GENERAL

1.1 SCOPE

A. Provide a complete wireless access point distribution design as specified herein.

The Wi-Fi Engineer shall provide all necessary design resources to furnish a complete 802.11 wireless access point network design according to the standards and practices set forth herein.

1. The design must be such that the installed AP equipment provides coverage that will support necessary capacity for 802.11a, g, n and ac Wi-Fi technologies with a maximum Standard Noise Ratio of 25dB and a minimum receive signal strength (Power Threshold) of -65 dBm throughout the designated coverage area(s).

   a). All areas shall provide sufficient cell overlap such that users can roam through the area(s) of coverage without loss of connectivity.

   b) Each Client should see a minimum of 2 APs at the same time while receiving a signal of at least -70 dBm.

   c). Capacity coverage:

      1) The estimated occupancy for each coverage area shall be appropriate for the expected usage of the area.

      2) Within coverage areas, APs shall be installed to accommodate a maximum of 20 users per AP.

      3) If the user density exceeds 16 sq. ft. per user, a special layout may be required beyond the 20 users per AP criteria. In addition to the requirements above, the following information shall be provided to assist the Contractor in this circumstance:

         (a) 5 GHz channels may be used upon confirmation that building and occupant systems support them.

         (b) 20 MHz channel width is generally used in the 2.4 GHz band.

         (c) 40 20 MHz channel width is generally used in the 5GHz band, but 40 MHz channel can be recommended and used with the Owner and UWIT Wi-Fi engineer's approval.

         (d) Design shall specify areas of high capacity, the number of users and the types of uses that were used to develop the design.

   d). Transmit power for each AP shall be between 6-9 dBM in 2.4GHz and 12-18 dBM in 5GHz.

B. The requirements called out in paragraph A above shall apply to outdoor Wi-Fi locations as well as indoor. Outdoor coverage shall be included as part of the project for all new buildings and major renovations.

1.2 WORK INCLUDED

A. Among the items required are:

1. Design drawings submitted in Autodesk DWG format as detailed below;
   a. Electronic AutoCAD file formatted per these specifications.
   b. PDF prints appropriate for tabloid size (ANSI B 11" x 17") paper of designs generated from the DWG set;
   c. Floor plans with AP placements.
2. Coverage and capacity maps must be drafted for both 2.4Ghz and 5Ghz ranges using Ekahau Site Survey. These maps shall be delivered in both a PDF/Word and Ekahau Site Survey electronic file.
3. A Wi-Fi Information Form as detailed in sections 1.4.A.2 & 2.1.J;
4. A descriptive narrative that outlines the design requirements including capacity and client considerations. This narrative and supporting files described will be used by UW-IT to assess the validity of the design.
5. A complete bill of materials for all components of the Design, including, but not limited to:
   a. wireless access points (WAPs)
   b. hardware required for proper installation and mounting of WAPS
   c. external antennas including related mounting and installation hardware, as required by the design.
   d. lightning arrestors , mounting poles or other equipment required by the design

B. Coordination Requirements

1. The Designer must be available by phone or other electronic medium to meet with Owner, UW Information Technology(UW-IT) and others as required by UW-IT;
2. The Designer shall be available to attend pre-design with the purpose of addressing specific project requirements prior to commencement of design. (See Section 1.5)
3. The Designer shall be available to attend other meetings such as site coordination meetings as required by the Owner's representative, UW-IT and others as required.
4. At the Owners discretion these meetings may be conducted via phone or other electronic medium. The Designer shall be capability and be available for these meetings.
5. The Owner may waive the requirement for any of these specific meetings on per-project bases.
6. The Designer shall provide all qualifying document described in 1.2.A.;
7. The Designer shall provide revised design if required by UW-IT after validation and acceptance review.

1.3 QUALITY ASSURANCE

A. Engineer Qualifications

1. The organization providing design work for this section shall employ an Aruba Certified Mobility Professional (ACMP) and an Aruba Certified Mobility Associate (ACMA), both in current good standing with Aruba Networks. The ACMP and ACMA shall be direct, full time employees of the organization providing design (i.e., an ACMP/ACMA designer who is not a direct employee is not acceptable) and be available to visit the site throughout the project

when work is ongoing. A current copy of the ACMP and ACMA certificates will be requested by UW-IT.

2. The Designer shall be a Wireless Design Professional with qualifications per paragraphs 1.3.A.2. though 1.3.A.8 of this document, and have been in the wireless network design business for a minimum of three (3) years.
3. The Designer shall have successfully completed five (5) designs equal in magnitude (in terms of size and construction cost) within the previous three (3) years. For projects consisting of less than 35 access points, these completed projects shall have been successfully integrated into a network consisting of no fewer than 400 access points within the previous three (3) years. These projects shall have used similar equipment to those specified herein.
4. The Designer shall have demonstrated experience in the system design of all components specified herein;
5. Only full-time permanent employees/staff of the design firm are approved to provide designs and documentation as set forth herein;
6. The Design Firm shall provide all needed software and shall provide a Designer and staff proficient in the use of Ekahau Site Survey and layered AutoCAD Design for incorporation into AutoCAD and have the capability to import a design file.
7. The Designer must be proficient in assigning RF attenuation and the signal reflection characteristics associated with them in both Auto Cad Layers and Auto Cad Objects. This is to qualification is to assure designs that are predictively accurate.
8. The Wi-Fi Designer must be proficient in the use of Ekahau Site Survey for predictive RF CAD designs that consider buildings and RF signal propagation in 3 dimensions and necessary capacity, as opposed to a flat, two dimensional assessment of RF coverage and capacity.
9. The Wi-Fi designer shall be available for the site pre-design meeting with Owner and the site pre-installation walk-through and/or other methods as required for understanding and communicating project requirements.
10. The Wi-Fi designer shall make and engineer any revisions to the construction documents that are a result from the pre-installation walk-through. These revisions shall, once approved by the UW-IT Wi-Fi Engineer, be communicated to the A/E team and the General Contractor to provide any required revisions in pathway resulting from these changes.

1.4 DESIGN REVIEW

A. Work Planning: There is a review phase for design which may be iterative based on UW-IT approval of design. The Designer shall:
   1. Provide AP placement design narrative in Microsoft Word **(**latest file format) doc format or Adobe Portable Document Format (PDF) and drawings in Autodesk's AutoCAD DWG and Ekahua Site Survey Files latest file format;
   2. Contact the Project Manager for access instructions to the Wi-Fi Information Form in a Google spreadsheet stored on a UW-IT maintained site. The designer is to complete the Designer's portion of this Wi-Fi Information Form.

1.5 PRE-DESIGN MEETING

A. This Designer shall be available in person or by phone or other electronic medium to participate in a pre-design meeting with a UW-IT representative. This meeting shall occur prior to commencement of Wi-Fi design.

B. The Designer shall be available to attend an onsite pre-design meeting. For specifically agreed upon projects UW-IT may waive this requirements on a per-project basis.for approval

C. The design shall be considered ready for bid when all of the review comments have been answered to the satisfaction of UW-IT.

1.6 PRE-INSTALLATION WALKTHROUGH

A. The Designer shall attend a pre-installation walkthrough with the Contractor and a UW-IT representative. This walk-through shall occur prior the Contractors commencement of installation. UW-IT may waive this requirements on a per-project basis.

Operation Design Requirements:

2.1 DESIGN GENERAL REQUIREMENTS:

The specified equipment must provide coverage for 802.11a, b, g, n and ac in both the 2.4 and 5 GHz bands throughout the designated coverage area(s), taking into consideration both capacity and signal strength;

A. The design shall provide for coverage in both the 2.4 and 5 GHz bands with a minimum SNR of 25dB and minimum receive signal strength of -65 dBm. These coverage levels will be verified post-installation and the designer will be responsible to provide design solutions for any deficiencies;

B. All areas designated for coverage shall provide sufficient cell overlap such that users can roam through the area of coverage without loss of connectivity;

C. Every client should be able to receive signals from a minimum of 2 Access points at the same time while receiving a signal of at least -70 dBm.

D. Capacity Coverage
   1. The designer will identify areas that require capacity coverage on the floor plans, with specific estimated capacities identified in the wireless narrative;
   2. Within capacity coverage areas additional APs should be designed with a target of no more than 20 users per AP based on occupancy estimates;
   3. If the user density exceeds 16 sq. ft. per user, special design may be required beyond 20 users (not devices) per AP. The following background information on UW-IT's typical configuration is provided to assist the designer in these circumstances:
      a. 5 GHz channels may be used upon confirmation that building and occupant systems support them.
      b. 20MHz channel width is generally used in the 2.4GHz band,
      c. 40MHz channel width is generally used in the 5GHz band, but may be disabled in very high capacity areas to provide additional discrete channels.

E. Air Monitors
   1. An Aruba Air Monitor (AM) overlay shall be designed only for facilities used by:
      a. UW Medicine,
      b. Housing and Food Services, or

c. any additional facility as directed by UW-IT.

2. Where installed one AM should generally be included for every five to seven Wireless Access Points (APs) on each floor, such that monitoring coverage is provided for the entire area in both bands.
3. AMs shall not be placed directly adjacent to APs.

F. The designer providing a wireless design for approval shall submit a complete AP placement design package to the Owner's Representative for review and coordination prior to bid. The design shall include a text in Microsoft Word doc format with the following information:
   1. areas that do not require coverage, with the rationale;
   2. areas where capacity coverage is required, with the rationale and number of expected simultaneous users;
   3. all special physical accessibility and aesthetic requirements, such as AP location restrictions based on building appearance or areas where standard AP install procedures cannot be followed;
   4. each AP that is attached to surfaces other than the ceiling, or is mounted 10 feet or more above finished floor with a rationale;
   5. any materials which could significantly attenuate 802.11 signals in either the 2.4 or 5 GHz band, with the type of material in question and the location of the material;
   6. appropriate diagrams from Ekahu Site Survey should be included to help illustrate the narrative ;
   7. at completion of construction work, the narrative must be amended with any changes made to the original design based on conditions encountered.

G. The Designer shall on the contract documents provide AP/AM location documentation in Autodesk AutoCAD® latest file format DWG format. The designer shall receive a DWG template file from UW-IT. The document provided by the designer shall include the following information:

   a. A block object with attributes which represents each AP location. This block is defined in the DWG template file and must be taken from there;

   b. Text label with values taken from AP object attributes which include:

   c. The AP name (e.g., SAV.102.AP01 or UWSS.B056.AP04). The name must follow the convention described in the Design Requirements.

   d. The mounting style. Acceptable values for this attribute include: WALL, CEILING, ENCLOSURE, BELOW ENCLOSURE, NEMA, HARDLID.

H. AP and AM icons and labels must be separated into drawing layers in the E-COMM layer name space. Only layers defined in the UW-IT supplied template may be used.;

I. The layer colors must not be altered from the template colors, and the AP and AM block objects must not be altered in any way;

J. The Designer shall modify the available on-line Wi-Fi Information Form after the design is accepted by UW-IT. Instructions for accessing and completing this form shall be provided by a UW-IT representative.

K. The Designer shall provide Ekahau Site Survey electronic files used to create and/or validate the design. This file should be properly configured with applicable wall, building and other elements and settings to ensure an accurate RF module of the proposed design. The file shall also be configured with the applicable coverage, capacity and signal requirements for the project.

2.2 DESIGN PLACEMENT & IDENTIFICATION REQUIREMENTS

A. Normally, any wireless access point must be mounted between 8 and 10 feet above finished floor (so as to be accessible by a standard eight-foot ladder for service). A mount between 10 and 15 feet AFF may be permitted if approved by UW-IT. If any other alternative placement is required, it must be approved by UW-IT prior to bid or completion of the design;

B. If wall mounted the project documents shall show:

1. an appropriate mounting bracket certified for use by Aruba must be utilized;
2. at least 6" of clearance between top of AP and ceiling must be provided.
3. the orientation of the AP should be considered, especially noting APs with integrated down-tilt antenna.

C. If ceiling mounted on a suspended acoustical ceiling tile system the project documents shall show:

1. an appropriate mounting bracket certified for use by Aruba must be utilized;
2. attachment to the main beam (rather than cross t) must be done where reasonable.

D. The design should reflect that all APs are to be mounted between 8 and 10 feet above finish floor.

1. Wall mounted Aps shall be designed with a minimum 6 inches of clearance between the top of the AP and the ceiling.

2. APs located on suspended ceilings shall located on the main beam (rather than cross tees.)

3. All alternative placements shall be approved by the Owner and UW-IT be for completion of the design.

E. Wireless Access Point Naming Convention for the design documents:

1. Each wireless AP must have a unique name. The name shall be in the format CCC.RRRR.APyy where:
2. CCC is the official building code, in all capital letters (e.g., SAV for Savery Hall and UMSS for the SS wing of UWMC). This code shall be provided by UW-IT on the Wi-Fi Information Form;
3. RRRR is the room number that the AP is located in, corresponding to the room or corridor number shown on the CAD drawings (and building signs);
4. yy is a two digit incrementing integer for each device within a room, beginning with 01;
5. Sample AP names include:

a. HMC.12EH-04.1.AP01; HUB.203.AP01; HUB.203.AP02; HUB.B100G.AP01; HUB.B100G.AP02; HUB.B260.AP01; HSJ.J100S.AP01; WCH3.100B.AP01.

F. Labeling requirements for the design documents:

1. Wireless Access Point Labeling Standard
   a. To each AP/AM affix label(s) which include at a minimum the following information (provided on the Wi-Fi Information Form):
   b. The device name, matching the configured name of the device.
   c. The University of Washington asset inventory tag number designated by UW- IT for each AP/AM.

PRODUCT DESIGN REQUIREMENTS:

3.1 WIRELESS ACCESS POINTS

Wireless access points (WAPS), support brackets and antennas will be furnished by Owner and presented as such in the documents unless directed differently by the UW CPD Project manager.

Wireless technology is rapidly changing resulting in updated products that may replace the existing UW standard during the time it takes to design and bring a project to the stage where WAPS should be ordered. As a result products need to be verified by the A/E with UW-IT prior to specifying and by the CPD PM/CM prior to ordering.

Documents should reflect that the Owner is to be notified of the need to order 90 days prior to the scheduled install of WAPS and related products.

Design shall specify a complete bill of materials.

A. Wireless Access Points or Air Monitors Inside Buildings

The designer shall verify the current products required with a UW-IT Wireless Engineer:

1. Aruba AP-214, AP-215, AP-224 or AP-225
2. Anther Aruba AP model supporting 802.11ac may be permitted with approval by UW-IT. The AP selection should be confirmed with UW-IT Wireless Engineering prior to specifying.

B. Wireless Access Points Outside Buildings

The designer shall verify the current products required with a UW-IT Wireless Engineer:

1. Aruba AP-274, AP-275, AP-277;
2. Aruba AP-224 or AP-214 properly weather secured in a NEMA 4X rated enclosure.
   Aruba AP-225 or AP-215 properly weather secured in a NEMA 4X rated enclosure.
3. AP-274, AP-275 and AP-277 are weather secure and do not need additional enclosures.

3.2 BRACKETS

The designer shall verify the current products required with a UW-IT Wireless Engineer:

1. For dropped ceiling mounting of AP-214, AP-215, AP-225:
   Aruba AP-220-MNT C-2
2. For wall mounting or Hard Lid Mounting of AP-214, AP-215, AP-224:
   Aruba AP-220-MNT-W2(Mount Kit)
3. Appropriate mounting hardware for all other uses and access points.

3.3 ENCLOSURES/ACCESSORIES/MOUNTS

The designer shall verify the current products required with a UW-IT Wireless Engineer:

A. When an AP other than the AP-274 AP-275 or AP-277 is mounted outdoors, include NEMA 4X-rated box *SURFACE MOUNTED* on exterior of building. Box dimensions shall be sized to accommodate the WAP devices as well as 27 17 51 Ethernet box with 27 17 52 faceplate and bend radius/excess length of patch cord. Box dimensions shall be sufficient to permit easy access for service and subsequent removal if required an AP other than the AP-175 is mounted outdoors, include NEMA 4X-rated box on exterior of building. Box dimensions shall be sufficient to permit easy access for service and subsequent removal if required.

B. Under-the-seat or other exposed designs. In locations where wireless APs may be mounted beneath user seating, special requirements for an approved NEMA enclosure may apply. These boxes would be used in cases where the AP needs to be protected and cannot be mounted overhead. Locking screws would be used for these enclosed locations. See specification 27 17 53 for recommended product.

3.4 WIRELESS ACCESS POINT ANTENNAE

The designer shall verify the current products required with a UW-IT Wireless Engineer:

A. Aruba AP-225, AP-215 and AP-275 equipment have built-in internal antennas.

B. Aruba AP-224, AP-214 and AP-274 equipment require external antennas.

C. The design must specify the choice of antennae and if they are not an Aruba Networks product, detailed information about the product.

3.5 MOUNTS FOR EXTERIOR ACCESS PONTS

Exterior rated access points shall be mounted using AP-270-MNT-H1, AP-270-MNT-H2, AP-270-MNT-V1, or AP-270-MNT-V2 mounts per location requirements.

POST-INSTALLATION

4.1 DESIGN VERIFICATION

A. The Designer/Surveyor must provide a heat-map review of the final wireless installation to satisfy Owner's criteria and the coverage and capacity requirements described in this document using the following criteria:

1. The site survey shall be conducted using Ekahau Site Survey (ESS). To get the most current version visit www.ekahau.com/downloads/ess
2. For projects that involve installing Wi-Fi Access Points (WAPS) in existing building configurations (not new construction or major remodels) the UW will provide the Designer/Surveyor with floor plans in either AutoCad.dwg, PDF, PNG or other format that is acceptable to ESS. The Designer shall verify the correct drawing scale of these drawings. Field verify wall lengths, do not just measure door opening on the drawings for scale verification.
3. The Post Construction/Installation shall be done on a clean version of the floorplan not the predictive survey format showing the design locations of the WAPS.
4. The Surveyor shall use the note functions in ESS to add notes to the floor plans to point out possible issues or anomalies.
5. Before performing the post construction survey the Surveyor shall verify with UW-IT that all AP's are up and functioning and the survey shall not be taken until at least 2 days after the AP's were installed.
6. Where possible an "Active" survey shall be conducted using the University of Washington Service Set Identifier (SSID) and pinging the ip gateway address of the connected network. If an "Active" survey is not practical, a "Passive" survey may be permissible upon prior approval from UW-IT.
7. A "Spectrum Analysis" survey shall also be a part of the "Active or Passive" survey for both 2.4 and 5 GHz covering all channels on each band, this will require 2 spectrum analysis adapters where each adapter is assigned one of the bands. The adapters that work with ESS can be obtained from either Ekahau (www.ekahua.com) or Metageek (http://www.metageek.com).
8. A "Continuous Survey" shall always be performed unless requested by UW-IT to do a "Stop-and-Go" survey. A "Hybrid" of both can be used to get a more accurate placement of the AP's (see step 13 for further details).
9. ESS shall be configured with the proper minimum design requirements, this can be found under the "Project tab" then by selecting "Coverage Requirements". These settings shall reflect the (original) design criteria of the building, if unknown use the following.

    a. Minimum Signal Strength - Min -65 dBm
    b. Signal-to-noise Ratio – Min 25 dB
    c. Data rate minimum – Min 11 mbps

d. Number of Access Points - Min 2 at min. -70 dBm
e. Channel Overlap = Max 4 at min. -80 dBm
f. Round Trip Time – Max 200 ms
g. Packet Loss – Max 2 %
h. Use Noise From: Measured Noise
i. Network Load: Moderate – 10%
j. Adapter: Raw Measurements

10. When performing the actual survey it is expected to keep a consistent pace during the survey and click at every direction change.
11. The survey shall include all areas where coverage is required and ensure that a sample or samples are taken from each area.
    a. For any room larger than a small to average size office the surveyor shall walk the perimeter of the room, keeping as close to the walls as possible and take one sample at each corner of that room.
    b. When surveying large open space areas the surveyor shall not only walk the perimeter, but shall make multiple paths wall to wall keeping no more than 10' between all of survey paths.
    c. In a small or medium office the survey sample shall be taken at the furthest point from the room's entrance along with a sample at the entrance of the room or office.
12. All UW access points, including those installed as part of the project shall be placed on the survey by ESS auto placement option, do not manually move the AP's on the survey, moving the AP's can skew the data and invalidate the survey. To more accurately place the AP's, the surveyor can perform a "Stop-n-go" survey under each installed AP. Surveyors shall consider using multiple segments on a given floor to make it easier
13. The "Coverage Area" tool shall be used to outline the actual expected coverage area and avoid adding any extra white space outside of the coverage area.

B. The Designer/Surveyor must supply the final as-built documentation to UW-IT.
    1. Using the ESS report function the Surveyor must supply an electronic report. This will include the results of the survey, and a narrative of areas found deficient. The Surveyor shall also make recommendation for eliminating any of the deficiencies.
    2. The ESS survey shall include all surveyed floors for a building in a single ESS file with the floors aligned properly and
    3. An AutoCAD file with the final Wi-Fi design and layout reflecting all AP placement location.
C. The Surveyor may be required by UW-IT to attend a follow-up meeting to discuss the project.