WIRELESS MESH NETWORKING:
ZIGBEE® VS. DIGIMESH®

WIRELESS MESH NETWORKING: ZIGBEE VS. DIGIMESH

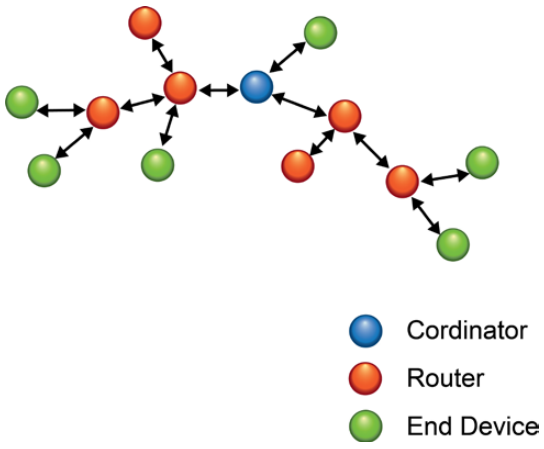
Mesh networking is a powerful way to route data. This methodology extends range capabilities by allowing data to hop from node to node. Mesh networking also increases reliability through "self-healing," which is the ability to create alternate paths when one node fails or a connection is lost.

Zigbee is one popular mesh networking protocol, and was developed by the zigbee® alliance. Digi International offers several products based on the Zigbee protocol, which is specifically designed for low-data rate, low-power applications. Additionally, Digi offers an alternate mesh protocol, called DigiMesh. Both Zigbee and DigiMesh offer unique advantages important to different applications. This paper discusses those advantages and provides comparisons to help you select the right protocol for your application requirements.

Both Zigbee and DigiMesh offer unique advantages important to different applications.

ZIGBEE NODES

The Zigbee protocol defines three types of nodes: coordinators, routers and end devices. Each Zigbee network requires one coordinator. While all nodes can send and receive data, there are differences in the specific roles they play.



Coordinator
The Zigbee network coordinator is the device responsible for forming the network and routing traffic. There is only one coordinator in each network. Once it establishes the network, it can store information about the network. For example, if it is configured as a trust center, it can store security keys. After the network is formed, the coordinator has the same capabilities as a router.

Router
A router acts as an intermediate node, relaying data from other devices. There can be multiple routers on the network. A router can also be an endpoint, but a router cannot sleep, as it needs to always be available to relay messages and act as a parent for end devices.

End device

An end device cannot route traffic. End devices have sufficient functionality to talk to their parents (either the coordinator or a router) but cannot relay data from other devices. These can be mobile devices, and they are allowed to sleep. Therefore, they can be low-power, battery-driven devices. Every end device must have a parent node in order to communicate with the network. Each parent node can support up to 20 end devices (children).

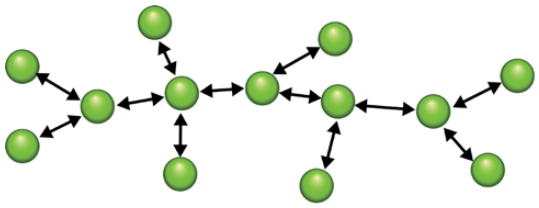
Zigbee offers these advantages:

- Zigbee is an open standard with interoperability between vendors
- Additional security options
    - Trust center
    - Network key rotation
    - Restricted joining
    - Out-of-band commissioning via device registration
- Source routing and many-to-one routing

Digi supports the Zigbee protocol on several RF devices, including the Digi XBee Zigbee module and the Digi XBee3 Zigbee 3.0 module.

DIGIMESH NODES

DigiMesh has only one node type. It is a homogenous network, which means all nodes can route data and are interchangeable. There is no parent-child relationship in DigiMesh.



DigiMesh offers these advantages:

- Network setup is simpler
- You have more flexibility to expand the network
- DigiMesh offers better broadcast support

Sleeping routers

Allowing a node to sleep helps to significantly reduce power consumption, which is especially helpful for nodes that are battery powered. Currently, Zigbee allows only end devices to sleep. Routers and coordinators must remain awake and available. Some variants of DigiMesh allow for synchronized cyclic sleep, where all nodes on the network can sleep and wake at the same time, thus allowing every node on the mesh network to be battery-driven.

Asynchronous sleep modes are also available, but require always-on routers to be able to communicate.

ADDITIONAL DIFFERENCES BETWEEN ZIGBEE AND DIGIMESH

Because Zigbee is an open standard, it offers the potential for interoperability with devices made by different vendors. Furthermore, Zigbee offers established profiles for common applications such as energy management and lighting control. A good selection of diagnostic support tools, like RF packet sniffers, is also available. Additionally, the Zigbee protocol is known to be highly secure, when set up correctly. To achieve a high level of security requires additional measures, making Zigbee more complicated to configure.

DigiMesh, as a proprietary protocol, has more flexibility with regard to features and enhancements that can be made. Easy-to-use diagnostic features have been built into the XBee application for use with network diagnostics and troubleshooting.

DigiMesh is available on sub-GHz platforms that provide much longer range and more RF data rate options than Zigbee. Frame payload can be larger, which can improve throughput for applications that send larger data blocks. Additionally, DigiMesh uses a simplified addressing method, which improves network setup and troubleshooting. Securing nodes on a DigiMesh network requires just a few specific commands, and the use of industry best practices.

For more information on device security for XBee and Zigbee devices, inquire about our XBee Security White Paper

ZIGBEE VS. DIGIMESH COMPARISON TABLE

	Zigbee Mesh®	DigiMesh®
Node types	Coordinators, routers, end devices.	One homogeneous device type with flexible routing configurations.
Configurability	Defined roles result in a less flexible network configuration. Each parent can only support a limited number of child devices.	More flexibility to expand the network. Simplified network setup. No parent/child ratios to consider. Optionally, you can disable the ability to route messages on a per-device basis. This allows you to tailor your network topology to your physical deployment. For example, you can configure routers on the edge of the network to not route messages or repeat broadcasts.
Sleeping routers and battery life	Only end devices can sleep. The coordinator and routers must always be awake, which affects power consumption.	With synchronized cyclic sleep, all nodes can sleep, which conserves power and enables devices to be battery powered.
Communication with sleeping devices	Because end devices are associated with a parent, it is very easy to have bi-directional communication with a sleeping device. The end device will poll its parent every wake period to see if any data is available. This allows you to send broadcast or unicast messages to end devices across the mesh network.	DigiMesh supports indirect messaging for point-to-point unicast messages. This allows a node to buffer a message for a neighboring polling device. This functionality is not available for broadcast messages or messages that are routed across hops. With synchronized cyclic sleep, messages are sent while the network is awake, allowing for bi-directional communication to sleeping devices on the network.
Background network traffic and discovery methods	Zigbee is a very noisy protocol with frequent link status messages being sent between nodes. This is to aide in network discovery, as a route discovery can rely on link status. Routes can be rapidly repaired as a result. Zigbee also has the capability to do source routing, where the route entries are stored on an external microcontroller or gateway. This provides better support for larger networks with reduced route discovery overhead.	DigiMesh is a less noisy protocol and only sends data when directed to. Route discovery is performed on an as-needed basis in order to reduce background network traffic. DigiMesh does not have source routing capabilities, but has a larger route table size to compensate.

	Zigbee Mesh®	DigiMesh®
Over-the-air firmware updates	Yes	Yes
Long-range options and frequency availability	Zigbee is only available on 2.4 GHz radios. Most Zigbee devices have a range of less than 2 miles (3.2 km) for each hop.	DigiMesh is available on 2.4 GHz as well as sub-GHz radios. This allows for considerably longer ranges (40+ miles).
Frame payload and throughput	Up to 256 bytes when using unicast messaging (fragmentation is used in this case). Up to 80 bytes when using broadcasts.	Up to 1024 bytes, depending on product. Improves throughput for applications that send larger blocks of data. The NP command enables you to determine specific payload size limitations.
Broadcast capabilities	Zigbee can only send approximately one broadcast per second. Zigbee has a broadcast event table with room for 8 entries; each entry persists for 8 seconds. This is to avoid broadcast storms or duplicates on a large network. Zigbee is primarily built with unicast messaging in mind.	DigiMesh has no restrictions on the number of concurrent broadcast messages that can be sent on the network. This makes it suitable for protocols such as Modbus that rely on network-wide requests and messaging.
Security	Zigbee security features: • 128-bit AES encryption Enhanced Zigbee-specific security features: • Centralized or distributed trust center • Network key rotation (centralized) • Joining can be restricted • Install code-derived link key • Out-of-band commissioning	DigiMesh security features: • 128-bit AES encryption. (256-bit AES is available on some products, such as XBee3 and XTend.) • One command (KZ) sets a password that prevents intruders from sending or receiving unsecured remote AT commands. For added security, this can be used on a device-by-device basis. • Simplified preset encryption key, with two configurable parameters.
Interoperability	Interoperability with third-party Zigbee devices.	Proprietary protocol. No interoperability options.
Interference Tolerance	Direct-Sequence Spread Spectrum (DSSS).	900 MHz: Frequency-Hopping Spread Spectrum (FHSS). 2.4 GHz: Direct-Sequence Spread Spectrum (DSSS).
Addressing	Two layers: MAC address (64-bit) and network address (16-bit). The coordinator can be easily addressed with a reserved 0 address.	MAC address (64 bit) only. DigiMesh has the ability to form a data aggregator, which causes remote nodes to route their traffic to a central node. This allows for a very simple many-to-one configuration.
Maintenance	Standardized diagnostic tools. Zigbee diagnostics are supported via ZDO requests. Complex network formation, routing, and security schemes can make troubleshooting issues more challenging.	Simplified network setup makes forming and managing a DigiMesh network very easy. Robust diagnostic tools can aid in tracking down weak network links or identifying poor deployments.

CONCLUSION

Zigbee and DigiMesh are excellent mesh networking protocols with distinct advantages. Review the following simplified comparison to help you decide which is right for you:

Choose **Zigbee** if you need:

- An open standard-based protocol
- Potential for interoperability with devices made by different vendors
- Bi-directional communication with sleeping end devices

View our Zigbee and DigiMesh products:

- Digi XBee3™ Zigbee 3.0 modules
- Digi XBee3™ DigiMesh® 2.4 modules

Choose **DigiMesh** if you need:

- The ability for all nodes to sleep (enabled with synchronized cyclic sleep)
- Simplified network setup and expansion (no parent/child dependencies)
- Support for longer range options (sub-GHz options available)
- Support for broadcast-intense applications

Contact a Digi expert and get started today

PH: 877-912-3444
www.digi.com

Digi International Worldwide HQ
11001 Bren Road East
Minnetonka, MN 55343

Digi International - Japan
+81-3-5428-0261

Digi International - Singapore
+65-6213-5380

Digi International - China
+88-21-5049-2199

Digi International - Germany
+49-89-540-428-0

/digi.international @DigiDotCom /digi-international