Cellular based Remote Vehicle Data Access

Vinayak S. Kumbar, Sneha Bharadwaj, Nagalaxmi B.V, Abhijeet Prem Jetly

0091-80-22440025-vinayak@deindia.com-http://www.deindia.com
0091-80-22440025-snehabharadwaj@deindia.com-http://www.deindia.com
0091-80-22440025-nagalaxmi@deindia.com-http://www.deindia.com
0091-80-22440025-abhijeet@deindia.com-http://www.deindia.com

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Abstract

Remote access to vehicle operational data is a central feature in leveraging next generation telematics services. A challenge with vehicles utilizing complicated computer systems is how to extract the vehicle diagnostic data, evaluate it to expose possible problems and determine how to fix any problems. This paper describes a Cellular based Remote Vehicle Data Access System that provides In-vehicle data access including the diagnostic data on to mobile cellular phones using GPRS technology.

1 Introduction

The Electronic modules provide a diagnostic network interface through a In-Vehicle network protocol (such as KWP2000 and CAN) to read the engine parameters and also monitor the Diagnostic Trouble Codes (DTC's). The DTC's provide valuable information on the faults and also the sub system where the faults have occurred.

The Cellular based Remote Vehicle Data Access System provides In-vehicle data access including the diagnostic data on to mobile cellular phones using GPRS. Using this technique the vehicle owners are able to access their vehicle operational / diagnostic data remotely on the cell phone through Short Message Service (SMS) using an Intelligent gateway or data access system fixed on to the vehicle.

2 Remote Vehicle Data Access System

The Remote Vehicle Data Access System is built on Dearborn Group's Gryphon hardware platform that has modular architecture to support most of the In-Vehicle networks. Gryphon has an Ethernet interface that works on TCP/IP protocol to make it readily enabled through internet for remote connectivity. Gryphon supports almost all the in-vehicle networking protocols such as: CAN, Single Wire CAN, ISO 11992, ISO 11898, LIN, KWP2000, J1850, J1939 and Honda UART. It has a PCMCIA to connect off the shelf GPRS Compact Flash adapter to enable mobile connectivity. It runs on Linux Embedded Operating System and embedded client applications can be written for specific use.

2.1 System Architecture

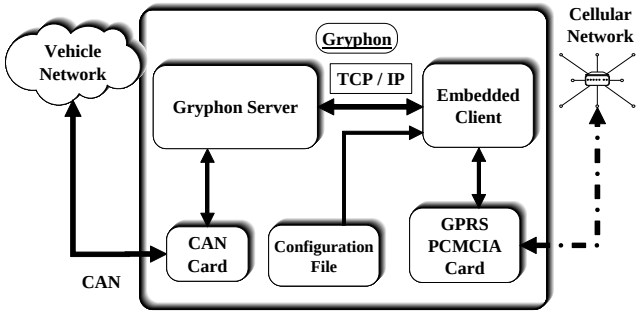

Figure 1: System Architecture

The System architecture is as shown in the Figure 1 above. Gryphon has a server component that runs continuously to accept client application requests and process them. The clients interact with server through sockets on TCP/IP. It supports custom written embedded client applications to be downloaded and executed within it. The embedded client software works as client and interacts with both Vehicle Network and GPRS network.

The embedded client interacts with the Gryphon server to fetch the requested vehicle parameter information. It also interacts with the GPRS PCMCIA card using AT commands [1] to transmit / receive the information to / from the remote station. The information exchange with remote station is through Short Message Service (SMS) protocol. The format of the SMS (Short Message Service) is in the form of a keyword "PARAM" appended with a signal name (example: PARAM Eng_Temp).

The embedded client continuously polls the vehicle network to fetch the latest values of the configured parameters to monitor.

When a mobile user sends SMS requesting Engine Speed, the embedded client receives the information through GPRS CF adapter and decodes the requested information. It compares the decoded signal name with configuration file. If the requested parameter name is configured, it sends the latest signal value from the vehicle network to remote station.

A PC based Windows UI application configures the different parameter information to allow monitoring of the required parameter details. It uploads the configuration data file to Gryphon using FTP protocol. A list of mobile phone numbers can be configured in order to give access to only authorized vehicle owners for vehicle data.

The system can be configured to respond to a request, sending alerts when there is a malfunction and sending periodic data at requested interval from the mobile phone.

2.2 Vehicle Connectivity

The system currently supports Vehicle connectivity through CAN (Controller Area Network) and KWP2000 protocols. The Gryphon unit with embedded client need to be placed inside the vehicle and make necessary vehicle network connections. The connections could be through J1962 connector or any other proprietary connector. Gryphon draws power from the vehicle battery. If vehicle has CAN network then, connect the CAN module on the Gryphon the vehicle CAN bus. If vehicle has KWP2000 as protocol, then connect KWP module on Gryphon to vehicle network.

As soon as system gets powered, it monitors the vehicle network and starts fetching the latest values of the pre-configured parameters from the network.

2.3 GPRS Connectivity

The GPRS connectivity is extended through GPRS CF adapter card fitted into the PCMCIA card slot of the Gryphon.

The embedded client implements AT Commands [1] to communicate to the mobile devices. The configuration file on the Gryphon shall have a list of trusted mobile phone numbers from which the application accepts the connection and communicates back. If the request has come from a non-trusted phone number, then the request is rejected.

2.4 Software

The software has been written for the following capabilities:

- Request for an information on specific vehicle parameter:
  For example: If vehicle speed needs to be known, then send SMS with appropriate command from a trusted phone number, then the system responds with the latest value of vehicle speed monitored over the CAN bus.

- Request for an information on specific vehicle parameter continuously at fixed time interval:
  For example: If fuel level needs to be known continuously at regular time interval, then send SMS with appropriate command from a trusted phone number, then the system responds continuously at regular intervals with the latest value of fuel level.

- Alerts based on an event:
  The system sends alert messages based on the event occurrence.
  For example: If Engine Temperature goes beyond normal value, then the system sends alert messages continuously to the all the mobiles configured.

- Request for Diagnostics Trouble Codes (DTCs): If an SMS is sent to know all current DTCs logged, then system responds with all DTCs stored inside the vehicle to help in diagnosing the problem. This has been implemented through diagnostics service *ReadDiagnosticsTroubleCodesByStatus* with service Id: 0x18.

- Clearing all Diagnostics Trouble Codes (DTCs): If an SMS is sent to clear all DTCs, then system clears all DTCs stored inside the vehicle and sends a notification of the result. This has been implemented using service *ClearDiagnosticsInformation* with service Id: 0x14.

The system consists of two software components:

1. Configuration Software
2. Embedded Client Software

2.4.1 Configuration Software

The PC based configuration software configures the system for:

- Parameters required to monitor with message details lie Identifier, signal location in the message and decoding procedure
- Response type like single response, periodic response or alert based on the event
- With administrator login – the trusted phone number list
- Gryphon and Vehicle Networks specific parameters
- Saving, loading and updating the configuration of the system.

2.4.2 Embedded Client Software

This is main core of the program. This software is written in C and runs as embedded application inside the Gryphon over Linux.

The main module reads the configuration file and stores all required configuration data. Processes the data and exchanges the data between Vehicle Network and GPRS network.

The Vehicle Network Module connects to vehicle bus gets established based on the configured protocol (CAN / KWP2000) and monitors the parameter data through Gryphon Communication (GC) protocol [2]. It stores the processed data into parameter specific buffers.

The GPRS module handles all the mobile communication tasks. This module continuously waits for any user query from the mobile. It processes the request and picks the

parameter specific buffer value and sends back the information to the requested mobile number using SMS.

The system can receive remote diagnostics service requests and sends back the responses.

3 System Setup

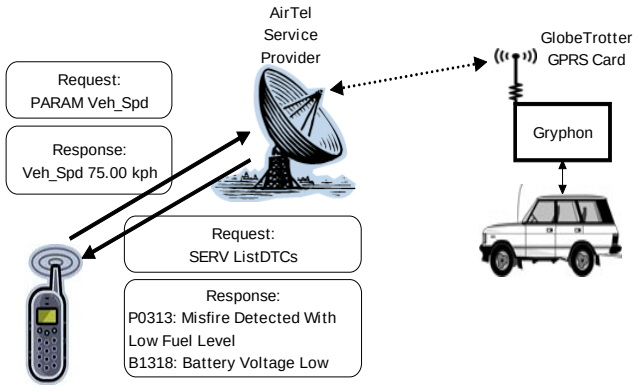

Figure 2: System Setup

The system setup is as shown in above figure. Gryphon is connected to the J1962 connector of the vehicle with Globetrotter GPRS CF card. The AirTel SIM card has been used to communicate using GPRS. The Motorola A760 mobile phone has been used to request parameter values and also to perform remote diagnostics. Some of the parameters like Vehicle Speed, Engine rpm and Engine temperature were monitored remotely. The diagnostics services like Reading the DTCs and Clearing the DTCs were performed remotely.

4 Conclusions

This Remote Data Access System can be used for wide variety of applications, some of them are:

- Remote Diagnostics of the vehicle
- Road side assistance
- Emergency Services
- Vehicle health monitoring
- Fleet Management
- Can be extended with a GPS module to monitor the vehicle location.

Currently system supports GPRS and can be extended to GSM / CDMA technologies by developing scan tool kind of applications on the mobile phones. It can be extended to any other Vehicle protocols. This concept can be realized into small portable hardware that can be mounted to any automotive vehicle to enable remote access. This can extended to have a GPS (Global Positioning System) so that all vehicle parameters including vehicle location can be monitored remotely. This system can be extended to remote vehicle diagnostics and troubleshooting and providing service support.

Acknowledgements

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References

[1] *AT Commands for GSM / GPRS Wireless Modems* from MultiTech Systems.

[2] *Gryphon Communication Protocol specification* from Dearborn Group, USA.