



# CISCO Embedded Wireless Controller Catalyst Access Points User Guide

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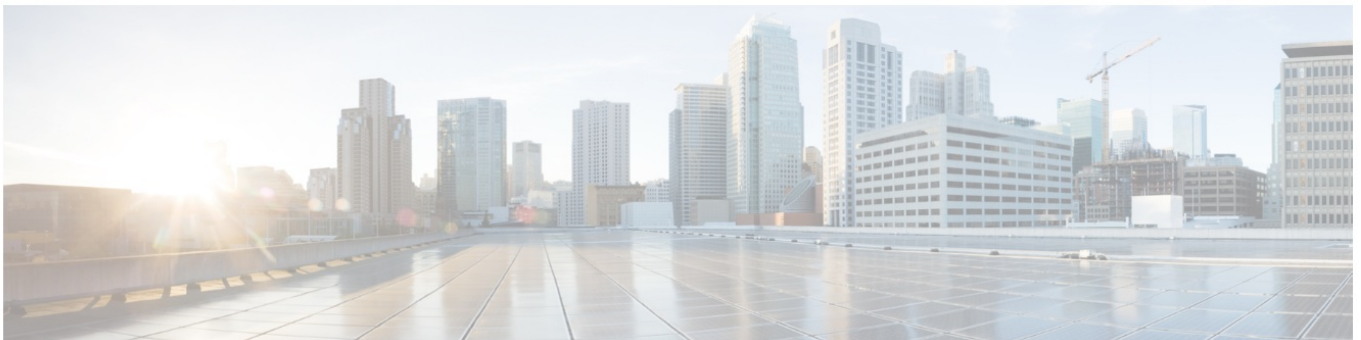


## Embedded Wireless Controller Catalyst Access Points User Guide

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## Embedded Wireless Controller Catalyst Access Points



### **Support for Hash-to-Element for Password Element in SAE Authentication**

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### **Hash-to-Element (H2E)**

Hash-to-Element (H2E) is a new SAE Password Element (PWE) method. In this method, the secret PWE used in the SAE protocol is generated from a password.

When a STA that supports H2E initiates SAE with an AP, it checks whether AP supports H2E. If yes, the AP uses the H2E to derive the PWE by using a newly defined Status Code value in the SAE Commit message.

If STA uses Hunting-and-Pecking, the entire SAE exchange remains unchanged.

While using the H2E, the PWE derivation is divided into the following components:

- Derivation of a secret intermediary element PT from the password. This can be performed offline when the password is initially configured on the device for each supported group.
- Derivation of the PWE from the stored PT. This depends on the negotiated group and MAC addresses of peers. This is performed in real-time during the SAE exchange.

## Note

- The H2E method also incorporates protection against the Group Downgrade man-in-the-middle attacks. During the SAE exchange, the peers exchange lists of rejected groups banded into the PMK derivation. Each peer compares the received list with the list of groups supported, any discrepancy detects a downgrade attack and terminates the authentication.

## YANG (RPC model)

To create an RPC for SAE Password Element (PWE) mode, use the following RPC model:

```
<nc:rpc xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0"
message-id="urn:uuid:0a77124f-c563-469d-bd21-cc625a9691cc">
<nc:edit-config>
<nc:target>
<nc:running/>
</nc:target>
<nc:config>
<wlan-cfg-data xmlns="http://cisco.com/ns/yang/Cisco-IOS-XE-wireless-wlan-cfg">
<wlan-cfg-entries>
<wlan-cfg-entry>
<profile-name>test</profile-name>
<wlan-id>2</wlan-id>
<sae-pwe-mode>both-h2e-hnp</sae-pwe-mode>
</wlan-cfg-entry>
</wlan-cfg-entries>
</wlan-cfg-data>
</nc:config>
</nc:edit-config>
</nc:rpc>
```

## Note

The delete operation performs one action at a time due to the current infra limitation. That is, in YANG module, the delete operation on multiple nodes are not supported.

## Configuring WPA3 SAE H2E

Procedure	Command or Action	Purpose
Step 1	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 2	wan wan-name waned SSID-name Example: Device(config)# wan WPA3 1 WPA3	Enters the WLAN configuration sub-mode.
Step 3	no security wpa akm dot1x Example: Device(config-wlan)# no security wpaakm dot1x	Disables security AKM for dot1x.
Step 4	no security ft over-the-ds Example: Device(config-wlan)# no security ft over-the-ds	Disables fast transition over the data source on the WLAN.
Step 5	no security ft Example: Device(config-wlan)# no security ft	Disables 802.11r fast transition on the WLAN.
Step 6	no security wpa wpa2 Example: Device(config-wlan)# no security wpa wpa2	Disables WPA2 security. PMF is disabled now.
Step 7	security wpa wpa2 ciphers aes Example: Device(config-wlan)# security wpa wpa2 cipher s aes	Configures WPA2 cipher. Note You can check whether cipher is configured using no security wpa wpa2 ciphers aes command. If cipher is not reset, configure the cipher.
Step 8	security wpa psk set-key ascii value preshared-key Example: Device(config-wlan)# security wpa psk set-key ascii 0 Cisco123	Specifies a presaged key.
Step 9	security wpa wpa3 Example: Device(config-wlan)# security wpa wpa3	Enables WPA3 support.
Step 10	security wpa akm sae Example: Device(config-wlan)# security wpa akm sae	Enables AKM SAE support.
Step 11	security wpa akm sae pwe {h2e   hnp   both-h2e-hnp} Example: Device(config-wlan)# security wpa akm sae pwe	Enables AKM SAE PWE support. PWE supports the following options: <ul style="list-style-type: none"> <li>• h2e—Hash-to-Element only; disables Hnp.</li> <li>• hnp—Hunting and Pecking only; disables H2E.</li> <li>• Both-h2e-hnp—Both Hash-to-Element and Hunting and Pecking support (Is the default option).</li> </ul>
Step 12	no shutdown Example: Device(config-wlan)# no shutdown	Enables the WLAN.
Step 13	end Example: Device(config-wlan)# end	Returns to the privileged EXEC mode.

## Verifying WPA3 SAE H2E Support in WLAN

To view the WLAN properties (PWE method) based on the WLAN ID, use the following command:

```
Device# show wlan id 1
WLAN Profile Name      : wpa3
```

WLAN Profile Name : wpa3

=====

Identifier	: 1
Description	:
Network Name (SSID)	: wpa3
Status	: Enabled
Broadcast SSID	: Enabled
Advertise-Apname	: Disabled
Universal AP Admin	: Disabled
Max Associated Clients per WLAN	: 0
Max Associated Clients per AP per WLAN	: 0
Max Associated Clients per AP Radio per WLAN	: 200
OKC	: Enabled
Number of Active Clients	: 0
CHD per WLAN	: Enabled
WMM	: Allowed
WiFi Direct Policy	: Disabled
Channel Scan Defer Priority:	
Priority (default)	: 5
Priority (default)	: 6
Scan Defer Time (msecs)	: 100
Media Stream Multicast-direct	: Disabled
CCX - AironetIe Support	: Disabled
Peer-to-Peer Blocking Action	: Disabled
DTIM period for 802.11a radio	: 1
DTIM period for 802.11b radio	: 1
Local EAP Authentication	: Disabled
Mac Filter Authorization list name	: Disabled
Mac Filter Override Authorization list name	: Disabled
Accounting list name	:
802.1x authentication list name	: Disabled
802.1x authorization list name	: Disabled
Security	
802.11 Authentication	: Open System
Static WEP Keys	: Disabled
Wi-Fi Protected Access (WPA/WPA2/WPA3)	: Enabled
WPA (SSN IE)	: Disabled
WPA2 (RSN IE)	: Disabled
WPA3 (WPA3 IE)	: Enabled
AES Cipher	: Enabled
CCMP256 Cipher	: Disabled
GCMP128 Cipher	: Disabled
GCMP256 Cipher	: Disabled
Auth Key Management	
802.1x	: Disabled
PSK	: Disabled
CKKM	: Disabled
FT dot1x	: Disabled

FT PSK	: Disabled
Dot1x-SHA256	: Disabled
PSK-SHA256	: Disabled
SAE	: Enabled
OWE	: Disabled
SUITEB-1X	: Disabled
SUITEB192-1X	: Disabled
SAE PWE Method	: Hash to Element (H2E)
Transition Disable	: Disabled
CCKM TSF Tolerance (msecs)	: 1000
OWE Transition Mode	: Disabled
OSEN	: Disabled
FT Support	: Disabled
FT Reassociation Timeout (secs)	: 20
FT Over-The-DS mode	: Disabled
PMF Support	: Required
PMF Association Comeback Timeout (secs)	: 1
PMF SA Query Time (msecs)	: 200
Web Based Authentication	: Disabled
Conditional Web Redirect	: Disabled
Splash-Page Web Redirect	: Disabled
Webauth On-mac-filter Failure	: Disabled
Webauth Authentication List Name	: Disabled
Webauth Authorization List Name	: Disabled
Webauth Parameter Map	: Disabled
Band Select	: Disabled
Load Balancing	: Disabled
Multicast Buffer	: Disabled
Multicast Buffers (frames)	: 0
IP Source Guard	: Disabled
Assisted-Roaming	
Neighbor List	: Enabled
Prediction List	: Disabled
Dual Band Support	: Disabled
IEEE 802.11v parameters	
Directed Multicast Service	: Enabled
BSS Max Idle	: Enabled
Protected Mode	: Disabled
Traffic Filtering Service	: Disabled
BSS Transition	: Enabled
Disassociation Imminent	: Disabled
Optimised Roaming Timer (TBTTS)	: 40
Timer (TBTTS)	: 200
Dual Neighbor List	: Disabled
WNM Sleep Mode	: Disabled
802.11ac MU-MIMO	: Enabled
802.11ax parameters	
802.11ax Operation Status	: Enabled
OFDMA Downlink	: Enabled
OFDMA Uplink	: Enabled
MU-MIMO Downlink	: Enabled
MU-MIMO Uplink	: Enabled
BSS Target Wake Up Time	: Enabled
BSS Target Wake Up Time Broadcast Support	: Enabled
802.11 protocols in 2.4ghz band	
Protocol	: dot11bg
Advanced Scheduling Requests Handling	: Enabled
mDNS Gateway Status	: Bridge

WIFI Alliance Agile Multiband	: Disabled
Device Analytics	
Advertise Support	: Enabled
Advertise Support for PC analytics	: Enabled
Share Data with Client	: Disabled
Client Scan Report (11k Beacon Radio Measurement)	
Request on Association	: Disabled
Request on Roam	: Disabled
WiFi to Cellular Steering	: Disabled
Advanced Scheduling Requests Handling	: Enabled
Locally Administered Address Configuration	
Deny LAA clients	: Disabled

To verify the client association who have used the PWE method as H2E or Hnp, use the following command:



```
Device# show wireless client mac-address e884.a52c.47a5 detail
Client MAC Address : e884.a52c.47a5
Client MAC Type : Universally Administered Address
Client DUID: NA
Client IPv4 Address : 11.11.0.65
Client IPv6 Addresses : fe80::c80f:bb8c:86f6:f71f
Client Username: N/A
AP MAC Address : d4ad.bda2.e9e0
AP Name: APA453.0E7B.E73C
AP slot : 1
Client State : Associated
Policy Profile : default-policy-profile
Flex Profile : N/A
Wireless LAN Id: 1
WLAN Profile Name: wpa3
Wireless LAN Network Name (SSID): wpa3
BSSID : d4ad.bda2.e9ef
Connected For : 72 seconds
Protocol : 802.11ax - 5 GHz
Channel : 36
Client IIF-ID : 0xa0000001
Association Id : 2
Authentication Algorithm : Simultaneous Authentication of Equals (SAE)
Idle state timeout : N/A
Session Timeout : 1800 sec (Remaining time: 1728 sec)
Session Warning Time : Timer not running
Input Policy Name : None
Input Policy State : None
Input Policy Source : None
Output Policy Name : None
Output Policy State : None
Output Policy Source : None
WMM Support : Enabled
U-APSD Support : Disabled
Fastlane Support : Disabled
Client Active State : Active
Power Save : OFF
Current Rate : m6 ss2
Supported Rates : 6.0,9.0,12.0,18.0,24.0,36.0,48.0,54.0
AAA QoS Rate Limit Parameters:
    QoS Average Data Rate Upstream      : 0 (kbps)
    QoS Realtime Average Data Rate Upstream : 0 (kbps)
    QoS Burst Data Rate Upstream        : 0 (kbps)
    QoS Realtime Burst Data Rate Upstream : 0 (kbps)
    QoS Average Data Rate Downstream     : 0 (kbps)
    QoS Realtime Average Data Rate Downstream : 0 (kbps)
    QoS Burst Data Rate Downstream       : 0 (kbps)
    QoS Realtime Burst Data Rate Downstream : 0 (kbps)
Mobility:
    Move Count                          : 0
    Mobility Role                        : Local
    Mobility Roam Type                   : None
    Mobility Complete Timestamp          : 08/24/2021 04:39:47 Pacific
Client Join Time:
    Join Time Of Client                 : 08/24/2021 04:39:47 Pacific
Client State Servers : None
Client ACLs : None
Policy Manager State: Run
Last Policy Manager State : IP Learn Complete
Client Entry Create Time : 72 seconds
```



Policy Type : WPA3  
 Encryption Cipher : CCMP (AES)  
 Authentication Key Management : SAE  
 AAA override passphrase : No  
 SAE PWE Method : Hash to Element(H2E)  
 Transition Disable Bitmap : None  
 User Defined (Private) Network : Disabled  
 User Defined (Private) Network Drop Unicast : Disabled  
 Encrypted Traffic Analytics : No  
 Protected Management Frame - 802.11w : Yes  
 EAP Type : Not Applicable  
 VLAN Override after Webauth : No  
 VLAN : VLAN0011  
 Multicast VLAN : 0  
 WiFi Direct Capabilities:  
     WiFi Direct Capable : No  
 Central NAT : DISABLED  
 Session Manager:  
     Point of Attachment : capwap\_90000006  
     IIF ID : 0x90000006  
     Authorized : TRUE  
     Session timeout : 1800  
     Common Session ID: 0000000000000000C76750C17  
     Acct Session ID : 0x00000000  
     Auth Method Status List  
         Method : SAE  
 Local Policies:  
     Service Template : wlan\_svc\_default-policy-profile\_local (priority 254)  
         VLAN : VLAN0011  
         Absolute-Timer : 1800  
 Server Policies:  
 Resultant Policies:  
         VLAN Name : VLAN0011  
         VLAN : 11  
         Absolute-Timer : 1800  
 DNS Snooped IPv4 Addresses : None  
 DNS Snooped IPv6 Addresses : None  
 Client Capabilities  
     CF Pollable : Not implemented  
     CF Poll Request : Not implemented  
     Short Preamble : Not implemented  
     PBCC : Not implemented  
     Channel Agility : Not implemented  
     Listen Interval : 0  
 Fast BSS Transition Details :  
     Reassociation Timeout : 0  
 11v BSS Transition : Implemented  
 11v DMS Capable : No  
 QoS Map Capable : Yes  
 FlexConnect Data Switching : N/A  
 FlexConnect Dhcp Status : N/A  
 FlexConnect Authentication : N/A  
 Client Statistics:  
     Number of Bytes Received from Client : 21757  
     Number of Bytes Sent to Client : 4963  
     Number of Packets Received from Client : 196  
     Number of Packets Sent to Client : 37  
     Number of Policy Errors : 0  
     Radio Signal Strength Indicator : -72 dBm  
     Signal to Noise Ratio : 20 dB  
 Fabric status : Disabled  
 Radio Measurement Enabled Capabilities  
     Capabilities: Neighbor Report, Passive Beacon Measurement, Active Beacon Measurement,  
     Table Beacon Measurement  
  
     Client Scan Report Time : Timer not running  
     Client Scan Reports  
     Assisted Roaming Neighbor List

To view the number of SAE authentications using the H2E and HnP, use the following command:

```
Device# show wireless stats client detail
Total Number of Clients : 0
```

#### Protocol Statistics

```
-----
Protocol          Client Count
802.11b           : 0
802.11g           : 0
802.11a           : 0
802.11n-2.4GHz    : 0
802.11n-5 GHz     : 0
802.11ac          : 0
802.11ax-5 GHz    : 0
802.11ax-2.4 GHz  : 0
802.11ax-6 GHz    : 0
```

#### Current client state statistics:

```
-----
Authenticating      : 0
Mobility            : 0
IP Learn            : 0
Webauth Pending     : 0
Run                 : 0
Delete-in-Progress  : 0
```

#### Client Summary

```
-----
Current Clients : 0
Excluded Clients: 0
Disabled Clients: 0
Foreign Clients : 0
Anchor Clients  : 0
Local Clients   : 0
Idle Clients    : 0
Locally Administered MAC Clients: 0
```

#### client global statistics:

```
-----
Total association requests received      : 0
Total association attempts                : 0
Total FT/LocalAuth requests              : 0
Total association failures                : 0
Total association response accepts        : 0
Total association response rejects        : 0
Total association response errors         : 0
Total association failures due to exclusion list : 0
Total association drops due to multicast mac : 0
Total association drops due to random mac  : 0
Total association drops due to throttling  : 0
Total association drops due to unknown bssid : 0
Total association drops due to parse failure : 0
Total association drops due to other reasons : 0
Total association requests wired clients  : 0
Total association drops wired clients      : 0
```

```

Total association success wired clients      : 0
Total peer association requests wired clients : 0
Total peer association drops wired clients    : 0
Total peer association success wired clients  : 0
Total association success wifi direct clients : 0
Total association rejects wifi direct clients : 0
Total association response errors             : 0
Total 11r ft authentication requests received : 0
Total 11r ft authentication response success  : 0
Total 11r ft authentication response failure  : 0
Total 11r ft action requests received        : 0
Total 11r ft action response success         : 0
Total 11r ft action response failure         : 0
Total 11r PMKR0-Name mismatch                : 0
Total 11r PMKR1-Name mismatch                : 0
Total 11r MDID mismatch                     : 0
Total AID allocation failures                : 0
Total AID free failures                     : 0
Total Roam Across Policy Profiles            : 0
Total roam attempts                         : 0
    Total CCKM roam attempts                 : 0
    Total 11r roam attempts                  : 0
    Total 11r slow roam attempts             : 0
    Total 11i fast roam attempts             : 0
    Total 11i slow roam attempts             : 0
    Total other roam type attempts           : 0
Total roam failures in dot11                 : 0

Total WPA3 SAE attempts                     : 0
Total WPA3 SAE successful authentications    : 0
Total WPA3 SAE authentication failures      : 0
    Total incomplete protocol failures       : 0
Total WPA3 SAE commit messages received     : 0
Total WPA3 SAE commit messages rejected     : 0
    Total unsupported group rejections       : 0
    Total PWE method mismatch for SAE Hash to Element commit received : 0
    Total PWE method mismatch for SAE Hunting And Pecking commit received : 0
Total WPA3 SAE commit messages sent         : 0
Total WPA3 SAE confirm messages received    : 0
Total WPA3 SAE confirm messages rejected    : 0
    Total WPA3 SAE message confirm field mismatch : 0
    Total WPA3 SAE confirm message invalid length : 0
Total WPA3 SAE confirm messages sent        : 0
Total WPA3 SAE Open Sessions                : 0
Total SAE Message drops due to throttling   : 0
Total WPA3 SAE Hash to Element commit received : 0
Total WPA3 SAE Hunting and Pecking commit received : 0


Total Flexconnect local-auth roam attempts  : 0
    Total AP 11i fast roam attempts         : 0
    Total AP 11i slow roam attempts         : 0
    Total 11r flex roam attempts            : 0

```

Support for Hash-to-Element for Password Element in SAE Authentication



## Documents / Resources

	<a href="#">CISCO Embedded Wireless Controller Catalyst Access Points</a> [pdf] User Guide Embedded Wireless Controller Catalyst Access Points, Wireless Controller Catalyst Access Points, Controller Catalyst Access Points, Catalyst Access Points, Access Points, Points
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## References

- [User Manual](#)