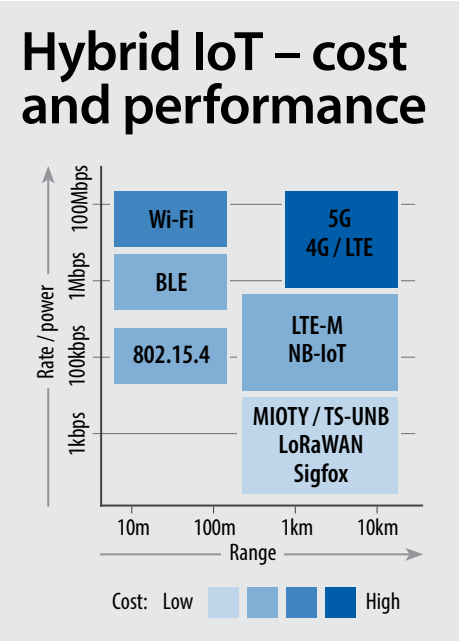
3 | Smarter power usage – the art of mixing and ditching tracking tech

The laser-focus on cost has brought innovation at the low end, with trackers optimised to make maximum use of the minimum tech

With cold-chain storage, we are getting into Vodafone's other IoT category: remote monitoring. With advances in IoT, the lines are blurring between tracking and monitoring as two functional aspects of the same discipline, geared around what might be termed 'remote asset-management'. Amman at u-blox describes the scene: "With time and position, these other measurements – temperature, vibration, acceleration, whatever – gain context and become meaningful."

We are also going outdoors, and out of range of short-range wireless tech, which is being deployed with tracking infrastructure in hospitals and other indoor venues. This narrative will not be tripped up by the relative merits of wide-area IoT technologies for outdoor tracking, just because *Enterprise IoT Insights* has run the rule over them already. (See the LPWA knockout match, between the cellular set in the red corner and the noisy, warring non-cellular brigade in the blue.)

But we should consider short- and long-range technologies together, briefly, in the context of the shift towards massive IoT. Because the new smartness, here, is not really about higher-grade embedded computing; it is about combining them efficiently and applying them creatively, in order to animate data trails around new asset-types. The key has been to budget this light-touch innovation on low margins and high volumes.



This trend towards hybrid IoT, making bedfellows of short and long-range wireless, is the subject of another long-form *Enterprise IoT Insights* report, available here. But it is worth briefly introducing outside commentary on this subject, as it makes clear the correlation between smartness and cheapness in pursuit of massive IoT. "There is a lot of multi-mode connectivity – and not just relying on GNSS, but on cellular and Wi-Fi, and BLE indoors," says Taylor.

Daniel Quant is vice president of strategic development at US-based MultiTech, a manufacturer which, as per its name, spreads itself across a range of connectivity types. He comments: "The market is moving towards multiple radio technologies in the same devices – so you have Wi-Fi transceivers in there to sniff out the SSIDs, and BLE and even LoRa to triangulate with beacon devices, and cellular or LoRaWAN to backhaul the data."

There are ways to arrange them in a single hardware design, and to prioritise them so the device shifts 'smartly' between. "You write a policy to rank and define position accuracy versus power consumption – so the device defaults to the least battery-consuming technology, and moves up the ranking if that's not good enough. The gubbins about which radio to use can be dictated in a configuration screen," says Quant.

He adds: "If accuracy is everything, and power usage does not matter, you can set those terms. If you're looking for the machine-that-goes-beep in a hospital, you don't want to know it is vaguely over there, you want to know which room it is in – it is no good being directed to the room

underneath, on the floor below in an emergency. But it can be quite dynamic, so you can move the index between the position and power ratings, even in the life of a product."

This new dynamism, to enable asset-owners to shift through the gears on location accuracy, brings longer-life to tracking devices, affording smaller and cheaper batteries, which opens new use cases. A geofence can be devised to spark the gear change; the tracking function might be practically dormant in a piece of equipment on a building site, for example, and triangulate between macro cells when the item is needed, and satellites when it goes off site.

"It is a very adaptive model, for sure," comments Quant. The shift to lower-cost trackers has necessitated a move away from power-hungry GNSS (global navigation satellite system) based positioning. Wi-Fi 'sniffing', which does away with the receiver unit, is effective in outdoor urban environments where MAC (media access control) addresses are as commonplace as house numbers; cellular positioning, still considered with suspicion, has value, too.

Chip-maker Nordic Semiconductor is another playing the field, a step further back in the stack than MultiTech. Kristian Sæther, product manager for cellular IoT at the firm, says GNSS will give five-metre accuracy and cellular will give 50-metre accuracy. "GNSS is great for tracking cars, to know where they are on the road, continuously. But you don't always want or need that accuracy – just to know you're in the right campus or city, and to know once an hour or once a day. But that is it, in many cases."

Quant is a little doubtful; the industry has been looking at ways to bring enhanced positioning to cellular for two decades already, he notes, and lots has been done in the meantime to reduce the impact of GNSS on the battery budget. Techniques for increasing NB-IoT positioning accuracy, based on the same as for assisted-GNSS (A-GNSS) and Wi-Fi, and dating back to LTE 3GPP Release 9, were introduced a couple of years back in Release 14 (in 2017).

These included a method for 'downlink

TRACKING CASE #3

Nafta Frigo + NB-IoT – cold-chain monitoring

Mexico-based logistics firm Nafta Frigo specializes in cold chain warehousing and distribution. It has worked with California-based tracking provider Roambee to deliver reliable 'real-time' cold chain temperature monitoring for long-haul shipments, including new storage and transport monitoring in 'deep freeze' conditions.

The company's success with cold-chain warehousing and short-haul logistics had seen demand spike for longer-haul deliveries, and its offering to expand from frozen food shipments to deep freeze products. Its rising demand and widening remit forced it to engage with third-party transport and warehousing providers, as well.

Roambee provided a cellular-based tracker and temperature logger for the company to record and send GPS location data and ambient temperature data over either a 2G or an NB-IoT network. The solution dovetails with BLE and Wi-Fi indoors, as well. The point was to enable a live feed, via cellular, to detect spikes in temperature in transit.

The alternative, to download data from sensor devices on arrival, is not an option; the information about spoilage comes too late, and products are discarded, as they would be without any monitoring at all. The Roambee solution also established an automated analytics system to issue live alerts about temperature 'excursions', as well as off-track deliveries in case of theft.

In both cases, it has enabled Nafta Frigo to take immediate action to secure and preserve frozen foods, pharmaceuticals, and other temperature-controlled products. Roambee's cellular-based tracking solution is well deployed in mobile operator channels, including with US carrier AT&T, Canadian operator Rogers Communications, and German outfit Deutsche Telekom.

Cold storage – cellular IoT is being deployed to monitor warehouses and trucks / (Image: Nafta Frigo)

multilateration' (triangulation) called 'observed time-difference of arrival' (TDOA), which derives the location of a device by cross-calculating time-stamped signal strengths (RSSI) and signal directions ('angle of arrival') from multiple eNodeB stations in the network. The rise of beamforming, focusing the signal towards specific receivers, has multiplied the antennas in play, and hence the ways to run the maths.

Still, it is mostly talk, and workshopping, suggests Quant. "Twenty years later, we are still discussing [these cellular] techniques. Which is not to say it's not happening, but we are yet to see it in widespread deployment. In a macro environment, most devices are shipped with GNSS, even though GNSS drains the battery," he says. The point is, with dynamic controls in the backend, hybrid antenna arrays in singular IoT units cover a multitude of wins.

"At this point, devices need reliable data location accuracy that may vary depending upon urgency and location. Multiple radio technologies enable [positioning] indoors and outdoors, and in [built-up] city blocks – down to sub metre accuracy," says Quant. He notes the applicability of LoRa-based positioning, which MultiTech promotes, as well. "GNSS, BLE, LoRa, RFID, and cellular systems have all come a long way to doing that together."

On GNSS, Amman at u-blox notes real-time kinematic (RTK) positioning has brought even higher precision to satellite positioning by using the 'phase' of the signal's carrier wave and running a deal of processing over the top to make real-time corrections; RTK brings GNSS accuracy to centimetre-level, compared to metre-level with straight positioning with GPS, GLONASS, Galileo, BeiDou, and the other national GNSS systems.

The Swiss-based firm – which started two decades ago, making miniaturised GPS receivers for the old M2M market, and carved a name in automotive tracking, before expanding with cellular, Bluetooth, and Wi-Fi modules – is enabling bike sharing with RTK-based GNSS positioning. "The city doesn't want bikes lying around, and the operator wants to optimise supply. And for that, they need high-precision to locate bikes very accurately," says Amman.

But the u-blox offer is notable because it brings the price point for the positioning system down, as well. "GNSS systems are in the $1,000-range; we offer a much lower price point with much higher accuracy – and it goes, as well, with cellular connectivity to backhaul the data and BLE to connect with the customer's phone."

On cellular, there is some incidental disagreement; Sæther at Nordic reckons cellular will, in the end, govern the idling position in most tracking cases, as well, even if GNSS is retained as the sport function in the gearbox. "Most tracking products will default to cellular positioning, and go onto GNSS when more granular data is required." He comes up with the same use case about tracking equipment inside and outside of a geofence on a building site.

Either way, gear changes drain the tank, and dictate whether the use case is even viable. In asset tracking, as discussed, the king-metric is cost; as the sector reaches for higher volumes, the calculation turns on ever-finer margins. Breihan at HID compares semi-comatose (passive) RFID tracking in retail outlets to hyper-critical (active) RFID tracking in hospitals; again, the same scenarios are always quoted, as he fixes on stray Covid-19 equipment.

"A blood analyser machine, no bigger than a shoe, costs $10,000; I want to know where that is, all the time – and whether or not it has been stolen. 'Right, so it's in the operating theatre, or in room 12 on floor two.' But if I am tracking 50,000 t-shirts, I don't want an expensive beacon. Passive RFID tags are cheap – 50 cents, each. They let you know these things are inside a certain perimeter; you just don't know where they are inside the perimeter."