Scope

- This document is a joint design and implementation reference guide for Aruba and Ekahau RTLS deployments
- This document specifies high-level requirements and design considerations for successful deployment of the joint solution
- For an online introduction to Ekahau deployments for RTLS, see this link\(^1\)
- This document covers the more common Tag Association Mode as well as the unique Aruba Blink Mode implementations
- This document covers Ekahau Activator usage
- This document assumes a base level of Aruba WLAN product and design knowledge. For details involving configuration of Aruba OS, please see the ArubaOS User Guide for the version of software in your environment, located on the Aruba Support site at http://support.arubanetworks.com

Solution Overview

Enterprises lose millions of dollars a year because critical equipment is misplaced, stolen or not maintained properly. Asset tracking with Real Time Location Systems (RTLS) over Wi-Fi allows continuous tracking of valuable equipment or people over the WLAN. The ability to instantly locate a critical device can reduce not only replacement costs for lost equipment, but also enable far more efficient use of existing inventory. The result is reduced costs as well as improvements in workflow, security and customer service.

The Ekahau RTLS solution leverages existing 802.11 networks to provide accurate, real-time location tracking of ‘tagged’ assets. An Ekahau asset tag is a small Wi-Fi enabled device that can be attached to a critical asset, or worn as a personnel badge. The tag then uses the existing wireless LAN to communicate with an Ekahau Positioning Engine server. The EPE uses signal strength values, received either from the tag or the Aruba infrastructure to calculate and continuously track the tag’s location. Software versions of tags also exist for Wi-Fi enabled devices such as laptops or handhelds. Solution components include Ekahau’s Positioning Engine server, the Ekahau Site Survey, and the Ekahau application layer, consisting of Ekahau Tracker or Ekahau Vision.

The Aruba User–Centric Network provides Ekahau RTLS users with two major advantages over other WLAN infrastructure vendors: superior security and tighter integration.

- **Superior Security:** Aruba controller’s security model allows a user role to be specifically assigned to Ekahau traffic. This enables appropriate isolation and prioritization of tag-to-server communications from other network traffic, offering optimized communication, and maximizing security of even older WEP-only tags.
- **Tighter Integration:** Aruba’s integration with Ekahau RTLS enables asset tags to operate in "Aruba Blink Mode." Aruba Blink Mode reduces the amount of time an asset tag spends transmitting radio

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\(^1\) http://www.ekahau.com/partner/training/
user name: training
password: sp3d3
signals and results in a 5x extension of tag battery life. In a hospital environment tracking thousands of devices, the reduction in overhead of managing tags is substantial.

**About the Ekahau RTLS Solution**

The Ekahau RTLS solution consists primarily of the Ekahau Positioning Engine (EPE) server, battery powered Wi-Fi tags and a laptop based planning and calibration tool, Ekahau Site Survey (ESS). There are also supporting applications and an open API for HTTP and XML access to the positioning engine data. The Ekahau RTLS installer file includes all the components of Ekahau RTLS, out of which the user can select the appropriate components. The Ekahau Application Layer, Ekahau Vision, is installed separately.

**Ekahau Positioning Engine (EPE)**

EPE is the centerpiece of Ekahau RTLS. It runs on Windows XP or Windows 2003 Server. The EPE manages and configures asset tags through the wireless network, calculates locations from Wi-Fi signal strength measurements, and provides event handling and two way tag communication.

**Ekahau Site Survey (ESS)**

Ekahau Site Survey is a planning / site survey / troubleshooting tool for Wi-Fi. It runs on a Windows laptop, and uses an Atheros-based 802.11a/b/g/n Wi-Fi adapter for site survey measurements.

ESS is also a tool for creating and calibrating a *Positioning Model* (or a Project) to enable accurate location tracking. A positioning model is a software representation of a building and its RF environment. ESS is used to import site maps, perform site surveys, and perform RTLS related operations such as drawing tracking rails and zones.

For details, see [www.ekahau.com/ess](http://www.ekahau.com/ess).

**Ekahau Wi-Fi Asset Tags**

There are several models of battery powered Wi-Fi tags available for Ekahau RTLS. The two most common are the T301a and the T301b.

The T301a asset tag has a multi-year battery and a motion sensor and is typically used for devices such as IV pumps, crash carts, etc.

The T301b is a rechargeable credit card sized badge for personnel tracking. It has a pull switch that serves as an emergency alarm, call buttons, and an option for sending and receiving text messages.

There are also specialized tags, such as a temperature sensor equipped model, Ex certified intrinsically safe tag, industrial tag, and software based “tags” for Wi-Fi enabled devices such as laptops, PDAs, barcodes scanners, etc.

**Ekahau Vision and Third-Party Software Integration**

Whereas the Ekahau Positioning Engine is used to manage the system and tag configurations, a separate application is useful for providing value-added services leveraging the location information provided.

Ekahau Vision is an enterprise asset- and people-tracking application that allows the user to search and find assets, raise and acknowledge alarms, monitor temperature levels, and send and receive messages from T301B tags.

Ekahau also provides an open API for third-party application development. The complete API with descriptions is included in the Ekahau RTLS installer package.
Ekahau Tag Activator

Ekahau Activator is used for activating Ekahau T301 series tags. Activating gives the initial configuration (SSID, encryption, etc.) for the tags, so that the tags can connect to the network and thus to the Ekahau Positioning Engine, where the tags can be configured for production use.

Aruba and Ekahau RTLS Design Considerations

Security

The Aruba user-centric network establishes the highest-possible security for an Ekahau RTLS deployment as part of its normal operation.

Ekahau T301 series tags support WPA2-PSK AES encryption (TKIP/AES mixed mode is not supported) and WEP encryption. Older Ekahau T201 tags support 64- and 128-bit WEP.

Ekahau recommends for additional security that a firewall be used between the RTLS SSID/VLAN and the rest of the network. The Aruba Controller’s Policy Enforcement Firewall and ICSA certified stateful firewall resident on the controller is ideal for this purpose.

A user role should be created specifically for the Ekahau tags allowing only Ekahau traffic between the tags and the Ekahau Positioning Engine server. No other traffic should be allowed from the tags to the rest of the network.

Tag Operation Modes: Aruba Blink Mode and Association Mode

The Ekahau RTLS system can be based on signal strength measurements taken at the tags (Association Mode) or, when using Aruba infrastructure, the measurements can be taken at the APs (Aruba Blink Mode).

Tag Association Mode

In association mode, the tag simply acts as a Wi-Fi client on the network. It associates to an AP for all communications with the Positioning Engine server. The tag, as a client, measures the signal strengths from the nearby APs and reports the results to the Positioning Engine server over the WLAN.

![Location Tracking in Association Mode](image)

1. At specified intervals (or upon motion, button press, etc) Tag sends probes to whichever 2.4GHz channels the APs are on (in this case 1, 5, 11)
2. APs respond to tags with probe responses
3. Tag calculates signal strengths from probe responses, sends the results to Engine server
4. Engine server calculates tag position, sends position to application layer
The advantage of this mode is it works with any WLAN. The disadvantage is that the accuracy may slightly suffer from dramatic changes to the AP infrastructure, such as several APs making drastic changes to the transmission power (1mW to 50mW for example). However, based on live testing, 2-4x Tx power changes on an AP have no noticeable impact to the Ekahau RTLS location accuracy, and ARM power changes can be limited to a predefined minimum and maximum range.

When using Association Mode to track Ekahau T301 tags, the recommended practice is to calibrate (survey) the network with Ekahau Site Survey and a T301 tag operating in Survey Mode. Prior to calibrating, the tag needs to be activated to Site Survey Mode using Ekahau Activator. An Atheros-based network adapter, such as the Ekahau NIC-300, is required for this, see [www.ekahau.com/devices](http://www.ekahau.com/devices).
Aruba Blink Mode

In Aruba Blink mode, the tag sends beacon signals at set intervals to a predefined set of channels. Aruba APs measure and report the signal strength of the beaconing tags and the signal strength information gets forwarded to the Ekahau Positioning Engine.

Figure 3  Location Tracking in Aruba Blink Mode

This approach has several advantages:

- ARM adjustments have no impact on location accuracy – tags beacon at a set power and on set channels, so changes in AP behavior do not affect RTLS accuracy. ARM maximizes the efficiency of the WLAN, so the user gets best of both worlds – an adaptive and responsive RF environment and accurate RTLS.

- Battery life and TCO – in beacon mode, tags extend their battery life by a factor of 5x. In a hospital tracking thousands of devices, the reduction in overhead to update or replace or recharge tags could
be tremendous. Note that the longevity of a tag’s battery depends on configurable factors – how often to beacon, etc. – but in beacon modes it would be typical for a tag battery to last for years.

When calibrating the RTLS for operation in Aruba Blink Mode, the recommended practice is to utilize Ekahau Site Survey with a T301a tag operating in Aruba Blink Mode. In this mode, the APs will measure the tag signal strength during the survey, and the data will be forwarded from the Aruba controller to the Ekahau Positioning Engine, and then back to Ekahau Site Survey via the Aruba WLAN.

Figure 4  Site Surveys in Aruba Blink Mode

Please note that for Ekahau tags operating in Aruba Blink Mode, there is no need to associate to the network to perform location updates. Tags can still, however, be configured to perform maintenance sessions in association mode in order to communicate to the EPE server for firmware updates, configuration changes, and to receive custom commands. Location-update intervals are configured independently of maintenance intervals (two-way sessions) in the Ekahau Positioning Engine.

Design Recommendations

There are a number of important planning decisions that should be considered for a proper RTLS deployment. This document is concerned with the details of the Aruba WLAN portion of a full Ekahau deployment. It is recommended that Ekahau documentation and resources also be referenced and utilized for optimum results. In particular, the document “Ekahau RTLS Guide” from Ekahau Professional Services is highly recommended for this purpose.

Aruba & Ekahau RTLS Deployment Steps

1. Deploy an Optimized Aruba WLAN Infrastructure: Ensure WLAN quality is sufficient for accurate RTLS, ‘Voice capable’ if possible, and ensuring smooth roaming throughout the tracking area for the tag
2. **Create the WLAN for RTLS**: Provide sufficient IP space in a single subnet for all tags, dedicate an SSID that supports 802.11b clients with 1 Mbps and 2 Mbps rates, and configure the firewall rules and user profiles for tags.

3. **Deploy Ekahau Positioning Engine (EPE)**: Install the EPE on the network, if in Aruba Blink Mode, configure Aruba controller(s) to feed data to the Ekahau server and configure the EPE to accept this data stream from the Aruba controller(s).

4. **Activate Survey Tags and Perform Ekahau Site Survey**: One tag must be configured for rapid blinking to perform quick site surveys.

The site survey process is done using a laptop computer and a wireless network adapter. The surveyor walks throughout the tracking area with the laptop, frequently clicking on the current location on the map.

Whether in Aruba Blink Mode or Tag Association Mode, an Ekahau T301a tag must be properly configured and carried by the surveyor when performing the site survey.

- In Aruba Blink Mode, the readings will come in to Ekahau Site Survey from Positioning Engine (a Wi-Fi connection must be maintained).
- In Tag Association Mode, the tag will send the readings to the local network adapter (needs to be Atheros based, see [www.ekahau.com/devices](http://www.ekahau.com/devices)), and the adapter will forward the readings to Ekahau Site Survey.

After the site survey, Rails and Open Spaces are drawn to indicate typical paths of movement, and optionally define Zones for advanced application layer functionality.

5. **Draw Tracking Rails, Open Spaces, and Zones**

6. **Upload Positioning Model from Ekahau Site Survey to Ekahau Positioning Engine**

7. **Deploy Tracking Tags**: Use the Ekahau Activator to connect the tags to the network and to the EPE, also use the EPE Web UI to configure the desired tag parameters such as wakeup interval, motion on/off, Aruba Blink Mode vs. Association Mode, etc.

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**Step 1: Deploy an Optimized Aruba WLAN Infrastructure**

For those with experience deploying Aruba products, Ekahau’s simplest recommendation for WLAN design best practices for RTLS is that the WLAN should be “voice-capable”. Accurate location requirements are more stringent than for basic data coverage. RF signal strength (RSSI), number of audible access points per location, and access-point proximity are factors that will affect the accuracy of the RTLS system.

**Signal Strength and Number of APs**

For reliable data transmission, the tag needs to hear at least one AP at -70dBm to be able to communicate with the network reliably. For high reliability we recommend “Voice Grade” coverage at -65 dBm minimum.

Coverage requirements for good location accuracy contend that the tag will always be capable of detecting at least three access points. At least one of those APs should be heard at -62 dBm or higher. The additional APs should be heard at -75 dBm. Location accuracy is expected to be better in close proximity to a strong access point. If at least one AP is audible at -50dBm or higher, then high location accuracy is still expected.

**ARM - Dynamic Power Allocation**

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2 If in Aruba Blink Mode, activate the tag and configure for rapid blinking via Engine. If in Association Mode, use Ekahau Activator to configure the tag to Site Survey mode.
Ekahau tags operating in Aruba Blink Mode are fully compatible with dynamic power adjustment. Tag power remains consistent, so the transmission power of APs does not impact location accuracy in any way. ARM also minimizes interference and automatically provides the most stable environment for tag communication.

In Association Mode, ARM changes can have a small impact on location accuracy, which can be further mitigated by setting minimum and maximum thresholds for ARM power adjustments.

In multi-vendor environments involving other non-Aruba WLAN infrastructure vendors, Association Mode should be used since Aruba Blink Mode is not supported and thus will not work at the entire site. The other vendor's automatic channel and power adjustment algorithms (if applicable) can also impact the location accuracy in the same way.

In either case where tag Association Mode is used, the Ekahau location algorithms are designed to neutralize the ARM impact as much as possible.

### Step 2: Create the WLAN for RTLS

#### IP Addressing

Tags require unique IP addresses on a single subnet. Two-way communication will take place with the server, allowing tags to receive programming changes over the air, and enabling messaging with the T301 BD tag. A sufficient number of static or DHCP IP addresses must be allocated for the number of tracked devices. Tags should not require a new IP address or default gateway until the DHCP lease time has expired.

#### WLAN SSID

A dedicated RTLS SSID is recommended to support communications between RTLS Tracking Tags and the Location Engine. The SSID assigned to the RTLS system must cover the entire tracking project area.

#### Data Rates

T301 data transmission is limited to 802.11b rates. 1 Mb and 2 Mb data rates should be configured as “required.” Other data rates (5.5, 11, etc.) including those for 802.11g and 802.11n may be configured as supported.

#### 802.11 Security

Ekahau T201 tags currently support 128 bit WEP encryption. Ekahau T301 tags support WEP and WPA2-PSK. For WPA2-PSK, encryption should be AES only (TKIP/AES mixed mode is not supported).

#### Tag User Roles

Tag traffic should be isolated from the rest of the network by the Aruba Policy Enforcement Firewall. A user role should be created for the tags. This rule should allow the tags to communicate only with the Ekahau Positioning Engine, and only over the correct protocols.

Client devices and applications initiate a session to the positioning engine via standard communication ports (see Configuration section in this document for this list in Table 1).

**Figure 5**  *Common WLAN Deployment Architecture*
Step 3: Deploy Ekahau Positioning Engine (EPE)

At this point, the WLAN and network would be prepared for the Ekahau deployment.

Install Ekahau Positioning Engine

Consult Ekahau documentation or Ekahau, Inc. for detailed recommendations. The EPE runs on Windows Server 2000, Windows Server 2003 or under VMWare. Hardware recommendations depend on the number of Tag clients to be serviced.

Configure Aruba Controller(s) for EPE communication

If using Aruba Blink Mode, assign an RTLS server in an AP configuration profile in the Aruba Controller:

Configuration -> Wireless -> AP configuration -> <AP group> -> AP -> AP system Profile -> RTLS Server Configuration

If Aruba Blink Mode is not used, you will not need to adjust RTLS server configuration in the Aruba system.

Configure EPE to Accept Aruba Data

If using Aruba Blink Mode, you will have to add a shared key to a file in a text editor and restart the EPE service.

If Aruba Blink Mode is not used, you will not need to adjust EPE server as the data will be coming in directly from the tags, not the Aruba system.

Step 4: Activate Survey Tags and Perform Ekahau Site Survey

Prior to deploying an Aruba/Ekahau RTLS system a site survey of the entire project area must be performed.

Prior to performing site surveys, you will need to activate the tag for a rapid blink rate. Please see later in this document for details on activating tags for either Aruba Blink Mode or Survey mode to operate Association Mode.

In Association Mode Site Survey, the RSSI values of APs are taken by the tags and directly sent to the site survey laptop in relevant locations.

In Aruba Blink Mode Site Survey, the signal data sent by the tag operating in Aruba Blink Mode (with frequent scanning, see Ekahau Site Survey documentation for set-up instructions) will be measured by the APs and sent via Positioning Engine to Site Survey.
Step 5: Draw Tracking Rails, Open Spaces, and Zones

After the site survey, rails will be drawn along the survey paths using ESS to indicate the common paths of movement of the tracked devices in a given environment. Open spaces represent areas where devices will not follow pre-defined pathways of movement. Leveraging rails and open spaces accurately increases the location accuracy.

Finally, depending on the location-based application, Zones may be drawn with Ekahau Site Survey. Zones are areas on the map which have a defined purpose. For example, in some applications it may be more intuitive to say “the doctor is in the cafeteria” than displaying a dot on the map.

Step 6: Upload Positioning Model from Ekahau Site Survey to Ekahau Positioning Engine

After the work with Ekahau Site Survey is completed, save the Project (Positioning Model). It is recommended to save the project during the survey work also, under different names, to prevent accidental loss of data.

To start tracking, the project then needs to be uploaded to Ekahau Positioning Engine and activated. Ekahau recommends manually copying the .esx Project file from the Site Survey laptop to Engine server, and then uploading the .esx Project file (Positioning Model) manually to Ekahau Positioning Engine using Ekahau Positioning Engine Web GUI. When uploading the Model, activate it to start tracking.

You can also save the Positioning Model directly from ESS to EPE (in ESS, select File > Save to Engine), but for this, a wired Ethernet connection is recommended.

Figure 6  Saving to the EPE Directly from ESS

Step 7: Deploy Tracking Tags

To deploy Ekahau tags for tracking, they must first be activated to connect to the WLAN and contact the Ekahau Positioning Engine server. This is done with Ekahau Activator.

Once tags have made a connection to EPE, configure them in the EPE via the Configs page and deploy them to critical assets as appropriate. Please note that the less frequently the tags blink, the longer the battery life will be. EPE Web GUI includes a battery life estimator to see how long the tags will last with the configured settings.

Different settings can be used for different use cases. For example, staff tracking may require 30 second updates, whereas waking up once every 30 minutes may be enough for asset tracking purposes.
If using Aruba Blink Mode, the appropriate tag configuration must be applied (check the Aruba Blink Mode checkbox in the EPE GUI).

**Aruba and Ekahau Configuration for RTLS**

**Configuring the System**

This document is concerned with the specific details of integrating Aruba and Ekahau systems. There is ample documentation specific to each system, and this document assumes that more detailed documentation is available from each vendor.

This section delves into further detail for each of the recommended design best practices steps.

**Configuring Step 1: Deploy an Optimized Aruba WLAN Infrastructure**

Please refer to the Aruba Configuration Guide and related Aruba documentation. The Aruba WLAN should be built out with the following needs in mind:

**Voice Capable**

Plan the WLAN under the same guidelines as for a voice-capable system

**Signal Strength and Number of APs**

Areas requiring “excellent” location coverage:

- Tags should be detectible by at least three access points.
- At least one of those APs should hear the tag at -62 dBm or higher. The other two APs should receive at least -75 dBm.
- You can achieve a high accuracy with just one AP being audible, as long as it is audible at -50dBm or better – the accuracy is typically good close to an AP

Areas requiring minimal location coverage

- A minimum signal of -75dBm (is always required. -65 dBm minimum coverage or better is recommended for higher reliability.

Ekahau Site Survey has the Location Coverage visualization to display how good the location coverage is. Use “Location Coverage for My Access Points”.
Ekahau tags are fully compatible with ARM when in beaconing mode. ARM is always recommended and has no impact on location accuracy. In tag Association Mode, there may be some impact on location accuracy. To limit this, set the maximum power adjustment threshold in ARM to a lower value.

**Configuring Step 2: Create the WLAN for RTLS**

The following steps are required in ArubaOS to create the WLAN used for location tracking:

- IP address space sufficient for all tags, in a single subnet
- Firewall rules and user role for tags
- Dedicated SSID for Tag use
- 802.11b with required rates of 1MB and 2 MB
- Channel assignment (as required for enterprise WLAN coverage)

**IP Addresses**

Tags require unique IP addresses on a single subnet. Two-way communication will take place with the server, allowing tags to receive programming changes over the air, and enabling messaging with the T301 BD tag. A sufficient number of static or DHCP IP addresses must be allocated for the number of tracked devices. Tags should not require a new IP address or default gateway until the DHCP lease time has expired.

How this is structured will depend on the architecture of the network. One possibility is to have a dedicated wireless VLAN for only tag-related traffic. This VLAN could then route to the location of the Ekahau Positioning Engine. To add a VLAN to the controller for RTLS tag, see next section on configuring VLANs.
Configuring the VLANs

Navigate to Configuration > Network > VLANs page and select the VLAN link. This page will display all the VLANs configured so far. To create a new VLAN, click on the Add tab and configure the VLAN. After entering the configuration information, click the Apply tab to apply the settings. This will create a new VLAN.
Navigate to Configuration > Network > IP page and select the IP link. This page will display all the VLANs along with their IP Interfaces that have been configured so far. To configure an IP interface for the VLAN, Click on the Edit button along the newly created VLAN and provision the IP address and the Net Mask.

Assigning ports to a VLAN

You have the option of assigning a physical port to the RTLS VLAN. However, the VLAN does not have to have a physical port assignment. The wireless traffic can be contained on a wireless only VLAN and then routed to a wired VLAN. The final design will depend on the network.

If you wish to assign a physical port to the RTLS VLAN:

Navigate to the Configuration > Network > Port page. Select the port that needs to be configured and set up as required. In this example, the port connecting to the L2 switch is a trunk port with other VLANs (data and voice for example). For configuration guidelines, refer to the ArubaOS User Guide.
Firewall Rules and User Role for Ekahau Tags

Ekahau tags may not use the same encryption as other devices on the network. Ideally, they should be restricted by the Aruba Policy Enforcement Firewall for maximum security. The standard ports for Ekahau traffic are listed below. Note that most of these ports are configurable, and that you may not use all tag models in your environment. The EPE server (for firewall purposes) does not initiate communication with the tags, but responds to the tag, so the firewall rules only need to be unidirectional to account for this flow of traffic.

Client devices and application initiate a session to the positioning engine via the communication ports as described in the table below.

Table 1  
Ekahau Communication Protocols and Ports

<table>
<thead>
<tr>
<th>Protocol/Port</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP/8550</td>
<td>Ekahau EPS GUI and T201 tag maintenance</td>
</tr>
<tr>
<td>TCP/8648</td>
<td>Ekahau T201 tags</td>
</tr>
<tr>
<td>UDP/8549</td>
<td>Ekahau T201 tags</td>
</tr>
<tr>
<td>UDP/8554</td>
<td>Ekahau T301 tags firmware update</td>
</tr>
<tr>
<td>UDP/8552</td>
<td>Ekahau T301 tags</td>
</tr>
<tr>
<td>UDP/8553</td>
<td>Ekahau T301 tags</td>
</tr>
<tr>
<td>UDP/8545</td>
<td>Ekahau clients (software tags) location update</td>
</tr>
<tr>
<td>UDP/8546</td>
<td>Ekahau clients (software tags) location update</td>
</tr>
<tr>
<td>TCP/8560</td>
<td>Ekahau Vision Application</td>
</tr>
</tbody>
</table>

To configure these access policies, navigate to the *Configuration > Security > Access Control > Policies* page. Click on *Add* to add a new firewall policy and configure it similarly to as shown.

Figure 11  ArubaOS, Configuring Access Control Policies
The policy as configured in the above example allows all tag models.

The Ekahau server is assigned an alias to simplify changes if the server’s IP address changes. Likewise, the tag network could be assigned an alias or defined more precisely, rather than using ‘any’ as the source in the rule definition.

A Note on Blacklisting

A rouge data device could attempt to spoof a RTLS client (tag) in order to gain network access. In order to prevent this, policy violators can be blacklisted. For example, a user on the Ekahau tag role that tries to access the non-RTLS servers or infrastructure or use non-Ekahau protocols or non-Ekahau ports can be blacklisted and denied any access to the network.

To configure blacklisting, navigate to the policy configuration page Configuration > Firewall Policies > Edit Policy (EkahauTags) and add the rule: ‘any any any deny blacklist’. Note that this must be the last rule in the ACL list.

To take action on the blacklisted clients and prevent them from accessing the network, go to Configuration > RF Management > Protection and enable DoS Protection. This will result in the client being de-authed if they try to access the network.

Assign Policies to the Role

Once the policies are created they need to be assigned to the user roles that the devices will be assigned to upon successful authentication. The role defined in this example is ‘EkahauTags’. Navigate to Configuration > Security > Access Control > User Roles, and then click Add. Name the role, then add the firewall policy created above. Once complete, then Apply and Save Configuration.

Figure 12  ArubaOS, Adding User Roles
Configuring the WLAN settings involves the following steps

- Configuring an AP group which is the logical collection of APs with the same RF and Security settings
- Assigning the virtual APs and authentication profiles to the APs
- Assigning the right AP groups to the APs that connect to the controller

Refer to the ArubaOS User Guide for initial configuration of the APs. Once the APs are connected, they will bootstrap to the controller and will be assigned the default profile. After this, the APs can be seen on the controller as “Aruba Access Points” on the Monitoring > Network Summary page.

In ArubaOS, related configuration parameters are grouped into profiles that can be applied as needed to an AP group or to individual APs. You can apply the following types of profiles to an AP or AP group:

- **Wireless LAN Profiles** configure WLANs in the form of **Virtual AP Profiles**. A Virtual AP profile contains an **SSID Profile** which defines the WLAN and an **AAA Profile** which defines the authentication for the WLAN. This is the profile we are concerned with for the purposes of Ekahau integration.

Other profiles available:

- **AP Profiles** configure AP operation parameters, radio settings, port operations, regulatory domain, and SNMP information
- **QoS Profiles** configure traffic management and VoIP functions
- **RF Management Profiles** configure radio tuning and calibration, AP load balancing, coverage hole detection, and RSSI metrics
- **IDS Profiles, Wireless Mesh Profiles**, etc. for more advanced configurations for WIPS and mesh deployments

**AP Groups, AAA Profile, Virtual AP Profile, SSID Profile Configurations**

Ekahau RTLS will be increasingly accurate as the density of deployed APs in the desired area for location tracking increases. Depending on how the APs are deployed and managed in the network, you may want to add the WLAN profile for the Ekahau SSID to most or all of your AP groups.
Navigate to Configuration > Wireless> AP Configuration > AP Group

**Figure 13  ArubaOS, Adding AP Groups**

Click on the New button to create a new group, or click on Edit to add the Ekahau WLAN profile to an existing group. Navigate to Wireless LAN and to Virtual AP. The full path is:

*Configuration > Wireless> AP Configuration > AP Group > [AP group name] > Wireless LAN > Virtual AP*

From the drop down, choose *New*, and then provide the profile a name (Ex. ‘EkahauRTLS’) and click *Add*. Note that if the Ekahau RTLS WLAN profile has already been created, it could be added to a Virtual AP profile from here. To finish the configuration:

- From the AAA drop down, choose “default-dot1x-psk” – click *Apply* in the resulting screen. Alternately, choose *New* from the drop down and create a specific AAA profile.

- From the SSID Profile drop down, choose *New*. In the resulting screen:
  - Give the profile a name – Ex. “EkahauRTLS”
  - Type an SSID for the profile – Ex. “ekahau”
  - Choose the radio button for “WPA2–PSK” (this is assuming T301 badges; choose *WEP* or *open* if otherwise required based on badge capabilities)
  - Choose AES encryption (default)
  - Under “Keys” choose *Hex* or passphrase and type the PSK (Pre Shared Key) you have chosen for this WLAN
  - Click *Apply*
  - In the resulting screen (the virtual AP list) click *Apply* and then *Save Configuration*

- Confirm SSID minimum data rates are supported
  - In the profile tree, go to the new profile, ‘SSID profile’ and then click *Advanced* in the right hand window. The full path is:

    * Configuration > Wireless> AP Configuration > AP Group >[ AP group name] > Wireless LAN > Virtual AP > [Ekahau SSID profile] > SSID profile > Advanced*
- Confirm that 1 Mbps and 2 Mbps data rates are supported on the g (2.4 GHz) band

**Figure 14** ArubaOS, AP Configuration, SSID Profile (Basic)
Channel Assignment and ARM

As stated earlier, Ekahau tags operating in Aruba Blink Mode are fully compatible with dynamic power adjustment. Tag power remains consistent, so the transmission power of APs does not impact location accuracy in any way. ARM also minimizes interference and automatically provides the most stable environment for tag communication.

In Association Mode, ARM changes can have a small impact on location accuracy, which can be further mitigated by setting minimum and maximum thresholds for ARM power adjustments.

One must ensure that the channels used for ARM are the same as those the tags are configured to use. In short, no major changes to ARM are necessary.

Configuring ArubaOS to Pass Data to the EPE

This step is only necessary for Aruba Blink Mode configuration, and is described in the next section.

Configuring Step 3: Deploy Ekahau Positioning Engine (EPE)

At this point, a WLAN that supports Ekahau tags has been configured. It is now necessary to complete the Ekahau configuration. As a first step, an Ekahau Positioning Engine server must be added to the network. Please see the Ekahau documentation for details, particularly:

- Ekahau Positioning Engine User Guide
- Ekahau RTLS Guide

Ekahau System Requirements

To set up infrastructure based positioning with Aruba, you will need, at a minimum:

- Ekahau Positioning Engine v.4.5 or newer
- Ekahau Site Survey 4.5 or newer
- Ekahau Activator 4.5 or newer
- Ekahau T301A tag FW version 2.3.43-3
- Ekahau Atheros Wi-Fi Adapter driver which is bundled with Ekahau Activator and ESS
Note: Activator and must be installed from the same RTLS package, otherwise there may be a driver mismatch if run on the same laptop

- Ekahau T301 tags
- Laptop computer running Windows Vista or XP  
  - This will run Ekahau Site Survey and Ekahau Activator
- Atheros-based 802.11abg adapter for the laptop computer (see www.ekahau.com/devices for supported adapters)
- Desktop computer running XP or Windows 2003 Server  
  - Ekahau Positioning Engine will run on this computer

Install Ekahau Software

- Install Ekahau Positioning Engine on a Windows XP or Windows Server system
- Deploy that system on the network. The IP address of the EPE should match the alias used in the Aruba Firewall Polices. Otherwise, the IP address of the firewall policy will have to be changed.
  - There will be an option to change the configuration of TCP/UDP ports used by the Ekahau system. Changes here will mean changes or modifications of the firewall policy.
- Install Ekahau Site Survey and Ekahau Activator on the laptop. Also install the wireless network adapter drivers for your Atheros-based wireless network adapter. The installer recommends a driver update, and updates the drivers if necessary.
  - This is in anticipation of the necessary site survey and creation of a positioning model

Configure the Aruba Controller to pass data to the Ekahau Positioning Engine

This step is only needed when using Aruba Blink Mode.

- Log into the Aruba Controller
- In the Aruba Controller Web Interface, navigate to:
  - Configuration > Wireless > AP Configuration > AP > AP System Profile
  - Scroll down to RTLS Server Configuration
In the RTLS server configuration, set Ekahau Positioning Engine IP, port, and enter an identification key (you will need to enter this twice). The identification key is a shared secret that you can freely choose. EPE uses the key to authorize the Aruba system to feed the signal data into the EPE.

Configure Ekahau Positioning Engine to Accept Data from the Aruba System

This step is only needed when using Aruba Blink Mode.

- Go to the EPE server
- Stop the EPE service
  - Start > run > services.msc
  - Scroll to “Ekahau Positioning Engine Service” and double click
  - Click ‘stop’ – leave the window open
In the folder you installed the Ekahau software, open the file conf/system.properties in a text editor

- Default path: C:\Program Files\Ekahau\Ekahau Positioning Engine\conf\system.properties
- Type the following line in the system.properties file:
  - `apreceiver.aruba.hmac.key=kukka`
  - where "kukka" is the key that you just typed in the Aruba Controller Web Interface
- Save the file and close the text editor

- Re-start Ekahau Positioning Engine service
  - Start > run > services.msc
  - Scroll to "Ekahau Positioning Engine Service" and double click
  - Click Start

**Configuring Step 4: Activate Survey Tag and Perform Ekahau Site Survey**

Ekahau Site Survey is a laptop-based application for conducting a site survey and uploading a positioning model to the EPE. See the appropriate Ekahau documentation for more details than are provided in this document.

**Figure 18** *Ekahau Site Survey (ESS) Example*
A complete site survey of the facility is required for the Positioning Engine to track the tags. When high location accuracy is desired, Ekahau recommends surveying the area with an Ekahau (T301a) tag.

Before surveying the area with a tag, the tag must be set to Survey Mode. This procedure is significantly different for Aruba Blink Mode and Association Mode.

Prior to site surveys, you will need to add maps to ESS and set their scale.
Surveying with Aruba Blink Mode

Should there be any questions concerning Site Surveys, please consult the Ekahau Site Survey documentation (Deploying RTLS with Ekahau Site Survey, included in the ESS installer). The following includes the primary differences in performing an Aruba infrastructure-based site survey rather than a client-based survey.

When performing site surveys using Aruba Blink Mode, you will need to:

- Activate the tag to connect to the Engine (EPE)
- Upload and update the tag firmware using Engine GUI (if necessary)
- Set the tag to Aruba Blink Survey Mode
- Connect to the Tag from Ekahau Site Survey (ESS)
- Perform Site Surveys

Tags need a WLAN that allows them to reach the EPE server in order to be configured and to have their firmware updated. You may use the WLAN we have already defined, or you may use an alternate WLAN for this purpose.

The steps in this section are only required when using Aruba Blink Mode. See the next section for Tag Association Mode.

Activate Survey Tag to Connect to Engine (EPE)

Ekahau Activator is a program that runs on Wi-Fi enabled Windows XP / 2000 / Vista laptop in order to wirelessly assign basic settings to an Ekahau location tracking tag. Activator will let you configure the tag with the EPE server’s IP address, and with the WLAN the tag should use to access the EPE server. For more details, please see:

- T301 Activator User Guide

After successful activation, the tag will show up in the EPE GUI and the administrator will then be able to fully manage the tags.

Figure 20  Ekahau Tag Activator, WLAN Settings
Figure 21  *Ekahau Tag Activator, EPE Settings*

Specify the IP address of the Positioning Engine server and interval of maintenance updates.
Upload and Update Tag Firmware

A tag firmware update is typically only required if Aruba Blink Mode is used.

- Go to the EPE Web UI – see Ekahau documentation
  - Default setting is: http://<server-IP>:8550
  - Default login is ‘admin / admin’
  - Note that default login can be changed under ‘users > admin’
- Check if the FW is 2.3.4 or newer. If not, proceed with firmware upload
- Upload new firmware to the EPE server
  - In the EPE UI, go to Configs > Upload new tag firmware
  - Browse to the new firmware (which needs to be on your management system hard drive)
  - Select tag FW 2.3.4 or newer
* Install firmware on tags
  * Navigate to the **Tags** page
  * Select (via checkbox) the tags you want to update the Aruba FW to (in other words, the tags that need to be located using Aruba Infrastructure-based positioning)
  * After checking the tags, click **Advanced**
  * Select firmware version from **Firmware Update**, click **Set**
  * Wait until the maintenance interval is due for the tags, and wait until the tag FW is updated
  * Optionally click on the white tag button to force immediate FW update

**Put One of the Tags in Aruba Blink Survey Mode**

Users already familiar with Association Mode should note that one does NOT use Ekahau Activator for setting the Survey mode. Instead, a manual command is pushed from the Engine to force the Aruba Blink Survey Mode:

* After activating the tag and updating the FW, in the EPE GUI, go to **Tags** page, select the tag you want to set to Survey Mode
* In the “manual commands” checkbox, type the following
  \[
  \text{wsc } 1, 6, 11 \\
  \text{I16:wsm } 1 \\
  \text{wcs } 1 \text{ 012345678901}
  \]

**Note:** IMPORTANT: In this example, 1,6,11 are the channels used in the Aruba APs operating at 2.4GHz. Adjust if necessary. Use only the channels that the APs are on, nothing more, and nothing less.
I16:wsm 1 sets the tag to Aruba Blink Mode. I16:wsm 0 sets the tag back to “traditional” ELP Mode. The wcs 1 012345678901 command enables the survey mode (tag blinks rapidly (the light does not, but the tag sends “blink packets” more frequently)

- Press “Send Commands”
- Push the white button on the tag to force the update or wait for the maintenance interval

**Note:** In FW version 2.3.4 the tag lights do not blink in Aruba Survey mode – you will need to check correct operation using ESS. There may be some other issues with the lights also (with periodic scanning, for example).

**Note:** When surveying with Ekahau T301 tags, the SSID will not be detected.

### Surveying with Tag Association Mode

The steps in this chapter are only required when using Tag Association Mode. See the previous chapter for Aruba Blink Mode.

Put one of the tags to (Tag Association) Survey Mode

Use Ekahau Activator to set the tag to Survey mode:

- Select the *Survey Activation* tab, and configure the appropriate settings
  - If the location SSID is non-broadcasting, ensure you enter the location SSID correctly
  - You can also enter a secondary SSID if so desired
- Now the tag will constantly blink, meaning it is constantly scanning and is ready for survey use
- Push the blue button to pause the scanning, and push it again to continue
- Close Ekahau Activator Application
Figure 24  *Ekahau Tag Activator, Activate Tag in Tag Association Survey Mode*

**Start Ekahau Site Survey (ESS)**

- Go do *Device > Devices*
- Select *Connect T301*
- If the tag is blinking, ESS should find the tag and start scanning with it
- Exit the *Devices* dialog
- Click on the miniature signal strength view
- You should see signal strength values updating, and data coming in from device T301 (if not, repeat the procedure to re-detect the tag)
- Perform site surveys as you normally would (for details, see *Ekahau Site Survey User Guide*)
- After performing the surveys, test real-time tracking of the tag and/or perform additional test surveys
Figure 25  ESS, Connecting a T301 Tag with Site Survey Associating Mode

1. Click here to access the Devices window

2. Click here to connect to a T301 tag

3. Insert the T301A tag MAC address here and hit Connect. The T301 needs to be activated in Survey mode prior to this.

**Note:** When surveying with Ekahau T301 tags, the SSID will not be detected.

Performing Surveys and Selecting My Access Points

Performing site surveys is easy: Just select the survey tool and click your current location on the map as you go. Note that the data is constantly collected, not just when you click on the map.
ESS needs to know which access points are in your network, and which are not. Only the APs in your network will be used in positioning. Select *My APs* using the AP list.

To help this procedure and to see a clearer network picture overall, you can place all the access points on the map after the surveys. Use *Site > Automatically Place Access Points* to automatically place the APs on the map. This placement may not be spot-on, but it gives a good idea where the strongest access points are. You can move the APs to their correct locations using the edit tool.
Configuring Step 5: Draw Tracking Rails, Open Spaces and Zones

Drawing Tracking Rails

For accurate location tracking, EPE needs the most common paths that are taken by the user. For this, Ekahau uses *Tracking Rails*. The tracking rails are drawn on the map, using ESS, before or after the surveys.

Select My APs from here.
To select multiple APs as My, simply select multiple APs (using the orange toggle on the left of each AP) and then check the My checkbox on one of them.
Drawing Open Spaces

Should there be no known pathways in some location (such as in lobby areas or cafeterias). Tracking Rails should not be drawn in these locations. Instead, use Open Spaces to draw a rectangle or a free-form polygon to indicate the area where the exact paths of movement will not be known a priori.

**Note:** Rails should always connect to Open Spaces to indicate that there is a way for the tracked device to travel to an Open Space.

**Note:** The rails should cover the entire tracking area, just as with the surveys. Wherever you have rails, you should have surveys also. Please use the Calibration Quality Visualization in ESS to see if you have surveyed on all the rails.
Drawing Zones

If you want to associate meaningful names to chosen areas of the facility (that are utilized in the end user application), use Zones. For example, if the application needs to display whether the doctor is in the ER or cafeteria, you will need to define those areas on the maps as ‘Zones’ – in this case, draw a Zone on the map to cover the ER, and another to cover the cafeteria.

To draw Zones, use the Zone tool on the RTLS tab in ESS.
Ensuring Location Tracking Accuracy (Precursor to Configuring Step 6)

Now that the Positioning Model is finished, it is recommended that one check the location tracking accuracy. There are two main methods for doing this, Ekahau recommends implementing both methods for optimum tracking accuracy:

- Live Accuracy Testing
- Accuracy Testing Using Test Surveys

Live Accuracy Testing

To test the accuracy right after the surveys, keep the Survey tag blinking, and keep the Ekahau Site Survey open. On the RTLS Tab of ESS, click the Track button (the “target” icon in the upper-right corner). This allows your survey tag to be tracked by ESS. You can, in real-time, see the location tracking accuracy when walking around the facility.
Accuracy Testing Using Test Surveys

Ekahau also recommends performing quick test surveys around the facility. Perform a secondary set of surveys similarly to the previous surveys. Covering about 10-25% of the original survey area is a good target.

Go to the Surveys tab (instead of Access Points list), and assign the surveys you just made as Test Surveys only. You can highlight multiple surveys, right-click, and select Deselect from Calibration and Select as Test.
Now you can analyze the location accuracy based on the test surveys in several ways:

- **Accuracy statistics**: Go to **Positioning > Accuracy Statistics** to display a summarized numerical analysis of the floor, meter/feet and zone accuracy

---

**Figure 32  ESS, Assigning Test Surveys**

![Assign Test Surveys](image)

**Figure 33  ESS, Analyzing Test Survey Location Accuracy, Accuracy Statistics**

![Accuracy Statistics](image)

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The percentage of locations filtered by Location Quality Filter

- **Overall Accuracy Across the Site**
- **Overall Accuracy on map MB3**
- **Accuracy on one Survey only on MB4**

---

**Figure 34  ESS, Analyzing Test Survey Location Accuracy, Location Accuracy Heatmap Visualization**

Location Accuracy Heatmap Visualization. Check visually, on a map, what your location accuracy looks like. This will display within-floor accuracy as well as any floor errors (floor errors marked with circles or rectangles, green is high accuracy)
Error Vectors (View > Error Vectors): This will show you the actual location errors on the map, one-by-one. The blue arrows will show where you were originally placed (the starting point of the arrow) and where the EPE would have placed you (the end point of the arrow).
Should there be locations where location accuracy problems are repeatedly encountered, check the signal coverage in those locations using Signal Strength and Location Coverage heatmap visualizations. If there is insufficient coverage there, Ekahau suggests first performing more (calibration) surveys in the area, and if the problem persists, adding more APs is recommended for consideration. Please see the image below for basic accuracy improvement guidelines.
Configuring Step 6: Upload Positioning Model from Ekahau Site Survey to Ekahau Positioning Engine

Now that the Positioning Model has been completed and tested, it's time to upload it to the Ekahau Positioning Engine:

- Save the .esx Project on a USB drive
- Copy the .esx to the Engine computer
- Using the Engine GUI, upload the Model to Engine:
  - Go to Models > Upload a New Model
  - Activate the model after uploading it by clicking on the model name and selecting Set Active

Your Ekahau Positioning Engine is now ready to track Wi-Fi devices.

Configuring Step 7: Deploy Tracking Tags

Your Tags, EPE and Aruba infrastructure have now been configured to use infrastructure-based signal measurements. You can now apply programming settings and change T301 tag configurations as described in the Ekahau Positioning Engine User Guide

Production Tag Configurations for Aruba Blink Mode

- Use Ekahau Activator to connect all the production tags to the Engine (EPE)
- In the EPE GUI, select all the tags or tag groups you want to set the configuration to, and send the configuration to the tags
  - Do remember to check the Aruba Blink Mode check box in the tag configuration page

For improving accuracy in Aruba blink mode, Ekahau recommends increasing the blink rate with the multi-scan command.
**Note:** Push the production configurations to the tags *immediately* after activating the tags, as the default initial tag activation sets the tags to frequent wakeup interval, which may drain the battery quickly.

**Production Tag Configurations for Tag Association Mode**

- Use Ekahau Activator to activate all the production tags to connect to Engine.
- Use the EPE Web GUI to configure the production settings to the tags.
- For improving accuracy in association mode, Ekahau recommends increasing the blink rate with the following Advanced Scan settings:
  - Initial Scan 3
  - Aftermotion Scan Count 3 – 6 (depending on battery life expectations) in cases where motion sensor is enabled.
  - Button Scan Count 3 if button is used in production.

**Tag Battery Life vs. Blink Rate**

The more frequently the tags blink, the shorter the battery life will be. In asset tracking scenarios, a 30-minute wakeup interval, combined with motion or aftermotion tracking, may be acceptable (resulting in years of battery life with T301a). Personnel tracking, however, may require 30 second wakeup (requiring frequent recharge).

The EPE GUI includes a battery life calculator based on the current wakeup settings.

See ‘Activate Tags to Connect to Engine (EPE)’ section above for more details relating to tag configuration and setup.

**Special and Advanced Considerations**

**Multiple Simultaneous Surveyors**

In a multi-floor building, several surveyors can survey different floors of the building simultaneously. Use File > Merge in ESS to combine the Projects after surveying.

**Outdoor Deployments**

When working in outdoor environments, special considerations may need to be taken. The accuracy may not be as high as for indoor deployments depending on the method of coverage, AP density, etc.

The survey data in EPE is associated with the rails, and needs to be close enough to the rails. This may not always be the case in large outdoor deployments. Go to Site > Set Active Map Type to adjust the map type to Outdoor – this allows the survey data to be connected to the rails from a further distance. Use the Calibration Quality Visualization to verify that the survey data has been associated with the rails.
改善准确性

如果准确性不令人满意，首先进行更多区域的调查。如果准确性仍然不令人满意，可以在问题区域增加接入点。

实现非常高的房间准确性

为了实现非常高精度，例如在优化流程应用中，Ekahau建议使用额外的定位信标。电池供电的定位信标被安装在房间中以提供额外的精度。在此情况下，Ekahau定位引擎同时使用Wi-Fi AP和定位信标来计算标签位置。

使用定位信标工具在ESS上放置定位信标。同时，每个放置定位信标的区域都需要一个Zone。

请参阅Ekahau Site Survey用户文档和Ekahau工程（support@ekahau.com）以获取更多关于定位信标的信息。
## Contacting Aruba Networks

### Web Site Support

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<thead>
<tr>
<th>Service</th>
<th>URL</th>
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<tbody>
<tr>
<td>Main Site</td>
<td><a href="http://www.arubanetworks.com">http://www.arubanetworks.com</a></td>
</tr>
<tr>
<td>Support Site</td>
<td><a href="http://www.arubanetworks.com/support">http://www.arubanetworks.com/support</a></td>
</tr>
<tr>
<td>Software Licensing Site</td>
<td><a href="https://licensing.arubanetworks.com">https://licensing.arubanetworks.com</a></td>
</tr>
<tr>
<td>Wireless Security Incident Response Team (WSIRT)</td>
<td><a href="http://www.arubanetworks.com/support/wsirt">http://www.arubanetworks.com/support/wsirt</a></td>
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<tr>
<td>Support Email</td>
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<tr>
<td>WSIRT Email</td>
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### Telephone Support

<table>
<thead>
<tr>
<th>Service</th>
<th>Phone Number</th>
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</thead>
<tbody>
<tr>
<td>Aruba Corporate</td>
<td>+1 (408) 227-4500</td>
</tr>
<tr>
<td>FAX</td>
<td>+1 (408) 227-4550</td>
</tr>
</tbody>
</table>

**Support**

- **United States**: 800-WI-FI-LAN (800-943-4526)
- **France**: +33 (0) 1 70 72 55 59
- **United Kingdom**: +44 (0) 20 7127 5989
- **Germany**: +49 (0) 69 38 09 77 22 8
- **All Other Countries**: +1 (408) 754-1200