Honeywell OneWireless

Site Assessment and Design Report
# Table of Contents

Table of Contents............................................................................................................................ 1
Customer – – Location Wireless Site Survey ............................................................................ 1
Introduction........................................................................................................................................ 1
Overview.......................................................................................................................................... 1
Introduction...................................................................................................................................... 1
Project deliverables......................................................................................................................... 1
Narrative ........................................................................................................................................ 1
Drawings ......................................................................................................................................... 1
Illustrations ................................................................................................................................... 2
Specifications ................................................................................................................................. 2
In this document.............................................................................................................................. 2
Executive Overview.......................................................................................................................... 3
Overview.......................................................................................................................................... 3
Introduction...................................................................................................................................... 3
Objectives of the OneWireless Network Design ........................................................................ 3
Introduction..................................................................................................................................... 3
Standards-based inter-connectivity................................................................................................. 3
Business needs/ objectives/ goals ................................................................................................. 3
Requirements/ criteria definition .................................................................................................... 4
Reliability and performance............................................................................................................ 4
User friendliness............................................................................................................................... 4
Scalability ....................................................................................................................................... 4
Security .......................................................................................................................................... 4
OneWireless Network........................................................................................................................ 5
Overview.......................................................................................................................................... 5
Introduction...................................................................................................................................... 5
Areas to be covered ....................................................................................................................... 5
Survey equipment specifications ................................................................................................. 5
Spectrum analyzer sweep ............................................................................................................... 5
Application requirements............................................................................................................... 7
Customer Refinery Tank Farm ........................................................................................................ 7
5.8 GHz OneWireless Mesh Network ......................................................................................... 8
Introduction..................................................................................................................................... 8
multinode /antenna location ......................................................................................................... 8
Site image overlay .......................................................................................................................... 10
Introduction.................................................................................................................................... 11
Mobile PKS access point /antenna location ............................................................................... 11
Wi-Fi Mobile PKS, Continued ..................................................................................................... 12
Site image overlay .......................................................................................................................... 12
2.4GHz FHSS OneWireless Transmitters.................................................................................. 13
Introduction..................................................................................................................................... 13
Transmitter /antenna location ....................................................................................................... 13
Tank Farm....................................................................................................................................... 16
5.8GHz OneWireless Mesh Network ......................................................................................... 16
The above table contains the actual readings taken during the site survey. These results are to be used as a guideline as actual readings may vary depending on environmental factors.
Customer – – Location
Wireless Site Survey

Introduction

Overview

Introduction

This document constitutes Honeywell’s report to Customer Co, – Location covering a Wireless Site Survey for the Refinery and Tank Farm projects. This document is the result of a site survey that examined the existing site Process Control network including strategic business and technology goals. The gathered information was used to focus on cost-effective wireless mobile and wireless transmitter solutions.

Surveyor Contributors: Andrew Neeb, Gary Henson, Jeffrey Turner, Steve Muenstermann, Brian Farabaugh, Guan-Jung Chen, Jeff Henry, and David Van Tyne.

Project deliverables

This design document includes the following:

• Narrative
• Drawings/Images
• Illustrations
• Specifications

Narrative

The narrative includes site survey guidelines and findings on the current network applications, architecture and infrastructure. Observations made during the site survey include access point locations and coverage areas.

Drawings

The following drawings will be included as part of this document:

• Photograph of the multinode and transmitter location point
• RF coverage area
• Signal strength readings
• Cabling requirements
• Bill of Materials of recommended wireless network equipment

Continued on next page
Illustrations are used to explain and clarify many concepts used in this document.

Specifications
Equipment specifications are provided as part of this document. These are to be used as a guideline for the implementation of the Refinery and Tank Farm’s wireless networks.

In this document
This document is organized as follows:

<table>
<thead>
<tr>
<th>Topic</th>
<th>See Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive Overview</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td>OneWireless Network</td>
<td>24</td>
</tr>
<tr>
<td>Appendix A</td>
<td>24</td>
</tr>
<tr>
<td>Appendix B</td>
<td>25</td>
</tr>
<tr>
<td>Appendix C</td>
<td>1</td>
</tr>
</tbody>
</table>
Executive Overview

Overview

Introduction

Customer Co’ realization of the maximum business advantages from communication technologies depends on acquisition and use of effective, efficient, reliable, and compatible networks and networking equipment at all levels of the Corporation. Customer Co selected Honeywell to design a wireless communications network for the Refinery and Tank Farm at the Location facility – a network that is compatible with the Customer Co Global Network Strategy and that establishes a growth path for facility communications.

Objectives of the OneWireless Network Design

Introduction

This project objective is to set a detailed view of desired technology solutions. This design provides for expansion without jeopardizing capital investment by utilizing materials and equipment that can adapt to or embrace advancing technologies where applicable.

Standards-based interconnectivity

This design adheres to open standards-based guidelines to facilitate interconnectivity with other communications services and to provide a generally accepted structure for interoperability with those services.

All technology solutions developed will maximize Customer Co’ current facility network investments, optimize network communications component zones of coverage and maximize cost effectiveness.

Business needs/objectives/goals

By providing a communications infrastructure that is scaleable and capable of providing foreseeable coverage needs at low incremental cost, strategic decisions for meeting application needs can be made at the department level with less concern about the underlying communications structure. Wireless technology can be the foundation for increased flexibility and productivity. Wireless technology is a key enabler in reaching the objective of field Engineer mobility.
Objectives of the OneWireless Network Design, Continued

<table>
<thead>
<tr>
<th>Requirements/criteria definition</th>
<th>Key requirements and criteria in assessing the network design include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability and performance</td>
<td>• Reliability and performance</td>
</tr>
<tr>
<td></td>
<td>• User friendliness</td>
</tr>
<tr>
<td></td>
<td>• Scalability</td>
</tr>
<tr>
<td></td>
<td>• Security</td>
</tr>
</tbody>
</table>

Reliability and performance factors include providing a system with the highest network availability, lowest latency, and most appropriate connectivity for users, servers, control devices, etc.

User friendliness

User friendliness relates to users being able to access appropriate information transparently and to use applications with a click of a mouse or simple movement to data fields.

Scalability

Scalability relates to the ability of the site Control Network to expand end points and aggregate bandwidth.

Security

Network security is an absolute requirement in wireless communications. Measures must be taken to insure that the integrity of data is not compromised and only authorized access to the wireless network is allowed.

Continued on next page
OneWireless Network

Overview

Introduction
Customer Co commissioned Honeywell to design a wireless extension to their existing Process Control Network. The extension will consist of Honeywell’s Wireless Mesh Network to cover specific areas of the facility and provide support for the Honeywell Mobile PKS, and XYR-6000 wireless transmitters. The design is based on industry standards and utilizes standards based equipment that will ensure compatibility with other standards based equipment.

Areas to be covered
The main areas to be covered in this project are the Refinery and Tank Farms in the facility.
- The Refinery Tank Farm consists of one hundred plus structures to include: tanks as large as 4 ft high by 100 ft wide, butane spheres as large as 50ft high, bullet tanks as large 35ft high by 100ft wide, metal buildings, 240VAC, 480VAC, and other higher voltage sources, overhead cable trays, and other metal barriers. One or two Gateways shall be installed with the primary location of the Refinery Tank Farm Control Building and a secondary location of Building 71-10-003.
- The Tank Farm consists of 50 plus structures to include: tanks up to 50 ft high by 100 ft wide; concrete buildings; 240VAC, 480VAC, and other high voltage electrical sources; overhead cable trays; other types of miscellaneous metal barriers. One Gateway shall be installed with the primary location of the Tank Farm Control Building.

Survey equipment specifications
The site survey was conducted with 802.11a/b/g and FHSS compatible equipment provided by Honeywell. The multinodes have a maximum output of 100mW and an ERP of 4watts, and the transmitters of 13mW and an ERP of 20mW. Output power and antenna types will be adjusted to achieve the desired coverage. Diversity antennae should be used to reduce the effects of multipathing. Equipment used and specified in this document is designed to be powered over Ethernet, or 24VAC through an adapter.

Spectrum analyzer sweep
A pre-installation analysis was performed prior to starting the wireless site survey. This analysis was performed to insure that the planned frequencies were not being used. The results of the analysis are in the table below

Continued on next page
## Refinery Tank Farm RF Spectrum Analysis

<table>
<thead>
<tr>
<th>Location</th>
<th>Sweep Time</th>
<th>Noise Floor</th>
<th>Center Frequency</th>
<th>Span</th>
<th>Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refinery Tank Farm 2.4GHz</td>
<td>200ms</td>
<td>-80</td>
<td>-70dBm</td>
<td>2450 MHz</td>
<td>2.4 - 2.5GHz</td>
</tr>
<tr>
<td>Refinery Tank Farm 5.8GHz</td>
<td>200ms</td>
<td>-100</td>
<td>-90dBm</td>
<td>5598 MHz</td>
<td>5.15 - 5.85GHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Devices Discovered</th>
<th>SSID</th>
<th>MAC Address</th>
<th>Channel</th>
<th>Media Type</th>
<th>Signal Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jumpstart-P1-6ef54a</td>
<td>00:15:E9:77:5A:C6</td>
<td>6</td>
<td>802.11b</td>
<td>-73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Sweep Time</th>
<th>Noise Floor</th>
<th>Center Frequency</th>
<th>Span</th>
<th>Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank Farm 2.4GHz</td>
<td>200ms</td>
<td>-100</td>
<td>-90dBm</td>
<td>2437 MHz</td>
<td>2.4 - 2.5GHz</td>
</tr>
<tr>
<td>Tank Farm 5.8GHz</td>
<td>200ms</td>
<td>-110</td>
<td>-100dBm</td>
<td>2437 MHz</td>
<td>5.15 - 5.85GHz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Devices Discovered</th>
<th>SSID</th>
<th>MAC Address</th>
<th>Channel</th>
<th>Media Type</th>
<th>Signal Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>br350- -R</td>
<td>00:40:96:53:61:28</td>
<td>11</td>
<td>802.11b</td>
<td>-75 Bldg N side of Tank Farm</td>
</tr>
<tr>
<td>2</td>
<td>Cisco:53:64:D3</td>
<td>00:40:96:53:64:D3</td>
<td>11</td>
<td>802.11b</td>
<td>-69 Control Room</td>
</tr>
</tbody>
</table>

---

**Overview, Continued**
The primary applications to be supported by Honeywell’s RF Mesh network are Honeywell’s Mobile PKS and XYR-6000 transmitters. Due to the possibility of expanding the RF network to support other wireless applications, a minimum of 6 Mbps throughput is required for acceptable performance. The site survey was conducted to meet this criterion. The initial applications listed above will have less bandwidth demand and therefore have greater operational range. The initial RF network may be used for applications and may function properly at lesser/greater range than indicated in the survey results.

The entirety of Customer site survey consisted of three separate, site surveys for the 5.8GHz Wireless Mesh, Mobile PKS, and the 2.4GHz FHSS transmitter products in both the Refinery and Tank Farms. The following sections will address the three products’ site surveys individually for each Tank Farm, in order to minimize confusion.

Customer Refinery Tank Farm
5.8 GHz OneWireless Mesh Network

Introduction

The Refinery Tank Farm consists of one hundred plus structures to include: tanks as large as 4 ft high by 100 ft wide; butane spheres as large as 50 ft high; bullet tanks as large 35 ft high by 100 ft wide; metal buildings; 240VAC, 480VAC, and other higher voltage sources; overhead cable trays; other metal barriers. One or two Gateways shall be installed with the primary location of the Refinery Tank Farm Control Building and a secondary location of Building 71-10-003.

multinodes location

multinodes locations:

a. Will be mounted in unclassified areas along roadways
b. Best effort placement close to power source with redundant RF sensor coverage as the main qualifier
c. multinodes to be installed in a mesh network configuration

The antennae chosen for this location is the Honeywell 5dbi Tri-band omni antenna, which will be mounted directly to the multinode.

Gateway1 - Light pole in front of Control Room
Gateway2 - N Side Peak of roof on Bldg. 71-10-003

Continued on next page
The above table contains the actual readings taken during the site survey. These results are to be used as a guideline as actual readings may vary depending on environmental factors.

Continued on next page
This drawing is for reference only. The color bar is scaled so that all colored areas are to be considered adequate RF coverage. The number scheme starts -75 being the lowest signal quality acceptable, and ends at 0 being the best signal quality.
2.4 GHz Wi-Fi Mobile PKS

Introduction

The Refinery Tank Farm consists of one hundred plus structures to include: tanks as large as 4 ft high by 100 ft wide; butane spheres as large as 50ft high; bullet tanks as large 35ft high by 100ft wide; metal buildings; 240VAC, 480VAC, and other higher voltage sources; overhead cable trays; other metal barriers.

Mobile PKS access point /antenna location

The Mobile PKS RF coverage will be hot spot or best effort within the multinode mesh network of the Tank Farm area. The antennae chosen for this location is the Honeywell 2.5dbi Tri-band omni antenna, which will be mounted directly to a second radio on the multinode.

Honeywell Wi-Fi RF Site Survey

<table>
<thead>
<tr>
<th>Mobile PKS Wi-Fi 2.4GHz Ch.1</th>
<th>Maximum range to maintain RSSI &lt; -74 Apprx. Ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway_1</td>
<td>423ft</td>
</tr>
<tr>
<td>multinode_1</td>
<td>650ft</td>
</tr>
<tr>
<td>multinode_2</td>
<td>720ft</td>
</tr>
<tr>
<td>multinode_3</td>
<td>820ft</td>
</tr>
<tr>
<td>multinode_4</td>
<td>612ft</td>
</tr>
<tr>
<td>Gateway_2</td>
<td>644ft</td>
</tr>
</tbody>
</table>

The above table contains the actual readings taken during the site survey. These results are to be used as a guideline as actual readings may vary depending environmental factors.

Continued on next page
This image is for reference only. The color bar is scaled so that all colored areas are to be considered adequate RF coverage. The number scheme starts -75 being the lowest signal quality acceptable, and ends at 0 being the best signal quality.
2.4GHz FHSS OneWireless Transmitters

Introduction

The Refinery Tank Farm consists of one hundred plus structures to include: tanks as large as 4 ft high by 100 ft wide, butane spheres as large as 50ft high, bullet tanks as large 35ft high by 100ft wide, metal buildings, 240VAC, 480VAC, and other higher voltage sources, overhead cable trays, and other metal barriers. Since the exact locations of the transmitters had not been determined by the time of this survey, it was conducted in a manner which factored in the most probable areas of coverage.

Transmitter/antenna location

Areas of instrument RF coverage:


For added redundancy, each transmitter shall maintain communications with at least two multinodes at any given time. The transmitters shall be equipped with a 2 dB omni antennae, which will be mounted internally at the factory. In addition, some of the transmitters may be shipped with external high gain omni and directional antennas for better signal quality.

* Exact transmitter location within the listed areas has not been determined

Continued on next page
2.4GHz FHSS OneWireless Transmitters, Continued

Refinery Tank Farm Wireless Transmitter Locations

Honeywell OneWireless Transmitter RF Site Survey

<table>
<thead>
<tr>
<th>Device</th>
<th>Gateway 1</th>
<th>iNode 1</th>
<th>iNode 2</th>
<th>iNode 3</th>
<th>iNode 4</th>
<th>Gateway 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>FHSS_Txm Ch.11</td>
<td>Range</td>
<td>RSSI</td>
<td>Data Link</td>
<td>Range</td>
<td>RSSI</td>
<td>Data Link</td>
</tr>
<tr>
<td>LN_1</td>
<td>326 ft</td>
<td>-70 dB</td>
<td>100%</td>
<td>303 ft</td>
<td>-60 dB</td>
<td>94%</td>
</tr>
<tr>
<td>LN_2</td>
<td>483 ft</td>
<td>-81 dB</td>
<td>98%</td>
<td>92 ft</td>
<td>-65 dB</td>
<td>98%</td>
</tr>
<tr>
<td>LN_3a</td>
<td>465 ft</td>
<td>-75 dB</td>
<td>100%</td>
<td>257 ft</td>
<td>-78 dB</td>
<td>82%</td>
</tr>
<tr>
<td>LN_3b</td>
<td>375 ft</td>
<td>-76 dB</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LN_3c</td>
<td>348 ft</td>
<td>-73 dB</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LN_3d</td>
<td>199 ft</td>
<td>-75 dB</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LN_3e</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

POOR | GOOD | VERY GOOD | EXCELLENT

Continued on next page
2.4GHz FHSS OneWireless Transmitters, Continued

The above table contains the actual readings taken during the site survey. These results are to be used as a guideline as actual readings may vary depending on environmental factors.

Continued on next page
**Tank Farm**

**5.8GHz OneWireless Mesh Network**

---

**Introduction**

Tank Farm consists of 50 plus structures to include: tanks up to 50 ft high by 100 ft wide; concrete buildings; 240VAC, 480VAC, and other high voltage electrical sources; overhead cable trays; other types of miscellaneous metal barriers.

---

**multinode/antenna location**

multinodes locations:
- d. Will be mounted in unclassified areas along roadways
- e. Best effort placement close to power source with redundant RF sensor coverage as the main qualifier
- f. multinodes are to be installed in a mesh network configuration

The antennae chosen for this location is the Honeywell 5dbi Tri-band omni antenna, which will be mounted directly to the multinode. In addition, multinodes listed as Gateway_1, multinode_1, multinode_2, multinode_3, and the motor start/stop wireless devices will be equipped with high gain sector antennas for increased signal strength. One Gateway shall be installed with the primary location of the Tank Farm Control Building. The motor start/stop system shall require two 3eTI, 3e-523F-2 radios for added redundancy and shall communicate wirelessly to the mesh network.

*Continued on next page*
5.8GHz OneWireless Mesh Network, Continued

Tank Farm multinode Locations

![Tank Farm multinode Locations](image)

### Honeywell OneWireless Mesh RF Site Survey

<table>
<thead>
<tr>
<th>Device</th>
<th>iNode 1</th>
<th>iNode 2</th>
<th>iNode 3</th>
<th>iNode 4</th>
<th>iNode 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mesh_5.8GHz Ch.64</td>
<td>Range Ft.</td>
<td>RSSI dB</td>
<td>Data Link Test</td>
<td>Speed Mbps</td>
<td>Range Ft.</td>
</tr>
<tr>
<td>Gateway_1</td>
<td>340</td>
<td>-58</td>
<td>100%</td>
<td>23.2</td>
<td>1923</td>
</tr>
<tr>
<td>iNode_1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iNode_2</td>
<td>-74</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iNode_3</td>
<td>-77</td>
<td>-57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iNode_4</td>
<td></td>
<td>-59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iNode_5</td>
<td></td>
<td>-73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Start/Stop</td>
<td>531</td>
<td>-53</td>
<td>100%</td>
<td>10.6</td>
<td>1100</td>
</tr>
</tbody>
</table>

**POOR** | **GOOD** | **VERY GOOD** | **EXCELLENT**

Continued on next page
5.8GHz OneWireless Mesh Network, Continued

The above table contains the actual readings taken during the site survey. These results are to be used as a guideline as actual readings may vary depending environmental factors.

Site image overlay

Tank Farm Wireless Mesh RF Coverage Area

This image is for reference only. The color bar is scaled so that all colored areas are to be considered adequate RF coverage. The number scheme starts -75 being the lowest signal quality acceptable, and ends at 0 being the best signal quality.

Continued on next page
2.4GHz Wi-Fi Mobile PKS

Introduction

Tank Farm consists of 50 plus structures to include: tanks up to 50 ft high by 100 ft wide; concrete buildings; 240VAC, 480VAC, and other high voltage electrical sources; overhead cable trays; other types of miscellaneous metal barriers.

Access point / antenna location

The Wireless Worker RF coverage will be hot spot or best effort within the multinode mesh network of the Tank Farm area. The antennae chosen for this location is the Honeywell 2.5dbi Tri-band omni antenna, which will be mounted directly to a second radio on the multinode.

Honeywell Wi-Fi RF Site Survey

<table>
<thead>
<tr>
<th>Mobile PKS Wi-Fi 2.4GHz Ch.6</th>
<th>Maximum range to maintain RSSI &lt; -74 Apprx Ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway_1</td>
<td>500ft</td>
</tr>
<tr>
<td>iNode_1</td>
<td>1500ft</td>
</tr>
<tr>
<td>iNode_2</td>
<td>1500ft</td>
</tr>
<tr>
<td>iNode_3</td>
<td>1500ft</td>
</tr>
<tr>
<td>iNode_4</td>
<td>1500ft</td>
</tr>
<tr>
<td>Inode_5</td>
<td>1500ft</td>
</tr>
</tbody>
</table>

The above table contains the actual readings taken during the site survey. These results are to be used as a guideline as actual readings may vary depending on environmental factors.

Continued on next page
This image is for reference only. The color bar is scaled so that all colored areas are to be considered adequate RF coverage. The number scheme starts -75 being the lowest signal quality acceptable, and ends at 0 being the best signal quality.
2.4GHz OneWireless Transmitters

Introduction
Tank Farm consists of 50 plus structures to include: tanks up to 50 ft high by 100 ft wide; concrete buildings; 240VAC, 480VAC, and other high voltage electrical sources; overhead cable trays; other types of miscellaneous metal barriers.

Transmitter/antenna location
Areas of instrument RF coverage:
   a. South side of tank 231 and tank 233 (near foot of stairs)
   b. North side of tank 230 (near foot of stairs)
   c. North side of pumping station located to the northeast of Tank Farm Control Building
   Area for the motor start/stop using Acromag devices
   d. Northeast corner of Tank 228

Continued on next page
2.4GHz OneWireless Transmitters, Continued

**Tank Farm Wireless Transmitter Locations**

![Tank Farm Wireless Transmitter Locations](image)

**Honeywell OneWireless Transmitter RF Site Survey**

<table>
<thead>
<tr>
<th>Device</th>
<th>Gateway 1 Range Appx. Ft.</th>
<th>Gateway 1 RSSI dB</th>
<th>Gateway 1 Data Link Test</th>
<th>iNode 1 Range Appx. Ft.</th>
<th>iNode 1 RSSI dB</th>
<th>iNode 1 Data Link Test</th>
<th>iNode 2 Range Appx. Ft.</th>
<th>iNode 2 RSSI dB</th>
<th>iNode 2 Data Link Test</th>
<th>iNode 3 Range Appx. Ft.</th>
<th>iNode 3 RSSI dB</th>
<th>iNode 3 Data Link Test</th>
<th>iNode 4 Range Appx. Ft.</th>
<th>iNode 4 RSSI dB</th>
<th>iNode 4 Data Link Test</th>
<th>iNode 5 Range Appx. Ft.</th>
<th>iNode 5 RSSI dB</th>
<th>iNode 5 Data Link Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>FHSS_XTM Ch.11</td>
<td>145</td>
<td>-79</td>
<td>91%</td>
<td>180</td>
<td>-80</td>
<td>96%</td>
<td>478</td>
<td>-78</td>
<td>90%</td>
<td>125</td>
<td>-73</td>
<td>94%</td>
<td>436</td>
<td>-82</td>
<td>72%</td>
<td>405</td>
<td>-75</td>
<td>100%</td>
</tr>
<tr>
<td>HW_ST.Tx1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HW_ST.Tx2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HW_ST.Tx3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HW_ST.Tx4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued on next page
The above table contains the actual readings taken during the site survey. These results are to be used as a guideline as actual readings may vary depending on environmental factors.
## Materials List

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIR-AP1231G-AK9</td>
<td>Cisco 1200 B/G Access Point</td>
<td>2</td>
</tr>
<tr>
<td>AIR-ANT2056</td>
<td>Omnidirectional Mast Mount 5.2dBi Antenna</td>
<td>4</td>
</tr>
<tr>
<td>AIR-ANT7441</td>
<td>Omnidirectional Dipole 2.2dBi Antenna</td>
<td>0</td>
</tr>
<tr>
<td>AIR-PWRINJ/B</td>
<td>Power Injector for Aironet 1100,1200 Access Point</td>
<td>2</td>
</tr>
<tr>
<td>AIR-PWRINJ/FIB</td>
<td>Power Injector / Media Converter w/MTRJ and UTP</td>
<td>0</td>
</tr>
<tr>
<td>AIR-ACC3354</td>
<td>Lighting / surge protector</td>
<td>0</td>
</tr>
<tr>
<td>Perferred Vendor</td>
<td>Environmental Enclosure for Access Point</td>
<td>2</td>
</tr>
</tbody>
</table>
Appendix B

Specifications

Introduction

This section contains the vendor specification sheets for the equipment to be used for this project

Continued on next page
Specifications, Continued

Continued on next page
Appendix C

Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF</td>
<td>Radio Frequency</td>
</tr>
<tr>
<td>FHSS</td>
<td>Frequency Hopping Spread Spectrum</td>
</tr>
<tr>
<td>ERP</td>
<td>Effective Radiated Power</td>
</tr>
<tr>
<td>RSSI</td>
<td>Receive Signal Strength Indicator</td>
</tr>
<tr>
<td>Txm</td>
<td>Transmitter</td>
</tr>
<tr>
<td>multinode</td>
<td>Honeywell OneWireless Mesh Radio</td>
</tr>
</tbody>
</table>