# Internet of Things Solutions for Railways

FOUR *key design requirements for electronic equipment on board trains*

*Prepared by IBASE Technology,* October 2017

## *Overview*

While railway technology has evolved slowly over the last 200 years, the next few years could bring greater transformation to the railways, and at a greater pace than we have seen in the past as railway operators begin to adopt Internet of Things technologies. This paper outlines some of the innovations that we may see in the railways - and in particular on board trains - and the features of the electronic hardware that will be needed to deliver these kinds of services.

We will examine how the environment on board a moving train differs from the typical operational environment for an IT or electronic system, and outline four key factors that must be considered in the design of electronic systems that will be used on board a moving train.

Finally, we present the IBASE Multi-purpose IoT Railway Terminal - a rugged hardware solution for use in the railway environment including on board moving rolling stock.

## *Contents*



## *1. The Internet of Things and its applications in railway services*

The Internet of Things (IoT) is the concept of connecting objects via Internet technology to build smart systems that will enable more efficient, more environmentally friendly living in our cities. Numerous IoT projects are already under way in the transport sector, and these innovations offer huge benefits in rail travel in particular, by addressing three areas: the efficiency of the railway system, the service provided to travellers, and the safety of moving trains.

As the cost of sensors falls, railway operators are increasingly using them to monitor the condition of their rolling stock, and the environment around the train. For example, sensors around the wheels and brakes of a train can detect changes in vibrations and detect situations that might potentially cause an accident, while sensors in the railway infrastructure could sense changes in temperature, weather, and even earthquake tremors. Using sensors provides continual monitoring of the conditions, is cost-effective, and is ideal for covering locations that are difficult for maintenance staff to reach.

Managing the railway infrastructure is a costly operation and the IoT could aid efficiency in many areas. For example, the new HS2 and Cross Rail lines will be smart railway services and will utilise numerous sensors to monitor for faults on board the trains and in the surrounding infrastructure. The aim is to keep rolling

stock moving and people travelling as set out the in the timetables, to track containers and cargo, and provide drivers with real time information in the cab to help them navigate and make operational decisions.

Machine-to-machine communications can also monitor and manage many of the services provided on board the train. For example intelligent systems can monitor the functioning of doors and air-conditioning, and provide automatic re-ordering and replenishment of supplies for the restaurant cars.

In the Netherlands, the train operators are already measuring passenger numbers and their footfall, and using the data to manage the flow of crowds around their train platforms and stations and keep the passengers moving freely. This will become more essential as passenger numbers rise.

The IoT also offers many improvements to the rail passengers' travel experience. For example, the railway operators can provide wireless broadband on board the trains, so that passengers can work with their laptops and use their smartphones while they travel.

Perhaps most important of all, is safety. Human error is a factor in most accidents on the railways, and the newer rail services are generally using driverless trains that have remote monitoring of speed and braking, all controlled by automated signals.

Many of these application areas will require a new kind of electronic systems on board the trains. They are likely to use wireless technology, sensors, live video, cloud-based technology and machine-to-machine communications. The next section of this paper discusses the requirements for ICT equipment to operate on board trains.

## *2. The on-board environment and FOUR key design requirements for on-board electronics*

There are strict controls for electronic equipment for railway applications, which are set out in the relevant British Standards and European Standards. Safety is the top concern, due to the large number of people that may be travelling on board a single train. This means that every component within the electronics must be assessed as a fire risk, and should be flame retardant so that it will not emit toxic smoke in the event of a fire on board. They should also be protected from electromagnetic interference.

To the exterior of the railway carriages, even during normal operation of the trains, the ambient temperature can vary from extreme cold to extremes of heat, while temperatures on board can become very warm. This means that electronic equipment for use on railways needs to have a far greater temperature tolerance than normal IT hardware, which is either manufactured with a fan inside, or is built to be installed in data centres with large scale cooling systems.

The constant motion of a moving train with vibration and shocks is not a suitable environment for electronic equipment with moving parts. Ordinary electronic equipment is quickly damaged if it is subject to constant shaking and impacts, so the electronic hardware that is built for use on board a train must be resistant to this kind of movement.

Finally, the electrical supply for electronic equipment on board a train may not be guaranteed. There may be surges to the power supply and occasional breaks in power as the trains travel through different areas. This means that on-board electronics must be able to overcome inconsistences in DC power.

To summarise, electronic equipment for use on board moving railway stock should have special features to protect it from fire, extremes in temperature, vibration and shock and an irregular power supply.

## *3. Overview of the IBASE Multi-purpose IoT Railway Terminal*

IBASE has developed a series of rugged PC terminals to provide IoT solutions and intelligent networking in a railway environment. Their design addresses the unique challenges associated with operating on board railway rolling stock, and meets all of the criteria for the International, European and British Standards for electronic equipment to be used on rolling stock: EN 50155, EN-45545-2 (fire testing), and BS EN50155 2007.

**MPT-3000R IoT Railway Terminal**
Powered by Intel® Atom™ Processor E3845

**MPT-7000R IoT Railway Terminal**
Powered by 7th/6th Gen Intel® Core™ Processors

Click for IBASE IoT Railway Terminal video introduction.

Powered by 7th/6th Gen Intel® Core™ processors, the MPT-7000R is packed with new and enhanced features suitable for railway platforms. The 7th Generation Intel Core is the newest family of Intel processors and built on the industry leading 14nm process technology to deliver even more performance than its predecessors. Its new media engine opens up a new world of premium 4K UHD content – for viewing, streaming, creating and sharing and allows the MPT-7000R terminal to have incredible performance and responsiveness, richer visuals with better integrated graphics, more refined and expanded user experiences and the ability to take full advantage of the immersive internet.

### Key features of the Multi-purpose IoT Railway Terminal

- The terminal has no fan – which can be a point of failure
- A separate power module can be switched to meet varying local demand.
- A built-in power module with self-detect and real time feedback functions which can apply its own self-protection.
- A built-in G-sensor which operates the environmental controls and can auto-save or reduce operational access to protect information
- 3G/4G/LTE communications with dual SIM allows for redundancy and recovery in the WAN, and maintains

communication as the network signal strength changes in the railway environment
- Certified to operate from -40 – +70 degrees Centigrade, the terminal can operate without air flow
- 3-Axis shock proofing
- The system operates upright or horizontal
- EN50155 Class Tx Certification

## *4. Conclusion*

The IBASE Multi-purpose IoT Railway Terminal is one of a family of products that have been developed specifically for the railway environment, and meet all of the criteria for ICT equipment for railway applications, to be used on board moving rolling stock, and in the train driver's cabin. This terminal is sold as an OEM product and can be customised to meet application-specific requirements – for example it can be a component of the railway condition monitoring systems that use networks of sensors or other IoT solutions on the railways. IBASE products are designed for a long operational life, in some cases as long as 15 years, with full life cycle service and technical support.

## *About IBASE*

IBASE Technology specialises in the design and manufacturing of robust industrial PC products. Since its establishment in 2000, IBASE has been committed to the production of high quality products, and to the rendering of excellent services. IBASE carries out manufacturing and quality control at its own production sites in Taiwan that are certified to meet ISO 9001, ISO 13485 and ISO 14001 standards. Specialising in OEM/ODM/JDM services, its current product offerings comprise of x86 and RISC based industrial motherboards, embedded systems, industrial panel PCs, digital signage players and network appliances for various applications in the automation, digital signage, gaming, transport, smart building, medical, retail and networking markets..

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