ALP LAB

Wi-Fi 6 Provisioning and Cloud Telemetry

AN-002 · E1M and E1M-X SoMs

Document Number: AN-002 **Revision:** 0.7 **Date:** November 2026 **Status:** Preliminary

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1 Scope

This application note covers Wi-Fi 6 provisioning on the on-module combo radio and publishing a JSON telemetry payload to an MQTT broker over TLS. It applies to every E1M / E1M-X SoM (the wireless combo module is mandatory per **E1M Spec** §6.5).

Audience	Firmware engineers building connected IoT firmware.
Prerequisites	Wi-Fi network credentials, an MQTT broker reachable from the network, **QS-** guide completed.
Outcome	Firmware that joins a Wi-Fi 6 network, opens a TLS-secured MQTT session, publishes telemetry every 10 s, and handles reconnect on link loss.
Time	30– 60 minutes (broker setup is the long pole).
Source	`docs/tutorials/11-mqtt-tls-publish.md` and `examples/connectivity/iot-connected-camera/` in alp-sdk.

Table 1 Scope summary

2 Hardware Setup

The Wi-Fi 6 + BLE 5.4 combo radio is **on-module** on every Alp Lab SoM — no carrier-side wiring required for the radio itself. Antenna setup is required.

SoM family	Wi-Fi / BLE combo + antenna outputs
E1M-AEN	TI CC3501E. 2.4 GHz only (Wi-Fi 6). Single `ANT_2.4GHZ` antenna pad (AH1). Route AH1 to a carrier PCB antenna or carrier RF connector (U.FL / IPEX / SMA); an on-module I-PEX MHF 4L connector is an assembly option.
E1M-X V2N / V2N-M1	Murata LBEE5HY2FY (Infineon CYW55513). Tri-band 2.4 / 5 / 6 GHz Wi-Fi 6 + BLE 5.4. Three antenna pads (`ANT_2.4GHz`, `ANT_5GHz`, `ANT_6GHz`).

Table 2 Wireless hardware per family

The E1M EVK (2641-R3) carries an on-board chip antenna (A1) on the `ANT_2.4GHZ` pad (AH1). Its U.FL connector J1 is fitted but not connected to the radio: to use J1, fit R111 and remove R132 (see the **E1M EVK User Guide**). Do not leave both R111 and R132 fitted, because that joins the chip antenna and the connector on one RF line. For the E1M-X EVK, check the **E1M-X EVK User Guide** for the populated antenna set on your revision.

3 Software Walkthrough

The flow is identical across SoMs (the SDK abstracts the underlying combo radio):

1. Provision credentials. For development, hard-code SSID + PSK in `prj.conf`:

   ```
   CONFIG_WIFI_SSID="your-ssid"
   CONFIG_WIFI_PSK="your-psk"
   ```

   For production, load the credentials from the EEPROM manifest at runtime via `<alp/hw_info.h>` instead.
2. Build with the example: `tan build --project examples/connectivity/iot-connected-camera` (the target comes from `som.sku` in the example's `board.yaml`).
3. Flash: `tan flash examples/connectivity/iot-connected-camera`.
4. Watch the console; the firmware prints connection state changes.

For production, replace the hard-coded credentials with a BLE-based Wi-Fi provisioning flow built on the SDK's BLE GATT server (`<alp/ble.h>`), or load them from the EEPROM manifest via `<alp/hw_info.h>`. The Wi-Fi station and MQTT-over-TLS API itself lives in `<alp/iot.h>`.

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4 Expected Output

```
[wifi] starting CC3501E (or LBEE5HY2FY on V2N)
[wifi] join: ssid="your-ssid"
[wifi] joined, IP=192.168.1.42
[mqtt] connecting to broker.example.com:8883 (TLS)
[mqtt] connected
[mqtt] pub telemetry/<som-sku>/000 -> {"t":24.7,"rh":47}
[mqtt] pub telemetry/<som-sku>/001 -> {"t":24.7,"rh":47}
...
```

5 Troubleshooting

Symptom	Likely cause / fix
`wifi` join times out	Wrong SSID / PSK, or 5 GHz / 6 GHz channel on a 2.4-GHz-only SoM. Confirm in router settings.
Join succeeds, MQTT connect fails	Broker URL / port / TLS-CA mismatch. Test the broker with `mosquitto_pub` from your host first.
Connect works, publish silently drops	Topic ACL on the broker. Enable MQTT broker logs.
Reconnect loop on weak signal	Antenna placement / gain. Move to a U.FL pigtail with an external antenna to validate.

Table 3 Common failures

6 Regulatory Reminder

> **Warning:** Modular certification status and certificate IDs are listed in the SoM datasheet; for E1M-AEN they are pending (FCC modular grant pending; RED / ISED / MIC IDs TBD) and the maximum antenna gain is TBD. Once granted, reusing the certifications on a customer's end product requires following the integration guidelines (antenna gain, RF trace, enclosure) from the certification report.

7 References

- **Canonical tutorial**: `docs/tutorials/11-mqtt-tls-publish.md` in alp-sdk.
- **Examples**: `examples/connectivity/iot-connected-camera/`, `examples/connectivity/iot-dashboard/`, `examples/connectivity/iot-fleet-ota/`. CC3501E combo-radio silicon bring-up: `examples/aen/aen-cc3501e-bringup/`.
- **SDK API**: `<alp/iot.h>` (Wi-Fi station + MQTT/TLS), `<alp/ble.h>` (BLE provisioning), `<alp/hw_info.h>` (EEPROM credential manifest).
- **SoM datasheets**: **DS-AEN-001** §8.4.1 / §8.4.3 (RF Characteristics and Regulatory Information); V2N datasheet §7.4 / §7.6.

8 Revision History

Revision	Changes	Date
0.1	• Initial draft.	May 2026
0.2	• Corrected SDK references to the current layout: ▸ example paths now under `examples/connectivity/`	June 2026

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Revision	Changes	Date
	▸ replaced non-existent <alp/wifi.h> / <alp/wifi_prov.h> with the actual <alp/iot.h> (Wi-Fi station + MQTT) and <alp/ble.h> ▸ fixed the west build path and prj.conf Wi-Fi Kconfig (CONFIG_WIFI_PSK) ▸ added the CC3501E bring-up example and EEPROM-credential (<alp/hw_info.h>) note.	
0.3	• Corrected the Alp SDK repository links: the alpDevs GitHub organisation does not exist, so every link 404'd; the canonical organisation is alplabai.	July 2026
0.4	• E1M-AEN antenna note: route AH1 to a carrier antenna or RF connector; the on-module I-PEX MHF 4L connector is an assembly option.	October 2026
0.5	• E1M EVK antenna description corrected for the 2641-R3 board: the 2.4 GHz pad feeds the on-board chip antenna A1. • The U.FL connector J1 is isolated unless R111 is fitted and R132 removed. • E1M-X EVK wording now points to its own user guide.	October 2026
0.6	• Release history: every entry formatted as a bullet list.	October 2026
0.7	• Product name on page 1 links to the product page on alplab.ai.	November 2026

Table 4 Revision History

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