Requirements and tests

A legend is available in Table 2 describing the reference number syntaxes for each section.

Table 1: Requirement Specifications, related tests, and pass/fail criteria for the prototyping stage of Petal radio and AVAlink.

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| --- | --- | --- | --- |
| Reference Number | Requirement | Test | Pass/Fail Criteria |
| 1-SW | R1 – The user interface MUST be accessible through a modern web browser without the need for a separate application. | T1.0 – Connect a smartphone with a modern browser to the node and scan the web server QR code.  T1.1 – Connect a PC to the node and navigate to the web server page. | C1.0 – UI is rendered and readable on a mobile device.  C1.1 – UI is rendered and readable on a PC. |
| 2-SW | R1 – Users MUST be able to send LoRa packets using the web interface to a public forum-like chat that can be viewed from another node.  F1 – Users can send chats between specific nodes that are not publicly visible to all nodes. | T1 – Send a message using the UI to another node | C1 – The sent message is shown on all other devices’ UIs.  FC1 – The sent message is only viewable on the intended receiver’s UI. |
| 3-SW | R1 – Chats on UI must have a username or device identifier and a timestamp of when the message was sent. | T1 – Send chat messages from multiple devices over the UI | C1 – The UI renders chat history with usernames in chronological order according to message timestamp |
| 4-SW | R1 – The repeater node MUST monitor battery voltage and disconnect when dropping below the low voltage threshold. The repeater node low-voltage disconnect MUST implement hysteresis to prevent power cycling.  F1 – The repeater SHOULD indicate to the rest of the mesh network that it is powering down. | T1 – Supply voltage to the node with a variable power supply and document which voltages result in disconnect and reconnect. The node voltage monitor will be compared to that of the power supply and measured with an external meter. | C1.0 – The reported battery voltage is accurate within 3%.  C1.1 – The load disconnects when the battery voltage drops below the low voltage threshold and turns back on when the battery charges above threshold voltage. The implemented hysteresis prevents power cycling of the device.  FC1 – Before the low-voltage disconnect, the device transmits an alert that it is powering down. |
| 5-SW | R1 – The software MUST implement a collision avoidance or multiple access protocol that deals with the hidden-node problem | T1 – Transmit a LoRa packet from two devices to a single receiver at the same time without a connection between the two senders to coordinate between them | C1.0 – Neither message is lost, or corrupted.  C1.1 – Messages are displayed in the UI in the correct order based on their timestamp |
| 6-HW | R1 – MUST Design and order a PCB | T1 – Before each revision is submitted for manufacturing, it will be subject to an internal review by the group and an external review by the Capstone Committee. | C1.0 – The PCB design passes an internal review process and review from the Capstone Committee.  C1.1 – Each revision passes our hardware testing suite. |
| 7-HW | R1 – MUST have a bespoke enclosure.  F1 – SHOULD be protected against rain and moisture ingress | T1.0 – The enclosure will be inspected by professors.  T1.1 – Third-party parts like cable glands are IPX4 certified.  FT1 – The enclosure is subjected to the standard IPX4 test | C1 – All materials have IPX4 or greater certification from reputable lab  FC1 – No water ingress is present after the IPX4 test. |
| 8-HW | R1 – Voltage regulator MUST effectively provide the required 3.3V to the hardware for a range of typical battery voltages. | T1 – Sweep the input voltage across the range defined by the regulator datasheet and measure the voltage regulator output while it is loaded with the expected full load current the PCB requires. | C1.1 – The hardware receives a stable 3.3V +/- 0.1V out across the range of test voltages while under the expected load.  C1.2 – The regulator operates as expected according to the manufacturer’s datasheet. |
| 9-HW | R1 – MUST provide recommendations for sizing batteries and solar panels based on expected insolation. | T1 – Use recommendations to size solar and battery power for a mock installation at Camosun College using insolation data for that location. | C1 - Recommended panel wattages and battery Ah meet or exceed node requirements as calculated by our power audit (datasheet specifications, duty cycle, solar insolation modeling) |
| 10-HW | R1 – Antennas MUST be well matched to the driving hardware | T1 – SWR/Impedance testing of antenna and source using VNA (may require tuning to meet these requirements) | C1 – Source impedance is matched to antenna so that VSWR < 2 and return loss < -10 dB |
| 11-HW | R1 – Prototype nodes MUST incorporate an accessible user button at access points for users to initiate the web server.  R2 – The Wi-Fi access point MUST time-out after 5 minutes of inactivity to save power. | T1 – Check that the Wi-Fi access point is powered down. Press the user button to initiate the Wi-Fi access point.  T2 – Leave the access point for 5 minutes without activity. | C1 – The Wi-Fi access point is available after pressing the user button.  C2 – The Wi-Fi access point is disabled after 5 minutes of inactivity. |
| 12- SW | R1 – The firmware has multiple modes:  Passive: The MPU is sleeping and listening for new messages. It will act as a repeater.  Message Available: The MPU is in passive mode, but it has saved new messages for the next user to view  Active: The MPU is powered up and advertising the Wi-Fi access point while continuing to act as a LoRa mesh node.  Low-Power: The low voltage disconnect has taken the node offline until the battery can be recharged.  F1 – An RGB LED indicates the state the hardware is in with different colours (Passive, Message Available, Active, Waiting, Low battery).  F2 – An SOS mode that activates across the entire network. It connects directly to emergency services, minimizes network latency at the expense of power efficiency, and disables the low voltage disconnect. | T1.0 & FT1.0 – Send a message from an Active node to a Passive node.  T1.1 – Receive a message repeated by a Passive node.  T1.2 – Test the current draw in passive mode.  FT1.1 – Input a voltage lower than the low-voltage disconnect but larger than the minimum voltage required by the linear voltage regulator. | C1.0 – The message is available when the Passive node is powered up later.  C1.1 – The message is received at the active node.  C1.2 – The current draw in passive mode is less than the current draw in active mode.  FC1.0 – The LED indicates a New Message state.  FC1.1 – The LED indicates low voltage. |

## Legend

Table 2: A legend describing the syntax used for the reference numbers.

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| Reference Number | Requirement | Testing | Pass/Fail Criteria |
| *#-(ID):*  *HW: Indicates a hardware requirement*  *SW: Indicates a software requirement* | *R#*:  A requirement, something the component MUST have, followed by an identification number that begins at 0.  *F#:*  A feature, something the component SHOULD have, followed by an identification number that begins at 0. | *T#.#:*  The test identification number. The number matches the requirement it corresponds to. If multiple tests relate to the same requirement, a second reference number is added with a decimal point.  *FT.#.#:*  Same as requirement tests but relates to a feature. | *C#.#.#:*  The criteria identification number. The number matches the test it corresponds to. If multiple criteria exist for the same test, a second sub-reference number is added. A Pass is required.  *FC.#.#.#:*  Same as requirement criteria but relates to a feature and is not required to pass. |