v0.6.1 Relay-Only Node - Implementation Changelog

Date: February 15, 2026 **Status:** COMPLETE AND VERIFIED **Result:** Relay node extends mesh range — silently forwards packets, blinks LED heartbeat, auto-rejoins mesh after power cycle via NVS persistence.

Final File Changes Summary

File	Lines Changed	What Changed
`ESP/ESP-Mesh-Relay-Node/CMakeLists.txt`	1 modified	Project name: `node-1-ble-mesh` → `relay-node-ble-mesh`
`ESP/ESP-Mesh-Relay-Node/main/main.c`	781 → 270	Full rewrite: stripped I2C, PWM, vendor model, command processing, console task. Added LED heartbeat task
`ESP/ESP-Mesh-Relay-Node/sdkconfig.defaults`	1 removed	Removed `CONFIG_BLE_MESH_GENERIC_ONOFF_CLI=y`

Total: ~510 lines removed, ~270 lines final (stripped from 781-line sensing firmware).

Task 1: CMakeLists.txt - PASSED

Change Made

- Line 8: `project(node-1-ble-mesh)` → `project(relay-node-ble-mesh)`

Task 2: main.c Rewrite - PASSED

What Was Removed

Component	Functions/Defines Removed
I2C/INA260	`I2C_PORT`, `I2C_SDA_PIN`, `I2C_SCL_PIN`, `INA260_ADDR`, `i2c_scan()`, `sensor_init()`, `ina260_read_voltage()`, `ina260_read_current()`
PWM/Load	`PWM_GPIO`, `pwm_init()`, `set_duty()`
Vendor Model	`VND_MODEL_ID_SERVER`, `VND_OP_SEND`, `VND_OP_STATUS`, `vnd_op[]`, `vnd_models[]`, `custom_model_cb()`
Command Processing	`format_sensor_response()`, `process_command()`
OnOff Client/Server	`onoff_client`, `onoff_server`, `onoff_cli_pub`, `onoff_srv_pub`, `generic_server_cb()`, `generic_client_cb()`
Console	`console_task()`

Component	Functions/Defines Removed
Includes	`driver/i2c.h`, `driver/ledc.h`, `<math.h>`

What Was Kept

Component	Details
Mesh Init	`ble_mesh_init()` with provisioning + config server callbacks
Config Server	Relay enabled, `relay_retransmit = TRANSMIT(4, 20)`, TTL=7
NVS Persistence	`save_node_state()`, `restore_node_state()` with key `"mesh_relay"`
Provisioning	Full callback chain: register, enable, link open/close, complete, reset
UUID	`0xdd 0xdd` prefix for auto-provisioning

What Was Added

Component	Details
LED Heartbeat	`led_init()` on GPIO8, `led_heartbeat_task()` FreeRTOS task
LED Patterns	Fast blink (200ms) = unprovisioned, Slow blink (1s) = provisioned & active
`provisioned` flag	Tracks state for LED pattern switching

Task 3: sdkconfig.defaults Cleanup - PASSED

Change Made

- Removed `CONFIG_BLE_MESH_GENERIC_ONOFF_CLI=y` — relay has no OnOff client
- Deleted stale `sdkconfig` (83KB), `sdkconfig.old` (83KB), and `build/` directory

Hardware Verification - PASSED

Provisioning

Provisioner auto-discovered relay node (UUID prefix `0xdd`) and provisioned it successfully. LED switched from fast blink to slow blink on provisioning complete.

Pi 5 Gateway Discovery

```
[POWER] Probing 3 sensing node(s)...
[POWER] Found node 1
[POWER] Found node 2
[POWER] Node 3 no response
[POWER] Discovery complete: 2 node(s)
```

Gateway correctly identified 2 sensing nodes, gracefully handled the relay's non-response, and proceeded with PowerManager balancing.

Command Forwarding

- `ALL:DUTY:100` and `ALL:DUTY:0` — both sensing nodes responded, relay silent ✓
- `ALL:READ` — both NODE1 and NODE2 returned sensor data, no NODE3 response ✓
- PowerManager priority balancing worked correctly with relay in the mesh ✓

Design Decisions

1. No Vendor Model

The relay has no vendor model, so it never responds to READ/DUTY/RAMP commands. The Pi 5 gateway's `_bootstrap_discovery()` naturally skips it after one failed probe. This is simpler and more robust than adding a "relay type" flag.

2. Separate NVS Key

Uses `"mesh_relay"` instead of `"mesh_node"` to avoid conflicts if both firmware types are flashed to the same device during development.

3. Config Server Only

The element contains only `ESP_BLE_MESH_MODEL_CFG_SRV` — no OnOff, no vendor. This is the absolute minimum for a functioning relay node. The provisioner's `bind_next_model()` chain completes quickly since there are fewer models to bind.

4. LED Heartbeat Over Serial

An LED heartbeat provides immediate visual feedback without needing a serial monitor. Two patterns (fast/slow) distinguish unprovisioned from active states at a glance.

Known Limitations

1. **BLE scan count inflation:** Gateway reports `"3 sensing node(s) in mesh"` because the relay advertises as `ESP-BLE-MESH`. This is cosmetic — the relay is correctly excluded from PowerManager after the failed probe.
2. **Single GPIO for LED:** Currently uses GPIO8. Must be changed in `main.c` if wiring differs.