INIT Innovations in Transportation

Karlsruhe - Chesapeake

Provider and Systems Integrator of Intelligent
Transportation Systems (ITS) for Public Transit

Time for an Integrated Vehicle IT

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1 Initial Situation

Good day, ladies and gentlemen, my name is Albrecht Simons. I am the Sales Manager of INIT GmbH and I am happy to talk to you on the subject “Time for an Integrated Vehicle IT“.

Please allow me to briefly introduce the company I am working for..

INIT Innovations in Transportation is the supplier of Intelligent Transportation System (ITS) solutions. INIT serves more than 200 customers worldwide. The firm was founded in 1983 by a group of engineers out of a research project within the Karlsruhe Technical University. From the beginning, the group was strongly involved in the specification and development of innovative fleet management technologies including both fixed-route and demand-responsive transportation modes. Meanwhile, INIT covers every ITS core field with software and hardware solutions under the brand name MOBILE.

The MOBILE system provides all ITS components for public transit authorities. All modules can be used separately or integrated into a system. The modular design enables an evolution strategy of the system. Starting with a single feature, other ITS functions can be integrated step-by-step. Starting point of the evolution can be, for example, a “vehicle autonomous” vehicle detection used for a single feature such as traffic signal priority or automatic passenger counting or emergency call management. Subsequent features for management of the on-board electronics, e.g. passenger information equipment and/or fare management, can be integrated up to the full-range CAD/AVL functions including advanced voice and data radio management between the vehicles and the control/dispatch center.

In detail, the system provides the following features and components for comprehensive and effective fleet management of both small and large transit fleets:

- AVL: Automated Vehicle Location and navigation (GPS/DGPS in combination with “dead reckoning”)
- CAD: Computer Aided Dispatch and computer-aided service restoration based on schedule adherence status or vehicle-reported incidents
- GIS: Geographical Information System and Map Display
- Fixed-Route and On-Demand/Paratransit Fleet Management
- Mobile Data Terminals/on-board computers as the core unit and central database on board the vehicles
- Automatic Management of Electronic On-Board Peripherals (e.g., information signs, fare management devices, health check components)
- APC: Automatic Passenger Counters (infrared sensor technology, suitable for all types of vehicles)
- TSP: Traffic Signal Priority (based on radio communication between vehicle and traffic signal controller including interface to intersection controller)
- Advanced Voice and Data Radio Communication (agency-owned or public cellular radio systems, digital or analog, trunked or simulcast)
- Real-time Passenger Information (on board, wayside, home, including Internet)
- Fare Collection/Management (including cashless payment and clearance via smartcards)
- Scheduling and Runcutting Software
- Paratransit Scheduling and Dispatch Software

- Operational Status Displays and Report Generation Tools
- Depot Management Software

As mentioned above, the solutions are available as stand-alone features or integrated into an overall concept.

1 Initial Situation

Over the past 25 years on-board computers have been developed particularly for ÖPNV vehicles, that control peripheral devices in the vehicle and took on increasingly intelligent tasks such as vehicle location, determination of schedule status, voice and data communication with a dispatch centre and, in addition, ticket sales. These special on-board computers are proprietory developments concerning the processor, operating system and application software. Further developments are correspondingly expensive.

2 The new requirements

Modern intelligent transportation systems require new intelligent on-board computers. Computers that cannot only handle the specified functions more efficiently, but also provide new safety and informational functions for the passenger. To this end the on-board computer becomes the communication platform for the vehicle's sub-systems while at the same time serving as their data server. New applications are among others:

- Providing data from Infotainment Systems combined with Next Stop und Connection information
- Navigatin system for the driver
- Control and data management of photos from interior and exterior cameras
- Sending vehicle diagnostic data to the depot and/or service station
- Data transponder for passenger information systems at the bus/train stop
- Data management for fare collection and e-ticketing incl. administration of white- und blacklists
- Automatically providing data and programming to the sub-systems in buses and trains

Add to that the previous functions realized with new technologies:

- Automatic vehicle location via satellite systems GPS/DGPS
- Clock synchronization via GPS
- Announcement functions per MP3 player

In order to do this the on-board computer must be able to control the most varied wireless communication paths almost simultaneously:

- Narrowcast Wireless LAN
- Mobile public communication system GSM/GPRS
- Digital trunked mobile radio systemTETRA/Tetrapol
- Satellite location GPS
- Analogue voice and data radio transmission

The new on-board computer must therefore be an efficint hardware platform which will also be able to run future applications and allow additional applications by other manufacturers to be installed.

3 Integration of common world-wide information technologies in the vehicles

Parallel to the above mentioned proprietory systems, hard- and software technologies for industry, office and home have become accepted world-wide with the help of which applications in ÖPNV are easier to realize and implement, offering an enormous range of additional possibilities. New possibilities that can make public transit more efficient and attractive.

This is a chance for manufacturers of Intelligent Transportation Systems to integrate industry standards in the vehicles and to develop and produce hardware components cost-effectively. Modern technology also allows the software to be developed with many standard tools.

The operators within public transit would like to “move” in a networked vehicle environment and carry out data management like they do in their internal network. Thus it becomes possible to address the on-board computer in the vehicle from the PC workstation per Wireless LAN and to carry out diagnostics, for example.

The integration of standard PC technology is successful since components are available that are meant for use in the harsh vehicle environment. Here are the most important technologies:

3.1 The PC

PC-based computers have become accepted as workstation computer and server. The processors are predominantly by INTEL or are INTEL-compatible. Suitable processors for use in buses or trains are available.

3.2 The bus interface Ethernet with TCP/IP-Protocol

Ethernet has proved itself as a secure data bus in the vehicle. Ethernet is even favoured over CANbus in many requisitions. Ethernet allows for a cost-effective wiring of vehicles.

3.3 Wireless LAN

Wireless LAN technology can be integrated in all PC-based systems. The standard IEEE802.11b with remote antenna allows Wireless LAN to be suitable for vehicles

3.4 MP3-Player

The audio compression standard MP3 can be integrated and used as automatic announcement function for the passengers.

3.5 Further Standard Interfaces

Many standard interfaces can also be used in the vehicle, e.g. VGA, USB, Cardbus Interface and RS 485 and 232

4 The working environment in the vehicle

Standard technologies can’t be integrated in vehicles just like that. The components must be specifically designed for the harsh environment in the vehicle. These are the specifications:

- Suitable for vehicle installation

Temperature range from –35°C to +70°C

Power supply range from 8 to 32V

- Reliable and robust

  Fanless and diskless operation

  Minimum of connections inside

- Service-friendly

  Quickly exchangable

  Flexible mounting capabilities

- Meeting the standards for bus and train

5 COPILOTpc the standard IT platform for transit vehicles

The COPILOTpc is based on Windows XP embedded® technology. Due to the standard IT platform in the vehicle, transit authorities can use cost-efficient standard tools for future expandability. The COPILOTpc provides all conventional ITS functions within a single board layout. It organizes voice and radio data traffic, calculates vehicle location information and the current timetable situation. It also automatically activates the peripheral devices in the vehicle, such as traffic signal priority (TSP), automatic ticket dispensing machine, ticket validator, (APC) automatic passenger counting systems and passenger information signs and displays.
Integrating other technologies is made easy due to the standardization of the COPILOTpc. For example, the standard integration with the wireless LAN radio unit WLANmobil and the automatic interior and exterior announcements are currently available. Future integration including Multimedia is also made possible with a standard interface. Furthermore, the COPILOTpc has an Ethernet interface using the TCP/IP protocol which enables the transfer of high secure data rates in the vehicle to and from third party systems.
This cutting edge design has been developed by INIT specifically for in-vehicle use. It guarantees state-of-the-art technology and flexibility and ensures a sound investment for the transit authority.

5.1 The operating system Windows XP embedded

The benefits are

Windows XP embedded is the scalable XP Professional version

Only about 80 MB of flash memory for operating system, including network and WLAN

Rest of CompactFlash is free for programmes and data, thus very large data quantities may be processed as well

COPILOTpc can also benefit from XP Pro improvements, e.g. encryption, audio compression

Third-party software may be used

Alternative operating system: Linux

6 Mobile Data Terminals

There are various terminals available, connected to the on-board computer COPILOTpc via Ethernet. Here are two examples.

6.1 TOUCHit Mobile Data Terminal with Touchscreen

This state-of-the-art mobile data terminal offers maximum clarity and easy operation for the public transit bus and train drivers.
The trendsetting solution TOUCHit meets the driver requirements for the interface to the on-board computer. It is important that the driver has all the necessary information available at a glance and all key features are easy to use.
The bright graphic color display offers maximum clarity and easy operation. The display features a high power luminous view in direct sunlight. The brightness of the screen can be adjusted to the appropriate level based on day and night time, and sunlight intensity.
The color display allows for a clear and distinguished view of the graphic user interface. Because of the touch screen there is no need for a fixed arrangement of function keys. The numeric keypad as required for many applications is displayed virtually on the screen. It is brought up as needed, but is otherwise not visible and space is left to display additional information. Due to the high resolution (400 x 234 pixels on an active area of 143 x 80 mm [5.63” x 3.15”]), it is also possible to display complex graphics on the screen. Even individual user profiles can be defined.
The TOUCHit is a sound investment and provides a very flexible platform for future expansion. When connected to INIT's new Windows XP® based on-board computer COPILOTpc, a standard IT platform is provided on the vehicle creating a modular solution that is expandable and allows for many peripheral connections.

6.2 PRESSit Mobile Data Terminal with Softkeys

The inexpensive mobile data terminal PRESSit utilizes traditional tactile keys. Its use is simple. There are ten numerical keys, which can also be used as softkeys, four dedicated softkeys, one “Escape” and one “Enter” key. A fixed assignment of functions to keys is not necessary. This ensures flexibility regarding future updates.
The driver can read all relevant information off the transflective, monochrome LC-display. Thus he can fully concentrate on the traffic.
The backlit display and keyboard ensure excellent legibility. Luminance is automatically adapted to the surrounding lighting conditions. In bright daylight the display luminance is high, too. In darkness the display illumination is automatically reduced so that the driver is not distracted. The keyboard is illuminated, too.

Moreover, PRESSit can be integrated into the driver's working environment. With its convenient quick-change brackets it can both be built-in or surface mounted.PRESSit perfectly compliments the Windows XP® based on-board-computer COPILOTpc. The modular design ensures flexibility with regard to future updates and thus security of investment.

7 References

The COPILOTpc is already being used internationally. Here a few references.

7 References

Houston, USA: In the just completed refurbishment of 1350 vehicles the COPILOTpc has been chosen as on-board computer in CAD/AVL with data communication via MOTOROLA RDLAP and controls among other things the passenger count (automatic passenger counting) in all vehicles.

Stockholm, Sweden: Over 2100 vehicles are being equipped with COPILOTpc. Communication with CAD/AVL is implemented via TETRA. In a first step the voice communication is switched on, in a second step the data communication. It is the largest TETRA-System for ÖPNV (public transport) at the time. Currently 800 vehicles are operating.

Oslo, Norwegen: In the first stage of CAD/AVL, 250 of 1250 have been equipped. Communication with the control centre takes place via GSM/GPRS.

Munich, Germany: In the CAD/AVL Munich the on-board computers of a competitor are being successively replaced with COPILOTpc from 2006 on. Here communication with the control centre takes place throughout the city via classic analogue voice and data radio transmission. Communication with the vehicles in the region takes place via GSM/GPRS.