

ARG Common Host API

Binary Serial Protocol for Host Board to Connectivity
Module | v2 | March 2026

Spec: host_api_spec.md

Header: arg_host_api.h

Status: In Production

OVERVIEW

The ARG Common Host API is the binary serial protocol used between any ARG host board (G360, iAQ-Pro, iAQ-Wall, iPM3, etc.) and any ARG connectivity module (Cell Modem / nRF9160, WiFi Modem / NINA-W131, G3-PLC). The protocol is identical across all modem types — the host application cannot distinguish which radio is active.

Design goals: modem is host-agnostic (handles radio, TLS, MQTT, retry, and buffering autonomously); host is modem-agnostic (sends payloads, receives data, no radio knowledge required); DMA on both sides for zero CPU burden; hardware-identical connector footprint across all ARG modem modules.

PHYSICAL INTERFACE

Parameter	Value
Connector	10-pin 1.27 mm pitch — identical across all ARG modem modules
Baud rate	460800 baud
Data format	8 data bits, no parity, 1 stop bit (8N1)
Flow control	Hardware — RTS / CTS
Signals	TX, RX, RTS, CTS, nRST (active-low), PWR_EN (active-high), GPIO0, GPIO1, GND, VDD
DMA — RX	Circular buffer (1 KB); idle-line/ENDRX interrupt triggers frame processing
DMA — TX	Single-shot transfer per frame; TC/ENDTX interrupt signals completion
CPU wakeup	On complete frame receipt only — not per byte

BINARY FRAME FORMAT

Wire layout (all integers little-endian):

```
[ SOF 1B | VER 1B | TYPE 1B | LEN 2B | PAYLOAD 0-512B | CRC16 2B ]
```

Field	Size	Description
SOF	1 B	0xAA — start-of-frame sync. Used for resync after noise, reboot, or buffer overrun.
VER	1 B	0x02 — protocol version. Receivers discard frames with unrecognized VER.
TYPE	1 B	Message type (ARG_MSG_* constant). See message table.
LEN	2 B LE	Payload length in bytes. Range: 0–512.
PAYLOAD	N B	Message-specific payload. 0–512 bytes.
CRC16	2 B LE	CRC16-CCITT (poly=0x1021, init=0xFFFF, no bit-reflection) computed over VER+TYPE+LEN+PAYLOAD.

MESSAGE REFERENCE

Type	Name	Dir	Description
0x01	CONFIG_SET	H→M	Set product_ns (16B), device_id (32B), offline_thresh_s (4B), feature_flags (4B), gnss_max_age_s (4B), gnss_timeout_s (4B), reserved (12B). 76 bytes. Modem persists to NVS.
0x02	PUBLISH	H→M	topic_suffix (16B) + payload_len (2B LE) + data (0–494B). Publish to AWS IoT MQTT. Queued to NVS offline buffer if modem offline.
0x03	ENDPOINT_SET	H→M	endpoint (128B null-padded). Override MQTT broker URL. Saved to NVS.
0x05	WIFI_CONFIG_SET	H→M	ssid (32B) + password (64B) + flags (1B). WiFi credentials. Cellular modems silently discard.
0x10	STATUS_GET	H→M	No payload. Request STATUS_RESP.
0x11	TIME_GET	H→M	No payload. Request TIME_RESP with current Unix epoch.
0x12	POWER_SET	H→M	1 byte: 0x00=OPERATING, 0x01=OFFLINE (radio off), 0x02=PSM, 0x03=SLEEP.
0x13	LOCATION_PUSH	H→M	No payload. Trigger GNSS fix and MQTT publish (requires LOCATION_EN feature flag).
0x20	OTA_HTTP_POST	H→M	url\0 + json_body\0. HTTPS POST via modem proxy. Returns response or OTA_HTTP_ERROR.
0x21	OTA_HTTP_GET_CHUNKED	H→M	url\0. Begin chunked HTTPS GET of firmware image from pre-signed S3 URL.
0x81	STATUS_RESP	M→H	state (1B) + rssi (1B) + offline_s (4B LE) + modem_fw (16B) + imei (16B) + gnss_state (1B) + reserved (3B). 42 bytes.
0x82	RECEIVED	M→H	topic_suffix (16B) + payload_len (2B LE) + data. Incoming MQTT command forwarded to host.
0x83	FAULT	M→H	fault_code (1B) + detail (4B LE). Codes: 0x01 OFFLINE_THRESHOLD, 0x02 SIM_MISSING, 0x03 MODEM_FAULT, 0x04 QUEUE_OVERFLOW, 0x05 WIFI_NO_AP, 0x06 WIFI_AUTH_FAIL.
0x84	TIME_RESP	M→H	unix_epoch (4B LE) + valid (1B). 1=network-sourced time; 0=modem clock may be inaccurate.
0x85	LOCATION_RESP	M→H	gnss_state (1B) + valid (1B) + lat_e7 (4B) + lon_e7 (4B) + accuracy_cm (4B) + epoch_s (4B). 18 bytes.
0x22	OTA_HTTP_CHUNK	M→H	offset (4B LE) + total_size (4B LE) + data (up to 504B). Sequential binary chunks.
0x23	OTA_HTTP_DONE	M→H	No payload. All chunks delivered; download complete.
0x24	OTA_HTTP_ERROR	M→H	message\0. Null-terminated error string.

CONNECTION STATES (STATUS_RESP.STATE)

Parameter	Value
0x00 UNCONFIGURED	No device_id received. Modem will not attempt to connect.
0x01 CONNECTING	Config valid; LTE attach or MQTT connection in progress.

0x02 CONNECTED	LTE + MQTT up. PUBLISH frames forwarded live.
0x03 OFFLINE	LTE lost; reconnecting autonomously. PUBLISH frames queued to NVS.
0x04 FAULT	Persistent failure requiring host attention. Preceded by a FAULT message.

GNSS STATES (STATUS_RESP.GNSS_STATE / LOCATION_RESP.GNSS_STATE)

Parameter	Value
0x00 IDLE	LOCATION_EN not set in CONFIG_SET; GNSS inactive.
0x01 ACQUIRING	Fix acquisition in progress.
0x02 FIXED	Fresh GNSS fix obtained and published.
0x03 CACHED	Cached fix used (within gnss_max_age_s).
0x04 NO_FIX	Acquisition timed out; no cached fix available.

OFFLINE QUEUE & NVS LAYOUT (PER MODULE)

Parameter	Value
OTA staging	0x000000–0x37FFFF 3.5 MB — receives host firmware images streamed via OTA_HTTP_GET_CHUNKED
Offline queue	0x380000–0x3BFFFF 256 KB — circular buffer, ~500 messages at 494B max payload each
Reserved	0x3C0000–0x3EFFFF 192 KB — future use
NV parameters	0x3F0000–0x3FFFFFF 64 KB — Zephyr NVS: product_ns, device_id, mqtt_endpoint, offline_thresh_s

TYPICAL STARTUP SEQUENCE

Host asserts PWR_EN → Modem boots and loads NVS. If NVS is valid (product_ns + device_id non-empty), modem begins connecting autonomously and emits STATUS_RESP(CONNECTING). Host may send CONFIG_SET to set or override identity. On LTE + MQTT success, modem emits STATUS_RESP(CONNECTED). Host may then send PUBLISH frames. Incoming MQTT commands arrive as RECEIVED frames. Host polls with STATUS_GET every 30 s.

WiFi modem additionally requires WIFI_CONFIG_SET (SSID/password) and optionally ENDPOINT_SET before it can connect. The three provisioning messages may be sent in any order.

CRC16-CCITT REFERENCE

Polynomial: 0x1021 | Initial value: 0xFFFF | No bit-reflection

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uint16_t crc16(data, len) { crc=0xFFFF; for each byte: crc ^= byte<<8; for 8 bits: crc = (crc&0x8000)?(crc<<1)^0x1021:(crc<<1); return crc; }
```

Coverage: VER + TYPE + LEN + PAYLOAD (all bytes after SOF, before CRC). CRC is transmitted little-endian.

COMPATIBLE PRODUCTS

Product	Role	Modem Used	Status
G360	Host board	Cell Modem + WiFi Modem (dual)	Active — pilot shipped
iAQ-Pro	Host board	Cell Modem (nRF9160)	In production
iPM3	Host board	Cell Modem (nRF9160)	Available

iPM1	Host board	Cell Modem (nRF9160)	Available
DC4	Host board	Cell Modem + WiFi Modem	In development
iAQ-Wall	Host board	Cell Modem or WiFi Modem	Planned