Technical Solution Overview for Passenger Information Systems

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Passenger Information Systems in the Mobile Era

As the mobile revolution digs ever-deeper furrows into popular culture and consciousness, more and more customers are demanding Internet services as they commute from city to city, and home to work. For many commuters this has become so true that the quality of IT services offered has become a determinant value in their quality of service. Traditional IT vendors are attempting to fill in the gaps, but these firms are more used to supplying Enterprise solutions, and the peculiar requirements of rapidly moving, on-board train, bus, and plane environments are something they are not well equipped to address. Industrial networking suppliers are better equipped to address these needs, and with the increasing trend towards more intensely concentrated urban centers where commuting populations continue to rise, local and state governments are broadening their search in hopes of finding more durable, reliable, and efficient solutions.

Passenger information systems are rapidly improving, with the most rapid adoption, development, and growth taking place along railways—though roadways, too, make up a remarkable portion of the market’s growth. Globally, Western Europe and Asia are the regions which are fuelling the adoption and refinement of passenger information systems.

Yet each information system will bring with it complications that can significantly drive up costs for customers, and can be roughly lumped into two sorts. The first sort involves working with aged or decaying infrastructure—both on the train itself as well as in the station—and incorporating outdated wiring technology with new networking devices. The other is the opposite situation: starting from scratch, on a new train, with no base network or system to build from.

Market Trends

Passenger Information Systems (PIS) are a powerful investment in the future for any current railway. Bringing increased safety, convenience, and satisfaction to every passenger, an effective PIS is a valuable investment in the future for any public transportation system, and one that guarantees a wealth of returns for decades after its deployment. An effective PIS not only makes a passenger’s trip more convenient and effective, but it can also provide entertainment, while building opportunities for passenger interaction and socialization through a constantly expanding range of personalized customer services. Where once a PIS might only display the name of the next train stop, today’s systems can include additional information such as distance and time to the destination, a local weather report, advertising, entertainment such as movies, or games, and full or partial Internet access.
At the same time, a modern PIS will also return passenger information back to the train operators, and help integrate onboard surveillance data. These networked systems allow local train operators, remote control rooms, and stations along the route to monitor the train’s onboard status and location. Reaction times will be much speedier in the event of emergencies, while details of occupancy, location, and onboard facilities may be monitored and updated in real-time, aiding in the logistics and management of passenger boarding and disembarking, as well as supply and maintenance. At the same time, these systems will serve as deterrents to criminal activity and inappropriate passenger behavior, as well as visual records in the event that policing is required. All of this is made possible thanks to the convergence of industrial automation networks with advanced Ethernet and wireless IT technologies.

Technical Challenges for Operators and Integrators

To achieve full integration of all onboard systems, train operators need an onboard controller that will report the status of train doors, HVACs, compressors, brakes, lights, and other key train infrastructure. These reports must be made in a way that helps maintenance engineers identify potential problems in a timely manner, so they not only reduce maintenance efforts, but also provide a better overall availability and higher quality of service.

While the deployment of passenger information systems on new trains is relatively straightforward, upgrading a PIS on an aging train is subject to many constraints, such as lack of space, obsolete wiring schemes, and other needs originally unanticipated by the train designers of yesteryear. For old trains like these, that must integrate aging PIS equipment with newer technology, a compact controller that is both EN 50155 compliant as well as equipped with a rich selection of serial, I/O, and Ethernet ports is a significant asset. It also has to be able to integrate a variety of subsystems so the PIS can integrate condition monitoring, the PA system, LED displays, and train information to give passengers and operators audio-visual updates on the status of the train.

Typical Scenarios when Deploying Passenger Information Systems

All PIS deployments can be separated into two primary categories, new and refurbished installations, each with its own unique set of challenges. When designing a new train, an operator’s biggest concern is how to improve the riding experience of a passenger by effectively integrating multi-media services with real-time information. For these systems, the most important concerns are connection reliability, bandwidth, and multiple system redundancies with seamless failovers. To create a network backbone that gives you the maximum available service and that also securely and effectively integrates the interior architecture with electronic equipment requires careful planning and detailed consideration of all available options.

On the other hand, for refurbished trains, system upgrades are usually done by system integrators who specialize in reusing or repurposing as much of the extant legacy systems as possible, to maximize savings and interoperability. When older systems are refurbished in this way, they tend to run into a few common challenges, which are listed below.

1. Limited cabinet and installation space

   When engineers of the past designed train carriages, they tended to take full advantage of all available space, leaving little space left over to house electronic devices and wiring.
Thus, when a train operator seeks out a system integrator to upgrade a PIS installed on an old carriage, the physical profile of the devices used are preferably as small as possible, so they may be hidden in existing cabinets or other chassis infrastructure in an inconspicuous manner. Common workarounds are converting electrical cabinets, beneath passenger seating, or in baggage compartments.

2. Limited pins on the couplers
When upgrading a PIS system on a refurbished train, one of the toughest challenges is the limitation of connector pins. Because it is an integral portion of the truck, on old carriages the coupler is part of the “untouchable equipment” category. Consequently, it is impossible to add any additional lines between carriages, so engineers must develop solutions that work using the consist’s existing backbone, which can often be a major challenge.

3. Limited budget
The budget is always a major concern, for any project. Operators do not want to spend a lot of money upgrading a legacy system if the cost to do so matches the price of a new carriage. Operators are always looking to strike a balance between a solution that fulfills their immediate needs and the range of available technology; this results in equipment trends that shift as time goes by. For instance, popular upgrades on refurbished carriages, these days, are LED displays and equipment monitoring systems. This presents difficulties for system integrators who want to navigate costs and functions, while meeting the customer expectations of the moment, and near future.

Key Considerations for New Trains

1. Highly reliable, high-bandwidth Ethernet
Build an Ethernet train Network with our gigabit-bandwidth managed switch as part of integral onboard solution. The built-in managed switch not only provides redundancy, but provides gigabit bandwidth powered over the Ethernet (PoE) links. PoE cuts wiring needs, while the gigabit capacity provides a stronger and more reliable network structure for better guarantees all data video, and audio may be faultlessly transferred to centralized storage.

2. Rail-level I/O Modules for Onboard Asset Monitoring
I/O modules with channel to channel isolation and which are EN 50155-certified should be a minimum requirement for the onboard train monitoring systems used to keep track of things like toilets, doors, HVAC, compressors, and brakes.

3. Automated configurations for all network stations
One of the most time-consuming tasks when it comes to deploying or replacing existing equipment is the hassle of configuring each individual device. Even experienced engineers find the configuration process tedious and time-consuming, and for regular maintenance personnel it can become a nightmare. With Moxa’s FLI technology, system integrators can write the configuration to a file and store it on a master controller that will allow the autoconfiguration of any or all devices on the network, allowing for much more efficient and rapid deployment and replacement.

Moxa Solution Highlights for New Trains

- **Turbo ring**, with 20ms recoveries, anchors a highly redundant Ethernet ring
- **Rail-level remote monitoring** using integrated ioPACs to manage I/O devices
• **FLI Technology** (Flexible, Location-based, Intelligent) automates configuration of networked devices to make replacement and maintenance much faster and simpler

• **Automation networking solutions** to cover the full spectrum of onboard railway networking needs

## System Diagram

### Key Considerations for Refurbished Trains

1. **Deploying an IP network on legacy 2-wire links**
   On old trains, connector pins across couplers are very limited. Even when you remove the existing RS-485 or CAN bus network, there are still only two wires available for access. System integrators who can provide a solution that can upgrade these wires to IP communications offer a very enticing solution to train operators.

2. **Multiple networking interfaces integrated into a single device**
   By having serial, I/O, and Ethernet links all natively available on a single device, integration and development times are considerably sped up. The convenience of such a variety of integrated interfaces makes it much easier for SIs to satisfy the needs of train operators.

3. **Integrate service and monitoring systems into a single device**
   If all the functions can be integrated into a single device it not only simplifies system development, but it also reduces maintenance costs a great deal, ultimately improving overall network reliability.

4. **Automatic carriage sequencing over 2-wire IP**
   Older trains often built their PIS around industrial interfaces like CAN bus or RS-485 which were then daisy-chained into redundant ring topologies. Because networking stations on these systems required sequenced addressing to operate, these legacy systems all featured a technological solution that automatically reconfigured device addressing each time the consist was rearranged. An IP network running over 2-wire systems also requires an automated re-addressing solution, but this is not as easy to duplicate over 2-wire systems as it is over Ethernet. Thus, system integrators that can acquire a solution that already
features automated address sequencing over a 2-wire networks gain a big shortcut for system development.

5. **Space Limitations**

Due to the space limitations that old trains suffer from, all networking devices will have to be as compact as possible. This will aid system integrators in building low-profile systems that can be deployed without altering or modifying the carriage interior.

**Moxa Solution Highlights for Refurbished Trains**

- **Integrated control and management platform**
  - Serves serial and Ethernet interfaces over a single device
  - Supports either C/C++ or IEC 61131-3 programming languages
  - Ready-to-run services (data logging, email alarms, Modbus, etc.)
- **Ethernet over a Daisy-Chained 2-Wire Relay-Bypass Network**
  - Ethernet backbone over 2-wire copper cable
  - Reduces wiring and labor cost
  - Relay bypassing technology improves reliability
  - Ideal for mid-life trains built prior to the mobile Internet era
- **Automatic Carriage Sequencing (ACS)**
  - Easy-to-use API
  - Reconfiguration does not require a system reboot
  - Sequences all devices in less than 3 seconds

**System Diagram**

- ioPACs connect sensors, the PA (Passenger Announcement) system, and the PEI (Passenger Emergency Intercom) system, and serial interfaces for passenger information LEDs over Ethernet
- Network attached storage for onboard railway applications
Moxa’s broad selection of passenger information solution products


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