Overview – CMU has had contractors install data jacks and mount brackets for APs. The new process that contractors are to use includes additional work for marking location for AP bracket, removal of temporary stickers, installing AP bracket, installation/positioning of antennas, mounting the AP device, plugging patch cords into the correct port on the AP and data jack and installation of locks and caps. Each project may call for multiple options for models of: AP’s, antennas, mounting brackets and enclosures. Outdoor AP’s are not addressed in this document. Contractors need to check individuals Scopes of Work and floor plans to correctly match these various options.

CMU will provide the contractor with floor plans, APs, AP mounting brackets and patch cords. AP’s are costly devices and are tested in advance for proper operation. Contractors are to take care not to drop/damage APs. Please report any mishaps rather than continue to mount an AP that may have been damaged. The overall goal is to have the contractor do all work that requires ladders to minimize CMU’s Network Operations group from having to go to each location to do that work. Prior to contractor work, Network Operations will have already gone through the areas to test wireless coverage by use of any ladders, AP’s mounted on tripods and placement of stickers to mark AP locations.

The installation process may first require removal of an existing AP. Otherwise, all new AP installations are typically performed in the following sequence:

1. Verify outlet can be installed within vicinity of AP (if new outlet)
2. Mark location of AP bracket
3. Remove temporary sticker marking AP location
4. Install AP bracket on wall if wall or hard ceiling mounted or on AP if drop ceiling mounted AP
5. Install communications outlet (if new outlet is installed) label and test
6. Install patch cord into port on AP
7. Install antennas (if detachable)
8. Install AP onto bracket if wall or hard ceiling mounted, Install AP/bracket onto spline if drop ceiling mounted.
9. Install patch cord into outlet

NOTE: Failure to install all antennas -before- plugging patch cord into the communications outlet can damage the AP.

General Mounting Height, Clearances, Coverage and Performance Guidelines -

• For wall mounted AP’s, the minimum height Above Finished Floor (AFF) to center of AP body is 7’ and the Maximum height AFF to center of AP body is 7’ 6”
• It is preferred that wall mounted AP’s are installed as high as possible without exceeding the maximum height.
• Average sq. ft. coverage based on drywall construction from 200 to 800 sq. ft. depending on capacity: performance ratio. Example: classrooms and lecture halls will require more dense placements.
• Average sq. ft. coverage based on hard plaster or masonry construction from 50 to 400 sq. ft. depending on capacity: performance ratio. Example: classrooms and lecture halls will require more dense placements.
• Clearances for ceiling mounted AP’s are shown in the diagram at the top of the proceeding page which take into account final clearance of existing and future APs that need to fit near vertical surfaces such as adjacent walls. As an example: an AP-220-MNT-W2 mount is 5.5” wide however AP-215 is 7” wide whereas a AP-220 is 7.8” wide.

For installs prior to June 2013, patch cords are to be plugged into the jacks on top when labels are orientated in the horizontal position.

WALL MOUNTED AP HEIGHTS - NOTE: Antennas not shown with correct positioning, diagram not intended for ceiling mounted APs
Installing outlets with only AP-215s in mind may not allow enough clearance for future AP’s which may be larger. Therefore the center of an outlet box or mount or AP should not be less than 4” from an adjacent perpendicular surface, which will accommodate AP’s that are up to 8” wide.

**AP OUTLET BOX OR “NO-BOX”**

**MINIMUM CLEARANCE BETWEEN WALL AND CENTERLINE**

**CEILING OR HORIZONTAL SURFACE**

**WALL OR VERTICAL SURFACE**

ABOVE: Side cutaway view indicating minimum clearances between adjoining horizontal and vertical surfaces for centering outlets for all ceiling mounted Aruba APs

Exact placement is desired however if installation requires horizontal repositioning of wall mounted APs, contractors can relocate center of AP to left or right up to 18” in either direction. Since relocation of one AP can affect overall wireless coverage, any variation from the planned locations of ceiling mounted APs must be approved by CMU. Contractors are to remove any temporary stickers, taking care not to harm wall or ceiling finishes.

Install outlets along either side of AP such that faceplate is not above or below the top and bottom edges of the AP body, typically centered with AP body. Outlets are to be positioned such that a 12” patch cord can connect to the correct port on the AP without exceeding a minimum bend radius of 4 x the diameter of the cable jacket. A typical distance from either side of an average Aruba AP to the center of the jack is no more than 4” between edge of AP body and edge of outlet faceplate.

**Floor Plans** – The floor plans provided by CMU will be labeled to show the AP and data outlet locations as well as the name of each AP and the outlet labels to be used. The outlet labels provide information for which closet, rack, panel and port each cable is to terminate within the communications closet. The APs will be labeled to correspond to the labels of the APs shown on the floor plans. It is important to match each AP with the location to where it is to be installed.

**AP Mounting Brackets** – It is important to match the correct AP mounting bracket to the model of AP as each bracket is specific to the model of AP and each model has multiple brackets based on construction. Each model AP may have multiple mounting bracket options depending if using a hard ceiling or drop ceiling. Due to the force required to install the drop ceiling bracket onto AP and to prevent damage to the drop ceiling spline, first attach bracket to AP before attaching bracket to spline.

**Correct AP & Faceplate Jacks** - Patch cord/s must be inserted at each end to match jacks of each duplex outlet to ports on APs. Verify that plug is fully inserted in outlet jack by observing clicking sound of tab on modular plug. APs have multiple ports that the Ethernet patch cords can be plugged into. Verify that plug is fully inserted into each AP by observing clicking sound of tab on modular plug. These ports are uniquely labeled. The specific ports that the patch cords are to plug into are shown in the table and diagrams on the following page.
<table>
<thead>
<tr>
<th>AccessPoint Model</th>
<th>Available Ports</th>
<th>Port/s to Plug Into</th>
<th>Antenna Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>105</td>
<td>&quot;ENET&quot; &amp; &quot;CONSOLE&quot;</td>
<td>&quot;ENET&quot;</td>
<td>Internal, not visible/adjustable</td>
<td>Smallest of all models</td>
</tr>
<tr>
<td>125</td>
<td>&quot;ENET 0&quot;, &quot;ENET 1&quot; &amp; &quot;CONSOLE&quot;</td>
<td>&quot;ENET 0&quot;</td>
<td>External, attached</td>
<td>Do not use port on back</td>
</tr>
<tr>
<td>134</td>
<td>&quot;ENET 0&quot;, &quot;ENET 1&quot; &amp; &quot;CONSOLE&quot;</td>
<td>&quot;ENET 0&quot;</td>
<td>External, removable</td>
<td>Wall mount. Positioning of antennas may be challenging</td>
</tr>
<tr>
<td>135</td>
<td>&quot;ENET 0&quot;, &quot;ENET 1&quot; &amp; &quot;CONSOLE&quot;</td>
<td>&quot;ENET 0&quot;</td>
<td>Internal, not visible/adjustable</td>
<td>Ceiling mount only. For drop ceilings: install bracket on AP before attaching to drop ceiling spline</td>
</tr>
<tr>
<td>214</td>
<td>&quot;USB&quot;, &quot;ENET&quot; &amp; &quot;CONSOLE&quot;</td>
<td>&quot;ENET&quot;</td>
<td>Internal, not visible/adjustable</td>
<td>Ceiling mount only. For drop ceilings: install bracket on AP before attaching to drop ceiling spline</td>
</tr>
<tr>
<td>215</td>
<td>&quot;USB&quot;, &quot;ENET&quot; &amp; &quot;CONSOLE&quot;</td>
<td>&quot;ENET&quot;</td>
<td>External, removable</td>
<td>Wall mount. Positioning of antennas may be challenging</td>
</tr>
<tr>
<td>224</td>
<td>&quot;ENET 0&quot;, &quot;ENET 1&quot; &amp; &quot;CONSOLE&quot;</td>
<td>&quot;ENET 0&quot; &amp; &quot;ENET 1&quot;</td>
<td>Internal, not visible/adjustable</td>
<td>Ceiling mount only. For drop ceilings: install bracket on AP before attaching to drop ceiling spline</td>
</tr>
<tr>
<td>225</td>
<td>&quot;ENET 0&quot;, &quot;ENET 1&quot; &amp; &quot;CONSOLE&quot;</td>
<td>&quot;ENET 0&quot; &amp; &quot;ENET 1&quot;</td>
<td>Internal, not visible/adjustable</td>
<td>Ceiling mount only. For drop ceilings: install bracket on AP before attaching to drop ceiling spline</td>
</tr>
</tbody>
</table>

**Use of Category-6A Cabling** – All communications outlets for APs are to have two (2) of Category-6A cables/jacks installed using Panduit plenum rated cabling with blue jacketing (Part# PUP6AM04BU-UG). AP installations will no longer employ Category-6 cabling.

**Additional AP outlets** – Scopes of Work for some residence halls may call for additional AP outlets to be installed without AP’s for future use. Such outlets are to be covered with a blank that matches surrounding surfaces. Check the particular Scopes of Work for details.
Category-5E upgrades – Scopes of Work for some residence halls may call for replacing existing AP outlets with one or two Category-5E cabling/jacks to have two of Category-^A cables/jacks. Check the particular Scopes of Work for details.

Patch Cord Locks & Jack Caps for Residence Halls – To deter tampering with AP’s in residence halls, contractors are to secure locking patch cord plugs into outlet jacks and install caps in the unused outlet jacks. CMU will provide patch cords with locks, jack caps and removal tools for both locks and caps. The locks will be Panduit part number PSL-DCPLX-BL. The caps will be Panduit part number PSL-DCJB-BL. Upon completion of each project, the contractor is to return all removal tools to the Cable Plant Project Manager.

Each patch cord will have a lock installed on one plug. The plug with the lock is to be inserted into the jack at the top of each outlet. The jack at the top can be distinguished from the jack on the bottom when the labels are orientated correctly in the horizontal position on the faceplate. The lock may first need rotated clockwise to properly orientate the locking mechanism. After the patch cord is inserted, the contractor is to place the removal tool/key into the round opening on the lock and rotate the tool no more than 1/2 turn counterclockwise to lock the plug into place. Verify that the white line at the bottom of the lock is aligned with the white line on the removal tool, then de-insert and retain the removal tool.

A cap will be provided for each unused jack on each faceplate. The cap is to be inserted into the jack at the bottom of each outlet. The jack at the bottom can be distinguished from the jack on the top when the labels are orientated correctly in the horizontal position on the faceplate. Insert cap with “prongs” protruding into the jack and by aligning tab of cap with the tap opening on the jack and verify correct insertion by observing “clicking” sound. No tools are required to install the caps but sometimes mistakes occur. If a cap needs to be removed, insert removal tool so that the tab of the tool that has the molded “P” is facing downward and that each of the two tabs of the removal tool are aligned with the slots on each side of the cap. Push tool into the jack/cap and pull out to remove the cap.
**Antenna Positioning** – Several different models of AP’s may be used within the same building. Some models have internal antennas that do not require positioning, some have attached, external antennas that require positioning and some have detachable, external antennas that require positioning. Proper antenna positioning is important for optimum coverage and performance. Contractors are to position external antennas based on the model of AP as per the following diagrams...

The AP-134 antennas are more difficult to position. Shown is a front view with center antenna positioned straight up and the side antennae positioned with 45 degree slant outward and forward. Attach each antenna by rotating the knurled collar clockwise onto the connector of the AP. Gently make sure antenna collar is fastened securely, and ONLY tighten from the collar, not from the antenna paddle.

Move the antenna into its proper orientation, ONLY then should the antenna to be rotated by the paddle.
Aruba Model 125 – This wall mounted AP requires all 3 antennas positioned to be parallel to the wall.

Aruba model AP-224 wall mount unit with external antennas to be adjusted similar to model AP-134.

AP-134 side view with center antenna positioned straight up and left and right antennae on a 45 degree slant outward and forward.

AP-134 top view with center antenna positioned straight up and left and right antennae on a 45 degree slant outward and forward.
Ventev Wall Enclosure – CMU is evaluating an enclosure from Ventev that adapts a ceiling mounted AP to a wall, similar to the adapter from Oberon. These enclosures are not yet in production for CMU wireless deployments. This document will be updated when that occurs but for now we are providing a preview of the product. The plastic bubbles that enclose the AP are available in clear (shown below) white and with a mirrored surface. The picture below on the right shows the label on the underside of the enclosure and placed to the left identifying the jack on the top of the faceplate. There would be a corresponding label on the right of the enclosure to identify the jack on the bottom.

Oberon Wall Adapters for Ceiling Mounted APs – In some cases it may be necessary to use adapters to attach ceiling mounted APs to walls. This will allow use of ceiling mount AP’s in residence halls to avoid using wall mount APs that are prone to having external antennas harmed. Previously, adapters that were installed prior to June 2014 were the Oberon Model-1029-00. All ceiling mounted APs are to have LEDs facing away from the wall.

Read before stating installation:
STEP-1 Prior to mounting on wall, match pre-drilled holes of Aruba AP ceiling mount bracket and Oberon wall-mount enclosure and insert screws to attach units together.
STEP-2 Determine location of communications faceplate on wall taking into consideration that it is recommended to later mount one side of the enclosure directly to a stud if possible. Install outlet/faceplate and labels.
STEP-3 Remove cover and place enclosure over the communications faceplate. Mark the 4 screw locations. Using four #10 x 2” screws, secure one side of enclosure to the stud and other side of enclosure to the wall using suitable anchors. If there is no stud at the location, use 4 suitable anchors to secure the mount in place.
STEP-4 Run the Ethernet patch cord/s through the rubber grommet then through the hole located on the top cover of the mount. Place the grommet in the hole of the enclosure. Plug patch cord in port of AP labeled “ENET 0”, secure AP to ceiling mount and plug other end of patch cord to the top jack of the communications faceplate. For models 224 & 225, install 2nd patch cord between port of AP labeled “ENET 1” ands the bottom jack.
**STEP-5** Adhere label to left side of enclosure’s front edge (as shown in picture above) that corresponds to the label of the top jack. Adhere label to right side of enclosure’s front edge (as shown in picture above) that corresponds to the label of the bottom jack. Secure cover to the enclosure using the 4 screws.

**Use of new Oberon model “1012-CMU/2” Wall Adapters for Ceiling Mounted APs** – As of June 2014, the model 1012-CMU/2 will replace the model shown on previous pages. The adapter will allow use of ceiling mount AP’s in locations such as residence halls to avoid using wall mount APs that are prone to having external antennas tampered with. The Oberon Wall-mount enclosure Model-1029-00 has now been replaced with the new model “1012-CMU/2”. This model still mounts over a single gang box or can be installed over a double gang box (preferred), can be field modified to rotate a single gang box 90 degrees, can be installed with direct conduit penetration (for hard surfaces) by use of 1” knockouts on either side, is of the same dimensions as previous models, is equipped with an adapter bracket that replaces the Aruba bracket and features a hinged/lockable cover and is equipped with a ty-wrap used as a tether between the AP and the adapter so that the AP does not fall and cause injury and to prevent the AP from being damaged.

The supplied ty-wrap was intended to be installed if the AP’s LEDs were facing the wall however CMU wants to LEDs to face into the hallways for ease of monitoring. Therefore the ty-wrap should be secured to where it starts to grip to itself (about an inch protruding through the ty-wrap’s opening) and the protruding end should be cut flush with the ty-wrap opening. Given the combined weight of adapter and AP, the preferred installation is over a secured double gang work box using 4 screws into work box and 4 more screws through keyhole openings and into wall by use of anchors. It is preferred if one side of keyhole openings were to penetrate a stud. Contractor is to return all keys to CMU after completion of project. Realizing that the preferred installation is not always feasible, variations of the installation are allowable if not compromising the overall attachment to the wall as to avoid creating a safety hazard.
1. New Oberon Model 1012-CMU/2 adapter shown installed with AP model 135 on adapter plate over 2 gang old-work box using yoke with tabs cut off and no faceplate to allow clearance for hinged cover and secured with screw/nut in middle position, secured with 4 screws into work box, further secured to wall with 4 screws/anchors using keyhole slots, key on right in locked position, ty-wrap tether installed through adapter plate over lock mechanism, outlet labels installed inside and outside of adapter, patch cord plugs installed into upper jack and into AP port “ENET 0”,

2. Adapter plate to slide over AP for mounting.

3. AP being secured to adapter plate by fastening screw in middle.

4. Mounting adapter plate to Oberon model 1012-CMU/2

5. Adapter plate secured to Oberon model 1012-CMU/2 by use of key/lock mechanism.
**Aruba model AP-130-MNT-W2 security bracket** – As of May 2014, the Aruba model AP-130-MNT-W2 security bracket is the preferred bracket for use on hard walls and ceilings when not using Oberon brackets. The brackets are to be mounted over deeper, 2-gang, old-work boxes such as the Carlon model BH234R available at The Home Depot. Contained within the work box is to be entry of 2 Category-6A cables, the 2 Category-6A jacks the cables are terminated with, and slack for the patch cord/s. Biscuits are not to be used. The bracket mounts over the box using holes provided for screws. The AP is then mounted onto the bracket by first pulling the release tab on the bracket, pushing AP onto bracket and then pulling on the tab. Use the security screw provided to lock the tab into place. Orientate duplicated outlet labels correctly based on whether wall or ceiling mount. Attach additional labels around each cable jacket within outlet box.

Carlon model BH234R. two-gang, old-work box for hard ceilings and walls. Aruba AP-130-MNT-W2 security bracket is to mount over box and secured with 4 screws into existing holes.

Aruba AP ready to be installed on Aruba model AP-130-MNT-W2 security bracket (release tab shown at top of bracket, wall box beneath bracket).

Aruba AP model 134 on Aruba model AP-130-MNT-W2 security bracket (jacks contained in wall box beneath).
Use of No-Box and “Biscuits” with tethers - Although the use of the 2-gang, old-work box is preferred, sometimes clearance of existing construction will not allow for placement. In those situations the next preference is use of a single gang “no-box” frame such as Panduit part# “LV-W-1G” is acceptable. The no-box frame does not provide for proper support of the AP and bracket, therefore use of 4 additional anchors is required. The jacks are to be contained by use of a 2 jack surface mount (also known as a “biscuit”) which is Panduit part# “CBX2EI-AY” (ivory) or part# “CBX2IW-AY” (off white) which will contain a quantity of 2 of Panduit Mini-Com Category-6A jacks part # “CJ6X88TGBL”. Furthermore, to avoid the installed biscuit from falling within the wall and no longer be accessible, the use of a Velcro ty-wrap (provided by the contractor) is to be used to tether the biscuit to the no-box frame. The following pictures illustrate the installation process.
Opening for no-box emphasized by use of tracing with black marker, showing overlay of Aruba AP-130-MNT-W2 bracket emphasized with blue marker and location of 4 anchors which line up with holes in AP-130-MNT-W2.

Completed mounting of AP-130-MNT-W2 over no-box with patch cords protruding, frame ready for mounting of AP and security screw. Not shown are labels on bracket with jack IDs as in previous pages.

Opening with no-box frame inserted. Biscuit with tether secured to no-box with screw inserted through Velcro, permanent cabling with butterflied labeling and knockout on cover removed for 2nd jack. Not shown is knockout removed at rear of cover for cabling to exit.

Tether hidden behind cables, cables terminated and secured with plastic ty-wrap (provided with biscuit) with enough pressure so ty-wrap does not distort cable jacket, jacks installed on base and outlet labels installed on cover.

Opening with no-box frame inserted. Biscuit with tether secured to no-box with screw inserted through Velcro, permanent cabling with butterflied labeling and knockout on cover removed for 2nd jack. Not shown is knockout removed at rear of cover for cabling to exit.
Drop Ceiling Mounted APs – Each Aruba model 135 ceiling mounted APs comes with two drop ceiling brackets, one bracket for 9/16” wide rails and one bracket for 15/16” wide rails. Some ceiling tiles protrude below the rails and require cutting so that the tiles reseat properly. These type of tiles are also known as “Tegular” (Armstrong’s term for protruding tiles or recessed rails).

All ceiling mounted APs are to have LEDs facing away from the wall. Outlet labels are to be placed on outlet faceplate above drop ceiling as well as on adjacent drop ceiling rails.

Aruba provides Model AP-130-MNT-C2 for other types of drop ceilings. That model includes one bracket for Open (Silhouette) rails and one bracket for Flanged (Interlude) ceiling rails as show below.

Cutting of ceiling tiles to allow for tiles to reseat properly for Tegular ceiling tiles.

Correct outlet labeling on drop ceiling rails and correct orientation of Aruba model 135 ceiling-mounted AP with LEDs facing away from wall.
Removal of Factory installed Stickers on APs - In some cases, contractors may receive APs with stickers containing “SN” numbers, “MAC” numbers and bar codes. If so, contractors should remove those stickers and discard. Please ignore the pictures in this document incorrectly showing stickers still on APs.

New Aruba Model 200 Series 802.11AC APs - As of June 2014, new Aruba model 224 and 225 AP’s will be deployed in place of the 130 series. These AP’s have wall/ceiling brackets similar to the brackets Aruba has for the 130 series and can use the same adapter plates on the Oberon mounts. These units are slightly larger, heavier and provide for faster network speeds. To help obtain the faster network speeds, the contractor is to install two patch cords between the two jacks and both ports so that the top jack of the outlet is connected to port “ENET 0” on the AP and the bottom jack of the outlet is connected to port “ENET 1” on the AP. The port labeled “CONSOLE” is not to be used.
New Aruba Models AP-214 and AP-215 802.11AC APs - As of January 2015, Aruba models AP-214 and AP-215 will be used for many new deployments. The AP-214 is similar to the model AP-224 with external antennas that need positioned similarly. The AP-215 is similar to the model AP-225 with internal antennas, no antenna positioning to be concerned with. The AP-214 and AP-215 are both slightly smaller than their 220 series counterparts. Like the models AP-224 and AP-225, the 210 series APs also uses the same models mounts (Aruba AP-220-MNT-W2, Aruba AP-130-MNT or Oberon) an follow the same installation processes shown on preceding pages. Only one patch cord is required to connect each AP-214 or AP-215. There are two ports on the AP-214 and AP-215 however the patch cord should only be connected to the port labeled “ENET” as shown in the picture to the right. When mounted on ceilings or on Oberon adapters, the USB port is to face towards the wall with LEDs facing outward.

Changing the color of the surface of Aruba 220 series APs - We have found a few occasions where the glossy white surface of a 220 series AP will not blend well with its surroundings. An example is where CMU had created “black box theaters” where all surfaces within are painted flat black. CMU had taken measures to paint the surface of the AP to match which can void warranties. A “skin” is now available for each model of the Aruba 220 series. The skin is paintable and can be attached and detached from the AP surface without warranty concerns.

Aruba 130 Series Mounts – In cases where aesthetics and security are not as much of a concern, the model AP-130-MNT will be used. Examples of locations are on concrete walls of mechanical or electrical areas. The mounts come in both beige and black and will hold the 130, 210 and 220 series AP’s. This mount should be centered where the sticker has been located. The communications outlet should be installed within 4 to 8” from the center of the mount, typically to the left or right as shown in the first diagram on page-1. It is important for antenna orientation that mounts on walls are to be installed with clips on each side as shown in the picture to the right.

Patching and Painting – In many cases, contractors will be asked to remove existing AP’s and brackets which may leave anchor holes and mismatches of paint. Contractors are to provide Network Operations with any AP’s and brackets that have been removed. Contact information for the painter that many CMU groups use is: Mauro Nofi, 412-370-3477,nofipaintinginc@gmail.com
CMU Contact info –
Pete Bronder. Manager of the Cable Plant Office, 412-268-8582, pete@cmu.edu
Daryl Hollinger, Manager of Network Operations, 412-268-5260, dhollinger@cmu.edu