

NB-IOT. The Internet of Bikes and Labradors.

We have designed the IoT. Or at least the radio. Maybe...

If you attended the Mobile World Congress in Barcelona this year, you might have thought that the Internet of Things was mainly about bikes and labradors, as they were the mainstay of applications which were depicted on most IoT stands. The reason for that was a marketing push for Narrow Band IoT (NB-IOT) orchestrated by the GSM Association, who had picked up on two applications from early trials and was promoting them at every opportunity.

There's probably a good market for tracking labradors, as in my experience they're not the smartest breed in the canine world, but they're definitely a lot smarter than anyone who believed the IoT message that the network operators were pushing out in Barcelona. According to companies like Vodafone, commercial trials were only four months away, with commercial services next year. But you need more than marketing to make something happen. So here's my view of the real progress of NB-IOT.

I should say at the start that we need something like NB-IOT. I say "something like", as we still don't really know what it is. To understand why that is, we need to start by looking at the last decade of mobile development.

For low data rate M2M and IoT applications, things started to go awry shortly after the introduction of 3G. If you look at the market applications that were initially proposed for 3G, they were driven by increased subscriber capacity for voice, with data thrown in as a potential benefit to enable services like picture messaging and voicemail. No-one at that point envisaged much in the way of internet connectivity on a phone. Even with the first smartphones, mobile internet was something for geeks. Then came the iPhone, which sucked up data like some mythical beast. Users liked it so much that they even forgot about the primary metric they'd previously used to judge a handset – the battery life. They just slurped up as much data as they could afford and recharged their smartphones at least once a day.

That fundamentally changed the direction for mobile standards development. Power management went out of the window in the race for more data capacity. So did low cost, as the target for these standards was expensive smartphones and tablets, which would support annual mobile contracts of \$200 or more each year. It brought us to the embarrassing position of a 4G (LTE) spec which doesn't natively support voice, and power hungry proposals for 5G with gigabits/second download rates.

In many ways, mobile specification development started to look much more like PC specification development, where the only things that mattered were more and faster. The development streams which had been in place in early 2000 for low cost, low power, low data rate options which would enable the billions of IoT devices were forgotten. Even when Ericsson made their famous prediction in [2010 of 50 billion connected devices within a decade](#), nobody paid much attention to what sort of network would be needed to accomplish that. Bizarrely they didn't pay much more attention late last year when [Ericsson downgraded the number of cellular connected IoT devices to just 1 billion](#).

In their desire to support more and more of these high throughput and high revenue data connections, operators began to look at reusing their 2G spectrum for 4G, where the same amount of spectrum could accommodate an order of magnitude more users, generating far more revenue. At which point the existing GPRS users quite sensibly asked "what about us?", as they saw the possibility of their networks disappearing. The M2M industry had expected something to become

available which would be lower power and lower cost. Instead they saw a set of network operators which had forgotten them.

But they'd not been totally forgotten. A new breed of startups had spotted the hole in the 3GPP plans and started to develop Low Power Wide Area Network (LPWAN) solutions to fill the gap. These use proprietary protocols, generally operating in the unlicensed spectrum at 868 MHz or 910MHz and offer low data rates at low cost. Network operators didn't take them seriously until two of them – Sigfox and LoRa started to get major investment. During the course of 2015, both began to sign contracts with network operators around the world to start rolling out LPWAN networks that would provide a migration path from GPRS to support the growth of the Internet of Things.

At first the GSM community viewed these as short lived upstarts. As they continued to gain traction, the shit hit the fan. The 3GPP standards group galvanised their low power development work from a sleepy backwater activity to a major priority. Their existing roadmap towards IoT friendly variants of the LTE Release specifications were pared down, the LTE-Cat 0 project jettisoned, and resources poured into a new group developing Narrow Band IoT (NB-IOT).

Work on NB-IOT had been gently rolling along with different groups of companies proposing different solutions. It's what is called a clean slate development, which means it doesn't carry the baggage of having to maintain compatibility with every previous GSM standard. Instead it's designed to fit into spaces within the existing spectrum where it can coexist. That makes it a lot simpler and cheaper to produce. In September last year, the competing companies miraculously came to agreement on a combined approach and promised to have the specification complete by March 2016. To put this timescale into perspective, it normally takes the 3GPP groups about this long to decide what sandwiches they're having for lunch. But the determination is there. They've just announced that the release date has slipped to the summer. It will probably slip again, but it's now a priority.

Which takes us back to the Mobile World Congress. The GSMA publicity machine was at full throttle, blasting out the message that NB-IOT was ready to go. There were live demos in the GSMA's innovation city and on most major network operators' own stands. According to Vodafone (and I apologise for the quality of the photo) commercial trial start this summer, with full deployment by the end of next year.



It's a pretty picture, but is it the real one?

The first thing that needs to get sorted is the specification itself. The good thing about the NB-IOT approach is that it doesn't need to interoperate with any previous versions of LTE, unlike the heavier weight LTE Cat-1 and LTE-M variants. The two different NB-IOT proposals from Nokia/Ericsson/Intel and Huawei/Vodafone have both been tested in the wild, so they should be fairly well advanced, but they now need to be amalgamated, which will take time. June feels aggressive for that.

That's not the end of the work for the specification. The final version will presumably contain parts from both contributing camps, so NB-IOT protocols will need to be rewritten to match this. That's only the first part of the story. To be an interoperable specification, 3GPP engineers need to write a comprehensive set of test requirements and then test different implementations to make sure that the spec is unambiguous and complete. That typically takes another six to nine months for the modem. You need to do the same for the network, which tends to be more complex, but is necessary if you want confidence that you can deploy a product across multiple network operators around the world. My guess is that will take us until the end of 2017.

I asked some of the test houses and test equipment suppliers about their estimates for when they would have test gear for NB-IOT and when they'd be able to certify solutions. None offered a date and most gave hollow laughs when I showed them the Vodafone timeline. They've been here before and know the true timescales. People forget about them, as they're one of the hidden parts of the industry, but until they're ready, nothing ships.

In parallel with this you need chips. A lot of the testing and development can be done on existing chips – you just don't use a lot of their capability. That's what been used for all of the trials so far. But these are too expensive and power hungry to go into high volume production, where the aim is to make an NB-IOT module for around \$5. Intel put out a press release on the first day of the show announcing that they would be releasing an NB-IOT chip, the 7115, in the second half of 2016. When a chip company says second half instead of the more precise third or fourth quarter, you generally know they're far enough away for it to be unlikely to ship before the third half of the year. So not before 2017.

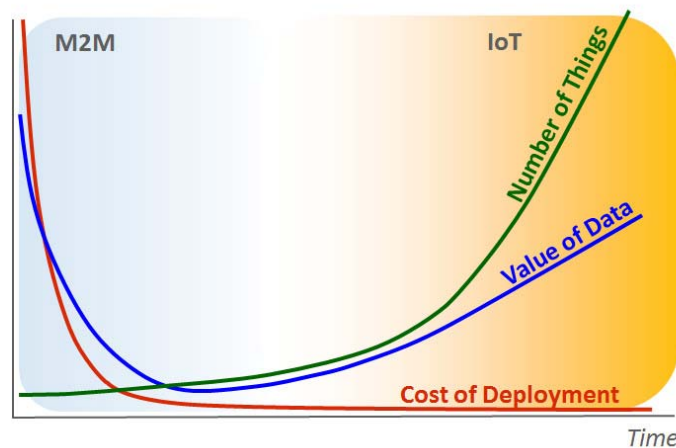
The sudden acceleration and emphasis on NB-IOT has wrong-footed most of the other silicon suppliers. Altair/Sony are still focusing on their LTE Cat 1 chipset, as are Sequans. Qualcomm were adamant that the industry wanted LTE Cat 1 and Cat M instead of NB-IOT, and everyone else was evasive. Over the last decade, Qualcomm has done a very efficient job of killing off competing baseband silicon vendors, so with the exception of Intel and a few start-ups, NB-IOT silicon is something of a vacuum, which won't help speed to market.

That was reinforced when I talked to the next level of the supply chain – the module vendors. One of them, μ Blox has already started work, supplying their SARA-N200 modules for the Huawei/Vodafone trials, which I suspect may run on the old Neul chipsets. But most of the others I talked to don't expect to ship anything before the middle of 2017. They all told me that they hadn't expected things to move this quickly and were re-evaluating their roadmaps. But bringing this stuff online takes time. Typically, at least a year.

Once you've got a modem, you need a network, and there was no shortage of network operators displaying the same application, which was generally tracking a bike or a labrador, with a smattering of parking and smart metering solutions thrown in for the smart city enthusiasts. It was interesting that some of them, most prominently SK Telecom of Korea were showing their NB-IOT solution next to an almost identical LoRa one. Behind the GSMA publicity offensive they're hedging their bets.

Network operators are good at PR, so it's useful to have a question ready to judge how much they understand about the technology. My question for NB-IOT is "will the devices need a SIM card?" With the exception of Deutsche Telekom, all of them answered yes, which is the wrong answer. Deutsche Telekom impressed me by saying that they would initially, but would migrate to embedded SIMs, although their embedded SIM expert blew it by telling me that embedded SIMs weren't relevant to IoT.

Let me explain why the SIM card is a good question. I explored this [in an article](#) I wrote at the end of last year, which argued that for the IoT to take off, we don't just need to get the hardware cost down, we need to reduce the cost of provisioning and the cost of data, in other words the complete deployment cost.



Talking to the NB-IOT lobby they're still envisaging modems which cost around \$7, data contracts which cost around \$1 per month and SIM cards. Today a GPRS modem costs around \$7, data contracts cost around \$1 per month and you need SIM cards. In other words, their great NB-IOT vision for the future has exactly the same implementation and financial barriers that exist for M2M and IoT today, which have prevented the IoT from taking off. If that's going to change, these products need to work out of the box, which means an embedded SIM, along with pre-provisioned data for life. Only once that happens will the market take off. So anyone that claims they will need a SIM card really hasn't got it. They're just parroting the PR story.

The problem is that these changes need new billing and commissioning software built into the networks. That normally takes two to three years, and the answers to my questions suggests the operators are not even thinking about this. Which means we might get "M2M GPRS replacement" networks in the next few years, but any real Internet of Things network is probably five years away. The consequence is that the volumes to drive IoT applications are also five years away, which won't help bring new start-ups into the picture. That could be very good news for LoRa and Sigfox, although the more they succeed, the more likely it is that the GSM community will rush something to market before it's ready and foul things up for everyone.

There was a useful quote from Ronald Zink of John Deere in the Industrial Internet of Things stream at the main conference, where he pointed out that "the key is to instrument everything – get the data first", as it's not until you have the data that you can start to discover the value. I've always thought that was a key differentiator between M2M and the Internet of Things. M2M is about data value that you can justify to your CEO before you get the money. The IoT is where it becomes cheap enough to instrument and get the data first before you can prove the value.

The conclusion from all of this, is that most of the industry doesn't really know what it's doing, which means that NB-IOT will take a lot longer to arrive. When it does, the technology won't be supported by provisioning and data plans which make it any different from GPRS, so we'll just see a gradual increase in deployment numbers. In other words, it will be NB-M2M, not NB-IOT.

However, there is a part of me which is more hopeful. What NB-IOT needs in order to work is for one large network operator to make the right connections so it can be deployed at scale, backed by Government stimulus money to start instrumenting everything. If that were to occur, then it could take off relatively quickly. I doubt that will happen in Europe or the US, but it could happen in China or Korea. If it does, then the centre of IoT expertise will move East, probably closely followed by data analytics. If Western operators and technology companies want to keep any ownership of the Internet of Things they need to rapidly revisit their understanding of what NB-IOT is all about. It is not just bikes and Labradors.

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