Adding Range and Robustness to Wireless Mesh Networks

By John Schwartz – Technology Strategist, Digi International

The terrific thing about **wireless** devices is that – well, they don't have any wires. As you look at most of the connections and cables behind a typical desk it isn't hard to see why that is good thing. Even in industrial environments, the issue with **wireless devices** has never been one of convenience, but rather one of range and reliable connectivity.

That is where **mesh networking** comes in. A mesh network is a network of nodes where each **node** must not only be able to consume its own data, but have the ability to relay messages on to other neighboring nodes. In a network where there are multiple nodes, **mesh networking** increases the range of the network by providing a lot of potential repeaters, and it also increases reliability by enabling several paths for data to travel. In most **mesh networks** not every device repeats every message. Rather, devices generally use a process to discover routes and then only maintain the list of routes that are used most frequently.

Different **mesh topologies** fit better into some applications than others. **ZigBee®** uses three different device types within a network. The ZigBee coordinator is responsible for picking a channel and forming a personal area network (PAN). A ZigBee router is always powered but can either receive packets or forward them on to the appropriate destination. **ZigBee** end devices can operate in extremely low-power sleep modes that, in some cases, can enable batteries to last for more than 5 years. ZigBee networks work best in applications like home automation where routers are connected to lights or other devices that have continual access to power, while end devices, such as light switches, can operate for years on batteries.

Other mesh technologies allow for all devices to sleep and can operate by having all devices wake and sleep in a synchronized fashion. With **DigiMesh®** (Digi's proprietary mesh networking protocol), all devices act initially as peers and nominate a coordinator from the nodes within the PAN. The nominated coordinator sends out periodic sync messages that allow the other nodes to coordinate their sleep/wake intervals. Messages can only be sent when the whole network is awake, so message latency can take up to the sleep interval time. The sleep interval for the network is programmable from 10ms on the low end to 4 hours on the high end. Battery life, of course, depends on the length of the sleep interval, the amount of time the network is awake during each interval and the number of times a given unit has to transmit. If the nominated coordinator is damaged or

goes offline, the network can automatically nominate a new coordinator to keep the units synchronized.

DigiMesh is ideal in applications where all the nodes must be battery powered or when the network commissioning has to be simplified. In a soil moisture sensing application, for example, there really is not a good way to have powered routers. Additionally, the harsh environments may make it less than ideal to have a dedicated coordinator that may be a single point of failure. Applications such as this that deal with remote sensing often have minimal data communication needs- soil moisture won't change that quickly- but because of where they are deployed battery or **energy harvesting** along with mesh networking is a must.

Point-to-point and Point-to-multipoint technologies will always be needed in application where higher bandwidth is the driving factor, and not all applications have the range challenges that may be inherent in environments outside the home. **Wireless** is sure to be a part of many applications in the future. The convenience factor alone will dictate that. If those applications require the robustness of a wire with the benefits of wireless, then **mesh networks** like ZigBee and DigiMesh are likely to play a part.

 *Schwartz joined Digi in July 2006 as Technology Strategist with more than 10 years of embedded, RF design and project management experience. In this position, he evaluates new standards and technologies, resulting in proposed product direction. He also provides product training internally and externally, and supports technical media relations and white paper development. Prior to joining Digi, Schwartz's major responsibilities included Director of Applications Engineering at Maxstream, a Digi-acquired company.*

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