1 Design Requirements

1.1 User Interfaces

Requirement: The pods will assist in their placement by outputting network connectivity information through a console interface.

1. The console interface will be provided through a USB access port.
2. Administrators will connect through a laptop and open a bash shell to log in.

Requirement: Pod's system will be password protected to limit access to administrators only.

Requirement: The central server will be password protected to limit access to administrators only.

Requirement: The wireless network will be password protected to limit access to only ICS personnel.

1. LEAN will provide a WPA2 encrypted wireless connection that responders will connect to as if they were connecting to their business Wi-Fi.
   (a) LEAN will provide no user interaction through wireless connection. This will only be provided by third party applications.

1.2 Hardware Interfaces

Requirement: The pods will have the ability to estimate their geolocation.

1. Each pod will be equipped with a GPS sensor to estimate their geolocation.
   (a) Data will be interrogated at a maximum of once every thirty minutes to preserve pod battery life.

Requirement: The pods will have the ability to be environmentally aware to detect damage and alert administrators if they need repair or replacement.

1. Each pod will be equipped with an accelerometer to detect movement and seismic activity.
   (a) Data will be interrogated at a minimum of once every ten seconds.
2. Each pod will be equipped with environment chips to detect the environment they're placed in.
   (a) Contains a minimum of one luminosity and temperature sensor.
   (b) Luminosity sensor will be interrogated at a minimum of once every five minutes.
   (c) Temperature sensor will be interrogated at a minimum of once every five minutes.

Requirement: Each pod will act as a repeater to extend coverage over an emergency area.

1. Each pod will be equipped with a Wi-Fi radio
   (a) The radio will meet at a minimum IEEE standard 802.11n.
   (b) The radio configuration will have at a minimum a maximum data rate of 600 Mbps like what is provided by the IEEE standard 802.11n.

Requirement: The central server intranet connection will meet at a minimum IEEE standard 802.11n.

Requirement: The central server will be able to handle all ICS wireless traffic load.

1. Additional servers will be added when traffic load has exceeded 85% of the servers processing power.

1.3 Software Interface

Requirement: The pods will have the ability to display other pods that are within connectivity range to assist in placement.

1. The software will be executed through a bash shell.
2. The software will detect power levels of pods within range and output them through a bash shell via USB.
3. The software will refresh the power levels of the detected pods at a minimum of every 15 seconds.

Requirement: The central server will have the ability to store sensor information.

1. The server will store sensor data into databases according to the sensor type.
   (a) Joined tables through a foreign key defined as the pod ID.
   (b) No null data will be stored for time stamps that don't contain data for every sensor.
2. The server will only run MYSQL databases for uniformity.
3. Every data write will be done in one single query.

Requirement: Every pod will have the ability to interrogate a sensor array connected to the GPIO of the raspberry pi.

1. Sensor interrogation will be executed by python scripts started when the pods are placed.
   (a) There will be a separate python program for each of the sensor array endpoints to interrogate.
   (b) Each timer that tracks the sampling rate of a sensor endpoint will run on a separate thread.
   (c) When a sensor array endpoint has been sampled, the value will be immediately sent with JSON encoding described in section

Requirement: Every pod will have the ability to send sensor information to the central server.

1. The pods will use JSON to encode sensor data packets.
   (a) Each pod to server transmission will use one JSON hash with two keys; one for identification and one for sensor values.
      i. The identification key will have one value containing an unique ID describing the pod.
      ii. The sensor values key will contain one value for each endpoint in the sensor array.
   (b) Each server to pod transmission will use one JSON hash with the same keys received and flags.
      i. Flags pertaining to HTTP status codes.
      ii. Flags pertaining to pod normal/emergency mode.
2. The pods will compute routing tables.
   (a) The node cluster will run the table driven routing protocol, wireless routing protocol (WRP).
   (b) The WRP provides extra information compared to other table driven protocols that will be useful for node integrity.

1.4 Communications Interfaces

Requirement: LEAN must use a communication protocol that can work in a commonly used web browser.

1. LEAN will operate on the HTTP-Intranet to achieve the fastest speeds possible.

1.5 Functional Requirements

Requirement: Each pod will act as a wireless access point for ICS personnel.

1. Wireless intranet will provide basic connectivity to a user.
   (a) Share their information with a central server.
   (b) 3rd party applications that need a network.

Requirement: Every pod will be able to detect its environment and its location in it.

1. Every pod will be equipped with a sensor array.
2. A GPS sensor will be included in the sensor array.
   (a) Geographical location will be collected for placing the pods on an interactive map.
   (b) When geographical location can not be updated, it will be marked as an anomaly.
   (c) When delta data indicates a large change in geographical position it will be marked as an anomaly.
3. A Temperature sensor will be included in the sensor array.
   (a) Collect thermal data to determine operating conditions for the pods.
   (b) When maximum threshold temperature is passed, it will be marked as an anomaly.
   (c) When delta data indicates a fast change in temperature it will be marked as anomaly.
   (d) When temperature can not be collected, it will be marked as an anomaly.
4. A Luminosity sensor will be included in the sensor array.
   (a) Collect light intensity data.
   (b) When minimum light intensity threshold has been exceeded, it will be marked as an anomaly.
   (c) When maximum light intensity threshold has been passed, it will be indicated as an anomaly.
   (d) When delta data indicates a loss of light or a great increase in light intensity, it will be marked as an anomaly.
   (e) When light intensity can not be collected, it will be marked as an anomaly.
5. An Accelerometer sensor will be included in the sensor array.
   (a) Collect movement and seismic data.
   (b) When data indicates that the pod has moved beyond the maximum threshold, it will be marked as an anomaly.
   (c) When seismic activity has passed the maximum threshold, it will be marked as an anomaly.

Requirement: The central server will have the ability to detect anomalies in the pod network.

1. The central server will use sensor data to detect anomalies
   (a) Detect abnormal data that does not characterize with the normal operating data of the sensors.
   (b) Detect threshold data that exceeds conditions resulting in pod damage.
   (c) Detect a large change in data (delta data) that would indicate abnormality.
2. The central server will be able to put the pods into emergency or normal mode
   (a) When an anomaly has been detected, emergency mode will be entered.
   (b) Will increase sampling rate of all sensors to gather enough data to directly monitor the reason for an anomaly.