

Leading the 5G IoT Race: Key Industry Insights Series 3. Asset Tracking

By **Robin Duke-Woolley**, CEO, Beecham Research



Logistics is about the safe transportation of goods to customers across the world. This entails tracking goods from production, storage (such as warehouses), through delivery and receipt by the customer. As a result, asset tracking is at the heart of modern life. Suppliers increasingly need to know where their assets are at all times and its condition, since late delivery may hold up further supply chain processing by partners.



1. Asset tracking is growing rapidly, addressing key concerns

Trailer and cargo container tracking is a specialized area within asset tracking focused on enhancing operational efficiency and security within transport chains. This approach typically involves real-time tracking solutions that include data logging, satellite positioning, and data communication to a back-office application through cellular or satellite networks. These devices enhance decision-making, improve asset utilization, save costs, and reduce environmental impact for supply chain stakeholders.

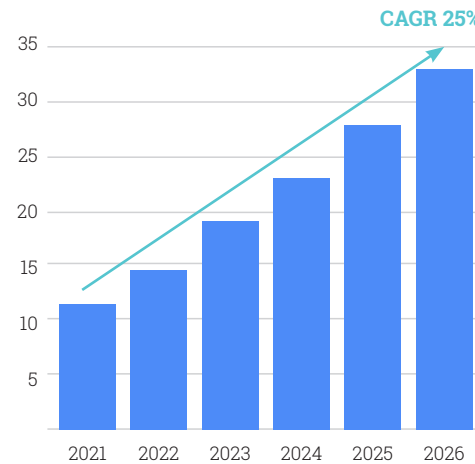
Figure 1 indicates the rate of growth over the next few years in this sector of the market. Such tracking devices are adaptable for monitoring various assets such as trailers, intermodal containers, rail freight wagons, air freight Unit Load Devices (ULDs), or the cargo itself. In more detail, a further breakdown for these subsegments is shown in Figure 2.

As is clear from this, the main subsegments are general cargo, air freight, intermodal containers and trailers. Key challenges for these are as follows:

- (a) **Cargo Theft:** Tracking solutions are essential for preventing theft, especially of high-value goods, by enabling door-to-door tracking and alerts for unauthorized events such as opening container doors while in transit, or temperature variations of the cargo.
- (b) **Cost and Battery Life:** Lower hardware costs have broadened the application of real-time tracking, but low cost and long battery life in devices is still a high requirement.
- (c) **Coverage Limitations:** While cellular technology (2G/3G/4G) offers sufficient performance in terms of area coverage, network latency, and data bandwidth, its coverage at sea and in rural areas is limited.
- (d) **Device Durability:** For long-haul sea transports, tracking devices need to be durable. For example, the tracking device includes a humidity sensor, and a higher IP classification (IP67), making it suitable for long-haul transport on sea and rail.

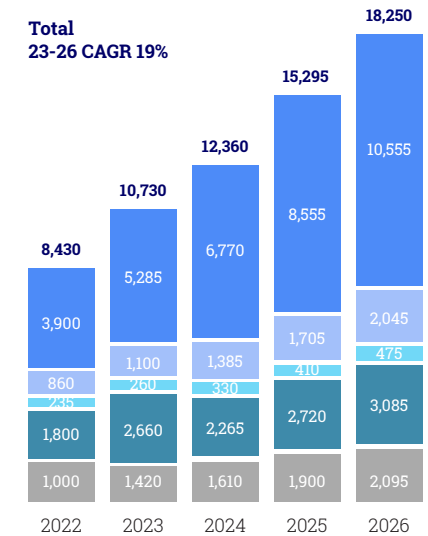
Each of these issues has been addressed by Fibocom in its design of modules for the asset tracking market – see later. A particular area is addressing coverage limitations, and for this there is now an opportunity to use satellite coverage integrated with cellular, to provide uninterrupted coverage worldwide.

Installed base of trailer and cargo container tracking units worldwide



Source: Berg Insight

World trailer and container tracking device shipments (k units)



- **General Cargo** 23-26 CAGR 26%
- **Air Freight Cargo** 23-26 CAGR 26%
- **Rail Freight Cargo** 23-26 CAGR 22%
- **International Containers** 23-26 CAGR 5%
- **Trailers** 23-26 CAGR 19%

Source: Berg Insight

Figure 1: Forecast of installed base growth for trailer and cargo tracking (m units)

Figure 2: Breakdown of trailer and cargo container tracking forecast

2. Adding satellite to 5G for uninterrupted worldwide coverage

Different satellite systems – also referred to as NTN or Non-Terrestrial Networks – have been used for years to provide services such as TV broadcasting, navigation, communications, surveillance, weather forecasting and emergency systems. Figure 3 illustrates the orbits of the three main satellite types – geostationary (GEO), medium-Earth orbit (MEO) and low-Earth orbit (LEO) – in comparison to a commercial aircraft and high-altitude platform system (HAPS) providing local service coverage. The opportunity now is to integrate NTN with Terrestrial Networks (TN) like cellular to provide complete coverage of the Earth's surface anywhere.

To that end, as part of the continuing development of 5G, 3GPP Release 17 has specified the use of GEO and LEO satellites for IoT connectivity via NTNs in a track known as IoT NTN. This track includes adaptations to NB-IoT and LTE-M that will enable them to support NTNs.

Essentially, integrating 5G with satellite, as envisaged in 3GPP Release 17, puts a stationary cell tower in the sky when considering GEO, or a fast-moving network of cell towers when considering LEO. It means a single SIM will be able to connect to both TN and NTN-compliant satellite networks.

Taking the case of GEO, incumbent satellite connectivity providers work with proprietary devices and communication protocols. These are relatively expensive due to relying on dedicated devices and high cost of infrastructure. As a result, customers have to invest in equipment that can only be used with one constellation and are therefore locked in. This is justified for critical applications but it limits the range of applications that can be cost effectively served.

In comparison, use of 5G introduces the opportunity to use standardised hardware made by many different suppliers for both TN and NTN use. This will significantly increase the addressable market. Fibocom is addressing this market opportunity with its 3GPP R17 compliant LPWA module MA510 with NTN capability and 5G LPWA MS180 module.

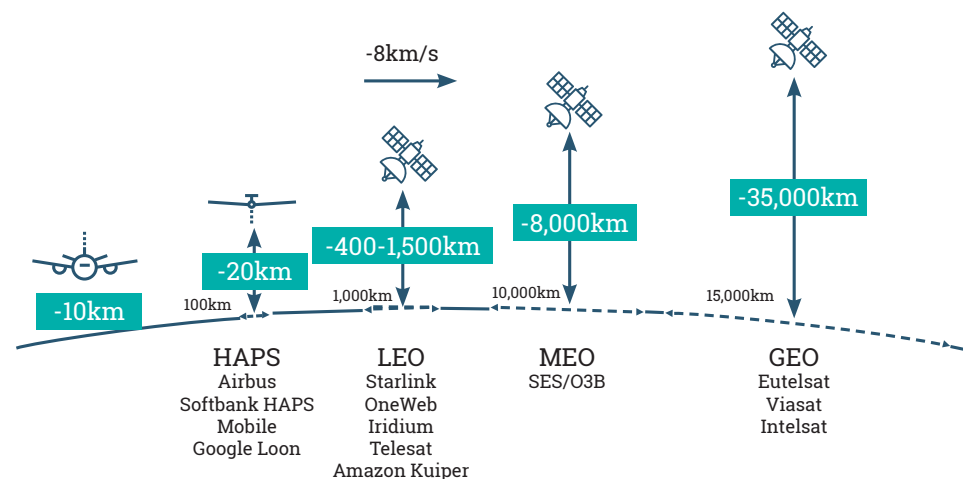


Figure 3: Typical altitudes and footprints of existing satellite systems

Source: Ericsson

3. Fibocom recent announcements related to asset tracking

Fibocom Unveils NTN Module MA510-GL, Enabling Satellite and Cellular Connectivity to IoT Applications

During MWC Shanghai in July 2023, Fibocom announced the global launch of the Non-Terrestrial Networks (NTN) module MA510-GL (NTN) and showcased the live NTN demonstration based on Qualcomm's NB-IoT over NTN technology. The module focuses on enabling satellite and cellular communication for IoT devices at global reach, making it possible to connect reliably and seamlessly anywhere, anytime.

Shanghai, China – July 4th 2023 - Fibocom unveils the Non-Terrestrial Networks (NTN) module MA510-GL (NTN) at MWC Shanghai 2023. Compliant with 3GPP Release 17 standard, the Qualcomm® 9205S modem empowered module MA510-GL (NTN) is capable of exploiting the highly resilient GEO satellite communication and cellular connectivity for IoT scenarios such as maritime transportation, emergency communication, scientific research in rural areas, etc.

Fibocom MA510-GL (NTN) is a high-performance NTN module, which is tailor-made for the global IoT market. Developed on the Qualcomm® 9205S modem, the module supports GEO satellite communication as well as LTE Cat M/NB2/EGPRS cellular communication that is perfectly applied for massive IoT applications. Adopting LCC+LGA form factors, MA510-GL (NTN) integrates multiple interfaces such as UART/USB/I2C/I2S for industrial customers. Built-in with GNSS and equipped with eDRX capability, the module is suitable for IoT applications with low power consumption and ultra-small size, such as maritime transportation, emergency communication, and scientific research in remote areas while maintaining long battery life.

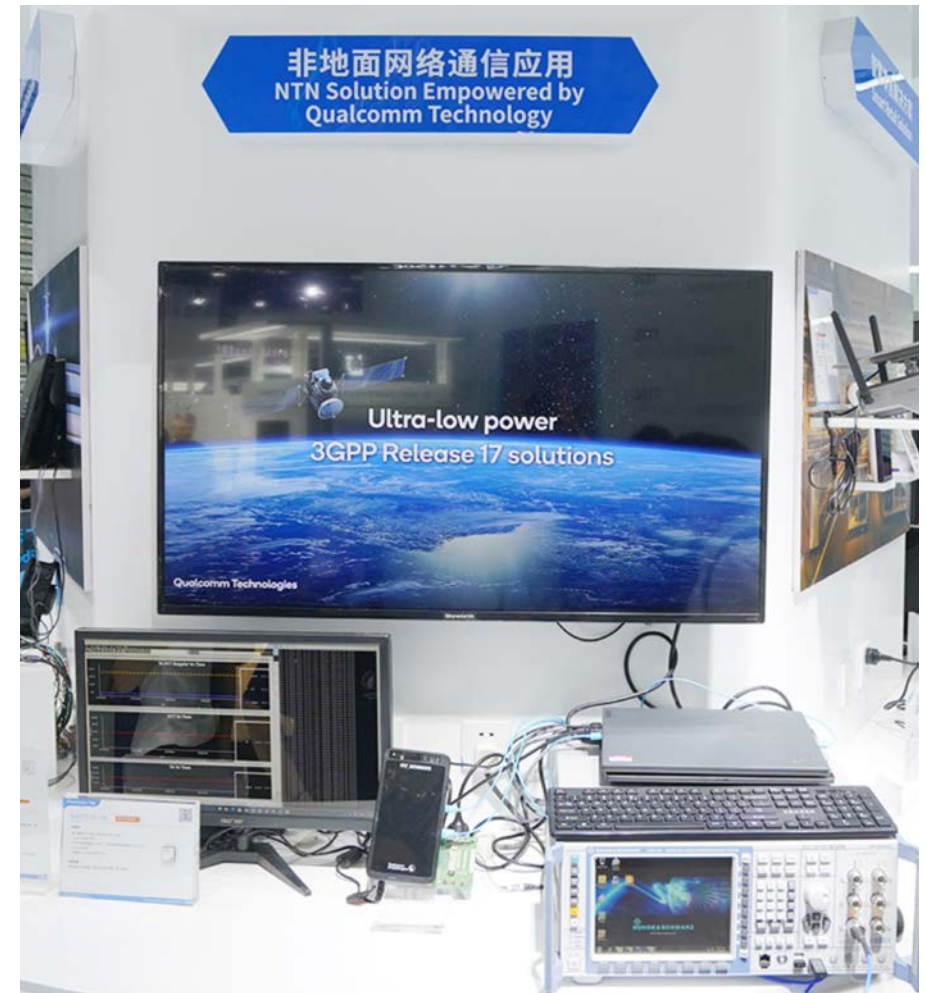


Figure 4: NTN live demo showcased during MWC 2023, integrated with Fibocom's MA510

Fibocom Launches New 5G LPWA Module MS180 Series Based on Sony's Altair ALT1350 Chipset at Embedded World 2023

Nuremberg, Germany – March 13th, 2023 –Fibocom announces the cooperation with Sony Semiconductor Israel (Sony), a leading provider of Cellular IoT chipsets, in launching the 5G LPWA module MS180 series. Powered by Sony's Altair, best in class ALT1350 chipset, the Fibocom MS180 module series is designed to provide ultra-low power consumption and reliable wireless connectivity for the 5G massive IoT market.

With optimized power consumption, Fibocom MS180 series is a SOC integrated LPWA module with an AI engine for edge processing, supports the latest 3GPP Release 14 through 17 of LTE-M/NB-IoT, unlicensed spectrum communications protocols, Non-Terrestrial Network (NTN) satellite communications, Wi-Fi SSID-based location, and Short-range radio. MS180 series will also adopt a compact footprint of less than 200 sq millimeters to be best utilized in the 5G Massive Machine Type Communication (MTC) applications such as smart metering, asset tracking and connected health. The MS18 series adopts LGA form factor, with ultra-compact size and optimized low power consumption, offering unprecedented battery life up to 15-20 years.

Fibocom Announces LTE Cat 1 bis Module MC610 Shaping a Connected Future

Shenzhen China - July 15, 2021 - Fibocom launches its new LTE Cat 1 bis module - MC610. Coming with a rich set of interfaces and supporting multiple operating systems, the Fibocom MC610 module is designed to provide stable and secure connectivity for the low and medium rate IoT market, which is ideal for IoT scenarios such as smart payment, sharing economy, IIoT, asset tracking and telematics.

The Fibocom MC610 module is a high-performance LTE Cat 1 bis module supporting VoLTE (Voice over LTE), Audio, Recording and SMS. Adopting LCC+LGA form factor, the module is pin-to-pin compatible with the Fibocom LTE Cat M module MA510, allowing users to easily switch between different technologies without changing hardware. Supporting LTE FDD frequency band with a theoretical downlink of 10 Mbps and an uplink of 5 Mbps, Fibocom's MC610 module enables seamless 4G experience, which is also backward compatible with GSM frequency band.

The Fibocom LTE Cat 1 bis module MC610 supports Windows, Linux and Android operating systems, coming with a rich extension of interfaces including USB, UART, SPI, I2C etc. MC610 can be widely applied in IoT scenarios such as smart payment, sharing economy, Industrial IoT (IIoT), asset tracking and telematics and so on.

4. Fibocom module range for asset tracking

Figure 5 shows a typical example of a Fibocom tracker solution, with the single module incorporating traditional cellular modem functionality and integrated MCU.

In terms of the key challenges for asset tracking outlined earlier, Fibocom modules offer the following:

Cargo Theft

Tracking devices play a vital role in security. They can show the container's travel history and ensure the integrity of the cargo with intrusion detection sensors, e-seals, and e-locks. Advanced sensors can also detect illegal or dangerous goods or movement inside a container.

Cat 1 bis modules and devices have a single antenna and a single receive RF chain, in contrast to the two antennae needed for Cat 1 devices. LTE-M and NB also offer a cost advantage: the RF front end needs no surface acoustic wave filter (i.e. it is SAWless) due to the half-duplex nature of the communication. As a result, using Fibocom Cat 1 bis and LPWA modules can lower the cost for widely implemented tracking devices.

Cost and Battery Life

Fibocom LPWA and Cat 1 bis modules have high integration, integrating GNSS, WiFi Scan, BLE, GNSS and iSIM. They also support OpenCPU, saving on MCU cost. They are very small in size, which can save PCB area, and low power consumption to save on battery cost. All of these features can greatly reduce the overall cost of tracking devices. Both also support PSM and eDRX low power modes, which greatly extend the battery life of devices.

Coverage Limitations

LPWA modules provide global network coverage with triple-mode Cat M/NB-IoT/GPRS. For regional deployment, Cat 1 bis is based on the existing LTE network and completely reuses the existing LTE resources. The Cat 1 bis product frequency band covers the 4G band of China, Europe, India and Latin America, while North America, Australia and Japan do not have Cat 1 bis so use the triple-mode LPWA is used there.

In addition, we support satellite connectivity protocol based on 3GPP Release 17 standards (NTN).

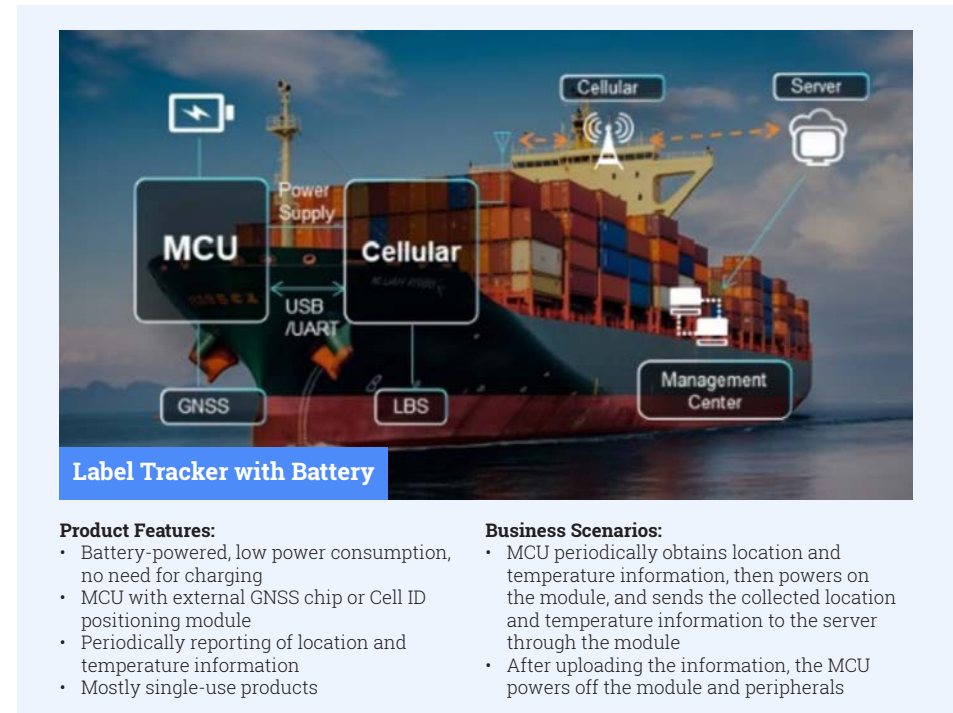


Figure 5: Fibocom tracker solution architecture example

Device Durability

Fibocom's modules utilize shielding cover bent components, where the adjacent sides of the bent edges interlock, ensuring a pentagonal gap that remains less than 0.08mm. In addition, Fibocom applies polyolefin resin three-proof paint to the module based on this design and has conducted high-temperature, high-humidity reliability testing. This conforms to IP67 requirements. Rigorous testing has confirmed that this design does not affect RF performance, while also providing more reliable protection for the module.

Fibocom's range of modules for asset tracking cater for different deployment requirements. For global roaming deployment, LPWA options provide for NTN support and integrated Wi-Fi scan with extreme low power consumption. For regional deployment, Cat 1 bis is offered, both with and without 2G fall back:

- MA510 is a high-performance LPWA module compliant with 3GPP R17 standard. Developed on the Qualcomm® 9205S modem, the module supports GEO (Geostationary Earth Orbit) satellite communication as well as LTE Cat M/NB2/EGPRS cellular communication that is perfectly suited for massive-IoT applications.
- MS180 is a SOC integrated LPWA module with an AI engine for edge processing. It supports all the latest 3GPP Releases 14 through 17 for LTE-M/NB-IoT, unlicensed spectrum communications protocols, Non-Terrestrial Network (NTN) satellite communications, Wi-Fi SSID-based location, and short-range radio.
- MC610 is an LTE Cat 1 bis wireless communication module. The product supports LTE, GSM dual-mode communication, as well as VoLTE, Audio, Recording, SMS, Wi-Fi Scan, BLE and other functions. The PIN package is compatible with MA510 module to meet the requirements of Cat 1 and Cat M products.
- MG661 is a high-performance LTE Cat 1 bis module that adopts the LGA form factor. It supports 4G frequency bands in Europe, Southeast Asia, Middle-east and other regions.



5. One-on-one interview with Fibocom



Robin Duke-Woolley
CEO
Beecham Research

Robin Duke-Woolley (RDW), CEO of Beecham Research, interviewed Kevin Guan (KG), Director of MTC Product Marketing at Fibocom, on how Fibocom is supporting the need in the logistics sector for regional and global asset tracking.

RDW: 3GPP Release 17 introduces the opportunity for 5G cellular integrated with NTN (Non-Terrestrial Networks) – satellite systems. When do you see this becoming available in the market and for what typical applications initially?

KG: Currently, we see the biggest interest in NTN is for asset tracking applications such as trackers on trailers, sea containers, rail freight wagons because most applications may operate in areas beyond the reach of traditional cellular networks. Making real time tracking over oceans and other remote locations will be very important. In that case, many of our clients in this industry are discussing NTN with Fibocom. At the same time, we acknowledge that NTN applications still require time to develop because currently NTN use for asset tracking is mainly using the GEO (Geostationary Orbit) networks. These networks have not completely solved the coverage issue yet. We work with NTN service providers worldwide. Currently, the deployment of satellite networks is still at an early stage and the coverage is limited to certain areas. Another big challenge is the cost. Current tariffs are too high compared with cellular tariffs, so it's less appropriate for large scale commercial use at present. Currently the whole communications ecosystem, including traditional mobile operators, is involved and exploring how to combine those NTN tariffs and cellular tariffs to make a more affordable offering for commercial use. So, in that case our preliminary estimate is for initial commercial trials maybe starting in 2024, then with larger scale commercial use expected after 2025.



Kevin Guan
Director of MTC
Product Marketing
Fibocom

RDW: What is required in the module to implement NTN? For example, does it need more power for NTN use compared with TN (Terrestrial Network) use?

KG: This is what our customers are frequently asking us. In fact, our cellular LPWA module MA510 which supports NTN is already in mass production and has been installed in larger quantities because it supports NB/Cat-M/2G triple mode. Now it is extending new capabilities to support NTN, which is compliant with 3GPP R17, so quad mode but what needs to be done is actually very simple. Hardware does not need to be revised because the NTN version maintains the same pin design and the only change is the internal chip. So the module will be replaced with a version that supports NTN. Additionally, customers tell us they most likely do not need to go through a redesign because most linear antennas can be used for NTN. There is no significant increase in power consumption compared with cellular because NTN operates in the frequency band close to NB-IoT, so its operational power consumption is not higher. This makes it very suitable for asset tracking using batteries.

Something that needs to be catered for is a maximum TRP (Total Radiated Power) of 23dBm to ensure regular transmission in power class 3. Also, GPS must be enabled to provide location information for satellite search. This is easy for our customers because Fibocom's MA510 supports GPS as an option.

RDW: Moving on to eSIM and iSIM, how significant do you see iSIM as being in the asset tracking market and would you expect eSIM and iSIM to coexist in this market?

KG: Currently iSIM is a very hot topic, especially this year. But right now, it has not yet been commercialised. We think this is because the cost of iSIM is still higher than traditional SIM cards and the cloud

management also entails additional cost, because the iSIM requires cloud management. For iSIM to be widely applied in asset tracking, it requires collaborative effort among mobile operators, chip manufacturers, module vendors and cloud platforms. Meanwhile, eSIM technology is already mature so we anticipate that eSIM and iSIM will coexist in the market for a long time.

Different asset tracking applications have different requirements. Railway wagons and containers for cargo tracking do not need to save space, so it's not necessary to have the SIM integrated. I believe for smart labels, personal asset tracking and similar applications which need small size and need much less power consumption will be the key market for iSIM. For most asset tracking applications operating right now in the market, eSIM or even traditional SIM cards should be sufficient.

RDW: Where do you see Cat 1 being used compared with NB-IoT and LTE-M? For which typical applications in asset tracking?

KG: In China, Europe, India and Latin America LTE Cat 1bis is already being used extensively in commercial applications, using Fibocom's MC610 and MG661 series modules. This is because the cost of Cat 1bis has significantly dropped and is now only just higher than NB-IoT. Additionally, the power consumption of Cat 1bis has approached that of NB-IoT. Currently we are seeing use in regular asset tracking applications such as trailers and fleet management already using Cat 1bis. However, there are some regions like North America, Australia and Japan that do not support Cat 1bis, so for global applications it is not feasible. In that case Cat-M, NB-IoT and 2G in triple mode are still required for global roaming applications like cargo containers and sea transportation. Also, Cat 1bis modules – which are 4G – do not support NTN because NTN starts in 5G Release 17, so only the Cat-M and NB-IoT LPWA module could extend to support NTN.

RDW: So there is a different solution for regional versus global tracking?

KG: Yes. For regional tracking, for example in China, or in Europe for applications involving fleet management or trailers in one country, Cat 1bis is sufficient. On the other hand, for global roaming especially for applications involving North America, Australia and Japan, they have Cat 1 but not Cat 1bis, so then they need a triple mode LPWA module.

RDW: Some Fibocom modules include Wi-Fi scanning. Can you clarify what that provides?

KG: The Wi-Fi scan feature is primarily used to support indoor tracking. Outdoors, cellular coverage is very good but when you go indoors, if a highly accurate positioning

is needed then the Wi-Fi scan feature can be used. In that case, indoor tracking is particular useful for example for warehouses, for in-factory use, for personal asset tracking on-site, and for patient tracking in a hospital. So it is useful for a wide range of additional applications.

RDW: Some Fibocom modules incorporate bent shielding. What is the benefit of that?

KG: The main reason we do this is because asset tracking operates in harsh environments, such as sea transportation and railway tracking. It is essential for them to be moisture proof and salt-spray resistant. To ensure this, the module and the PCB surface are coated with a carbon fibre coating. We use components with very small gaps in the shielding cover to prevent anything entering the module during operation and also for use in high temperatures. To verify this, Fibocom has conducted extensive technical quality validation procedures.

RDW: Are there other key features that Fibocom offers in its modules for the asset tracking market?

KG: Many customers utilise Fibocom's Open CPU functionality to further reduce the overall cost of their solutions. For most applications, our customers normally require use of an MCU in their devices for local data processing and of course a modem for the connectivity. They can replace all of this with the Fibocom module CPU functionality, with the application running on the CPU in the module. This saves on the total cost of the device, which is a key issue in the asset tracking market.

RDW: So they can use the CPU in the module as opposed to one on the device circuit board and therefore save cost. Are there other features that Fibocom modules also offer?

KG: Our module integrates more and more functions to save the total cost. For example, we also offer Wi-Fi scan. In addition, we offer Bluetooth functionality, which is supported by Cat 1bis. Those features are currently the most interesting for our customers.

RDW: By incorporating more of these features in the module, would that also reduce not only the size of the device but also the power consumption?

KG: Customers want to use for example Cat-M and NB-IoT in different countries and then integrate other features both for keeping the size down and for reducing the power consumption – saving the battery. The more integration there is, the better for them. This reduces the battery cost as well as the PCB space. In this way, our module can help customers make their whole solution more competitive in the market.

6. Summary

Fibocom's modules are used in a wide variety of IoT asset tracking scenarios, including fleet management and cargo tracking, utilities payments, smart cities, after-market auto location and many more. Fibocom has been working in this area since 1999 and in that time has focused on the research and development of wireless modules for 2G through to 5G and beyond towards 6G. Building the foundation for the digital world and everything associated with a 'smart life' has always been Fibocom's mission.

