Passenger Interface Systems in Modern Railway Application: A Dedicated Passenger Information System for Istanbul Tramway

Anil Ates*1, Hakan Celik2

1Anil Ates, Istanbul Transportation Cooperation; aates@istabul-ulasim.com.tr
2Hakan Celik, Istanbul Transportation Telecommunication and Security Tech., hcelik@isbak.com.tr

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Abstract:
After 1860’s the railway systems has started to be used in urban transportation in the world. However, especially after the 1950’s, automobile usage has been increased quickly. Thus the dense of transportation has started to move from railway systems to the ones with rubber tire vehicles in Istanbul. Traffic density in urban transportation has started to be experienced since 1950 with the increase in the automobile usage and other rubber tire vehicles. The length of railway systems in Istanbul, which reached to 130 kilometers till the year of 1950, became null with a continuous decrease in 1966. However, the priority in the developed countries in the same period of time was given to the mass transportation systems, specifically to the railway ones, that were more comfortable, more secure and more economic (Ocak and Manisali, 2006).

Keywords: Railway systems, tramway, passenger information system, communication protocol.

* Corresponding Author
1. Introduction

Passenger Interface Systems are one of the most critical elements in Railway Industry and it is developed day by day. Many equipment and communication protocols can be used according to user’s demands and main problem in this system is always “being able to integrate”. As an example of integrity Istanbul Tramway Project can be indicated - “Istanbul Tramway Project” is initiated by “Istanbul Transportation Cooperation” company includes a Passenger Interface System (PIS) which contains LCD and LED displays (for driver and passenger), central computer, video surveillance and automatic and manual announcements and all these contents are fully integrated with each other.

Istanbul Tramway PIS Equipment List:
• 2 Unit Rear View Monitors
• 5 Unit LCD Displays
• 7 Unit Passenger LED Displays
• 13 Unit Cameras
• 2 Unit Amplifiers
• 1 Unit Streamer
• 2 Unit Car Controllers
• 1 Unit HMI (Human Machine Interface)
• 2 Unit Driver Audio Controller Units (DACU)
• 8 Unit Emergency Phones (Intercom)

PIS in Istanbul Tramway uses CAN Bus communication protocol for getting data from the tramway’s central computer and it can combine all the data in one Ethernet line. System is also redundant to breakdown in Ethernet line, even in the worst case scenario manual and automatic announcements can be made by the driver just by ignoring the external and internal announcement selection. For input information to the PIS, it is only enough to give vehicle number, active cabin, number of vehicles, doors close/open and distance value. Only using this information, it is completely enough for PIS to manage all the system for the driver.

Between many protocols, all the LED and Emergency Phone and DACU communication is completely handled by RS485. By using hardware addresses on them using some jumpers, PIS can detect every phone’s and LED’s location including its exact point according to tramways layout. In addition, due to communication line always checks the state of the equipment driver can always take a system check directly from HMI unit. As a basis, the PIS use Ethernet line communication for every subsystem. All protocols are always converted to Ethernet protocol to set up a communication line between Cab A and Cab B, and between couplings of two tramways. As it is predicted, this situation is so critical for a tramway that carries passengers in case of a system failure. If a corruption occurs in Ethernet line, all the data flow from master cabin to slave cabins is lost and there cannot be any change in video stream or LED displays, but the system on the tramway is totally reliable for announcements and camera recordings which is mainly most critical for the operator companies.

Structure of audio and recording system should be totally reliable in PISs and driver should always have availability of making manual announcements. Istanbul Tramway is totally solid in this issue due to voice information is always sent by UIC (International Union of Railways) Lines and voice signal is sent as analog. Because every cabin has its own amplifier to strengthen the voice signals so that only critical issue for announcement is mechanical and electrical coupling. There cannot be any problem in systematic when coupling is normally done, due to the system carries voice in simple UIC lines. When the issue is same for camera recordings structure is similar with the UIC logic. Every camera in the tramway is connected to an Ethernet switch directly and sends the data directly to its own cabin’s Recorder unit. All the recorders are independent from each other and there is 1 recorder in every cabin. However the system looks separated, all camera streams are united in the Ethernet protocol and if there is not a problem in Ethernet line between tramways user can always reach the streams any time. In the light of these explanations, it can be said that Istanbul Tramway’s PIS design is totally reliable and redundant system.

The main task of the “Passenger Information System” is to provide the passengers with audio visual information on the headway and to establish audio connection between the passengers, camera recordings which is mainly most critical for the operator companies and the driver's cab using the emergency speech unit or between the driver's cabs as described below:

• Automatic information to the passengers via external and internal LED displays and loudspeakers.
• Viewing of pre-defined messages to the passengers on the internal and external information LED displays.
• Driver can control “Passenger Information System” by
using HMI.
• During the headway cameras will be on and when passenger pushed on the Intercom, driver is able to monitor passenger from HMI.
• Driver is able to monitor to entrance-exit passenger via “Rear View Monitor”.
• With wireless module, technical personnel can modify all specifications.
• Passenger LCD Displays enable time on the screen.
• External and internal announcement from the driver to the passengers.
• Communication between the driver and the passengers via “Interkom” units.
• Cab-to-cab communication between the train personnel in the driver's cabs.
• When to be required the manual announcement, driver can make an announcement external or internal or both of them.

Passenger Information System has distinctive communication and controlling structure that required working with compatibility. Main equipment on tramway of PIS is shown in the Figure 1 below.

2. Main Structure
Passenger Information System has two main cable structures. One of them is Ethernet Line, other one is UIC Line. Main cable structure of PIS is shown in the Figure 2 below.

2.1. Ethernet Switch
Tramway has two Ethernet switches and these provide camera (head, external, internal, driver, coupling), car controller A-B, HMI, rear view monitors, passenger LCDs, Wi-Fi module, previous car controller and next car controller. Using the PoE (Power over Ethernet) structure can be facilitated harnessing design and reducing the cost. Istanbul Tramway's PIS design is totally reliable and redundant system. With a redundant, reliable
star backbone, the railway company is able to prefer their passengers’ state-of-the-art information and entertainment services, and also make use of security functions such as video surveillance (EN 50155, 2008).

2.2. Car Controller

Tramway has two car controllers like car controller A and car controller B these are different car controller because Car Controller A has CAN Bus communication unit (EN 50121-1, 2006, EN 50121-2, 2006). Car Controllers (A-B) are common specifications as described below:

- Digital Video Recorder is able to save a record with hard disc capable of 15days*24hours record.
- Prerecorded passenger information system announcements and manual announcements, both inside and outside played by inside-outside speakers.
- Every car controller can drive LED display within side via RS 485.
- Every car controller control DACU (Driver Audio Control Unit) unit within side via RS 485.
- Car Controller A has CAN Bus connection and with CAN Bus can be reached number of vehicle in a train set, quantity of vehicles in a train set, vehicle’s plate number, driver’s cab active, shunting desk active, speed (km/h), door function, switch on, driver key for the slave car, distance, emergency brake handle from the slave to master, drive key a-car, driver key shunting desk, emergency brake handle, vehicle direction in train set, vehicle driving direction, status report time (EN 50121-3.1, 2006).
- If car controller A is master, automatic announcements will run audio files via Car Controller A.
- Car Controller has media server management and that provide to manage “Passenger Information System”.

Car Controller B as described below:
- Car Controller B can broadcast all passenger LCD’s.

2.3. DACU (Driver Audio Control Unit)

While driver making manual announcement via microphone, voice send to amplificatory within all Car Controller. Driver can select within the switch on the dashboard panel for internal or external or both of them announcement. DACU monitor all Intercom units via RS 485 and when one of the Intercom units were demanded, that send the message to Car Controller. DACU is communicated to Intercom via UIC Line (EN 50121-3.2, 2006).

2.4. LED and LCD Displays

LED and LCD displays are controlled by Car Controller. LED displays are communicated via RS 485 and LCD displays are communicated via Ethernet (EN 50121-4, 2006, EN 50126, 1999). If the pantograph is powered up, LED and LCD displays will be run. When the tramway was movement speedy more than 20 km/h, rear view monitor will be showed master car’s right and left side external camera. If speedy was less than 20 km/h, monitor will be showed all tramways right and left sides’ external cameras.

2.5. Cameras

The resolution of IP camera has 1.3 Mpixel. Supply of all cameras can be sustained via PoE switch or exterior supply line and cameras are located at each vehicle providing more than 95% view coverage inside the vehicles. Each of the exterior cameras can be seen the whole vehicle with A and B sides and all passenger doors easily (EN 60529, 1997, EN 61373, 2010).

2.6. HMI

Touch screen interface to control the information and monitoring system. HMI controls both the information and monitoring system in main interface software. That allows driver to control all cameras & camera monitors, LED & LCD displays, announcements and Intercom units. Information systems are showed the station and route information to the driver on the HMI touch screen when the vehicle stops at a station. If passenger pushes an Intercom button, Interkom units were rung a warning voice to hear driver, also visualization signal on the HMI screen, placed in the driver cab. The passenger-driver communication can only be activated, if the driver accepts the Interkom unit request.

2.7. Wi-Fi

Vehicles are equipped with a Wi-Fi, communicating with the passenger information system and has remote access for advertorial uploads, route information updates. With Wi-Fi module, technical personnel can access the Ethernet Switch and who is able to upgrade new version not going tramway.

3. Conclusion
Given the opportunities offered by present-day technology, a wide variety of communication means could be employed for meeting passenger information needs. PIS system provides high level of security in accordance with the rights and privacy of individuals. Audio and visual equipment design is provided great convenience to passenger on the headway duration. For example if passenger is a sight-disabled person, that cannot be see station and station’s name. With PIS system, who is sight-disabled person is able to hear automatic announcement. In additional, when passenger went to travel or business travel in different city or country, who can easily find to travel direction and route.

With LCD’s on PIS system, commercial companies make application for advertisement to operator companies or municipalities and visual media can be affected to people. In M4 Line of Istanbul, which made of projects and services are advertised by municipalities. Furthermore, via LCD’s PIS system is shown station information, arrow, weather condition, time/date and news.

In tramway, all of cameras can be saved a record by recorders and with saved a record coupling cameras are provided to couple to 2 tramways, external cameras can be monitored to entrance-exit to passenger, internal cameras can be replied to people in emergency situations and finally via saved a record driver cameras are provided to monitor drivers performance.

At the present time, Passenger Information System was important by train producers. Equipment of Passenger Information System is designed according to the EN 50155, EN 50121-1, EN 50121-2, EN 50121-3.1, EN 50121-3.2 EN 50121-4, EN 50126, TS 3033 EN 60529, EN 61373 standards (EN 60529, 1997, EN 61373, 2010).

References


