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This preface provides an overview of this guide, a list of all documentation related to the Aruba Outdoor RF Coverage Planner, and contact information for Aruba Networks, and includes the following sections:

- "Document Organization" on page 5
- "Executive Summary" on page 5
- "Updates Since the Last Release of the Aruba Outdoor RF Planner" on page 7
- "Related Documents" on page 7
- "Notice Icons" on page 7
- "Contacting support" on page 7

### Document Organization

This user guide is intended to guide you through the process of using your facility maps/overlays, Google Earth Pro®, and the Aruba Outdoor RF Coverage Planner to create an outdoor Wi-Fi coverage plan for your site or facility.

This user guide includes instructions and images that describe how to generate an outdoor RF coverage plan. The first part of the guide describes how to use Google Earth Pro to create a KMZ file using customer/site data. The second part describes running that KMZ file through the Outdoor Planner to add the coverage plan data to the KMZ file.

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<th>Description</th>
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</tr>
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<td>Chapter 2, “Working in Google Earth Pro” on page 11</td>
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</tr>
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<td>Describes handy tips and best practices from users in the field.</td>
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### Executive Summary

The Aruba Outdoor RF Coverage planner is a web based file processor and model generator. The utility takes a previously created Google Earth file (*.kmz), processes it for the AP and antenna settings and RF parameters, and then outputs a new Google Earth file (*.kmz) with the RF coverage and mesh visualization models added.

For version 2.2, the Outdoor Coverage Planner supports configuration for the following Aruba APs:
Planning Workflow with Google Earth and the Outdoor Planner

Figure 1 shows the workflow you will follow to prepare an outdoor RF coverage plan.

Figure 1 Coverage Plan Workflow

System Description and Requirements

The Aruba Outdoor RF Coverage Planner is a web-based file processor and model generator. It takes a previously created Google Earth file (*.kmz), processes it for the settings and RF parameters you select, and outputs a new Google Earth file with the RF coverage and mesh visualization models added.

Aruba Networks recommends the following hardware and software to support the Outdoor Planner’s 3D graphics models:
- Google Earth Pro (required for commercial use) version 5.0 or later
- DirectX- and OpenGL-compatible video acceleration (see Google Earth’s required minimum specs)
- Up-to-date video drivers

Outdoor Wireless Design Experience Requirements

In order to make the best use of the Aruba Outdoor RF Coverage Planner, Aruba Networks recommends that users have the following types of knowledge and experience with outdoor wireless design:
- Solid knowledge and understanding of RF design principles and antenna patterns
- Experience installing, aiming, and validating outdoor radio installations
- Experience completing outdoor mesh site surveys
- Familiarity with Aruba outdoor APs and antenna products
Updates Since the Last Release of the Aruba Outdoor RF Planner

Please see the Release Notes for the latest version of the Outdoor Planner.

Related Documents

- Outdoor Solution Guide

Notice Icons

The following notice icons are used throughout this document:

<table>
<thead>
<tr>
<th>Notice Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Note" /></td>
<td>Indicates helpful suggestions, pertinent information, and important things to remember.</td>
</tr>
<tr>
<td><img src="image" alt="Caution" /></td>
<td>Indicates a risk of damage to your hardware, loss of data, or other potential errors.</td>
</tr>
</tbody>
</table>

Contacting support

Main Site | arubanetworks.com
---|---
Support Site | support.arubanetworks.com
North American Telephone | 1-800-943-4526 (Toll Free)
 | 1-408-754-1200
International Telephones | arubanetworks.com/support-services/aruba-support-program/contact-support/
Software Licensing Site | licensing.arubanetworks.com/login.php
Wireless Security Incident Response Team (WSIRT) | arubanetworks.com/support/wsirt.php

Support Emails

Americas and APAC | support@arubanetworks.com
EMEA | emea_support@arubanetworks.com
WSIRT Email | wsirt@arubanetworks.com
Please email details of any security problem found in an Aruba product.
Determining Coverage Requirements

Prior to starting an outdoor RF coverage plan, collect the following information:

1. Facility location information; a Google Earth placemark (preferred), street address or latitude/longitude coordinates. Wireless engineers can use a handheld GPS that can export data to a laptop to collect waypoints of radio-mounting locations then import that data into Google Earth.

2. A facility plan (CAD drawing or map) showing available AP outdoor mounting locations (approximate or to best of knowledge). You must convert all drawings and maps to PNG or JPG files in order to use them in the planning tool.

3. A clear understanding of the coverage requirements.

4. Digital photographs of all potential mounting locations for mesh portals and mesh points.

5. Photographs of line-of-sight paths from each AP, if available.

6. AP mounting heights for known, expected, or typical mounting locations.

7. For directional antennas, the expected direction from the mounting location to the coverage area.

8. Target Signal Strength, throughput and services (802.11a/b/g/n) including whether high throughput (HT) modes are planned to be supported in 20 MHz (HT20) or 40 MHz (HT40) channel widths

9. Client device info (power and typical antenna gain, if available).

10. Areas believed to need bridging/mesh links due to a lack of available Ethernet or fiber.

11. Number and placement of mesh nodes that will be used exclusively as portals.

12. Number and placement of mesh nodes that will be used as mesh points.

13. Number and placement of mesh nodes that will be used as multi-hop points by design.

14. Locations of significant sources of interference (RF) or other environmental factors that would negatively affect system performance.

Learning to Use Google Earth Pro

Before proceeding, be sure that you are familiar with the Google Earth Pro application. Download and install Google Earth Pro (http://earth.google.com) and use the available help and documentation (http://earth.google.com/support/bin/static.py?page=guide_toc.cs) to learn basic functions. In particular, focus on:

- Tilt/rotate 3D view
- Using the ruler for distance measuring
- GPS data importing
- Working with folders and saving images
- Using the Image Overlay feature

If you are using Google Earth for commercial purposes, you must acquire a license for the Pro version of Google Earth.
To get started, you need to know the location of the property for which you are creating a coverage plan. Either the property’s address or latitude/longitude coordinates will work.

When you have the property information, launch Google Earth Pro.

**Figure 2  Google Earth Pro at Startup**

Locating the Property in Google Earth

To locate the property in Google Earth, complete the following steps:

1. In the Layers pane, select **Terrain** and **Roads**.
2. In the Search pane, select the **Fly To** tab.
3. Enter the property address (or Lat/Long values) and click **Search**.

You can also use the mouse controls to zoom in to the subject property.

4. After locating the property, select the address in the Search pane and press **Delete** to clear the extra text from the map.
5. In the **Places** pane, right-click **My Places**.
6. From the **Add** menu, select **Folder**. This will be your master folder, and the name of this folder will be the name of the KMZ file you export later.
7. Create the following folder structure exactly:

**Figure 3 Folder structure**

- Places
  - My Places
  - Mesh Link.kmz
  - Locations
  - Map Overlays

In order to proceed, you must create a top level folder named “Locations” inside the master folder. The Locations folder must also contain at least one placemark. Do not put anything other than placemarks and sub-folders in the “Locations” folder.

If you are planning a point-to-multipoint mesh, it may be helpful to organize the multipoint mesh points with their portals in the same folder under “Locations.” For example:

- <Group 1>
  - Portal Placemark
  - Point Placemark
  - Point Placemark

The use of subfolders (see “Creating Logical Groupings of APs Using Subfolders” on page 19) is completely optional and can be used to help organize your plan into logical groups. However, it will only be possible to create mesh links between APs that are in the same folder, so keeping all APs within the same subfolder or within the Locations folder directly is generally recommended if you intend to automatically create arbitrary mesh links between all nodes.

**Adding Image Overlays**

Image overlays, such as CAD drawings and facility maps, can be very useful to help place locations accurately. If a scaled drawing of the facility is available, place the locations of the APs relative to the drawing and use Google Earth imagery as supplemental.

**Figure 4** and **Figure 5** show an example where 40-meter high monopoles (HMs) are placed relative to their locations on the CAD drawing.

**Figure 4** Using a CAD image to initially place AP Locations (Plan view and CAD is turned up to Opaque)
Figure 5  Same Area as Figure 4 showing monopoles placed against CAD drawing. Elevation view with CAD semi-transparent and terrain turned on

Text will only be readable to the zoom level that you select in the original image file. Aruba Networks recommends breaking the large drawings into sections so the desired text is legible at your normal screen resolution before you save the file in either PNG or JPG format. Each smaller image must be separately placed. In this case, each drawing section must be placed individually prior to locating access points.

Figure 6  Example Facility Map and Legible Detail Section

A screenshot of the entire map shown on the left side Figure 6 would not make the text legible when imported into Google Earth. However, a section of the map can be “zoomed in” to make the text legible, then saved as individual PNG files to use as overlays in Google Earth.

The map image must be to scale for the overlay to work well with Google Earth.
To import PNG or JPG Map Images into Google Earth

To import your map section image as an image overlay, follow these steps:

1. From the **Add** menu, select **Image Overlay**.
2. Enter a name for this image.
3. Select **Browse** to navigate to the map section image file you saved locally.

**Figure 7 Adding an Image Overlay in Google Earth**

4. Select **OK** to import the image.
5. Use the **Transparency** slider to set the image to the appropriate transparency for your work. Aruba Networks recommends 50% transparency.
6. Press Shift and drag the corner of the image to uniformly scale it so that it does not become distorted. Use landmarks that show in both horizontal and vertical directions (e.g., roads, water features) to scale and align the background image with the imported drawing.
7. When you have finished, select **OK**.
8. Repeat this process until you have loaded and placed all of your image overlays.

See **Figure 8** for a properly scaled and placed map background image overlay. Absolute precision is not necessarily critical as maps and images will always slightly differ.
9. Move the imported images to the **Map Overlay** sub-folder within the project folder. Make sure that they are not in the **Locations** sub-folder.

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Caution: Failure to follow this instruction will render the file unreadable by the Aruba Outdoor RF Coverage Planner.
Adding Location Placemarks

Create placemarks on the map to show where to place APs.

**To add a placemark under a location group:**

1. In the Google Earth toolbar, click **Add Placemark**. This will open the New Placemark window.

   ![Figure 9 Adding a Placemark](image)

2. Enter a unique **Name** for the placemark.
3. Optional: Select the **Set Icon** button next to the **Name** field.
4. Select the icon you want to use for this placemark and click **OK**.
5. Select the **Altitude** tab.

   ![Figure 10 Setting the Placemark Altitude in the New Placemark Window](image)

6. Use the **Ground to Space** slider to enter the altitude in meters.
7. Select **Absolute** or **Relative to Ground**, depending on the information available to you. (Aruba Networks recommends Relative to Ground as the default mode for planning purposes.)
8. **OPTIONAL:** Aruba Networks recommends selecting **Extend to Ground**, which drops a vertical line in the 3D view from the elevated placemark to ground level or onto your CAD image.

---

**Note:** Setting the altitudes for your locations to the best known value is critical to the accuracy of your model. With some antenna types, the difference of a few meters in altitude can make a large difference in coverage.
9. If you are planning to use directional antennas at certain locations, make sure to note the bearing in degrees of each antenna’s intended direction. Use the Measure Tool from the Google Earth toolbar (the Ruler) to draw a line from the placemark in the direction that you wish for the antenna to aim. The measure tool will provide a heading as shown in Figure 11.

**Figure 11 Google Earth Measure Tool**

![Google Earth Measure Tool](image)

10. Make a note of any expected downtilt you believe will be needed for this AP location.

You may find it useful to incorporate the heading and downtilt into the location name. For example "AP1_230_10" could be used to denote AP1, heading:230, downtilt:10. You can change the name of a placemark to add this information at this time by right-clicking on it and selecting Properties. The heading and downtilt are the most common parameters requiring adjustment after a plan is generated, so if you use this naming suggestion be sure to update the names if you make additional changes later.

---

**Importing Location Placemarks from a GPS device**

As an alternative to locating and placing each placemark individually, you can use a GPS device to acquire and store a collection of locations, and then import them into your project file in Google Earth.

This method requires a Garmin, Magellan, or Google Earth-compatible GPS device with a USB or serial port and cable for connecting to the computer running Google Earth. Because compatibility problems have been reported with some GPS units, Aruba Networks suggests testing out the import functionality before going out on a survey. Responsibility for GPS support rests with Google.

To add location placemarks from a GPS device, follow these steps:

1. Connect your GPS device to your computer (see the documentation for your GPS unit for specific connection instructions).
2. From the Tools menu, select **GPS**.
3. Select the type of GPS unit you have: **Garmin** or **Magellan**.

4. Clear the **Tracks** and **Routes** checkboxes.

5. Select **Import**.

   After Google Earth finishes importing the GPS data, it creates a new folder under **Temporary Places** to contain the imported data.

**Figure 13 GPS data stored in a Google Earth folder named Temporary Places**

The folder inside of Temporary Places that contains the imported data will be named in the format of `<GPS Device Type>GPS Device Created<MM/DD/YY><HH:MM:SS>`. Inside this folder are all imported waypoints with the names they were assigned by the GPS unit.

Google Earth assigns a flag icon as the default symbol for these imported GPS waypoints. If you did not clear the **Tracks** and **Routes** checkboxes on the **GPS Import** window, there may also be separate folders with these titles if there are stored tracks and/or routes on the GPS unit.

---

**NOTE**

The Aruba Outdoor RF Planner automatically adjusts waypoint symbols the first time they are processed through the model.
6. In the **Temporary Places** folder, create a new folder named for the site location or network name (for example, “Acme Corp Refinery”).

7. Inside the site location / network name folder, create a new folder named “Locations.”

8. Inside the **Locations** folder, create a new folder named “Unused Locations.”

9. Using notes taken during the onsite survey, inspect each waypoint and take one of the following actions:
   - **Delete the waypoint**—Determine whether the waypoint should be kept for the design. Because more waypoints can be saved than are needed for the final network design, you may need to delete one or more waypoints you do not plan to use.
   - **Rename the waypoint**—If you are going to keep a waypoint, rename it to identify the waypoint’s location (for example, “Comm Tower 12” or “Building 7 NE Corner”). Also, set the waypoint elevation to the anticipated antenna mounting height for that location (see 9. on page 17).

10. For waypoints that you keep, take one of the following actions:
   - **Move the waypoint to the Locations folder**—If you are going to use the waypoint in the model, drag it to the “Locations” folder.
   - **Move the waypoint to the Unused Locations folder**—If you are keeping the waypoint but not planning to use it in the model, drag it to the “Unused Locations” folder.

11. Right click on the Site Location folder and select **Save As**.

12. Name the KMZ file, select a location to store the file, and then select **Save**.

### Creating Logical Groupings of APs Using Subfolders

If you have a large number of APs, grouping your APs is a handy way of keeping them organized under your **Locations** folder. When planning a point-to-multipoint mesh, it may be helpful to organize the multipoint mesh points with their portals in the same subfolder. For example:

- `<Group Name>`
  - `<Portal Placemark>`
  - `<Point Placemark>`
  - `<Point Placemark>`

The use of subfolders for creating AP groups is completely optional and can be used to help organize your plan into logical groups. However, it will only be possible to create mesh links between APs in the Outdoor Planner that are in the same folder (as well as on the same channel), so keeping all APs within the same subfolder or within the Locations folder directly is generally recommended if you intend to automatically create arbitrary mesh links between all nodes.

If you want to use groups, they should be set up in Google Earth prior to uploading the KMZ file into the Outdoor Planner—APs cannot be moved from group to group in the Outdoor Planner.

To create a new group in Google Earth, follow these steps:

1. Right-click the **Locations** folder and choose **Add > Folder** in the menu options. This creates a new subfolder under Locations.

---

*NOTE*  
Engineers often collect extra mounting waypoints while onsite as alternatives in case the prime waypoint candidates don’t work out for one reason or another (the RF model doesn’t work, site permissions cannot be acquired, backhaul services are not available, etc.).

Google Earth and the Aruba Outdoor RF Planner preserve all of the waypoints you store in the KMZ file.

If you want to change waypoints after completing an RF model, simply reopen the KMZ file, drag unwanted waypoints from the Locations to Unused Locations folders. Then drag the replacement waypoints from the Unused Locations to the Locations folder.
2. Name the new subfolder the name you want to use for the group (for instance, “Admin Mesh”).
3. Drag the placemarks you want for that group into that subfolder. You can reorder your placemarks so that the Portal placemark is the first in the group.
4. To create more groups, repeat the process from step 1. Figure 14 shows an example logical grouping of AP placemarks:

Figure 14 Groups of Placemarks Under the Locations Folder and On The Map

Saving the Initial KMZ file

Once you have loaded the image overlays and entered and grouped placemarks, save your KMZ file.

Everything in your project must be contained in folders under your top-level folder to be included in your saved file. Folders that are not nested under your project folder will not get saved to the file and can lead to errors.

To save the KMZ file:

1. Right-click the top-level folder for your project.
2. Select Save As.
3. Enter a file name and select a location.

Google Earth can export files in both KML and KMZ formats. KMZ is a binary file format, while KML is an XML grammar and file format for modeling and storing geographic features. Keep in mind that the Aruba Outdoor RF Planner can only process files stored in KMZ format, and not KML.

4. Select Save.
5. Delete the folder from My Places by right-clicking it and selecting Delete. (Opening it again later would create a second instance of the same folder.) You are now ready to upload this file into the Aruba Outdoor Planner.
This chapter describes the steps to follow in the Aruba Outdoor RF Planner web application after you have created a properly formatted Google Earth KMZ file.

The necessary steps will vary depending on whether you have used the tool before, whether the file is recognized by the Outdoor Planner from a previous upload, the type of network you are setting up, and whether the file or your settings contain errors in antenna alignments or modes.

This chapter contains the following topics:

- “Registering for the Outdoor Planner” on page 21
- “Logging In to the Planner” on page 22
- “Uploading Your KMZ File” on page 22
- “Defining Global Parameters, Client Models, and Locations” on page 23
- “Selecting Access Points, Antennas, and Mesh Roles” on page 28
- “After you have made all the necessary changes to each of the access points, select Save and then Submit.” on page 31
- “Processing the KMZ and Downloading a New File” on page 36
- “Viewing your Finished File” on page 38
- “Finished RF Plan Examples” on page 39

**Registering for the Outdoor Planner**

Before you begin, you will need to register to create login credentials for the Outdoor Planner.

To self-register:

1. Launch your browser and go to https://outdoorplanner.arubanetworks.com
2. Click the registration link halfway down the page.

**Figure 15 Registration link on the Outdoor Planner home page**

**Welcome!**

Welcome to the Aruba Networks Outdoor Coverage Planning Tool.

Authorized users should login with their provided username and password.

Email Address: [ ] Password: [ ] Login>

Not registered for the Aruba Networks Outdoor Planning Tool? You can register here.

If you have forgotten your password, please enter your email address below and it will be emailed to you.

3. Enter your contact information. In the **Relation** field, select whether you are an employee of Aruba Networks, a Service Edge Partner, a Customer, or a Reseller. If you choose Other, specify your own information.
4. When finished, select Register.
A password will be automatically generated for you and will be mailed to the e-mail address you entered. When you first log in, you will be prompted to change the password.

**Logging In to the Planner**

To start the Outdoor Coverage Planner for the first time, go to https://outdoorplanner.arubanetworks.com/. Enter your username and password and select Login. You will be able to change your password and proceed to the Upload page.

**Uploading Your KMZ File**

When you have arrived at the Upload page, select Browse, select the KMZ file you want to upload from your hard drive, and then select Open.

After the file name appears in the Upload .KMZ File field in the Outdoor Planner UI, select Continue to begin the upload process.

*Figure 16 Uploading a New KMZ file*

**Welcome!**

Welcome to the Aruba Networks Outdoor Coverage Planning Tool. This tool can be used to create 3D representations of various Aruba antennas and access points.

Use this page to upload your properly formatted Google Earth .KMZ file to begin. See the user's guide if you are unfamiliar with how to create a proper .KMZ file.

If the Outdoor Planner recognizes the file that you upload as having been previously uploaded, it will summarize all changes in the file, as shown in *Figure 17*. Select Submit to proceed.
Figure 17  Summary of Changes in a Recognized KMZ file

**Location Differences:**

The KMZ you’ve uploaded has been analyzed to determine what changes were made after the
tool was run through the system last. Changes found are listed below:

| Folder: General stayed the same
| - AP1 was moved
| - AP2 was deleted
| - AP3_Guard_Shack was renamed
| - AP4 stayed the same
| - AP5 stayed the same
| - AP6 stayed the same
| - AP7 stayed the same
| - AP8 stayed the same
| - AP9_East_Property_Line was renamed and moved
| - AP10 stayed the same
| - AP11_North_Property_Line was added

---

**Defining Global Parameters, Client Models, and Locations**

After the upload completes and you have reviewed any changes to the file (if applicable), the Global
Parameters page opens. On this page, the planning tool reads from your KMZ file and extracts the locations
in the Locations folder of the opened KMZ file. You can now define global parameters, client models, and
locations of your APs. You can also update the AP location and altitude parameters, if necessary.
Defining Global Parameters

To set Global Model parameters such as the country of the installation, the default AP, and other common design considerations, follow these steps:

1. In the **Country** drop-down menu, select the country where the installation is located. This sets the EIRP limits for each of the available services and displays them in the **Max EIRP** field for each band.

2. Click the **Select Access Point** drop-down menu and select the default AP model.

**NOTE:** The default AP is only used for the regulatory information shown on this page. You will be able to change the individual AP selected for each location later.
3. Set the **Design Margins** (also known as Fade Margins) for clients and the mesh. This may typically be lower for mesh than client access if clear line-of-sight is ensured for mesh links.

### Table 3 Design Margins Recommendations

<table>
<thead>
<tr>
<th>Decibels</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 dB</td>
<td>The minimum recommended design margin; this value should be used when clients can always have a clear line of sight to the access point mounting locations in an obstruction- and absorption-free environment, and for mesh links that have clear line of sight and are free of obstructions (including Fresnel zone incursions).</td>
</tr>
<tr>
<td>6 dB</td>
<td>Recommended when clients typically have a clear line of sight to the access points, but may have minor obstructions like light vegetation. 6 dB is a design margin of 2 in linear distance terms. This is the recommended standard design margin for general client coverage planning purposes or for additional margin on mesh links that may have minor obstructions.</td>
</tr>
<tr>
<td>10 dB</td>
<td>Recommended for environments with heavier vegetation, or crowds. 10 dB is a design margin of 3 in linear distance terms. For mesh links 10 dB margin may be appropriate when high design confidence or design safety margin is a project requirement.</td>
</tr>
<tr>
<td>15 dB</td>
<td>Recommended for areas of heavy vegetation and/or heavy crowds and should only be used when there are known difficulties and obstructions in the path from AP to clients, or if a very high design safety / fade margin is required.</td>
</tr>
</tbody>
</table>

4. Select **Save** at the bottom of the page to save your global model settings.

Setting the design margin higher than 15 dB limits the predicted range of the access points. When designing for heavy-use areas such as stadiums, a higher design margin increases AP density. A design margin above 15 is not recommended because this is beyond the ability of the Access Point to compensate by power reduction should the design margin prove too conservative after implementation. Up to 15 dB is within the typical range of capable AP power reduction via controller and ARM settings.

### Client Model Parameters

Predicted coverage is most accurate if the client power and antenna gain values are known. Typically, client devices have a lower available power than access points and will use a low gain antenna. If client types are unknown, it is suggested to use the default client models as these have been developed as representative of typical client devices such as laptops, tablets and smartphones.

The default client model, a typical laptop, is filled in by default. You can edit these existing parameters for this model or add new client models. You may add one client model per frequency band.

To set Client Model parameters, follow these steps:

1. Select the **Include** checkbox on the top right hand corner of the frequency band used by the client model you want to add or edit. The choices are:
   - 2.4 GHz Client
   - 5 GHz Client
   - 4.9 GHz Client
2. In the Name field, enter a name for the client type.

3. Select the Supported checkboxes to indicate whether the client model supports different modes such as 802.11b, 802.11g, HT20 (High Throughput 20 MHz data rates) or HT40. The choices available will depend on the frequency band selected.

4. Set the Output Power for each mode this client model -- the maximum transmitting power level for the laptop or portable devices being used.

5. Set the Antenna Gain in dBi.

If a client employs a higher gain antenna system than 3 dBi, care has to be taken to ensure the client antenna pattern is aligned with the access point antenna pattern. As the client antenna gain increases above 3 dBi, the radiation pattern becomes more directional, making the alignment of the client and its antenna more critical to the communication with the AP. Aruba Networks does not recommend using a gain value higher than 3 dB in the client model unless the client will be aimed and fixed during installation, or the user is knowledgeable about how to aim and align the client device antenna.

---

**Figure 20** Client Models Section of the Global Parameters page

**Client Models:**

Client models are used to describe the typical client devices that will be used in an AP Grouping. The default model (typical of a laptop client) is listed.

<table>
<thead>
<tr>
<th>4.4 GHz Client</th>
<th>5 GHz Client</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td><strong>Mode</strong></td>
</tr>
<tr>
<td>Laptop</td>
<td>802.11b</td>
</tr>
<tr>
<td></td>
<td>802.11g</td>
</tr>
<tr>
<td></td>
<td>HT20</td>
</tr>
<tr>
<td></td>
<td>HT40</td>
</tr>
</tbody>
</table>

---

**Locations Parameters**

The locations are loaded and grouped according to your “Locations” folder in the uploaded KMZ file. You can edit the following Locations parameters on the Global Parameters page:

- The names of the folders that contain the location groups.
- The names of the locations themselves
- The latitude and longitude values for each location
- The altitude value for each location

Verify and edit the parameters of any of the locations listed as necessary, and then select Save.

Locations can be edited if needed on this page, but if your location requires extensive additions or changes, best practices are to edit the file in Google Earth then re-upload the file when you are finished. Errors introduced by manually entering lat/long values in the Outdoor Planner can result in large errors in placement. In general, you should limit any changes to the information on this screen to minor location corrections from on-site GPS readings and fixes to any altitude errors from the uploaded file. (Tip: You can fix errors caused by an undefined altitude in this section).

**Figure 21** shows an example of the information pulled in to the Locations section from the KMZ file.
Submitting changes

When you are finished making and saving changes to the Global Model, Client Model, and Locations parameters, you are ready to move to the next stage of Outdoor Planner.

1. Verify that you have saved any changes that you made on this page. Select Save if necessary.
2. Select Submit. This will direct you to the Access Points page.
Selecting Access Points, Antennas, and Mesh Roles

The Outdoor Planner imports AP group names and AP locations from the Locations folder in Google Earth. You can configure and organize access points, antennas and mesh roles here.

**Figure 22 Access Points, Antennas, and Mesh Roles**

**Groups and Access Points:**
Use this page to assign specific values to access points, and to organize access points into logical groupings. It is best to add all required groups and access points before actually filling any of them out as the addition and subtraction process will clear your entries.

The Set Default AP Values section can save you a lot of time if the majority of your APs have the same AP model and antenna model or other common settings. Select those values here and the Outdoor Planner will populate all of your APs with those values. You can then change only those APs with different values below, rather than configuring each AP individually.
Be aware that if you reopen a previously-created KMZ file for editing purposes and then change one of these defaults, you will overwrite ALL APs with the new value and any previously selected value will be overwritten.

**Configuring Default Access Point Values**

The **Set Default AP Values** section allows you to configure one or more default values for your access points. To define default values for all radio settings, select the checkbox by the radio number. To define defaults for just one or more individual AP settings, click the checkboxes by only those values you want to define as defaults. When you click the **Apply** button, the selected values will be pushed to the Access Point radio as the new default settings, but the unselected values will not.

1. Click the **Set Default AP Model** drop-down list, and select a default AP model. This will set all APs for this project to the same model. This feature is only for time savings on entry; you can make changes to individual AP selections if desired below.

2. Select a default **Band Assignment** for each radio supported by the AP you selected. If desired, you can select **Disabled** as the default setting.

3. Select a default **Mode** (802.11x, HT20 or HT40) for each radio, if desired.
   
   AP radios in **HT20** mode will typically have a higher available output power than AP radios in **HT40** mode, but HT20 radios will only achieve approximately 50% of the close-distance peak throughput of HT40 radios. If you are modeling an 802.11n network that requires maximum range, best practices is to select **HT20** for the mode. If your 802.11n network requires maximum throughput, best practices is to select the **HT40** mode.

4. Select a default **Channel** for each radio. If you select the **Client Coverage** role in step 6, you can click the **Channel** drop-down list and select the **Auto** option to allow the Outdoor Planner to automatically assign a channel to the radio.

5. Select a default **Antenna** model for each radio.

6. If you selected a directional antenna, enter a default **Heading** (direction relative to true north in Google Earth) for each radio using compass units.

7. Enter a default **Downtilt** angle for each radio (0° is the horizon, 10° down from horizon, and so on). Note that negative downtilt is uptilt, and may be entered when appropriate.

8. If an extension cable is used, enter an appropriate **Cable Loss** (in dB) for the expected length of cable for each radio. Refer to Table 4 for guidelines.

9. Select a default radio **Role** to match the specified band. The options include:
   
   - **Mesh Portal**
   - **Mesh Point**
   - **Client Coverage**
   - **Multihop**
   - **None**

10. Set the **Target EIRP** in dBm. The default target EIRP is the maximum value for the regulatory domain, but this value may be reduced by entering a lower number in this field. To return the target EIRP to its default value, enter **max** in the **Target EIRP** field.

    To view the currently assigned conducted power levels, click the **Target EIRP** link to display a pop-up window with additional modeling details.
• If the target EIRP is equal to or less than the regulatory maximum, the planner will use the use the formula \(\text{Target EIRP (dBm)} = \text{Conducted Power (dBm)} + \text{Antenna gain (dBi)} - \text{cable loss (dB)}\) to calculate conducted power levels for that radio.

• If the target EIRP is set to a value greater than the Regulatory Max EIRP, then conducted power (dBm) will be reduced to meet the regulatory maximum requirement.

11. When you have entered the default settings you wish to apply to all (non-locked) APs, select the Set Default Values button.

### Configuring Access Point Settings

After you finish setting valid default values, you can enter individual settings for each AP as desired. APs that have been locked so they will not receive default Access Point values can still be individually configured in this section.

1. If necessary, select an AP Model. (If you selected a default model in the previous section, you may not need to select a model here.)

2. Select a Band Assignment for each radio supported by the AP you selected. If desired, you can select Disabled as the setting.

3. Select a Mode for each radio.

4. Select a Channel for each radio.

5. Select a Antenna model for each radio.

6. For directional antennas, assign the antenna Heading (0° is North in Google Earth) and any Downtilt angle (0° is the horizon, 10° down from horizon, etc.). If an AP requires uptilt instead of downtilt, enter a negative value instead of a positive one. For instance, if you require 8° of uptilt, enter -8 in this field.

7. If an extension cable is used, enter an appropriate Cable Loss for the expected length of cable.

For client coverage, estimate the desired headings from your KMZ file. When creating the KMZ file, use a spreadsheet to note headings wherever you expect to use a sector antenna for client coverage. The Outdoor Planner performs no checks of headings entered for client coverage APs. See Figure 11 on page 17 for information about setting bearings for APs using the Measure Tool in Google Earth.

For mesh with directional antennas, the Outdoor Planner checks all headings to ensure beamwidth alignment and calculates all ideal headings. Aruba Networks recommends entering the best estimated heading, as the Outdoor Planner includes this in the report once all mesh associations are aligned. If mis-aligned, you cannot proceed, and the Outdoor Planner gives you the option to correct to the ideal headings or enter a different heading to correct the alignment.

### Table 4  Cable length and loss values by cable type

<table>
<thead>
<tr>
<th>Cable Length (in feet)</th>
<th>LMR-400</th>
<th></th>
<th>LMR-600</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.4 GHz</td>
<td>5.8 GHz</td>
<td>2.4 GHz</td>
</tr>
<tr>
<td>10</td>
<td>0.7 dB</td>
<td>1.1 dB</td>
<td>0.5 dB</td>
</tr>
<tr>
<td>25</td>
<td>1.7 dB</td>
<td>2.7 dB</td>
<td>1.1 dB</td>
</tr>
<tr>
<td>50</td>
<td>3.4 dB</td>
<td>5.4 dB</td>
<td>2.2 dB</td>
</tr>
<tr>
<td>100</td>
<td>6.8 dB</td>
<td>10.8 dB</td>
<td>4.4 dB</td>
</tr>
</tbody>
</table>

8. If you selected a directional antenna, enter a Heading (direction relative to true north in Google Earth) for each radio using compass units.

9. Enter a Downtilt angle for each radio with a directional antenna (0° is the horizon, 10° down from horizon, and so on). Note that negative downtilt is uptilt, and may be entered when appropriate.
10. If an extension cable is used, enter an appropriate **Cable Loss** (in dB) for the expected length of cable for each radio.

11. Select a default radio **Role**. The options include:
   - Mesh Portal
   - Mesh Point
   - Client Coverage
   - Multihop
   - None

12. Set the **Target EIRP** in dBm. The default target EIRP is the maximum value for the regulatory domain, but this value may be reduced by entering a lower number in this field. To return the target EIRP to its default value, enter **max** in the **Target EIRP** field.

13. To view the currently assigned conducted power levels, click the Target EIRP link to display a pop-up window with additional modeling details.

14. Select **Save** after updating each Access Point.

---

You can also use increased design margin in the Global Parameters page if you want to show coverage with reduced power. The design margin affects both AP and client predicted range, whereas the AP power setting reduces AP power only.

If you choose to use the AP power reduction feature, note that predicted and displayed coverage models are typically limited by the lesser of client or AP power. As a result, you will not notice a reduction in coverage by use of this feature until the AP power is below the defined client power (default 12 dBm for Laptop).

15. After you have made all the necessary changes to each of the access points, select **Save** and then **Submit**.

---

**Defining Mesh Calculation Methods and Client Modeling Options**

If you set any radios to a mesh role (e.g., mesh point or mesh portal) you will proceed to the Mesh Points section to determine whether the mesh calculations should be applied manually or automatically (by group and channel), whether your output mesh links should be color-coded by channel or throughput, and to set up 3-dimensional client coverage models based on throughput, signal levels, or channels.

By default, this page selects the automatic calculation option with a threshold of -75 dBm, color codes by throughput, and client models are displayed by minimum throughput levels, as shown on Figure 23.
Mesh Definition

Define Mesh Calculation Method:

- Manually select mesh links to validate and display.
- Automatically associate mesh nodes by group and channel.

**Threshold**: -75 dBm

**Options**: Select whether to color-code the mesh nodes by channel or throughput.

**Figure 23** Default Mesh Calculation and Client Modeling Options

Client Modeling

- Display 3D models based on target minimum throughput levels.

**Figure 24** Channel and Throughput Color Coding

Mesh Calculation Options

To define the calculations, follow these steps on this page:

1. In the Define Mesh Calculation Method section, select whether you want to manually select mesh links or automatically associate mesh nodes by group and channel. The automatic option will calculate and display all available links on the same channel based on the value in the **Threshold** field.

2. The default value in the **Threshold** field is -75 dBm. If desired, use this field to edit the signal level.

3. In the Options section, choose whether to color-code the associated mesh nodes in the output KMZ file by **Channel** (which will display channel options you can edit) or by **Throughput** (which will display Mbps values you can edit next to color swatches). These options are illustrated in **Figure 24**.

4. When finished, select **Save** and scroll to the Client Modeling section of the page.
Client Modeling Options

Select the types of 3D models to display based on target minimum TCP throughput levels, signal level, or channel:

1. Click one or more of the checkboxes in the Client Modeling section to display the following 3-D client coverage model types:
   - **Display 3D models based on target minimum throughput levels**: Enter the values for each color in Mbps, and select whether to include all or some of the values and colors in the output file.
   - **Display 3D models based on signal level**: Enter the dBm values for each color, and select whether to set the levels at the Client or AP.
   - **Display 3D models based on channel**: Set the Threshold at client setting and assign channels to colors so that models can be created for signal level threshold. This will create 3D models that are all sized based on the signal level threshold entered, but with different colors based on the channel assignments.

![The three Client Modeling Options](image)

2. When ready, select **Save**, then **Submit**.

Defining Mesh Links

The Defining Mesh Links page appears if any mesh nodes have been defined. As an RF planning utility, the purpose of the mesh associations is to check that a valid connection is possible with the distances, antennas, and APs you have selected. If a connection is possible for the association you have selected, the mesh links defined on this page will appear in the final KMZ file as a line that is colored according to the associated data rate of the mesh link. This allows for simultaneous inspection of 3D client coverage and 2D representation of the associated backhaul/mesh.

For each group, the mesh portals are automatically listed on the left pane and all mesh nodes (portals and points) are listed on the right pane.

As each node is used, a check next to the node appears in the list at the right. Note that not all nodes are required to be used, and any node may be used more than once. However, for each node on the left at least one association must be provided, or you should return to the previous page and change the mesh role to “client coverage”.

If you selected **Automatically associate mesh nodes by group and channel** in the previous page, they will be arranged accordingly with a checkbox by each node within each group and channel. The example in Figure 26 shows a group named “Admin Mesh” that is meshing on Channel 1 and contains one mesh portal and four multi-hop mesh points.
If you chose to manually associate your nodes, you can use the Add and Remove buttons on the interface to set up and arrange your nodes.

As this Outdoor Planner is primarily for RF planning checks, it does not inspect the logic of your chosen mesh associations. Be sure that the mesh associations you create represent the mesh network you wish to present and are complete and logical. Aruba Networks recommends planning which mesh points and associations to display before starting this Outdoor Planner.

The Aruba mesh software will dynamically construct the mesh using ambient RF conditions and measured signal strength. The Outdoor RF Coverage Planner is intended to help the wireless designer visualize and validate all of the lengths in a possible mesh. However, the actual mesh configuration may change from time to time and is under control of the mesh software.

To manually associate mesh points with mesh portals, follow these steps:

1. In the All Mesh Nodes pane on the right, select a node.
2. In the Group pane on the left, select the Add button of the mesh portal with which you want to associate this node.

You will need to select Save each time you create a mesh association.

3. Select the multihop point from the list in the right pane and select the +Multi-hop button. This creates a listing for the mesh point in the Group pane on the left. Further associations can be mapped to this point.

You can assign multiple mesh points at the same time. Hold down the Shift key and select each of the APs to be assigned to a specific mesh portal before selecting Add.

4. In the Group pane on the left, click the +Multihop button of the mesh portal with which you want to associate this node.
5. To associate nodes with the new multihop mesh point, click the node in the All Mesh Nodes pane and then click the Add button of the multihop mesh point.
6. Repeat this procedure with each group and channel on the page.
7. Select Save with every change in case of an interruption in the process.
8. When you have made all necessary associations, select Submit.
Validating Mesh Link Details and Fixing Errors

After you have finished associating your mesh links, the Outdoor Planner checks each mesh association for the following:

- Valid signal strengths at both ends of the mesh link
- Beamwidth Alignment, both horizontal and vertical, based on the headings, altitudes, and antennas selected
- Fresnel zone and Earth Bulge for long-distance links
- Associated Data Rate for the mesh link is above the minimum rate specified

After performing these checks, the Outdoor Planner displays a Mesh Link Details page with general and node details, as shown in Figure 27:

**Figure 27**  *Mesh checks that have passed the Outdoor Planner validation*

**Mesh Link Details:**

This page shows the details of each link specified on the Mesh Links page as well as any errors that were found with the links and possible solutions.

<table>
<thead>
<tr>
<th>General Details</th>
<th>Node Details</th>
<th>Node Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Admin_Mesh</td>
<td>Name: AP-175</td>
<td>Name: AP-175</td>
</tr>
<tr>
<td>Meshing On: 1</td>
<td>Admin</td>
<td>Tennis</td>
</tr>
<tr>
<td>Distance: 3.139 km</td>
<td>Portal</td>
<td></td>
</tr>
<tr>
<td>Minimum clearance height: 3.04 m</td>
<td>Ideal Bearing: 0°</td>
<td>Ideal Bearing: 160°</td>
</tr>
<tr>
<td>Minimum transmit power: N/A</td>
<td>Actual Bearing: 0°</td>
<td>Actual Bearing: 0°</td>
</tr>
<tr>
<td>Total Alignment Error: 9.26</td>
<td>Horizontal Alignment Error: 9 db</td>
<td>Horizontal Alignment Error: 0 db</td>
</tr>
<tr>
<td></td>
<td>Height: 3 m</td>
<td>Height: 3 m</td>
</tr>
<tr>
<td></td>
<td>Vertical Alignment Error: 0 db</td>
<td>Vertical Alignment Error: 0 db</td>
</tr>
<tr>
<td></td>
<td>EIRP: 20 dBm</td>
<td>EIRP: 20 dBm</td>
</tr>
<tr>
<td></td>
<td>Received Signal Level: -41 dBm</td>
<td>Received Signal Level: -41 dBm</td>
</tr>
<tr>
<td></td>
<td>Data Rate: 16 Mbps</td>
<td>Data Rate: 16 Mbps</td>
</tr>
</tbody>
</table>

9. If any errors are found, they will be displayed above the affected node, as shown in Figure 28:
In order to proceed with generating the final KMZ file, you must repair all node errors. Common errors are related to alignment of directional antennas.

To correct errors, select any of the shortcuts in the errors and use the information in them to eliminate the causes. You may need to re-define calculation options and client models after fixing the problem.

Once your mesh associations are error free, all mesh links you have proposed are checked through as valid and you can **Submit** the validated data to generate your final KMZ file.

### Processing the KMZ and Downloading a New File

After submitting your data, you will see a progress bar on the screen.

When the processing is complete, the Outdoor Planner will prompt you to download a new file, as shown in **Figure 29**. This file will contain all of the mesh links and color-coded coverage models you have previously entered.

Save it to your drive with a new file name so that you don’t replace your original KMZ file (in case you need to make changes later).
Figure 29  Download the completed KMZ file

Aruba Networks strongly recommends that you save the completed KMZ locally before opening it.

Download and save the Input Report, which contains:

- Bill of Materials (AP and antenna counts)
- All Inputs for the Model, including Country, Design Margin, Location details (Latitude/Longitude/altitudes), APs and Antennas selected, Antenna heading, mesh roles and cable loss
- Mesh Checks
Viewing your Finished File

To see the results of your planning, click on your finished KMZ file to display it in Google Earth. Complex models may need a few minutes to fully load in Google Earth.

Two new folders will appear containing the client coverage models and mesh links. These folders will be structured, named and populated with models according to the output options chosen in the earlier topic, “Defining Mesh Calculation Methods and Client Modeling Options” on page 31.

Figure 30  Finished KMZ file

After the models have fully loaded, to improve performance Aruba Networks recommends turning off all folders/views and turning them back on one at a time as you need them.

The Mesh Links folder contains the mesh links, represented on the map by color-coded lines for the associations according to data rate. (See Figure 31.) You can view details, including the distance and data rate, by expanding the Mesh Links folder tree. On the map, click any link to launch a pop-up window with details about that association.
Finished RF Plan Examples

The following figures show examples of a completed RF plan.

Figure 31  Coverage example: Viewing Mesh Links

Figure 32  Coverage example: Simultaneous Mesh/Coverage View with Color-coded Channels in Two Groups
**Figure 33** Elevation Profile visible in Google Earth

**Figure 34** Client Throughput Display
Figure 38  Coverage By Throughput - Side View - 50 Mbps Model, 2.4 GHz HT20, ANT-2x2-D805
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Appendix A

Tips, Tricks, and Known Issues

- **Follow the folder structure:** You must have a folder named "Locations" at the top level in your KMZ file. You can put subfolders under this folder. The Outdoor Planner creates groups for you.

- **Break the project into multiple KMZ files:** If you experience performance problems, break the project into groups of no more than 50 APs. Aruba Networks has successfully tested files containing more than 120 APs and the Outdoor Planner has no limit on how many APs you can place. But performance will vary based on your system (e.g., video card, processor speed).

- **Keep a Backup:** Google Earth is prone to crashes from time to time, particularly if you attempt to save the file before all models have loaded. If this happens, the KMZ may become unreadable on the next open. Create a backup copy before opening the KMZ every time, just in case. This is a known issue with Google Earth that doesn't have a fix for now. You can avoid this by waiting for all spinning icons in the tree at the left to stop spinning before you try to save the file again.

- **Empty folders:** The Outdoor Planner creates some empty folders. Delete them if you don’t need them and re-save your file.

- **Delete Uninteresting Models:** To improve performance, delete old folders and models containing data you no longer use and re-save the KMZ. This will not affect you ability to reload the KMZ later and restore variables. All “post entry” information that gets added to the KMZ file has no effect on the ability to make changes and rerun the file later.

- **Turn off everything:** Viewing large 3D model files can challenge your laptop’s video system. It helps to turn everything off (e.g., hiding locations and data rates) after the entire file loads. Then inspect coverage by zooming in and turning on locations and data rates one at a time. Aruba Networks also recommends that after all models load (indicated by all spinning icons ceasing to spin) you turn off the coverage folders completely and save the file. The next time you load the KMZ, the models will be off by default and it will load much faster. You can then turn details on as you want to see them.

- **Turn on Terrain:** Google Earth contains detailed elevation models for all points on the Earth in addition to providing satellite imagery. The check for vertical alignment of mesh link is based on the same base elevation and does not account for any information shown in the terrain database of Google Earth. If antennas are separated by a large elevation difference due to terrain, the planning tool will not flag this and it may be necessary to align the antennas on sight by uptilt/downtilt according to the proper elevation difference during installation. You can see the approximate terrain base elevation differences by activating the Terrain feature; this will provide a visualization of the terrain difference, but note that the planning tool checks do not access the terrain database for performing alignment checks (as of current revision).