

A/E Design Guide for Drawings and Spec Section 27 17 53 WIRELESS COMMUNICATIONS

Instructions to A/E: The Wi-Fi Specification 27 17 53 shall be included and coordinated within the master specification unless directed otherwise by the University Project Manager.

Under most design and contracting situations the University Project Manager should request the Wi-Fi design from the UW-IT Mobil Communications Services. Use of any other Wi-Fi designer should be coordinated between the CPD Project Manager and UW-IT.

The design provided by UW-IT would be for location of the Wi-Fi access points (WAP(s)), predictive performance report, activation and testing with a comprehensive post testing survey (heat mapping). All pathway and cabling for the WAPS would be the responsibility of IT Designer to be installed by the contractor.

If after consultation with UW-IT the Wi-Fi design is to be provided as part of the A/E contract the A/E must verify the current design criteria with UW-IT.

All Submittals and approvals that need to be provided to/by UW-IT shall be done through the CPE Owners Representative.

PART 1 - GENERAL

1.1 SCOPE

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

The Architect/Engineer must 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. This includes floor plans, reflected ceiling plans, furniture/fixture layout and areas that are out-of-scope. Unless specifically stated all areas within the building as well as pathways, courtyards and other green spaces in or around the building must have Wi-Fi coverage that meets our guidelines and adheres to the vendor's validated reference design guidelines.

The Wi-Fi design must adhere to requirements found in section 2.1 DESIGN GENERAL REQUIREMENTS

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;

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- 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 (WIF) as detailed in sections 1.4.A & 2.1.L;
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 to meet with Owner, UW Information Technology (UW-IT) and other project stakeholders as required by UW-IT;
2. The Designer must 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 must 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 Owner's discretion these meetings may be conducted via phone or other electronic medium. The Designer must be available for these meetings.
5. The Owner may waive the requirement for any of these specific meetings on a per-project basis.
6. The Designer must provide all qualifying documentation described in 1.2.A.;
7. The Designer must 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 may be requested by UW-IT.
2. The Designer must be a Wireless Design Professional with qualifications per paragraphs 1.3.A.2. through 1.3.A.8 of this document, and have been in the wireless network design business for a minimum of three (3) years. CWDA or similar cert is preferred.

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3. The Designer must 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 must have been successfully integrated into a network consisting of no fewer than 400 access points within the previous three (3) years. These projects must have used similar equipment to those specified herein.
4. The Designer must 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 must provide all needed software and must 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 AutoCad Layers and AutoCad Objects. This 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 must 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 must make any revisions to the construction documents that are a result from the pre-installation walk-through. These revisions must, 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 provide:
 1. AP placement design narrative in Microsoft Word (latest file format) doc format or Adobe Portable Document Format (PDF)
 2. Drawings in Autodesk's AutoCAD DWG
 3. Ekahua Site Survey Files latest file format
 4. Wi-Fi Information Form (WIF) with designer information filled out. Contact the Project Manager for access instructions to the WIF (Google spreadsheet stored on a UW-IT maintained site).

1.5 PRE-DESIGN MEETING

- A. This Designer must 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 must occur prior to commencement of Wi-Fi design.
- B. The Designer must be available to attend an onsite pre-design meeting. For specifically agreed upon projects, UW-IT may waive this requirement on a per-project basis.

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- C. The design will 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 must attend a pre-installation walk-through with the Contractor and a UW-IT representative. This walk-through must occur prior the Contractors commencement of installation. UW-IT may waive this requirement on a per-project basis.

PART 2 - Operation Design Requirements:

2.1 DESIGN GENERAL REQUIREMENTS:

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

- A. The design must provide sufficient signal strength
 - 1. Minimum SNR of 25dB
 - 2. Minimum receive signal strength (Power Threshold) of -65 dBm
- B. Users must be able to roam throughout the coverage areas with no loss of connectivity. Each client must:
 - 1. See minimum of 2 WAPs at any location within the coverage area
 - 2. second strongest WAP must have receive signal strength of -70 dBm
- C. The designer must identify expected usage throughout the coverage area; define areas that have different usage characteristics. The design must support the following requirements:
 - 1. WAPs must support up to 20 users; a user may have 2-3 devices
- D. Areas where user density exceeds 16 square feet per user requires special consideration and may deviate from 'normal' guidelines.
- E. Designs must be based on UW-IT standard settings:
 - 1. Transmit power: 2.4 GHz 6-9 dBm; 5 GHz 12-18 dBm
 - 2. Channel width of 20 MHz in both 2.4 GHz and 5 GHz bands
 - 3. DFS channels on campus locations
 - 4. No DFS channels in Medical Center locations
- F. Air Monitors (AMs) should be used within UW Medicine locations, Housing and Food Services (HFS) locations and other locations if directed by UW-IT. AMs must be place according to the following specifications:
 - 1. One AM per every 5-7 WAPs on each floor
 - 2. Must provide monitoring for the entire coverage area in both 2.4 GHz and 5 GHz bands.
 - 3. AMs shall not be placed directly adjacent to APs

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- G. Outdoor Wi-Fi coverage must be addressed as part of the overall design; each outdoor location will be considered an area in the Wi-Fi design for the building. Outdoor areas that are in scope are green spaces around the building, walkways to the building and major pathways as well as indoor courtyards, terraces and patios. The requirements called out in paragraphs a.--e. above shall apply to outdoor Wi-Fi locations as well. In addition, it should be determined if “short-guard interval” is enabled or not. Criteria for this determination should include height of APs, distance to client and proximity of other outdoor structures.
- H. The designer providing a wireless design for approval must submit a complete AP placement design package to the Owner’s Representative for review and coordination prior to bid. The design must 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 5GHz band, with the type of material in question and the location of the material;
 6. appropriate diagrams from Ekahau 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.
- I. The Designer must on the contract documents provide AP/AM location documentation in Autodesk AutoCAD® latest file format DWG format. The designer should receive a DWG template file from UW-IT. The document provided by the designer must include the following information:
1. 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;
 2. Text label with values taken from AP object attributes which include:
 3. The AP name (e.g., SAV.102.AP01 or UWSS.B056.AP04). The name must follow the convention described in the Design Requirements.
 4. The mounting style. Acceptable values for this attribute include: WALL, CEILING, ENCLOSURE, BELOW ENCLOSURE, NEMA, HARDLID.

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- J. 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.;
- K. 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;
- L. The Designer must modify the available on-line Wi-Fi Information Form after the design is accepted by UW-IT. Instructions for accessing and completing this form must be provided by a UW-IT representative.
- M. The Designer must provide Ekahau Site Survey electronic files used to create and/or validate the design. This file must be properly configured with applicable wall, building and other elements and settings to ensure an accurate RF module of the proposed design. The file must also be configured with the applicable coverage, capacity and signal requirements for the project.

2.2 DESIGN PLACEMENT & IDENTIFICATION REQUIREMENTS

- A. Wireless access points should 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;
 - 2. attachment to the main beam (rather than cross t) where reasonable.
- D. The design must reflect that all APs are to be mounted between 8 and 10 feet above finish floor.
 - 1. Wall mounted Aps must be designed with a minimum 6 inches of clearance between the top of the AP and the ceiling.
 - 2. APs located on suspended ceilings must be located on the main beam (rather than cross tees.)
 - 3. All alternative placements must be approved by the Owner and UW-IT for completion of the design.

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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.

PART 3 -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:

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1. Aruba AP-214, AP-215, AP-224 or AP-225
2. Another 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 must 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-W3(Mount Kit)
3. Appropriate mounting hardware for all other uses and access points.

3.3 ENCLOSURES/ACCESSORIES/MOUNTS

The designer must 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 must 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 must be sufficient to permit easy access for service and subsequent removal if required an AP other than the AP-27X is mounted outdoors, include NEMA 4X-rated box on exterior of building. Box dimensions must 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 must be used in cases where the AP needs to be protected and cannot be mounted overhead. Locking screws must be used for these enclosed locations. See specification 27 17 53 for recommended product.

3.4 WIRELESS ACCESS POINT ANTENNAE

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

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- A. Aruba AP-225, AP-215, AP-275 and AP-277 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 antennas and if they are not an Aruba Networks product, detailed information about the product.

3.5 MOUNTS FOR EXTERIOR ACCESS POINTS

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.

PART 4 - 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 must 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 must provide the Designer/Surveyor with floor plans in either AutoCad.dwg, PDF, PNG or other format that is acceptable to ESS. The Designer must 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 must be done on a clean version of the floorplan not the predictive survey format showing the design locations of the WAPS.
 - 4. The Surveyor must 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 must verify with UW-IT that all AP's are up and functional and the survey shall not be taken until at least 2 days after the AP's were installed.
 - 6. An "Active" survey must 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 must also be a part of the "Active or Passive" survey for both 2.4 GHz and 5 GHz covering all channels on each band, this will require 2 spectrum

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analysis adapters where each adapter is assigned one of the bands. The adapters that work with ESS can be obtained from either Ekahau (www.ekahau.com) or Metageek (<http://www.metageek.com>).

8. A “Continuous Survey” must 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 must 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 and beneath each WAP.
11. The survey must include all areas where coverage is required and ensure that a sample is taken from each area.
 - a. For any room larger than a small to average size office the surveyor must 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 must not only walk the perimeter, but must 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 must 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 should perform a “Stop-n-go” survey under each installed AP. Surveyors should use multiple segments on a given floor.

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13. The “Coverage Area” tool must be used to outline the actual expected coverage area and avoid adding any extra white space outside of the coverage area.
 14. The “High Capacity Area” tool must be used to define areas where there is high user density such as auditoriums and cafeterias.
- 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 must also make recommendation for eliminating any of the deficiencies.
 2. The ESS survey must include all surveyed floors for a building in a single ESS file with the floors aligned properly.
 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.