Michael L. Sena Consulting AB

Mobility Research Special Report

DATA STRATEGY FOR TELEMATICS

Data Strategy White Paper

Report Prepared for:

Internal Usage

Author:	Michael L. Sena
Original Date of Writing:	11 July 2006
Revision Date:	18 November 2006
Number:	002
Recipients:	
Date Provided:	

(REF:Data Strategy White Paper

Table of Contents

Data Strategy for Telematics

1. Executive Summary

1.1. Purpose

This White Paper identifies the principal issues that should be considered when designing, developing and implementing a vehicle-related data strategy.

1.2. Expected Results

Proprietary

1.3. Major Findings

Proprietary

1.4. Recommendations

Proprietary

2. Automotive Data Service Delivery in Europe

2.1. What is Telematics

Telematics is two-way communications between a vehicle and a service center, or between a vehicle and another vehicle. Data communications is a pre-requisite for all services. Voice communications is necessary for some functions, desirable for others, and non-essential for most. Adding a positioning device in the vehicle and mapping capabilities at the service center enables a range of location-based services to be provided. Telematics services can be vehicle-centric, driver-centric and/or passenger centric, but in all cases telematics refers to services which are delivered to a vehicle to enhance safety, security and comfort, and from a vehicle to provide information about the vehicle, its passengers or the vehicle's interaction with the transportation infrastructure.

Telematics is not a trend or name for a new product. Telematics is a set of technologies that deliver services related to a specific location to wireless devices. These technologies are having a profound effect on the automobile and automotive services industries, and these effects are reaching into the home and business, positively changing the way we do things.

The term *telematics* was originally said to be a combination of telecommunications and informatics, the latter word referring to "the making of information". Literally, *telematics* as derived from the Greek root *tele*, meaning "far off" or "distant", and the Roman root *matic*, meaning "to make happen", means "to make something happen at a distance". I have modified and extended the definition during the past ten years since I first used the term in a report for Volvo Car Corporation in 1996. I have seen it used in market reports describing *autonomous navigation systems* (i.e., navigation systems that contain all map data on media directly inserted in the device, and that do not include dynamic traffic information delivered via FM or wireless telecommunications), as well as in the context of service delivery to wireless devices outside the vehicle environment, such as server-based map delivery and navigation on smart phones.

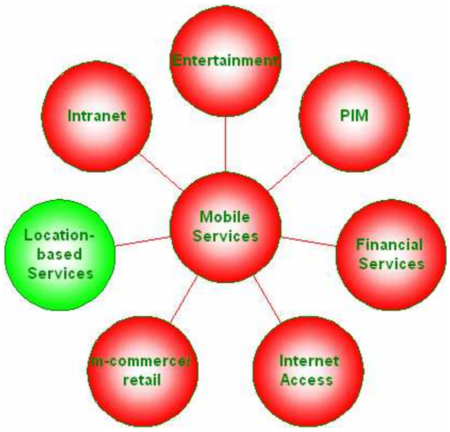
I do not include these applications in my definition of telematics. In my opinion, limiting the definition of *telematics* to the vehicle has the advantage of focusing our attention on three special conditions:

- High-speed movement (as opposed to stationary or walking users) and its impact on both service delivery and connectivity;

- The provision of services to a person engaged in driving a vehicle; and,

- The interface between internal vehicle systems and the communications and positioning device, and the different types of services that can be delivered depending on the degree of their integration.

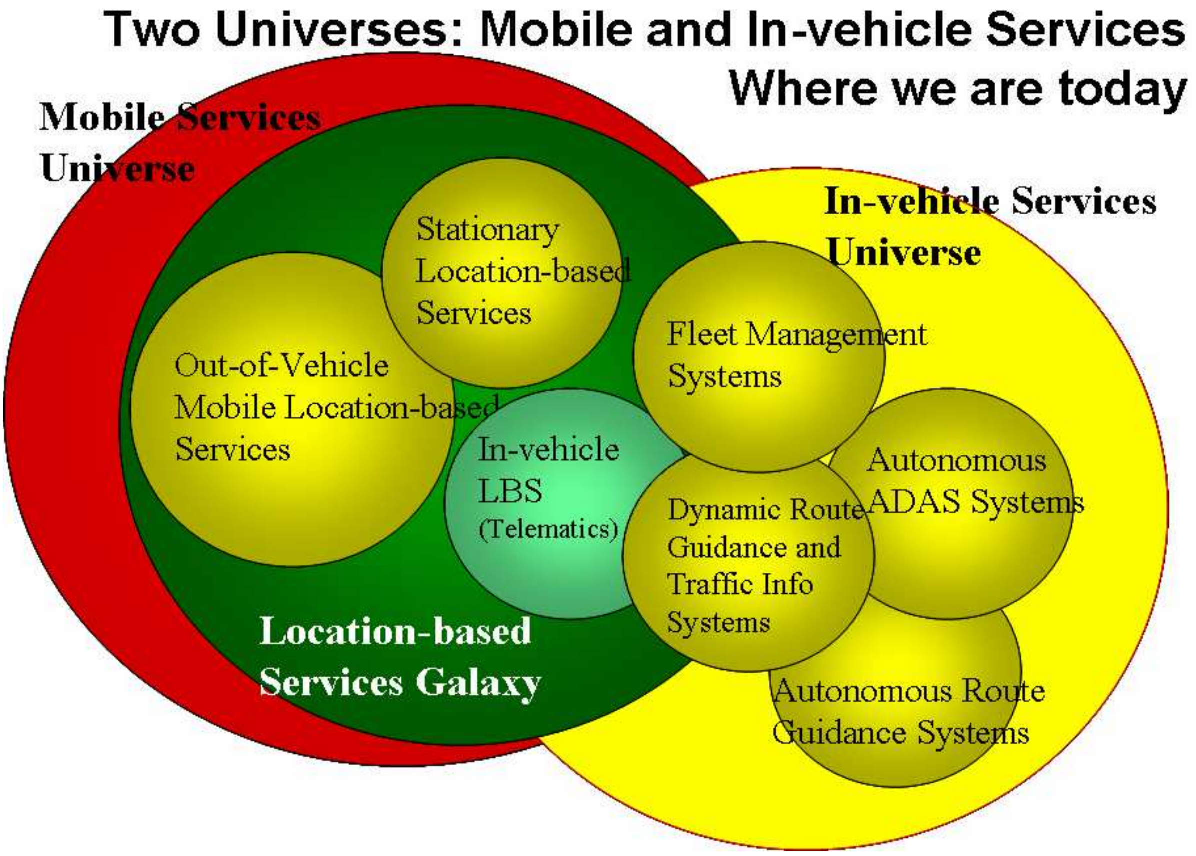
What about one-way communications, such as delivering traffic information to the vehicle via RDS-TMC, or sending information from the vehicle, such as roads travelled for tolling or car insurance applications, without sending any data back to the vehicle? Can these also be considered telematics, and if not, what are they? Rather than trying to expand the definition of telematics, I find it more useful to place telematics in the context of other location-based services straddling the Mobile Services and In-vehicle Services universes.



Mobile Services

- Intranet
- Entertainment
- Personal Information Management
- Financial Services
- Internet and e-mail
- M-commerce and online retail
- Location-based Services

The mobile services universe consists of seven principal areas. Location-based services is one of the seven, and it includes telematics. Services within the other six can be delivered without reference to a specific location, such as providing Internet access to a mobile device, downloading of music and videos or broadcasting TV, on-line shopping and stock quotes. Some of these services can be given a location reference and become an LBS, such as location-sensitive messages on items for sale or entertainment events. In-vehicle Services universes.



There are growing numbers of services, with and without location, that can be delivered to mobile devices, both inside and outside of vehicles. There are also growing numbers of in-vehicle services, both with and without wireless communications services. Where these two universes overlap is what I define as the domain of telematics. Outside the overlap area are <u>non-vehicle mobile services</u> and <u>non-mobile in-vehicle services.</u> They share content and technologies, such as map data and georeferencing tools, and they share companies who have offering in one or more of the areas. Working in one arena does not exclude working in the others.

The original *<u>technology</u>* concept for telematics (i.e. wireless communication with position transfer between a vehicle and a service center) was developed by Ford Motor Company, or at least their filing for U.S. and European patents would indicate that they believed they were the inventors of telematics.[1] Ford worked in cooperation with Motorola and Westinghouse Security Services. Motorola built the in-vehicle device that integrated wireless communications and a GPS device.

[1] European Patent Application Number EP 0 789 498 A3, 06.05.1999 (May 6, 1999). The original date of filing was December 11, 1996. The applicant is listed as Ford Motor Company, Dearborn, MI, and the inventors are Garth Stephen, Mark Timm and Walter Dorfstatter.

Westinghouse Security Services built the service center for managing the messages from and to the vehicle. The Ford Lincoln ***RESCU*** system service went live in 1996. It was followed shortly after by General Motor's ***OnStar*** service for the Cadillac that was developed for GM by their subsidiary at the time, EDS.

Between 1996 and 2002, most car manufacturers either had operational telematics programs, were in the process of developing systems and services, or had evaluated the requirements and decided to wait for a more opportune time to implement. Companies with active telematics programs in Europe at that time were: Volvo, Ford, Renault, VW, Audi, GM, Mercedes, BMW and Fiat. By the end of 2002, Ford, Renault and VW had halted their European programs. In North America, the active companies in telematics were: Volvo, GM, BMW, Mercedes, Saab, Nissan Infinity, Toyota Lexus, Honda Acura, Subaru, Audi, Jaguar, and Lincoln.

In June 2002, an event occurred that shook the confidence of the nascent telematics industry at its foundations. Ford closed *Wingcast*, its telematics joint venture with Qualcomm. Ford had already spent over $100 million in Wingcast, and Qualcomm had invested a further $25 million. The venture had asked for a further infusion of capital equal to the amount already spent to carry it through to product release. Ford's new CEO, William Clay Ford, who had recently replaced Jac(ques) Nasser, made the closing one of his first acts after he took over. Wingcast had been a cornerstone of Nasser's determined effort to convert Ford from an automobile assembler to an information company. Bill Ford claimed that the closing of Wingcast did not reduce the company's commitment to and belief in telematics. It was merely a decision that Ford did not need to own the service infrastructure, as Nasser had thought. Nevertheless, many business analysts, the press, and most importantly, investors, took Ford's actions as a sign that telematics was not the next big thing after the Internet, and either they lost interest or turned negative toward telematics and its proponents.

Almost overnight, the entire industry appeared <u>from the outside</u> to have pushed the break pedal with both feet. Was it entering an over-wintering mode from which it would emerge like a hibernating bear the next spring, or would it just go on sleeping for a few dozen more years like Washington Irving's *Rip Van Winkle* in the short story of the same name?

It turned out that it was a little bit of both. The engineering research and development departments in Detroit, Stuttgart, Gothenburg and Paris kept on working, rethinking their strategies and building newer and better systems. Budgets were much harder to justify, but work on all aspects of telematics continued. Even Renault and Ford, who had stopped the commercialisations of their respective telematics systems, re-organised their activities under new management and focused on laying the proper groundwork for both services and the in-vehicle systems through a co-operative effort between the two companies in conjunction with a third, PSA Peugeot Citroën, in a venture called *Signant*. While this venture was cancelled in January, 2004, it appears to have been due to differences in company philosophies than lack of support of telematics. PSA announced its new telematics services in the third quarter of the same year, which they began rolling out the following year. Renault continued with in-house developments, although at a much reduced scale, and Ford shut down all telematics activity.

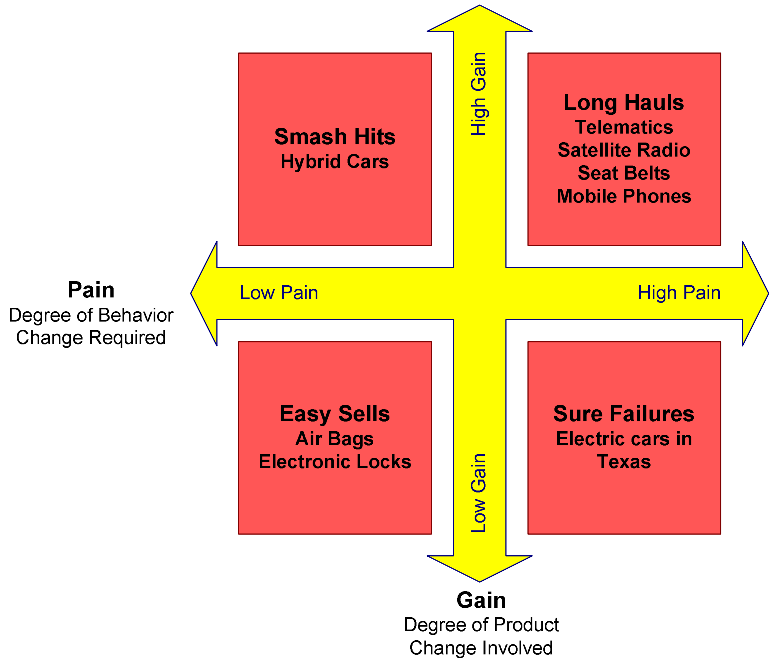
Telematics is still in its adolescent stage of development, with second-generation systems developed for the European market in the fourth quarter of 2003 by DaimlerChrysler, PSA and BMW[2]. These systems, both in the vehicle and in the service infrastructure, look very similar to the Volvo On Call system, with a central telematics service provider receiving the data message and directing this message to the appropriate service provider.

DaimlerChrysler with T-Systems (formerly Tegaron) and BMW with ATX Europe (formerly Vodafone Passo), adopted Volvo's approach developed together with WirelessCar. Both companies were working with one of Volvo's customer service center providers, Mondial, to offer similar services as the *Volvo On Call* system. General Motor's *OnStar* Europe introduced its new systems in 2004, and these too looked similar to the Volvo/WirelessCar solution. But then DaimlerChrysler halted its entire European roll-out in the Spring of 2004, and GM halted the entire *OnStar* program as of 1 January 2005.

Companies that started and stopped their telematics developments were those that were looking at the new technologies as "easy sells" or "smash hits", rather than truly appreciating the amount of behaviour change that would be required by car buyers to appreciate their real value. Purchasing a Toyota *Prius* requires no behaviour change whatsoever. The vehicle is still taken to the filling station for refuelling, only there are fewer of these inconvenient trips to be made (gain). The annual cost of fuel is therefore lower (gain). The car costs a bit more than a non-hybrid (pain), but the owner feels better about driving a fuel-efficient vehicle,

[2] First Generation Telematics system were single country systems, with no international roaming, no transaction billing, and limited voice functions with call-backs to the vehicle the common method of voice interaction. Second Generation systems include two-way voice and data communications, full safety and security services, and many convenience services.

and doing his or her part to save the environment and reduce dependence on foreign oil (big psychological gain). Electric-only cars require a huge change in behaviour, especially in places where cars are driven long distances and where there are long-standing interests in the status quo, such as Texas. The owner has to make sure that there are re-charging stations along the route and in the vicinity of the destination. The trip must be planned so that time for re-charging is allowed if it is longer than a certain distance. In practical terms, owning an electric car is only possible if the owner can drive the car home each evening.



Telematics systems and services are, like satellite radio, seat belts and even mobile phones were at the time of their introductions, innovations that will take time for consumers to first understand, and then begin to demand from their car manufacturers. Those companies that tailor their introductions for the “long haul” will eventually be rewarded.

In spite of other companies’ setbacks, BMW, PSA, Fiat and Volvo appear committed to a European-wide rollout. Volvo now has service in fourteen European countries, with call centers in Sweden, U.K., Italy, France, The Netherlands and Belgium. BMW has service in Germany, U.K. and Italy, and will soon be offering their system in additional markets. PSA is available in six European cities, and Fiat bConnect can be purchased anywhere in Europe.

All of these developments are downplayed by the car companies, just like the industry has been very cautious about discussing their telematics plans in public and at conferences. Their telematics managers, when they do make public statements, have stopped talking about telematics as a moneymaking service opportunity. It is a service option and a customer service feature, they say, offered in conjunction with a built-in hands-free telephone and/or a navigation system.

Automotive OEM-supplied Telematics

Purpose

To allow the car and the driver to communicate with other cars, other drivers and the transportation service infrastructure.

Alternatives

• Stopping to find a telephone booth and hooking up a cable from the car with a dial-up modem.

Prerequisites

• A communications device integrated with the vehicle's systems.

• Connectivity across all possible boundaries (physical, technological, jurisdictional).

• A functioning service infrastructure

User's Value Proposition

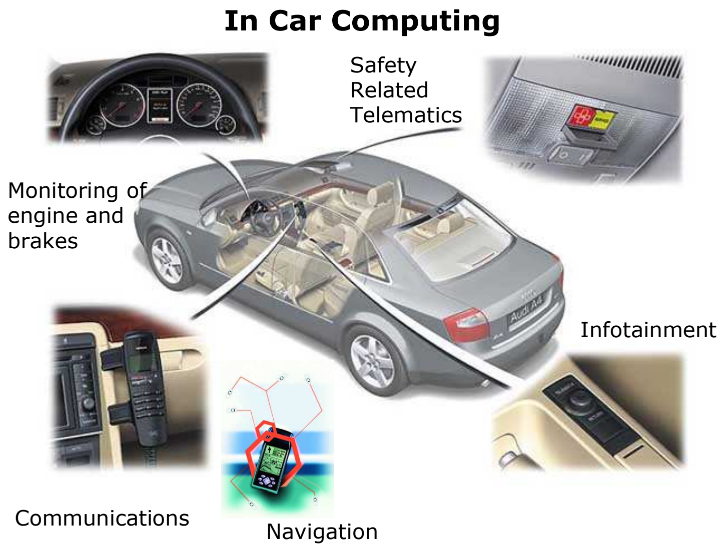
A trade-off between the chances of having an accident or a mechanical problem, or requiring some form of emergency assistance and the cost of connectivity

The Automotive Company's Value Proposition

Enable ITS. No ITS without connectivity

Volvo's approach in the UK serves as a good example of how telematics is being re-positioned. *Volvo On Call* is currently sold in the UK as part of a so-called "communications package", that includes the hands-free telephone with Volvo On Call buttons, the DVD-based *RTI navigation* system, and a high-end audio system. Total cost for this package is approximately £2650. The VOC system adds £300 to the package, which without it is £2350. The customer receives one year free subscription with 25 free minutes for the year, one free SOS call and one free roadside assistance call. The customer will be obliged to pay for additional services, such as remote door unlock or stolen vehicle tracking, using a direct debit account set up with Volvo. Subscription to VOC services will continue in the second year and subsequent years automatically unless the customer specifically cancels, and the customer will pay approximately £8 per month for the subscription after the first year.

I do not believe that most car company executives ever viewed telematics systems as differentiators that would help to sell vehicles—or determine whether a new model would be a success or failure. Volvo's decision not to include *Volvo On Call* from the outset in their new flagship product, the XC90, when it was first introduced is a clear indication that the industry did not see the inclusion or exclusion of telematics as a critical sales feature. (The XC90 was subsequently fitted with Volvo On Call, and it is the vehicle that is sold most often with the option.) Even Jac Nasser's vision of a future Ford with Wingcast at its center was not car-centric. Wingcast would deliver location-based services to consumers, and the car would be just one of the methods of receiving this information. Telematics was just one of the many features that their cars would have.



Source: Enea Embedded Technology AB

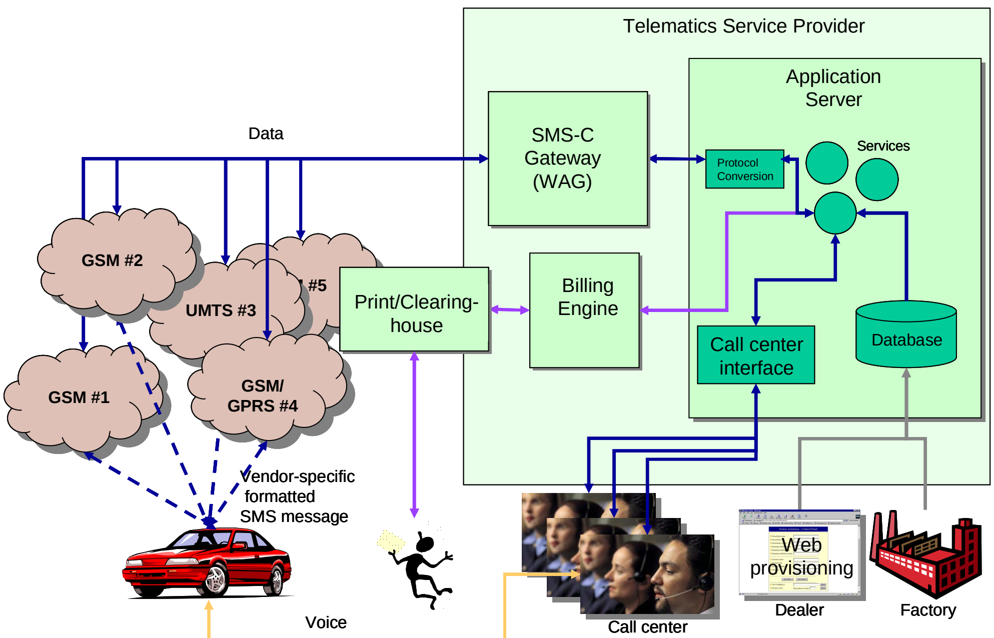
Although they may not have seen telematics as a differentiator, car company executives have been unclear about their views on whether telematics would become a necessary feature (standard fit), or an option that they would have to develop and offer. There is a major difference between a standard fit differentiator and a must have option. The standard fit differentiator, like side impact air bags or skid control, helps buyers decide between one brand and another. For example, an American buyer might pay more to buy a Volvo S80 rather than an Oldsmobile because it has these features as standard fit. A must have option, if not available, usually does not discourage a buyer who truly wants a particular car, like the Volvo XC90, but their absence does make the buyers less enthusiastic about the brand, and probably would cause them to buy another brand next time if other aspects of the vehicle did not live up to expectations. The exclusion might also cause them to not recommend the car to friends.

Today, car makers in all major markets cannot deliver their luxury models without a navigation system—either as a standard fit or as a customer option—but up until late 2005, they could still deliver these models without telematics. And there still is no consensus among the OEMs about whether telematics is essential as a must have option, either at the luxury segment level or at the mass market level.

What companies like Ford, GM, Renault, PSA, Fiat, Volkswagen and the Japanese manufacturers do in Europe during the next three years will determine whether telematics will reach mass market status by the end of this century's first decade, or whether, like route guidance systems, it will continue to be a luxury brand item until it is replaced by the new, "disruptive" technology, the portable devices. Sales of devices like TomTom rose from just 700,000 units in 2003 to 7 million in 2005. During the same time, integrated navigation system sales rose from 1.1 million to 1.7 million. The portable units offer similar functionality as the integrated units at a price that is 70-90% lower.

Like route guidance, telematics must be proven as a functioning technology. The companies involved in the system and service delivery chain—service companies like WirelessCar, ATX and Mondial, and system companies like Motorola, Siemens, Blaupunkt and Autoliv, who have the most to gain or lose by the success of failure of telematics—will determine the future of the telematics. If the systems work and if the services are delivered efficiently and cost-effectively, the car companies will continue to develop and install them. If the systems do not work—or if the services do not meet or exceed customers' expectations—telematics will go into a long period of hibernation.

Telematics Service Delivery



2.2. What are the current applications

2.2.1. Possible In-vehicle Services on Different Types of Devices

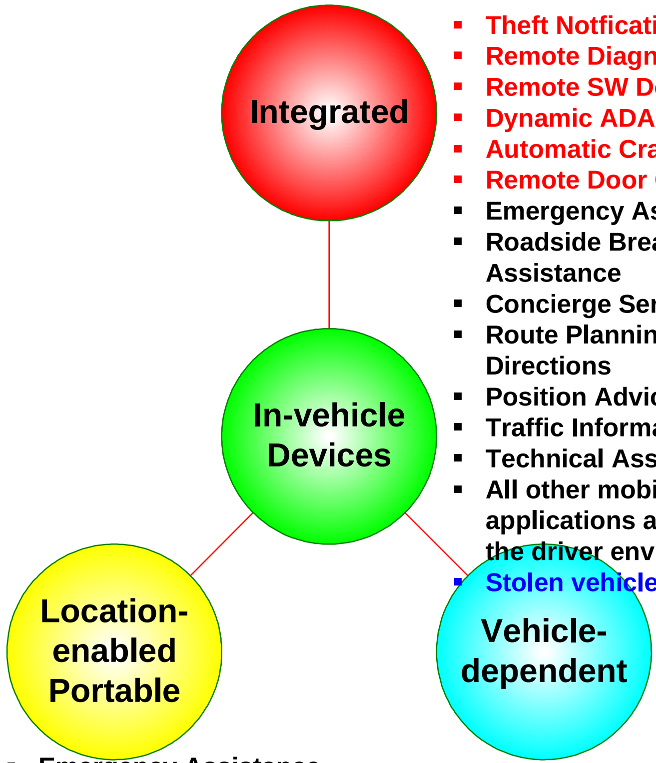
The types of services offered are in part a function of the type of device to which they are delivered. There are three types of in-vehicle devices: Integrated; Vehicle-dependent and Location-enabled Portable. Using the example of navigation systems, an integrated navigation systems is entirely built into the vehicle by the manufacturer in the factory. A Vehicle-dependent navigation system is a Bosch TravelPilot or Siemens Dayton aftermarket system. These devices must be connected to vehicle systems to function, and they do not function outside of the vehicle.

Location-enabled Portable devices include the portable telephones or PDAs with built-in GPS units or Bluetooth connections to GPS. They also include the very popular TomTom, Navigon and other portable navigation devices. Volvo On Call and BMW Assist are examples of Integrated telematics systems. ADAC, the German automobile club, has offered its members a three-button dedicated Vehicle-dependent telematics device. A number of network operators in Europe and the U.S. (e.g. Orange, Vodafone, Sprint), along with companies like Rand McNally, MapQuest, Michelin and others offer location-enabled services on phones.

The vehicle OEM as the single controller of the telematics customer relationship is a temporary phenomenon. I believe that the OEMs will leave the convenience service side of telematics as soon as they have built the necessary infrastructure to provide the safety and security functions and have the systems in place to do the things that they are really building in the telematics systems to do. In the bubble diagram above, these are the items in red:

- Theft Notification
- Remote Diagnostics
- Remote Software Download
- Dynamic Advanced Driver Assistance Systems (using map data)
- Automatic Crash Notification (ACN)
- Remote Door Control

These services require integration with the vehicle systems, and the OEM will either need to control them completely, or work with systems and services providers who will deliver them to customers.



- Theft Notfication
- Remote Diagnostcs
- Remote SW Download
- Dynamic ADAS
- Automatic Crash Notif.
- Remote Door Control
- Emergency Assistance
- Roadside Breakdown Assistance
- Concierge Services
- Route Planning and Directions
- Position Advice
- Traffic Information
- Technical Assistance
- All other mobile applications adapted to the driver environment
- Stolen vehicle tracking

- Emergency Assistance
- Roadside Breakdown Assistance
- Concierge Services
- Route Planning and Directions
- Position Advice
- Traffic Information
- Technical Assistance
- All other mobile applications adapted to the driver environment
- Non-vehicle-based services

- Emergency Assistance
- Roadside Breakdown Assistance
- Concierge Services
- Route Planning and Directions
- Position Advice
- Traffic Information
- Technical Assistance
- All other mobile applications adapted to the driver environment
- Stolen vehicle tracking

Emergency assistance is a function that can be provided in multiple ways, including by a totally portable device if the service is for a person and not connected to a vehicle. Integrated solutions for vehicles are the most secure, but regulations may mandate other technical solutions. Stolen vehicle tracking requires integration, either at the factory or at an installation point, to ensure the integrity of the system. So SVT can be provided by the OEM as a factory fit, or by an aftermarket supplier.

Another way of categorising services is by dividing them between those that require or benefit from operator assistance and those that can be automated, and those that are vehicle-based versus those that are driver-based. Operator-based services tend to be the most expensive to deliver. Automated services require a high level of system integration and sophisticated technology.

	Operator-based	Automated
Vehicle-based	Emergency Services Roadside Assistance Theft Notification Stolen Vehicle Tracking Technical Assistance	Remote Diagnostics Dynamic Advanced Driver Assistance Systems Remote Door Controls Automated Tolling
Driver-based	Concierge Services Route Planning and Directions Traffic and Traveller Info Position Advice	Route Planning and Directions Traffic and Traveller Information Postion Advice All other mobile services adapted to the driver environment

There is yet another way of categorising services, and that is to view them as relationships between the car, the driver and various service providers. Cars or trucks can communicate with other cars or trucks to avoid collisions. Advanced Driver Assistance Systems are being developed to allow the car to communicate with and assist the driver, such as when the driver dozes off at the wheel, or when the speed of the car exceeds the legal limit.

Services-to-Car and Services-to-Driver are the two areas where satellite digital radio can supplement existing telecommunications technologies. GSM technology can easily manage communications for simple tasks, such as remote door unlocking, and RDS-TMC is serviceable for basic traffic and weather information alerts. But for data-intensive tasks, such as remote database updates, remote software updates and fixes, and full traffic flow information, higher bit rates are needed. Even more important is the reliability of the connection between the service provider and all vehicles. Satellite digital radio can meet these difficult requirements.

The Car-Driver-Services Matrix

	Car	Driver	Services
Car	*Collision Avoidance*	*Wake-up Call* *Intelligent Speed Adaptation* *Steering Assistance* *Breaking Assistance*	*Theft Notification* *Automatic Emergence Assistance* *Toll Payments*
Driver	*Environmental Control* *Steering* *Breaking* *Acceleration* *Shifting* *Audio Controls*	*Traffic Warnings* *Signal Driver Intentions* *Location Identification*	*Manual Emergency Assistance* *Information Request*
Services	*Remote Door Unlock* *Stolen Vehicle Tracking* *Remote Diagostics* *Remote Repair* *Remote Database Update*	*Traffic Alerts* *Location Assistance* *Navigation* *Weather Alerts* *All Mobile Services* *Information Delivery*	*Ambulance* *Roadside Assistance* *Police* *Fire*

2.2.2. Non-vehicle-dependent Telematics Services

It is worthwhile looking at services that can be delivered outside the vehicle in order to identify areas where portable satellite digital radio-enabled devices can provide a complement to the in-vehicle systems.

2.2.2.1 Home

Personal Alarm – As more elderly and infirmed people live alone in their homes and apartments, rather than with caretakers or in service facilities, personal alarms serve an increasingly important function. The current devices are simple radio signallers that send a short alert message with the device ID. The address of the user of the device is recorded in a database. These simple systems work as long as the user is in or near the home because the devices are not location-enabled. Placing a geographic positioning module into the device so that it can be used anywhere is becoming both practical and affordable.

Home Alarm – Home security alarms are GSM/SMS/GPRS-based today in Europe. Vodafone Sweden is one of the largest suppliers of SIM-cards to this application primarily based on its contract with Securitas Alert Services for their home security systems in all markets where they are active.

The Vodafone Sweden Telematics Business Group that is supplying the SIM-cards to Securitas is the same group supplying SIM-cards to Volvo Cars for Volvo On Call, and to Volvo Trucks for Dynafleet, among other customers. They make no distinction between applications in vehicles and elsewhere.

Smart Home – Beyond safety and security, a home equipped with a telematics platform can provide other services, such as appliance control, heating/air conditioning control, etc. If a problem arises while the home owners are away or possibly asleep, and a message is automatically sent from the home to a service center, assistance may be directed to the residence more quickly if the emergency message sent from the home is location-enabled.

Home Repair Services – Locating a dependable home repair or home improvement tradesmen (e.g. plumbers, carpenters, electricians, gardeners) is becoming increasingly difficult in Europe. Providing an intermediary service of matching service providers with individuals or businesses in need of their services has been seen as an obvious extension to matching towing services with drivers in need of assistance. Ensuring that the tradesmen arrive at the proper job site when they are needed is a task for which consumers have shown a willingness to pay.

2.2.2.2 Travel

Medical Insurance – Adding the location of a customer who is calling from a distant land can help to speed up the delivery of needed medical services. If the service platform includes information about hospital and other emergency services, the value to the customer for the service should be measurably better. One problem with this concept is that a single telephone does not work everywhere in the world. For example, GSM does not work at all in Japan, for example, and GSM data services (SMS, GPRS, EDGE) cannot be guaranteed in all areas even where there is GSM coverage because the necessary agreements may not be in place. Nevertheless, a geographic information system can today include map data for most places in the world due to increased coverage by the map data suppliers. So even though the location of the caller may not arrive automatically, when the caller does provide his or her location, assistance can be offered more quickly and completely with a good map database.

Personal Items Insurance – Tracking personal items around the globe has the same limitations as tracking people, plus a suitcase has no way of making a call if there is no coverage that matches its technology.

2.2.2.3 Medical

Condition Information – Providing information about an individual's particular ailments, drug sensitivities, allergic reactions can be delivered in case of an accident or a medical emergency.

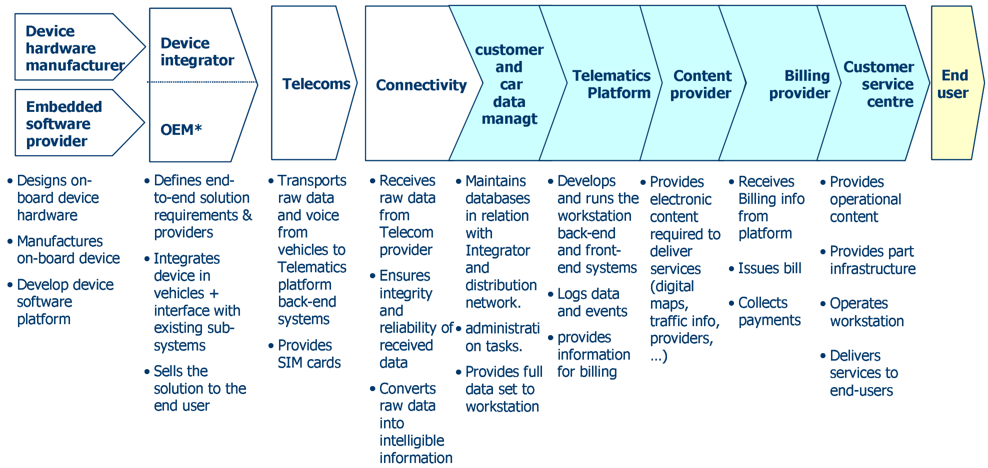
2.2.2.4 Recreation

Event Information – Location-based services, particularly information about activities occurring in the vicinity of the individual subscribing to the service, have had difficulty catching the attention of consumers. The 3G network *Three* had predicted that 75% of its revenue would come from LBS in the first years following its launch in 2002 in Italy, UK and Sweden. Three's telephones were to be equipped with GPS positioning devices, but due to cost and other factors, only a fraction of the phones they sell in 2006 are GPS-equipped. At the same time, personal navigation devices without communications are outselling in-vehicle navigation systems 4-to-1.

2.3. The Telematics Value Chain

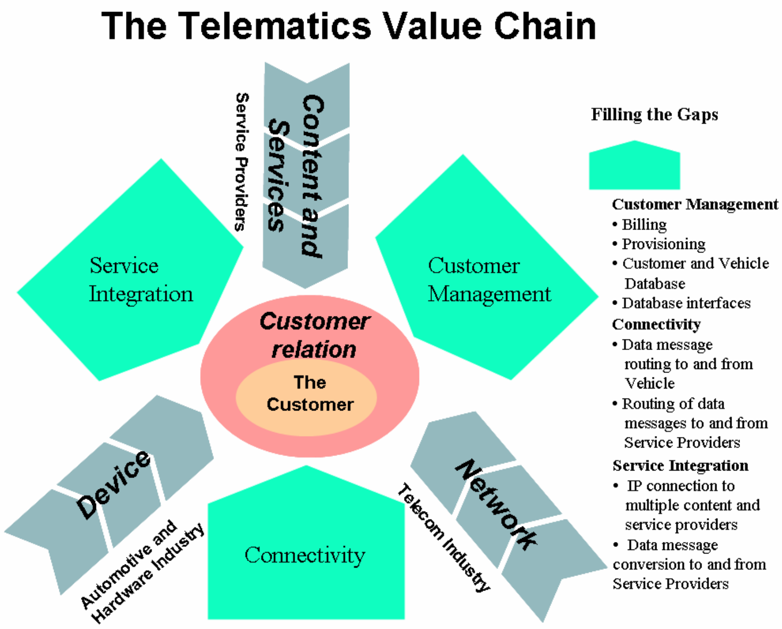
There are several ways to look at the Telematics Value Chain. The traditional, linear value chain view is useful for understanding the role of a particular company, like Mondial Assistance, in service and/or product delivery. The device is delivered to the OEM or other device integrator who require network services and connectivity to deliver the desired content and services to the end user/customer using a platform that is compatible with the in-vehicle system and service delivery mechanisms.

Telematics value chain

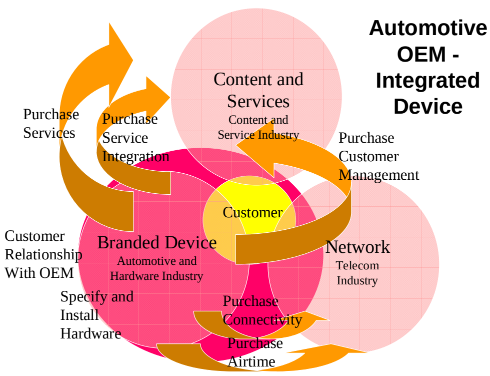


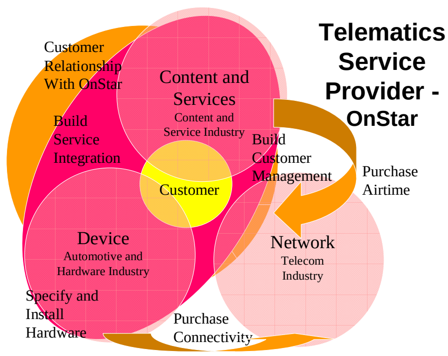
* Device integrator differs to OEM in retro-fitted case. No distinction in wide sale applications (factory-fitted)

Because telematics is a complex network, its value chain is composed of multiple and distinct business areas, each of which can have a direct and exclusive relationship with the end user. The general business areas are *device*, *network* and *content/service*. Each of these areas has its own sales channel and particular relationship with either end users of their product or service, or with the businesses that serve these customers. A device manufacturer can develop a telematics unit that does not require any permissions by the automotive OEM, and this manufacturer can either develop its own relationships with the content/service providers or network operators, or leave that choice up to the end user. The value chain then becomes more of a wheel, with three main spokes (*device*, *network* and *content/service*) and three secondary spokes (*connectivity*, *customer management* and *service integration)*.

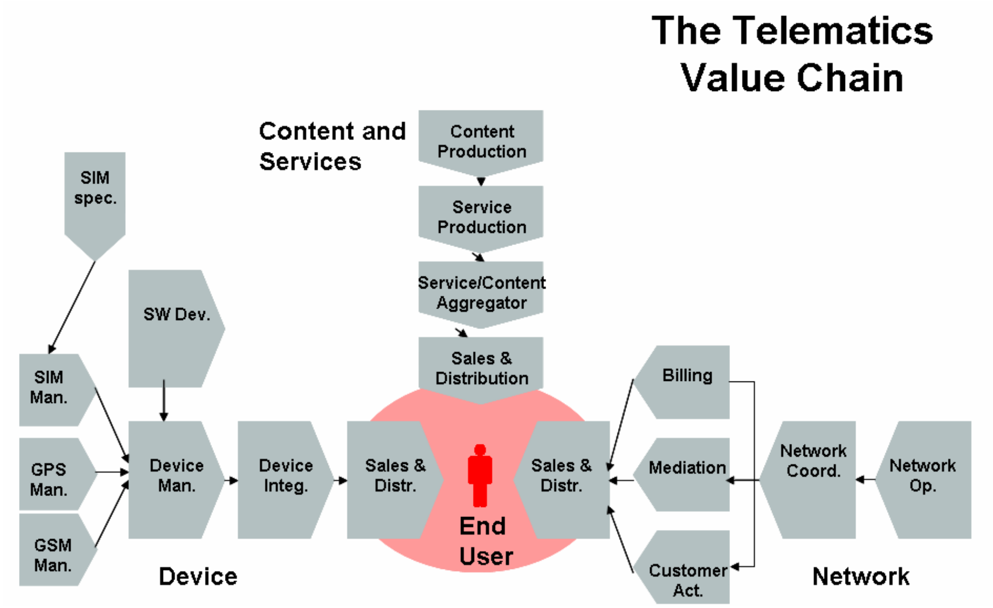


A company can decide to control one, two or all three of the major areas. For example, **Volvo** controls only the device, branding its telematics system ***Volvo On Call***. Volvo specifies, sources and integrates the hardware and software, including the SIM-card that is built into the telematics unit. It purchases network (Vodafone) and content services (Mondial/Viking), as well as the connectivity services (WirelessCar) required to link the in-vehicle unit with the service providers. Most importantly, Volvo owns the customer relationship, and the system is sold through its dealer network.





A look at telematics service provider **OnStar** in the U.S. shows a very different set of relationships. OnStar is owned by **General Motors**, a vehicle OEM, but in addition to providing services to GM, OnStar also provides systems and services to other vehicle OEMs, including Toyota, Subaru, Honda and Audi. OnStar has its own operators handing calls from its over four million customers, and contracts with roadside assistance providers to deliver that service to OnStar customers. It has the *Network* relationship with Verizon, the network service provider, and it also sells airtime to OnStar customers who subscribe to its hands-free telephone service.



Because telematics is not a product, but an enabling technology, the value chain is made up of the primary business areas that both develop and employ the technology to serve the end user. Device*, Content and Services/Network* are the three primary business areas, each one have its own sales and distribution channel to the customer. The companies filling the gaps have no offer that they can sell directly to the customer; they are support organisations to the primary players. However, they play a vital role that must either be purchased or brought into the principal company's offering, as both OnStar (Device/Service) and ATX (Service adding Connectivity) have done adding all three gap filling services: Service Integration, Connectivity and Customer Management.

2.4. Telematics Trends

This section will describe some developments occurring in hardware and systems, applications and services, and connectivity arenas.

2.4.1. Hardware and Systems Trends

2.4.1.1 SIM-card

There are several technical approaches aimed at reducing both hardware and operations costs that are currently being evaluated by the car industry and its suppliers. One approach, already tried by Ford, DaimlerChrysler, BMW and GM Opel, is to have a customer SIM-card both for telematics services and private voice services. The objective is to remove the SIM-card from the entire hardware and operations equation and thereby significantly reduce costs.

The second approach is to have an embedded telematics SIM-card, but to limit telematics functions to data-only services. Any services that truly require live operator intervention, such as roadside assistance and emergency assistance, would be directed to the customer's private wireless device using Bluetooth, 802.11b, or a similar wireless LAN interface. All data services would be handled by an embedded SIM-card that is purchased by the OEM, the system manufacturer, or the service provider for a one-time cost. Ongoing costs for service usage would be billed to the customer and/or the OEM. Except for the limit on voice transactions, this is similar to Volvo's approach, in which there is an embedded SIM-card and Volvo has the billing relationship with the SIM-card provider (Vodafone Sweden)[3].

Embedded, data-only SIM-cards are being promoted by the network operators who claim that it is the only way they can offer the OEMs lower prices for data services. The network operators who provide the SIM-cards say that the regulators in each of their countries force them to offer equal pricing to all customers. They cannot, according to the regulators, offer one pricing structure to one set of customers, and a second to another set--as long as the services are equal. So, they argue, if the OEMs are willing to change the service so that only data is offered, they can lower the data prices below what they charge their other customers who want both data and voice.

[3] Volvo has a full-function SIM-card purchased from Vodafone. Volvo purchases SIM-cards from Vodafone and delivers them to Autoliv, their telematics system supplier, who install them in each of the telematics systems that are delivered to the Volvo factory for installation in vehicles. .

This data-only approach is also being promoted by several groups working on next generation systems. Chrysler in the US has a variation of this approach in which they use the customer telephone for limited telematics services and communicate with it using Bluetooth. I assume that when they move to a more complete service offering they will have an embedded data-only connection device (depending on the technology used).

Connexis, a company owned by former Navteq owner, T.Russell Shields, is positioning itself as a pure connectivity provider. They do not currently offer telematics services, but are in a test phase with several automotive OEMs, including DaimlerChrysler and BMW. Their eventual offering will include a SIM-card. They intend to charge a one-time fee for the SIM-card and all connectivity services in return for the right to be the billing agent to the customer.

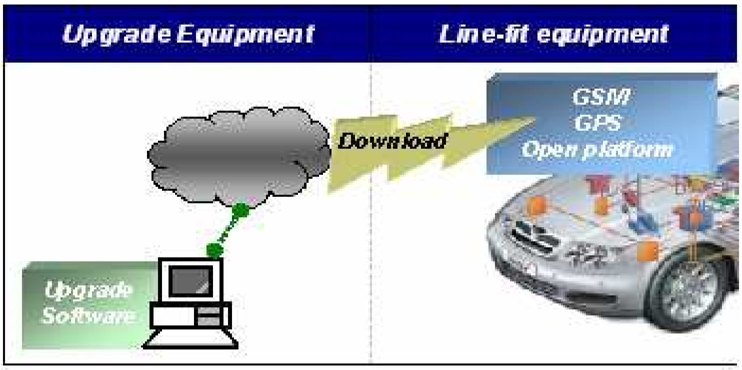
With telematics systems, the company that controls the SIM-card is the company that controls the customer relationship.

2.4.1.2 Open platform

The idea of an open platform is to allow line-fit equipment (i.e., installed in the factory) to be upgraded or updated without requiring equipment modifications. The Open Software Gateway Initiative (OSGi) has been attempting to define an open platform standard for several years. Whether it is OSGi or some other approach, an open and standardised solution will be essential for mass market introduction of in-vehicle system platforms. There are two components for such a platform:

- Roaming between different service centers to able to allow the customer to take advantage of the widest range of content and service; and,

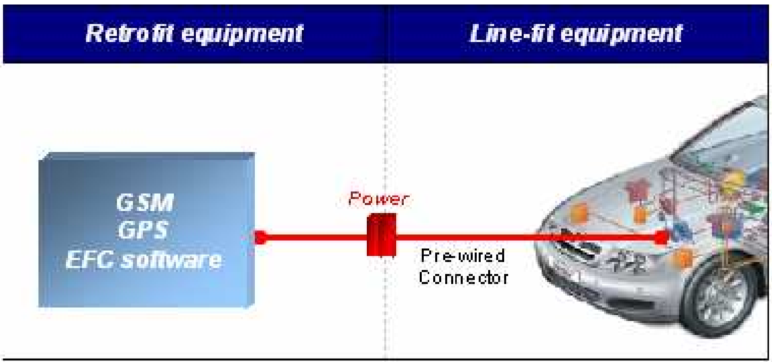
- Providing for interoperability of on-board equipment to ensure that vehicle manufacturers can provide their customers with the most advanced system and service solutions.



Source: MLS in conjunction with SBD (2005)

There are no precedents in the automotive industry of standard platforms that are modifiable or upgradeable. Furthermore, the automotive industry has shown a great deal of resistance to software applications that can be accessed remotely using wireless technologies because of the danger of hackers introducing viruses into their vehicles.

2.4.1.3 Standard connector



Source: MLS in conjunction with SBD (2005)

A standard, pre-wired connector is an idea developed in conjunction with Secured By Design. The purpose of the connector is to provide plug-and-play capability for hardware systems delivering different types of services, including automatic eCall and other safety services, toll collection, speed limit advice, pay-as-you-go information, off-board navigation, and any other type of service. The connection would deliver information processed from the vehicle's internal bus or buses, such as CAN and MOST, and send information to specific on-board systems. It is similar to the standard DIN radio connection (which is being phased out by vehicle manufacturers in favour of completely integrated head units). The American SAE committee developed a standard for CAN messages, called SAE 1587. It is a message set for the CAN bus that works on all American trucks. It provides for a standard plug into which any manufacturer can attach a device, such as fleet management. In Europe, the truck manufacturers use a version of SAE 1587 that filters out some of the CAN messages, but also provides for plug-in capability.

2.4.2. Applications Trends

2.4.2.1 Combine with SVT

The first telematics systems, such as GM/OnStar, Mercedes TeleAID, BMW Connect, Volvo On Call and others, were designed for safety and security applications. The idea was to provide a means of communicating the location of the vehicle in case of an accident or service need. Volvo and BMW saw an opportunity to expand the applications to include theft notification and vehicle tracking. However, compared to the purpose-built aftermarket systems from companies like Cobra and Viasat, the OEM systems have had difficulty meeting the strict requirements established in Belgium and The Netherlands, both for the hardware and its operation, and for the integration with secure operating centers who handle the tracking sessions.

OEMs have now understood that it makes sense to take the extra steps needed to make their telematics systems comply with the regulations because it appears that more countries will adopt the specifications already used in The Netherlands and Belgium. It has been difficult for the aftermarket players to move into the OEMs' safety and security territory because these services require integration with the vehicle's internal systems, which are controlled by the OEM.

2.4.2.2 Combine with emergency call

There is an initiative being led by the EU to require an automatic emergency call system in every vehicle starting in 2009. Whether such an initiative will succeed in resulting in European-wide legislation requiring such fitment, and whether the vehicle manufacturers can comply—which they surely cannot in such a short timeframe—are matters for discussion and debate. What is beyond discussion, and not debatable, is that at some point in the future all cars will have the capability of signalling their location and providing information about the status of the vehicle and its passengers.

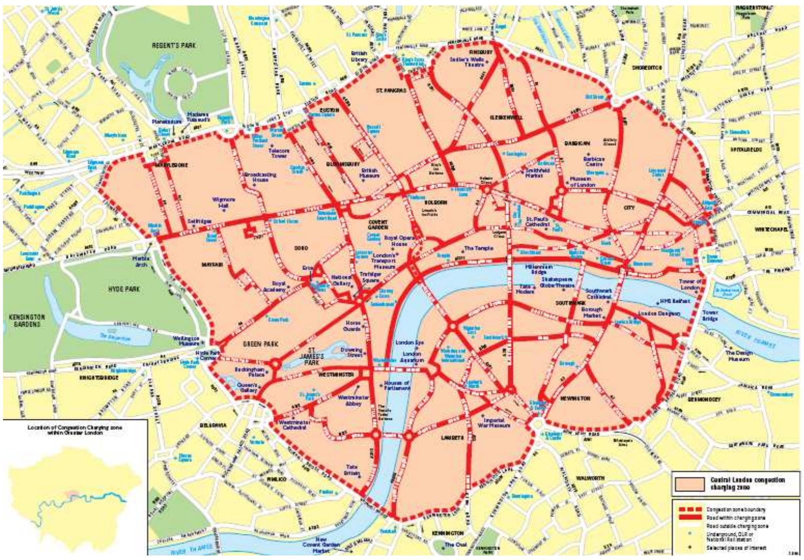
If automotive manufacturers are required to install automatic eCall systems in their vehicles, and if there is an economic incentive to do so (i.e., the customer pays directly or the government pays indirectly through tax incentives or other rebates), some companies may build the automatic functions into a broader telematics offering—assuming that it is allowed. In this way, the mandatory system could provide a subsidy for other services, such as roadside assistance notification, remote door controls or stolen vehicle tracking.

2.4.2.3 Combine with toll collection

Electronic Fee Collection (EFC), also called electronic toll collection, road user charging or congestion charging, is gradually being adopted by countries in Europe to replace fuel taxes, which have dwindled as the fuel economy of vehicles has increased. Governments, with the support of environmental interest groups, promote road user charges as a method to reduce traffic congestion and lower polluting vehicle emissions. Nevertheless, they are just another way of collecting taxes from a country's citizenry, and they will soon be a fact of life in most parts of Europe.

In order for EFC to be implemented, it will have to be possible for all vehicles to participate. There are three approaches to implementation of an automatic toll collection system:

- The London solution (also used in Stockholm, Sweden) – Digital cameras are placed on as many roads as possible at the periphery of the congestion charging zone which covers a significant area of Central London. The cameras are networked to a central server and database. Vehicles entering the zone have their license plates photographed. The images are sent to the central server where they are matched to a list of licenses that have paid the toll of £8 for that day. If the fee has not been paid by 22.00, it is raised to £10. If it is not paid by midnight of the day that the vehicle entered the zone, a fine of £100 is levied. After 28 days of non-payment, the fine is raised to £150. The driver may enter and exit the zone as many times as he or she wishes during the 7.00 and 18.30 Monday to Friday, excluding holidays.



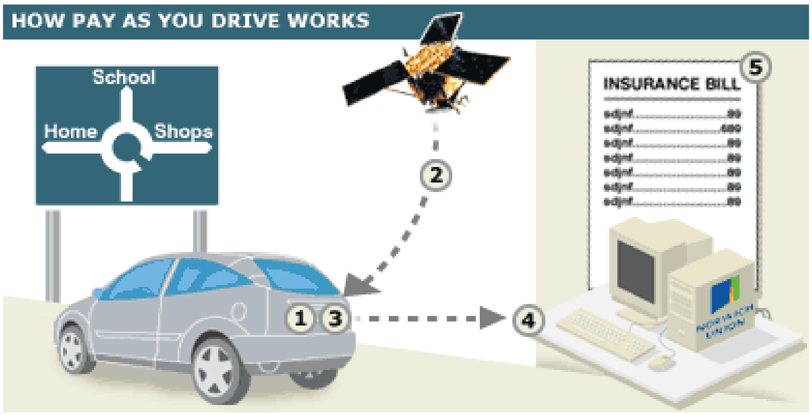
Source: Transport for London (2006)

- The German Toll Collect solution – This solution differs from Stockholm and London because, first, it is only for trucks, and second, it depends on the vehicle having an on-board system to chart the roads on which the vehicle has travelled, and a communications device for transmitting this information to the tolling authorities. The authorities calculate the toll for each individual vehicle and invoice the vehicle owner. This type of system can potentially be used for other types of in-vehicle location-based services.

- The transponder ETC solution – The solution is used extensively in Japan and the U.S. A device called a transponder is placed in the vehicle somewhere above the instrument panel behind the windscreen. When the vehicle passes through a tolling station, there is communication between the transponder and the toll reader using some form of short range communication. The toll amount is deducted from a pre-paid account that the vehicle's driver has established.

The London solution with automatic license plate recognition solution is the least practical for applications outside of a limited geographic area. The transponder solution works well on limited access highways where all cars must pass through a gate, but it is not well-suited to a combination of highway tolls and city congestion charging. A system that can keep track of its own location and report on the roads on which it has travelled at specific times provides the greatest degree of flexibility.

2.4.2.4 Combine with vehicle insurance



1 Telematic device fitted in boot of car
2 GPS satellite used to track car's route and time of travel
3 Information is stored by the device in the car
4 Device then calls insurer's computer with data
5 Computer works out your bill

Source: BBC News article, Wednesday, 18 August, 2004

AVIVA/Norwich Union Insurance has been at the forefront of testing the concept of setting insurance premium fees on the basis of a driver's actual performance and the location and distance driven. Norwich Union in its web site describes the way it works as "simple and similar to pay as you go mobile phone technology, where you pay a fixed monthly fee plus costs based on the miles you drive. A small Smart Box with its own GPS tracking system is installed into your car. The GPS technology monitors your journeys, which allows real-time information to be relayed to a central computer. Your premiums are then calculated based on your usage and you'll receive a monthly bill."

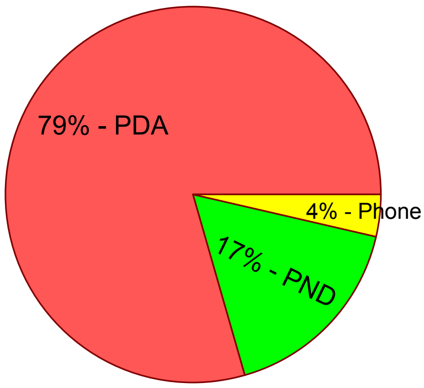
Whether it is possible to build other services on top of a system that supports pay-as-you-drive insurance will depend on the particular method used to communicate the driver's record to the insurance company. Norwich Union is bundling their "Smart Box" with stolen vehicle tracking. If this method is a simple periodic download using Wi-Fi, digital short range communication (DSRC) or other short-range communications technique, it will be difficult to piggy-back other services on top of it. If, however, it is GSM or 3G, as is with Norwich Union, it will open doors for most other telematics services.

2.4.2.5 Combine with navigation

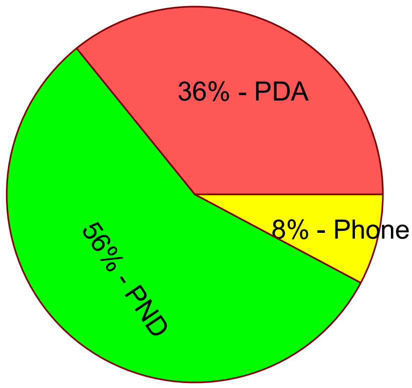
Several automotive OEMs offer navigation systems that include communications capabilities. The Magneti Marelli system installed in Fiat-brand companies and the Siemens VDO system installed in BMW, both combine telematics features with the navigation system. In addition to signalling for assistance, the systems provide for the sending of a location's latitude/longitude that has been found by a customer service assistant to the navigation system. The system then uses this location as the destination of a route. This saves the customer from searching in the navigation system for the location, and is a feature that has been identified as very beneficial by navigation system users.

The first generation BMW system required the customer to search through multiple screen menus to reach the SOS command. The second and subsequent generations corrected this error by installing a special-purpose SOS button in the roof of the vehicle above the rear-view mirror.

Portable Navigation Market - Device Market Share



2004 Portable Navigation



2005 Portable Navigation

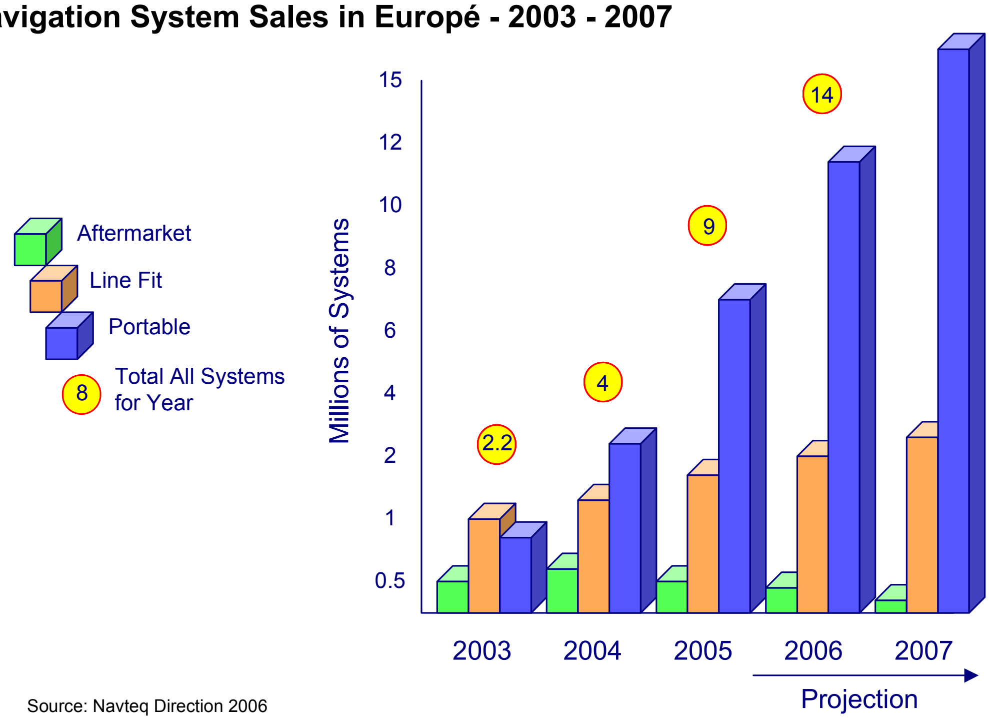
Portable Navigation Market

Countries where sold	
Germany	28%
UK	18
France	13
Benelux	13
Italy	8
Spain	7
Other	13

Outlets	
Consumer Elect	60%
Car Accessories	5
On-line Retail	8
Mobile Ph Retail	5
Mass Merchant	20

Vendor Market Share	
TomTom	34%
Navigon	17
Destinator	15
Navman	9
Garmin	6
ViaMoto	4
Other	15

Navigation System Sales in Europé - 2003 - 2007



Source: Navteq Direction 2006

2.4.3. Connectivity Trends

2.4.3.1 GSM

Another trend is the switch from GSM/SMS to GSM/GPRS (General Packet Radio Service). The main drivers for the switch to GPRS are a potential reduction in data transfer cost, and an increase in the amount of data that can be transferred in a shorter period of time. GSM/SMS is used by the majority of telematics systems in Europe. Even though the amount of data that can be transferred is limited to 160 character messages, the method is reliable and fast, and SMSs can be sent from both the in-vehicle device and from the service centers.

GPRS, with its always-on connectivity and faster data transfer rate, will enable more services, such as diagnostics, software maintenance and software uploads, and off-board navigation, that require larger data transfers that are both impractical and costly with GSM/SMS. However, GPRS is not yet a stable technology. It does not yet work as flawlessly as SMS. Another major problem is that the network operators have not yet signed GPRS roaming agreements to the extent that they have for SMS. And the connection must be established by the wireless device, which means that for some services there will have to be a continuation of SMS alongside GPRS or some time.

2.4.3.2 3G/UMTS

Third generation telecommunications systems are not yet widespread enough, either in geographic coverage or telephone usage, to make the technique viable for telematics or any type of location-based services. Most data services being delivered at present do not require the megabyte level of bandwidth available with 3G.

2.4.3.3 Digital Audio Broadcast

What is DAB? **DAB** is **D**igital **A**udio **B**roadcasting. According to the *DAB Association*, it is a “method for the digital transmission of radio signals”. The analogue radio sound signals are converted to a series of ones and zeros prior to sending, and decoded to sound at the receiving end. The intention is that digital radio will eventually replace analogue radio in the same way that digital television is replacing analogue TV. DAB is a broadband channel, 1.54 MHz, with data rates up to 1.2 megabits per second (Mbps). Compared to GSM, which is 9.6 kilobits per second (kbps), and GSM/GPRS, which is effectively 50 kbps, data transfer rates with DAB are significantly faster, and more data can be transmitted in the data packages.

DAB was first developed within a European research project called EUREKA in the late 1980s, and it is currently being implemented in countries around the world, including all European countries, Australia, Singapore, Taiwan, South Korea, China and India, and in the Americas in Canada, Mexico and Paraguay. It is not being implemented in the United States nor in Japan. In the U.S., the Federal Communications Commission has recommended adoption of its own standard called HD Radio (originally called IBOC for In Band On Channel). HD radio uses existing FM radio transmitters, and allows both analogue and digital signals to be transmitted simultaneously.

It is important to distinguish between two forms of DAB, Terrestrial-DAB and Satellite-DAB. T-DAB is the technology that is currently being implemented in the countries listed above. S-DAB, also called Satellite Digital Radio (SDR), is the technology behind Sirius and XM Radio in the United States. The main difference is that T-DAB, as the name implies, relies on ground transmission towers, while SDR uses satellites for transmissions with supplementary ground towers in areas where line-of-site is difficult, such as deep canyons, both natural and man-made.

2.4.3.3.1 T-DAB, SDR and Analogue Radio

Developers and promoters of T-DAB have been trying to gain traction for over seven years. SDR has been operational in North America for only a few years, and the two stations combined already have close to ten million paying subscribers. It is an option on all car models sold in North America, either from XM-Radio or Sirius (Volvo's partner). GM (XM-Radio and Delphi) is making it an integral part of its OnStar offering. The situation is very different in Europe, where there are currently no services from the two competing companies who are vying for the market, WorldSpace/Viatis based in France, and ONDAS based in Spain. The reasons why services in Europe are behind those in North America and other parts of the world are two:

- The satellite system used in North America is not totally appropriate for European services. XM Radio uses two satellites placed in geostationary orbit about 36,000 km above earth. Sirius uses three satellites placed in elliptical orbits, with each satellite spending at least sixteen hours per day above the continent. Because of the higher latitude of European countries, the geostationary approach, which WorldSpace/Viatis is taking, requires a large number of expensive repeater towers. The elliptical approach of ONDAS is more practical from an economic standpoint, but it also requires a large investment, and this leads to the second problem.

- There are people in influential places who do not believe that there is a market for satellite radio in Europe. They claim that the large number of different languages and the existence of nationwide coverage (which does not exist in North America) for the national radio channels, makes the business case for SDR a difficult one.

In spite of the doubts, the SDR companies are pushing ahead, and each one is attracting substantial investments. XM Radio has invested in WorldSpace/Viatis, and Delphi, the leading provider of satellite radio technology worldwide, has made a significant investment in ONDAS.

Why switch to digital radio in the first place? The answer is similar to the main reason for digital TV: It opens up new possibilities for selling products and services to consumers. These consumers are not demanding it, and the slow pace of acceptance of T-DAB in Europe indicates that the market is not yet excited about what they receive fro the added cost. However, a large part of the problem with offering services, as opposed to radio broadcasts, is that the services are national, and few of the countries have totally embraced T-DAB. A pan-European digital audio broadcast alternative would eliminate this problem.

The chart below provides an overview of the advantages and limitations of the different technologies.

Advantages	
DAB over Analogue Radio	**T-DAB over Satellite Radio**
▪ Sound quality can be significantly better than FM. ▪ No interference between stations that are close in frequency, and no fading signals ▪ Access to more radio stations. ▪ Data, audio, text and video services can be offered with T-DAB because of wide bandwidth. ▪ There are more features available with T-DAB	▪ T-DAB is free while S-DAB will be subscription-based. ▪ Programming is country-specific with T-DAB and in local language, while S-DAB will have to use channel capacity to broadcast in country-specific languages. ▪ The shift from FM to T-DAB for the broadcasters is relatively easy, although costly, while S-DAB is very costly.
Disadvantages	
DAB versus Analogue Radio	**T-DAB versus Satellite Radio**
▪ Consumers must purchase new radios. ▪ The technology is more costly for all parties. ▪ Audio quality is based on the amount of bandwidth used for DAB, and can be inferior to FM.	▪ Access is country-specific with T-DAB while with Satellite Radio it is continent-wide for voice, video and data transmission, so pan-European services can be provided ▪ High quality sound is guaranteed with Satellite.

	▪ **Multiple languages can be broadcast simultaneously**

2.4.3.3.2 Who is doing what with DAB in the Automotive Industry

2.4.3.3.2.1 T-DAB

Opel – The first T-DAB radios were introduced in the Astra in 2004.

Ford – Dealers sell DAB radios in the U.K.

BMW/Mercedes/Audi – These companies have been involved in a project called Mobile.Info in Germany where DAB services are being investigated and tested.

2.4.3.3.2.2 SDR

In North America, both Navteq and its competitor Tele Atlas are delivering traffic information to vehicles via satellite radio. Initially, twenty-two metropolitan areas are being covered, but both companies are assembling data for additional areas. Navteq plans to have over fifty cities in its service by 2007. Both companies are investigating how they can deliver similar services in Europe over T-DAB and/or SDR.

2.4.3.3.2.3 Alternatives

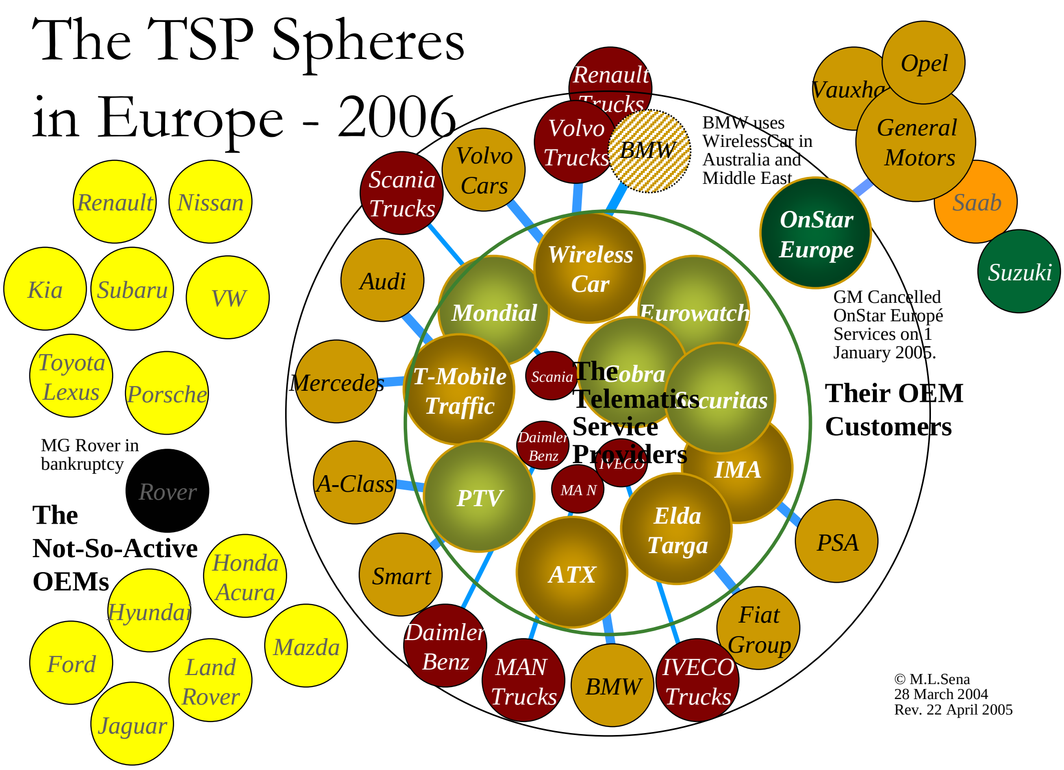
Digital Radio Mondiale (DRM) – A digital replacement for AM radio. It is not a competitor to DAB as a digital replacement for analogue FM.

Digital Video Broadcasting (DVB). DVB-T (Terrestrial) is intended for home and in-vehicles receivers, and DVB-H (Handheld) is intended for battery-powered portable devices, such as phones and PDAs. DVB-T is already a threat to DAB because it provides similar services as DAB, and often uses the same frequencies assigned to DAB. DVB-H could provide an opportunity for phone-based data delivery in the vehicle.

2.5. Automotive Telematics Competitor's landscape

2.5.1. The Telematics Service Provider Spheres in Europe

Telematics spheres have evolved in Europe during the past ten years since telematics was first introduced. As the diagram below shows, four telematics services providers (WirelessCar, ATX, T-Systems and Elda Targa), four assistance companies (Mondial, IMA, Europe Assistance and ADAC) and one map data portal provider (PTV), deliver a combination of connectivity, call center and content services to a total of twelve vehicle OEMs.



Before GM closed its OnStar service, there were five TSPs. Before Ford closed down Signant, there was a mega-sphere consisting of Ford, Renault and PSA, that was in the process of being built. While what exists today may be only a small fraction of what might have existed had all of these operations, the companies that are involved in the different spheres have been working on building their service offerings and their business models, and there is a very strong foundation that has been built in Europe for expanding services and adding more brands.

2.5.2. Who does what?

WirelessCar is a wholly-owned subsidiary of AB Volvo. It has created a sphere within the Volvo brands, providing services to AB Volvo's *Truck*, *Construction Equipment* and *Penta* companies, and *Volvo Cars* (owned by Ford Motor Company). WirelessCar has also managed to break into the ATX sphere by providing services to BMW in certain markets outside of Europe. WirelessCar is a pure connectivity, message translation, billing and customer database provider. They have no operator services.

ATX Europe is a wholly-owned subsidiary of U.S.-based ATX Technologies. Through its legacy as Mannesmann Passo, Vodafone Passo and now ATX Europe, it has a sphere consisting of only BMW. However, since the BMW Assist system sells very well as an option to the navigation system, ATX has relatively large customer base with a company that is reported to pay its service providers very well. ATX Europe, like its owner in the U.S., provides both connectivity services and operator services.

T-Systems had a head start when it was called Tegaron and a 50/50 joint venture between DaimlerChrysler Services and Deutsch Telekom's T-Mobil. It formed a sphere with Audi and Mercedes. Together they provided almost 40,000 customers before both OEMs decided to stop selling new systems.

Targa Infomobility was purchased from Fiat by **Elda Engineering** in August 2005. Targa Infomobility provides *bConnect* roadside assistance and route assistance services to the Fiat brands, Fiat, Alpha Romeo and Lancia, wherever they are sold in Europe. Elda is a €22 million turnover Italian engineering company that has, in recent years, expanded into software services, digital map data support and navigation systems.

Inter Mutuelles Assistance (IMA) is PSA's roadside assistance provider in Europe. It is providing TSP services to PSA for its system in France, Germany and four other European countries. IMA has developed both a connectivity platform to receive and process messages from the vehicles, and an operator service platform for delivering the limited services currently offered by PSA. At present the service platform is country-specific. ATX Europe has repeatedly stated that they will become part of the IMA/PSA sphere, offering pan-European connectivity, but this has not yet materialised.

ADAC is Europe's largest, and the world's third largest, automobile services membership club. It is based in Munich, Germany. ADAC was an early competitor in the TSP arena, and it managed to win contracts from both GM for OnStar in Germany, and from Ford for its telematics offering. Volvo also worked for a time with ADAC before deciding to focus on other markets. It still provides services to OnStar legacy customers in Germany, and to Fiat bConnect customers in Germany.

Europe Assistance provides call center services for BMW Assist customers in Italy, similar to the types of services provided by Mondial for BMW in the U.K. The company does not seem to have expanded beyond this role.

PTV is part of two spheres, the Mercedes/Smart off-board navigation systems and the WirelessCar/Volvo Cars/AB Volvo telematics systems. PTV is a Karlsruhe, Germany software development company, Internet map portal provider (Nissan, Toyota), and telematics map data provider (WirelessCar) and off-board navigation. This is in addition to its core business in logistics and fleet management support. It is a closely held, family-run set of interlocking businesses (map&guide) that has grown and prospered by following an organic pattern of growth.

Mondial Assistance is also part of two spheres, Volvo Cars and BMW, but it was well on its way to be a major part of a third, DaimlerChrysler, before DC cancelled its roll-out plans.

2.5.3. The positions of the companies

There are four categories of competitors:

Market Leader – This is a company that has high market visibility, characterised by broad brand recognition and well developed external relationships. There can be more than one market leader, or there can be no clear market leader. In the automotive manufacturing and sales sector, it would be difficult to name a company that is clearly in the lead. Although General Motors sells more vehicles than any other company (at least for the moment), its total market share has been shrinking. Ford was close to overtaking GM a few years ago, but Ford is now struggling and has been passed by Toyota. DaimlerChrysler gained in size and market share following its acquisition of Chrysler[4], but Chrysler and Mercedes have taken turns losing money, and their troubles have weighed heavily on DC's share price. Only Toyota seems to have solid momentum, while Renault (with Nissan) and PSA have put together some very good years in recent times.

Emerging Challenger – This is a company that has exhibited strong capabilities for meeting market needs, but has not yet achieved brand recognition or developed an extensive network of external relationships. New challengers eventually either achieve market leadership, or are relegated to the struggling companies.

Struggling – This is where the majority of companies are positioned. They compete for what is left over after the market leaders have taken the largest share. They attempt to develop new capabilities and move up into the new challenge sector, or they try to build external relationships and define new competitive ground by establishing a new market reference.

Newcomer – Within every business sector there are customer segments—they can be large or small—that are not served by available offerings. An example is navigation aids for small boat owners. When navigation aids for boats were introduced twenty years ago, positioning devices were prohibitively expensive for all but large shipping companies. When GPS devices were introduced, a large segment of the market opened, but small boat owners were still excluded. As GPS devices became less expensive, they became affordable by all boat owners. Each business sector has a new market player who is attempting to redefine the competitive landscape by introducing a new concept that is less expensive than the current offerings.

[4] It was not a merger as originally billed. A recent US court ruling in favour of a suit brought against DC for lost share value by Chrysler shareholders confirmed that it was a takeover.

2.5.3.1 Market Leader

WirelessCar has established itself as the market leader for several reasons.

- It has multiple customers, including both vehicle and non-vehicle companies.
- It has contracts that are multi-continent and multi-country.
- It has a telematics platform that is scalable, and a workstation that is adaptable to different service designs.

ATX is still in a market leadership position because BMW has been successful in selling its telematics option on top of its navigation system. On the negative side, ATX has not yet managed to go live with any customers other than BMW, and they have services in only three countries.

Mondial is a solid choice for market leadership in operator services, with a pan-European service center in Paris for Volvo's OnCall program, operator services for Volvo and BMW in the U.K., and additionally for Volvo in Belgium, France, Italy, Luxembourg, and The Netherlands.

2.5.3.2 Emerging Challenger

Elda's Targa Infomobility is still only offering a relatively low level of services for customers outside of Italy through relationships with assistance centers like ADAC in Germany. Because it was totally tied to Fiat, it was able to offer services only to that company's brands. With new ownership, it has the possibility to expand on the companies it serves, and there are still a large number of prospects to choose among.

IMA is somewhat of a dark horse in the telematics race. They are delivering services to PSA brands in several countries, but the prospect of ATX entering the scene puts their importance for PSA into question. They could be relegated to being a second division player, like Europe Assistance.

PTV has not shown any degree of interest in providing connectivity or operator services. They could easily do so by purchasing a TSP, like ATX or T-Systems, as their Italian competitor Elda has done. PTV is a very well-run company that has proven in the past that it can move into profitable markets.

2.5.3.3 Struggling

OnStar Europe, having closed its operations, is beyond struggling. But it must be kept in mind that GM's OnStar in North America has over 4 million subscribers, and is profitable.

T-Systems will most likely be closed by its owners, T-Mobile, as soon as the DaimlerChrysler contract runs out in another year. There does not appear to be any signs coming from the former TSP leader that they are trying to revive their business after DC stopped its ten-country roll-out.

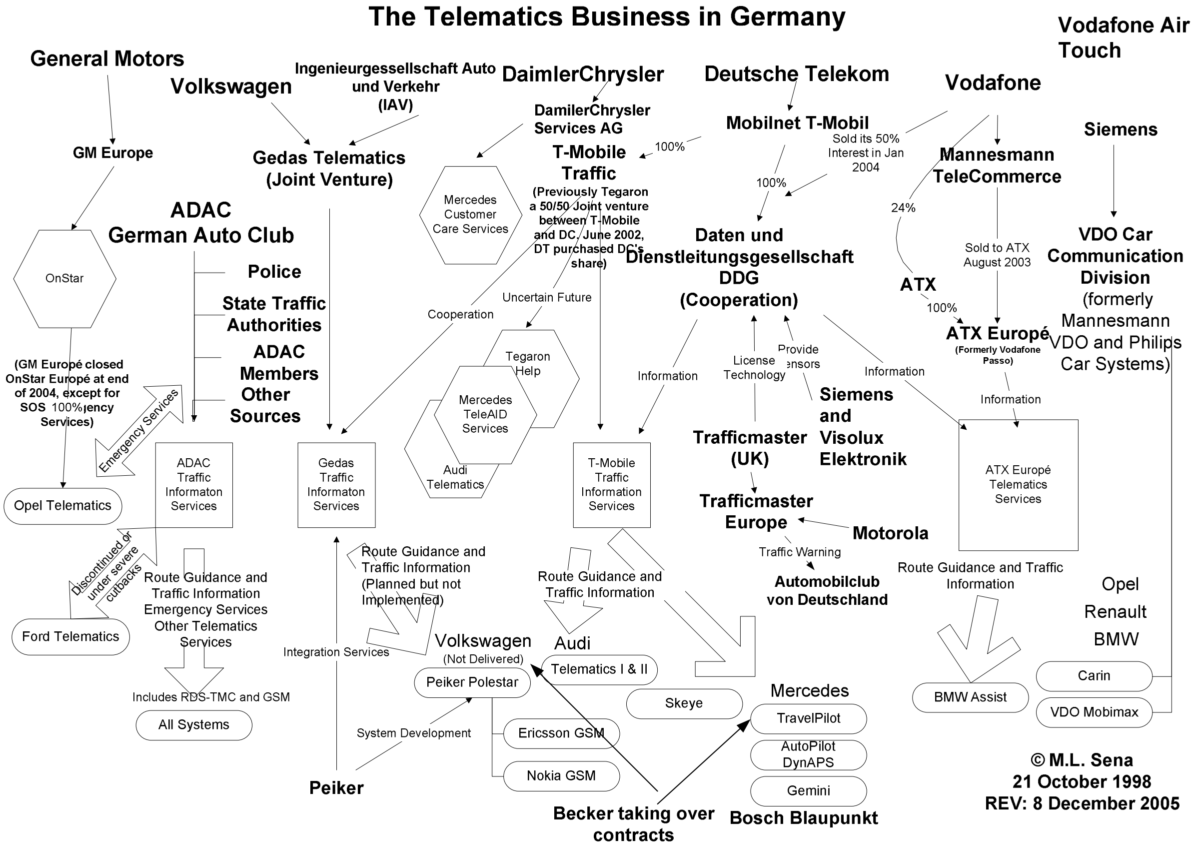
ARC/ADAC are still trying to make a breakthrough in the telematics arena. ADAC Services GmbH (ASG) is in charge of the club's B2B activities, and they have recently added services to Fiat bConnect to their OnStar legacy customer list. They are not to be counted out just yet, but they will need to show some progress soon

2.5.3.4 Newcomer

Connexis is the new name for SEI/Ygomi. They have no customers, only test partners in BMW, DC and Nissan. Russ Shields has promised to use most of the $80 million he received as his share of the initial public offering in August 2004 to build a TSP that services all OEMs everywhere.

Securitas also has no telematics customers, but it does have a European network of call centers that are fitted for security applications, and it is providing stolen vehicle tracking services to a number of OEMs through aftermarket agreements with companies like Cobra. It would not be too far a stretch to see these services extended first into operator services and then connectivity.

As the diagram below shows, there are many complex and interlocking relationships among the many companies involved in telematics system and service provision. The scene is constantly changing through mergers, acquisitions and new entries.



2.5.4. The Telematics Landscape and Existing Relationships

The following tables describe the various relationships and services provided by existing telematics players.

Telematics Systems on the Market in 2006

Company	Program Name	E-call	B-Call	Convenience	Tracking
Volvo	Volvo On Call	✓	✓	No	✓
PSA	Assistance	✓	✓	No	
Fiat/Lancia/Alfa	bConnect	-	✓	Yes	
BMW	Assist	✓	✓	Traffic/Navigation Support/Parking	✓
DaimlerChrysler	Teleaid	✓	✓	No	
DaimlerChrysler	Dynaps			Navigation Support	
GM US	OnStar	✓	✓	Route Guidance/Traffic/Booking	
GM EU	Program cancelled				
Volkswagen	Under development				
Audi	DynamicNavigation			Route Guidance Support	
Saab US	See GM				
Renault	No solution				
Ford Europe	No solution				
Ford US	RESCU	✓	✓	No	
Toyota US	OnStar	✓	✓	Route Guidance/Traffic/Booking	
Nissan US	Nissan Assist	✓	✓		

Telematics Systems Functionality and System Suppliers

Company	Program Name	In unit Combined with Telephone	In unit Combined with Navi	In unit Combined with Audio	SIM card	System Supplier
Volvo	Volvo On Call	✓			Vodafone Sweden	Autoliv
PSA	Assistance	✓	✓	✓	Private	Magneti Marelli
Fiat/Lancia/Alfa	bConnect	✓	✓	✓	Private	Magneti Marelli
BMW	Assist	✓	✓	✓	T-mobile	Siemens & Motorola
DaimlerChrysler	Teleaid	✓			T-mobile	Motorola
DaimlerChrysler	Dynaps		✓			Blaupunkt
GM US	OnStar	✓		✓	NA	Delphi
GM EU	Program cancelled					
Volkswagen	Under development					
Audi	DynamicNavigation		✓		Private	Blaupunkt
Saab US	See GM					Delphi
Renault	No solution					
Ford Europe	No solution					
Ford US	RESCU	✓			NA	
Toyota US	OnStar	✓		✓	NA	OnStar
Nissan US	Nissan Assist	✓			NA	Xanavi

Telematics Systems Connectivity and Telematics Service Providers

Company	Program Name	Connectivity Partner	Call center partner	Cross-border Services
Volvo	Volvo On Call	WirelessCar	Mondial	Local and European call centre
PSA	Assistance	ATX -	IMA	Calls home
Fiat/Lancia/Alfa	bConnect	Targa	Targa	European call centre
BMW	Assist	ATX - WirelessCar	Mondial - Europassistance	Local
DaimlerChrysler	Teleaid	T-Mobile Traffic	Mondial	Calls home
DaimlerChrysler	Dynaps	T-Mobile Traffic	T-Mobile Traffic	
GM US	OnStar	OnStar	OnStar	US OFFER
GM EU	Program cancelled	OnStar		
Volkswagen	Under development	NA		
Audi	DynamicNavigation	T-Mobile Traffic	T-Mobile	
Saab US	See GM	OnStar		
Renault	No solution			
Ford Europe	No solution			
Ford US	RESCU	ATX	ATX	
Toyota US	OnStar	OnStar	OnStar	US OFFER
Nissan US	Nissan Assist	ATX	ATX	US OFFER

Telematics Systems and Markets Served in 2006

Company	Program Name	Countries where services was available at the end of 2005 before end 2005	Models
Volvo	Volvo On Call	SE, UK, NL, FR,IT,BL,LX	All Volvo
PSA	Assistance	FR, IT, ES, DE, BE, NL	Peugeot/Citroen
Fiat/Lancia/Alfa	bConnect	European wide	Fiat/Lancia/Alfa
BMW	Assist	DE, UK, IT	BMW
DaimlerChrysler	Teleaid	DE	Mercedes
DaimlerChrysler	Dynaps	European wide	Mercedes
GM US	OnStar	North America	GM US
GM EU	Program cancelled	NA	Opel
Volkswagen	Under development		Volkswagen
Audi	DynamicNavigation		Audi
Saab US	See GM	North America	Saab
Renault	No solution	NA	Renault
Ford Europe	No solution	NA	Ford
Ford US	RESCU	NA	Lincoln, Jaguar
Toyota US	OnStar	North America	Lexus
Nissan US	Nissan Assist	North America	Infinity

2.6. New players

2.6.1. What new kinds of players are emerging

The companies that have been working with telematics applications have either been specialists in content aggregation/services (e.g. ARC, Mondial, PTV), hardware/software (e.g. Motorola, Autoliv) or network services (Vodafone, T-Mobile), or they have been specialist telematics services providers, like ATX, Elda/Targa, OnStar or WirelessCar. These companies have functioned at times as partners and at other times as competitors to deliver services to telematics customers. As the market has matured, it has attracted other types of companies that have traditionally provided the services that telematics systems are attempting replace, such as security companies (stolen vehicle tracking) or emergency services organisations. Insurance companies are seeing the possibilities offered by telematics systems to modify their current offerings or provide new products or services to their customers. Content providers see the prospect of communications devices in vehicles as an opportunity to move further up the value chain, by-passing the content aggregators.

2.6.2. Who are they and what do they do

2.6.2.1 Security

Security firms have already started participating in the telematics arena. **Falck Räddningskår**, which was part of the Danish security company of the same name until it was spun off and sold to a group of investors, was the original customer service center for the Volvo On Call system in Sweden. On 1 January 2006, Volvo replaced Falck with Viking Sverige AB, a subsidiary of Viking Redningstjenste AS, Norway, a firm specialised in the provision of roadside assistance and security services. In March 2006, Falck Räddningskår purchased Viking, and thereby took back the Volvo On Call business.

Securitas Alert Services NV (SACNV), based in Brussels, is a wholly-owned subsidiary of Securitas. SACNV have their headquarters and principal IT facilities in Brussels, Belgium, within walking distance of the Belgian SVT system testing authority, ANPI. SACNV have offices in six European countries that report directly to the SACNV CEO. These countries are Sweden, Finland, Belgium, The Netherlands, France and Germany. As of 1 January 2006, they will have a fully operational SACNV office in the UK, one of the major markets for stolen vehicle tracking systems. In the other countries they share Securitas offices or they have agreements with other SOCs to handle cross-border vehicle tracking cases.

SACNV are currently monitoring 12,000 cars for SVT in all markets. The Belgian facility has 5,000 subscribers, 41% of the total. The Belgian facility handles 40 real (i.e., not false alarms) tracking cases annually. Subscribers pay approximately €20 per month for the service, and have unlimited numbers of events per subscribed period. SACNV Belgium has a 95% return rate for the cases they have handled thus far.

Seven years ago, SACNV had its own black box system. They abandoned this system a few years ago when they decided it was too costly, not sufficiently profitable, and not their core business. They also consider non-tracking services, such as roadside assistance and emergency assistance, as out of there are of core competency as well. They want to focus on being an SOC for security applications. However, they are interested in entering the market for servicing car manufacturers' OE stolen vehicle tracking systems. They see this as a growing market, while they believe that the aftermarket system business will decline. Their reasoning for this thinking is that as the car manufacturers install SVT systems in the high-end vehicles, there will be reduced opportunities to fit these cars with aftermarket systems.

SACNV see their main competition as ADT, a U.S. company and one of the largest security companies in the world. They have begun offering their standard security services in Europe.

Eurowatch has created a network of Secure Operating Centers in thirty European countries. Each of these SOCs can receive a theft notification message from a vehicle equipped with a properly configured system. The SOCs can track the vehicle in any country where there is GSM coverage and where at least one network operator has a roaming agreement with the provider of the SIM-card for the system.

Eurowatch does not develop or sell vehicle tracking hardware. The company provides a software development toolkit (SDK) to system developers. The SDK allows the system developers to adapt their systems to the Eurowatch workstation, and to program the SIM-card so that it sends a data message to the Eurowatch SOC partner in the country where the system was originally sold.

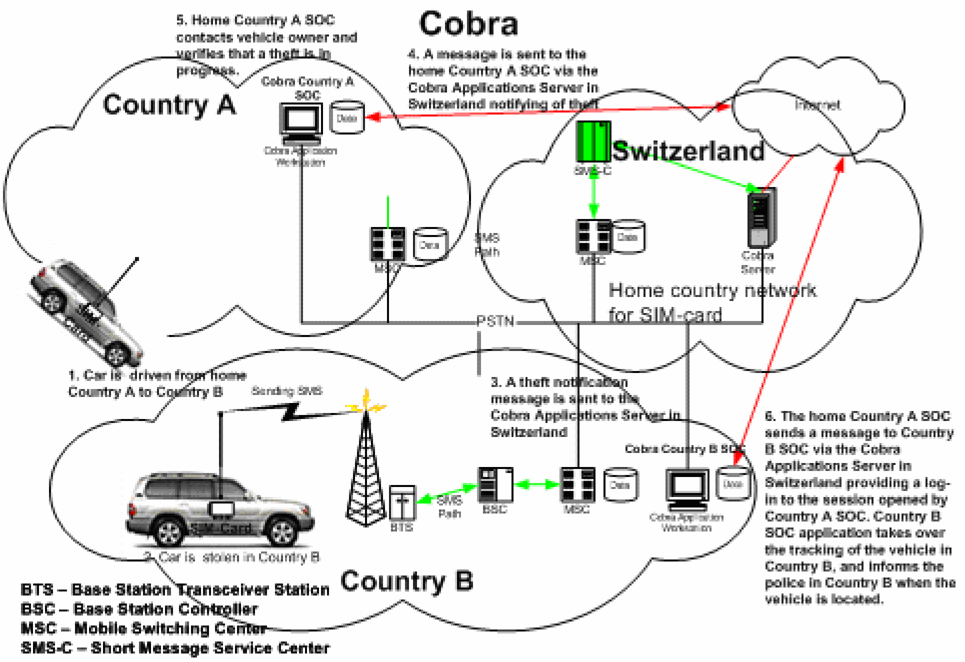
Eurowatch has developed a web-based application that allows each SOC to contact any other SOC in order to inform them that a vehicle is being stolen in the contacted SOC's country, or that a vehicle is about to enter that country. Included in the information that is sent from the originating SOC to the contacted SOC is a secure log-in that allows the contacted SOC to open the tracking session started by the originating SOC. Eurowatch provides the workstation software, including the mapping, as a web service to each of its SOCs who have an exclusive sales and service agreement with Eurowatch for the country in which they operate.

Cobra offers an end-to-end solution to stolen vehicle tracking. They have developed their own hardware, CobraTRAK5, which they fit with a single SIM-card provided by the Swiss network operator, Sunrise. Cobra operates a connectivity center in Switzerland, with a direct connection to the Sunrise SMS-C. Cobra has signed non-exclusive agreements with SOCs in each of ….countries who perform the tracking and police notification services.

When a theft notification message is sent from a vehicle, the SMS is directed to the Sunrise SMS-C in Switzerland. A workstation session is started at the SOC in the country in which the Cobra system was originally sold and installed. The reason for this is that the first action taken by the SOC is to contact the owner and verify that the vehicle has indeed been stolen before initiating a tracking session and a police chase to recover the vehicle. Connecting to the home SOC is primarily for language reasons, to be able to speak to the customer in his or her native language, and secondarily for cost reasons, to keep the phone charges to a minimum. It is also about having a customer relationship.

MPL BV, the SOC handling Volvo On Call stolen vehicle tracking in The Netherlands, is a Cobra partner. The Cobra system in The Netherlands is sold under the Clifford Alarm brand.

Cobra claims that it was the first company to achieve a *Thatcham* listing. In 1993 the Motor Insurance Repair Research Centre (MIRRC) at Thatcham in Berkshire, UK was tasked with establishing standards for car security systems—testing, evaluating and approving them according to their ability to meet the demands required by insurance companies. The result was the so-called *Thatcham* set of criteria, rigorous product testing standards and lists of approved products, reviewed regularly. More than 20 Cobra security products are approved by MIRRC at Thatcham, more than any other security manufacturer.



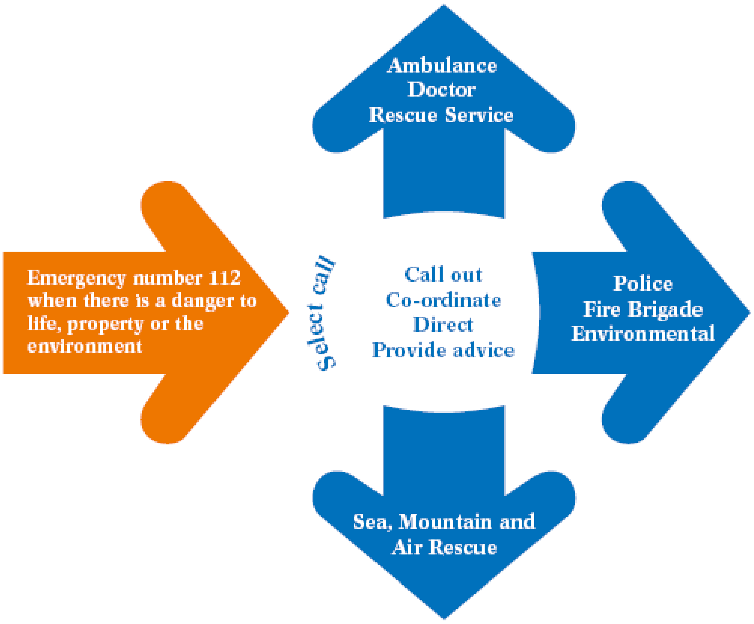
Source: Michael L. Sena Consulting AB, October 2005.

The key to pan-European stolen vehicle tracking service delivery is the ability to contact the police in each country. This can only be done by an officially authorised secure operating center in the country where the theft is being made. The SOC must have an agreed relationship with the police in their country. Signing agreements with an SOC in each country is the foundation for a pan-European stolen vehicle tracking service.

2.6.2.2 Emergency Services

SOS Alarm, a government-owned Swedish organisation responsible for all 112 calls in Sweden, are aggressively pursuing business opportunities outside the traditional public service answering point (PSAP) boundaries. They view the potential of automatic eCall as an opening into the vehicle telematics arena and the base for offering other vehicle- and non-vehicle-related services. They have already begun cooperating with companies offering stolen vehicle tracking services.

SOS Alarm Sweden Services



BT, the privatised former national British Telecom, are the receivers of 999 (112) calls from U.K. mobile operators Vodafone, Orange, O2 and Three, e112 calls from all mobile operators, and of telematics calls from Volvo and BMW telematics customers. **Cable&Wireless**, a competitor to BT, handle the 999 calls for T-Mobile, but they are not equipped for e112 or telematics, so BT handle the T-Mobile calls on behalf of C&W. These companies are clearly positioned to provide additional services should they choose to do so because of their monopolistic status and their state mandate.

2.6.2.3 Insurance

Aviva/Norwich Union in Great Britain have been testing pay-as-you-drive insurance for several years. They recently purchased RAC Automotive Services, which expands their business into warranty roadside assistance and traffic information delivery (with the Trafficmaster/RAC joint venture). It appears that Aviva is attempting to become a full service location-based services company.

2.6.2.4 Warranty Roadside Assistance

A series of acquisitions and management shifts in Scandinavia provides an indication that competition is increasing. **SOS International a/s**, a Danish company, acquired **Sorab**, a Swedish company, following the purchase of **Viking Redning** NO, a Norwegian company, by **Falck Rädningskåren**, a Swedish company that had been spun out of **Falck Security**, a Danish company. Viking Sweden had taken over the Volvo On Call account from Falck

Rädningskåren on 1 January 2006, and had already owned the Volvo Assist account for all warranty breakdown assistance on Volvo cars sold in Sweden. With the Falck purchase of Viking, Falck regained the Volvo On Call account that it had had since the start of Volvo On Call services in 2001. The former managing director of Viking Sverige left Viking to take over the managing director job at Sorab. One of Viking's principal accounts, besides Volvo, is Assistanskåren, a competitor to Falck Räddningskären, and they had voiced their intention of leaving Viking if the Falck purchase was actualised.

2.6.2.5 Content Providers

Navteq and Tele Atlas, two competing map data providers to the navigation and location-based services industries, have been attempting for years to move further downstream in the value chain. They would like to get closer to the consumer, by-passing especially the navigation system suppliers who compile their databases into their own proprietary formats. They have both made a successful first step in this direction in the North American market by becoming providers of traffic information to satellite radio users.

New Players' Profiles and Associated Risk (new players in blue)

Telematics Service Providers		Coverage			Customers			Technique		
		Multi Cont.	Multi Country	Single Country	Diverse	Multiple Car	Single Car	Multi Format	Single Format	None
Connectivity Provider	WirelessCar	✓	✓		✓	✓		✓		
	T-Systems			✓[1]		✓			✓	
	ATX	✓	✓			✓		✓		
	Connexis[3]	✓				✓		✓		
Call Centre and Connectivity	ATX		✓				✓[2]		✓	
	ADAC			✓		✓			✓	
	IMA			✓			✓		✓	
	Elda/Targa		✓			✓			✓	
	RAC									
Content and Call Center	Mondial	✓	✓			✓				✓
	Securitas		✓			✓				✓
	SOS Alarm			✓	✓					✓
	Navteq	✓	✓			✓		✓		

1) T-Systems established services in ten European countries, but Mercedes cancelled the program in the Spring of 2004 before it went live.
2) ATX announced an agreement for services to PSA for both Peugeot and Citroën brands that should have begun in 2005. It is now announced by ATX that it will start during 2006. No confirmation of this is available from PSA.
3) Connexis has no services at present. Their concept, when and if implemented, will be a multi-continent connectivity platform

3. Applications and Content

3.1. Traffic Information

3.1.1. Introduction

Public agencies in many European countries collect traffic data and provide it for free distribution, mostly using the RDS-TMC FM radio broadcasting distribution method. They also deliver their data directly to information aggregators using the Datex standard of data transfer. Private companies also collect and distribute traffic data, and it is often of a higher and more consistent quality than the public data. European car drivers, especially those in the most congested countries like Great Britain, France and Germany have exhibited a willingness to pay for high quality data that can be delivered in a usable form.

The public and private sectors have cooperated in developing the RDS-TMC standard for traffic information coding and distribution, and this has led to wide adoption of traffic information systems, particularly integrated with navigation systems. Without public sector support and strong involvement by the road authorities in those countries where traffic data is collected, and without encouragement from the nation radio stations, it is doubtful that RDS-TMC would ever have become a reality.

This section includes information on the collection and provisioning processes for traffic and road data in the European Union. The table below shows the collection, delivery and display methods that are used and supported with public agencies and private companies active in Europe.

		Collect			Deliver			Display		
		Probe	Sensor	Phone	TMC	Flow	Other	Symb	Map	Text
Public Agencies	DLR	✓	✓		✓	✓		✓	✓	✓
	Road Administrations		✓		✓	✓	✓	✓	✓	✓
	City Authorities (VMZ)		✓		✓	✓	✓	✓	✓	✓
Private Companies	Applied Generics			✓		✓			✓	
	DDG	✓	✓		✓			✓	✓	✓
	ITIS Holdings	✓		✓	✓	✓	✓	✓	✓	✓
	Mediamobile		✓		✓	✓	✓	✓	✓	✓
	Trafficmaster	✓	✓		✓	✓	✓	✓	✓	✓

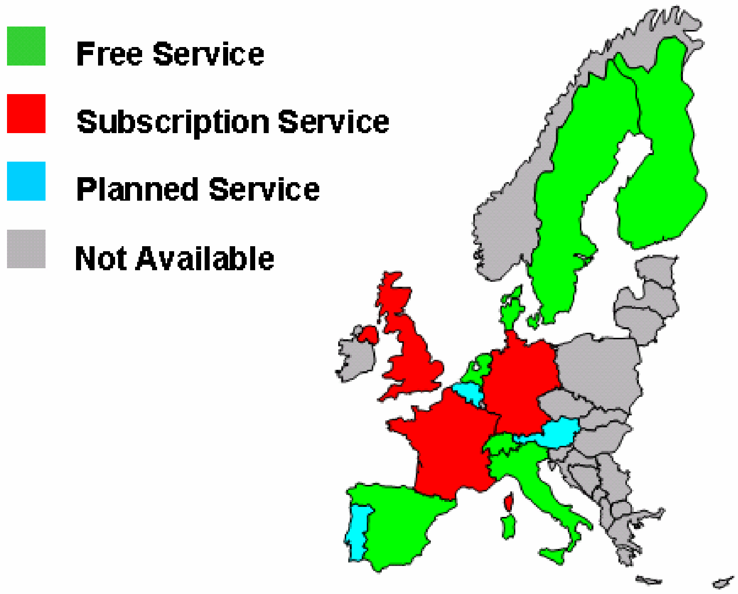
The key to using traffic data is to put the data into a form that is useful for helping drivers make pre-trip and on-trip decisions about what is the best alternative route to take to complete their journeys in the fastest possible times. Starting in the late 1980s, groups in Europe and Japan, operating independently, developed methods for coding traffic data collected using the techniques described above. In Japan the result was VICS (Vehicle Information and Communication System). In Europe, they chose to work backwards from the end use applications in order to design a coding system that could meet their usage requirements. In the first instance, the intended use was not integration with navigation systems, but for radio broadcasting audible or text messages on radios.

The *principal requirement* for the European traffic messaging system was to convert a digitally coded text message into an audible message that would be played through the vehicle's radio, and to be able to broadcast a single message in multiple languages, essential in Europe with its forty-one countries and their respective unique languages.

The system that was developed was built on top of the Radio Data System. Radio Data System has been operational in Europe since 1987. It was originally developed by the European Broadcasting Union. It uses a technique of adding data to a sub-carrier on an existing stereo transmission in such a way that the data is carried inaudibly. RDS supports program-related features, such as tuning to alternative frequencies to obtain the best signal for a channel, and non-program-related features, such as broadcasting digitally coded data on the Traffic Message Channel (TMC). RDS-TMC provides a system for collating real-time traffic-related data in a digital coded form, and broadcasting it over standard FM radio channels.

Free traffic information is broadcast via RDS-TMC in a number of European countries, including Germany, Italy, The Netherlands, Sweden, Finland, Denmark, Spain, Switzerland, Austria and France. Germany, Italy and France have fee-based services as well. The UK has no free RDS-TMC services. Private traffic collecting companies, *ITIS* and *Trafficmaster*, have licenses for RDS-TMC broadcasting in the UK. They charge fees to hardware manufacturers or vehicle manufacturers who incorporate methods for reading and decrypting their broadcast traffic data.

RDS-TMC Service in Europe



RDS-TMC Traffic Information Provision in Europe

Country	Public Provider	Free	Commercial Provider	Fee
Austria	Road Administration	√		
Belgium				
Flanders (North)	Flanders Road Admiin	√		
Walloon (South)	TMC4U	√		
Czech Republic	Planned - Road Admin	(√)		
Denmark	Road Administration	√		
Finland	Road Administration	√		
France	Motorway Operators	√	Mediamobile	√
Germany	Public Radio Stations	√	T-Mobile Traffic	√
Hungary	Planned - Road Admin	(√)		
Republic of Ireland	Planned - Road Admin	(√)		
Italy	Road Administration	√	Cities - Mizar	√
Luxembourg	Planned - Road Admin	(√)		
The Netherlands	Road Administration	√		
Norway	Road Administration	√		
Portugal	Planned - Road Admin	(√)		
Spain	Road Administration	√		
Sweden	Road Administration	√		
Switzerland	Road Administration	√		
The UK				
England			iTMC (ITIS)/Trafficmaster	√
Wales			iTMC (ITIS)/Trafficmaster	√
Scotland			iTMC (ITIS)/Trafficmaster	√
Northern Ireland			iTMC (ITIS)	√

RDS-TMC over FM broadcast is now the principal method used for transmitting traffic information. No new OEM navigation systems can be sold in Europe without integrated RDS-TMC. Because of this, the standardized methods for packaging the messages form the guiding principles to how the information is collected and coded. The method is described in detail in Section 4.3.2.2.1. In the future, other bearer channels may be used, including T-DAB (Terrestrial Digital Audio Broadcast), S-DAB (Satellite Digital Audio Broadcast), GSM/GPRS (using the GST service definition), or other yet-to-be-developed methods.

ERTICO has been a major promoter of RDS-TMC, and hosts the TMC Forum. This group has now succeeded in making ALERT-C coding, the standard used in RDS-TMC, the method used in the U.S. for traffic broadcasts over satellite radio (S-DAB). Both navigation map database providers, Navteq and Tele Atlas, are using the same coding scheme in their respective North American databases. ERTICO has also sponsored efforts to export RDS-TMC to China. The DYNASTY project in Beijing brought European system suppliers Siemens VDO and Blaupunkt together with VW to demonstrate a platform for dynamic traffic information services. The database was provided by Navteq's China office, a joint venture with the Chinese government mapping agency.

3.2. Traffic/Road Information Collection

3.2.1. Traffic/Road Information Collection Organizations

Traffic information is collected in most of the European countries by public authorities at the national, regional/state and municipal levels. In some countries, such as Germany, France, Italy and the United Kingdom, both public authorities and private organizations collect traffic information. The public road authorities in Europe have broad responsibilities to supply information to a range of agencies for planning and management processes. The private organizations collect traffic information in order to sell it to consumers as well as to public agencies.

3.2.1.1 Public Authorities

There is a sub-group of public authorities and quasi-public organization from countries that are especially active in the field of traffic information collection and management. The following national/regional/local authorities and organizations are actively involved in European Intelligent Transport Systems and Services through participation in the ERTICO (ITS Europe) Public Authorities Platform. The Public Authorities Platform was established in 1995 as a response to the mutual interest of national transport departments to promote cooperation and consensus. It has evolved into a network with a broad scope involving a large majority of EU Member States – including those from Central and Eastern Europe. The group also consults with countries outside of Europe to ensure a comprehensive approach.

Participation in this Platform comes from all levels of public authorities, including:

- National governments
- Local and regional organizations
- Representatives of police agencies
- Aerospace and research institutes

The Platform is currently chaired by Mrs Monica Sundström of the Swedish Road Administration, consists of the following members:

- **Austria**: Federal Ministry for Transport, Innovation & Technology
- **Belgium**: Walloon Ministry for Equipment & Transport
- **Belgium**: Ministerie van de Vlaamse Gemeenschap
- **Czech Republic**: Ministry of Informatics
- **Czech Republic**: Ministry of Transport
- **Denmark**: County of North Jutland
- **Denmark**: Danish Road Directorate
- **Finland**: Finnra - Finnish Road Administration
- **France**: Ministry for Transport, Infrastructure, Tourism and Sea
- **Germany**: DLR - German Aerospace Center
- **Germany**: Federal Ministry for Transport, Building & Urban Development
- **Hungary**: Ministry of Communications and Information

- **Hungary**: Ministry of Economy and Transport
- **Ireland**: Department of Transport
- **Italy**: Ministry of Infrastructure and Transport
- **Luxembourg**: Administration des Ponts et Chaussées
- **Norway**: NPRA - Norwegian Public Roads Administration
- **Poland**: General Directorate of National Roads & Motorways
- **Portugal**: General Directorate for Land Transport
- **Portugal**: Portuguese Road Administration
- **Slovak Republic**: Ministry of Transport, Posts and Communications
- **Slovenia**: Ministry of Transport
- **Spain**: Dirección General de Tráfico
- **Spain**: Basque Government - Department of Public Works
- **Spain**: Ministry of Internal Development, Directorate General of Road Transport
- **Sweden**: SRA - Swedish Road Administration
- **Switzerland**: Directorate General of Swiss Customs
- **Switzerland**: Swiss Federal Roads Authority
- **The Netherlands**: Ministry of Transport, Public Works & Water Management
- **The Netherlands**: KLPD - Dutch National Police Agency
- **United Kingdom**: ACPO - Association of Chief Police Officers for England, Wales and Northern Ireland - ITS (Sussex Police)
- **United Kingdom**: DfT - Department for Transport

Municipal authorities within the cities of Europe, such as Transport for London (TfL) and Stockholmstads Trafikkontor, have the primary responsibility for traffic management within their cities' boundaries. In some cases these organizations run the transportation system and manage the roads. In other cases, as in Stockholm, traffic is managed by the Traffic Office, and transportation networks are managed by a separate agency, (e.g., Stockholms Lokaltrafik (Stockholm Local Transportation) for underground and busses, and Sveriges Järnväg (Swedish National Railroad) for trains).

The overlap in responsibility between the national agencies and local authorities can lead to difficulties with collecting and providing traffic information that is consistent across municipal boundaries and along major roads that pass through built-up, urban areas. While the local and regional agencies collect data, it is usually the national organizations that have the responsibility for coding the traffic databases (see below, 4.2.2.2. Standard Provisioning Methods) that are the basis for traffic information provision in the majority of European countries.

This picture is complicated further by the existence of private organizations in some countries who both collect and distribute traffic data. In the U.K. only private companies are involved in traffic information distribution, while in Germany and France, both private companies and public agencies collect and distribute information.

3.2.1.2 Private Organizations

3.2.1.2.1 RAC Trafficmaster (U.K.)

RAC Trafficmaster Telematics (RTT) is a joint partnership between *Trafficmaster PLC* and *RAC Motoring Services*. A complete presentation is made of Trafficmaster in Section 2.1.1.6. The *RAC*, which originally stood for Royal Automobile Club but now is simply a name, is one of the two large automobile clubs in the United Kingdom, the other being the Automobile Association (AA). *RAC Motoring Services* was owned by the Royal Automobile Club, but it was sold to Lex Service PLC in the late 1999s. It was then sold to *Aviva* in late 2005, and incorporated into the *Norwich Union Insurance* division. *Aviva Norwich Union* is a UK insurance company that has been very active in testing and now applying usage-based car insurance. The alliance between RAC and Trafficmaster began when the RAC required a competitive response to the AA Roadwatch traffic information service. Since this service has been taken over by ITIS Holdings plc, this direct threat no longer exists. However, Trafficmaster and ITIS are fierce competitors, and the alliance with a motoring organization is viewed as a competitive advantage.

The national RDS-TMC service offered by *RTT* gathers traffic data in real time from Trafficmaster's established network of over 7,500 roadside nationwide sensors. This is then supplemented with incidental data from the *RAC's* roadside assistance patrols who report accidents and other congestion-causing incidents as they perform their normal duties of assisting members who have had problems with their vehicles.

The data is transmitted through the RDS bandwidth supplied by *Trafficmaster's* commercial radio partners – GCap Media Plc and Chrysalis Radio, who together ensure that motorists across mainland Britain can receive the *RTT* service. Data is provided to navigation or traffic information system manufacturers, application service providers, or directly to automotive manufacturers.

Trafficmaster's traffic information is derived from its network of nationwide static roadside sensors and transmitters that gather and distribute traffic data from over 8,000 miles of motorway and trunk routes. It is supplemented with Floating Car Data retrieved from its on-board units. Traffic data is then delivered to the customer through a number of screen or speech-based receivers. These include a variety of in-car products and services that include *Trafficmaster's* own navigation system, called *Smartnav*, as well as to the *Trafficmaster's* *Monitor*, *YQ², Oracle* and *Freeway* units. Traffic information can also be obtained by phoning the 1740 service, which is run in partnership with the RAC and the UK's main mobile phone operators.

3.2.1.2.2 ITIS (U.K.)

ITIS Holdings plc has been describe in Section 2.1.1.7. of this report. The company collects traffic information using its floating vehicle data systems. The company uses its in-house developed data processing systems to match the collected data to specific roads and links, and to create output in several different formats, including RDS-TMC.

Contact:

Stamford new Road, Altrincham, Chesire
United Kingdom "A14 1EP
Tel.: +44 (0) 161 927 3600
Fax: +44 (0) 161 929 5074
Email: dwoolard@itisholdings.com

3.2.1.2.3 DDG (Gesellschaft für Verkehrsdaten mbh - Germany)

In addition to the public RDS-TMC service in Germany, there is a national commercial TMC service, called TMCpro, operated by *T-Mobile Traffic*. The traffic content for the TMC service is provided by the DDG, which, since

January 2004, has been a 100% subsidiary of T-Mobile Traffic GmbH. (See section 2.1.1.5.)

The RDS-TMC service has been in live operation since March 2004. Country-wide service coverage is implemented through a network of private broadcasters, with coverage of landmass and motorways beyond 90%. The service is provided by T-Mobile Traffic GmbH under a commercial agreement with automotive and terminal manufacturers. The RDS-TMC Message Management and distribution activities are operated by T-Systems Media&Broadcast, a branch within the group Deutsche Telekom dedicated to the operation of broadcasting platforms.

Traffic reports from the police authorities complete the information input, in particular with an indication of the cause of the traffic disturbances.

3.2.1.2.4 Mediamobile (France)

Mediamobile, a subsidiary of France Telecom and TDF, is described in Section 2.1.1.4. of this report. Information is collected using infrared road sensors, surveillance cameras and probe vehicles.

3.2.1.2.5 Targa Trafficmaster (Italy)

Trafficmaster has a joint venture in Italy with Targa Infomobility to collect and distribute traffic information to both the Trafficmaster units and, via the Targa Infomobility telematics server, to Magneti Marelli navigation units. Targa Infomobility, based in the former Alpha Romeo production facilities outside the city of Milan, Italy, was originally a wholly-owned subsidiary of Fiat. The group was sold to Elda Group Engineering in late 2005.

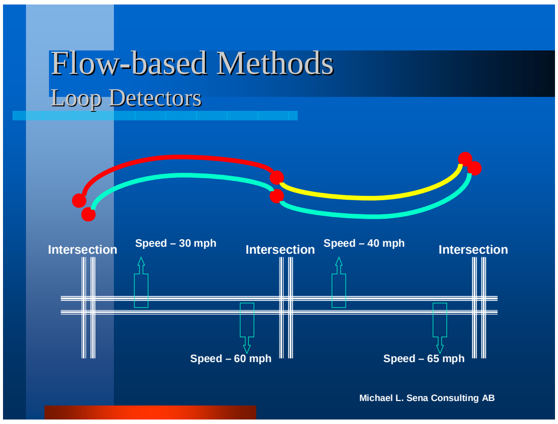
3.2.2. Types of Information Collected and Collection Methods

3.2.2.1 Traffic Information

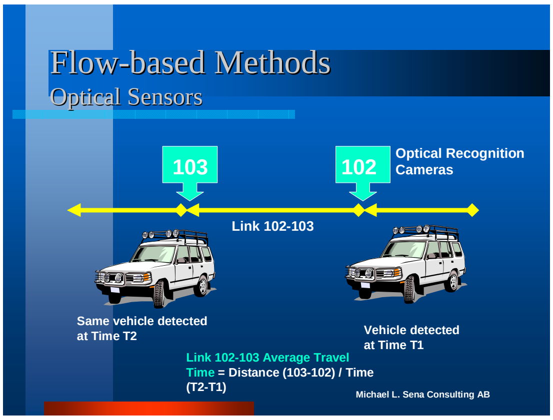
3.2.2.1.1 Traffic Flow and Congestion

3.2.2.1.1.1 Flow Information

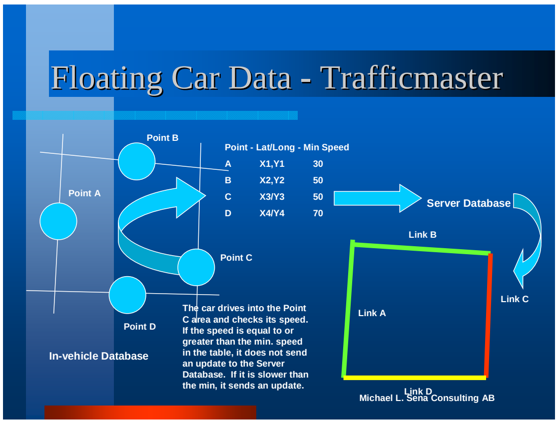
With flow-based methods, actual speeds along road segments are measured. There are several ways that traffic flow is measured, as illustrated and described below. The main advantage of using flow-based methods for traffic congestion reporting applications is that no human intervention is required to collect the data. The collected data can also be used in traffic prediction models to supplement real-time data feeds.



Loop detectors embedded in roads measure the speed of vehicles passing above them. These values are fed back to a central server where they are processed into average speed of travel at point locations (i.e., above the detector), or along a road segment. One of the principal advantages of below-surface loop detectors is that they are not subject to vandalism. The disadvantage is that they are costly to install and tend to be limited to the major highways.



Optical recognition cameras provide a reliable method of measuring average speeds along pre-defined road segments. They can distinguish cars from trucks, offering a level of detail that is useful for traffic management. The best location for the cameras is on overpasses. These are not always available in the most convenient locations, and cameras are more easily reachable by vandals than on roadside poles. Traffic measurement cameras are also confused with speed cameras, which increases the possibility for vandalism.



Traffic flow can also be measured by use of floating car data or floating cellular phone data. Both techniques are now in use in commercial applications by companies like Trafficmaster, ITIS, DLG, DLR and others. Floating car data (or floating vehicle data as it is called by ITIS), relies on vehicles sending their positions on a regular basis as they move about on the road network. This information is processed into average speeds along all road segments for which data has been obtained. This method requires an in-vehicle positioning unit and some form of communications. Cellular systems require only the presence of a phone in the vehicle.

3.2.2.1.1.2 Incident Information

A traffic incident is an occurrence that disturbs the normal flow of traffic, causing blockage on the road network and delays. Incidents can be temporary and of short duration, such as a car with a flat tire in the breakdown lane, or they can be more severe, such as a multi-car accident. Incidents can also be of a longer nature, such as roadworks or bridge repair. Incidents are the causes of congestion. The impact of the incidents is what flow-based systems measure. Traffic collection systems that rely on the reporting of incidents must observe the impact in order to report it in the form of coded messages. This is the disadvantage with incident-based systems: if no one observes and reports the incident, it is not included in the information flow.

3.2.2.1.2 Road Information

Public authorities at the national and/or community level collect road and store various types of road information, including the following:

- Surface type and condition
- Slope
- Objects (light and sign poles, fences, physical dividers, etc.)
- Accident locations
- Hazardous goods restrictions
- Height, width and weight restrictions
- Risks for high winds, snow drifts, falling rocks
- Legal turn and passage restrictions
- Legal speed limits

There were no sources that listed the types of data stored by each of the countries. Such lists would have to be compiled on a country by country basis.

3.3. Traffic/Road Information Provision

3.3.1. Information Provision Organisations

Traffic information in European countries is provided by a combination of public and private organizations, oftentimes working in conjunction with one another.

3.3.1.1 Public

The following national, regional/state and municipal authorities provide a TMC service[5]:

3.3.1.1.1 National Road Authorities

3.3.1.1.1.1 Austria

In Austria, ORF is broadcasting the free service on the radio channels Ö1, *Ö2* (9 regional channels), *Ö3* and FM4 and is supported by the *Federal Ministry for Traffic, Innovation and Technology (BMVIT)*. *ASFINAG* is responsible for the location table, currently in version 1.0 and plan an updated version 2.0.

3.3.1.1.1.2 Czech Republic

In the Czech Republic, two services are available. They are in test phase but are basically regular services.

TMC developments are coordinated by *CEDA*. They are responsible for the location table (current version is 1.36, a new version is under preparation and expected beginning 2006).

3.3.1.1.1.3 Denmark

The free TMC service *DK-TMC* in Denmark is operated by *Vejdirektoratet* or *DRD* (Danish Road Directorate). It is broadcast on DR *P3* and *P4*.

They are also responsible for the location tables. Since October 2003 version 6.0 of the location database is transmitted, but already a backwards compatible version 7.0 has been certified by the TMC Forum in June 2004. In case of changes they will transmit both the old and the new location code.

3.3.1.1.1.4 Finland

A free service is available in Finland serving principally the south of the country. It is transmitted by YLE on *YLE Radio Suomi*. Both the service and the location tables are provided by the *FINNRA*, the Finnish National Road Administration. The current version of the location table is 1.31.

3.3.1.1.1.5 France

Both a free public service and a commercial service are available in France. The free service is provided by the motorway operators and provides information on their toll-

[5] Information taken directly from the TMC Forum Internet home page.

roads. The toll-road operators are *AREA*, *ASF*, *ATMB*, *Cofiroute*, *ESCOTA*, *SANEF*, *SAPN*, *SAPRR*, *SFTRF* and *SMTPC*. The TMC data is on the 107.7 traffic channel so it can only be received along the motorways. The commercial services is by Mediamobile.

Location tables are released by the government agency *SETRA* and includes about 20000 locations. The current version 0.4 includes both inside Paris and outside Paris. The latest certified version is 5.1.

3.3.1.1.1.6 Germany

In Germany both a public and a commercial service are available. The public service is an open, free service that can be received by the public radio stations.

BAST, the German Federal Highway Research Institute, is releasing location tables. The current version is 4.0, which has been on air since April 2005. Compared with the previous version 3.0, it also includes all major access roads leading to the football arenas which will be used in the World Championship in 2006.

3.3.1.1.1.7 Italy

A TMC service is available in Italy. *CCISS* (national traffic information centre) is providing the service. It is broadcast on the RAI FM network, on *Radio 1*. This service principally covers major routes in the North of the country, especially Autostrada A4 Torino-Trieste.

Another free TMC service is provided by the commercial radio station RTL, transmitted on the national radio station RTL 102.5. The service covers 90% of the population of Italy, and is still increasing.

The location table, provided by *Mizar Mediaservice*, is in its version 1.1 but a new version 2.0 has already been certified.

3.3.1.1.1.8 Norway

A TMC service is available in Norway. It is available in a limited area (Østfold, Akershus and Oslo) and expanding to cover larger parts of the country. It is transmitted on NRK *P1*. *Statens Vegvesen*, the *Norwegian Public Roads Administration (NPRA)* is releasing location tables. The current version is 1.1.2004, but a new version 1.4.2004 has been certified.

3.3.1.1.1.9 Spain

Location tables are coming from *DGT*, *Dirección General de Tráfico*. The current version is 1.6 (previously called 6.0) and contains about 5000 locations. A new version is expected in 2005 and will contain about 9000 locations (but it will be backwards compatible with the current version).

3.3.1.1.1.10 Sweden

A free service is available in Sweden. *SNRA*, the *Swedish National Road Administration* or *Vägverket*, is responsible for the free service and for making the location tables. The previous version 1.2003 contained about 9800 locations. Since October 2004 version 1.1.2004 is transmitted. A new version 1.2005 has been certified. New versions are always backward compatible.

Regarding the transmission, Sweden is divided into 8 broadcasting zones in order not to transmit traffic information that is not useful at that location. They cover the European, national and major county highways and contain information about traffic accidents, road works and road weather. The service is broadcast on Sveriges Radio P3 radio station and cover 98 percent of Sweden.

3.3.1.1.1.11 Switzerland

A TMC service is available in Switzerland. The broadcaster is SRG SSR idée suisse or *Swiss Broadcasting Corporation* who transmits TMC on *FM chain 1* (general, services) and *FM chain 3* (pop/rock) all over Switzerland.

In German speaking areas: DRS 1 (G) / DRS 3 (G) / RSR 1 (F) / RSI 1 (I) partly

In French speaking areas: RSR 1 (F) / RSR 3 (F) / DRS 1 (G) / RSI 1 (I) partly

In Italian speaking areas: RSI 1 (I) / RSI 3 (I) / DRS 1 (G) / RSR 1 (F)

It is *Viasuisse*, a daughter company of it, that operates the service.

Location codes are the responsibility of the *Swiss Federal Roads Authority FEDRO* but *B+S Ingenieur (Bundesamt fur Strassen)* makes the location tables. Version 5.0 is on air from September 2004. It is backward compatible with version 4.5 as most changes are additions.

3.3.1.1.1.12 The Netherlands

The service provider *TMC4U* is delivering a TMC service in The Netherlands. Currently it is free, but they plan a pay-service including local information. *TMC4U* is a collaboration between *Siemens* and *ANWB*. The transmissions are on the radio channels of *SkyRadio*, *Radio Veronica* and *Radio 1*.

A second TMC service *ViaTMC* is provided by *Vialis*. They are transmitting on the FM channels of *Q-music* (previously *Noordzee*) and *Radio 538*. Information of traffic jams, road works and so on is the same on both channels, but they add information on speed traps to it independent of each other.

Location tables come from *AVV Transport Research Centre* and are supplied by *TIC Nederland*. The current version is 2003.a.

3.3.1.1.1.13 United Kingdom

Private companies are collecting and transmitting traffic data.

3.3.1.1.1.14 Other Planned services

It is also planned in Portugal. In Ireland,Hungary and Luxembourg no service is currently planned. In Poland a private radio station did some tests but *General Directorate for National Roads and Motorways* (GDDKIA) didn't decide yet on a real implementation.

3.3.1.1.2 Regional/State Authorities

3.3.1.1.2.1 Belgium

In Belgium there are 3 TMC services: VRT and 4FM in Flanders and RTBF in Wallonia. All of them are free services.

The service *TIC-VL* is broadcast by VRT on *Radio 2* and is using content from *Verkeerscentrum Antwerpen*. Coverage of content and transmissions is limited to the Flanders region.

In the southern part of Belgium, Wallonia, the service *CLASS.21* is broadcast by RTBF on *Classic 21*. The service is from the *Centre PEREX* of the *Ministère de l'Équipement et des Transports (MET)* in collaboration with *TMC4U*. Both coverage of transmissions and content is limited to Wallonia.

A third TMC service is *ViaTMC* provided by *Vialis*, which is also operating TMC services in the Netherlands. It is broadcast by 4FM in Flanders, but the content contains both the content from *Verkeerscentrum Antwerpen* and *PEREX* and so covers Belgium in total. In future they plan to add information on speed cameras.

Tritel creates the location tables by order of the regional communities. Since December 2004 the broadcasted messages are according to location table version 1.4b, in which N-roads are added. The latest certified version is 2.0.

3.3.1.1.2.2 Spain

A TMC service is available in Spain on *RNE 3*. It is provided by the following organizations:

SCT as the operator of traffic management in Catalonia Autonomous Community

DT in the Basque Country Autonomous Community

DGT (Traffic General Directorate) as the operator for the rest of the country's traffic management.

The road network coverage is the motorways, national roads and first level roads that belong to the Autonomous Communities. Next to that, RACC [1] is working on urban TMC services, starting with Seville and Barcelona. This will broadcast on *RNE 2*.

3.3.1.1.3 Municipal Authorities

3.3.1.1.3.1 Czech Republic

A service, called *TSK TEST*, is available in Prague. It is broadcast on Český Rozhlas – *Regina* (92.6MHz). The service provider is *TSK-PRAHA* (Communication Technical Administration). The content comes from the traffic centre in Prague(*TIC Praha*). A second service, provided by *Global Assistance* is available countrywide. It is broadcast by CRo1 Radiozurnal

3.3.1.1.3.2 Germany

VMZ (VerkersManagementZentrale) is an initiative of the State of Berlin Senate Department of Urban Development, which covers the area of Greater Berlin. VMZ is managed by a consortium including *debis Mobility Services* and *Siemens AG*. The VMZ Content Platform Berlin includes all traffic and transport relevant information, such as parking facilities or traffic problems caused by major events. Based on the integration of various data sources, VMZ provides mobility services which are available via the Internet and mobile devices.

3.3.1.2 Private Organisations

3.3.1.2.1 RAC Trafficmaster

RAC Trafficmaster Telematics (RTT) is a joint partnership between Trafficmaster PLC and RAC. The national RDS-

TMC service offered by RTT gathers traffic data in real time from Trafficmaster's established network of over 7,500 roadside nationwide sensors. This is then supplemented with incidental data from the RAC.

The data is transmitted through the RDS bandwidth supplied by Trafficmaster's commercial radio partners – GCap Media Plc and Chrysalis Radio, who together ensure that motorists across mainland Britain can receive the RTT service. Data is provided to navigation or traffic information system manufacturers, application service providers, or directly to automotive manufacturers.

Trafficmaster's traffic information is derived from its network of nationwide static roadside sensors and transmitters that gather and distribute traffic data from over 8,000 miles of motorway and trunk routes. Traffic data is then delivered to the customer through a number of screen or speech-based receivers. These include a variety of in-car products and services that include Trafficmaster's own navigation system, called *Smartnav*, as well as to the Trafficmaster's *Monitor*, *YQ², Oracle* and *Freeway* units. Traffic information can also be obtained by phoning the 1740 service, which is run in partnership with the RAC and the UK's main mobile phone operators.

3.3.1.2.2 ITIS Holdings plc

Information on ITIS Holdings plc, a UK-based company, is found in this report in the Probe Data section under section number 2.1.1.7.

Contact for Traffic Information :

Danny Woolard
Technical Director
5th Floor, Station House
Stamford new Road, Altrincham, Chesire
United Kingdom "A14 1EP
Tel.: +44 (0) 161 927 3600
Fax: +44 (0) 161 929 5074
Email: dwoolard@itisholdings.com

3.3.1.2.3 DDG with T-Mobile Traffic

TMCpro is a pay service provided by *T-Mobile Traffic*, a wholly owned subsidiary of T-Mobile. The service went live in March 2004 across Germany. The content is provided by *ddg Gesellschaft für Verkehrsdaten mbh*, a wholly owned subsidiary of *T-Mobile Traffic GmbH*. It is an encrypted service, based on the conditional access specifications made by the *TMC Forum*.

3.3.1.2.4 Mediamobile

Traffic information provider Mediamobile has recently launched a new TMC service, V-Trafic (http://www.v-trafic.com/), in France. The new service offers traffic information over the internet and via mobile telephone or GPRS-equipped PDA in addition to via TMC-enabled satellite navigation systems. This enhanced service replaces the previous Visionaute service. The service is broadcast nationwide on FM station *France Inter*. It covers the majority of the Autoroute network, and also Paris and Ile-de-France in detail - in all, over 80% of daily traffic. Data is provided by a variety of sources such as the Police, city road departments and autoroute management companies, using automatic loop detectors, cameras, floating car data from taxis and reports from patrol vehicles.

The service is available on a Conditional Access basis, through direct arrangements between V-Trafic and vehicle or navigation system manufacturers. It is offered on selected vehicles and navigation systems from brands including BMW, Renault, Subaru, Volvo, Alpine, Clarion, Kenwood, Pioneer and VDO Dayton - more detailed availability and compatibility information is available on the V-Trafic website.

The commercial service *V-Trafic* is provided by *Mediamobile*. It is a partnership between TDF, Renault, *Trafficmaster* and *Cofiroute*. The service, which replaces the previous *Visionaute* service, is transmitted on the frequencies of *France Inter* and can be received nationally. It includes the information from the motorways but also on Paris congestion. The service was first open but it is now a pay-service, but it is not encrypted: by using a different location table number they can restrict the use. This method is *TMC Forum* 's Interim encryption method. They have about 60000 customers.

3.3.2. Provision Methods

The following methods are available today in Europe to deliver traffic information to users.

- Dedicated RDS-TMC Receivers – There are a few dedicated RDS-TMC receivers on the market today, such as the Volvo Trucks Dynafleet system. Standalone receivers were judged by the automotive OEMs to be too expensive for consumers.

- In-vehicle Navigation Systems with RDS-TMC – combined with navigation systems, and using the components already provided with these systems, traffic information is a minimal incremental cost.

- DAB receivers – Terrestrial Digital Audio Broadcast systems are available in the U.K. and a few other European countries, and the BBC has begun broadcasting traffic information using the TPEG proposed standard. Satellite DAB, similar to what has become so popular in the U.S., will be available Europe in the 2009 timeframe, and this holds promise for expanded traffic and traveler services.

- Voice/Data (GSM/SMS/GPRS) – Traffic services are offered in many markets by network operators using text-to-speech, Short Message Service alerts, and data packages using General Packet Radio Service over GSM.

- Wireless Application Protocol (WAP) – Prior to GPRS, WAP was the principal method used to gain access to pre-defined web pages on the Internet.

- Internet – The Internet is a popular method for obtaining an overview of the traffic flow in metropolitan regions. Services are available from both public and private sources.

3.3.2.1 Proprietary Provisioning Methods

3.3.2.1.1 Trafficmaster

Trafficmaster has provisioning methods for both a proprietary set of products and for standard RDS-TMC systems. Its proprietary products include The full-function Trafficmaster Monitor, the Trafficmaster Y^2, the TrafficView and TrafficView Internet, and the simple Oracle Messenger. All of these products receive messages using paging technology.

TrafficView information can be transmitted from the system to one or more monitors, ranging in size from a 14" screen up to the largest TV projection systems. It can already be seen on plasma screens at major shopping centres around the UK, helping shoppers to plan their journey home avoiding traffic congestion. In hotels for example, the system can also be linked to private cable or 'Pay-TV' systems.

YQ² is a screen-based portable unit that displays information on traffic hold-ups and problems on over 200 map screens. It can be used either in the car or on your desktop to help you plan your journey before you leave.
Functionality includes coverage of 8,000 miles of motorways and trunk roads in England, Wales and Scotland. Traffic congestion is shown on the map screen as an arrowhead-shaped icon signifying the location, speed and direction of the traffic at that point, allowing the driver to select an alternative route well ahead of the problem area.
Cost:
YQ² is priced at £189.99 including VAT. It comes with a universal in-car mounting kit and a one-month traffic information key.
£110.00 for 12 months information key
£60.00 for 6 months information key
£39.95 for Executive Desk Stand for YQ²
Supplied with plug-in adaptor to ensure the unit remains fully charged.

3.3.2.1.2 ARC Transistance ERIC 3000

ARC Transistance is an organization comprising eight automobile clubs as principal owners, and an additional thirty automobile and travel clubs or companies as associated partners. The ERIC (European Road Information Consortium) provides a service for members of these associations and other organizations that agree to exchange traffic information with the members of the service network. For this reason it is listed amongst the proprietary provisioning methods.

ERIC consists of twenty-two organizations in twenty-two European countries. The information collected covers more than 80% of European roads and more than 450 million European people. More than 100,000 messages per month are distributed. The headquarters and central communication center for ERIC is in Geneva, Switzerland.

ERIC 3000 is the name of the traffic information service provided by ERIC. It The real-time exchange between the organizations is performed in a fully automated manner with the ERIC 3000 system. The system was developed for ERIC 3000 by *GEWI*, a software company based in Bernburg / Germany.

The ERIC 3000 system operates according to European standards for coded information exchange like DATEX or RDS/TMC.

Minimum definition of road-incidents for pan-European use:

- Traffic jams with a minimum length of 10 kilometers;
- Road closures because of road works, weather conditions, accidents, etc., with a minimum duration of one hour;
- Inefficient traffic conditions caused by weather, transport workers' strikes, or other reasons, which cause an estimated delay of a minimum of thirty minutes compared to normal driving times;
- Roadworks with a minimum duration of 4 hours, or, in case of lane closures, with minimum duration of 2 hours; and,
- Border waiting times with a minimum duration of 45 minutes.

Minimum road network covered through this definitions:

- Complete highway-network of every ERIC-member-country;
- Network of main national roads which are important for middle- and long-distance connections;
- Main crossing roads in urban areas with a population of more than 100,000;
- Main mountain-passes which are important for middle- and long-distance connections, or tourist-relevant areas (e.g., Swiss and Austrian skiing areas);
- Main road network in tourist areas (e.g.,Adriatic coast)

Membership is open to all organizations who are based in Europe and are active or have interest in cross-border traffic and travel information. According to the statutes of ERIC, the ERIC-board decides about the proposal for integration of new members, the final decision itself is taken by the General Assembly, which takes place once per year.

Within the ERIC Federation there are two categories of members, the Full members and the Associate members. Associate-membership cannot exceed a period of two years after applying for admission and will be transformed into Full Membership.

The **minimum technical requirements** for being part of ERIC:

- Pentium III PC-Station (256 Mb RAM Minimum)
- Windows 2000 Professional
- Connection to Internet (DSL minimum recommended)
- Software *ERIC 3000* transmitted from GEWI (Germany) after allowance through ERIC operational Management

Information on ERIC and ERIC 3000 can be obtained from office@eric-info.com.

Country	Public Provider	Free	Commercial Provider	Fee
Austria			ÖAMTC – ERIC2000/3000	Members of ÖAMTC
Belgium				
Flanders (North)			TCB – ERIC2000/3000	Members of TCB
Walloon (South)			TCB – ERIC2000/3000	Members of TCB
France			Foreign members of ARC clubs	Members of ACR Clubs
Germany			ADAC – ERIC2000/3000	Members of ADAC
Italy			ACI – ERIC 2000/3000 TargaInfomobility and Trafficmaster Joint Venture	Members of ACI Fiat car brands with bConnect Service
The UK				
England and partial Wales, Scotland and N. Ireland			Trafficmaster and RAC	RAC Members or buyers of Trafficmaster equipment or owners of cars equipped with trafficmaster equipment

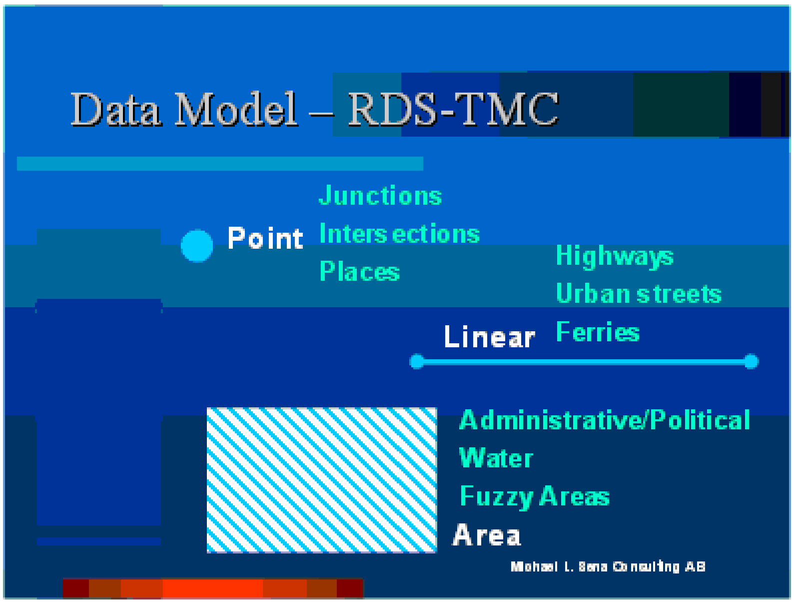
3.3.2.2 Standard Provisioning Methods

The standard for traffic information provision in Europe is RDS-TMC. For a period of time there was a competing protocol developed within the GATS (Global Automotive Telematics System) Consortium that used the GSM/SMS (Short Message Service) bearer service to deliver messages coded in the GATS protocol. This technique was never adopted because it lacked support amongst the public authorities, who supported RDS-TMC, and because there was no reliable method for coding locations of events. The method relied at first on a geocoding scheme based on a referencing system that used a point in Berlin as its origin, and coded locations to a resolution of only 100 meters.

Another competitor for traffic information provision is TPEG (Transport Protocols Experts Group) over T-DAB (Terrestrial-Digital Audio Broadcast). Complaints over the slowness and limited message size of RDS-TMC (1,200 bits/second and 35-bit data stream per event) resulted in certain groups working for a completely new approach. This effort failed to gain broad support for similar reasons as the GATS initiative. It has now been co-opted by the RDS-TMC Forum who are attempting to expand the ALERT-C standard for transmission over a higher bandwidth network.

3.3.2.2.1 RDS-TMC

How RDS-TMC Works



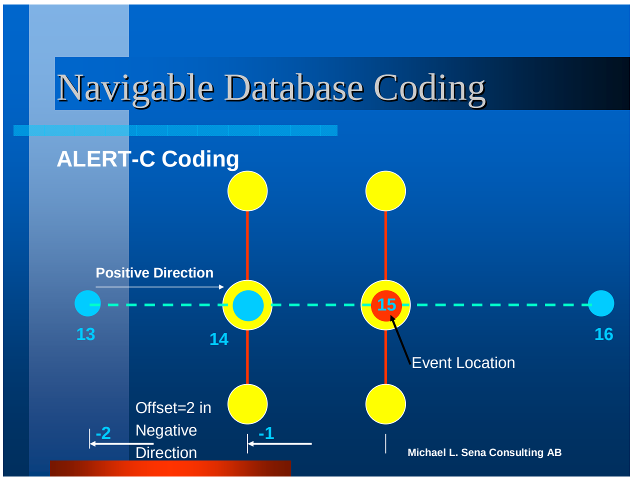
There are three types of features in the RDS-TMC data model defined in the ALERT-C standard:[6]

- Point Features
    - Junctions – A junction is the generalized version of the intersection of two or more highways.
    - Intersection – An intersection is the simple crossing of two or more urban streets.
    - Places – A place is any location that can be used as a destination, such as a town centre, a shopping center, an office park.
- Linear Features
    - Highways – Major roads with multiple driving lanes in both directions.
    - Urban Streets – Collector roads in built-up areas.
    - Ferries – The routes taken by boats to connect roads that start or terminate at the shore of a

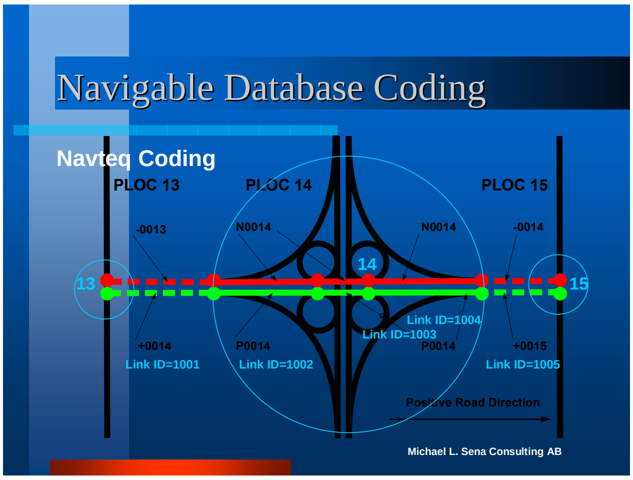
[6] ALERT-C - EN ISO 14819-2 is the second part of the EN 12313 / EN ISO 14819 series of standards, covering the so-called 'ALERT-C' protocol encoded for transmission into the RDS -TMC feature. EN ISO 14819-1 describes the ALERT-C protocol concept and message structure used to achieve densely coded messages to be carried in the RDS-TMC feature. This part (2) of the EN ISO 14819 series of standards defines the 'Events List' to be used in coding those messages.

water body with roads that start or terminate at another shore on the same water body.

- Area Features
    - Administrative/Political – State, county and city areas, as well as neighborhoods.
    - Water Bodies – Lakes, seas,
    - Fuzzy Areas – Areas that do not have specific, defined boundaries, such as districts in cities or mountain regions in the countryside.



The coding of these features using the ALERT-C standard follows strict rules. Points connect only to Points; Lines connect only to Lines; and Areas can be within one and only one larger Area. Linear features have direction, depending on the order in which the points are stored in the Location Code Table (see below). Usually, a single set of Location Codes is used to define the path of a road. The positive order of points (e.g. 13, 14, 15, 16) refers to one direction of travel, and the negative direction (e.g. 16, 15, 14, 13) refers to the opposite direction. If an incident occurs at Location 15, and it affects the lanes of travel which are along the positive path, the length of traffic build-up is defined by an offset in the negative direction.



The illustration on the left shows actual road geometry present in a navigable database (in black), the set of Point Locations overlaid on the roads (Points 13, 14 and 15), and the coding method used by the navigable database providers (Navteq and Tele Atlas) to code their databases for use with RDS-TMC traffic broadcasts. At the present time, only point locations are included in the navigable database coding. Lines and areas are not coded. This means that if a message is broadcasted with reference only to a Linear or Area feature, it would be ignored by the navigation system software. Note also that Location Code 14 refers only to 13 in the negative direction, and to 15 in the positive direction. The intersecting road is part of another chain of Point Locations.

ALERT-C Location Code Table

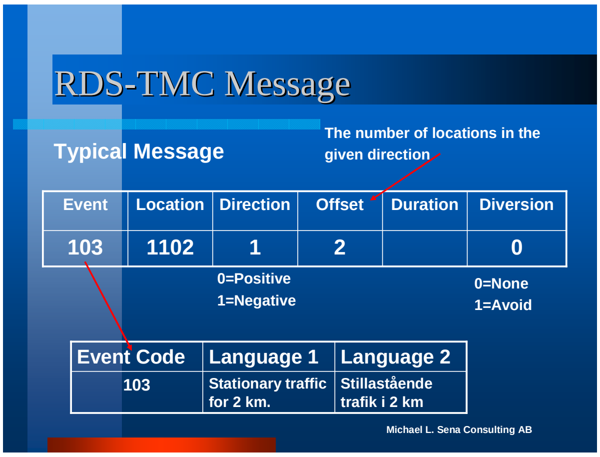
Location Code	Type	Road Number	First Name	Second Name	Ref A	Ref L	- offset	+ offset	Long/Lat
1100	P1.11	Rt A	Village X	Main St	10			1101	
1101	P3.34	Rt A	Town Hall H	Main St	10		1100	1102	
1102	P1.1	Rt A	Junction J	Main St	2001		1101	1103	
1103	P1.1	Rt A	Village Z	Main St	2001		1102		
55	P3.1	Rt B	Tunnel P		1110	756		56	
56	P1.1	Rt B	Junction J	Rt A	2001		55	57	
57	P3.2	Rt B	Bridge K		2001		56		
756	L1.1	Rt C	S-Town	t-Town	1110			757	
757	L1.1	Rt C	S-Town	u-Town	2001		756	758	
758	L1.1	Rt C	S-Town	v-Town	2001		757		
10	A.		Village X		2001				
1110	A.		Tunnel P		2001				
2000	A.		State S						
2001	A.		City Y		2000				

Key to Location Code Table

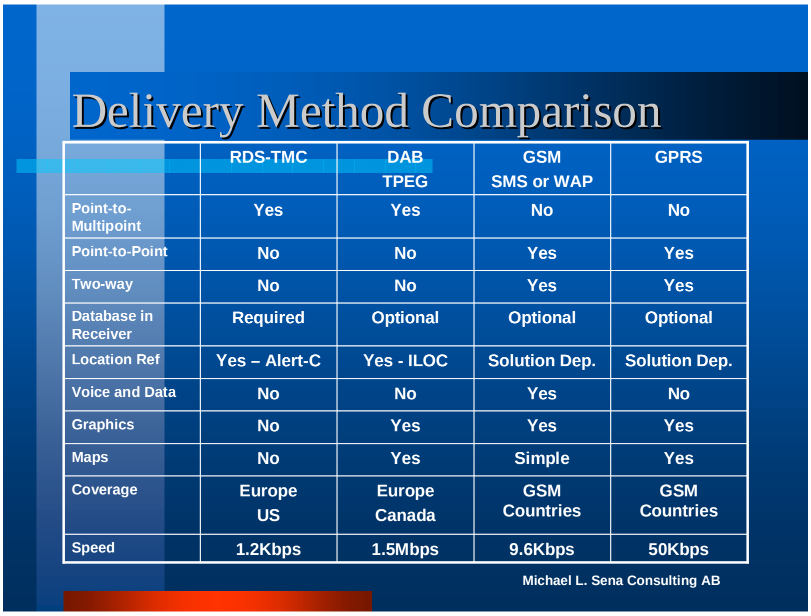
Location Code -	The number assigned to the feature. Allowed numbers range up to 65,536.
Type -	Point, Linear and Area. Each of these features has sub-types that are defined in the standard.
Road Number -	The route number of the highway on which the Location Code is located.
First Name -	The most important or recognizable name that can be assigned to the location. It can be the name of the junction, the name of the village, or the name of a feature, like a tunnel.
Second Name -	Usually the name of the street or road on which the Location Code is located.
Ref A -	This is the Area Feature inside which the Location is located. In the table above, Point Location 1100 is inside Area 10, which is called Village X. Village X itself is inside Area 2001, which is City Y.
Ref L -	This is the Linear Feature on which a Point Feature is located. Not all Point Features refer to a Linear Feature, and the coding of Linear Features varies widely among the different organizations coding the Location Code Tables.
- Offset -	Negative Offset is the reverse order of Location Codes. A Location Code refers back (in the negative direction) to the previous Location Code. For example, Location Code 2 refers back to 1.
+ Offset -	Positive Offset is the forward order of Location Codes. A Location Code refers forward (in the positive direction) to the next Location Code. For example, Location Code 2 refers forward to 3.

Long/Lat -	A place in the table has been added to assign an approximate latitude and longitude (WGS84 coordinates) to a location that would be used to represent the feature on a map.

Messages are broadcast on the FM radio channel or over T-DAB or S-DAB, or they are sent as a text message via GSM/SMS or as a packet over GSM/GPRS. The structure of the content contained in the message is identical in all transfer media.



The RDS-TMC message starts with a code for an Event. An Event is defined in an Event Code Table that is also part of the ALERT-C Standard. For example, Event Code 103 is defined as *Stationary Traffic for 2 kilometers*. There is another code for *Slow Moving Traffic*, or for *Accident*. The event is placed at a Location, which refers to a Location Code. The Direction of the Event is either in the Positive direction (i.e., following the order of Location Codes) or Negative. The Offset defines the distance affected by the Event by referring to a number of Location Codes. An estimate of the Duration of the Event can be given, but it is not mandatory. Whether it is recommended to take a diversion around the Event is also not mandatory.



	RDS-TMC	DAB TPEG	GSM SMS or WAP	GPRS
Point-to-Multipoint	Yes	Yes	No	No
Point-to-Point	No	No	Yes	Yes
Two-way	No	No	Yes	Yes
Database in Receiver	Required	Optional	Optional	Optional
Location Ref	Yes – Alert-C	Yes - ILOC	Solution Dep.	Solution Dep.
Voice and Data	No	No	Yes	No
Graphics	No	Yes	Yes	Yes
Maps	No	Yes	Simple	Yes
Coverage	Europe US	Europe Canada	GSM Countries	GSM Countries
Speed	1.2Kbps	1.5Mbps	9.6Kbps	50Kbps

RDS-TMC – Radio Data System – Traffic Message Channel
DAB – Digital Audio Broadcast
TPEG - TPEG protocol (Transport Protocols Experts Group) - Provides for transmission of text and graphic data between DAB transmission source and DAB receiver.
GSM – Global System of Mobile Communications
SMS – Short Message Service - Provides for 140 bytes of user data, which is 160 GSM 7-bit character messages (70 Unicode characters) between GSM handsets or between a GSM handset and an information source.

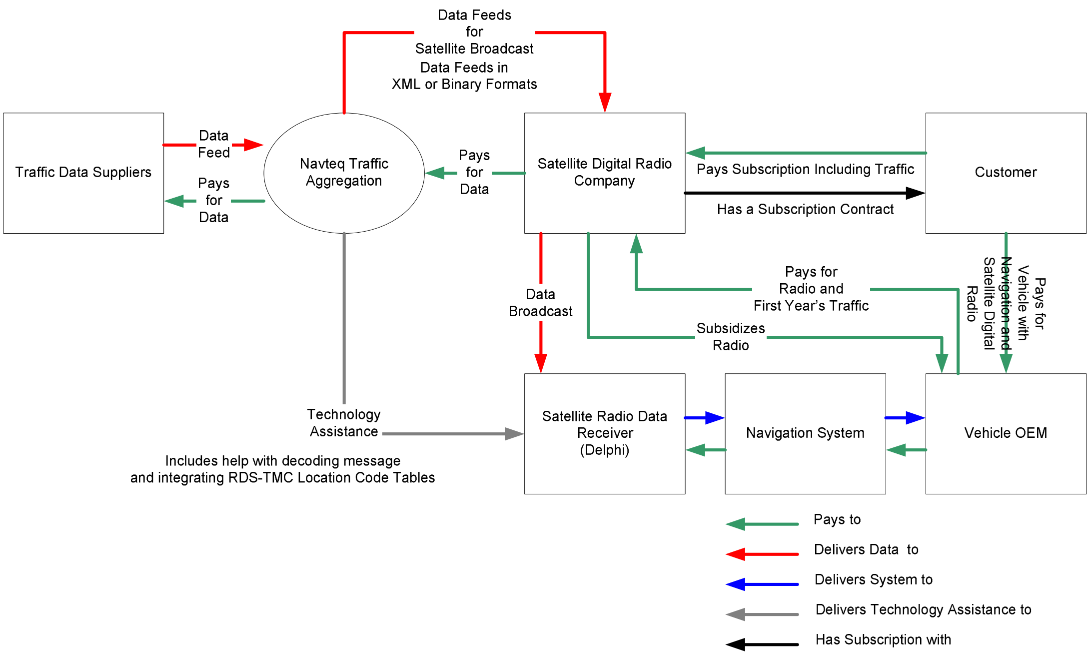
WAP – Wireless Application Protocol. Enables mobile operators to make mobile Internet access and mobile e-commerce available to WAP-compliant wireless devices.
GPRS -General Packet Radio Service for GSM, enables more efficient use of radio resources leading to increased capacity and higher speed data services.

A comparison of the delivery methods shows that the speed of message delivery for RDS-TMC is very slow, and the message size at 35 bits is quite small. It also requires that there is a database in the vehicle, the Location Code table for the country in which the service is being used. However, as a broadcast technique it is able to reach multiple vehicles, and it is a standard that now has been adopted by the automotive and in-vehicle navigation systems industry and the public sector.

3.3.2.2.2 RDS-TMC in the United States with SDR

The diagram below shows how the traffic information flow works in the U.S. for navteq with satellite digital radio. Navteq use a combination of public and private traffic data sources in the fifty markets where it currently delivers services. Its principal national supplier is Traffic.com. Navteq aggregate the traffic messages and prepare traffic messages according to the ISO standard RDS-TMC, ALERT-C protocol. These messages are identical to those prepared in Europe for broadcasting on the FM/TMC channel. The locations of the incidents are coded to match location codes in a database covering the entire country, which was prepared jointly by Navteq and its competitor, Tele Atlas.

Dynamic Traffic Information Process Flow in U.S. Market: Navteq Traffic
16 May 2006



Once the messages are defined, Navteq create two data feeds, one for XM Radio and another for Sirius Radio and CBS FM Radio. The XM Radio feed is a binary format, while the Sirius and CBS feed is an XML text file. XM take the file directly and broadcast it over their satellite channel. Sirius and CBS prepare the file before broadcasting.

Navteq work with the satellite radio data receiver suppliers chosen by the automotive OEMs, or the OEMs' navigation system suppliers. Navteq provide them with the keys to decoding the broadcasted messages. The satellite radio data receivers deliver a standard RDS-TMC data message to the navigation systems, similar to the ones that would be received via an FM/TMC broadcast. The navigation systems apply the message content for display and/or for re-routing.

Navteq is paid by the broadcasters, and, in turn, pay their data suppliers. The digital satellite radio companies are paid for the data by the customers from subscription payments. The vehicle OEM may subsidize the first year's subscription. The digital satellite radio companies are currently subsidizing the vehicle OEMs for installing their radios.

The vehicle OEM is the orchestrator of what happens in the vehicle. It is the OEM who decides whether its navigation system will interface to satellite digital radio, HD radio or continue with FM.

3.3.2.2.3 TPEG

TPEG is an abbreviation for Transport Protocol Experts Group. This group has developed two CEN/ISO standards for the transmission of traffic and travel information over digital broadcast systems, such as DAB, DVB and Internet. The coding of TPEG is independent of the bearer system.

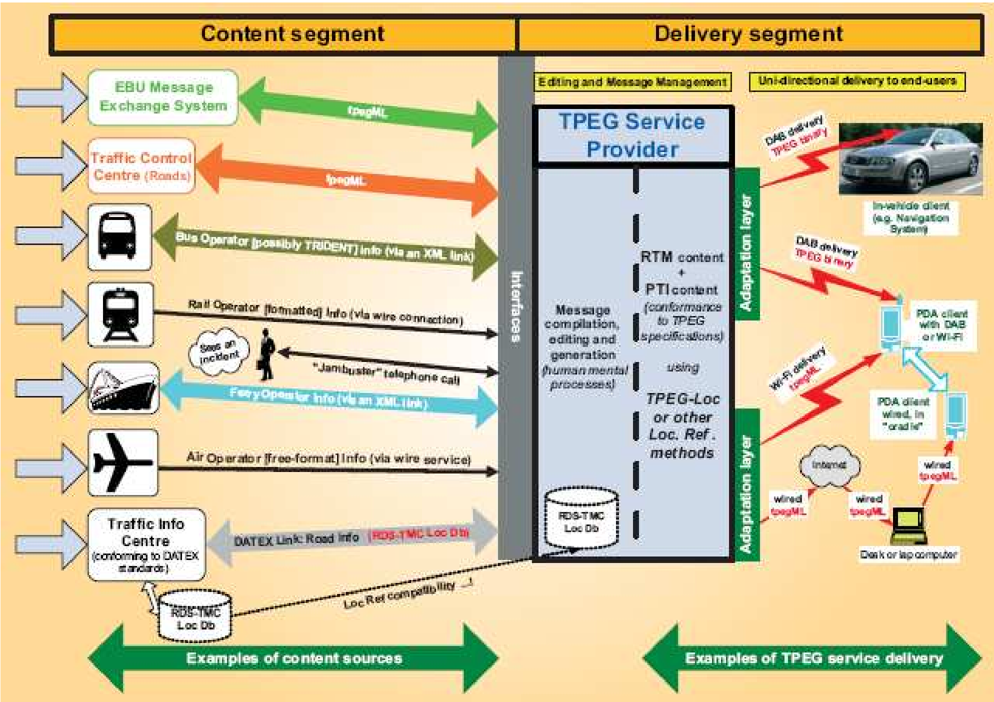
TPEG-Binary – originally developed for Digital Radio delivery	CEN/ISO TS 18234-Series Adopted: 2004-08-27
tpegML – developed for Internet bearers and message generation using XML	CEN/ISO TS 24530-Series Adopted: 2005-02-04

To some extent, it builds on experience gained with the developments of RDS-TMC for FM broadcasting, but without the known limitations of that system, specifically without the need to use location code numbers within the road network. The development of the TPEG specifications involves more than sixty organisations and companies in Europe. The TPEG Forum was in its early stage of formation in early 2006. it is supported by the European Broadcasting Union.

There are already TPEG services in the United Kingdom being operated by the British Broadcasting Corporation (BBC) which started in 1999 with DAB and the Internet. TPEG will support a number of different traffic and travel applications, specifically for all modes of transport. Because of its larger bandwidth, TPEG will be able to support a wide range of receivers, from simple text- and symbol-based receivers to more complex map-based systems with navigation.

3.3.2.2.4 RDS-TMC and TPEG – The Future

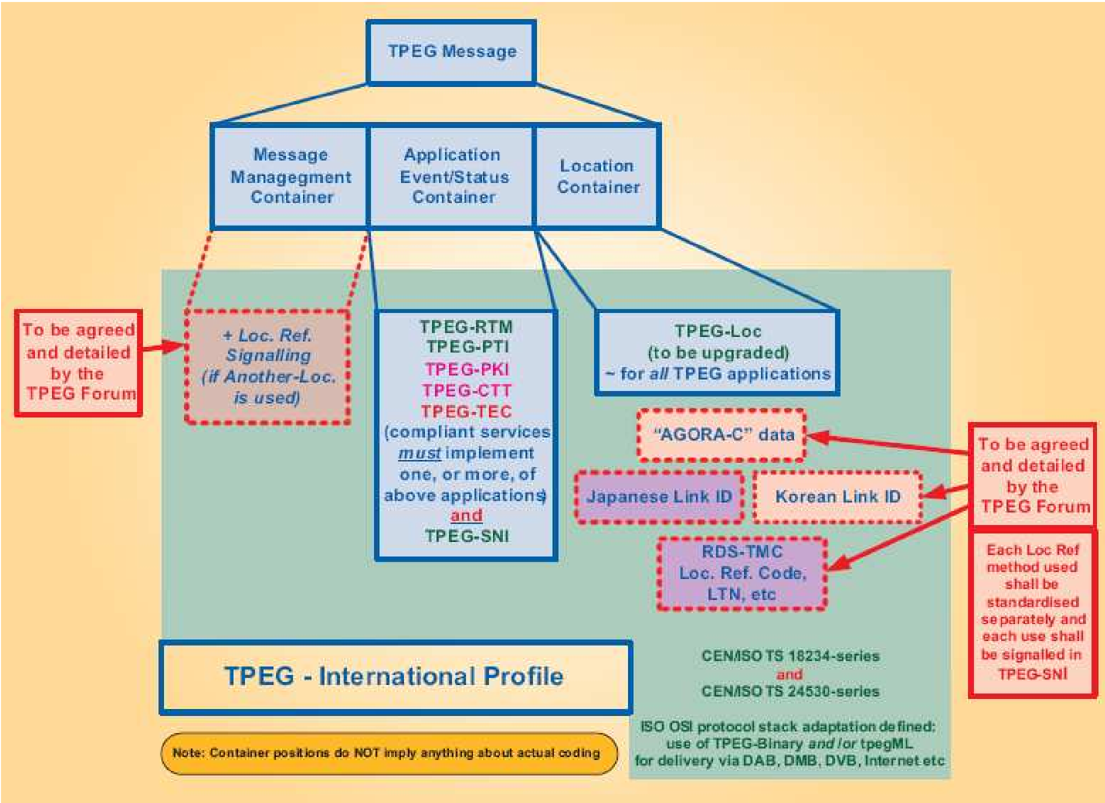
A TPEG working group is also now operational within the **TMC-Forum**. In the middle of 2004, at the suggestion of the TMC Forum, a joint meeting with the TPEG Forum was held to consider how even greater market-driven developments for Road Traffic Information could be managed. As a result, the **Road Traffic Information Group (RTIG)** was initiated. RTIG has met on a regular basis, and is beginning to produce results. It has initiated a project in Germany called *mobile.info* to begin to express its intentions to use some aspects of both RDS-TMC and TPEG technology.



RTIG has exposed two key issues:

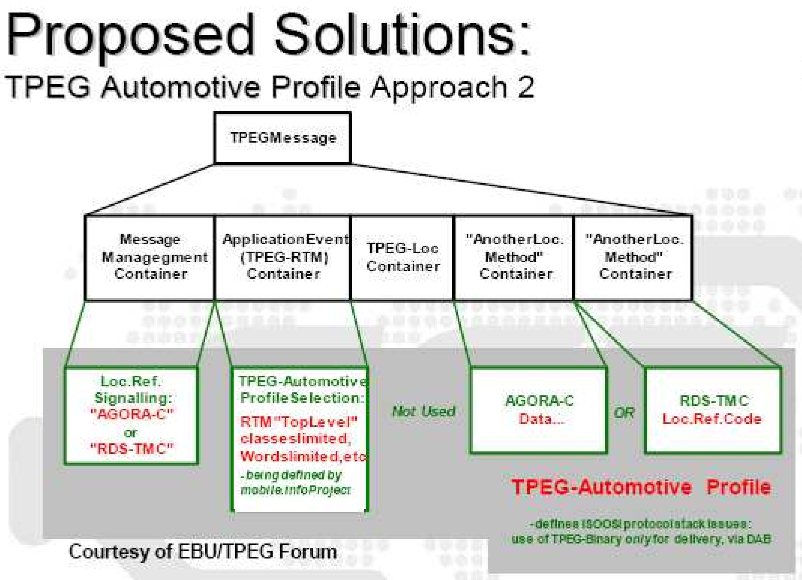
- The location referencing needs for navigation systems; and,
- The need for better understanding of TPEG profiles.

The initial implementation of TPEG provided for a location referencing method named TPEG-Loc. This method was designed for all potential client types, from simple non-map-based thin clients that deliver only text or simple icons to full-function systems. Its generality made it ill-suited to the demanding requirements of navigation systems. AGORA-C location referencing provides for a more robust on-the-fly location referencing. It has been proven to provide 95% accuracy of location in its most basic form, and close to 100% when the full complement of attributes is used. Average size of location portion of a message is 50 bytes.



Source: TPEG EBU Technical Review, Bev Marks, TPEG Forum Chairman, October 2005.

TPEG Automotive is another, separate initiative that is intended to define a method for transmitting messages to navigation or telematics systems. It is a proposal by the **GST Forum** to use the expanded message size capacity of TPEG to carry information such as speed limits, weather warnings, traffic status and event information. Both RDS-TMC and AGORA-C are suggested as possible location referencing methods. At present, the TPEG Automotive and RTIG initiatives are moving separately and in parallel, although there are individuals participating in both initiatives.



Source: GST Safety Channel Presentation, May 31, 2005

3.3.3. Information Display Methods

This section provides a sample of different display methods used for traffic information. There are dedicated traffic display monitors, like the Trafficmaster sample described below, and multi-use displays that show traffic information as well as other information. These are the navigation systems, personal navigation systems and smart phones shown below.

3.3.3.1 Dedicated Display

Trafficmaster Monitor

The *Trafficmaster Monitor* is a full colour touch screen that displays traffic problems on a map detailing the whole of the UK motorway network and 95% of trunk roads. It is designed to ease the burden of congestion by displaying the problems ahead in good time, allowing motorists to consider an alternative route and make journeys more efficient and less stressful.

Trafficmaster Monitor features include:

- Auto Locate, enabling the unit to display vehicle position and direction of travel on the road network.
- Touch-screen interface provides manual scrolling of the map, five levels of zoom, whilst text screens provide incident data.
- A choice of either actual traffic speed or delay time at congestion points. Coloured icons are graded to show, at a glance, the intensity of traffic congestion.

3.3.3.2 Multi-use Display

Examples are described below.

Blaupunkt TravelPilot navigation system overlays traffic symbols obtained via RDS-TMC on the navigation map.

Mediamobile- Product Orange – shows travel speeds along the roads using different colors. Also shown are symbols indicating traffic problems at specific locations. As traffic data collectors combine flow measurement with incident reporting, it is becoming more common to have both average speeds and incident symbols displayed on the same screen.

Navman system with Mediamobile traffic information. This portable navigation device (PND) from Navman is equipped with RDS-TMC functionality. Traffic incidents are shown on the 3D map.

Alpine has a split-screen display, showing on one side an overview of the road network with traffic problems indicated with symbols, and on the other side an exit map with the manoeuvre that is recommended.

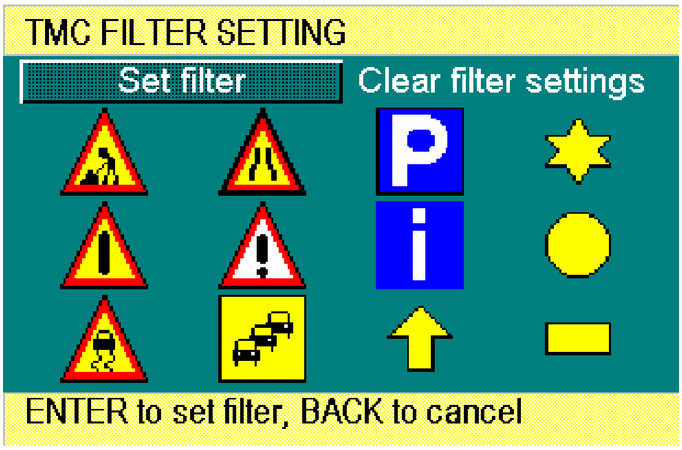
Volvo RTI (Road and Traffic Information) System was the first navigation system to display traffic problems derived through the RDS-TMC service.

3.3.4. Form of Display

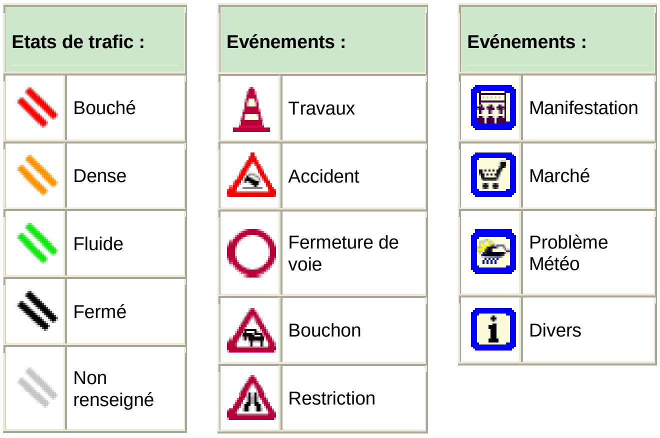
3.3.4.1 Symbols on Maps

The most common way to display traffic in Europe on in-vehicle systems is to show symbols on maps. The symbols are stylized roadworks symbols used within Europe, such as “Men Working”, “Danger; Beware”, “Danger for Skidding”, etc. The location of the incident is marked by an arrow, and severity of the incident is indicated by the color of the arrow: yellow for moderately severe, and red for severe. The direction of the effect of the incident is marked by the head of the arrow. The combination of the arrow and the symbol are intended to provide the driver with an immediate picture of where the incident is located and the reason for the problem.

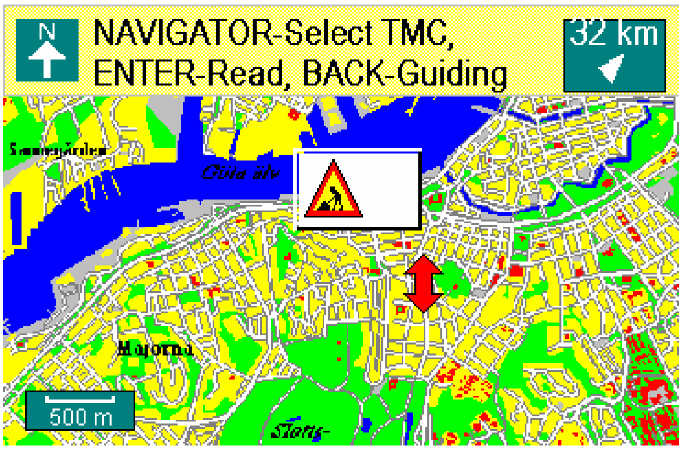
The first system to use these symbols on a map in Europe was the Volvo Trucks Dynafleet system developed by Volvo Technology Corporation. When Mitsubishi Electric developed Volvo Car Corporation’s first navigation system, he Volvo RTI System, Volvo Technology Corporation provided the complete methodology for processing RDS-TMC messages, converting them to symbols and text, and displaying them on the maps.



The Volvo RTI system, like most of the systems sold in Europe today, allows the user to select which types of traffic messages to display on the screen, and which to ignore. In central city areas, it may be more important to know where there are available parking locations, and less important to know that there are queues. Slippery road conditions may always be important. These symbols have now become integrated into other traffic message mediums, such as variable message signs along roadways and web sites.



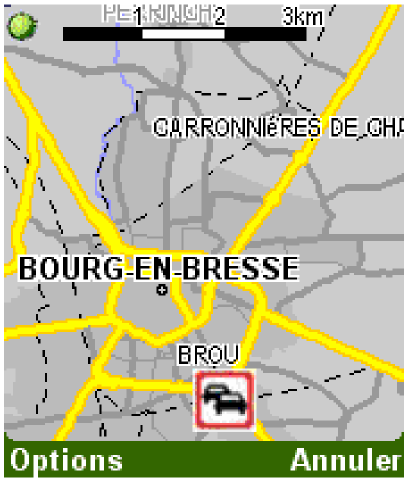
The Mediamobile symbols (shown on the left) are an example of the use of different colors (restriction), different designs for the same meaning (roadworks/travaux), and totally new symbols (weather problem in the Mediamobile sample).

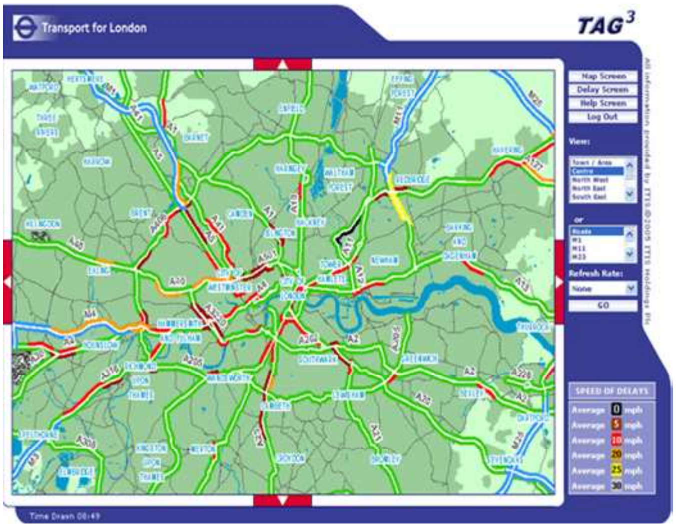


Early Volvo RTI System – Over a map of Gothenburg, Sweden is overlaid a double-headed red arrow on Linneagatan indicating that there is a disturbance in traffic flow in both directions. A roadworks symbol is displayed to show the reason for the traffic disturbance. In the earliest systems there was no connection between the event and the routing software. In later versions, after Navteq coded their databases with RDS-TMC Location Codes, an event along a planned route would trigger a re-route request.

The placement of the Volvo RTI System display on the top of the instrument panel (shown directly above) was the result of extensive research into driver distraction. It was found that placement in the radio area caused drivers to take their eyes off the road for too long a period in order to understand what was being displayed.

TomTom Traffic Information Display (shown below) shows another version of the traffic queue symbol on a small scale map of a French region.





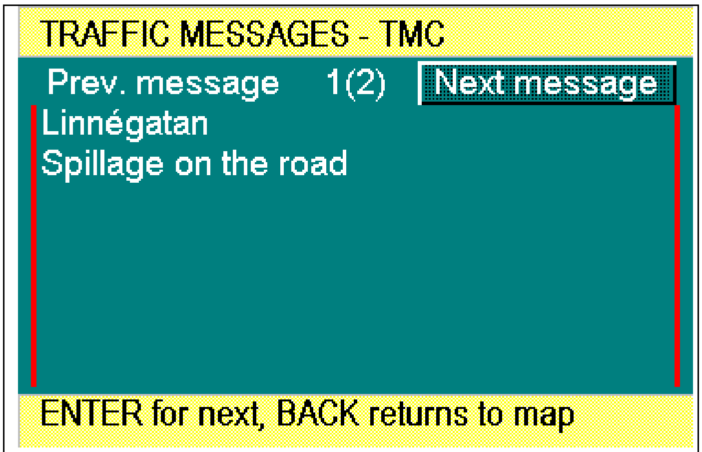
The ITIS web display for *Transport for London* (on the left) uses another type of symbol. Since ITIS collects exclusively traffic flow data, they have colored the roadways to indicate whether roadways are free of congestion (Blue for Motorways and Green for A-roads), or congested. They have colour-coded speed limits on the roads, with Black being a total stoppage, Purple being a 5 mile per hour crawl, etc. Web maps with traffic information have proliferated all over the world, and are now a standard feature on many web sites.

3.3.4.2 Text

Written or verbal messages are an integral part of the RDS-TMC standard. Navigation systems that have included the RDS-TMC standard offer the user the option of a text message that has been converted from the coded message to readable text. These text messages are derived from a TMC Event List that is part of the ALERT-C coding standard (see the following illustration).

The name of the street, Linnégatan, comes from the Location Code Table that is stored in the vehicle. It is important to remember that only the Location Code, the Event Code, Direction, Offset, Duration and Diversion are sent to the vehicle. The Location Code is the key that unlocks all position information, such as the street name.

The section taken from the Event List shown below includes the Event Code 103 that was used in the example above in Section 4.3.2.2.1. RDS-TMC. Event Code 103 is translated to "Stationary Traffic for 2 km". Another Event Code is for "Spillage on the road".



A part of the TMC event list is included below:

Code	Text (CEN-English)
	EVENT LIST
	1. LEVEL OF SERVICE
1	traffic problem
101	stationary traffic
102	stationary traffic for 1 km
103	stationary traffic for 2 km
129	stationary traffic for 3 km
104	stationary traffic for 4 km
105	stationary traffic for 6 km
106	stationary traffic for 10 km
130	danger of stationary traffic
108	queuing traffic (with average speeds Q)
109	queuing traffic for 1 km (with average speeds Q)
110	queuing traffic for 2 km (with average speeds Q)
131	queuing traffic for 3 km (with average speeds Q)
111	queuing traffic for 4 km (with average speeds Q)
112	queuing traffic for 6 km (with average speeds Q)
113	queuing traffic for 10 km (with average speeds Q)

Event Code lists are available in multiple languages. The code numbers are the same, it is only the language of the message that is different. This means that a person traveling from, for example, Sweden to Spain, can have the RDS-TMC traffic messages displayed as Swedish text on his or her navigation system as the car passes through each of the countries. The RDS-TMC broadcasts include the code, and it is the in-vehicle system that translates the code to the text. This is one of the major advantages of the ALERT-C coding technique. All of the principal European languages are included in the message lists, including U.K. English, French, German, Italian, Spanish, Portuguese, Swedish, Danish, Norwegian and Finnish. American English is also included.

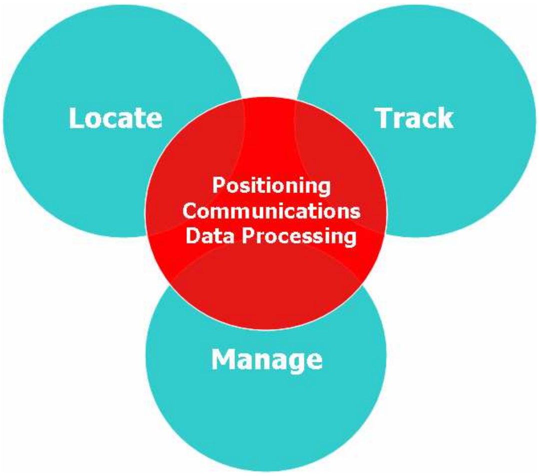
A variety of display methods

To summarize, there are a variety of display methods in use in Europe, and they usually show either travel speeds along links, or problem reasons with direction. The Mediamobile solution is an exception. It shows both flows and symbols indicating why the flow is disturbed.

3.4. Fleet management

Fleet management involves the use of positioning, communications and data processing technologies to locate, track and manage vehicles.

The business of the transport industry today and tomorrow, whether it is moving goods or people is about where the vehicle is right now, at this very minute, and how the dispatcher is going to get it to where it needs to be in the next several hours, keeping the customer informed about its location and expected time of arrival, collecting information about the truck's performance to maintain its availability and residual value.



Fleet management developments are being driven by major changes in the trucking industry that have been occurring in Europe and North America during the past twenty years. As background information, it is useful to know about these developments because they have an impact on non-trucking applications of fleet management, such as emergency vehicle dispatching, and they have had spill-over effects in most areas of location-based services, including telematics.

Initially, deregulation of the trucking industry resulted in expansive growth in the number of trucking firms (carriers). This led to overcapacity in the trucking industry beginning in the mid-90s, which in turn caused intense competition among carriers and resulted in consolidation among both Truckload and Less Than Truckload carriers.[7] Shippers (companies who contract with carriers to carry their goods) continued to narrow their core carrier list and their price focus.

As the number of trucks increased, driver shortages occurred. At one point in the late 90s, the trucking industry in the U.S. was short an estimated 50,000-80,000 drivers out of a total of 3 million drivers. Carriers decided that higher pay was one solution. Three years ago, J.B. Hunt, one of the top three carriers in the U.S., increased pay by 30%. Incentives, like in-vehicle e-mail, chiropractor visits, special encouragements to husband-and-wife teams, changed the profession--and vehicle design. Tractors (the driving

[7] Full truckload carriers normally deliver a semi trailer to a shipper who will fill the shipment with freight for one destination. After the trailer is loaded the driver returns to the shipper to collect the required paperwork (i.e., Bill of lading, Invoice, Customs paperwork) and depart with trailer containing freight. In most cases the driver then proceeds directly to the consignee and delivers the freight. Less than truckload carriers typically have several drivers in a city where a shipper is located to collect freight from various shippers. Usually the same driver will visit the same shipper each time a shipment goes by a particular carrier. Once the driver has made several stops and has picked up enough freight to fill his trailer with either enough volume or weight, he returns to his terminal to have his trailer unloaded. The trailer is unloaded and the individual shipments are then weighed and rated for billing purposes. Next, the freight is then loaded onto an outbound trailer which will forward the freight to either a break-bulk or other terminal. Once the freight arrives at its next stop along its way it will be transferred to another trailer and forwarded to the terminal in its destination city where it will be transferred to the trailer that will deliver it to the consignee. (Wikepedia Online Encyclopedia, 2006)

component of the trucks) became mobile homes. Another incentive used to attract drivers was to reduce trip length to under 500 kilometres. This coincided with new methods of supply management, including just-in-time delivery, and the result was the creation of super large regional distribution centers.

With pressure on the drivers to maximise their time on the road, governments increases scrutiny of driver logs to prevent illegally long trips by drivers who were exceeding the allowed limits, and prosecution of trucking firms that either encouraged or did not strictly enforce the limits. In order to make the recording task acceptable to the drivers and manageable by the carriers, automatic in-vehicle driver logs were developed, the digital tachograph.

The Internet quickly became a vital information source for the trucking industry. Infomediaries began putting together shippers, carriers, brokers and third-party logistics companies to change the way business was carried out. Routes and miles, which were the basis of carrier cost estimates, became less important as players took part in on-line auctions to bid for loads. Additional examples of Internet use in the business include:

- U.S. Xpress Enterprises provides an interactive load tracking program called Xpress Connect. Key benefit: It eliminates phone calls to customer service; customers get better info by logging on to the Internet.
- J.B. Hunt Logistics uses its home page to provide information to customers, status of inbound deliveries, reports based on performance information.
- C.R. England provides weather conditions, potential road delays, alternate routes, road closures.
- Roberts Express provides info on equipment suppliers, industry resources, technology providers.
- Boyd Brothers offers its customers the ability to track shipment status via the Internet--in real time. Customers can get current load location, ETA's and other information.
- Tracking technology is providing increased visibility of goods in transit - demanded by customers and a major help to dispatchers. Qualcomm, the leader in in-vehicle system technology based on satellite communications, has over one-half million of its systems installed worldwide in trucks on the road.

- New wireless technologies competing with more expensive satellite technologies providing better communications (voice and data) and allowing tighter integration of in-vehicle and office systems

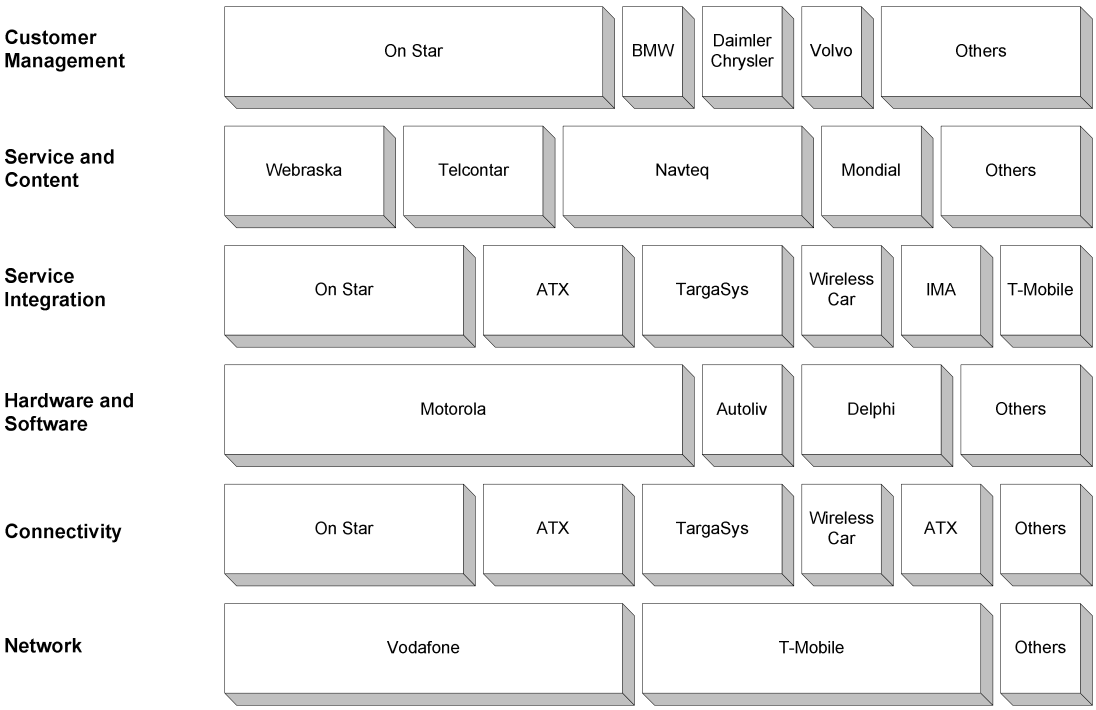
- Routes have become a commodity. Routes are available for free on the Internet, even down to street-level. The difference between calculating routes for mileage and for actual driving is now more visible to carriers and shippers.

ITS technology is increasingly being integrated and sold by OEM's who are organizing service and content (Mercedes/Freightliner; Paccar/Peterbilt/Kenworth; Volvo Trucks/Renault/Mack have or are developing in-vehicle and office-based systems). Their motivation is to satisfy the comfort, safety and security of the driver and the vehicle, increase vehicle utilization, improve residual value. Until the latest oil crisis, higher fuel prices were having less of an impact than believed. In 1998, fuel costs were only 8% of operating costs for long-haul companies, and 3% for short-haul. By 2005 these costs had increased by 75%, and fuel savings became the number one justification for in-vehicle ITS technology.

3.5. Telematics Technology

Telematics technology covers all six components of the value chain. The diagram below shows the current positions taken by major telematics players. Technology required by each of the players depends on the positions they occupy. OnStar requires more technology than BMW because OnStar provides all customer management, integrates all content and services, and is the connectivity provider. ATX requires more technology than WirelessCar because ATX offers call center operators in selected markets, while WirelessCar does not.

In-vehicle Location-based Services - The Horizontal Industry Structure



Customer Management – Systems are needed to register both equipment and customer details. Volvo has a direct link between the end-of-line factory systems and WirelessCar. They also have commissioned web-based portals for the input and storage of customer details. The main requirements are for database management tools and web-based services. .

Service and Content – This area covers the tools, the personnel and the data to deliver all necessary services to customers. Mapping tools are one of the most critical data services. They are essential for placing the location of the caller at a geographic position so that help can be provided more quickly and efficiently. Map data providers Navteq and

Tele Atlas are the principal providers for street and point of interest data, but there are other types of data that need to be integrated with street data. Companies like PTV and Telcontar provide complementary technology to service providers. In the case of Telcontar, they provide a map server toolkit, while PTV provides a complete application with all necessary data. .

Service Integration – Technology required for service integration includes linking in-line factory systems, in-vehicle unit sales and maintenance systems, and billing systems with the service and content delivery systems. OnStar in the U.S. has made a single, unified system for this purpose. Accenture built a similar system for OnStar Europe as that used by OnStar North America. Elda/TargaSys also have a similar system to OnStar's. WirelessCar and ATX have integrated diverse systems for their different customers. Connexis is proposing to build yet another.

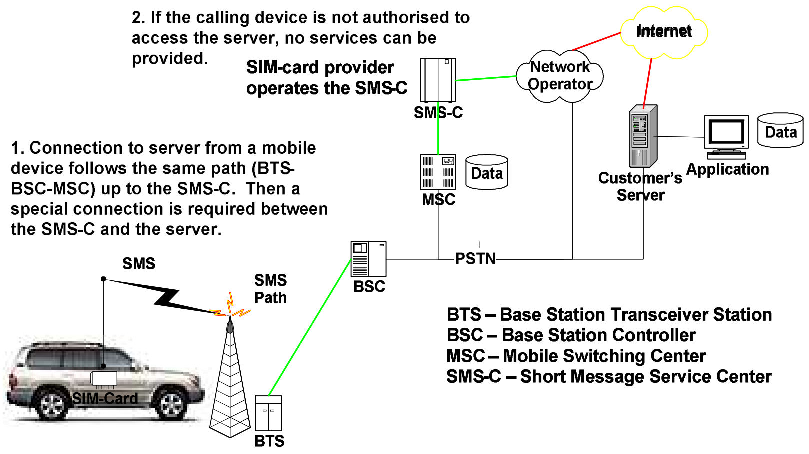
Service integration is the most important function provided by the current telematics service providers, like Elda/TargaSys, WirelessCar and ATX. .

Hardware and Software – In-vehicle systems have thus far been specified by the vehicle OEMs and then built by specialist telematics hardware suppliers, such as Motorola for DC and BMW, Autoliv for Volvo, Delphi for OnStar and Magneti Marelli for PSA. This situation may change if special-purpose systems are required by law (e.g., tolling, eCall, Intelligent Speed Advice) or if insurance companies begin to introduce pay-as-you-go insurance premiums. Then, the hardware may be specified by other parties and incorporated into the vehicles by the OEMs or installed as aftermarket-fit items.

Connectivity – The main requirements for serving as a provider of connectivity services between on-board devices and service centers is direct links from application servers and databases to SMS-Centers with dedicated SMS-C large accounts with the network operators, as illustrated in the diagram below, *SMS Path to Server*.

Sending SMS Data Messages

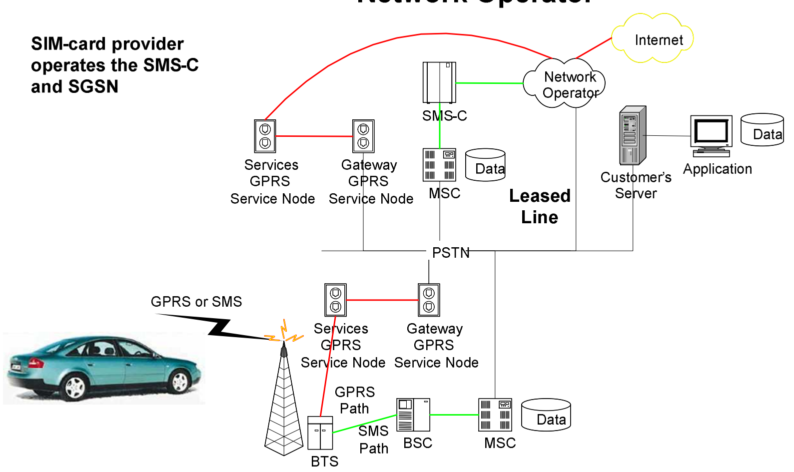
SMS Path to Server

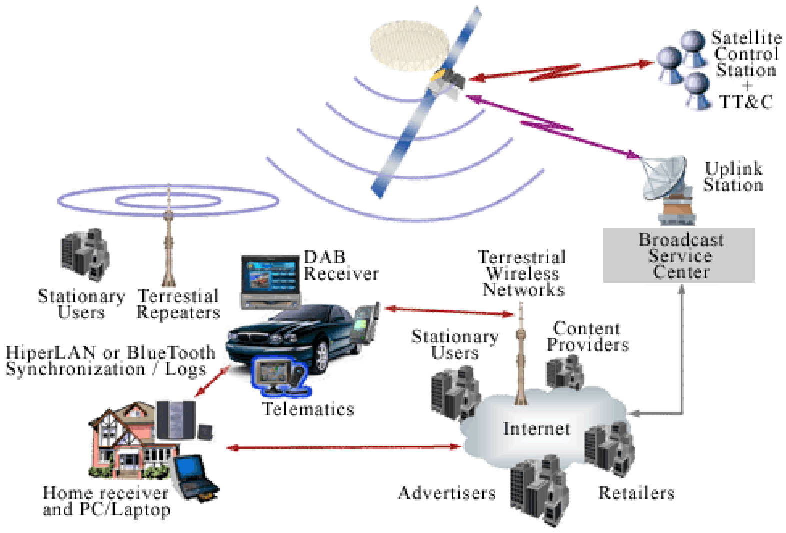


Communications links with General Packet Radio Switching (GPRS) are similar to those for SMS, with links to a Services GPRS Service Node rather than to an SMS-C.

Communications Links

Network Operator





The major software requirement is a set of protocol conversion tools to take a message from a vehicle that has been coded in a specific protocol, such as GATS or a proprietary format, and convert it to a readable message. Formatting a message for return to a vehicle in the specific protocol is also a requirement. There are software tools that can assist in this protocol conversion effort that have been developed by the current connectivity providers.

Network – This area is the domain of the mobile network operators. In North America, OnStar has found a way to incorporate network services into its customer offering by delivering hands-free telephone services to its customers. In Europe and other GSM markets, mobile device penetration is higher than in North America, so it is unlikely that a car owner would have a need for telephone services offered in conjunction with a telematics system. The SIM-card owner, whether it is the network operator, the hardware provider or the vehicle OEM, will always be in the best position with respect to paying customer.

4. Influencing Factors

4.1.1. Market trends

4.1.1.1 How do the targeted markets move

There are no first mover advantages with in-vehicle location-based services because there is so much interdependence among the various players. The winner will not necessarily be the company that manages to first put all the pieces of the puzzle in place; the winner is likely to be the first company to put the last piece of the puzzle in place. Apple Computer's *iPod* is an excellent example of the final piece in the mobile music market.

None of the players can deliver the full package of services on their own. Therefore, they must move together, supporting each other like the members of a bicycle racing team, until the strongest of them is positioned well enough to sprint ahead. Networks, hardware and services have been developing over the past ten years, and a complete offering at an affordable price to consumers is close to being ready. Someone will try to take a clear lead in providing a compelling offering to the market.

The OEMs will not allow any of their vehicle real estate to be used for any purpose (audio, navigation, entertainment, communications) unless such use provides them with a direct financial return in the form of higher prices or increased sales. Hardware suppliers have had high sunk costs for developing and testing in-vehicle systems, and they understand that there are high barriers to entry because of the complexity of these systems. They will try to leverage their Tier One position with the vehicle manufacturers to keep their proprietary systems in place and prevent any plug-and-play options from being adapted. The network operators will exchange direct customer control for stable income streams that in-vehicle services can provide. However, the network operators will not willingly (i.e., without force of legislation) support SIM-cards in every vehicle unless they can treat them like any normal SIM-card in a mobile phone.

Service providers who do not control the client relationship (e.g. OnStar) have been at a disadvantage compared to these other players. They have not been able to generate significant revenues because they are usually paid on a per-use or per customer basis by the hardware or network supplier, and these costs must be kept to a very low level in order to ensure that customers will use the services.

4.1.1.2 Product and technology trends

Personal navigation devices, aftermarket vehicle tracking systems, dealer-fit tolling systems and dealer-fit pay-as-you-drive systems are opportunities for all players in the telematics value chain with the exception of the vehicle OEMs.

4.1.1.2.1 Portable navigation devices

These devices are outselling integrated OEM systems almost four-to-one.

4.1.1.2.2 Aftermarket vehicle tracking systems

Formal regulations are in place in The Netherlands and Belgium, and are being considered in the UK. Informal regulations exist in Spain.

4.1.1.2.3 Dealer-fit tolling systems

4.1.1.2.4 Dealer-fit pay-as-you-drive systems

4.1.1.3 Political forces

- eCall – The EU-led eCall initiative for installing an automatic emergency call system in every vehicle in Europe starting in 2009 can either be a curse or a blessing with respect to whether it will enable other services or perform only as a single-function device.

- Tolling – There are strong forces in most European countries for both city congestion charging and highway road tolls. These initiatives will eventually mean that every vehicle will be equipped with some form of toll payment system since the technologies used congestion charging in, for example, London and Stockholm (i.e. optical license plate recognition), are not practical for use on all roads. The eventual technology could be as simple as a transponder that registers the vehicle as it passes in the vicinity of a short-range detector. This is what is used in most tolling systems in the world today. The device could also be robust, fitted with a GPS unit and a digital map, like the Toll Collect system used for large commercial vehicles in Germany, capable of reporting on both where and when the vehicle has driven during a specific time period. If the unit is of the robust type, it will have the possibility to be used for other purposes, such as safety and security, pay-as-you-drive insurance.

- Intelligent Speed Alert/Advice (ISA) – The road authorities in many European countries are determined to introduce some form of speed warning or speed control on vehicles. The car industry is equally determined to prevent any system which takes over control of the vehicle from being mandated.

4.1.1.4 Environmental Forces

- Fuel savings are the primary reason that the commercial trucking industry is very interested in advanced driver assistance systems that involve the use of road gradient to optimise acceleration, braking and shifting of gears. Since many of these systems now under development will use a navigation database as the source of this information, more of these systems will be installed. It makes sense to maximise the use of such systems, so navigation will be combined with other fleet management applications.

- High fuel prices are also beginning to have an impact on the types of private vehicles people are buying. Thus far the major impact has been on the growth of hybrid and bi-fuel vehicles, even though the modern-day diesel engines are often equally fuel-efficient. Systems that can be shown to increase fuel efficiency, similar to those used in commercial fleets, will attract buyers.

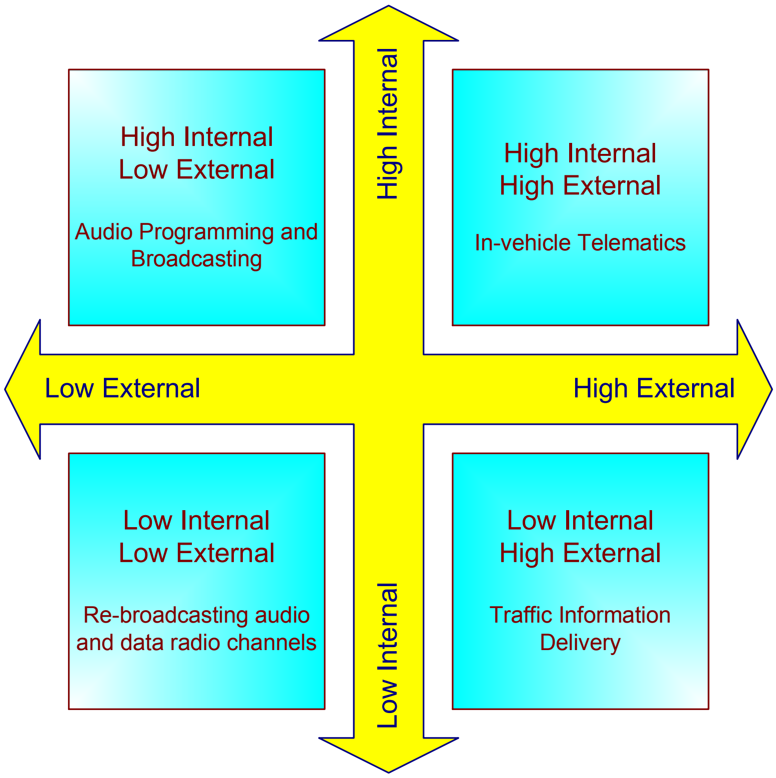
4.1.1.5 Business Forces

- Low-cost producing countries, like China, India Malaysia and others, will eventually have cars ready for sale in selected European countries. European producers will have to compete on higher quality and higher levels of services because it will be difficult to compete on price alone.

5. Analysis

5.1. Risk Management

Developing services to mobile devices, whether these devices are integrated in vehicles or sitting in a coat pocket, requires a great deal of interdependent development. The probability of success depends on the performance of each company in the value chain. If one company fails, the entire offering is endangered, even if all of the other companies meet their individual time, cost and quality objectives. An example is DaimlerChrysler cancelling its planned telematics services roll-out in ten European countries at the last minute because its hardware supplier and its internal engineering department failed to meet their goals. As a result, T-Mobile, its telematics service provider, and Mondial, its customer call center operator, have not been able to deliver their services. Service introduction of Volvo On Call in The Netherlands was been delayed by over a year because the system did not meet a critical regulation in the market. All suppliers to Volvo had to wait until this regulation was satisfied before it could begin offering their services.



As the diagram above shows, there are two kinds of risk: *Internal* and *External*. **External Risk** is more difficult to manage and control than **Internal Risk**. This is why companies oftentimes decide to build or buy critical components rather than depending on a partner to develop them in a joint venture. *OnStar* owns customer management, content and service and connectivity in their operation. *OnStar* could have outsourced all of these components as did *Volvo, BMW, PSA* and DaimlerChrysler. <u>*OnStar* took a higher internal risk</u> and invested heavily to build its platform. Its internal risk was limited to managing these developments. The result is that *OnStar* does not need to share the rewards with any partners.

Ford Motor, on the other hand, attempted to build an enterprise based on a high degree of risk sharing when it created *Wingcast*. All of its partners had to meet their individual milestones before Ford's customers could start using the new products. *Ford* minimised its internal risk by putting more risk on its partners. The venture failed when one of its partners, *Qualcomm*, decided that it had invested enough money and backed out of the venture. Ford, unwilling and unable to finance the venture on its own, closed it down.

Volvo has spread its risk with Volvo On Call, but it has attempted to minimise the financial exposure of all partners, in part by limiting the scope and scale of its offering, and in part by financing some of the development costs incurred by its partners. This relatively low risk, relatively low reward strategy appears to be succeeding since the system is now sold in seven European markets and services are provided a total of fourteen countries. Further, the system design and service delivery approach has been adopted by Volvo's European rivals..


Risk Management
Integration Risks
Who has to adopt the solution before the customer can?
OEMs?
Navigation system developers?
Regulatory authorities
Interdependence Risks
Whose project must succeed before yours can?
Telecoms?
Connectivity providers?
Automotive OEMs?
The project must be coordinated with complementary innovators.
Interdependence Risks
Integration Risks
Initiative Risks
Initiative Risks
What to do.
What to leave to others.
What to avoid.

6. Notes: