ALWAYS CONNECTED, ANYWHERE

Multi-year battery life for cellular IoT and Skylo NB-NTN, with the Altair ALT1350

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Satellite IoT, without the power penalty

Altair's state of the art **ALT1350** now officially certified by **Skylo** to support NB-IoT non-terrestrial networking (NB-NTN) over satellite. For the data patterns that drive the vast majority of cellular IoT deployments, short, infrequent uplinks of tens to a few hundred bytes, the energy cost of reaching a satellite is now on the same order of magnitude as a terrestrial NB-IoT modem at the edge of coverage.

In other words: going to satellite is no longer constrained by the device power budget. The same device, on the same battery, can now stay connected *anywhere where there is open sky* and still promise years of life in the field.

79 µAh	1.2 uA	5 yrs
Energy per 50-byte uplink over Skylo NTN	Deep-sleep current between reports	325mAh Li-on cell life at one report per day

What is new here

This is the first published power profile of the ALT1350 on a live, commercial Skylo NB-NTN cell covering a full connection event end to end, and translated into the number customers actually care about: years of battery life under realistic reporting cadences.

20,000× the distance, only ~10× the energy

Here is the result that surprises most engineers. In a typical terrestrial deployment a device sits perhaps **2 km** from its cell. A geostationary satellite sits roughly **40,000 km** away, about **20,000 times farther**. Yet the measured energy to send the same small uplink message rises only by about **a single order of magnitude**.

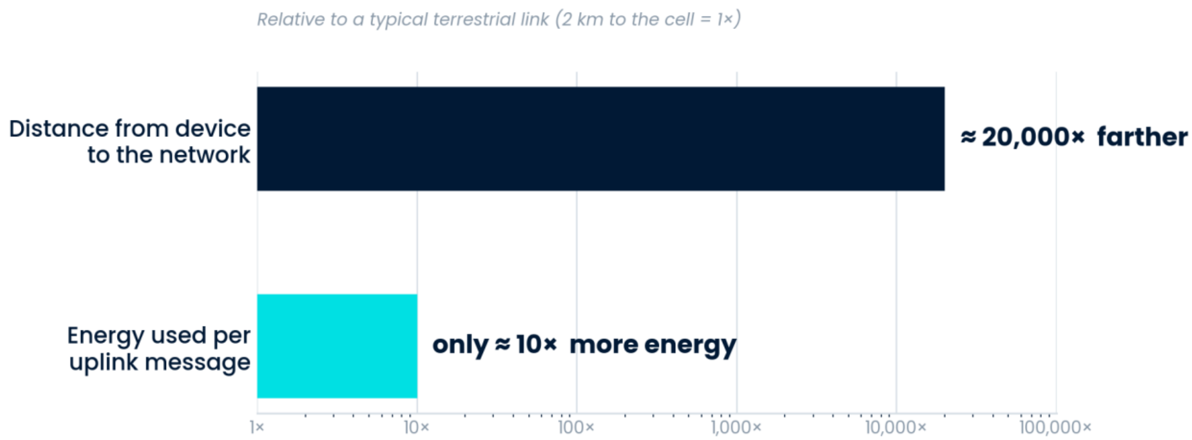

Figure 1. *Distance to the network grows ~20,000× going from terrestrial to geostationary satellite, while the energy per uplink message grows only ~10×. (Log scale; terrestrial link = 1×.)*

That gap is the challenge that Altair and Skylo have overcome. The link budget to a satellite is vast, but Skylo's NB-NTN design and Altair's ALT1350 radio efficiency cross the entire chasm. For the small, periodic messages that define field IoT, the practical choice between terrestrial and satellite stops being a battery decision and becomes a coverage and economics decision.

Why this matters now

Cellular IoT has spent a decade optimizing two variables: coverage and power. NB-IoT and LTE-M delivered real gains on both. But billions of assets still operate where terrestrial coverage is sometimes unreliable, intermittent, or simply absent like pipelines and power lines, ships and ports, agriculture and livestock, environmental sensing, lone-worker safety. For those assets, satellite has historically meant a separate, expensive, proprietary radio alongside a cellular device.

3GPP Release 17 changed that by standardizing NB-IoT NTN, and commercial operators such as Skylo have made it real. One chipset can now talk to a terrestrial NB-IoT cell *and* to a satellite using the same protocol stack, the same SIM ecosystem, and the same engineering & deployment teams. That leaves device makers with a single question, the one this paper answers:

> *"If I add NTN to my next product, what does it actually cost me in milliamp-hours and how many years of battery life can I still promise my customers?"*

The advantage of NTN with Skylo

What makes this practical rather than a science project is the combination of a standards-based satellite network and a chip built to live on it. With Skylo, NTN stops being an exception and becomes part of the same connectivity fabric as terrestrial cellular, reducing both capex and opex.

- **Truly global coverage.** Skylo uses geostationary satellites already in orbit from multiple satellite operator partners, delivering wide-area, always-available coverage over land and sea including the gaps terrestrial networks will never economically reach.
- **Standards-based, not proprietary.** It is 3GPP NB-IoT NTN. No bespoke modem, no separate protocol, no parallel toolchain and the device speaks the same language to the ground and to the sky.
- **One SIM, one stack, one cloud path.** The data looks identical from the application's point of view whether it arrived via a tower or a satellite. No manual fallback logic, no dual data pipelines.
- **No separate SKU.** Because terrestrial and NTN share the ALT1350 radio, "connected" and "satellite-connected" product variants collapse into a single design and deployment.
- **Commercial and live today.** This is a service in operation, not a roadmap promise and the ALT1350 is officially supported on it.

Built for low power: inside the ALT1350

Power efficiency at the system level is decided long before the radio turns on. What sets the ALT1350 apart is how much it folds onto a single chip as a purpose-built, tightly integrated architecture engineered for ultra-low power at the silicon level. These choices compound across every connection event:

- **Asymmetric multi-core design.** A dedicated low-power domain handles application logic and sensors while the cellular subsystem is gated off entirely while the radio cores wake only for active events.
- **Integrated GNSS.** On-die positioning removes the second chip, its power rail, and its separate wake-up sequence that location-aware devices have traditionally needed.
- **Hardware security subsystem.** Cryptographic operations and key storage run off the main MCU, so security-by-design carries no sleep-current penalty.
- **Aggressive sleep states.** PSM and eDRX are first-class power states with deep retention; the chip rests in the low single-digit microamp range between reports which, as the next pages show, is the real driver of multi-year life.

Individually, each of these is an incremental saving. Together, they are what keep the ALT1350's average power in the microamp range and that same efficiency is precisely what carries over to the satellite link, making the NTN power numbers on the next pages not just possible, but attractive for real, battery-constrained products.

> **The principle in one line**
>
> Average power decides battery life. So the ALT1350 spends as little time as possible above microamps, and integrates everything else needed to make that possible.

The energy numbers

Every connection event below was measured end to end: the radio leaves sleep, completes the procedure, and returns to its idle anchor. So each figure is the full energy cost of the event, not just the moment the radio is transmitting.

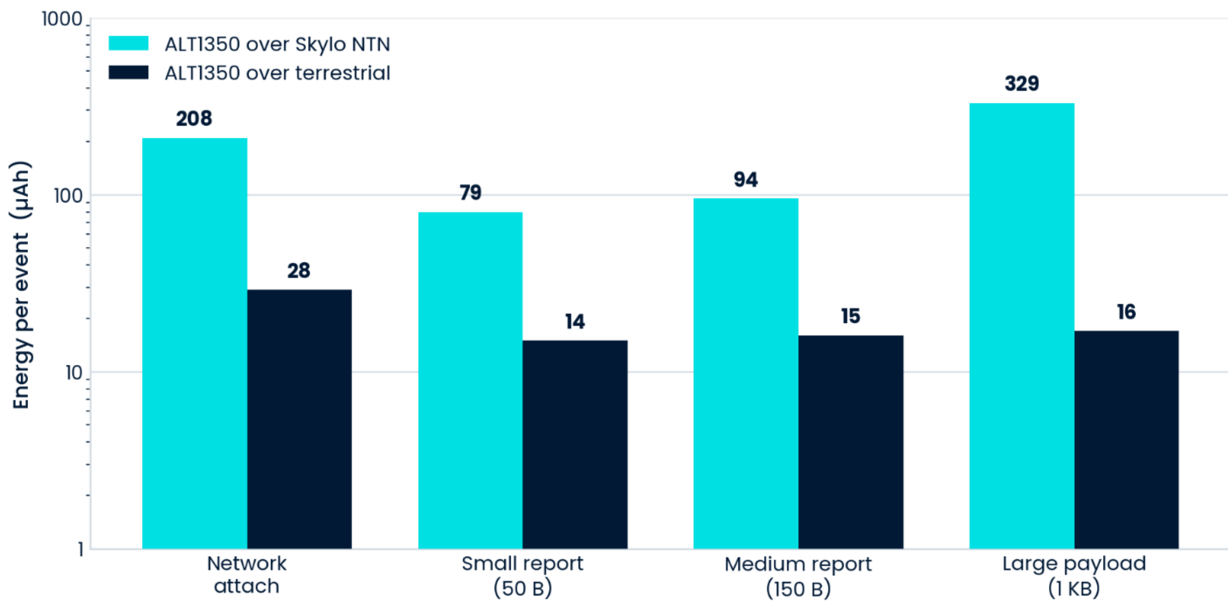

Figure 2. *End-to-end energy per event for the ALT1350 over Skylo NTN vs. the same chip on a terrestrial cell.*

Event	Payload	Over Skylo NTN	Over terrestrial
Network attach	—	**208 µAh**	28 µAh
Uplink — small report	50 B	**79 µAh**	14 µAh
Uplink — medium report	150 B	**94 µAh**	15 µAh
Uplink — large payload	1 KB	**329 µAh**	16 µAh
Deep sleep current (PSM)	—	**1.2 µA**	1.2µA

Reading the numbers:

- **Small payloads dominate real deployments.** For the tens-of-bytes messages that make up most field IoT, NTN energy stays within an order of magnitude of terrestrial. Bearer choice becomes a coverage and cost question, not a battery question.

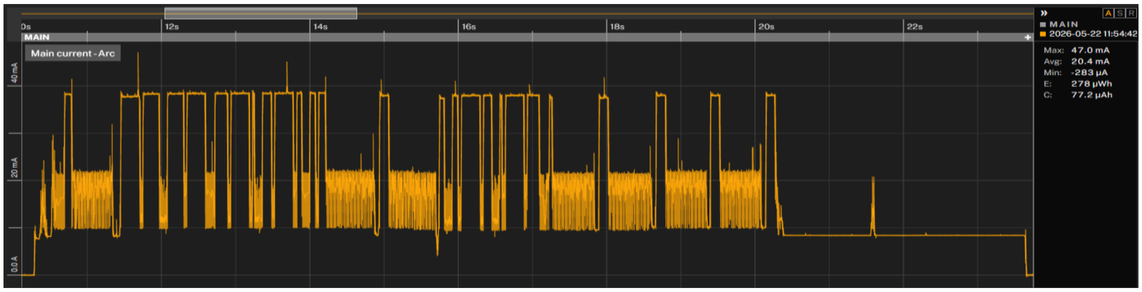

Figure 3. *ALT1350: 50B payload – 79 uAh*

- **Large payloads are bearer-sensitive.** At 1 KB the satellite event is meaningfully longer because of the geostationary link's latency. GEO NTN is not the right tool for high-throughput, latency-sensitive transfers and it is not trying to be.
- **The sleep floor matters most.** Across realistic cadences, the microamp deep-sleep current dominates the energy budget which is exactly where the ALT1350 architecture pays off.

From milliamp-hours to years

Per-event energy is the engineering number. Battery life is the customer expectation. Combining the measured per-event energy with the measured deep-sleep current, delivers a projected deployment lifetime across common reporting cadences and battery types.

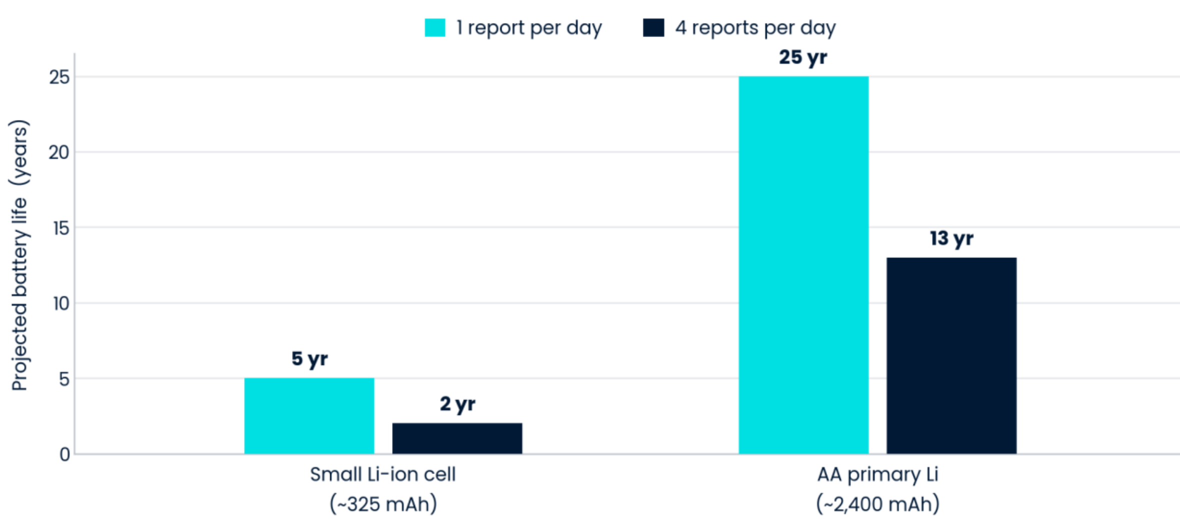

Figure 4. Projected battery life for the ALT1350 over Skylo NTN, by battery type and reporting cadence. Model assumptions: ~50 B payload per report, 80% usable-capacity derating, 2%/year self-discharge.

The deployment-economics takeaway

For the cadences that drive most field IoT, once a day to a few times a day the ALT1350 over Skylo NB-NTN sits comfortably in the multi-year battery-life regime, on small and primary cells alike. That is the threshold at which satellite stops being a compromise SKU and becomes a default capability.

And in practice, most deployments do even better. In a dual-mode design, terrestrial is the everyday path and NTN is called on only occasionally as an urgency or fallback mode when the device moves out of coverage, or when the terrestrial link can't get through. So the real-world energy budget is dominated by the far cheaper terrestrial events, with the satellite cost applied only now and then. The figures above treat NTN as the sole bearer, which is the conservative, worst-case view; a realistic mix of mostly-TN with occasional NTN stretches battery life meaningfully further. And, for those devices coupled with an optional small solar panel, the device lifetime can exceed the need.

Where this changes the conversation

Multi-year life on a satellite link unlocks a class of devices that previously had to choose between coverage and battery life. A few examples:

Segment	Why ALT1350 + Skylo, changes it
Agriculture & livestock tracking	Daily location, geo-tracking, and health pings from herds and fields far beyond terrestrial coverage: grazing land, remote farms, open range. It all runs on a single low-power SoC built to outlast the animal it's tracking. A dairy cow's five-year working life falls comfortably inside a collar's multi-year battery window, so once it's on, it's on for good."
Asset tracking	Sub-100-byte position and status reports that follow high-value assets wherever they travel across borders, ports, and coverage gaps with terrestrial and satellite on the same chip and SIM, so the tracker never goes dark.
Pipeline & grid monitoring	Threshold alerts (pressure, temperature, vibration) from infrastructure that was previously wired-only or simply unmonitored.

Segment	Why ALT1350 + Skylo, changes it
Maritime & cold-chain logistics	Reporting from containers and vessels far outside terrestrial coverage on the same SoC as the in-port path.
Environmental sensing	Wildfire, water-level, soil and air-quality nodes deployed where there is no power and no tower.
Lone-worker & safety	An always-available emergency uplink built into a wearable or vehicle device, not a separate satellite product.
Consumer devices - Wearables	Off-grid SOS and messaging built into a smartwatch or fitness band, not a separate satellite device. One low-power SoC handles both the everyday fitness features and the emergency uplink, so the wearable stays thin, light, and runs weeks on a single charge, exactly what consumers expect from a watch.
Pet Trackers	Location tracking for pets that doesn't quit when they run past the fence line, the property, or the last cell tower. One low-power SoC handles daily GPS tracking and satellite fallback, so owners always have a last known location, and the collar stays small and light enough for a cat or small dog to wear all day.

Designing for ubiquity

Ubiquitous IoT used to mean accepting either coverage gaps or a much shorter battery life. The data in this paper says that trade-off has shifted. With the ALT1350 and Skylo, devices can be designed for years of operation and global coverage at the same time on a single chip and a single SIM.

That changes what an IoT roadmap looks like. Coverage stops being a per-product decision and becomes a default. “Connected” and “satellite-connected” variants collapse into one. The conversation moves from “can we afford to add satellite?” to “what could we build if connectivity were simply always there?”

> **Going to satellite used to be a power-budget event. With the ALT1350 over Skylo NB-NTN, it is not.**