Vehicular Telematics Systems

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INTRODUCTION

In the last 15 years, connectivity and communications have increased dramatically. As a matter of fact, from 1990 to 2Q of 2004, the number of mobile phone subscribers has growth from a few million to over 1.5 billion. In the same period, the number of Internet users worldwide raised from 2 million to 810 million (IWS, 2004; Juliussen, 2003). This means that today a large section of the population is dependent on communications and content, and wants to be connected any time and any place, even in their cars (Comunicar, 2002; Microsoft, 2005). To answer this requirement, telematics are being fitted into cars, giving rise to *vehicular telematics systems* (VTS). Indeed these systems represent the in-vehicle convergence of mobile communications and information processing, allowing drivers and passengers to stay in communication with the world outside their automobile. Vehicular telematics market is projected to be about $17 billion by 2006, equaling a growth by 280% since 2000 (Juliussen, 2003).

From a technological point of view, a VTS is composed of three basic components:

1. A two-way wireless communication (voice/data) system;
2. Some location technologies able to identify current geographic position;
3. Some computing technologies, to handle data and manage information flows from/to the user.

By fully exploiting the features offered by these systems, exciting new usage scenarios, opportunities, and markets are being available for both end-users and automotive manufacturers. As an example, drivers can receive contextual services, such as updated route calculations, basing on traffic alerts for the selected route, or can perform remote diagnosis of electronic car components, while passengers can access to e-mail and Web sites.

In the meantime, new business opportunities are being available for automotive manufacturers, since VTSs allow them to sell "services" and after-market upgrades, to have an open communication channel with buyers during the whole car life-cycle, and to understand their customers' individual needs, thus providing an exceptional marketing link. This obviously is requiring deep changes in the business model for vehicular original equipment manufacturers (OEM). However, telematics is also affecting their design model, posing challenging technological issues, ranging from embedded real-time aspects, to context-aware ones, to the definition of innovative and safer human-machine interfaces.

In this article, we will provide an insight on the new mobile-commerce opportunities offered by telematics, together with the posed technological challenges. In particular, after a brief outline on the evolution of VTSs, we will analyze the services, the business challenges, and the opportunities that next-generation systems will offer. Subsequently, we will describe the technological difficulties posed by VTSs, with particular interest on human-machine interaction (HMI) and the safety issues. Finally, we will depict the future trends on this fascinating scenario.

BACKGROUND

A lot has happened since the first wireless technology (AM radios) was fitted into cars dashboards. Complex electronic systems began to be installed into cars in the 80s, with electronic injection, anti-lock braking system (ABS), etc. … Since then, the number of functionality provided to the driver/passengers by electronics constantly raised, and nowadays computing technologies are so massively present in vehicle's interiors that top-class cars embed more than 1 Gigabyte of code (Pretschner, Salzmann, & Stauner, 2004).

In this scenario, telematics appeared only ten years ago, and still five years ago most advanced VTSs offered only limited navigation and entertainment (Tuner, CD) characteristics. Now almost all systems in production

allow drivers to exploit a plethora of features, such as multiple audio sources (MP3, digital audio broadcasting, DVD), Web browsing, e-mails, phone calls, voice control, and so on. However, most advanced commercial VTSs (e.g., BMW *iDrive*, Fiat *Connect+* or GM *onStar*) are deeply changing the definition of product: they are starting to provide *services*, i.e. advanced functionalities involving interaction with a support centre. Typical examples are remote vehicle diagnosis, dynamic route calculation (taking into account contextual information about road, vehicle, traffic, and weather conditions), tele-aid, or hotel reservation.

Thus, VTS are opening new and exciting business opportunities. Automakers have to change their "mission" and business model, no more selling exclusively hardware but also services, shifting from the age-old one-time sale into an ongoing service-oriented revenue stream. In the meantime, there is the necessity to design and deliver context-aware services and information, creating great opportunities also for third-party content providers.

DEVELOPING EFFECTIVE TELEMATICS SYSTEMS

The definition of a vehicular telematics system is a very challenging task, involving substantial investments and a number of different skills, ranging from information and communication technologies (ICT) to marketing and psychology. In the following we will detail the posed business and technological challenges and opportunities.

Business Challenges and Opportunities

We can outline three main branches of business opportunities offered by VTSs: service selling, upgrade selling, and warranty claims reduction.

Service Selling

The main revenue opportunities can come from service-oriented businesses. With telematics, for first time car manufacturers have the opportunity to stay constantly in touch with their customers during the life of the car, and to understand clients' individual needs. Thus OEMs and/or content providers can provide them with a plethora of pay-per-use or subscription services, such as traffic advices, hotel information/reservation, etc., limited only by the imagination of creative marketers. In the following we describe some push/pull services that are (or will be) part of VTSs, and that can generate attractive revenue streams:

- **(Dynamic) Navigation Systems:** Current VTSs offer localization and navigation features. In next generation systems, these will be improved with dynamic routing instructions, basing on real-time information about traffic or other infrastructure situations, provided by some data-centers, through wireless data connections.

- **Infotainment:** This can still be considered the crucial feature of a VTS, since people like to listen music during their commutes. Current systems provide a huge amount of entertainment sources, such as tuner (even digital or satellite), CD, MP3, TV, DVD players, etc… In perspective, future systems will be able to connect to Web-stores, such as *iTunes* (iTunes, 2005), to purchase and download further digital entertainment contents, such as audio tracks, video-games for kids on rear seats, movies, etc…

- **Communications:** VTSs include wireless voice communication features, based on 2,5-3G cellular infrastructure. So, they can exploit most of the services offered by mobile phone carriers, such as calls, SMS, MMS, voice-activated e-mail service, and high bandwidth downloads (even for data or software/service upgrades).

- **Remote Diagnostics:** A valuable new characteristic will be the ability to extract critical data from onboards electronics and transmitting them to the OEM, in order to perform remote vehicle diagnostics. Customers can pay an annual subscription to have their car's health constantly monitored. This will significant reduce breakdowns, thanks to early problem detections. For example, a faulty sensor that could go undetected for months could be discovered almost immediately. In perspective, another exciting future scenario considers (controlled) interaction between vehicle and service centers. For instance, a tire sensors detecting flats could alert towing services, or in the event of an airbags opening, the system can automatically notify road assistance and physicians (Tele-aid).

- **Contextual Information Services:** By exploiting wireless communication and location awareness, VTSs will deliver a vast selection of customized information, ranging from weather news to stock price, traffic advices, movie show times, etc… Moreover, it is easy to extend these functionalities with traditional e-commerce services, for instance allowing driver to buy theatre tickets.

- **Location-Based Services:** such as assistance in case of breakdowns and stolen car recovery, can be easily provided in charge of a subscription.

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