THEORY OF OPERATION

CSE COM module is based on Cisco Radio Frequency mesh technology and it communicates with Neighborhood Area Network (NAN) rooted at a Cisco's Connected Grid Router (CGR). CSE COM module is driven by industry standards including UDP, IPV6, IEEE 802.15.4e, 802.1x / EAP-TLS, and topology (Field Area Network with the Wide Area Network and Neighborhood Area Network).

Mesh network can relay messages using routing technique. With routing, the message is propagated along a path by hopping from node to node until it reaches its destination. To ensure all its paths' availability, the network must allow for continuous connections and must reconfigure itself around broken paths, using self-healing algorithms such as Shortest Path Bridging. Self-healing allows a routing-based network to operate when a node breaks down or when a connection becomes unreliable. As a result, the network is typically quite reliable, as there is often more than one path between a source and a destination in the network. The channel hopping scheme employed in our RF CG-Mesh networks is of Cisco's own design but based upon IEEE 802.15.4e.

CG-Mesh frequency hopping utilizes different channels randomly for transmission at different times. Receiver will switch to the next channel for listening according to hash algorithm, and transmitter has to learn the receiver's schedule and use the same hash algorithm to calculate the same channel index for transmission. Hence, the hopping is random.

Below is the list of frequency the module can utilize with a dwell time to send a packet that is no greater than 400ms within 20s at each channel.

Channels	902.4 MHz to 927.6 MHz	64 Channels
Channel Spacing	400 KHz	
Dwell Time per channel	400 ms	
Window Per Channel	20 s	
Maximum Occupied Band Width	165 KHz	

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