Telematics Overview

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In a nutshell

The next generation of communications technology is being developed behind the steering wheel and, more recently, on the wireless handset. Telematics is an emerging industry that offers location-based voice and data communication tools. In other words, telematics provides "smart" information, tailored to where customers are and to what they are doing -- providing enhanced security, navigation, and convenience to mobile consumers.

1.1 Entities Involved in a typical Telematics System

On-Board device: It is the computing device inside the vehicle on which most of the Telematics software runs. The device need not be interactive therefore might not require a Human machine interface, these devices are generally constrained with memory and computing power.

On-Board Human Machine Interface (HMI): Some of the in vehicle Telematics applications are interactive and therefore require a Human Machine Interface (HMI), such as a console and a keypad or a mike for voice interface.

Communication Service provider: The communication between a moving or stationary vehicle and the rest of the world happens over a wireless network and it requires a provider for that specific network such as GSM & GPRS.

Telematics Services Host: The Host on which the Telematics services and application run to provide two-connectivity, i.e. from the vehicle on one hand and with rest of the connected world on the other hand.

2 Telematics Domain Spectrum

2.1 On-Board Telematics H/w equipments

The most essential components for any Telematics system are the in-vehicle hardware devices, which ranges from a computing device for running an application to a network & communication devices. Following are some of the device types:

2.1.1 Computing Device optionally with HMI (Console, Keypad or Mike)

All the on-board Telematics application requires some hardware to run on which are generally low-end computing devices and they can also have specialized hardware for HMI. Hitachi & Motorola provides some of the popular in-vehicle microprocessor devices.

2.1.2 GPS Receiver

The nominal GPS Operational Constellation consists of 24 satellites that orbit the earth in 12 hours these Satellites or Space Vehicles (SVs) send radio signals to the GPS receiver, which convert these signals into position, velocity, and time estimates. Four satellites are required to compute the four dimensions of X, Y, Z (position) and Time. Vendors provide devices, which work on this simple principle but could additionally provide sophisticated features like Maps and driving directions by just making use of this positioning information.

2.1.3 Vehicle bus interface

With the enactment of increasingly stricter emissions laws, sophisticated Engine control & On-Board devices were built in vehicles, which gathers analog data through various sensors convert them in digital forms, process it and subsequently control the various aspects of vehicle like regulating air fuel mixtures in engine. The digital data can also be transmitted to common modules through a communication bus for Diagnostic purposes using communication standards such as Controller Area Network (CAN). Many Telematics hardware vendors provides hardware interface for these existing communication bus in vehicles.

2.1.4 Infotainment Devices

Some vendors provides in-vehicle devices for information and entertainment such as streaming video player, MP3 players, Hands free phones and touch screen terminals.

2.1.5 LAN interfaces

With more and more devices getting inside the vehicles the vehicle becomes a networked environment and to communicate among these devices a Standard Wire-less or Wire-line network environment should be available such as BlueTooth, 802.11b, IEEE 1394 & MOST. Therefore the devices need to have hardware interface for such standard networks.

2.1.6 Long-range Wireless Interface

For certain functionalities such as remote door-unlock, Traffic information and Direction Assistance in a moving or stationary vehicle it becomes necessary to communicate over long-range wireless networks with central host servers providing these services. Therefore these devices need to provide hardware interface for the wireless networks such as GSM, GPRS & TDMA/CDMA.

2.2 Real Time Operating System

Most of the devices inside the vehicle not only have less computing power as compared to PCs, but also needs to support real-time systems where correctness depends not only on the correctness of the logical

result but also on the result delivery time, There are many Operating systems based on this concepts, which also takes into consideration the small memory footprint and various microprocessor architectures, popular ones being QNX Nutrino, VxWorks & Windows CE.

2.3 Application Environment

Although end-user application can be built over the low-level Operating systems interfaces and languages, but in order to reduce the development effort, enhance the deployment ease, achieve application portability & to provide a robust & scalable runtime support an application environment becomes essential. There are lots of them, and most popular being Java and .NET, the interesting part about these environments is, their availability for both embedded and Host platforms.

2.4 Communication Stacks

Telematics systems are networked systems and needs to interact with other system over short range and mid range wired/wireless network protocols and for this communication protocol stacks are required for each type of protocols, these protocol stacks are generally based on the OSI –Layer model. Some of the lower layers are provided by vendors of Network Hardware Interfaces and the rest are either provided by another vendor or are developed along with the Application since each application might requires a different way of exchanging information with other applications.

2.5 Application Frameworks

Advances Telematics application/services requires some basic features such as bundling, deployment, management, standardization, extensibility, state management, thread management, transaction management & remote communication, there are platforms and frameworks which provide these set of features for developing and deploying next generation Telematics applications over and above them. Popular platforms for Embedded side are Java Embedded Server & Car.NET whereas for host side J2EE and .NET are some of them. There are Frameworks, which additionally provides common Telematics domain specific services thereby shortening the time to market a new Telematics application/service using these frameworks. Few of them are OSGi based Acunia & Gatespace Telematics framework.

2.6 Telematics Applications

Telematics applications and services are broadly divided into two categories On-Board and Off-Board or in other words the ones running inside the vehicle and the others running on the host.

2.6.1 On-Board Applications

On-Board applications can be divided into ones, which are standalone and the ones, which communicates with the Host for the desired functionality. Another way of categorizing could be based on interactive Applications for in-vehicle passengers and non-interactive applications primarily for exchanging vehicle information with remote users. There are innumerable On-board interactive applications, but they are primarily targeting passengers in the various physical Vehicle Zones Viz. Driver Zone, Front Seat Passenger Zone & Rear Seat Passenger Zone.

Driver Zone: The Driver and Front Seat Passenger share the same computing interface but can interact with it in different fashions. Drivers should stay focused on interacting with the vehicle controls and the road ahead. The Driver Zone applications need to be an integral part of the driver's space, to enhance it but not intrude on it. Therefore the driver of the vehicle has to interact with the computing environment utilizing speech commands and to retrieve information via audible Text-to-Speech technology from the computer. There can be a visual display within the driver's vision but it should be only used for extra visual clues as to the status of a request.

Front Seat Passenger Zone: Since the Front-Seat Passenger shares the same interaction interface as of Driver, they can interact with the system utilizing push buttons located on the sides of the display. In this way, when a passenger is present, they can act as Telematics navigators for the driver or enter personal requests into the system.

Rear-Seat Passenger Zone: These Zones are essentially equal zones with separate computing interfaces. In this way each rear cabin passenger can have his or her own interface with full-fledged keypad, Monitor and Multimedia Devices. The applications can range Personal Home Management to Infotainment.

Following is list of some of the On-Board Application/Services (Interactive/Non-Interactive):

- Route Guidance (Dynamic Navigation)
- Concierge Services (Tickets, Restaurants & Hotel Reservations)
- Roadside Assistance & Emergency Response
- Mobile Commerce
- Personal Calling
- Internet Radio, Music & Movie Downloads

2.6.2 Off-Board Applications

Off-Board services are generally targeted for Telematics Service providers (TSPs) and they essentially run on Host servers of TSPs. The services and applications provided are broadly categorized into two, Ones that provided information/services to the On-Board applications such as Route Guidance & Concierge Services. The others are the ones, which provide interface to vehicle for Remote Users these can be further divided into ones, which provide User & vehicle online information exchange such as Remote Door Lock/Unlock and the ones, which provide Historical vehicle information to the Users such as Driver Behavior. Following is the list of some of the Off-Board Services:

- Remote Diagnostics & Vehicle Health
- Automatic Vehicle Location
- Fleet Management
- Automatic Collision Notification
- Remote Door Lock/Unlock
- Location Based Services (Nearest Hotel, Filling Station & Hospital)
- Legacy Application Integration (e.g. Driver Behavior with Insurance System)

2.7 Telematics Standards

With Telematics becoming the next generation Application lot of Telematics system vendors and Original Equipment Manufacturers (OEMs) have emerged providing different categories of Telematics products thereby making it necessary for them to follow certain standards to interoperate between different products, unless until an end to end complete product is provided by a Single vendor. Today there are many standards followed by the Telematics industry important ones among them being AMI-C & OSGi.

2.7.1 AMI-C

Stands for Automotive Multimedia Interface Collaboration, which is a consortium of companies together working on to develop a core set of enabling design specifications for Mobile Information and Automotive Multimedia Following are the key work-products of AMI-C which are either in process of being developed or are already developed:

- Telematics Application Requirements/Use-Cases; Already Developed

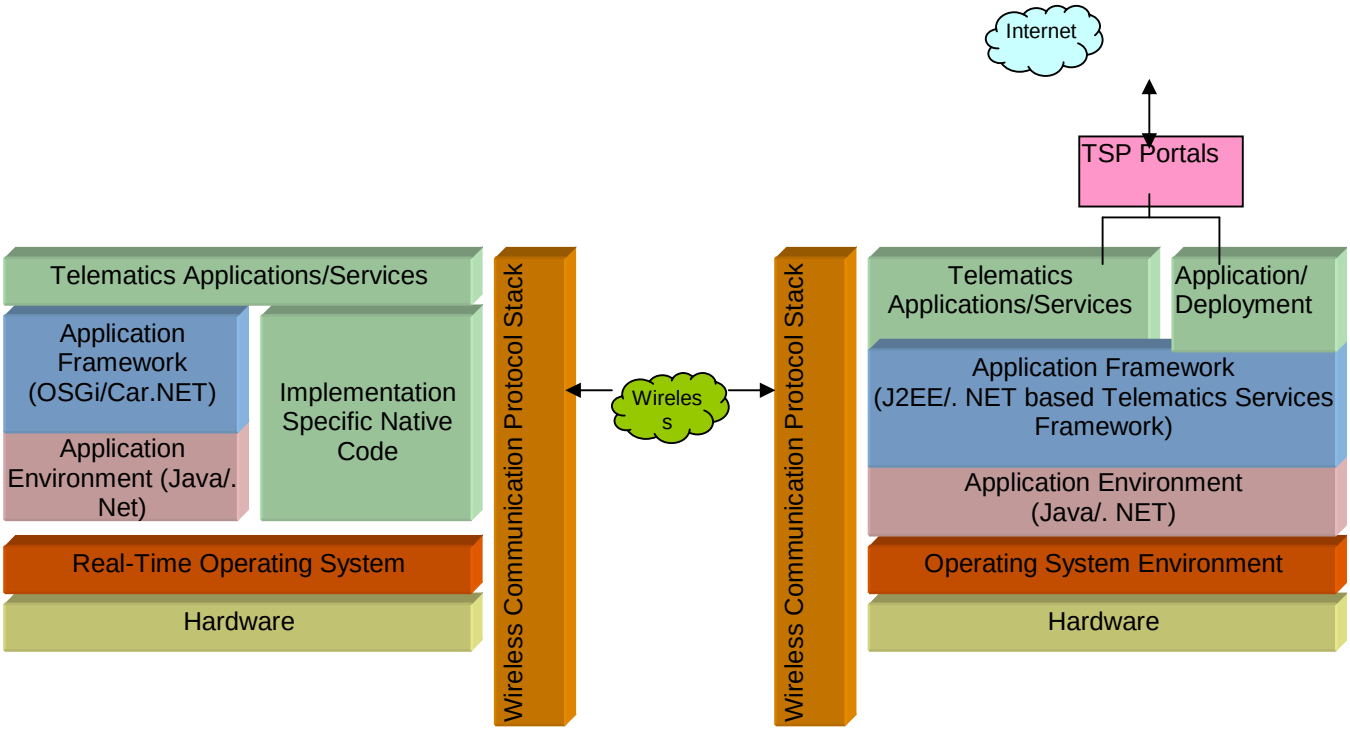
- Recommended Telematics Software Environment, Architecture and Programming Guidelines; To be Developed.
- Communication Models (HOST, 1394-AUTO and BlueTooth); Already Developed.
- Vehicle Interface & Common Message Sets; Already Developed.
- AMI-C Reference Implementation; To be developed
- AMI-C Test and Validation Tools; To be developed

2.7.2 OSGi

Stands for Open Services Gateway Interface it is again a consortium of over 80 companies developing standards for the next generation Internet services to Homes, Cars, Small Offices and Other Environments. The purpose of Specification is to provide an open, common architecture for service providers, developers, software vendors, gateway operators and equipment vendors to develop, deploy and manage services in a coordinated fashion. The initial OSGi specification consists of Java APIs and a clear and concise definition of their semantics. The release 1.0 of the OSGi specifications included the framework and three basic service specifications:

- Logging
- A web server
- Device access

OSGi Services framework provides an environment for electronically downloadable services, called bundles. Deployed bundles are executed inside that framework and find a well-defined and protected execution environment. This environment includes a Java runtime and adds life cycle management, persistent data storage, version management and a service registry. Services are Java objects implementing a concisely defined interface. In the upcoming release 2.0, the OSGi will improve and extend these existing APIs and add a minimum execution environment specification.



In-Vehicle Telematics System Stack

Telematics Service Provider Host System Stack

2.7.3 Application Communication Protocol (ACP) and Global Automotive Telematics Standard (GATS)

ACP and GATS are the two leading protocols for delivering Telematics services to the vehicle. These have been developed by Telematics forum. Both protocols have enjoyed rapid take-up by the market as many OEMs use them for their telematics products. But as the value of telematics lies in the applications (customers do not care about which protocol is implemented in their terminal), the competition between ACP and GATS have been harmful. Telematics Forum has now announced the converge of the two. The activity will lead to a new, combined protocol that will be promoted as a worldwide standard.