As such, there should be more discussion, including the introduction of a floating car data system.

With respect to center-based DRGS, the usefulness has been verified. Specifically, the system can provide drivers with a sense of security that they can take the fastest route whenever there is any traffic congestion on their route. It can also provide an estimated time to destination and reduce the burden on drivers of the need to search for alternative routes. Such a sense of security ultimately supports safe driving.

Success in any country will depend on the following three points:

1) Nationwide deployment

2) Inexpensive unit cost to be paid by users (less than 50,000 yen; about US $500.00)

3) Monthly maintenance cost equal to regular phone charges

When these requirements are satisfied and taking into account growing driver needs, DRGS will become widely popular.

REFERENCES

1. Universal Traffic Management Society of Japan, (UTMS), Field Trials, 1996

CONTACT

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ABSTRACT

The global market for mob
and content (C^3) delivery
demanding ubiquitous
anywhere. Examples incl
WAP Internet Browsers
devices such as the Palm

This paper will explore t
challenges as Mobile Infor
the vehicle world. For ex
machine interface be desig
the internet?" How will
standards for vehicle hard
cost and product developn
opportunities for future wid
vehicles? How will inform
And what kind of media
when?

INTRODUCTION

The global market for mo
Consumers are discoverin
any information, anytime, a
home, on portable devices,

One of the impacts of th
everything that can go
Furthermore, the silicon
continue to follow Moore
capability every eighteen
level. The value and usefu
exponentially with the nu

Figure 1: Infotronics Cockpit

This paper explores the special opportunities and challenges as Mobile Information is brought into the vehicle world. For example, what is the overall end-to-end solution required to provide content to consumers in vehicles and how are information (bits) and value (dollars) exchanged? How will the human-machine interface (HMI) in the vehicle be designed to allow drivers to use the information without being distracted? How will we deploy common, open standards for infotronics hardware and software to enable universal connectivity and reduce development cost and cycle time? What are the opportunities for future wideband wireless connectivity? How will information networks be designed, and what kind of information content will be available?

THE END TO END SOLUTION

When consumers think about infotronics in vehicles they immediately focus on the hardware such as shown in Figure 1: full color displays, audio systems, controls, and

portal, and content originators. A schematic of this end-to-end solution is shown in *Figure 2*.

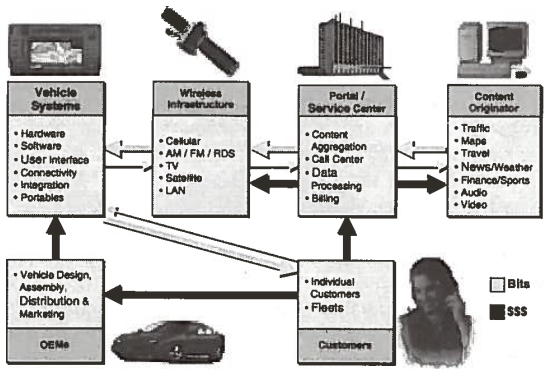


Figure 2: The End to End Solution

In addition to the critical four steps mentioned above, the role of vehicle OEMs and customers is shown in the context of the overall value chain. For example, as shown in the narrow arrows in *Figure 2*, customers request information from the vehicle system, but the request actually passes through the wireless infrastructure to the service center where information is obtained from content originators and then aggregated and processed. The bits are then transmitted on the wireless link to the vehicle and passed onto the customer through the HMI devices in the vehicle. In return for the information, the customer pays the service center a monthly subscription fee, a pay-per-use fee, and/or agrees to view or listen to advertising. The value (or dollars) the customer pays the service portal is indicated by the vertical arrow. In addition, the customer must also pay the vehicle OEM for the vehicle and its infotronics hardware/software systems.

The success of this end-to-end solution actually depends more on the success of the infotronics business model than on the technology. We all believe that the

Starting at the left-hand side of th
Figure 2, let us now look at each s

VEHICLE SYSTEMS AND SOFT

VEHICLE SYSTEM ARCHITECTU

In order to make provision for the
information, we will have to
architecture of the vehicle elec
information systems must be en
upgrade path for functional g
demands from customers over the

The required flexibility calls for sy
certain degree of openness. T
system needs to support vari
communication/reception systems
playback and audio components,
for interaction with the system
further likely to be distributed ins
packaging constraints, hence re
buses to share information betwe
In our terminology, this new a
system is called the Mobile Mult
See *Figure 3*.

Of course, access between the
"proprietary side" has to be restr
guarantee that no misuse of in
jeopardize the performance of the
control system. This requires an
firewall in the MMM computing pla

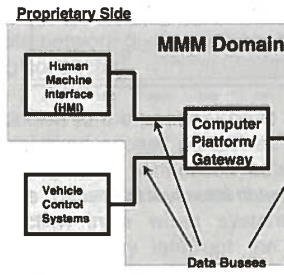


Figure 3: Vehicle Systems and

OPEN STANDARDS

platform would enable us to create unique services that are tightly coupled with the vehicle itself, such as remote diagnostics and preventive maintenance. Other value-added services that could emanate from a secure platform include the possibility for an OEM to make upgrades to the software of the vehicle, and to offer temporary features like for instance increased engine power or dynamic gear-shift pattern while pulling a trailer.

The Open System Gateway Initiative (OSGi) consortium is promoting a standard for such a secure platform. In our opinion, the automotive industry should as far as possible avoid making their own standards and instead join forces with other industry branches to leverage broad efforts. After all, we have to realize that today our annual volumes are small in comparison to those of telecom, data communication and computing and consumer electronics.

HUMAN MACHINE INTERFACE

The Human Machine Interface (HMI) is extremely important for safe and convenient interaction with the user and hence a key to successful introduction of mobile information services. In this section we provide a summary of some options at hand for designing a good HMI for interacting with mobile information services. We distinguish between the driver and a passenger using a service, as these cases have different implications on safety.

Technologies for interaction with the driver will include different combinations of flat panel displays, head-up displays, voice recognition/speech synthesis, steering wheel controls, and other means for interfacing that have already been employed over the past years. These technologies are constantly being upgraded to more and more improved performance, and will in the future provide the basis for intelligent HMI systems.

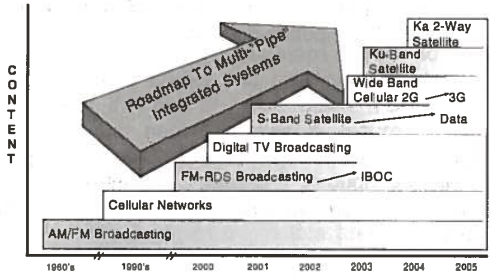
In addition, we believe that we will see an accelerated development of customized (to be adapted to your preferences) and context-sensitive (to be adapted to the traffic situation) HMI management software.

Interaction with passengers will be more straightforward. Rear Seat Audio/Video systems are already entering the market, and they will continue to grow in capability. Short-range wireless links like Bluetooth™ will also enable passengers to have their own interaction devices and even their own audio channels, through use of wireless headsets, as means for interacting with their services of choice.

Another aspect of the HMI in the future will be to identify sophisticated voice-recognition algorithms and even biometrics sensors may in a few years time be viable alternatives for our industry. Whatever technology we choose, it is clear that we in some way will need to make provision for secure identification of the user/users.

WIRELESS INFRASTRUCTURE

As shown in *Figure 2*, mobile information systems employ one or more wireless "pipes" to transmit information to and from vehicles. Figure 5 shows how these "pipes" are being rolled out over time. For many years now we have received broadcast information via AM/FM radio, but customer's information experience in vehicles really began to change in the 1980s when the first generation of cellular networks were introduced, launching the opportunities for easy bi-directional communication. This experience was augmented in the 1990s with second generation digital cellular systems. FM-RDS broadcasting in the late 1990s in the US, and even earlier in Europe, brought the advent of new information services such as traffic information, news headlines, and paging. Now in the early 2000's, new broadcast systems such as digital TV broadcasting in Europe, DVB, and S-Band Satellite broadcasting, like XM and Sirius radio in North America, offer a very broad choice of digital quality audio and eventually video



information

Figure 5: Wireless Infrastructure Rollout

Mobile phones have grown in popularity to a level where we will soon see the number of mobile users exceed the users of stationary systems. This trend will continue and in the future the stationary line users of today will use only personal wireless devices for telephone communication. The wireless communication today is

(digital) systems for mobile teleph
experiencing the introduction of
see the Third Generation as we
and Ku band satellite services in
five years. With these broa
information can be singlecas
customers in response to specific

The major impact of this evo
Information Society will go "m
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increased bandwidth for true hig
to 2 Mbit per second, although
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To further improve the Megabit
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interactive channel with high thro
price.

Not only increased bandwidth is
the Mobile Information Socie
Networks – Always Connected"
step that will be taken before th
the Third Generation systems.
where Global System for Mobile
already is introduced and in s
Radio Services (GPRS) will very

This technology will enable highe
allocation of multiple channels to
benefit is the feature of not ne
connection before starting to s
basically eliminate the time ne
remote network giving the user t
being connected.

In addition to the physical radio
standardized access protocols,
environment. A connection betw
and its base station can hard
connection in a wired system
valleys etc. may interrupt the
problems with the ongoing co
being delivered. In response
Wireless Application Protocol, W
protocol has a designated ses
suspension and re-establishme
minor overhead. Further, it is d
even with today's limitations i

increases the requirements on the Content Originator since the content must be presented in different ways on different platforms. This feature could also be added by the Portal/Service Center.

A key issue from the Portal/Service Center point of view will be to continuously identify customers' requirements and to rapidly adopt or build new services that fulfil these requirements. This is required in order to provide an automotive tailor-made portfolio services.

CONTENT AND SERVICE OPPORTUNITIES

There is a huge opportunity to add value to customers in the Mobile Information Society in general. Even the vehicle-related infotronics information services are growing very rapidly. A partial list of content and services is shown in *Table 2* below. Today's focus is primarily on safety, security, and concierge services via telematics systems using a GPS receiver and an embedded cellular phone in the vehicle. But the list grows very quickly to include 100-channel satellite digital radio broadcast, traffic information, and a huge portfolio of e-mail, internet access, electronic commerce as well as position-based commerce transactions. Ultimately, infotronics services will provide very high value content such as audio and video entertainment on demand.

Content and Services

- Safety, Security, and Concierge Services
- Satellite Digital Audio Radio Services
- Real Time, Dynamic Traffic Information
- Turn-by-Turn Navigation
- Advertising and Electronic "Coupons"
- Wireless Airtime
- E-Mail
- Internet Access and Internet Purchases
- Fuel, Tolls, Retail Kiosk Purchases
- Parking
- Dealer Services
- Remote Diagnostics and Maintenance
- Financial Transactions (Stock Purchases, Transfers)
- Audio On-Demand (Music, Books on Tape, "Talk Radio")
- Video On-Demand (Movies, "MTV", News and Sports Clips)

Table 2: Infotronics Content and Service Opportunities

To understand what content/services we need to provide to our customers, we must look at the driver and his/her passengers separately. Driver-related content/services for increased productivity mainly applies to business being able to verbally fill-in travel expense reports on the way home rather than doing it the next morning in the office.

Safe driving should always be the highest priority and neither entertainment nor productivity features should never distract the driver. Productivity improvements and entertainment features should therefore primarily be based on audible services.

Passenger-related content/services regarding productivity will be basically everything mentioned above for the driver, but in addition also services based upon visual presentations on advanced displays and more sophisticated interactive tools. This will include normal office services, data retrieval, watching news/stocks, training/education as well as general HTML internet browsing and watching terrestrial or satellite television.

More sophisticated entertainment facilities for passengers could be a big help in travelling with children when they have access to video, interactive games, "movie-on-demand", chatting etc. The chatting services may in fact be the driving force in the whole mobile data-communication market. This is the situation within the GSM market today, where teenagers are using Short Message Service (SMS), a simple "store and forward" mechanism for messages no longer than 160 characters. The unexpected success of SMS has influenced the design of the service platform for UMTS to include an evolved version of SMS, called MMS, Multimedia Message Service. This will enable users to chat with others and to attach pictures as well as audio and video clips.

Also a third category of services can be identified for direct support and maintenance of the vehicle itself, consequently adding value to the owner. Features like Remote Diagnostics, Remote Software upgrades, stolen vehicle tracking, and so on will deliver significant value.

In summary, our office systems and tools as well as our living-room entertainment features will go mobile together with a realistic implementation of the "Smart Car".

CONCLUSION

Availability of technology is not going to be the main issue going forward in the mobile information society. The main issue is proper integration to ensure safety and acceptance by the customers.

We can foresee a strong impact of the mobile information revolution. Smart phones will lead the market, and

hand-held and carry-on produc
outside the car.

If this challenge will not be me
will most likely occur. Mobile de
the vehicle and manufacturers
devices will continue to improve
as well as the HMI of the device
the limited integration with the v
a significant safety issue. The p
manufacturers and telematics s
the customer" will be more diffic
other players in the mobile indus
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Providing a well-integrated Mobi
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However, the platform could hav
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via Bluetooth™ can transform
usable mobile information gate
the vehicle, to full-fledged Mol
with multiple user interfaces, mu
and possibilities for remote man
can fulfill the goal of delive
Services to the vehicle users.

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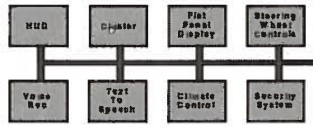
PROPRIETARY SIDE



Human Machine Interface (