Device Operation
The Z-Wave module is an expansion component designed to be integrated with our system host (SiteSage Gateway) via an expansion port fitted to the rear of the system host. This expansion port is USNAP compliant providing both communications and power with some elementary signaling logic.

The Z-Wave module consists of a Z-Wave Network Controller, capable of establishing and supervising a Network of one or more Remote Z-Wave enabled sensor/actuators, allowing each sensor/actuator to be remotely accessed through the system host via our Remote Management Portal.

A Z-Wave network is established by setting the Z-Wave Network Controller (Z-Wave Module) into a state known as Inclusion Mode; this state allows individual Remote Z-Wave enabled devices to be added to the Z-Wave network by physically adding each one locally to the Network. Inclusion mode is typically set to have a duration of 90 seconds once invoked from either the system hosts embedded web page, of from the Remote Management Portal.

Once inclusion mode times out, no additional Remote Z-Wave Enabled Devices can be added to the network until inclusion mode is again initiated. The system host on reset or power-up initiates a 90 second inclusion mode, this feature is used to add nodes to a Z-Wave system if the operator does not have access to either the embedded web pages of the system host or the Remote Management Portal.

The Z-Wave Network Controller behavior is dependent on the inclusion state of the system; If no devices are included in the Network the Z-Wave Controller enters an idle state where all wireless communications are disabled.

When Remote Z-Wave devices are included in the Network, the Z-Wave Controller supervises each node in a round robin format, once every 90 seconds. With no individual Remote Z-Wave device being accessed within 200ms of the previous device. Unresponsive nodes are still polled within the same polling cycle, until the device reconnects or is excluded from the network via either the system hosts embedded web page or the Remote Management Portal.

Circuit Description
The Z-Wave module comprises a number of discrete sections:

- ZM4102 (U17) – Z-Wave system module, providing an integrated sub-GHZ radio and an 8-bit 8051 microprocessor, with 64KB program memory, and 16KB SRAM.
- PIC18F25K22 (U1) – an 8-bit PIC18 microprocessor to translate Asynchronous serial data to Synchronous Serial data.
- Antenna (E1) – 50 ohm impedance matching PCB antenna for the ZM4102
- EEPROM (U2)– storage for protocol information, such as routing table, homeID etc.
- Module supply decoupling/filtering (L2)– a simple filter to reduce EMI induced into the Host supply

  ZM4102
  The ZM4102 is an FCC part 15 compliant sub-GHz wireless module, operating at 908.4MHZ with a 40KBits/s data rate. The module itself contains a ZM4101, supply decoupling of the digital supply from the analogue supply and a sub-GHz SAW filter.

  The RF filtering is to reject interference signals in RX mode and attenuate harmonics in TX mode. The SAW filter is used in sub-GHz bands to suppress interference from powerful cellular

handsets, located in adjacent bands. RF io is single ended in internally matched to 50ohms.

PIC18FK22
This processor provides the translation functionality to convert the asynchronous serial io from the ZM4102 into a serial peripheral interface (SPI) protocol compatible with the Hosts USNAP compliant interface.

Running on an 11.0592MHz crystal this device is optimized for serial communication with the ZM4102 module, and translates data streams to and from that device under the control of the Host systems controller, which retains master status withn the Master/Slave connection status of the SPI protocol.

PCB Antenna
The PCB Antenna is a ¼ wave whip antenna providing an omnidirectional radiation pattern giving a gain of approximately -8 to -12dbm when the board is in the horizontal plane. The PCB trace is optimized for the dielectrics of the PCB and enclosure with a length of approximately 57mm.

The ZM4102 is matched to the PCB antenna, via 50 ohm impedance connection point, the PCB connection point is laid out to provide a matching “pi” circuit (which is not implemented in the current design) with C8 and C9 not fitted and R4 replaced with a 0 ohm resistor. This antenna match configuration provides the best power transfer between the ZM4102 and the PCB antenna.

Ground Plane
The Z-Wave module is a two layer construct, with the top layer providing, logic, power and the antenna, and the bottom layer predominately providing a ground plane for the circuit components.

Other than the antenna connection point the ground plane is excluded from the area of the PCB used to locate the antenna, this should reduce/eliminate the induction of RF currents in the digital and power planes of the Z-Wave Module and the system Host it is integrated with.

EMI Filter
During field testing was identified that an EMI filter consisting of L2, be included in the Z-Wave supply line to eliminate unwanted low frequency harmonics being induced in to the supply lines.