Richard Thatcher B.Eng (1st Class Hons)

Founder and Consultant, Hellequins Systems Ltd

*A highly experienced and flexible **freelance embedded software and firmware engineer**, who has a proven track record of successfully delivering demanding embedded engineering projects in consumer, commercial and military environments*

Summary:

- Provides bespoke software and firmware design, development and integration for applications, middleware and low level drivers for any custom or off-the-shelf embedded microcontroller or DSP based hardware in any industry sector
- Undertakes project implementations utilising bare-metal, multi-threaded RTOS and Linux using procedural or object oriented design methods in Assembler, C, C++(11-17) and Java alongside build, debugging and test in custom environments
- Works with low power and resource restricted architectures utilising sensors, short and long range wireless, network protocols, cloud access, IoT connectivity, board level communications and GUI implementation. Excellent electronics knowledge
- Takes ownership from conception to completed product for “greenfield” or established project assignments from startups and mature companies alike at any point in the development lifecycle

Recent achievements:

- Complete implementation (C++/C/ARM/FreeRTOS) of home hub software for healthcare startup Alcuris. Connects to AWS IoT via wifi or cellular, sensors via Zigbee and uses Bluetooth for configuration. Achieved successful delivery for customer trials and minimum viable product (MVP) to allow market rollout.
- Designed and implemented all software (C/ARM/bare-metal) for a combined multi-language display sensor product to improve on and replace 11 existing products. Achieved exceptional low power operation to support a 5 year battery life and substantial manufacturing cost savings for Tunstall Healthcare
- Created many firmware features (C/PPC/ThreadX) for Cobham’s TacG2 Digital (military) Vehicle Intercom. Including mDNS/IP connectivity, VoIP calling and a ruggedised user interface. Also proposed and developed remote control procedures via network services which went on to become a major selling point with clients
- Complete clean sheet driver board firmware implementation (C/8051/bare-metal) for a high power LED 3D projection system to allow the company to enter new simulation markets. The design centred on a PID control algorithm

“A great developer and someone I would have no hesitation to work with again”
Richard Osborne, Tunstall Group Embedded Software Manager

“Good Value, High Integrity, Creative ... Highly recommended”
Vincent Mifsud, VP Technology/CTO Cobham Avionics and Surveillance

“He is innovative and very thorough in determining the best value option”
Peter Bradley, Staff Officer Operations - Communications and Information at RNLI

Skills Summary

Skill	Detail	Competence	Years
Software Development Languages	Assembler, C, C++(11-17), Java, Python, C#, LUA, scripting. Object oriented and procedural methodologies	Expert	15+
Coding Standards	MISRA and proprietary in-house	Advanced	15+
Multi-threaded and Real-time OS	FreeRTOS, ThreadX, VxWorks, OS-9, OSE, several in-house proprietary	Expert	15+
Embedded Linux	U-Boot, Busybox, OpenEmbedded. Raspberry Pi, Beaglebone, custom platforms	Intermediate	3
Software support for FPGA platforms	Xilinx Vivado/MicroBlaze, Xilinx Virtex 4 with PPC405 soft core, Altera Cyclone and NIOSII	Advanced	5+
Microprocessors	ARM Cortex M0+, F3, F4, F7 from STM32, Freescale/NXP Kinetis, Silicon Labs, various MicroChip PIC, Xilinx MicroBlaze, MIPS, PowerPC, NIOSII, TI MSP430 and others	Expert	Various
DSP	Analog Devices ADSP21x, TI TMS320C54,55	Intermediate	5+
Wireless	WiFi, Zigbee, DECT, GPRS/3G/4G, Bluetooth, BLE, RFID, SubGHz	Expert	15+
Networking protocols	MQTT, TCP, UDP, IP, PPP, Ethernet, VoIP, DHCP etc	Advanced	15+
Web services	AWS Cloud, MQTT, HTTP, XML and JSON	Advanced	3
Board level communications	UARTS synchronous and asynchronous, RS232/422/485, SPI, I2C, I2S, USB	Expert	15+
Build, development tools and static analysis	Make, GCC, G++, GDB, Visual Studio, Eclipse, Altera SDK, Xilinx SDK, Source Insight, Code Composer, Silicon Labs Simplicity Studio, Freescale NXP Kinetis, uVision, NetBeans	Advanced	15+
Project tools	Git, Mercurial, BitBucket, SourceTree, JIRA, Code Collaborator, OnTime task and defect tracking, Subversion SVN, Tortoise SVN/Git client, CVS, SourceSafe, MKS	Advanced	15+

Freelance Embedded Software Assignments

Alcuris (contract, remote), 2017 – 2019, 22 months

Development of all embedded software aspects of their connected healthcare solution for independent living for this startup.

Based upon an STM32 ARM F4 Cortex running FreeRTOS, created an object oriented multi-threaded design implementation in C++ with interface to AWS SDK C libraries, functionality for AWS cloud connectivity using TLS and MQTT over WIFI and GPRS/3G/4G cellular data, a mobile app connection over BLE, multiple Zigbee sensor types, RFID card tap and touchscreen LCD GUI. Used SPI, I2C and UARTS for peripheral communication

Created a custom Eclipse / ARM G++, GDB based toolchain for build and debug. Implemented hardware validation, bringup and debugging of board iterations using scopes and analysers. JIRA, Sourcetree and Bitbucket GIT used for software management.

Cobham (contract, on-site), 2017, 6 months

Implementation of Zero Configuration networking, multicast DNS (mDNS) and Link Local IP addressing for the company's IP based military intercom system. Reworked significant parts of the existing networking software to facilitate integration of the open source (Apple) multicast DNS stack before moving onto writing the interface framework and drivers.

Identification and porting of package gSOAP to construct an embedded SOAP server to provide a web service to reflect defined WSDL and XSD files to support SOAP 1.1 and 1.2 messaging with WS-SecurityPolicy and TLS.

Both projects implemented in C and LUA, on a Xilinx FPGA embedded PowerPC and Altera FPGA embedded NIOS II both in a ThreadX RTOS environment using Eclipse and GCC / GDB based custom toolchain. Python used for test script creation, JIRA task and issue tracking, BitBucket GIT and TortoiseGIT used for software management.

Waters Corporation (contract, on-site), 2016 – 2017, 6 months

Produce new low level interface drivers and an application interface for the company’s new range of mass spectrometry equipment.

Implementation in C and C++ on an embedded Xilinx FPGA MicroBlaze microcontroller using Xilinx Vivado SDK. Used SPI and I2C for peripheral communication including on-board flash and a very high speed Analogue to Digital convertor.

Configuration tools produced using C# in Visual Studio. Mercurial Git used for revision control.

Tunstall Healthcare, System Group (contract, remote/on-site), 2016, 8 months

The company operated medical software design safety process to IEC 62304.

Voice control using WIT.ai speech engine to demonstrate radio broadcast selection and switching applications such as light control via voice control. Subsequently moved the project over to Amazon Alexa for an assistant based approach.

Peer to peer networked product implementation using Alljoyn. Replaced a previous master / slave unit architecture with an architecture that individual product elements can be added and removed at any time. Each product element is aware of every other element in the system and maintains real-time status of those elements.

Both projects used Linux (Debian) on BeagleBone Black and Raspberry Pi before moving to the company's ARM based custom Linux platform. Implementation using embedded C, C++ and Java (Netbeans 8 and Oracle JDK 8). Python, Bash and Javascript on Node.js for test. ARM A7 running Debian LInux and later a custom Linux build. Agile under Visual Studio Team Services, command line Git for revision control.

Tunstall Healthcare, Product Group (multiple contract, remote/onsite), 2014 – 2016, 24 months

Complete firmware design and development of a new wireless low power Universal Sensor product which incorporates 11 previously separate products in one. The product supports European and Nordic languages and has a battery lifetime of 5 years. The company operated medical software design safety process to IEC 62304

Developed in bare-metal C using Kinetis Studio on a Freescale ARM Cortex M0+. The product consisted of a Sitronix dot matrix LCD display for which the low level driver, graphics library, font library and multilingual menu system were developed. Drivers and application code were developed for a Texas Instruments TMP102 digital temperature sensor, an on-board analogue to digital converter, I2C and SPI for peripheral control, serial RS232 UARTS for external communication and digital I/O.

A further project was undertaken for evaluation/feasibility stage development for the company’s next generation low power receiver/trigger product. The receiver was based on an EFM32 ARM Cortex M0+ to which I ported FreeRTOS running under Silicon Labs Simplicity Studio IDE. The evaluation used Silicon Labs radio devices (Si4460, Si1082) and involved Python scripting to convert radio parameter text formats. The project had an aim of a 7 year battery life. The full development is now subject to revalidation of market requirements assessment.

Digital Projection (contract, on site), 2013 – 2014, 6 months

Complete clean sheet design and the subsequent development of the embedded software for a very high power LED output driver board which operates as part of a new breed of digital projection systems aimed at the professional simulation market.

Implemented bare-metal C using a Keil C51 compiler in an ARM uVision 4 IDE for the design on a fresh custom ATMEL AT89C51 based hardware platform with an untested Lattice LCMXO640C FPGA implementation, 3 * I2C analogue to digital converters, I2C serial UART, I2C non-volatile memory and an SPI Maxim digital potentiometer. Hardware debug performed as required. Wrote an extensive design description, software functional interface and software for the board from scratch.

Notable software elements included: PID controller, NVRAM wear levelling, provision of self test and system diagnostics and highly configurable.

Cobham (contract, on site), 2011 – 2013, 32 months

Working in a multithreaded RTOS embedded C environment, predominantly on the development of new application features, protocol middleware and device drivers for a wireless communication product for military vehicles. The product has a scalable FPGA based distributed architecture, voice and data capability and support for VoIP/SIP over IPv4 and IPv6 networks on custom hardware.

I worked on several significant pieces of work including:

- Definition, design and development of several hardware interface device drivers including, proprietary FPGA provided functionality, Ethernet, proprietary highway synchronous serial interface, external RS232 serial interface, SPI connected LCD display, I2C connected EEPROM and digital I/O for rotary control inputs and general purpose logic outputs
- Requirements capture, design, development and test of an embedded HTTP based network remote control protocol using RESTful techniques. Coded in LUA and C
- Design of an alternate interface to the above HTTP interface using SOAP
- Integration, configuration and test of an embedded web-server
- Systems requirements capture, design , development and integration of a PPP stack for operation over multiple serial ports
- Re-working of the product self test functionality
- Big-endian (PowerPC) and Little-endian (NIOS II) issue resolution
- DSP work centred on the host processor / DSP serial interface
- System and product level defect resolution
- Design and development of several C# based applications and tools

The embedded software was developed using multi-threaded techniques and utilised:

- C programming (majority), LUA scripting and C# to MISRA coding standard
- Eclipse based SDK and GCC tools, Code Composer for TMS320C55 DSP
- Altera Cyclone 4 FPGA with NIOS II soft core
- Xilinx Virtex 4 FPGA with PowerPC 405 softcore
- Texas Instruments MSP430 for MMI interface
- ThreadX Real Time Operating System
- Serial standards RS232, I2C to EEPROM and SPI to LCD
- Ethernet, PPP, IP, TCP, UDP, HTTP, DHCP, NAT and HTML
- JSON and XML data processing and interchange
- Subversion SVN with Tortoise client
- On-Time and JIRA task and defect tracking tools
- Code Collaborator for peer reviews

Arqiva/RNLI (multiple contracts, remote)

MOB Guardian project: This project created a vessel tracking, monitoring and Man-Over-Board alerting system. Providing consultation on preparation of formal requirements, design architecture and development of all embedded software and communication protocols.

- UML design and embedded software development in C and Assembler
- Microchip PIC 16F and 8051 microcontrollers using IAR IDE
- SPI connection for Flash memory and LCD, I2C for EEPROM parameter storage
- Utilised an Iridium Satellite Modem and GPS with NMEA 0183 command set
- GPRS, Bluetooth and Intelligent battery charging with temperature sensing

RNLI All Weather Lifeboat tracking and reporting project: This project was undertaken as a feasibility project to trial Lifeboat tracking, monitoring and provision of Man-Over-Board detection capability and in addition collect data from the ship's crew and internal systems.

- Driver, middleware and application embedded software development
- Embedded Linux using C/C++ on an ARM 9 based PC104 SBC board
- U-Boot, Busybox and Open Embedded utilities
- Bluetooth and Iridium satellite operation

Blick Communications (multiple contracts, remote)

Complete DECT wireless based communication system for use in safety critical scenarios

Thales (contract, remote)

Port selected DSP algorithms from the company's TETRA handset.

- Texas Instrument TMS320C54 to TMS320C55 target
- Code Composer IDE for each environment

IPWireless (multiple contracts, remote)

3G protocol stack development. Development of multiple projects using C and Telelogic/Object Geode SDL tools in an ARM9 /RISC environment for their TD-CDMA 3G based mobile broadband product. My projects included the complete development and integration of:

- RADIUS accounting and authentication subsystems
- 3G RANAP protocol stack
- PPP stack for Mobile User Equipment

Using:

- OSE and ThreadX
- ARM 9
- Telelogic IDE
- C

Simoco (multiple contracts, on site)

Simoco is a supplier of system infrastructure and handsets for TETRA, the digital replacement for public mobile radio. I developed a transcoder subsystem to handle conversion and routing of U-plane CELP encoded audio and C-plane data.

The conversion interfaced a proprietary protocol layer model carrying C-plane data and a G703 U-plane audio stream to TCP/IP protocol. Various management and alarm functions were also implemented to control routing of data and status reporting.

The unit was responsible for interfacing a central switching unit and several base-stations using TCP/IP across X21 links. I also implemented an SNMP agent for remote control and diagnostic, a FLASH memory filing system for storage of various parameters and initialisation data and the ability to download new application software from a remote location.

- MIPS target
- ADSP 2101 DSP
- VxWorks RTOS
- Tornado toolset
- Development in C and ADSP 2101 assembler

- Bespoke audio drivers, DMA driver
- In house coding standards
- DOORs requirement capture

In addition to the above I also developed a PCI bus based Tetra Base station test system.

Symbionics (multiple contracts, on site)

Symbionics, Cambridge

Developed specific parts of their DECT protocol stack:

- Hardware integration and bespoke device driver development for the DECT Burst Mode Controller chip and RF parts
- Development at Medium Access Layer, Link Layer, Network and Application levels
- Yourdon and Telelogic TAU SDL design
- Software implementation in C and various Assemblers
- MISRA based coding standard

A selection of additional projects completed included:

- Custom modification and interfacing directly to the stack to complete a point to point radio communication system using DECT for Alcatel
- Custom modification and interfacing directly to the stack for a residential DECT (GAP compliant) system for Samsung, including base station and handset
- Custom modification and interfacing directly to the stack for a business system including base-station and handset for Samsung
- Integration and adaptation of the DECT stack into a PBX for Alcatel
- Feasibility study for development of a new DECT stack for data transfer in a WAN like environment

The Symbionics stack was licensed to many end clients resulting in a significant amount of porting work.

Mobicom (Now Simoco Derby, employed)

Key developer of the company's digital PCM switching systems for the Public Mobile Radio Industry, supplied to public and private sector clients including British Rail, the Emergency Services and various utility companies.

My responsibilities included the development of hardware and embedded real time software for Mobicom systems and products using Analog Devices ADSP 2101 (signalling), Hitachi H8 and Motorola 68000, 68302, 6809 and 6303. I also interfaced to various codecs for audio conversion and routing.

I gained extensive experience of DSP hardware and software algorithm development and became conversant with various DSP techniques including digital filtering, frequency domain analysis, time domain analysis and multiple frequency generation.

Designs were to industry standards including BABT (For private wire and PSTN connection), Smiths Associates Mobile Radio C3 Specification, MPT1317 (FFSK) and MPT1327 (Trunking using FFSK), BR1602 and BR1655 for British Rail communication systems.

Other responsibilities include project planning, the production of detailed requirement and test specifications, user documentation, quotations and feasibility studies.

Professional Development & Education

Feabhas	Developing for Embedded Linux	
Nottingham Trent University	B.Eng (Hons) Electrical & Electronic Engineering Awarded Boots PLC Prize	**First Class with Honours**
Cambridge College of Technology	Higher National Certificate Electronics	Distinction

Location

I am based in New Longton near Preston, Lancashire in the North West of England, and I typically work a mixture of on-site and remote from my fully equipped home office lab

Recommendations

"I have worked with Richard for a few years and have found him to be a very dedicated engineer that gets the job done in a professional and technical manor. He is always willing to take on new challenges and learn new skills and often exceeds expectations for quality and delivery of work. A great developer and someone I would have no hesitation to work with again."

Richard Osborne, Tunstall Group Embedded Software Manager

"*Good Value, High Integrity, Creative. Richard has performed a number of tasks within this project in Cobham. He took responsibility for a particular element of the system from concept to implementation, generating clear and appropriate options, advising on the way forward, and then implementing and documenting the selected solution. He continues to deliver on time and to budget, demonstrating commitment and a clear understanding of the relevant technologies. He has fitted in well with the team, able to contribute to group discussions as well as taking ownership for his sub-system. Highly recommended.*"

Vincent Mifsud, *VP Technology/CTO Cobham Avionics and Surveillance*

"Richard has proved to be a valuable addition to the team. He has a very wide and extensive range of skills allowing him to contribute widely to the team's activities. His skills range from excellent embedded knowledge through to windows application development. He has brought to the team extra skills that were not previously present allowing us to improve the product with this knowledge. I would recommend Richard for any development effort through all stages of the life cycle."

Mark Bacon*, Software Team leader, Cobham Defence Communication*

"Richard provided detailed technical and business solutions meeting the operational requirement. He is innovative and very thorough in determining the best value option."

Peter Bradley, Staff Officer Operations - Communications and Information at RNLI

"Richard was the Director of Raycomm Electronics and we contracted his company to help us (NTL at the time) to develop a man overboard system. It was a great success and a pilot product was produced for test by the RNLI. Following the pilot, NTL's work was complete but I understand that Richard continued with the product working directly with the RNLI to productise the MOB device."

Mike Crane, Project/Programme Manager, Arqiva