BlueChip Technology

CASE STUDY

Industrial computer platforms for the PPP London Underground upgrade project

Background

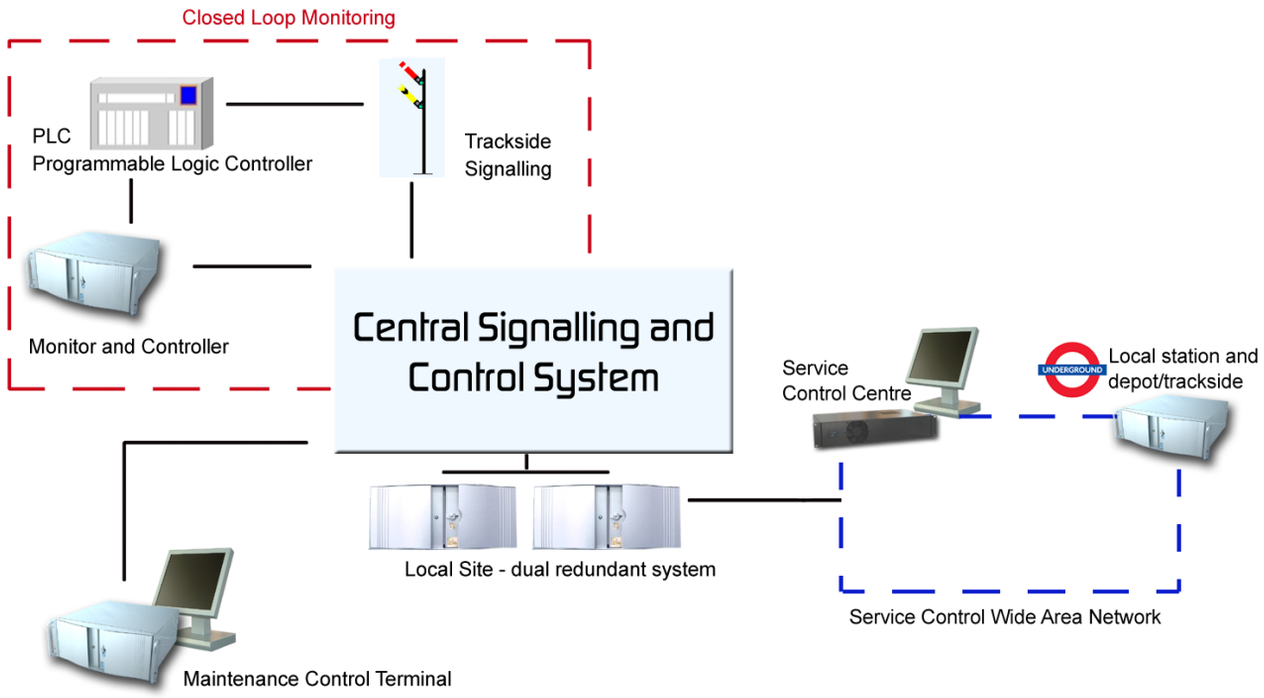
Never far from public and media scrutiny, the Rail Industry is a demanding arena to compete in. The rail network faces the ongoing challenge of improving passenger service within a comprehensive structure of health and safety regulation. This environment defines the term 'mission critical' and exemplifies the demands put upon an industrial grade computer (IPC).

Blue Chip Technology is a key supplier to the rail industry, designing and manufacturing system and board level product in the UK. Blue Chip, who were the sole IPC supplier to Alcatel for the Jubilee line extension, won a major IPC contract for the current LUL (London Underground) refurbishment. Under the Public Private Partnership project, the signalling and train control on the Victoria, Hammersmith and City, District, Metropolitan and Circle Lines is undergoing a major upgrade. The programme is planned to run until 2017 and the overall requirement for industrial computers is anticipated to be in excess of 500 units.

The industrial computer is a very different proposition from the office or home desktop. Built to perform in exacting conditions over extended periods of time, an industrial will typically be housed in a rugged, rack-mountable chassis with a passive back plane, capable of accommodating 12 or more expansion cards. Potentially deployed in a foundry or production line, it is designed to cope with levels of temperature, humidity, shock and vibration far beyond the benign desktop.

From the bottom up, industrial computer components are selected for quality, whereas in the volume desktop market, pennies count and components will be chosen accordingly. The calibre of an IPC can be seen in its power redundancy, hard drive MTBF, magnetic levitation bearing fans, shock mounted drive bays, lockable system front, hardware watchdogs and quality stainless steel metal work. The ability to hot-swap key components, such as power supply modules and cooling fans, can also be a key factor for conducting system maintenance without disrupting on-going operations.

The soft issues of product continuity and support are equally as important for an industrial computer buyer. Any complex project, such as a rail network installation, will have lengthy time scales and will usually be subject to a raft of industry health and safety regulations. The LUL upgrade falls under the remit of three different sets of regulations - LUL Engineering and Fire Safety standards, EMC standards (both general and specific to the Rail Industry) and international standard SIL (Safety Integrity Level) 2. SIL 2 compliance in a single channel IPC is widely accepted as being a significant industry achievement. Where there's an involved



approval process, any key re-specifications may need to be re-certified, costing tens of thousands in test house fees and man-hours. In addition, typical support commitments for a rail signalling installation are up to twenty years. This is why an industrial computer is built for product stability and 'fit, form and function' managed upgrades. An industrial computer lifecycle is typically five years, potentially longer.

The LUL contract covers three main upgrades – the Victoria Line, the Sub Surface Lines (SSL) and the Service Control Centres (SCC). The Victoria Line upgrade was the first project phase to go to tender. Although not the original front runner, Blue Chip's UK based engineering team and fast prototype execution through the design phase secured contract.

The solution

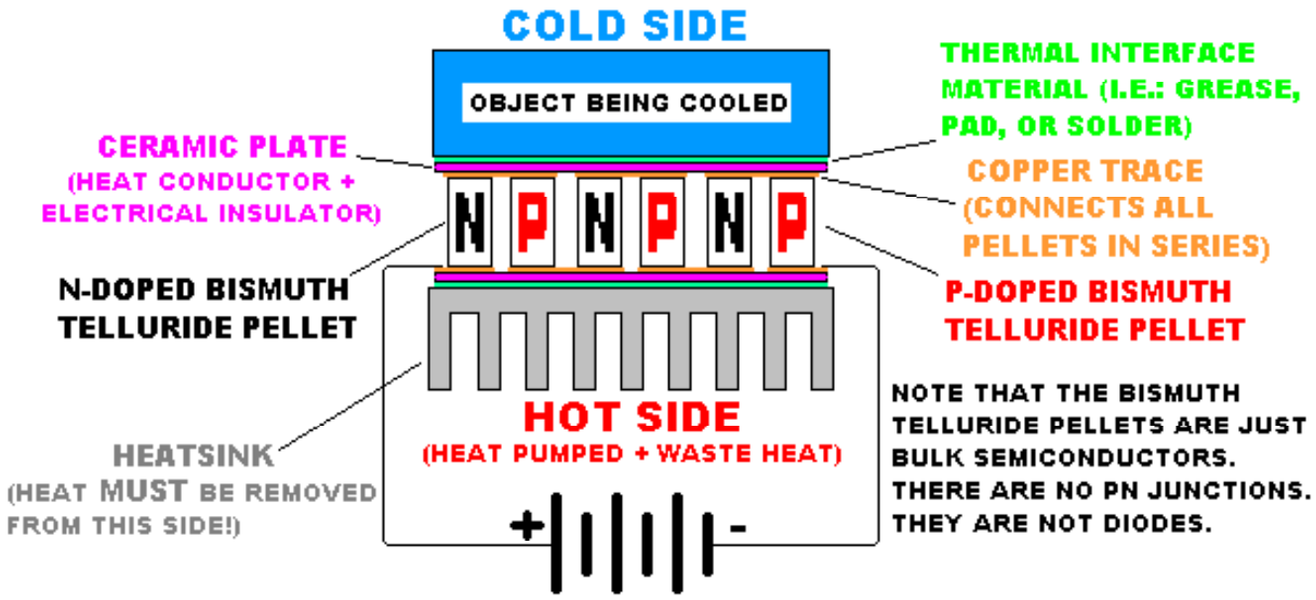
The Ultima industrial computer and 17" industrial monitor act as a key building blocks across the network upgrade. Several configurations support a SIL 4 approved logic hardware system interfacing with the trackside interlocking, radio block systems etc. The Ultima acts as an interface to the Service Control Centres, forms part of the Relay monitoring system and supports event logging and reporting and it also provides an operator interface when local control is required for track signalling. Within the actual Service Control environment, Ultima forms part of the Command and Control (CCO) processing suite including back up, maintenance and simulation systems.

Peltier Based Cooling

In addition to the features expected in a quality industrial computer, the Underground installation required some very specific criteria. One configuration of the Ultima industrial computer was required to operate in a 0 - 70ºC ambient temperature range to conform to specific LUL regulations plus an additional engineering safety margin. Off-the-shelf industrial computers are specified to 40ºC or 50ºC, normally using a fan based cooling system. The fundamental principle of this cooling method is that the outside air needs to be cooler than the computer components. At a 70ºC ambient this becomes a technical impossibility.

The Blue Chip Technology engineering team started developing a special cooling system capable of handling these temperature extremes. The unit was also required to use Low Smoke Zero Halogen (LS0H) materials, ruling out water-cooled systems, which would require flexible non LS0H piping. The eventual solution called for a sophisticated Peltier-cooling device. Chassis cabling and paintwork were also re-worked to minimise potential toxic emissions in the advent of fire.

Peltier devices, also known as thermoelectric (TE) modules, are small solid-state devices that function as heat pumps. A typical unit is a few millimetres thick, by a few millimetres to a few centimetres square. It is a sandwich formed by two ceramic plates with an array of small Bismuth Telluride semiconductor cubes in between. When a DC current is applied, heat is moved from one side of the device to the other



- where it must be removed with a heatsink. The "cold" side can be used to cool the hotspots in an enclosed computer chassis.

Since Peltier elements are active heat pumps, they can be used to cool components below ambient temperature - which is not possible using conventional cooling, or even heat pipes. Effectively, the cooling solution created a localised air-conditioned environment within the chassis – an attractive option when it isn't practicable to place your unit in an air - conditioned cabinet or server room.

The custom Ultima unit uses a dual Peltier cooling system which manages the processor and hard disk temperatures. The success of this method can be attributed to a unique control board designed by Blue Chip to create a closed loop monitoring system capable of fine tuning the chassis thermals, preventing condensation and remaining operational up to 95% relative humidity. The control board also interfaces with Westinghouse's system software, providing an additional watchdog function.

Conclusion

The Public Private Partnership is committed to making Underground travel faster, safer and more comfortable. These principles are encompassed in a set of Journey Time Capability (JTC) metrics, which define the success or failure of the installation. Each contract is measurable against the JTC criteria and underpinned by severe financial penalties if improvements in performance levels aren't achieved. The track performance has much to do with the industrial computer installation.

Bringing computers into the heart of the network allows more trains on the tracks, within the given safety parameters. A failure in these computers directly impacts the train timetable, the operator bottom line and most importantly – the commuter waiting on the platform. Consider how many times an office desktop crashes in week – in the absence of an industrial grade computer, it could be a long wait.

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