

Dust Networks: Beyond Industrial Wireless

By Harry Forbes

Summary

[Dust Networks](#) has dominated the field of wireless sensor networking (WSN) technology in industrial applications. Last month, Dust announced a new product line that preserves key features of their industrial products, but is targeted to serve both commercial and industrial applications, and to extend their market leadership beyond the industrial space.

The network technology at the core of the “Internet of Things” is a low power wireless network called IEEE 802.15.4. This technology is shared by ZigBee, IEC62591 (WirelessHART), ISA100 and other sensor network standards. The original vision of 15.4 was to serve as a wireless network for low-power, low data rate sensors that could operate using only a small battery. Another aspect of the vision was that these devices would be too lightweight to support the TCP/IP protocols that define the Internet. Since those early days both these aspects of the original vision have changed. Many applications using 15.4 now have access to abundant electric power (e.g. smart metering). Furthermore, it is now possible to use the Internet protocol suite (IPV6) directly on 15.4 networks.

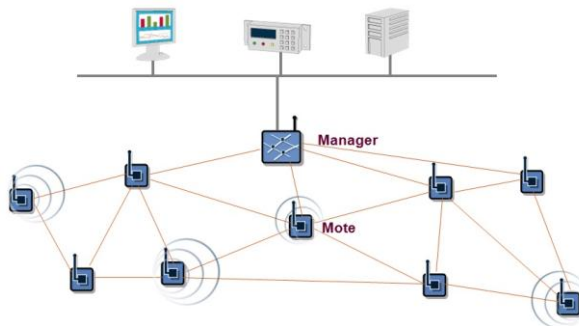
But in applications where power is limited, battery life remains a major issue. As 15.4 has developed it has now incorporated a technology called TSMP (Time Synchronized Mesh Protocol). TSMP enables devices to conserve their battery power by synchronizing their wake/sleep cycles, so that the devices are only “awake” and consuming power when there is active communication.

Dust Networks in Low Power Industrial Networking

TSMP was originally developed by [Dust Networks](#) in the early days of wireless sensor network (WSN) research before standards existed. Dust’s objective was to create a sensor network that combined low power consumption with “reliable delivery”. Unlike conventional IT networks, any single point-to-point connection in a sensor network has quite low reliability. In order to make end-to-end delivery of sensor information highly reliable, the sensor network as a whole must compensate for the inevitable periodic loss of point-to-point connectivity.



Dust Networks believed that a highly intelligent network manager was the best way to add intelligence to the sensor network as a whole. Their architecture concentrated the complexity of an active network manager in the sensor network gateway – the home node of the sensor network.

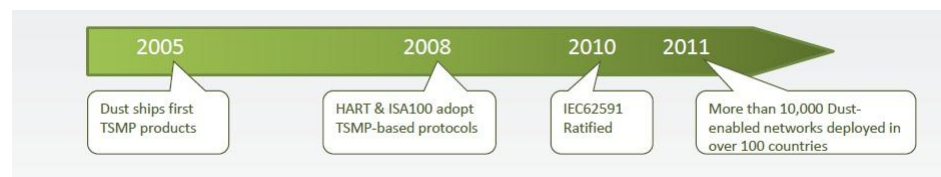


A Typical Wireless Sensor Network

The gateway contained a powerful computer and a hard-wired power supply, so it could handle the computational heavy lifting and thus this enabled the sensor nodes to be simpler (and less power-hungry).

Dust Networks used this combination of long battery life and reliable delivery to differentiate their first products. These properties came about as a result of TSMP and superior network management. Major industrial OEMs benchmarked Dust products against many other sensor network technologies. Over time, Dust emerged as a clear winner in the industrial space, securing supplier relationships with major OEMs including Emerson and GE. Unlike their many rivals in the sensor networking space, Dust's products achieved acceptance by industrial OEMs.

Eventually TSMP technology became part of sensor network standards. Dust continued to enhance its network management capability, and also worked actively to reduce the power consumed by its products at the chip level. Dust never saw itself as purely a software company. A hidden Dust differentiator was their ability to develop and manage chip-level design. Indeed the company most resembles a fab-less semiconductor firm. As such, Dust worked to release a 2nd generation of products that incorporated power optimization at the chip level. This 2nd generation of products, released in 2007, had power levels that were roughly 50% lower than the products they replaced, further extending battery life for the industrial applications that demanded it and cementing Dust's lead in the industrial space.



A Timeline of Dust Networks Milestones

Sensor Networks Reach Beyond Industrial Applications

The combination of IPV6 and sensor networks was a watershed development that has opened huge new possibilities. Sensor networks had always been envisioned as operating without the TCP/IP protocol suite. This vision became a significant liability. For example, much of the resources expended in the ZigBee initiative ended up re-inventing services for 15.4 networks that had mature and standardized equivalents in the TCP/IP realm. When IPV6 became feasible for sensor networks (the combination is known as “6LowPAN”) the ubiquitous TCP/IP suite became part of the available technology for sensor networks. This was an “Aha!” moment that truly sent the entire sensor network community back to the drawing board.

Dust Networks recognized the importance of this development immediately. In 2011, they emerged from their drawing boards with a new 3rd generation product line that is designed to leverage IP’s new capability while at the same time maintaining the advantages enjoyed by Dust’s older products. This new product line is called SmartMesh® IP. Dust sees the new product line as a platform that will extend into commercial markets the same advantages that Dust perfected to dominate industrial wireless sensors.

There are significant changes in this new product line, as well as some aspects that have deliberately been maintained. The line includes a new Eterna™ 802.15.4e system-on-chip product. The most notable difference

| New Feature | Existing Feature |
|-----------------|------------------|
| ARM processor | Network Manager |
| 6LowPAN Stack | Ultra-low power |
| Location engine | TSMP (now 15.4e) |

Properties of SmartMesh IP

here is that the Eterna includes a powerful, low power ARM® Cortex™-M3 processor. Earlier Dust products had far less on-board processing power, which was appropriate for their limited functional scope. IP-based sensor networks, by contrast, will require support for multiple protocols and even applications at the sensor node itself. One such new capability that is now built-in to Dust is location awareness via an optional onboard location engine. Another big difference is that while the product is designed for any type of network, the first supported network stack is 6LowPAN rather than an industrial protocol.

What features have been held over? Ultra-low power consumption remains, for one. Dust has again used its in-house design expertise to develop a product that can further surpass commoditized chipsets with respect to power use. Dust’s “Intelligent Network Management” is another

common thread with their earlier successes. Finally, the new products include TSMP, but the new TSMP implementation is now compliant with that defined in the latest IEEE 802 standard (15.4e).

A Future Scenario for WSN

ARC believes that the industrial wireless sensing market will grow rapidly, at a mid-double-digit rate. Mature products incorporating international standards like IEC62591 and supported by leading suppliers will be sufficient factors to drive penetration of WSN in industrial applications. ARC believes that IEC62591 devices now dominate this market, and Dust is likely to remain the supplier of the best technology in this arena.

Beyond industrial applications, the WSN market will move toward IP, or 6LowPAN. The driver for this direction is simply the huge advantage that stems from the adoption of TCP/IP. However, the need for ultra-low power operation will remain a major consideration in long lived, higher value applications where multi-year unattended operation is needed to support total cost of ownership (TCO) requirements. With the addition of its new SmartMesh IP products, Dust Networks has now positioned itself as the premier supplier of WSN technology for all segments of the market. Dust Networks has adopted the fundamental strategy of serving applications that require higher performance than can be achieved with a commoditized WSNs product. ARC expects commercial OEMs to “get” this value proposition in the same manner that industrial OEMs have embraced Dust’s earlier technology.

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