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Communications

Convergence of Communications Systems into a Single Platform to Improve Efficiency

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Processor technology has progressed rapidly from 8088 processors to today's Intel Processors. The improvement in processing power has resulted in tremendous improvements in process control and communication systems. This advanced digital convergence, together with the major trends, has had a big impact on the systems that are being delivered to infrastructure projects. It promises improved performance and efficiency, less and easier maintenance, and most importantly, reduced resources for energy, space and staffing etc. This article describes the digital convergence affecting railway operations and highlights its impact to SCADA and communication systems

What is Digital Convergence?

Around 1980, Nicolas Negroponte - Director of the Media Lab at the Massachusetts Institute of Technology (MIT) - drew a diagram that featured three overlapping rings to represent the industries of computing, (tele)communications and publishing/broadcasting.

Negroponte illustrated that in 1980 there was relatively little overlap between the computing, communications and content industries, whilst also predicting that by the year 2000 major overlaps in the boundaries of the three industries would exist. The logic for this proposition was that by 2000 the computing, communications and content industries would all have converged due to a common reliance on digital systems, with all three industries basically dealing in the creation, manipulation and storage of binary data. This famous prediction has proved to be correct.

Some examples for the convergence are as follows:
Voice – Voice has converged from analogue to VoIP. VoIP, also known as IP Telephony, is the real-time transmission of voice signals using the Internet Protocol (IP) over the public Internet or a private data network. In simpler terms, VoIP converts the voice signal from your telephone into a digital signal that travels over the Internet. This improves the carrying capacity by 5-10 times over the same bandwidth used by 1 analogue channel. Today we use this features extensively via Skype, call card etc.

Video – The turning point for digital video systems in PC's came as processors finally exceeded 200MHz. Digital video grew with compression as a core enabling technology The most important series of recommendations and standards for video compression were defined by groups of the ITU (ITU-T Rec. H.261/262/263/264) for application domains of telecommunications, and by the Moving Pictures Experts Group of the ISO/IEC (ISO standards MPEG-1/-2/-4) for applications in computers and consumer electronics.

System Integration

Digital convergence fuels the requirement of integrating various sub-systems as a single platform. This is becoming a rising priority for many system owners. The fundamental of Digital Systems (the 0s and 1s), is the key that unlocks understanding to enable the integration multiple system into a single platform. Accordingly, different system manufacturers are now providing Software Development Kits (SDK)/ API to allow their system to be integrated with 3rd party systems keeping up with the requirement for integration (digital convergence). The level of flexibility and detailing of the SDK/API differs between different manufacturers and as such the operators/system owner needs to detail out their requirement clearly of the expected functionality that needs to be integrated.

Trends Impacting Railway Industry

There are certain trends in the world that will impact on future railway systems. Populations are migrating, generally to bigger cities looking for better opportunities. This is resulting in the creation of megacities.

This will also result in better city planning to manage congestion and heavy investment infrastructure, which will result in the growth of rail networks. Due to the size of the megacities, the transport operation will be given to multiple operators to ensure an element of competition and efficiently. Rail operators of different networks will have to work together to manage connectivity.

Digital Convergence

Digital convergence and Trends impact on SCADA and Communication system in railways. The following figure shows the typical system relative to a communication and SCADA package normally installed in railway systems.

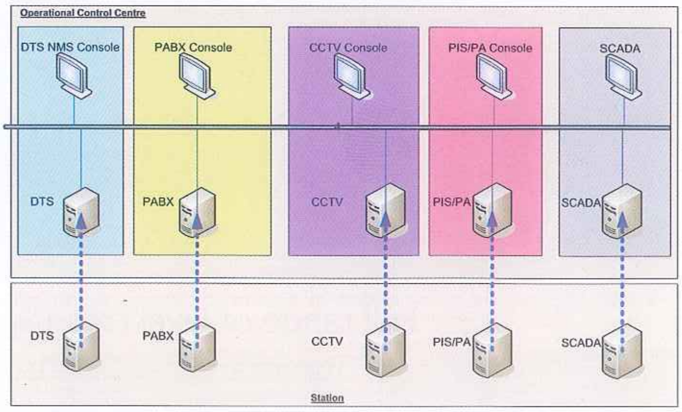

Figure 1: Existing communication/scada system

Each individual system is independent from each other and this results in clients having multiple operators to operate each system individually.

Digitally Converged Op. Control Centre

This approach basically removes the individual operators for each subsystem and replaces the various subsystems with an integrated operator workstation for the operation of the complete communication system plus SCADA. See figure 2.

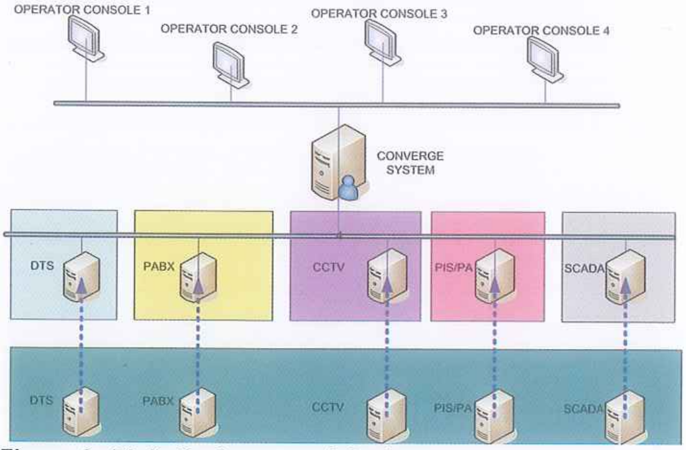

Figure 2: Digitally Converged System

The client is free to select any future subsystem for the extension of the networks and integrate it into the control centre application. This is the biggest advantage the integrated system provides to the client. The control system provides a modular architecture, which results in the additional modules, added without interrupting the existing system performance and interfaces. The next section describes the interfacing and integration for the complete control centre system using PSItraffic i.e. digitally converged system offered by PSI Incontrol Sdn. Bhd. to highlight the details of this approach.

PSITraffic: Digitally Converged System

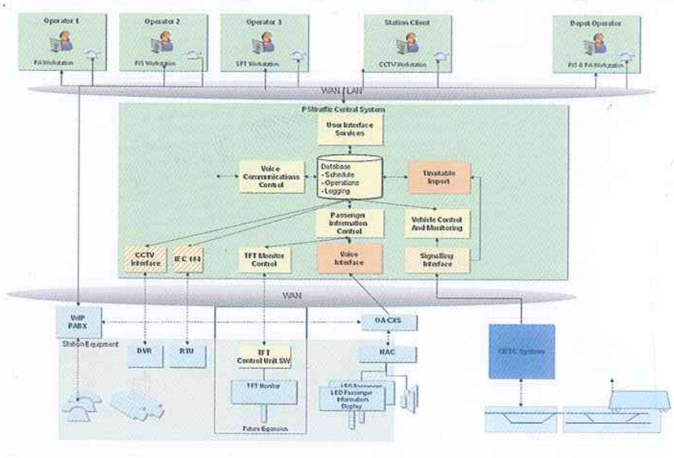

Figure 3: PSI Traffic overview

PSItraffic Control System

The central system is the core of the operations control system. All information is collected here and distributed to other system components. The different subsystems and functions are implemented as plug-in modules, which exchange data through the central operational database. This architecture ensures that individual subsystems can be added or modified with minimum impact on other systems. The PSItraffic system collects information from all external systems and distributes it to the user workstations.

Core functions integrated in the central system include:

- Operational Database: The operational database maintains a record of the schedule and movements of all trains, as well as the status of all equipment controlled by the system. Information is distributed to all other systems through this database.
- Vehicle Control and Monitoring: This module is responsible for tracking the current position of trains, logging their progress and forecasting future arrival and departure times. This information will be obtained from the CBTC system via the CBTC interface module. The PSItraffic software module shall receive the current train positions and tracks from the ILTIS system.
- Passenger Information Control: This subsystem is responsible for generating passenger information data based on the timetable and current rail operation status. It incorporates the rules, according to which visual and acoustic passenger information is generated. This is distributed to different passenger information devices including platform and station displays, as well as public address systems. It uses different types of device drivers to interact with different categories of devices:
- Announcement Generation: This module generates audio announcements and streams them to platform or station loudspeakers via the Open Access system.
- Message Control: This module is responsible for generating the content of passenger information displays.
- User Interface Services: The PSItraffic software services that handle interaction with the Control room applications on the PSItraffic workstations.
- Timetable Import: The software module that extracts the timetable data from Train Control Systems.
- IEC 104 Interface to RTU (or any other protocol): The Interface of the PSItraffic control system to the RTU, handling the exchange of SCADA data using the IEC 104 protocol.
- CCTV Interface to CCTV Servers: The CCTV interface components allow users to access video cameras and video streams from within the PSItraffic control room application.
- Voice Communications Control: The generic PSItraffic software module that provides the logic for managing incoming and outgoing voice calls from a PSItraffic control system client. Users may establish calls directly with all objects (e.g. stations, Emergency Phone or Radio) visualised in the control room application, without needing to know individual telephone numbers or access information. This module interfaces with specific device drivers to make use of the PABX or communications systems available.
- System Monitoring: The PSItraffic control system monitors connected external software modules and is connected to the installed network management system. In case of a component or network failure, an alarm message is generated in the alarm list. Based on this alarm message the operator can initiate without delay a more detailed failure analysis.

PSITraffic: Multi-Modal Transportation

Multi-PTO concept: The PSI/Traffic system has been developed to fit the needs of multiple organisations or cross over organisations. The so called Multi PTO (Public Transport Operator) concept has been successfully applied in Germany to companies like Omnipart, which incorporate data from 12 different Transport Operators.

The PSI/traffic system merges all this data from different sources and ensures that the data is coherent. i.e. individual stops which are used by a different PTO have different stop names. The PSI system merges these to one internal bus stop definition. Both definitions/names are kept in the system.

The Multi-PTO concept also allows different users with different roles to import or visualise their data. Each PTO has its own responsibilities and accessibility. This can be defined dynamically, for example by an attribute in the PTNS, or in the data from the RTI/AVL interface.

By implementing the Multi PTO central system, the railway operator or authority can ensure

1. Connectivity Data between different PTO is available. This data will be made public to help commuters plan their trip.
2. Performance of multi PTO operators to be monitored. This will help identify the weak link to be addressed to improve the service.
3. Contracts to PTO operator can be implemented based on performance. Penalties on operators can be imposed for non-performance as the data will be available within the system and reports can be generated to prove the case. This should lead to an overall improvement in the quality of service.

Conclusion

Technological advancement in digital technology has fuelled the integration of sub-systems into a single integrated system. This helps to ensure better system performance and efficient usage of resources which helps to meet the increasing demand of the commuter who is expecting more and more information.

Railway operators can't shy away from these advances and need to embrace them to improve their service levels to meet this increased expectation. The resources skills also need to be upgraded to be able to handle and operate the advance systems.