Resume - Scott Penrose

Electronics and firmware engineer: remote monitoring, Iridium satellite, LoRa and low power design

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Available now for contract and consulting work, working remotely from Melbourne.

Professional Summary

Electronics and firmware engineer and independent consultant with over 30 years of experience. I design devices for remote and off-grid monitoring and get their data home over Iridium satellite and LoRa: wave buoys on Antarctic sea ice, farm and fleet sensors, gateways and touch panels. I build the whole chain, from circuit board and firmware to server and dashboard. I am also a full stack software developer: I spent a decade as lead architect of education platforms serving tens of thousands of concurrent users, with a team of 20, and more recently modernised a Fortran ERP system from the back end to its web interfaces and API.

Work Experience

Principal Consultant, Digital Dimensions

2000 to present, Melbourne, Victoria, Australia

Independent consulting practice in electronics, firmware and the software around them. Recent and selected work:

- **2026**: WII6, the next generation of the Waves In Ice buoy, in development. Zephyr RTOS on an STM32U5, a custom four-layer board, and Iridium Certus messaging through the RockBLOCK 9704
- **2026**: Wave buoys built for KOPRI (Korea Polar Research Institute) and deployed in Antarctica
- **2026**: OGLAS second-generation firmware moved to Zephyr across nRF52840, ESP32 and STM32, with the first customer site live
- **2026**: LoRaScope, a LoRa / MeshCore / LoRaWAN analyser, designed and built as a product
- **2026**: Open source releases of the WII5 buoy (hardware, firmware and maths) and of a Zephyr module for the RockBLOCK 9704 modem
- **2012 to present**: Firmware for the Waves In Ice buoys, with about 70 Iridium modems deployed on Antarctic sea ice and data published in *Nature*
- Profitool: full stack work on a Fortran ERP system, from the back end to web interfaces and a REST API, including migration from 32-bit to 64-bit, SQL support, containers and a unit test suite
- Educational platforms, a multi-site authentication system and the HealthMap health monitoring platform, with APIs, dashboards, CI/CD and test automation for client teams

Key clients and sectors: Research institutions, educational providers, industrial automation, agricultural technology, marine science.

Senior Software Developer, NSIP (National Schools Interoperability Program) / Education Services Australia

Melbourne, Australia

Senior software developer for the national program responsible for schools data interoperability across Australian education departments.

- Built example and trial systems for national education data standards
- Imported and managed NAPLAN and SIF (Schools Interoperability Framework) data
- Authored technical requirements documents for state and territory education departments
- Delivered training to department staff and stakeholders

Lead Architect, Head of Software Development / Head of R&D, Schoolsnet / Myinternet / Editure

1997 to 2008, Melbourne, Australia

Led software development and research for educational technology companies delivering learning platforms across Australia.

- Lead architect and software developer for a decade, leading a team of 20
- Head of Software Development, progressing to Head of Research and Development
- Built education software platforms deployed across most of Australia
- Scalable content delivery, assessment, and student engagement systems

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Systems Administrator & Software Developer, Melbourne University

1991 to 1997, Melbourne, Australia

Software development and systems administration roles.

- Developed one of the first web mail systems
- Deployed and managed the first Linux mail servers at the university
- Domain management and network administration
- Automated lab computer builds and student login systems

Software Developer, BHP

1991, Melbourne, Australia

Early career role developing communications software.

- Developed Snapchat, a communication tool in Visual Basic that shared images and mouse movement between PCs. The name predates the later product of the same name.

Embedded Software Developer, Exicom Power

1990 to 1991, Melbourne, Australia

C development for embedded battery power charging systems.

- Firmware development in C targeting Motorola 6800 CPUs
- Battery power charger systems for Telstra

Software Developer, PAS Consultants

1989, Melbourne, Australia

- Developed a non-blocking keyboard and printer driver in assembler for DOS PCs.

Key Projects

Waves In Ice (WII): Antarctic Wave Measurement Buoys

Published in Nature

Designed and developed firmware for wave measurement buoys deployed in Antarctic sea ice, reporting over Iridium satellite and running for months on battery in low temperatures.

- Custom embedded firmware on low-power microcontrollers
- LoRa and Iridium satellite communications for remote data retrieval
- Real-time wave detection and data logging algorithms
- Deployed since 2012 with NIWA, Japan, Unimelb and NYU, and with KOPRI (Korea Polar Research Institute) in 2026
- Custom dashboards for real-time monitoring of deployed buoys
- Results published in *Nature*, contributing to sea ice research
- WII5, the open source generation: wii5.sh3d.com.au
- WII6, the next generation, in development: wii6.au
  - Zephyr RTOS on an STM32U5, replacing the earlier microcontroller and Raspberry Pi pair
  - Wave processing runs on the buoy's own microcontroller
  - Iridium Certus messaging through the RockBLOCK 9704
  - Stop-mode sleep with a watchdog, and firmware updates through MCUboot
  - Custom four-layer board, schematic and layout

LoRaScope: LoRa / MeshCore / LoRaWAN Analyser

Product: lora.dd.com.au

Designed and built a single-radio spectrum and traffic analyser for the LoRa family of protocols: live capture, packet decode and link health in one tool.

- Decodes LoRaWAN, LoRaBASIC, and MeshCore through one interface, at the radio layer
- Capture store with filter, search, export, and replay; CSV logging to SD
- Hub/node emulation and packet injection for testing nodes in isolation
- Agent-readable and agent-controllable over telnet and REST for closed-loop, AI-driven testing and fault diagnosis

OGLAS: Off-Grid Local Alert System

Product: oglas.au

A custom monitoring product line for off-grid and poorly connected sites: farms, fleets, factories and remote power installations.

- Sensors → Hubs → Local → Cloud pipeline, with custom builds of any link in the chain
- Second-generation firmware built on Zephyr RTOS across nRF52840, ESP32 and STM32, with BLE commissioning, OTA updates, crash reporting and multi-year battery life
- Touch panel hubs on 7" and 10.1" displays that update themselves over the air, with rollback
- Cloud and local hub back-ends in Rust, with MQTT ingest, dashboards, alerts and automation flows
- Solar and battery data from an auto-detecting RS485 Modbus node and from vendor imports (Victron VRM, select.live, Fox ESS, Deye, Sigenergy)
- Browser-based firmware flasher and catalogue covering the whole fleet
- First customer site live in 2026
- Long-range wireless (LoRa, mesh, satellite) instead of telco dependency
- Local-first, open-format data storage with an optional private cloud copy
- No subscriptions or vendor lock-in; the client owns their data and hardware

LoRa Gateway: Multi-Transport Bridge

Product: lora.dd.com.au/gateway

A rules-based gateway that bridges a local LoRa network to the wider world, forwarding selected data over the transport that suits it.

- Backhaul over LoRaWAN, Iridium/LEO satellite, LTE mobile data, or SMS
- Rules engine for thresholds, schedules, and aggregates to control airtime cost
- MeshCore relaying and a secure remote-access tunnel for off-site management

Profitool: Fortran ERP Modernisation

Migrated a legacy Fortran ERP system from 32-bit to 64-bit, adding modern language features and a testing framework.

- 32-bit to 64-bit architecture migration
- Added SQL database support, regular expressions, and hash maps
- Implemented container support
- Designed and built a full suite of unit testing
- Modern REST API to existing ERP
- Automated build and deployment processes

HealthMap: HIV Health Monitoring Platform

Built a platform to manage and monitor the health of individuals with HIV by connecting them with coaches and health professionals and tracking changes over time.

- Linked patients with coaches and health professionals for ongoing support
- Longitudinal health monitoring and trend tracking
- Secure handling of sensitive health data

Custom Authentication Platform

Built a multi-site authentication system with user management dashboards, custom database views, and flexible authentication methods.

- Unified identity management across multiple web properties
- Custom admin dashboards for user management and database inspection
- Secure authentication flows with role-based access control
- Magic-link sign-in and multi-factor authentication, with step-up challenges and per-site enforcement

Embedded Dashboard Framework

Created a single-file embedded dashboard system: a self-contained HTML file with all SVG, CSS and JavaScript bundled, for small embedded devices.

- No external dependencies; a single self-contained HTML file
- Auto-discovery of device settings and status
- Light controller interfaces, WiFi configuration, system status, and charting
- File management and JSON API integration
- Designed to run on ESP32 and similar constrained platforms

Custom Display & Monitoring Systems

Developed custom display and HMI products for solar monitoring, property and industrial data, and long-running embedded displays.

- Touch HMI panels on 10.1" (ESP32-P4) and 7" (ESP32-S3) displays, built with LVGL and EEZ Studio on ESP-IDF
- Multi-page interfaces for power, weather, cameras, alerts and settings, with alert sounds and light and dark themes
- Panels that double as the site's LoRa hub and register to the cloud with a six-digit code
- Over-the-air self-update with update slots, automatic rollback of a bad image, and a beta channel
- Smaller formats: a 1.8" round rotary knob display, reflective LCD, and a battery colour e-paper dashboard that runs for months per charge
- OLED, eInk, and LCD display integration
- Touch input and scroll navigation on embedded displays
- Real-time firmware upload and management dashboards
- Ultra-low-power display designs with automatic logging

Educational Software Platforms

~20 years of experience

Architected and built learning management systems, assessment platforms, and analytics tools for educational institutions.

- Scalable platforms supporting large numbers of concurrent users
- Assessment and analytics engines for student engagement tracking
- Content delivery systems with institutional integration
- Custom API layers with full documentation and load management

Technical Skills

Area	Technologies
Languages	C, C++, Rust, Go, JavaScript, TypeScript, Python, Perl, Fortran, Shell scripting
Embedded Platforms	STM32, nRF52840, ESP32, AVR, RP2040, Raspberry Pi and Embedded Linux
RTOS & Firmware	Zephyr (BLE, WiFi, LoRa, devicetree bindings, out-of-tree modules, Twister tests in CI), ESP-IDF, FreeRTOS, NuttX, bare metal; MCUboot and ESP-IDF OTA with rollback; ultra-low-power deep-sleep design

Area	Technologies
Radio & Networking	Iridium satellite (SBD and Certus), LoRa, LoRaWAN + ChirpStack, MeshCore, LPWAN (Cat-M1, NB-IoT), HaLow, BLE, ESP-NOW
Protocols & Interfaces	I2C, SPI, UART, CAN (OBD-II, ISO-TP), RS485 Modbus RTU and TCP, NMEA, MQTT, NATS
Electronics & Displays	Schematic and PCB design, power management, solar and battery systems; LVGL 8 and 9 with EEZ Studio on touch panels up to 10.1", e-paper, OLED
Web, Data & Infrastructure	REST APIs, Rust/axum and Node/Express back-ends, real-time and single-file embedded dashboards, SQLite, PostgreSQL, MySQL, Docker Compose, CI/CD, Linux administration
Approach	Start simple, iterate fast, build for reliability, document along the way

Community & Open Source

OSDC: Open Source Developers' Conference

Founder

Founded the Open Source Developers' Conference (OSDC), a community-run conference for open source developers in Australia and the region.

- **Open source**: Released the Waves In Ice (WII5) wave-buoy hardware, firmware, and maths under Apache 2.0, at wii5.sh3d.com.au
- **Zephyr modules**: rockblock9704-zephyr, a Zephyr module for the RockBLOCK 9704 Iridium Certus modem with a devicetree binding, shell command, host tools and a fake modem for testing; and VictronBLE, a library for reading Victron solar and battery devices over Bluetooth
- **Source**: gitea.sh3d.com.au

Publications

- Kohout, A. L., Williams, M. J. M., Dean, S. M., & Meylan, M. H. (2014). "Storm-induced sea-ice breakup and the implications for ice extent." *Nature*, **509**, 604-607. nature.com/articles/nature13262. Based on data from the Waves In Ice buoys.
- More than a decade of peer-reviewed publications using the Waves In Ice data, listed at wii5.sh3d.com.au.

References

Available on request.

Last updated: 2026. For consulting enquiries, contact me.