

Framework For Asset Location Using Aplicom-12 Module

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Abstract

This paper presents a framework for location of an asset using Aplicom-12 as building block. The whole setup is easy to realize and the cost is within the reach of common man. The proposed asset locator can be employed in diverse areas of application where regular and periodic up to date information about the location of objects/items of interest is currently situated. The problem of theft of asset or kidnap can be greatly minimized. The connectivity was provided using GSM based wireless communication is used to provide a global, practical and cost-effective solution for wide-area monitoring. A tracking device was designed and constructed using Aplicom-12 GSM Module and a GPS Simulator. The device during testing was able to readout the location when a message was sent to module and a message was sent back to mobile phone which indicates the location of the object being tracked.

1. Introduction

The incessant problem of vehicle theft or asset loss in transit or kidnap incidences can be greatly reduced by using GSM based wireless communication to provide a global, practical and cost-effective solution for wide-area monitoring. A GPS tracking unit is a device that uses the Global Positioning System to determine the precise location of vehicle, person, or other asset to which it is attached and to record the position of the asset at regular interval. Means of linking GPS to the local GSM Modem over the air interface are provided at each BTS cell site. Therefore, a reliable communication link is constantly established between a mobile phone and the local GSM Modem via a GSM network, so that the location status of a desire object or asset can remotely be monitored from the mobile phone on a regular basis.

The Aplicom-12 GSM module is a device that is being embedded on the Aplicom-12 test board. It is a Data Communication Equipment (DCE) and the hardware application with which it is integrated is a

Data Terminal Equipment (DTE). Aplicom-12 GSM module provides M2M connectivity between a mobile phone within an intranet and a remote device as shown in figure 1. Aplicom-12 GSM module provides both wireless connectivity and local connectivity. Local connectivity is meant to manage the components of the remote device. This is possible when there is local connection between the Aplicom-12 module and the device to be managed. Local connectivity between Aplicom-12 module and a remote device can be established using either TCP socket, UDP sockets, Asynchronous serial connection, AT commands, I/O control connection or GPS connection. Aplicom-12 module provides wireless connectivity over GSM network using GPRS, EGPRS, CSD, HSCSD and SMS bearer. How the wireless connectivity of the Aplicom-12 module is used depends on the application.

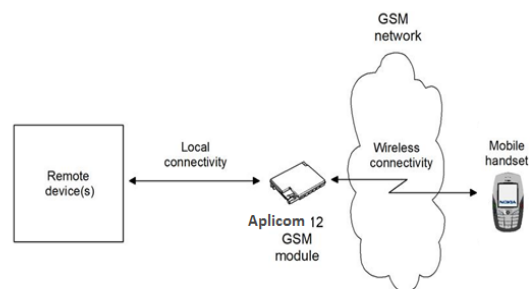


Figure 1: Aplicom-12 GSM Module in a typical M2M Architecture

Aplicom-12 test board includes the following features and functionalities: Power supply to the Aplicom-12 module using external AC power supply; Reset button; SIM Reader with a 'lid open' indication switch; RS-232 level translators for all three serial ports of the Aplicom-12 module; analogue audio connector for the Nokia HSU-3 handset; switch for standard AT commands; and pin headers for I/O access. Input voltage to the test board can be between 8V to 40V and output voltage to the test board that supplies the module is adjusted to 3.8V. I/O voltage is conveyed via a linear

regulator, and is adjusted to 3.3V. There is one common ground for the power supply and I/O pins in the Aplicom-12 module. All signals are routed through the M2M system connector except the antenna, which is routed through the miniature microax RF connector. M2M system connector is a 60-pin (2 rows, 30 pins per row), 1.27mm pitch pin header connector. It has a frame that helps in the physical integration and also holds the Aplicom-12 module firmly in position.

2. Design and Implementation

Aplicom-12 GSM Module offer modes of operation such as AT command mode; M2M mode; and user control mode. In the user control mode, the Aplicom-12 GSM module will be controlled with a compatible mobile phone. Control messages are sent as text messages from mobile phone to Aplicom-12 GSM module. Based on the information in the text message, the Aplicom12 GSM module in turn controlled the device attached to it through the M2M system connector. The Aplicom-12 GSM module processed the control message it received, and sent the response as a text message back to the originator. Received and recognized control messages were not stored in the Aplicom-12 module. Only messages that were not recognized as control messages were stored in the SIM card or the module as normal text messages. For a control message sent to the Aplicom-12 module to be effective, the module need to be configured with Aplicom-12 Configurator software. After successful installation of the Configurator software on the PC, the following steps were taken:

Step 1: Aplicom-12 GSM module was mounted on the 60-pin connector of the test board.

Step 2: A SIM card was inserted into the test board SIM card holder.

Step 3: Antenna was connected to the module with the antenna adapter cable.

Step 4: Data cable AXS-3 was used to connect a test board to a compatible PC. Port 2 D9 connector was used. M2M system protocol in the preference dialog (*File->Preferences*) was selected as the communication type.

Step 5: The communication mode switch was turn ON to normal and RS-232 switch was turn ON.

Step 6: Power supply was connected to the test board and to an AC wall outlet.

After completing the above steps, Configurator automatically established a connection between the PC and the Aplicom-12 module when the Configurator was started.

Next is writing of a GPS simulator; a simple test tool for developing PC software for GPS communications using the NMEA protocol. The basic function of the program is to generate a number of different NMEA

sentences, and to send these sentences over a standard RS-232C link to a receiver, in many cases another PC, in user-selectable intervals. The GPS simulator position data is updated in regular intervals. Initially the parameter "course" and "speed" has to be specified to make the GPS simulator virtually moving, though all parameters can be changed in "real time", so that a realistic NMEA output can be achieved. The data transmission is bi-directional. After, the connection has been made to the PC or NMEA device, the program is run. The program can be run without a physical connection. This way can for example create a log file for analysis or for uploading to a receiver later. The user interface looks a little bit like a real GPS device. On the left side there are buttons for setting up the simulator, for starting the log and for toggling the trace window on and off. The start button, the hold/continue button and the exit button are on the right side. The operation of the program is simple. Pushing the set-up toggle button opens a window where you can fill in the initialization parameters. The window can always open to change any parameters, even when the program is running. Care must be taken, however with the communication settings; these are by default set to NMEA standard. (4800, 8, 1, N), using COM1. The set up screen can also indicate which NMEA sentences will be transmit to the listener, and whether a checksum should be added or not. Any or all of the following sentences are supported: \$GPGLL, \$GPRMC, \$GPVTG, \$GPZDA, \$GPGGA, \$GPGSA.

The transmit interval can be set in seconds, that is the frequency at which the transmission takes place. Default is 1 burst per second. At the click of "Start", the simulator starts transmitting. This can be displayed in the trace window, so that data transmitted can be seen. The trace window can be switch off if liked. The hold/continue button does what it says: it suspends the transmission to give for example the opportunity to analyse the data in the trace window. Note that the data transmission is bi-directional (duplex), and that data received by the GPS simulator is written to the log file and displayed in the trace window the moment it is received. GPS simulator can also be used as listener. This means that you can connect your GPS to a PC (using the appropriate cable) where GPS simulator is running, and it will receive all data transmitted by the GPS. The GPS simulator module is shown in figure 2 below.



Figure 2: The GPS Simulator Model

Parameters values were read from and written into the Aplicom-12 GSM module with the aid of Configurator. Each Configurator dialog box has “Read parameters” and “Write parameters” button for this purpose. Data was transferred between the Configurator and the Aplicom-12 module only after either of this buttons was clicked. For instance, after a parameter has been successfully written or configured to the Aplicom-12 GSM Module, the dialog box in figure 3 below appears.

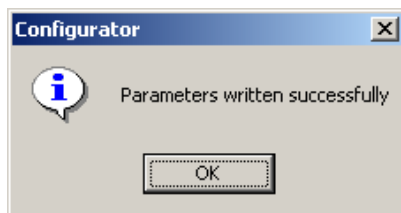


Figure 3: Dialog Box for successful parameter configuration

It is compulsory to configure Message Identifier and SMS Centre address before using user control mode of the Aplicom-12 GSM module. The message identifier is 1 – 8 characters long and case sensitive. The message identifier is a mandatory setting that must be configured in order to use the user control mode. Figure 4 shows a dialog box (*User Control Mode*->*Settings*->*Initialize*) where the identifier in the Configurator was set. The message identifier was defined with the string “test123”, and then a click on “Change”. Lastly, “Write parameters” button was clicked to activate the new identifier as shown in figure 4. After the message identifier have been set, more parameters become available. A dialog is used to set the SMS Centre address with Aplicom-12 Configurator (*GSM Settings*->*Advanced*->*Short Messages*) is shown in the figure 5.

Read parameters button was pressed to verify whether the SMS Centre address is available on the network

service provider SIM card or not, if not there is need to enter it. SMS can be stored in the SIM card or the Aplicom-12 GSM module memory. “Remove oldest message when new arrives” option was selected in the short message dialog so that the oldest message would be removed from the SIM card and the Module when a new message arrives.

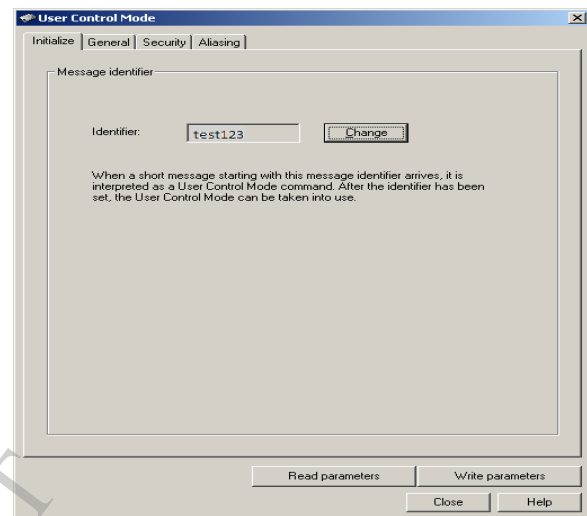


Figure 4: User Control Mode Dialog

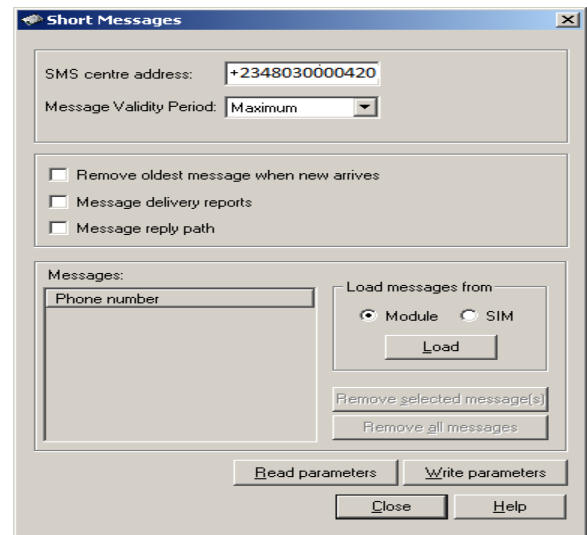


Figure 5: Short Message Dialog

This allowed the control messages to get to their destination and fulfilling their purposes. Optional settings that may be set on the Configurator are security settings; disabling acknowledgements; aliasing for text

messages and input settings. Aplicom-12 GSM module acknowledges whether or not a text message has successfully commanded a device, by sending a response as a text message back the mobile phone that sent the control message. It should be noted that “Disable acknowledgement” option did not disable the status messages (responses to input status or value queries), alarm messages (responses to alarm subscriptions), error messages (responses to control message with correct message identifier, but wrong commands) and response messages to password change messages.

The location information can be query from the Aplicom-12 module if an external GPS device is connected to either the serial port 1 or 3. The serial port used has to be configured with the configurator. In order to use GPS support, the GPS setting is configured (baud rate and used NMEA parameters). The location is query with the Location get command as shown in figure 6 below.

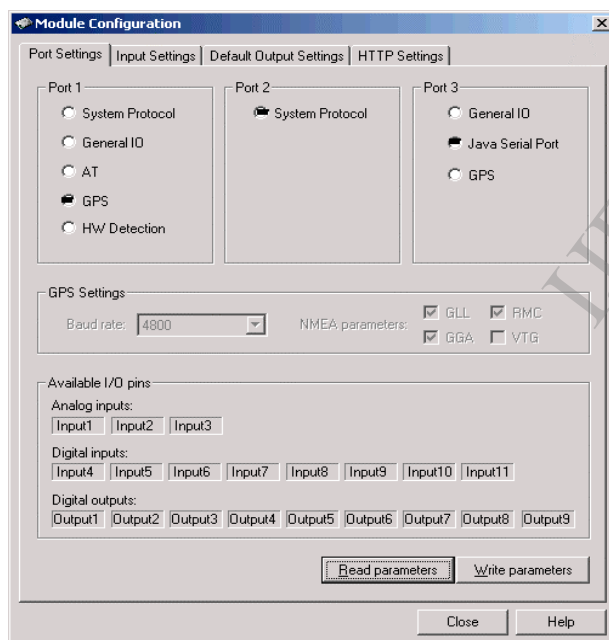


Figure 6: Port Setting

Asynchronous serial port 2 on the test board was used to connect a compatible PC and the test board through a data cable. Figure 7 displays a dialog where port 2 was configured (*File->Module Configuration -> Port Settings*). Then the “Write parameter button was clicked to activate serial port 2.

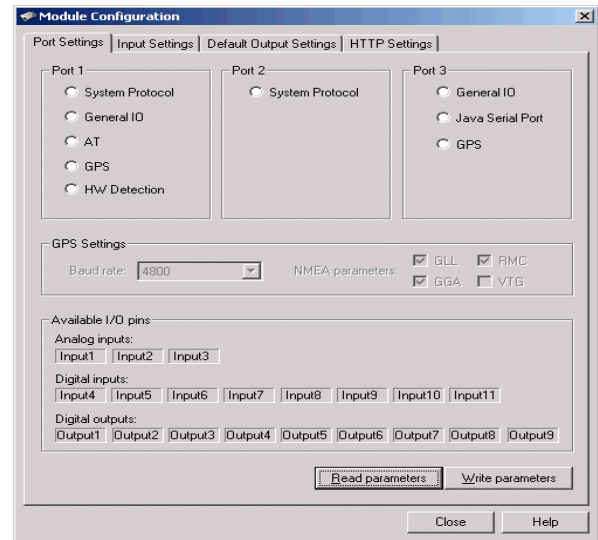


Figure 7: Ports Setting in the Configurator

3. User Control Mode SMS Commands

The commands and status messages used in this work are described in this section. After defining alias for each of the commands that are sent to the module, status messages are sent in response to device status queries. The identifier string used was “test123” and the password properly set off. An instance of the control message used during the experiment and the response received are stated below:

Control message: test123 Location Get

*Response: LOCATION:
LATITUDE: 00, 00.6420, N
LONGITUDE: 000, 00.6420, W
SPEED: 315.0, 005.0
SATELLITES: N/A
ALTITUDE: N/A
TIME: 16, 27, 18
DATE: 13,04,2010*

When a wrong control message was sent to the module, the module replies the originator with an error message as stated below:

Control message: test123 Location Get

Response: LOCATION: NOT SUPPORTED

For password change the following steps are taken. The identifier used was “test123” and the command *Change Password* is used to control to effect the change.

Control Message: test123 Change _Pword secret

Response: OK

The above implies that the password was “secret”. The password later changed using the command below and a response was sent back to the originator.

Control Message: *test123 secret Change_Pword telnet*
 Response: *OK*

The above implies that the password was changed from "secret" to "telnet".

4. Testing

The first stage was the connection of the Aplicom-12 GSM module to the computer via COM PORT1 and powering of the setup, after which the configuration of the Aplicom-12 GSM module was successful carried out. Signal detection from the antenna was established and connection to the GPS simulator was done. The GPS simulator was connected directly to the computer COM PORT2 while the Aplicom-12 module was isolated. The GPS simulator was configured and the demo mode was run to test the effect on the GPS. The mobile phone was used to issue out commands. The command prompt was sent as text message to the Aplicom-12 GSM module to get location. The command prompt reads:

Test 123 location get

The Aplicom-12 GSM module sent back a message, stating in detail the present location of the assets after receiving the text message. The text sent back reads as:

LOCATION:

LATITUDE: 00, 00.6420, N
LONGITUDE: 000, 00.6420, W
SPEED: 315.0, 005.0
SATELLITES: N/A
ALTITUDE: N/A
TIME: 16, 27, 18
DATE: 13,04,2010

But, in case the text message did not get to the destination of the assets a text message is sent back to the mobile phone reading:

LOCATION: NOT SUPPORTED

Finally since the desired result had been achieved and the location of the assets known, the location is then read on the map to get the area where the assets is located since the GPS simulator only give the Latitude and Longitude of the location of the asset. The rest of response is shown in the appendix.

5. Conclusion

A framework for monitoring and precise determination of location of a vehicle, person other assets to which it is attached was designed using Apilicom-12 GSM module as building block. The recorded location is sent to the mobile phone for easy tracking and real time monitoring.

References

1. Aplicom-12 GSM Module (2005) Hardware integration manual rev. 2.2

2. Aplicom-12 GSM Module (2005) Remote I/O control guide rev. 2.1
3. Aplicom-12 GSM Module (2005) Test Board Product specification rev. 1.1
4. Ger Rietman (2002) "GPSSIMUL operating instructions", Page 1-2
5. GPS tracking unit (2008) <http://wikimediafoundation.org>
6. National Marine Electronics Association: <http://www.nmea.org>

Appendix

Control message: *test123 Location_Get*

Response: *LOCATION:*

LATITUDE: 12, 41.3160, N
LONGITUDE: 001, 30.2740, W
SPEED: 354.0, 996.0
SATELLITES: N/A
ALTITUDE: N/A
TIME: 14, 47, 15
DATE: 03,04,2010

Control message: *test123 Location_Get*

Response: *LOCATION:*

LATITUDE: 07, 50.9160, N
LONGITUDE: 000, 59.3660, W
SPEED: 354.0, 996.0
SATELLITES: N/A
ALTITUDE: N/A
TIME: 13, 29, 12
DATE: 03,04,2010

The output from the GPS simulator

*\$GPRMC,223438,A,0004.6690,N,00004.2090,W,985.0,318.0,280210,000.0,E*6D*
*\$GPRMC,223439,A,0004.8720,N,00004.3920,W,985.0,318.0,280210,000.0,E*6B*
*\$GPRMC,223440,A,0005.0750,N,00004.5750,W,985.0,318.0,280210,000.0,E*64*
*\$GPRMC,223441,A,0005.2780,N,00004.7580,W,985.0,318.0,280210,000.0,E*67*
*\$GPRMC,223442,A,0005.4810,N,00004.9410,W,985.0,318.0,280210,000.0,E*62*
*\$GPRMC,223444,A,0005.6840,N,00005.1240,W,985.0,318.0,280210,000.0,E*69*
*\$GPRMC,223445,A,0005.8870,N,00005.3070,W,985.0,318.0,280210,000.0,E*66*

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