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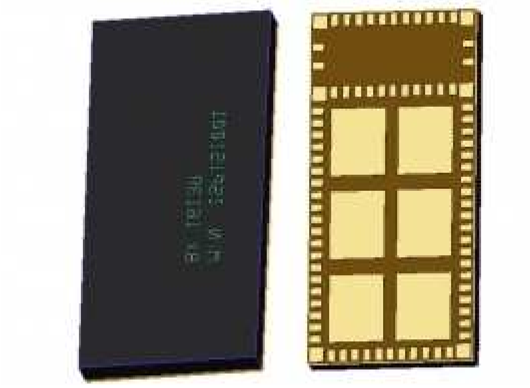

Ultra-Wide Band (UWB) has for some time been the "Cinderella" technology of the RF world – seemingly never quite receiving an invite to the wireless party that has been in full swing over the last decade.

Whilst Bluetooth, WiFi, GPS and 4G are well known to the average teenage smartphone user, even industry insiders can return with a quizzical look when the UWB acronym is thrown into conversation.

The technology has been around since 1901 when Marconi used spark gap radio transmitters to send Morse code data across the Atlantic, so it isn't new. Current UWB uses the unlicensed bands between 3 and 8 GHz, so in theory offering up a nice chunk of increasingly crowded spectrum to play with. What has been less clear is what to do with it.

Various use-cases have been tried without finding any real market traction. Wide-area networking, high speed WiFi, ultra-fast "contactless" data transfer have all been mooted as applications. A number of silicon vendors (Staccato, Alereon, Wisair, and more) have come and gone pinning their success on the technology.

Perhaps the diversity of possible applications has been one of the problems, because UWB is not really a standard, but more a method of radio transmission. In essence, UWB is a technology for transmitting information spread over a large bandwidth; this should, in theory and under the right circumstances, be able to share spectrum with other users. In more precise terms FCC and the International Telecommunication Union Radiocommunication Sector (ITU-R) currently define UWB as an antenna transmission for which emitted signal bandwidth exceeds the lesser of 500 MHz or 20% of fractional bandwidth.

Now there is a new wave of interest in UWB, but with the application this time being precise distance measurement and indoor positioning. There's a real optimism that this time UWB may have found a niche that it can really claim as its own.

Of course, after the false starts, a degree of scepticism might be in order, but there are some good reasons to think this is the right use-case for the technology. To start with, the ubiquity of GPS means positioning solutions are widespread, and so the concept is well understood, with a plethora of software and systems already developed. But GPS sometimes doesn't provide the necessary accuracy, and of course may stop working altogether inside buildings.

There are other solutions for indoor positioning – using Bluetooth beacons, or Wi-Fi access points for example – but frankly, these don't work very well. These solutions are based on signal strength, and there are simply too many factors that can vary signal strength by 50% or more (for example the orientation of a smartphone). By contrast, UWB positioning is based on time of flight measurement of an extremely narrow pulse, so it can achieve high accuracy, and is not sensitive to variations in signal strength. The result is that one can achieve accuracy of 10 centimetres with UWB, over measurement distances of up to 50m, whereas signal strength based methods struggle to achieve accuracy of greater than +/- 1m, over a much shorter range.

One further advantage of this method can be found in the domain of security – another hot topic of the day. Many cars these days have keyless entry systems, which effectively detect proximity of the key through signal strength. Boris Danev and his associates have shown (in a real practical experiment, not just theoretically) that these systems can be often quite easily be hacked via a "relay-attack" with off the shelf electronics. A UWB-based system is resistant to this kind of attack, as the time of flight method of distance measurement is extremely hard to fake. The same applies to other wireless entry systems.

These concepts may be interesting, but to implement solutions, working technology is needed. Fortunately there are a number of vendors supplying them. On the silicon side, the most advanced is the Irish vendor Decawave, which already has its first chip on the market (DW1000), and is already working on the next generation. However there are others such as BeSpoon and 3DB Technologies following on behind, and the big players of the silicon world are keeping a close eye on the market, ready to step in at the first signs of real traction.

Silicon is not enough on its own, though. Customers need a complete working solution, and the RF design required to generate wide-band transmissions over a large spectral range are far from trivial. Here RF module specialist Insight SIP is providing solutions, offering a fully functioning, certified module complete with integrated antenna, based on the Decawave solution, with others to be offered when silicon is available.

Insight SIP has been working on UWB technology for several years, in particular tackling the challenging antenna issues involved in working with such a wide frequency band. The UWB spectrum is divided in two for regulatory purposes (the unimaginatively named 3-5 GHz “low-band” and 5 to 8 GHz “high-band”). Not all territories permit use of both bands, so any solution for global markets has to be flexible enough to use either band on demand.

Insight SiP has developed a range of innovative miniature antennas that fit directly above the RF components in small system in package (SiP) modules. Combining the antenna with the electronics in a single package makes deployment of UWB as simple as mounting a single QFN style device on a PCB.

There are a number of companies starting trials with the technology, with applications in automotive, warehousing and asset tracking. Gemalto, the secure element vendor, is leading a large European project that uses the technology to combine secure data exchange with accurate positioning.

There seems little doubt there will be a market for the technology – the question is more how big it can be. The holy-grail for the vendors of course would be for the technology to be adopted inside the phone. This may be a little way off, but being able to accurately and securely position a phone could open up a number of interesting use-cases – for instance payments, or passing an airline boarding gate, but without having to take the phone out of your pocket. What past history has shown is that if a wireless technology proves useful, it migrates inside the phone quite quickly.

In the short term it will be standalone solutions that kick-start the market. Nevertheless, UWB is back, with a new role and a new lease of life, and it’s the wireless technology to watch for the second half of the decade.

Insight SiP has designed an extremely small integrated SiP combining UWB, Smart Bluetooth and an ARM Cortex M4 processor, together with both UWB and Bluetooth antennas in a small package whose size is only 9x19x1.5mm.

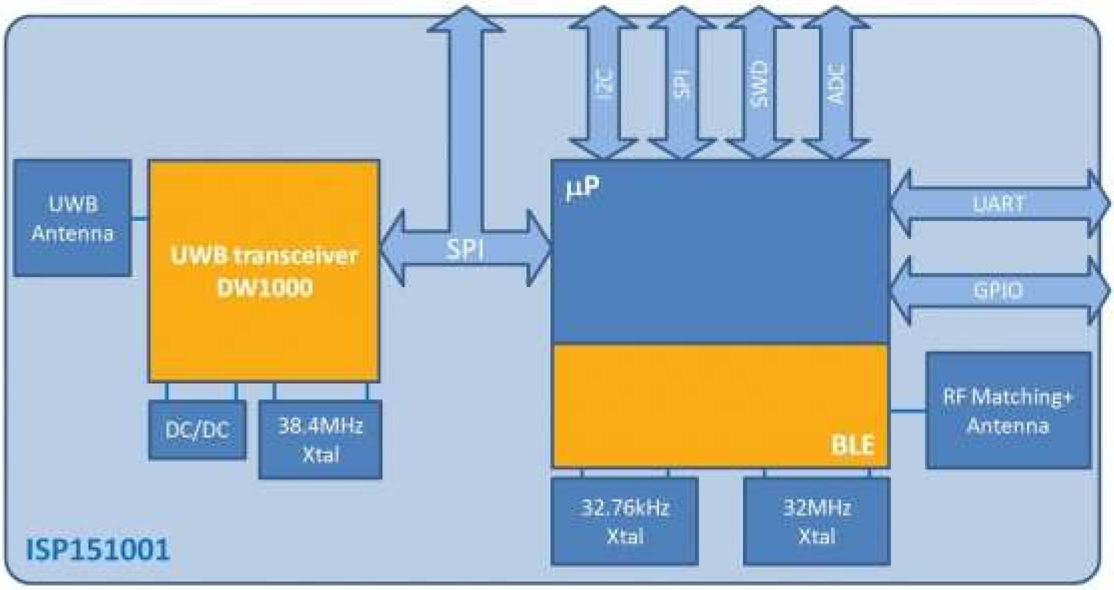

Fig. 1: Insight SiP’s ISP151001 module combines an UWB transceiver, Smart Bluetooth and an ARM Cortex M4 processor, packed with the necessary antennas in 9x19x1.5mm package.

The module is based on the Decawave DW1000 transceiver and the Nordic Semiconductor nRF52 Smart Bluetooth ASIC. A smaller variant of the product that does not include the Smart Bluetooth function is also available, measuring 9x15x1.5mm.

The ISP151001 outline is shown in figure 2: it has a 43% smaller footprint than the original PCB based Decawave reference module that only includes the transceiver, the antenna and the crystal; yet it is 50% thinner.

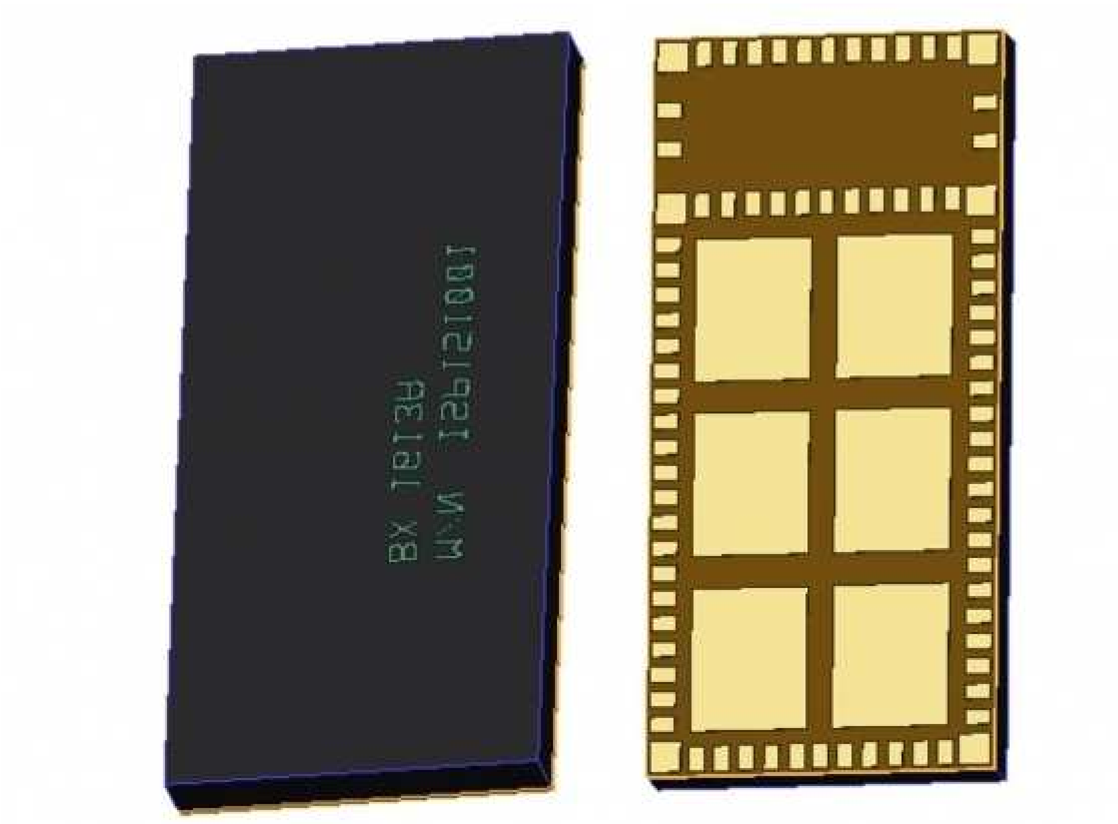

Fig. 2: The ISP151001 UWB Smart Bluetooth module measuring 9x19x1.5mm.

The small size of the complete solution is possible thanks to the combination of very dense SiP assembly on a state of the art SiP substrate. This is coupled to a proprietary over IC antenna design that is integrated into the package in the same way as a metal shield. Figure 3 shows an outline of the module with the position of the antenna.

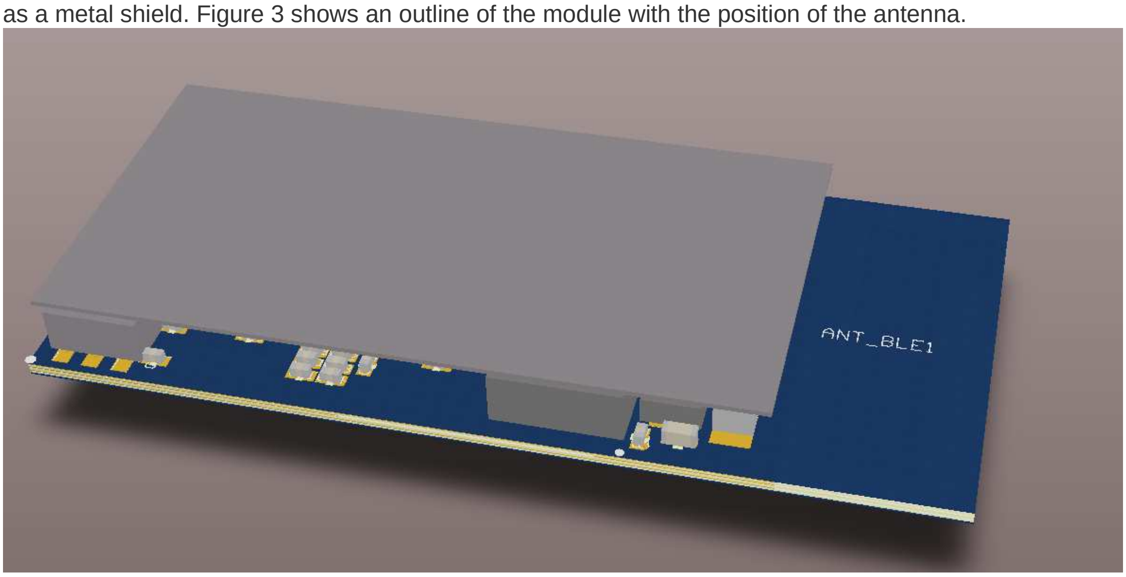

Fig. 3: Outline of the ISP151001 module showing the antenna.

About the authors:

Nick Wood is President of Insight SiP – www.insightsip.com – he can be reached at nick.wood@insightsip.com.

Christopher Barratt is Chief Technical Officer at Insight SiP – he can be reached at chris.barratt@insightsip.com