MACHINE COMMUNICATIONS IS LACKING SPECTRUM TO ENABLE A UBIQUITOUS NETWORK

Machine communications, often termed M2M, has long been forecast to be a sector with massive growth. Over the last few decades many have noted that the installation of a wireless connection into myriad devices would bring a range of benefits. An enormous range of examples have been suggested, from cars to sensors to traffic lights to healthcare applications and much more. More recent forecasts of 50 billion connected devices by 2020 do not sound so incredible when it is realised that this is only ten devices per person – many people already have more than ten wirelessly enabled devices in their home.

However, the market for machine communications to-date has been weak. There are some cars with embedded cellular modems and some relatively high-value items such as vending machines are equipped with cellular packet-data modems. But the market today is only a tiny fraction of the size it has long been predicted to grow to. This is predominantly due to the lack of a ubiquitous wireless standard that meets the needs of the vast majority of the machine market. These needs include:

- Low cost, both of the hardware and the service. Many machines are individually of relatively low value – imagine for example a temperature sensor. Chipset costs need to be in the region $1-$2 and annual

ABSTRACT

The value in machines having wireless communications has long been understood and a large market is predicted for many years. This has not transpired without difficulty of meeting all the requirements for machine communications within the constraints of the available radio spectrum. These constraints changed significantly with the advent of white space which provides near-perfect spectrum with free access. However, the combination of the unique and unusual nature of that access and the very different characteristics of machine traffic compared to human traffic means that using any existing standard is far from optimal. This paper discusses the design of a new standard called Weightless which is designed and optimised for this application.

Keywords: Machine Communication (M2M), Radio Spectrum, Weightless, White Space, Wireless Communication

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service charges less than $10 to make it worth embedding wireless technology in such devices.

- Excellent coverage. To make applications such as smart metering viable there needs to be coverage of near 100% of all meters. With many meters deep within the home or even in basements this implies vastly better coverage than achieved with today’s cellular networks.

- Ultra low-power operations. Many machines are not connected to the mains and so have to operate on batteries. Having to change the battery is at best an annoyance and at worst a significant expense. Battery life of ten years or more is essential.

- Secure and guaranteed message delivery. While machines rarely need ultra-rapid transmission, they do need to be certain that messages have been received and that security of the system has not been compromised in any way.

There is no current wireless system that comes close to meeting all of these requirements.

Cellular technologies do provide sufficiently good coverage for some applications but the hardware costs can be $20 or more depending on the generation of cellular used and the subscription costs are often closer to $10 per month than $10 per year. Battery life cannot be extended much beyond a month. Cellular networks are often ill-suited to the short message sizes in machine communications resulting in massive overheads associated with signalling in order to move terminals from passive to active states, report on status and more. So while cellular can capture a small percentage of the market which can tolerate the high costs and where devices have external power, it will not be able to meet the requirements of the 50 billion device market. Indeed, if it could, it would have done so already and there would be no further debate about the need for new standards.

There are many short-range technologies that come closer to the price points. These include Wi-Fi, Bluetooth, Zigbee, and others. However, being short-range these cannot provide the coverage needed for applications such as automotive, sensors, asset tracking, healthcare and many more. Instead, they are restricted to machines connected within the home or office environments. Even in these environments there may be good reasons why a wide-area solution is preferred. For example, an electricity supply company is unlikely to accept that their meter is only connected via, e.g., Zigbee, into a home network, which in turn connects to the home broadband. Were the home owner to turn this network off, fail to renew their broadband subscription or even just change the password on their home router, then connectivity could be lost. Restoring it might require a visit from a technician with associated cost. Maintaining security across such a network might also be very difficult.

Finally, it is critical that the technology is an open global standard, rather than a proprietary technology. With a wide range of applications there will need to be a vibrant eco-system delivering chips, terminals, base stations, applications and more. The manufacturer of a device such as a temperature sensor will need to be able to procure chips from multiple sources and to be sure that any of them will interoperate with any wireless network across the globe.

Without a wide-area machine communications network that meets all of the sector requirements it is unsurprising that forecasts for connected machines have consistently been optimistic.

While the needs of the machine sector have long been understood, the key problem to date has been a lack of insight as to how they could be met. Ubiquitous coverage requires the deployment of a nationwide network, and the conventional wisdom has been that such networks are extremely expensive. For example, a UK-wide cellular network can readily cost $2 billion with costs of spectrum adding another $1-2 billion. With the machine market unproven, such investments were not justifiable and would result in an overall network cost that would not allow the sub $10/year subscription fees needed to meet requirements.
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