Implementing Passenger Information, Entertainment, and Security Systems in Light Rail Transit

VALENTIN SCINTEIE
ALSTOM Transport Information Solutions

Passenger information, entertainment, and security systems are becoming indispensable in LRT and other mass transit transportation modes. They respond to the changes underway in the railways and mass transit global environments, such as government debt reduction, demands of the aging population, integration of disabled people in society, private–public partnerships, utilizing information technology to lower costs, improved customer services, and enhanced commuter safety and security.

Several major cities (New York; Montreal, Quebec; Hong Kong; Santiago, Chile) around the world have successfully introduced passenger information, entertainment, and security technologies that also allow for the generation of advertising revenues.

Before implementing new passenger information, entertainment, and security systems, the operator needs to carefully assess the technical solution to be implemented, the impact on passengers in terms of satisfaction and increased ridership, the advertising potential and new revenue streams, and the set up of media and security operations. The methodologies to implement emergency, assistance, safety, and public information via real time electronic customer displays, audio systems, and surveillance systems are described.

INTRODUCTION

Over the last decade, passenger information systems (PIS) have evolved from standalone simple audio and visual displays to multimodal integrated systems that keep passengers informed, safe, and entertained all along their journey in public transit systems (metro trains, commuter rail, station platforms, buses, or bus shelters). Today's passenger information and security systems encompass multiple technologies, including advanced visual displays, public address, emergency intercom, digital surveillance systems, IP networks, wireless networks, video streaming, coders, decoders and many more. These systems deliver real time information seamlessly on-board vehicles and in stations, while controlled and managed from a single control centre.

This paper describes the implementations an integrated trainborne and wayside passenger information and security systems. It results from our experience deploying multimodal systems in Santiago, John F. Kennedy Airport, Singapore, Paris, and New York City. The difficulties encountered and the lessons learned from those projects can certainly benefit other operators.

MULTIMODAL PASSENGER INFORMATION AND SECURITY SYSTEM

The multimodal passenger information and security system architecture is illustrated in Figure 1 and explained in the following sections.

System Description

On board each vehicle, the passenger information and security system consists of displays (text-only LED, advanced LED, TFT LCD and/or dynamic end route maps), a public address system, emergency intercoms, cameras, controllers for closed circuit television (CCTV) and media, operator console for PIS and CCTV, high-speed train local area network (LAN) and wireless interfaces to the wayside. The controllers can interface with the train management system (TMS) or other external systems to obtain train position information.

In the stations, the passenger information and security system also consists of displays (text-only LED, advanced LED, TFT LCD and/or plasma screen), a public address system, emergency intercoms, cameras, controllers for CCTV and media, wide area network (WAN) and wireless interfaces to the trains. The controllers can interface with the Supervisory Control and Data Acquisition System (SCADA) system at the control center to obtain train arrival information, which is sent to the platform displays. The passenger information and security system are also integrated at the control center via a common management interface.
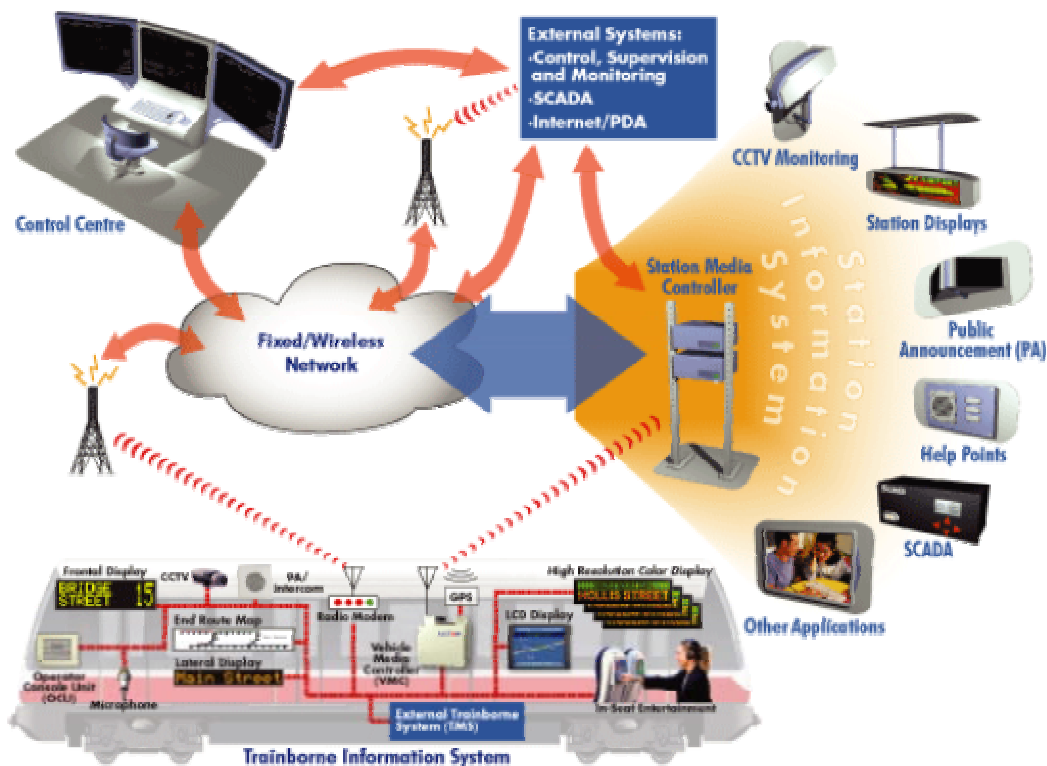

FIGURE 1 Multimodal passenger information and security solution.

Integration of Passenger Information and Security

PIS are part of a global security concept. An Integrated Transport Security System (ITSS) for passengers, installations, and operations performs the following functions: passive and active surveillance, fire and gas detection, and anti-intrusion and access management.

The integration of passenger information within the ITSS is performed at three levels:

- Fusion of ITSS and PIS information at operator level via a generalized Human Machine Interface (HMI) at the control center and the trainborne Operator Console;
- Common infrastructure: high-speed train LAN, WAN, and wireless WAN and LAN; and
- System health monitoring and event triggered alarm interfaces (when the passenger emergency intercom is activated, the digital video recorder can record at a higher frames per second rate than normal).

A common HMI for both PIS and CCTV provides several advantages. It improves the efficiency in transit operations and optimizes the response time during emergencies, while reducing human intervention errors. A common HMI optimizes usage of cab space on board transit vehicles.

COMMUNICATION INFRASTRUCTURE REQUIREMENTS

The communication infrastructure within public transit vehicles and between vehicles and the wayside is a critical part of the passenger information and security solution. New CCTV and media applications requiring high bandwidth data transfers have driven the evolution of the communication infrastructure.

Low Bandwidth

The following are examples of passenger information or security user applications requiring low bandwidth: train and destination identification, next stop and connection announcements, broadcast of audio and visual emergency messages, and passenger emergency intercom.

A low bandwidth network has the following characteristics:

- Provides transmission rates in the order of tens of kbps;
- Supports very good quality of service for vital applications (emergency intercom);
- Leverages the existing trainborne network infrastructure;
- Uses standards-compliant trainborne protocols such as IEEE 1473, LonWorks, FIP, CAN, RS-485, MVB, or IBIS; and
- Uses low-bandwidth train-wayside protocols such as GSM, GSM-R, CDMA, TDMA, GPRS, CDPD, DAB, or Tetra.

High Bandwidth

The following are examples of passenger information or security user applications requiring high bandwidth: media entertainment and advertising broadcasting (web-like content), trainborne

CCTV video streaming to the wayside, platform CCTV video streaming to the trains, in-seat information and entertainment, and interactive Internet or Intranet access.

A high bandwidth network has the following characteristics:

- Support transmission rates from few to hundreds Mbps and very good quality of service for vital applications;
- Leverage the existing trainborne network infrastructure in refurbished trains;
- Standards-compliant trainborne protocols: adapted or standard Ethernet, power-line protocols, Wi-Fi, IDB 1394, or MOST; and
- High-bandwidth train-wayside protocols: IEEE 802.11 a/b/g/e/h, UMTS (3G), leaky coaxial cables, waveguides, DVB-T, and DVB-S.

LESSONS LEARNED

This section describes the lessons that we learned from deployments of multimodal passenger information and security systems. The following are shared for illustration purposes only to help prevent similar mistakes in the future while promoting good practices:

- Proper identification of cross-functional stakeholders and key end-users at the beginning of the project is essential (rolling stock, signalling, control center, security, maintenance, information technology, customer service, etc.).
- Implement a product strategy approach, in addition to the traditional project-driven approach, to ensure that core system functions and components evolve properly from project to project to a rich and optimized feature set.
- It is critical to also have an integrated multimodal information strategy that clearly defines the interfaces between train, station, bus, control center, external systems, and so on.
- Manage the risk of turnover (and in some cases absence) of key end-users throughout the project lifecycle.
- Acknowledge that advanced CCTV and media functionalities require enhanced train and train-to-wayside communication infrastructure
- System operability, reliability, and maintainability can be increased via integration with the TMS/Communications-Based Train Control (CBTC) and ATS/SCADA systems.

Proper Identification of Project Team Members

In order to successfully deploy a multimodal project, the appropriate team needs to be put in place from the beginning, both on the customer and the supplier side. The introduction of a multimodal system requires involvement and commitment by all cross-functional stakeholders and end-users, as well as technical and management leadership during the entire duration of the project. If third-party car builders or multiple suppliers are involved in the project, strong teamwork and open communication between all the parties is crucial to success.

Product Strategy Approach

Most of the time, passenger information and security systems are adapted electrically, mechanically, and software-wise for specific train configuration and specific customer needs. Thus, the short time vision is to develop systems one project at the time. A clear product strategy allows the definition of the base product functionalities that are available in a specific system in a given release. This baseline can be customized by adding features tailored to specific operator needs. If a feature can benefit other operators, then it becomes part of the baseline of the next release. Furthermore, the baseline is enriched by research and development activities.

Integrated Multimodal Information Strategy

Contrary to standalone systems, multimodal systems have the particularity that they affect several parts of the transit network. Therefore, the transit operator needs to have an integrated multimodal information strategy and the interfaces should be clearly defined between train, station, bus, control center, and external systems. This is important even if—due to budget constraints—the implementation is phased in several stages.

Manage Risk of Turnover of End-Users

It can occur that after passenger information or security systems are fully deployed, as a result of some organizational changes, a new group of users starts using the systems. This change needs to be managed carefully. The new users have to be trained. If the system's new functionalities were not captured in the initial requirements, the system may require modifications to satisfy the new requirements.

Importance of Communication Infrastructure

The communication infrastructure within public transit vehicles and between vehicles and the wayside is the pillar of the passenger information and security solution. Most of the new applications, like web-like entertainment content or streaming video surveillance, require large amounts of bandwidth. It is important to take into account the impact on the communication infrastructure. Communication networks have evolved quite a bit, and there are many options to choose from. The selection of a specific infrastructure depends on the applications, the public network, and the specifics of the operator's network.

Integration with External Systems

The reliability and the maintainability of an entire passenger information and security system can be enhanced by its integration with other external systems, such as TMS/CBTC and ATS/SCADA system. TMS provides the train location to the trainborne PIS, while ATS gives train schedules to the wayside PIS. A common HMI for both PIS and CCTV, integrated with ATS/SCADA, improves the efficiency of the transit operators and optimizes the response time during emergencies. PIS and CCTV alarms and diagnostic data can also be presented in a standard format with other operator subsystems.

CONCLUSION

This paper described some of our experiences in implementing integrated passenger information and security systems in several cities. Nowadays, providing passengers with relevant travel information and making their trip safer and more enjoyable is an essential part of the modern transit landscape. The innovations on communication technologies, electronics, and software enable applications that did not exist less than a decade ago. As an example, live video surveillance image transmission from vehicles to a control center in real time is now a reality.

Based on our experience, the following should be considered when implementing multimodal integrated passenger information and security systems:

- During the requirements definition phase, keep in mind the whole picture (public announcement, signs, CCTV, trainborne, wayside, control center, bus, etc.), including all subsystem interfaces.
- Select a solution that can evolve with your needs and evolve with multiple technology facets.
- Compare a base passenger information and security system versus a more entertaining and revenue-generating, advertising-enabled media system.
- Select a system that has a lifetime of at least ten years (innovative with limited risk).