



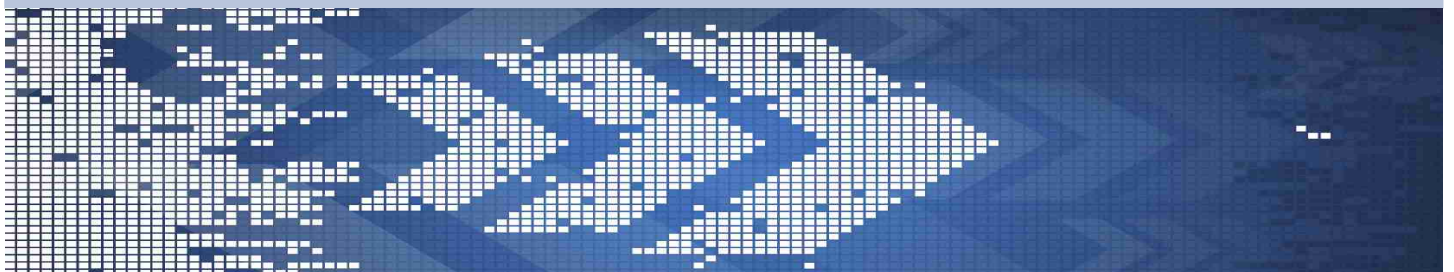
# Bluewater Systems



## The TRUMPETER Project Connexionz Case Study

Bluewater Systems' Snapper CL15 System Module forms the basis of the Connexionz i-hub on-bus computer system. Through the integration of the CL15 into Connexionz Real Time Information system, Connexionz created a mobile media and display unit for the Reading Borough Council Bus System in the United Kingdom.

With products like the RTI system, Connexionz continues to operate successfully in mass transit solutions while providing reliable information to bus passengers and service operators.



## Connexionz and Transit Solutions

In 1996, Robert Burke, founder and sales director, recognised an opportunity in the mass transportation sector and established Connexionz in Christchurch, New Zealand. Since then, the company has risen to become a global competitor in the scheme of transit solutions. This fast-growing and ever-evolving company has implemented systems in 6 countries. Providing reliable at-stop information to bus passengers via Electronic Signage, WEB and cellphones and providing reliable controls and reports to bus operators and regulators.

### Real Time Passenger Information System

In February 2007, Connexionz contracted the services of Bluewater Systems to quickly create an upgraded in-vehicle hardware platform for its existing customer, the Reading Borough Council Bus System in the UK. The Reading Borough Council purchased the Connexionz system back in 2001 and the hardware platform was coming to the end of its life and a new platform was required to meet new functionality and improve the reliability of on-bus hardware.

Connexionz's required features and specifications provided a unique project for Bluewater Systems from both a design and innovation perspective. The platform was to use an embedded ARM CPU and offer peripheral options such as RS232, RS485, USB, Ethernet, WiFi, 3G, GPRS and VGA output. It had to meet a range of environmental standards, having the capability to withstand varied temperatures, vibrations and impacts given that the units were to be installed on-board buses.

The i-hub needed to provide a number of on-bus functionalities which included an interface to an Electronic Ticket Machine and Next Stop Annunciator Display, which also displayed advertising. But the primary function of the i-hub was to reliably report the buses location to the central server system for arrival information which is displayed at bust stops. Electronic Displays are installed at over 200 of the Reading Bus Stops and this information is the public window to the bus system. Communication between bus, signs and the central system is over the Orange GSM network.

### Key Decision Factors

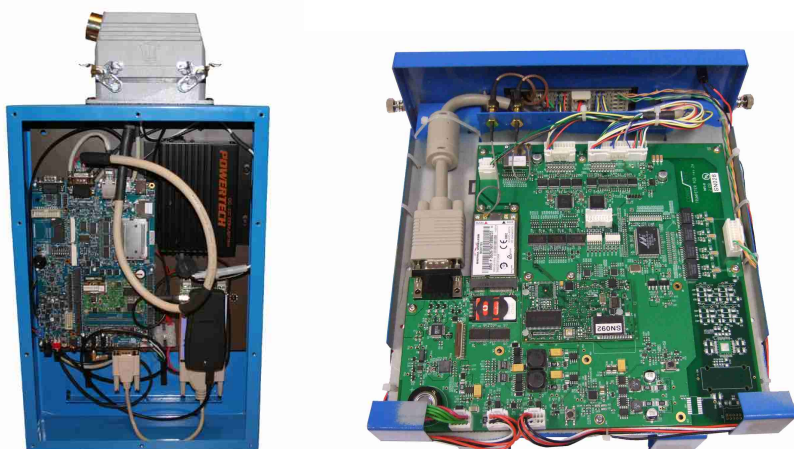
Several factors influenced Connexionz's decision to select Bluewater Systems to develop the hardware necessary for the Reading Borough Council RTI. The factors include:

- Connexionz was looking for an embedded solution that did not require fans or aggressive cooling and would provide a service life of 8 to 10 years and the Snapper CL15 provided this.
- Robert Burke was aware of Bluewater's presence in the industry for electronic design and consulting services.
- Bluewater is located in Christchurch, which offered the convenience of working locally.
- Connexionz's awareness that Bluewater's Snapper System Module was an established platform and therefore would enable faster development time.

### Innovation Meets Design

In the parameters set forth by the venture, Connexionz required a solution to fit within the needs governed by the Reading Borough Council. The necessity for rapid hardware development and prototyping for software applications was paramount, all the while keeping costs to a minimum and increasing reliability and ease of maintenance. Driven by Bluewater Systems' Snapper CL15 System Module, the Trumpeter carrier board was prototyped, designed, built and integrated into Connexionz's product. With initial time constraints at an extreme, the first 10 units used Bluewater's *off-the-shelf* Rig 200 Application and Development Platform.

The Snapper CL15, with its proven core design, was easily embedded into the Trumpeter platform, providing various product integration possibilities while reducing overall risk, time and cost. The use of the existing core design of the Snapper CL15 aided in the quick and efficient development of the hardware platform and software



The initial Trumpeter prototype (left) for the RTI system was developed using a Rig 200 Application Platform in order to allow for testing and software application development to occur in parallel. The customised carrier board (center) was then developed with an integrated Snapper CL15 System Module, providing the necessary hardware functions to support the system and enabling a compact, smaller enclosure for the unit (right).

application drivers. Trumpeter was developed as a customised carrier board with all relevant communications, processing and storage capabilities needed to support the software applications. The board features peripheral options including a built-in GPS receiver, 3G modem, WiFi connectivity and a VGA interface. Powered by the Snapper CL15, Trumpeter uses these peripherals to deliver all of the functions required by Connexionz for the RTI.

From a hardware perspective, Trumpeter needed to possess a robust power supply that could protect against abnormally large voltage spikes on the input and still provide a clean, regulated 12V output. Trumpeter also needed flexibility within its configuration. The board had to be designed to support a wide range of usage cases, such as serial ports that could be configured for RS232/RS485 mode, and 802.11b/g wireless Ethernet port and a USB host. Utilising Power over Ethernet (POE) supply to simplify wiring in the bus, Trumpeter was able to have the Ethernet cable power the far end device so that separate power cabling was not required. Trumpeter is unique in that it possesses an automatic power on function for predetermined times. This allows the unit to turn on at a planned, yet arbitrary time, connect via the wireless network, and then download new advertising information. This removed a potential bottleneck of multiple buses all wanting to update their content at once. It also allows the batteries to be smaller since the battery run-time was reduced.



The Real Time Information system, enclosed in a small, blue metal box, relays information to the Reading Borough Council Bus System, providing both passengers and service operators with an effective display system of wait times, next stop announcements and advertising that enables the efficient operation of their public transportation fleet.

From a software point of view, an essential function Connexionz required for Trumpeter was mid-range graphical capability. One of the many features of the Snapper CL15 is a flexible graphics output, thereby providing Connexionz with the ability to run graphical applications at resolutions up to 1024 x 768. In order to maximise the functionality of the graphics, Bluewater ported Connexionz's existing graphical software to use their own optimised embedded GUI technology, which in turn uses a lightweight, simple graphical library suitable for ARM embedded platforms. This aided in the prevention of bottlenecks that tend to occur for graphical systems. In terms of sound playback, Connexionz wanted to use the MP3 format. In order to prevent the gaps and stuttering that would occur in the decoding process based on aspects of the Snapper CL15, Bluewater utilised an integer decoding library, instead of the MP3 floating point math, to provide good playback speed. Overall, very little work was needed to get the core Snapper CL15 components working on the Trumpeter. The principal benefit of using the Snapper CL15 for Trumpeter from a software perspective was that most of the hardware support, such as Ethernet, USB, GPIO, etc. was already written, reducing the required development time.

## Trumpeter Features and Specifications

- Snapper CL15 System Module
- Linux Operating System
- Power input 12-36V, isolated above 48V
- Dual 2Ah 7.2V Lilon batteries, built-in charger and system load balancing
- IP55 rated metal box
- 8 UARTs - 4x 232 and 4x 232/485
- WiFi 802.11g module
- 3G cellular module
- VGA output
- Mono audio output
- Ethernet 10/100MBit with 4 port hub
- Ignition sense line from the engine
- 4x digital opto-isolated inputs
- 4x digital outputs
- USB full speed host
- Accelerometer

## Product Achievements

One of the difficulties in the development process of electronic products is that hardware upgrades occur readily in the market. For Connexionz, this made buying hardware for the RTI system troublesome because it invariably became obsolete during the development stage. Ultimately, they were in need of a solution that had a level of permanence. By working together with Bluewater Systems, Connexionz now have a stable platform with some longevity of manufacturing life. According to Robert Burke, "Bluewater's Trumpeter provided us with a low-power, renewable resource that we can continue to manufacture into the future. Bluewater's product provided Connexionz with a reliable, robust platform with additional connectivity for additional on-bus products like CCTV, Passenger Counters and more."

## About Bluewater Systems Ltd. [www.bluewatersys.com](http://www.bluewatersys.com)

Bluewater Systems, a fast-growing company formed in 1996, is an ARM Technology Solution Centre, specialising in embedded electronic and FPGA design. With offices in Christchurch, New Zealand and the United Kingdom, Bluewater Systems services a number of local and international customers, including ARM, NEC and the Defence, Science and Technology Organisation of the Australian Department of Defence.

The company's vision is to empower all companies to realise the benefits of ARM technology through engineering and design services, development tools, support and ARM-based system modules. Products and services offered by Bluewater Systems include:

- Extensive range of ARM, Keil and RealView development tools
- Snapper Single Board Computer Modules, which enable fast and cost-effective design turnaround
- Consulting services, from FPGA design to full product development

## About Connexionz [www.connexionz.co.nz](http://www.connexionz.co.nz)

Established in 1998, Connexionz offerers comprehensive, end-to-end, transit solutions that simplify management, maximise productivity and improve services. With dependable software and hardware products of innovative design, Connexionz can help customers to reduce costs, increase security and grow patronage. Connexionz's systems benefit everyone in the mass transport chain, from the transit authority right through to the passenger at the bus stop. With the information a Connexionz system provides, each one can enjoy greater certainty that their bus service is operating effectively. Connexionz has implemented their systems in:

- USA
- United Kingdom
- Australia
- Netherlands
- Brazil
- New Zealand

Bluewater Systems Ltd  
Unit 5, Amuri Park  
404 Barbadoes St.  
PO Box 13 889  
Christchurch 8013  
New Zealand

Ph. +64 3 377 9127  
Aust. Ph. 1 800 148 751  
USA Ph. 1 800 261 2934  
Fax. +64 3 377 9135

[sales@bluewatersys.com](mailto:sales@bluewatersys.com)



**Bluewater  
Systems**

*ARM Technology Solution Centre*

[www.bluewatersys.com](http://www.bluewatersys.com)

Bluewater Systems Europe  
2 Century Place  
Lamberts Road  
Tunbridge Wells  
Kent TN2 3EH  
United Kingdom

Ph. +44(0)1892 774 850  
Fax. +44(0)1892 774 801  
[europe@bluewatersys.com](mailto:europe@bluewatersys.com)

Authorised Agent: