The CDS GSM tracker V1.0.8.

Design History:

For sometime there has been a need for a multi-mode APRS tracker. The technology has been around for some time, and eventually the costs of production got to the point where a design like this would be feasible.

What is a Hybrid tracker ?

A hybrid tracker is a unit that can access both the radio frequency domain and the gsm cellular domain. A hybrid tracker is the answer to low density I-gate systems, as it can act as both a digipeater and an I-gate, it will store and forward aprs packets on command.

Feature list:

1. 3 beaconing modes, a-constant time between beacons, b-equidistant beaconing (10m to 2500m), c-smart beaconing mode.
2. Programmable low data balance email to user, (Certain providers)
3. Built in Lithium Ion battery back, standard 2200mAH and extended 4400mAH
4. Easy serial terminal configuration, Hyper-term at 115200 Baud.
5. On board lithium Ion charger 800mA maximum charge current.
6. Optional GPS with internal antenna or GPS with external active antenna.
7. User can receive email of the cellular number used, it can also be checked on the aprs.lrlabs.net website
8. SMS control of certain system parameters
9. Boot-loader for field upgrades (using avrdude)

Optional Features:

1. 1 watt VHF radio 1200baud TNC, frequency software programmable.
2. 1 watt UHF radio 1200baud TNC, frequency software programmable.
3. Data-flash for storage of track points while outside network reach, minimum 1000 points history
4. Relay output controlled by SMS
5. If a TNC is fitted the unit will report GPS/Cellular jamming (gsm modem dependent)

Changing of parameters:

After connecting a serial port to the device and opening the terminal emulator for 115200,8,N,1 with no handshake settings, no hardware and no software handshake. Pressing the enter key will bring up the command prompt. Sending and h or ? Followed by the enter key will result in the display of the on-line help list. To look at the various parameters type Px where x is 0 to 9 followed by the enter key.

Parameter list as per v1.0.44 software.

Parameter dump page 0:

```
S00.CALLSIGN  :ZS6LMG
S01.ID        :15
S02.PASSWORD  :xxxxx
S03.BEACON:
ZS6LMG GSM hybrid tracker
S04.ICON TABLE:>
S05.ICON      :1
S06.BEACON INT (min) :55
S07.GPS Power Mode :120
S08.GPS WDT (sec)  :120
```

S00.CALLSIGN
8 digit callsign for the aprs servers.

S01.ID
This is your aprs id from 1 to 15.

S02.PASSWORD
The numerical password for use by the aprs servers, at the time of order you will be supplied with this code.

S03.BEACON
This is the beacon text line 60 characters maximum length, try to only use the standard ASCII character set.

S04.ICON TABLE
This is the icon table entry you want to use.

S05.ICON
The icon symbol for display on the servers.

S06.BEACON IN (min)
Then aprs beacon time in minutes valid 5 to 200.

S07.GPS Power Mode
A 0 implies no power management on the gps module whatsoever. A value greater than 1 will indicate the time the GPS should be powered down when there is no movement, the range of this parameter is in seconds from 60 seconds to 2500 seconds. We do not recommend making this value above 300 seconds. Parameter gets set in 10 second intervals, so setting it to 56 seconds will make it default to 50 seconds.

S08.GPS Watchdog (sec)
This is the gps watchdog timer, if no fix is reached in this time the CPU will power the gps down and power it up again, on the third retry it will send a GPS failed beacon packet. Parameter is alsset in 10 second increments.

Parameter dump page 1:

```
S10.SERVER 1  :www.aprs-za.com
S11.PORT      :14580
S12.SERVER 2  :euro.aprs2.net
S13.PORT      :14580
S14.SERVER 3  :www.aprs-za.com
S15.PORT      :14580
```

S10 to S15 server details.
The tracker will cycle between the 3 servers to upload points.

Parameter dump page 2:

```
S20.Stationary Interval (min) :42
S21.Track Mode :1
Track Mode 0 settings:
 S22.Interval (sec) :120
Track Mode 1 settings:
 S23.LOW speed (km/h) :20
 S24.HIGH speed (km/h) :80
 S25.LOW rate (sec) :120
 S26.HIGH rate (sec) :30
 S27.Heading change (deg) :20
Track Mode 2 settings:
 S28.Distance (m):400
```

S20.Stationary interval (min)
When the tracker is standing still the unit will send a position report every 42 minutes, the value can be from 10 to 250 minutes.

S21.Track Mode
This is the heart of the tracker

Mode 0 - Constant time Beaconing mode, in this mode tracking packets is sent at a fixed schedule with no other means. S22 sets this interval from 20 seconds to 2500 seconds.

Mode 1 – Smart beaconing mode, this is the preferred mode of operation and has 5 parameters associated with it. There is no timeout value for a heading change, but the packet rate is limited to a rate of 1 per 7 second.

Mode 2 – equidistant mode, in this mode a position reporting packet is send ever 400 meters, but can be set from 20m to 1000m

Parameter dump page 3:

```
S30.Send signal strength with beacon :ON
S31.Send Firmware version with beacon :ON
S32.Send signal strength with location :ON
S33.Send battery voltage with beacon :ON
S34.Battery Only operation :OFF
S35.Use RF radio :OFF
S36.Charge Until battery full :ON
S38.ADC compensation value :xxxx
```

S30.Send signal strength with beacon
The GSM signal strength is sent with a beacon in dBm. Use 1 to set ON and 0 to set OFF.

S31.Send Firmware version with beacon
You current firmware release version is add to the beacon. Use 1 to set ON and 0 to set OFF.

S32.Send signal strength with location
Same as above but it added to the location packet. Use 1 to set ON and 0 to set OFF.

S33.Send battery voltage with beacon
The internal lithium battery level is sent with the beacon, if the ignition is on the ignition voltage is also sent. Btx.xxV for battery Voltage and Vixx.xxV for the input voltage. Use 1 to set ON and 0 to set OFF.

S34.Battery Only operation
This parameter tells the tracker to not look at the 12V DC present and 'ignition on' signals. Use 1 to set ON and 0 to set OFF.

S35.Use RF radio
A KISS TNC is connected to the radio port. Use 1 to set ON and 0 to set OFF.

S36.Charge Until battery full
When a mobile unit a flat battery can take 5 to 6 hours to fully charge, this will ignore the ignition signal and carry on charging the internal battery until it is full. Parameter S52 will terminate the charge cycle in the input battery voltage falls below the preset value. Use 1 to set ON and 0 to set OFF.

S38.ADC compensation value
Users should not change this value. The CPU used has some ADC quirks when operating in single ended mode and needs a compensation value.

Parameter dump page 4:

```
MAIL settings.
S40.Port    :9002
S41.Server  :aprs.lrlabs.net
S42.Mail To :xxxxx@gmail.com
S43.Retry   :3
S44.low balance (K):1000
S45.Interval (days):0
S46.Send email balance values :OFF
```

Do not change S40 and S41 this is a free service offered by CDS, the main reason here is that changing your simcard would also mean editing and changing SMTP etc settings. All mail from your tracker will originate from aprs.lrlabs.net.
S46 use 1 to set ON and 0 to set OFF.
Note: The total maximum length of field S42 is 40 characters.

Parameter dump page 5:

```
Battery management settings.
S50.Ignition ON Voltage :10.00
S51.Battery recharge low voltage :3.70
S52.Input voltage stop charger :11.00
S53.Charge topup time (minutes) :15
S54.Cellular Provider :0
1-VodaCom,2-Telkom,7-CellC,10-MTN
S55.Cellular APN :
Internet
56.Cellular APN user :

S57.Cellular APN password :

S58.Cellular APN DNS :
0.0.0.0
```

S50.Ignition ON Voltage
Set in 10mV steps, to enter 10,00V the value entered must be 1000

S51.Battery recharge low voltage
Set the point where the lithium battery should be recharged, 10mV steps for entry

S52.Input voltage stop charger
This is the value of the main battery where the charger should be turned off to prevent a flat battery in the vehicle.

S53.Charge top up time (minutes)
This is the time that the tracker should keep the charger on after the charge subsystem has indicated a full battery. We recommend a value of 15 minutes.

S54.Cellular Provider
Enter the numerical cellular provider here, if you use a data card that has roaming this value do need to be set for balance inquiries and telephone number retrieval.

Parameter dump page 6:

```
General settings.
S60.Enable GEO alarm :OFF
S61.GEO alarm radius :0m
```

S60.Enable GEO alarm
When the ignition is in the off position send an alarm event to the server. Note this setting will not work when you are in battery operation mode, the tracker needs to be configured into mobile mode.

S61.GEO alarm radius
Set the desired radius in meters for the alarm condition.

SMS commands:
All commands must be in uppercase, multiple commands can follow each other with no line breaks or spaces in it. The sms driver does not recognize any but the commands listed. These commands are not written to non volatile storage and will be reset to the ROM values when power cycled.

Format is:
CALLSIGN:command=value:

MODE,
Change the tracker mode by sending you mode can be 0, 1 or 2 this changes the tracking mode of the tracker.

ICON,
Change the tracker icon table and icon to the value specified, the first character is the icon table, the second character is the actual icon.

PARAM,
Save parameters to server at aprs.lrlabs.net

UPLOAD,
upload the amount of points to the server for exporting to csv file.

Example:
CALLSIGN:MODE=1:ICON=>5:
This will change the tracker into mode 1 smart beaconing) tracking and change its icon.
See also http://www.aprs.net/vm/DOS/SYMBOLS.HTM

Field upgrade procedure:

Make sure your tracker is fully charged, before attempting a firmware upgrade.

Make sure your usb to serial adapter is plugged in and the appropriate driver installed, make a note of the COMxx device it is mapped to, on a Linux workstation check for /dev/ttyUSBx
Open a terminal emulator and save your parameters in one of the slots provided by the data flash chip (Ps0 to Ps4)

The firmware will be supplied as a file with an extension of HEX. Download the latest avrdude and install it.

Remove the system plug from your tracker and switch the slide switch to the off position. Plug the supplied cable in (gray connector with switch, plugged into tracker).

Press and hold the button on the connector and switch the power on, the status led should show a steady on. Release the button. The tracker is now ready to be programmed.

Copy the hex file to your avrdude directory and open a command screen there.

WINDOWS: To program the flash for a x128a4u device (the RS232 adapter is on COM21):
avrdude -c avr911 -P COM21 -b 115200 -p x128a4u -e -U flash:w:filename.hex

LINUX: (serial port on ttyUSB0):
avrdude -c avr911 -P /dev/ttyUSB0 -b 115200 -p x128a4u -e -U flash:w:filename.hex

WINDOWS: To program the flash for a x64a4u device (the RS232 adapter is on COM21):
avrdude -c avr911 -P COM21 -b 115200 -p x64a4u -e -U flash:w:filename.hex

LINUX: (serial port on ttyUSB0):
avrdude -c avr911 -P /dev/ttyUSB0 -b 115200 -p x64a4u -e -U flash:w:filename.hex

DO NOT BACKUP AND RESTORE EEPROM IMAGES UNLESS SPECIFICALLY INSTRUCTED TO DO SO.
To backup eeprom image:
avrdude -c avr911 -P COM21 -b 115200 -p x128a4u -U eeprom:r:eeprom.hex:i

To restore eeprom image:
avrdude -c avr911 -P COM21 -b 115200 -p x128a4u -U eeprom:w:eeprom.hex

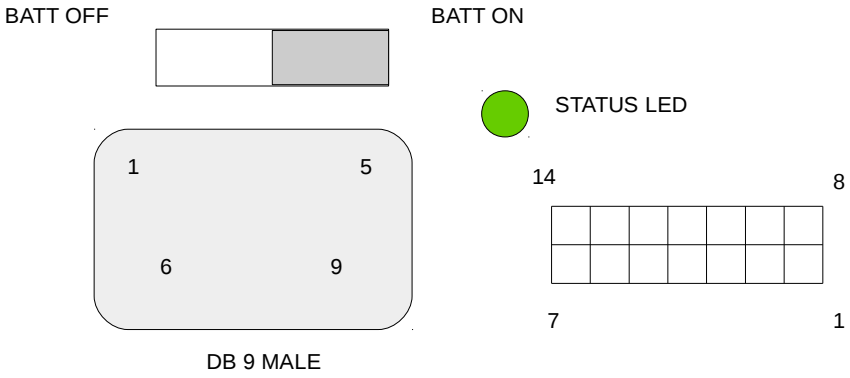
Once your device is reprogrammed the status led will start flashing status codes. Enter the serial emulator again and to a parameter restore by typing Prx where x is the number you used to backup with. IF there was a change in the configuration structure you will receive a message like “Found old configuration, please re-save to update” instead of the normal “Restored” message. This indicates that there was a structural change to the configuration eeprom, please re-save it with the new structure.

Tracker Status codes:
A single flash indicates normal operation.

The status codes is flashed in blocks of 4 flashes. A Short flash is a 0 and a long flash is a 1. The first flash corresponds to the left bit.

0000	0	Charging
0001	1	No data connection
0010	2	aprs authorization failure
0011	3	GPS fail, after multiple soft restarts
0100	4	SIM not ready
0111	7	GPS no lock

Mobile tracker connector layout.



DB9 Female pin-out

2 To pin 2 of computer DB9 RS232 connector
3 To pin 3 of computer DB9 RS232 connector
5 To pin 5 of computer DB9 RS232 connector
7 Fused battery voltage
8 Fused battery voltage
9 Bootloader enable line, short this to pin 8 to enter bootloader mode

14 pin connector

1 +12V battery input
2 RTXD
3 LiIon battery (unfused)
4 +12 ignition sense input
5 Do not connect
6 Do not connect
7 Ground connection
8 +12V battery input
9 RRXD
10 LiIon battery (unfused)
11 Do not connect
12 Do not connect
13 Enable internal power supply, ground to turn switch on
14 Ground connection