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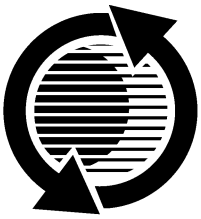

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ABSTRACT

In the near future, car multimedia systems will be essential to enable emerging digital media and cater to expanding business opportunities utilizing various information contents. Since a strong demand for the standardization to be ready and beneficial for both the customers and the manufacturers exists today, an open platform is the most desirable. Clarion has co-developed an open architecture in-car multimedia system in a 1DIN form factor for installation in the dash of a vehicle. This open architecture, known as Auto PC, is powered by the Microsoft® Windows® CE 2.0 operating system. This in-car multimedia system will provide solutions for the major tasks required of next generation in-car information systems.

INTRODUCTION

Car audio devices, as in-car entertainment equipment, are going through metamorphoses in their configurations from the conventional combination of an AM/FM radio and a cassette tape player to digitized music sources such as CDs. Moreover, navigational systems are enjoying booming popularity, especially in Japan. Navigational systems, along with LCD display devices, are further refining themselves and are now considered to be the vehicle's information center.

Data storage and delivery is also evolving. With improvements in both storage technology, most recently witnessed in memory and DVD technologies, and wireless technologies, digital data will become more prevalent. The biggest benefits of digitized information are: 1) ease of creating content, 2) easy handling, 3) data integrity (lack of data degradation) during transmission, 4) easy automatic control, and 5) lower product cost to the end user. It is obvious that media utilized in the car environment will become even more versatile and digitized. Also, recent trends suggest vehicles to become a tool to provide not only transportation but also enable productivity in a mobile information environment.

In the near future, a car will be expected to process new digital media information on a real-time bases. The infrastructure of such digital media information is currently media systems to process this multimedia information, it will be necessary to integrate all the potential technologies into a platform, similar to how its counterpart, the personal computer, has been combined. In this paper, the importance of an open architecture concept and the benefits experienced by both consumers and manufacturers are explained.

DIGITIZATION OF MEDIA

DIGITIZATION OF PACKAGED MEDIA – Large capacity packaged media, such as high-density optical discs like DVD, will become increasingly popular in the automotive environment to provide visual information or to store high quality audio information. With the introduction of DVD-RAM, new applications such as re-writable map databases for navigational systems are expected to become available. Also, IC memory, with its increased capacity, will be used as a major information medium.

DIGITIZATION OF BROADCASTING MEDIA – Digital broadcasting is currently being investigated to replace existing worldwide analog audio broadcasting (e.g., AM, FM). Some hybrid services (e.g., RDS in Europe, RBDS in the United States, VICS in Japan) have already been implemented with digital information being broadcast on FM subcarrier channels. DAB is the first true digital audio broadcasting system and is being rolled out in Europe and Canada. Digital TV broadcasting which can be received in a moving vehicle is currently being examined in Japan. Mobile communications reception via broadcasting satellites is being studied. As a result, broad bandwidth downloading of digital information into a vehicle via a digital broadcasting will soon become a reality.

DIGITIZATION OF COMMUNICATION MEDIA – In the wireless communication realm, digitization is also the trend for increased radio spectrum efficiency. Digital telephone systems are already widespread at a global scale. New systems have already been proposed in an effort to increase the data transmission speed. The establishment of ITS (Intelligent Transportation System) has been examined worldwide. Wireless communication is considered as a key technological function of ITS to exchange

VARIOUS DIGITAL MEDIA – As stated above, the advancement of technologies is driving versatile new media to enable the transmission and reception of multiple types of digital information. At the same time, consolidation of functions among each medium will take place. With these advancements, information systems will no longer be dependent on only one medium, and will in fact rely on multiple media forms for the delivery of information. For example, Japan's VICS system utilizes simultaneous reception of data via several media types. In VICS, FM subcarrier broadcasting and infrared/microwave beacon are used to receive real-time traffic information, and the map database in the CD-ROM is used to display the best route based on traffic conditions. Cases such as illustrate how the borderlines between the communication realm and the broadcasting realm are disappearing. In fact, competition between packaged media and wireless media will soon occur. For example, map data for navigational systems are contained on a CD-ROM in today's implementation. In the future, downloading the same data from a satellite will be possible.

DIGITAL CONTENTS BUSINESS

The principal function of automotive electronics is to provide the user a comfortable space that is fun to drive, convenient and safe. In order to achieve this goal, real-time digital information that utilizes communication infrastructures (e.g., emergency service, traffic information, route guidance, general information service) are aggressively being introduced into the auto environment. Content delivery services are drawing strong attention as potential profitable business opportunities. Route guidance or traffic information will be crucial for the driver to reach to his/her destination in a timely manner. In some countries, emergency communication systems are already in operation to better handle life-threatening emergency situations.

This indicates that the driver no longer collects information passively. Rather, he/she can now aggressively collect information via external network resources. The car interior can be transformed from a cabin where the driver sits to get from one place to another to a place where the driver can collect vital information such as route guidance or POIs (Point of Interest) from an information service provider or via the internet. Such environments are becoming a reality in many places all over the world.

The result is the possibility for the automobile to shift its existing role from a mere commuter tool to an "information space" with global-scale connections.

IN-CAR MULTIMEDIA SYSTEM

New functions are required for the in-vehicle equipment to cater to the evolution of the digital media environment. Since the infrastructure is making major progress daily, corresponding devices should follow to keep up with for each new medium. However, numerous difficulties such cost, installation or operation issues remain.

HARDWARE COST – In the past, new devices were added for each medium. This practice is believed to raise the cost of the whole system due to the duplication of fundamental functions such as operation, display or calculation.

INSTALLATION SPACE IN A VEHICLE – Limited space in the vehicle will cause inevitable problems as long as a device must be added each time a new medium is introduced. In order to avoid space problems, possibilities of combining black box type equipment and infrared remote controls exist. If several remote controllers are required, each remote controller will only operate a single function resulting in safety hazards of verifying the proper remote controller while driving. Verifying the switches on a moving vehicle will also cause a serious safety hazard.

COMPUTER-BASED MULTIMEDIA SYSTEM – The ultimate solution for all the problems described above is the establishment of a computer-base multimedia system. In reality, almost all media are digitized in today's world. As experienced with the PC, achieving personal, function goals by using software that is application specific on a common platform enables efficient input, processing and output. By implementing a common HMI (Human-Machine Interface), space savings, cost reduction and cohesive tactile feedback are easily achievable. If key components such as ICs can be carried over from a PC, the cost of hardware can be drastically reduced.

Segmentation of hardware and software – The common practice of separating hardware and application software in the computer industry could happen to the AutoPC. This factor could cause revolutionary changes in the existing business structure.

Expandability – Multimedia systems allow customers to build configurations to best suit their desired functionality. Customers are not forced to make a major investment during the initial purchase. They can easily start with a basic system and gradually expand the system with both hardware and software upgrades in the future.

HISTORY OF OPEN PLATFORM

CURRENT ISSUES –

Lack of compatibility among manufacturers – In the past, target functionality was achieved primarily by hardware. Recently, embedded microprocessors have been developed, with the hardware controlled by proprietary software. More major-scale hardware products such as navigation systems with computerized hardware configuration are available now. However, the compatibility and the connectability are not guaranteed between manufac-

pose an entire system that may consist of several pieces of equipment.

Barrier among proprietary systems – In the retail market, each manufacturer builds a barrier when a customer purchases its product as the main unit. This situation restricts a customer from selecting potentially better products from competitors.

Car manufacturer's own standard – Similar to the situation in the retail market, there is virtually no existing standard in terms of system compatibility among car manufacturers except the physical layer on some external buses.

Difficulties in introducing after-market products – In the case of analog audio systems, a user can easily modify his/her system by replacing the radio/cassette player or adding amplifiers. Enthusiastic users who are not content with the original manufacturer's original parts are at least given opportunities to upgrade the system.

In the case of multimedia systems, adding or connecting new functions to the standard equipment system is difficult unless room is provided during the vehicle manufacturer's development phase, or the vehicle manufacturer prepares a solution themselves. Due to the lengthy development period necessary for a new vehicle, timely introduction of a new function is rather difficult.

Model year compatibility – Guaranteeing compatibility, even among products from the same manufacturer, is difficult due to the different development period these products went through.

MERIT OF THE STANDARDIZED MULTIMEDIA SYSTEM – As discussed above, standardization for in-car multimedia has not yet been implemented. The following merits are expected to become reality once a new industry standard for both hardware and software that guarantees connectability and compatibility of the entire system is established:

USER MERITS –

System expandability –

- Users are not forced to replace main units when a new function is introduced.
- Users can gradually build up the entire system by upgrading hardware and software.
- Users can be tailor their systems to their desired level of functionality.
- Upgrading the entire system will improve performance.
- Improved functionality can be achieved via software upgrades.
- Functions can be expanded by adding peripheral

Manufacturer choices –

- Users can choose optional equipment from among numerous manufacturers.
- Users can select among abundant application software provided by third parties.
- Users can enjoy a wide range of software and hardware solutions made possible because they are developed on the same reference standard.

Uniform Operation – Once the user interface is standardized, users can easily learn the operation of each newly added function based on past experiences.

MERITS FOR RETAIL MANUFACTURERS – Today, even major manufacturers find it difficult to create large-scale systems using only internal resources. For proprietary system development, a manufacturer must develop all the hardware and software on its own. It is easy to image how hard a timely development can be depending on the available resources. It is also possible that a manufacturer has no choice but to develop devices with different specifications for each system. Development expenses could skyrocket, resulting in a higher price to the end users or a delayed product delivery. By adopting an open platform, the manufacturers building systems can achieve the following merits:

Timely market introduction – Once a common platform, especially one with an OS that operates application software, becomes widely adopted, development times can be dramatically shortened. This is because existing software providers can be used to implement new functionality, and the hardware manufacturer can concentrate solely on designing and developing hardware.

Creation of a new market & market share expansion – Once a common platform is publically accepted, manufacturers will be able to reach potential customers who have traditionally been reluctant to invest in proprietary systems. Easy-to-use and user-friendly systems with proper price settings are achievable. Some small markets were previously ignored for many reasons such as an uncommon language spoken in a particular market. With the permeation of the common platform, it is now possible to yield lucrative business opportunities from these small markets.

Development cost allocation – A manufacturer no longer needs to develop the entire system on its own. It can focus its developmental efforts on its most capable area. The entire system development cost can be reduced.

MERITS FOR THE ASSEMBLY LINE ADOPTION BY CAR MANUFACTURERS – Today, the multimedia infrastructure is on such an aggressive growth path that the most recent system cannot be incorporated into a new vehicle model. The open platform provide bridges the gap by enabling the addition of new functions constantly

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