(config)#aaa authentication login nologin none
C1921_pod4(config)#aaa authorization exec nologin none
...
```

Enable GPS and NMEA function:

```
C1921_pod4(config)#controller Cellular 0/0
C1921_pod4(config-controller)#lte gps mode standalone
[Cellular0/0/0]: Please ensure NMEA is enabled in order to get all satellite and GPS location
information!
[Cellular0/0/0]: GPS mode selected successfully
C1921_pod4(config-controller)#lte gps nmea
[Cellular0/0/0]: NMEA streaming engine switched ON
C1921_pod4(config-controller)#exit
C1921_pod4(config)#
...
```

Define the EEM variables and enable the EEM script:

```
C1921_pod4(config)#event man env server "67.163.112.181"
C1921_pod4(config)#event man env udp_port "12345"
C1921_pod4(config)#event manager environment server XX.YYY.112.181 (address hidden)
...
```

Define the EEM applet that invokes the NMEA script:

```
C1921_pod4(config)#event manager applet NMEA
C1921_pod4(config-applet)#$/]+, changed state to up" maxrun 31536000 (line truncated, see #6 above)
C1921_pod4(config-applet)#action 010 cli command "enable"
C1921_pod4(config-applet)#action 020 syslog msg "NMEA streaming starting now"
C1921_pod4(config-applet)#$d "tclsh flash:stream_NMEA2.tcl $server $udp_port" (line truncated " " )
```

```
C1921_pod4(config-applet)#end
```

```
...
```

Confirm configuration and save:

```
C1921_pod4#sh run | s event man
```

```
event manager environment server "67.163.112.181"
```

```
event manager environment udp_port "12345"
```

```
event manager directory user policy "flash:/"
```

```
event manager scheduler script thread class N number 1
```

```
event manager applet NMEA
```

```
  event syslog pattern "LINEPROTO-5-UPDOWN: Line protocol on Interface Cellular[0-9W/]+, changed state to up" maxrun 31536000
```

```
  action 010 cli command "enable"
```

```
  action 020 syslog msg "NMEA streaming starting now"
```

```
  action 030 cli command "tcclsh flash:stream_NMEA2.tcl $server $udp_port"
```

```
C1921_pod4#
```

```
C1921_pod4#sh run | section controller
```

```
controller Cellular 0/0
```

```
  lte gps mode standalone
```

```
  lte gps nmea
```

```
control-plane
```

```
C1921_pod4#wr
```

```
Building configuration...
```

```
[OK]
```

```
C1921_pod4#
```

```
...
```

Shut/no shut the ISR LTE interface to initiate the script:

```
C1921_pod4#conf t
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
C1921_pod4(config)#int cell 0/0/0
```

```
C1921_pod4(config-if)#shut
```

```
C1921_pod4(config-if)#
```

```
*Jun 18 13:27:37.989: %LINK-5-CHANGED: Interface Cellular0/0/0, changed state to administratively down
```

```
*Jun 18 13:27:38.989: %LINEPROTO-5-UPDOWN: Line protocol on Interface Cellular0/0/0, changed state to down
```

```
C1921_pod4(config-if)#no shut
```

```
C1921_pod4(config-if)#end
```

```
C1921_pod4#
```

```
*Jun 18 13:27:45.001: %SYS-5-CONFIG_I: Configured from console by cisco on console
```

```
C1921_pod4#
```

```
*Jun 18 13:27:46.329: %LINK-3-UPDOWN: Interface Cellular0/0/0, changed state to up
```

```
*Jun 18 13:27:47.329: %LINEPROTO-5-UPDOWN: Line protocol on Interface Cellular0/0/0, changed state to up
```

```
*Jun 18 13:27:47.349: %HA_EM-6-LOG: NMEA: NMEA streaming starting now
```

```
*Jun 18 13:27:47.405: %LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel0, changed state to up
```

```
*Jun 18 13:27:47.417: %SYS-5-CONFIG_I: Configured from console by on vty1
```

```
*Jun 18 13:27:47.529: %SYS-5-CONFIG_I: Configured from console by on vty1
```

```
*Jun 18 13:27:47.533: %SYS-5-CONFIG_I: Configured from console by on vty1
```

```
*Jun 18 13:27:48.365: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback7, changed state to up
```

```
C1921_pod4#
```

```
...
```

GPS information from ISR:

```
C1921_pod4#sh cell 0/0/0 gps
```

```
GPS Info
```

```
-----
GPS Feature: enabled
GPS Port Selected: Dedicated GPS port
GPS State: GPS enabled
GPS Mode Configured: standalone
GPS Error Count: 21
Latitude: 40 Deg 6 Min 8.1728 Sec North
Longitude: 75 Deg 7 Min 20.2581 Sec West
Timestamp (GMT): Wed Jun 18 13:46:27 2014
```

```
Fix type index: 0, Height: 103 m
```

```
Satellite Info
```

```
-----
Satellite #14, elevation 33, azimuth 113, SNR 48 *
```

```
...
```

```
C1921_pod4#
```

```
...
```

NMEA information posted to the server from the NMEA app on this ISR:

(IP address of ISR hidden, first 2 octets replaced with X and Y)

```
09:51:03.322475941 X.Y.125.2 60646: 65 $GPRMC,134838.0,A,4006.152992,N,07507.354367,W,0.0,,180614,,A*5E
```

```
09:51:04.303889374 X.Y.125.2 60646: 65 $GPRMC,134839.0,A,4006.152990,N,07507.354370,W,0.0,,180614,,A*5B
```

```
09:51:05.297133729 X.Y.125.2 60646: 65 $GPRMC,134840.0,A,4006.152991,N,07507.354374,W,0.0,,180614,,A*50
```

```
09:51:06.297635238 X.Y.125.2 60646: 65 $GPRMC,134841.0,A,4006.152987,N,07507.354378,W,0.0,,180614,,A*5A
```

```
09:51:07.313955173 X.Y.125.2 60646: 65 $GPRMC,134842.0,A,4006.152983,N,07507.354383,W,0.0,,180614,,A*59C
```

```
...
```

A new line was added when "lte gps nmea" was configured under the cell controller:

```
C1921_pod4#sh line
```

Tty	Line	Type	Tx/Rx	A	Modem	Roty	AccO	AccI	Uses	Noise	Overruns	Int
*	0	0 CTY		-	-	-	-	-	0	0	0/0	-
	1	1 AUX	9600/9600	-	-	-	-	-	0	0	0/0	-
	2	2 TTY	9600/9600	-	-	-	-	-	0	0	0/0	-
A	0/0/0	3 TTY		-	inout	-	-	-	0	0	0/0	Ce0/0/0
*	0/0/5	8 TTY		-	inout	-	-	-	1	733	12/0	NM0/0/5

```
...
```

Testing ended, delete the 5-line EEM script and clear the line to stop sending NMEA stream:

```
C1921_pod4#conf t
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
C1921_pod4(config)#no event manager applet NMEA
```

```
C1921_pod4(config)#end
```

```
*Jun 18 13:50:17.716: %SYS-5-CONFIG_I: Configured from console by cisco on console
```

```
C1921_pod4#
```

```
C1921_pod4#clear line 8
```

```
[confirm]
```

```
[OK]
```

```
...
```

To re-enable the NMEA stream

- Redefine the 5-line EEM applet that invokes the NMEA script (copy in the lines again in IOS configuration mode from step 7 above)
- Cause the cellular interface to come up again (via shut/no shut, modem-power cycle, ISR reload during scheduled maintenance, etc.)




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