

The Serval Mesh Extender: Using OpenWRT to support disaster communications

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The Serval Project

- Focus on disaster/emergency/remote communications
- Mobile ad-hoc communications using unmodified smart-phones
- Text messaging, file transfer, voice and other services
- Custom P2P-optimised protocols
 - Primarily store-and-forward/delay-tolerant networking (DTN)
 - Fully distributed architecture + zero configuration
 - Can be deployed *during* a disaster

Motivation for the Serval Mesh Extender

- P2P long-range communications between smart-phones hard
 - Cellular radio? → Use prevented by regulators, carriers, mobile OS vendors, many different chipsets to support etc.
 - Ad-hoc wi-fi? → Use prevented by Android
 - Bluetooth? → Poor interoperability and performance
- ... and we need to minimise power consumption

Serval Mesh Extender Network Architecture

- Wi-Fi Access Point (10s – 100s of metres, 1-100mbit/sec)
 - Low power interface for smart-phones to connect.
 - Can share a single Mesh Extender among many phones
 - Wi-Fi performance improves during blackout/in remote areas
- Ad-Hoc Wi-Fi (10s – 100s of metres, 1-100mbit/sec)
 - High-bandwidth interface between Mesh Extenders when they are close-by.
- Ad-Hoc UHF Packet Radio (1000s of metres, 1-100kbit/sec)
 - Increased range, at the cost of bandwidth
- Ad-Hoc & P2P VHF/HF Radio (to 1000s of km, 0.01-10kbit/sec)

Serval Mesh Extender Software Architecture

- OpenWRT Linux on Atheros 9k hardware
- Serval DNA (Serval Core)
 - Full secure network scheme in ~16MB RAM, single-threaded, all user-land
- Serval LBARD (Low-bandwidth Radio Link Management)
- On-board Web Server
 - Instructions / Information about Serval Mesh
 - Download Serval Mesh Android App
 - Basic Mesh functions for phones without Serval Mesh App
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Australian Outback Field Tests

- Arkaroola Wilderness Sanctuary / Resort
- Rugged mountainous country, lacking cellular coverage
- Temperature range -7C to 50C
- Fixed and Vehicle-Mounted Mesh Extenders
- Primary field test location

AusAID Pacific Pilot

- Pilot Serval Mesh in a Pacific Nation
 - Intra-village
 - Inter-village
 - Intra-island
 - Inter-island
- Cooperation with Red Cross, local cellular carriers, UN World Food Program (WFP) and local government and community groups.
- ~50 – 100 Mesh Extenders + 100s of Android handsets

Serval Mesh Extender Hardware Prototyping

- Initial prototypes based on TP-LINK WR703N/MR3020
- USB memory stick for bulk storage
 - Problematic on non-battery-backed autonomous devices
- Serial port used to connect to RFD900 or similar UHF packet radio
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Custom Mesh Extender Design (in progress)

- GL Domino Core Ath9k module (compatible with GL-AR150)
 - More RAM, dual-ethernet, more flash
- GPIO-based MicroSD interface to end dependence on problematic USB storage
- Solar panel / 5v USB / 12v / 24v DC input
- Multi-chemistry battery controller
 - Solar/battery powered solution requires no external circuitry
- Socket for RFD900/RFD868 UHF packet radios
- Option for external radio, e.g., Codan HF
- IP66 weather rated

Tension between Open Firmware & “No modification” Regulation

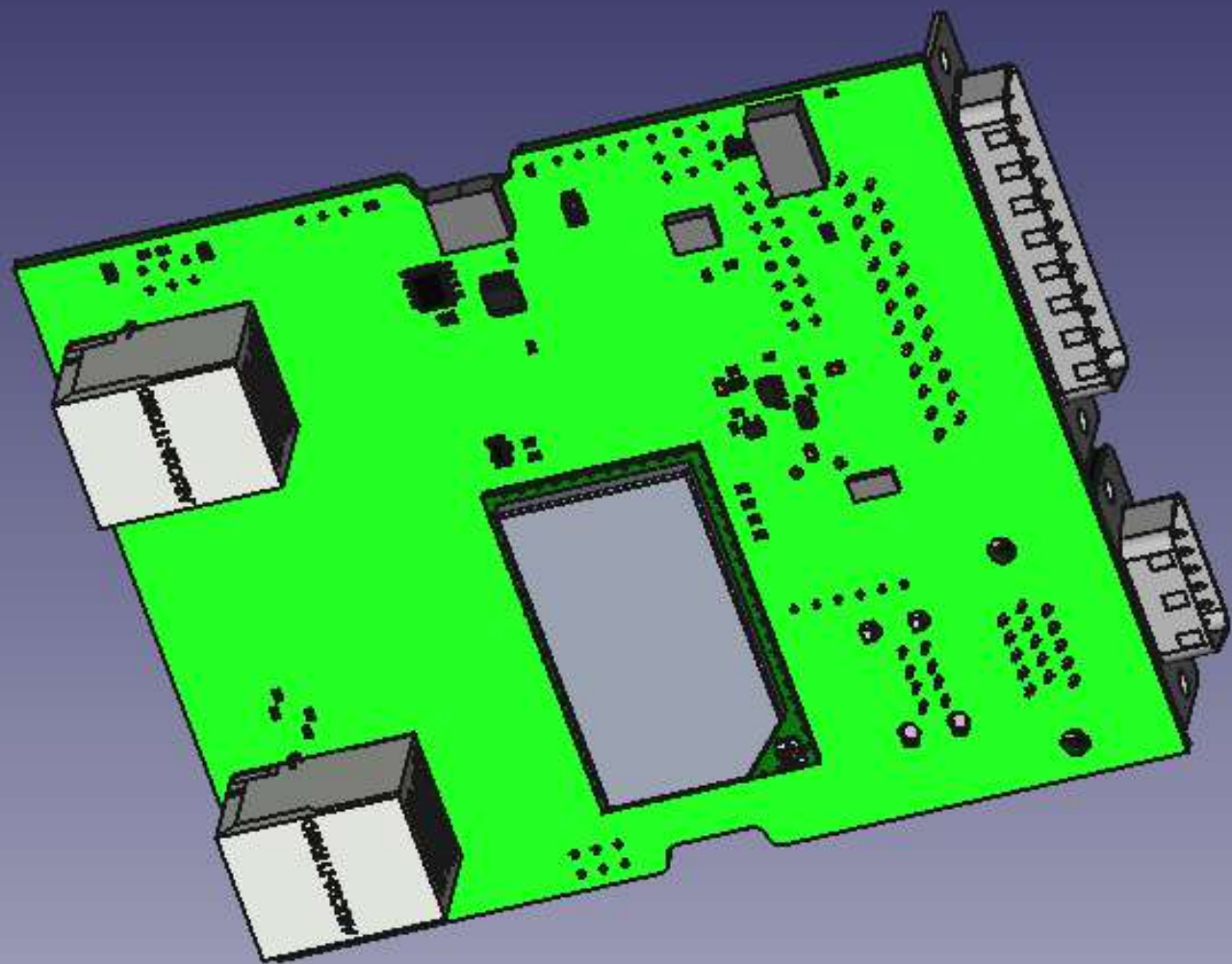
- Community and public benefit demand open firmware, but ...
- 1. Customs border delays if hardware is not clearly locked to authorised frequencies
 - e.g., An ambiguously labelled antenna cable joiner caused a 3 week delay in importation of VHF repeaters by NZ RC into Nepal.
- 2. Regulators in some countries demand that end users cannot modify firmware.
 - Much lesser issue than the above
 - US is the main culprit, e.g., recent proposed FCC rules

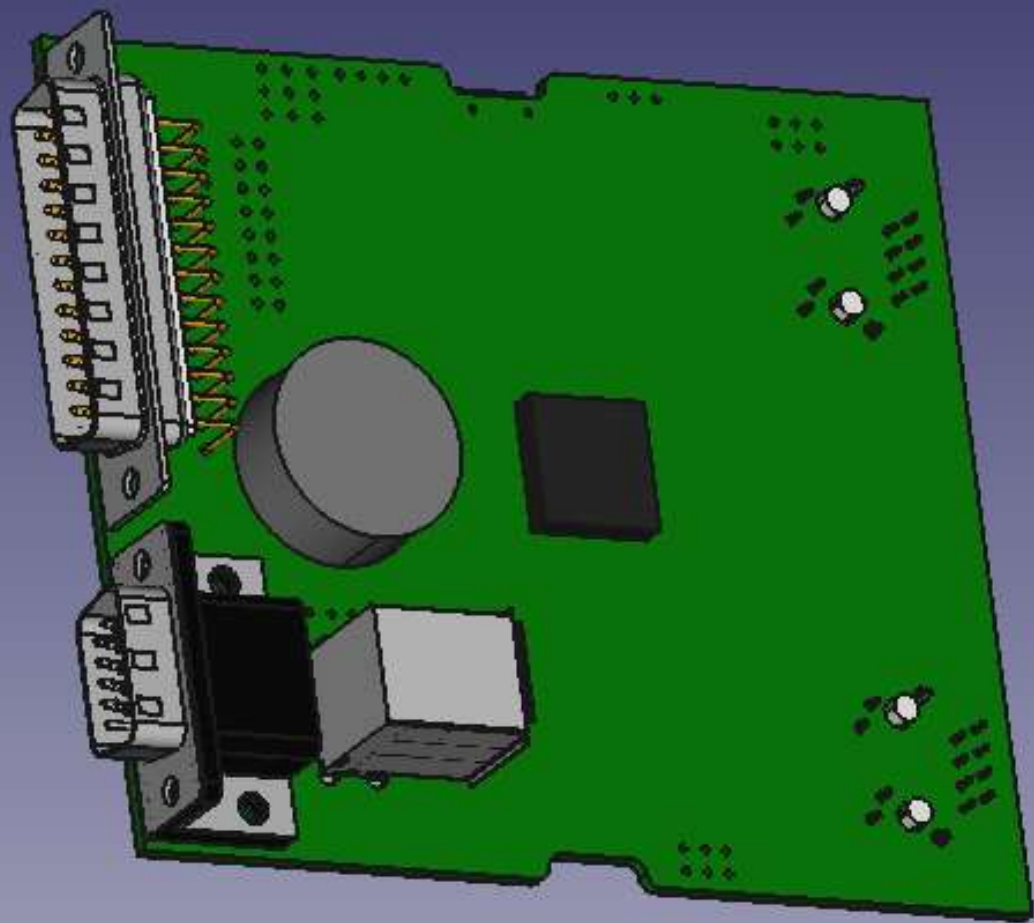
Our cut at the Gordian Knot

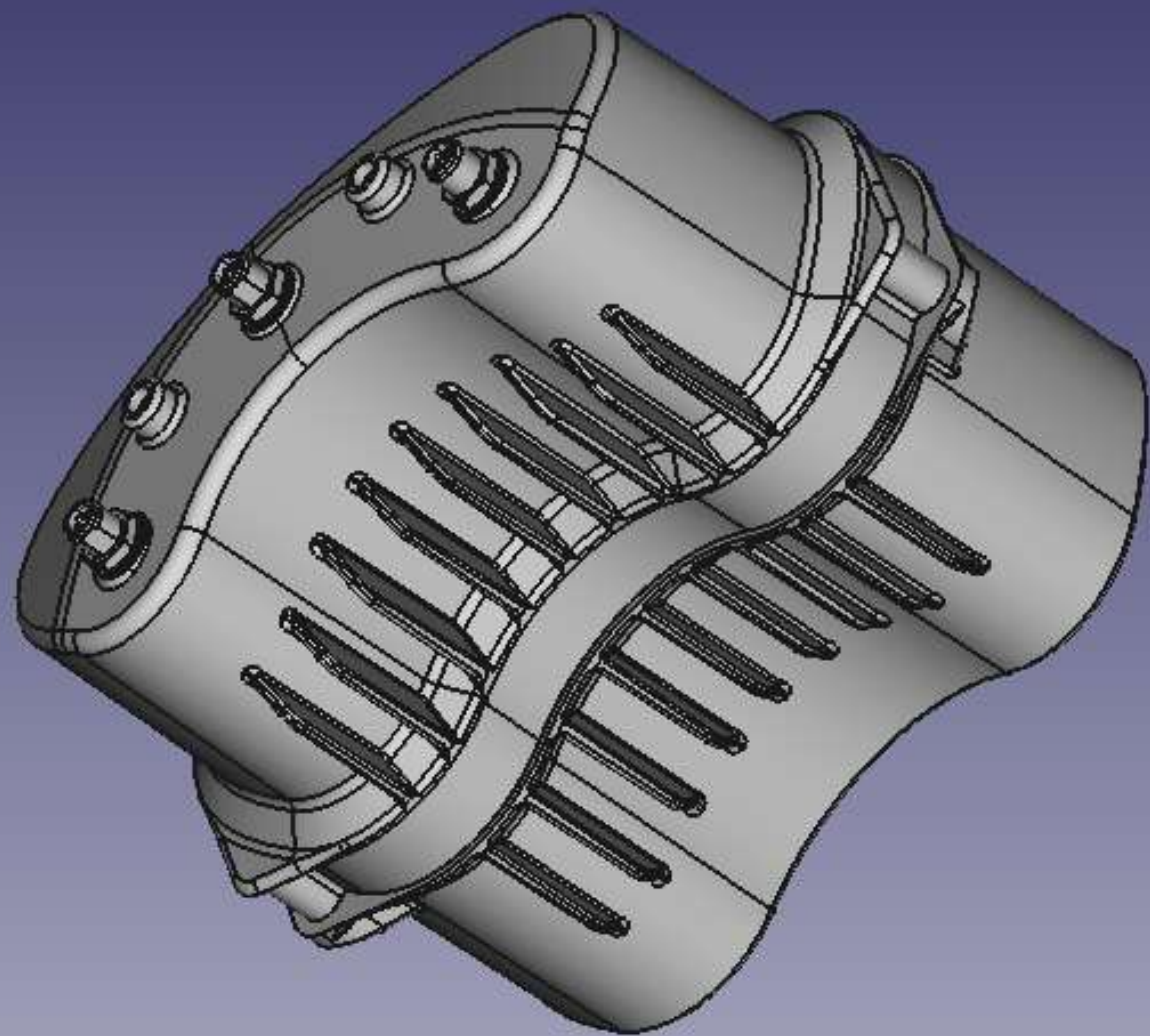
- Common Mesh Extender hardware and firmware for all regions
 - Simpler inventory control, and allows easier forward-positioning of equipment at a regional level.
- UHF packet radio firmware reads frequency authorisation from pin-out of power cable
 - Only alternate power cables are required to “region lock” Mesh Extenders to a given countries spectrum regulation.
- Optional 3 firmware flash lock based on power cable pin-out
 - Only used for countries where local regulators are problematic, i.e., USA.
 - Developers can build their own programming cables without the lock.
- We acknowledge the imperfection of this, and that it won't please everyone.

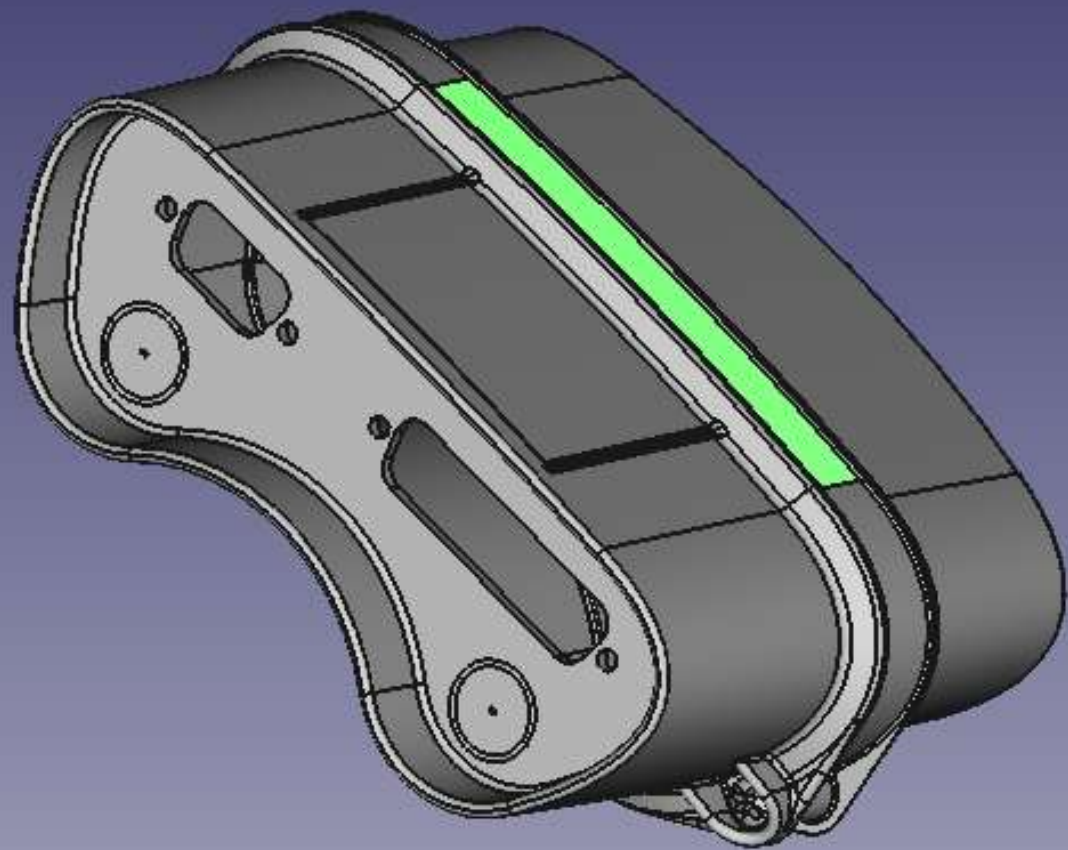
Making Hardware is not Cheap

- PCB design
- Industrial design of casing
- Injection moulding tools
- FCC/EC/Australian regulatory approvals
- IP-rating evaluation
- Software development
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- Help and advice always welcome!









Questions?

- <http://servalproject.org>
- <https://github.com/servalproject>
- <http://developer.servalproject.org>