WIRELESS & NETWORKING EXPERTS

Port Based Authentication
802.1X (dot1x)

March 2025 © Jono Thompson
Multithread Consultants Ltd

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Jono Thompson

- Networking background started as a Cisco Engineer
- Started using ROS June 2010
- MikroTik Consultant Since Dec 2014
- MikroTik Trainer since March 2017
  - MTCNA
  - MTCRE
  - MTCINE
  - MTCWE
  - MTCTCE
  - MTCUME
  - MTCSE
  - MTCIPv6
  - MTCSWE
  - MTCEWE

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Presentation Objectives

- Look at the components of dot1x
- See how to configure dot1x on RouterOS
- See a demo of dot1x in action

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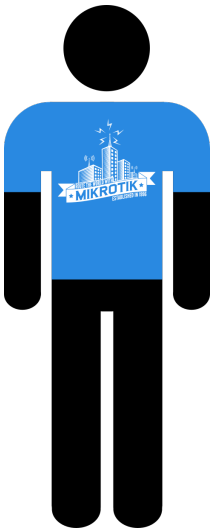
Meet Mike



- Last time we met Mike, he had just installed his new MikroTik Switches
- He has finally got all his switches working really well thanks to some really cool guy from the EU MUM
- Mike has not had any problems with his network performance since

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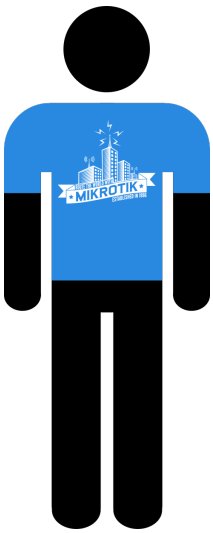
Mike's Problem



- However
- Mike keeps finding that visitors come and plug into his data outlets and can then access his network
- Mike doesn't think that's a good idea!

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Dave

- Mike ring his friend Dave
- Mike explains his problem to Dave
- Dave suggests that he should pay more attention to the release notes and look at the new MikroTik feature of dot1x

LinITX

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Dave

- Dave also suggests that Mike should go on the brand new MTCSWE (MikroTik Switching Engineer) Training Course

LinITX

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What is Dot1x?

- MikroTik Dot1x is an implementation of IEEE 802.1X standard in RouterOS
- Dot1x is not available on RouterBOARDs with smips hardware

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What is 802.1X?

- 802.1X defines port-based authentication on a client-server bases to restrict unauthorized clients from connecting to a LAN.

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What can Dot1x do?

- An authenticated interface can also be assigned a specific VLAN ID if using bridge VLAN filtering
- Dot1x can also create dynamic switch rules to apply to a switch port.

Dot1x Components

Dot1x (802.1X) defines three terminologies:

- Supplicant (Client)
- Authenticator (Switch)
- Authenticator Server (radius)

Dot1x - Supplicant

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Dot1x - Supplicant

- The Supplicant is a device (normally an end user device eg laptop/desktop) that is requesting access to the LAN.
- Supplicant is typically a user's workstation but can be a router, switch, printer or IP phone

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Dot1x Supplicant

- RouterOS can be a Supplicant (Client) and connect to a network with 802.1x authentication
- RouterOS refers to a Supplication as dot1x Client
- RouterOS supports a number of different EAP types

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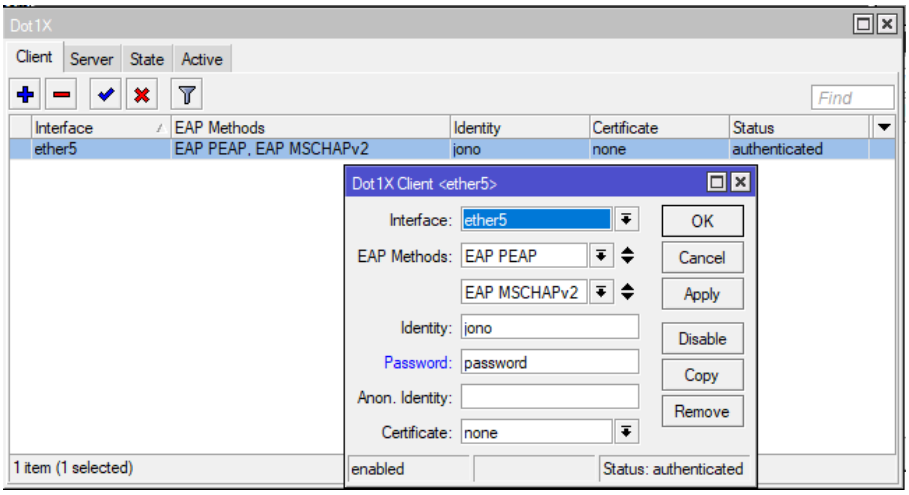
Dot1x Supplicant



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Dot1x Authenticator

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Dot1x Authenticator

- A device that controls the physical access to the network (eg a switch or a wireless access point) is called the Authenticator
- The Authenticator requests the identity from the supplicant and verifies that information with the Authentication Server.
- The Authenticator will include a RADIUS client.
- The Authenticator will encapsulate and decapsulate the EAP messages while interacting with the Authenticator server

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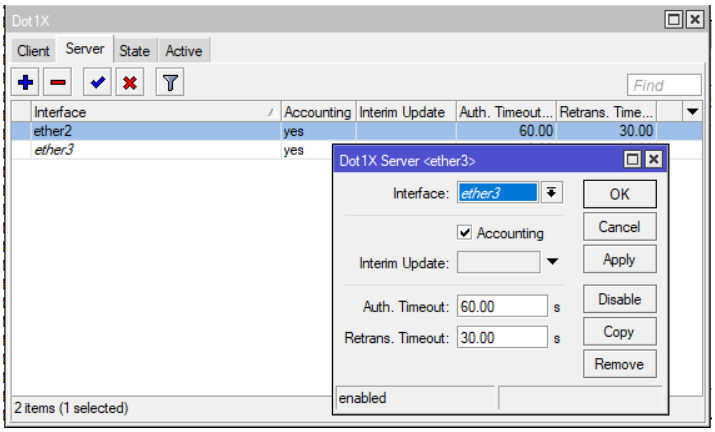
Dot1x Authenticator

- RouterOS can be an Authenticator on one or more ports
- RouterOS refers to an Authenticator as Dot1x Server



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Dot1x Authenticator

- If using dot1x on a bridge port then the bridge must be running (R/M)STP otherwise the EAP packets from the client will not be accepted.
- A newly created bridge by default runs RSTP.

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Dot1x Authenticator

- When an interface has dot1x server configured, it will block all traffic except for EAPoL (Extensible Authentication Protocol over LAN) packets.
- Once the port has been successfully authenticated the interface will accept ALL received traffic on the port.
- If the interface is connected to a shared medium with multiple hosts then traffic will be accepted from ALL hosts.

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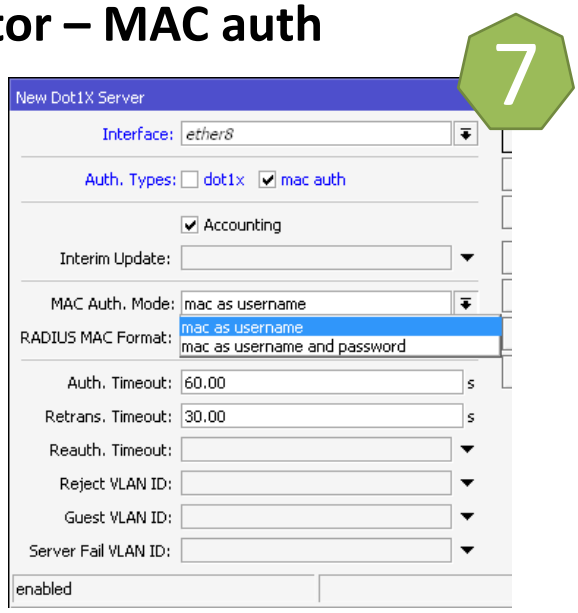
Dot1x Authenticator – MAC auth

- Mac-auth-mode – used to control the username and password Radius Attributes



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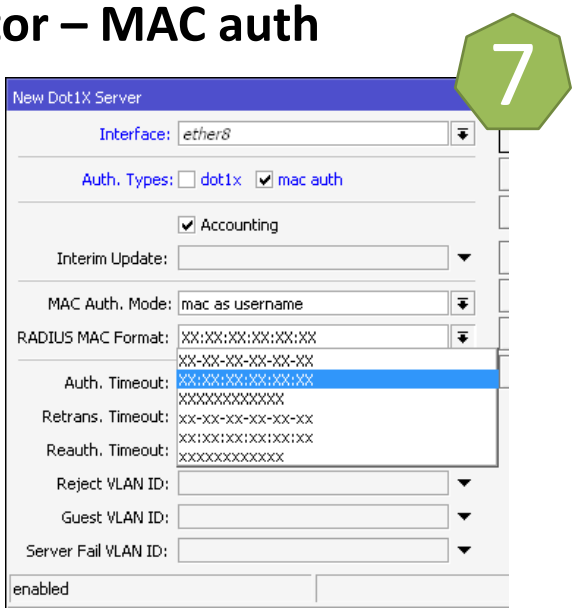
Dot1x Authenticator – MAC auth

- RADIUS MAC Format - Controls the format used for MAC of the client when sending username and/or password in the RADIUS attributes



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Dot1x Authenticator – Additional settings

- Additional settings can be applied to define what happens in a number of different cases
  - Radius Server is down or unreachable
  - Client does not support 802.1X
  - Client fails to authenticate 802.1X

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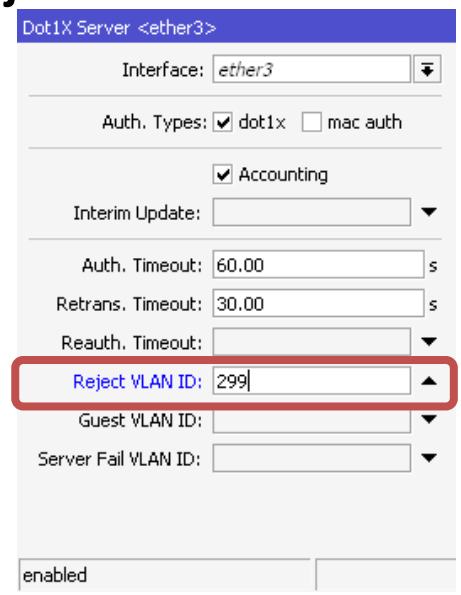
Dot1x Authenticator – Reject VLAN

- Reject-vlan-id is configured when dot1x authenticator receives an access-reject from radius
- Normally an incorrect username/password
- Clients will be show as authenticated and placed into reject-vlan
- Only applies when bridge VLAN-Filtering is enabled.



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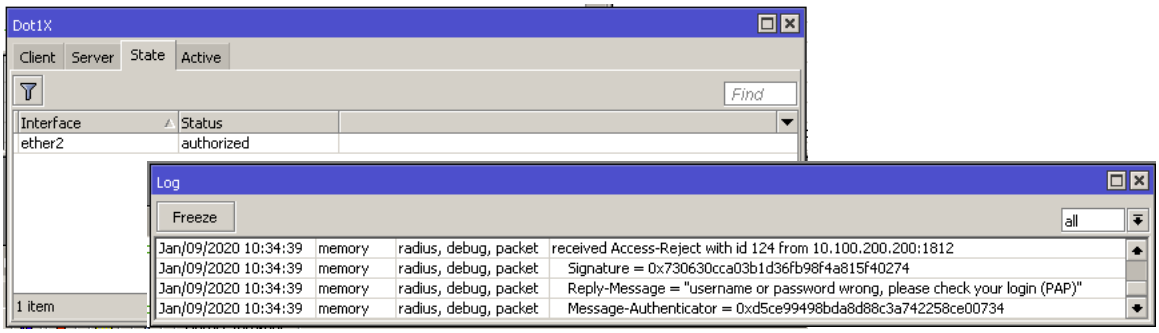
Dot1x Authenticator – Reject VLAN

- Server will show port as authorised
- Can be used with mac-auth to create a guest VLAN
- Logs will show any incorrect username / password attempts



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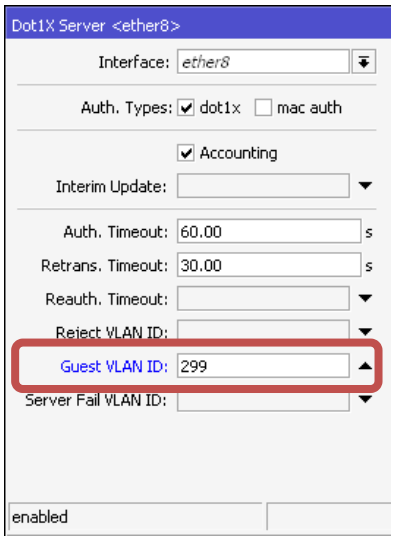
Dot1x Authenticator – Guest VLAN



- VLAN assigned when client devices does not support 802.1x authentication and no mac-auth fall back has been configured
- VLAN is assigned after 3 retrains-timeout periods.
- Only applies when bridge VLAN-Filtering is enabled.

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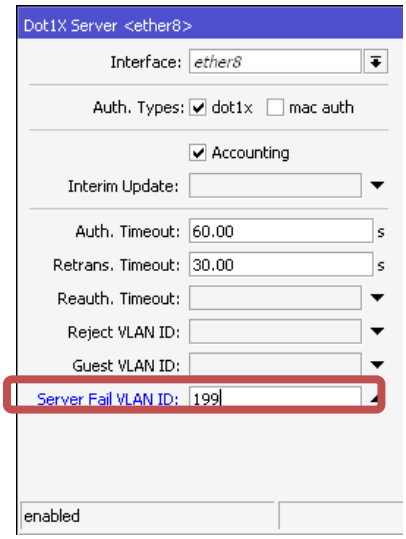
Dot1x Authenticator – Server Fail VLAN

- VLAN assigned when RADIUS server does not respond and request timeout as elapsed.
- Only applies when bridge VLAN-Filtering is enabled.



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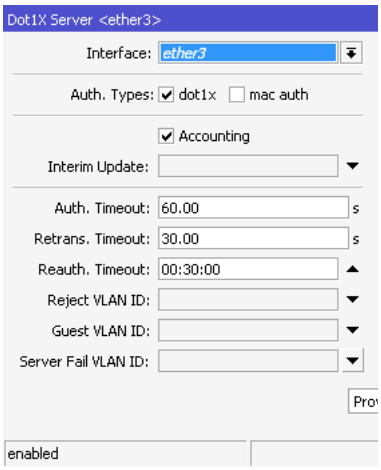
Dot1x Authenticator – Reauth



- The Authenticator can force a client to reauth at a set time intervale to ensure any changes to the user's parameters on the radius server are applied.

Port based VLAN assignmernt

Dot1x VLAN assignment

- Dot1x can assign an authenticated interface to a specific VLAN ID
- This requires bridge VLAN filtering to be enabled
- This is done using radius attributes of
  - Tunnel-Type=13
  - Tunnel-Medium-Type=6
  - Tunnel-Private-Group-ID= “VLANID”

Dynamic Switch Rules

Dot1x Authenticator Dynamic Switch Rules

- If additional access rules are required then switch rules can be assigned by the radius server.
- Dynamic switch rules can be added using the MikroTik Switching-Filter Radius attribute
- These rules are only active as long as the client session is active and the interface is running.

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Dot1x Authenticator Dynamic Switch Rules

- Each rule needs to end with an action of either drop or allow. If no action is set then default action of allow will be used.
- Multiple rules must be separated by a comma.
- Chain has default action of allow so may need a final rule of action drop at the end.

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Dot1x Authenticator Dynamic Switch Rules

- Following Parameters are supported
  - Mac-protocol – Hex or decimal format eg Protocol 17 or Protocol 0x11
  - Src-mac-address – supports format "xx:xx:xx:xx:xx:xx" or "xxxxxxxxxxxx" also can be set as src-mac address none
  - Src-address & Dst-address – IPv4 address/mask
  - Protocol – IPv4
  - Src-port/dst-port – supports single or range values src-port 10 or src-port 10-20

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Dot1x Authenticator Dynamic Switch Rules

- src-mac-address (if not specified), switch and ports parameters are dynamically configured for each rule

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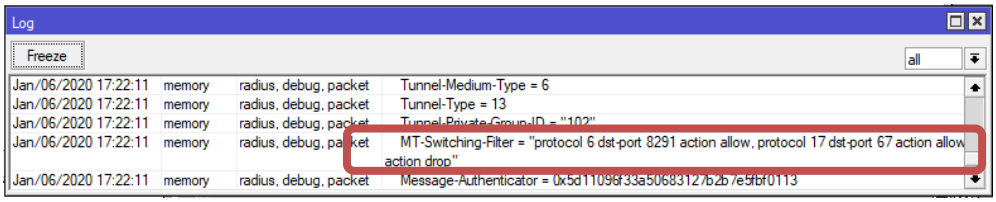
Dot1x Authenticator Dynamic Switch Rules

Example:

- Allow Winbox access (tcp port 8291) and DHCP (udp 67) and drop all other traffic

```
MikroTik-Switching-Filter = “protocol 6 dst-port 8291 action allow,
protocol 17 dst-port 67 action allow, action drop”
```



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EAP

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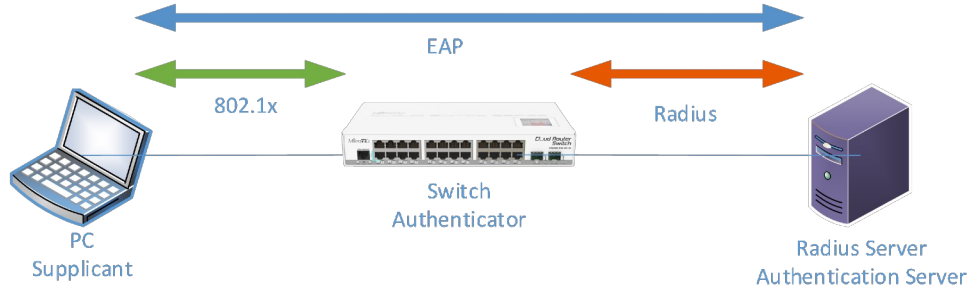
EAP

- Extensible Authentication Protocol (EAP) is used to pass authentication between the supplicant and the authentication server (Radius)
- The EAP type handles and defines the Authentication



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EAPoL

- Dot1x uses EAP encapsulation over LANs (EAPoL) for the communication between the Supplicant and the Authenticator Server
- EAPoL uses EtherType of 0x888e
- EAPoL uses a special destination multicast MAC address of 01:80:C2:00:00:03

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EAP

- The Authenticator takes the EAPoL frames relays them to the Authentication server (Radius)
- The Ethernet header is stripped and the remaining EAP frame is re-encapsulated in Radius Format.
- The Authenticator does not modify or examine the EAP frames

EAP Types

- RouterOS supports one or more of the following supplicant EAP Types:
  - EAP-TLS v1.0 – v1.2
  - EAP-TTLS
  - EAP-MSCHAPv2
  - PEAPv0/EAP-MSCHAPv2

EAP-TLS

- Transport Layer Security (TLS)
- Both sides require a Certificate.
- With a client side certificate a compromised password is not enough to break into EAP-TLS protected systems.
- This could require more work to deploy client certificates to systems

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EAP-TTLS

- Tunnelled Transport Layer Security
- Only the server needs a certificate
- The client verifies the server using the certificate on the server
- The server now uses this secure tunnel to authenticate the client

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EAP-MSCHAPv2

- Microsoft Challenge Handshake Authentication Protocol
- EAP version of common MSCHAPv2 authentication mechanism
- Most common authentication method used with Microsoft windows clients
- Commonly used as the inner authentication for PEAP

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PEAP/EAP-MSCHAPv2

- Protected Extensible Authentication Protocol (PEAP) uses a server side certificate.
- PEAP is an encapsulation, not a authentication method
- PEAP works in 2 phases
- Phase 1 – server-side authentication is performed and a encrypted tunnel (TLS) is created
- Phase 2 – the client is now authenticated using EAP-MSCHAPv2 inside the TLS Tunnel

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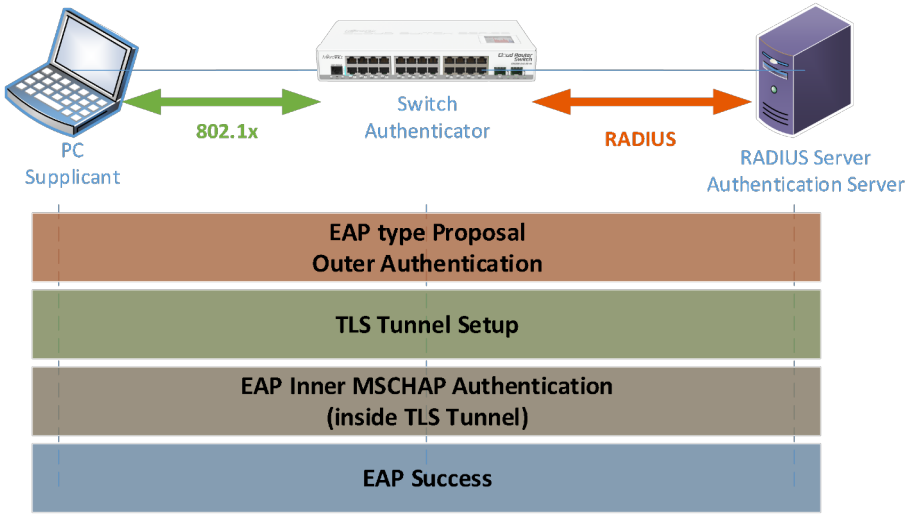
PEAP/EAP-MSCHAPv2 Flow



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Certitificates

- The use of Certificates is not covered in this presentation
- For more information on the use of certificates in RouterOS see https://help.mikrotik.com/docs/display/ROS/Certificates

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Dot1x Authentication Server

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Dot1x - Authentication Server

- The authentication server is the device that performs the actual authentication of the supplicant (client)
- The Authentication server validates the identity of the supplicant and notifies the Authenticator if the supplicant is allowed to use the LAN and any network parameters to be assigned.

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Dot1x - Authentication Server

- Dot1x requires Authentication server(s) which is the user database which is a Radius (Remote Authentication Dial In User Service) Server
- MikroTik User Manager can be an Authentication Server
- User manager requires an additional package to be installed

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Authenticator Server (Radius)

- Radius server does not need to be in the same LAN as the authenticator nor running on the authenticator
- As Radius communications are done in plain text if using radius over untrusted networks then consider using either an encrypted tunnel or using RadSec

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Dot1x Authentication Server

- Dot1x can assign an authenticated interface to a specific VLAN ID
- This requires bridge VLAN filtering to be enabled
- This is done using radius attributes of
  - Tunnel-Type=13
  - Tunnel-Medium-Type=6
  - Tunnel-Private-Group-ID= “VLANID”

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Debugging
What to do when it doesn’t work!

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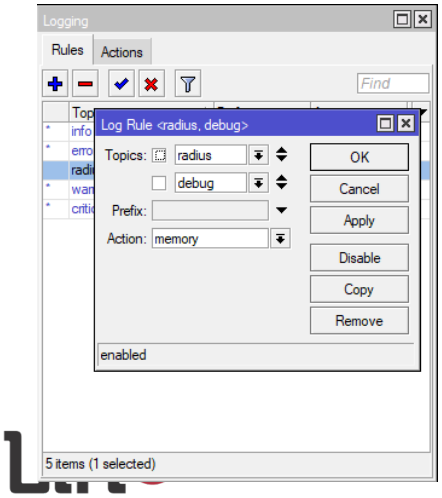
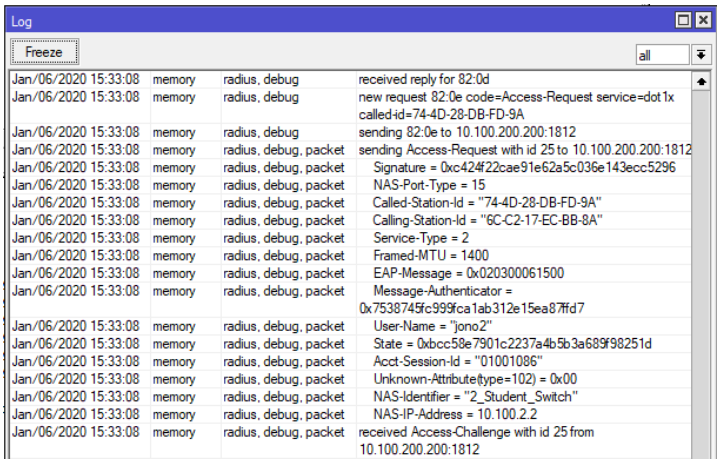
Dot1x Authenticator

- Enabling radius debug logs will enable you to see the radius messages being sent to check for any errors!





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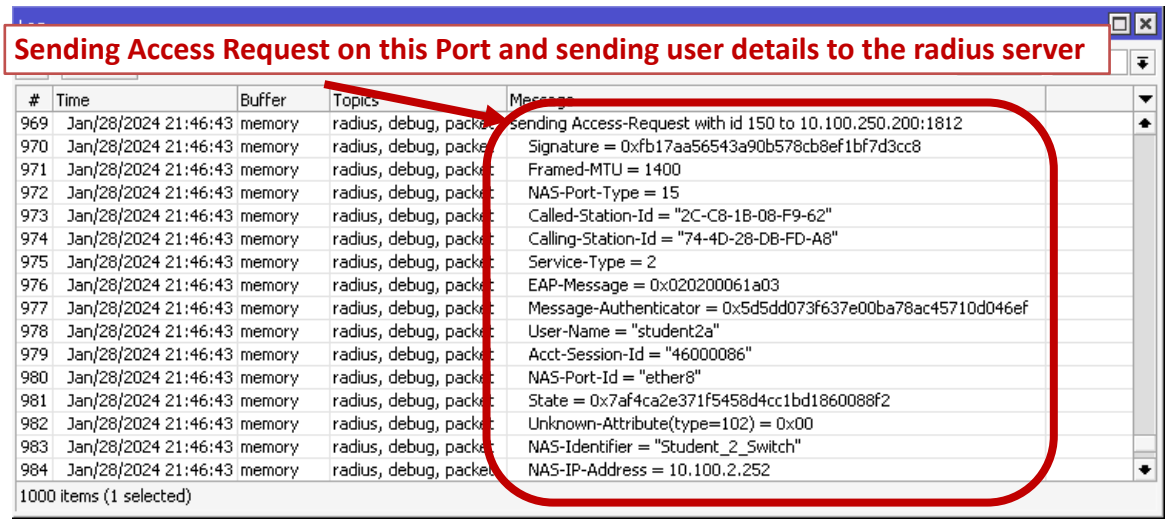
Dot1x Authenticator - Logs



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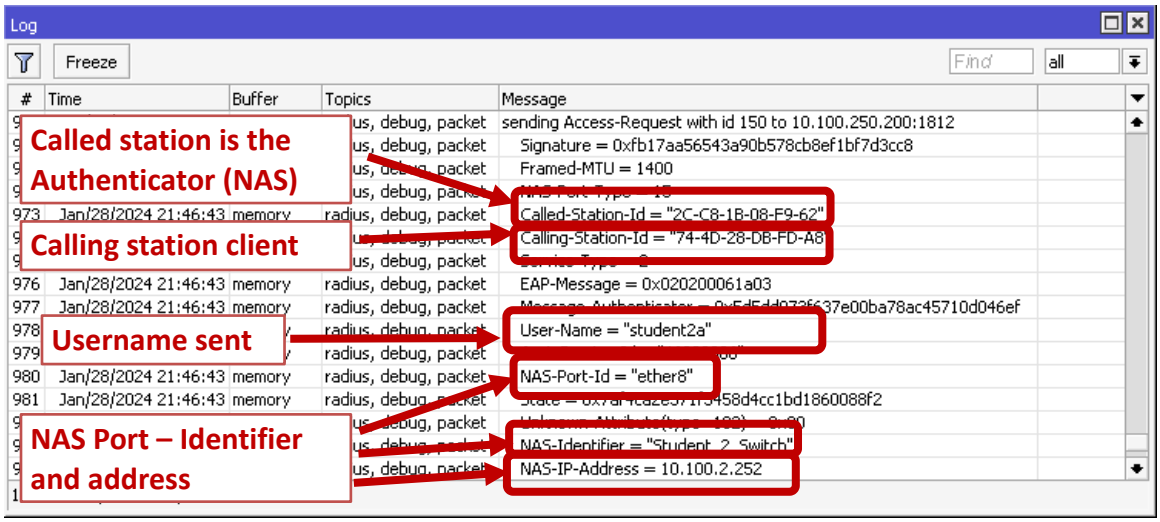
Dot1x Authenticator - Logs



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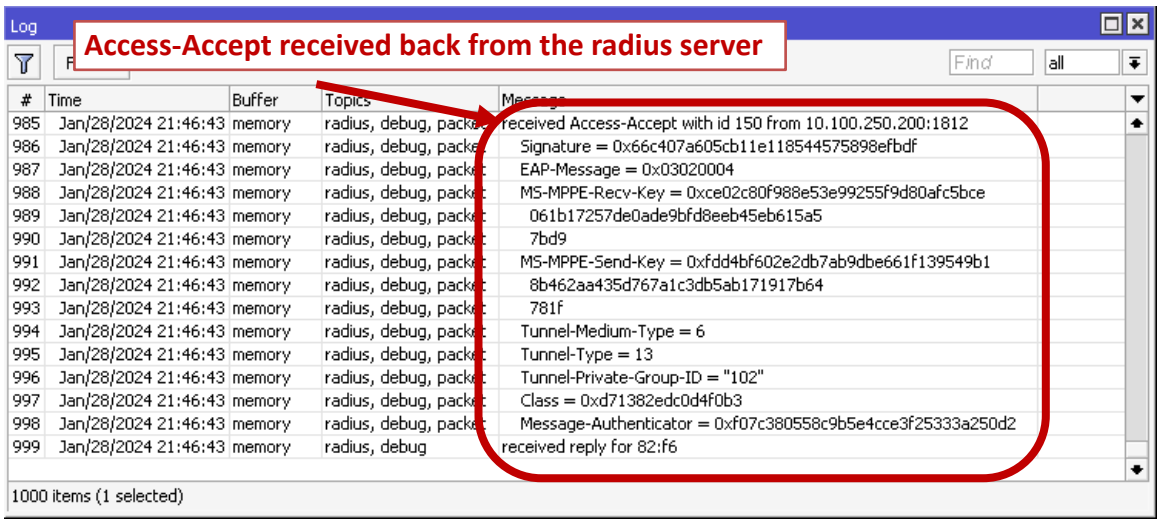
Dot1x Authenticator - Logs



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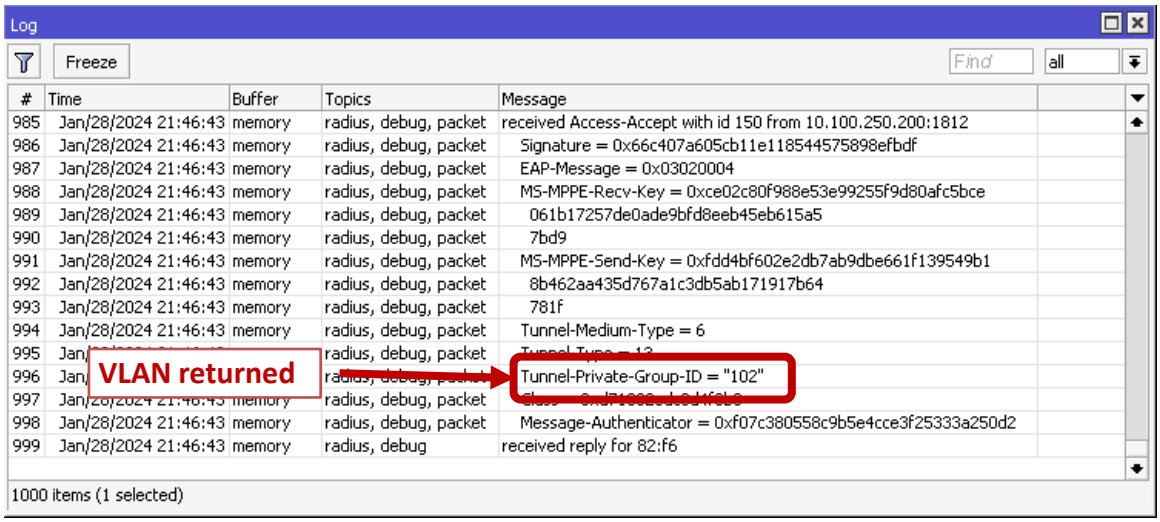
Dot1x Authenticator - Logs



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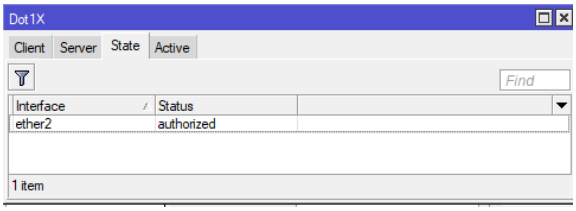
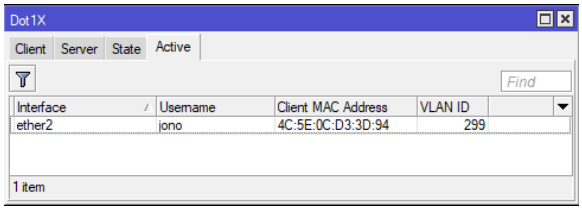
Dot1x Authenticator Status





Status

- **authorized** - access to interface is granted
- **iface-down** - interface is not running
- **rejected-holding** - access was rejected by the RADIUS server
- **un-authorized** - access to interface is not granted

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MikroTik dot1x Setup

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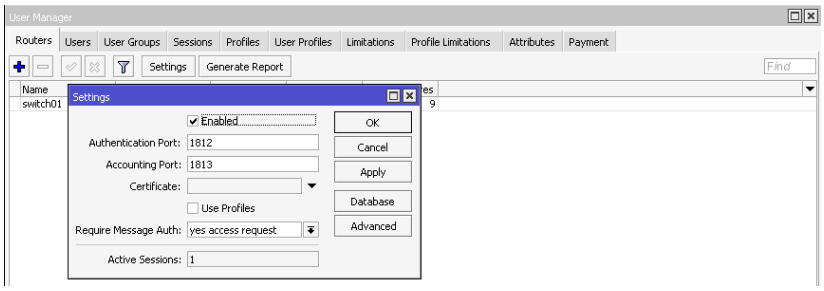
Setup

- Show configuration for Usermanager
- Show configuration for Authenticator
- Show configuration for RouterOS as a supplicant
- Show VLAN allocation
- Show Dynamic Switch rules

Setup - Topology

User manager Setup

1. Install User-manager additional package
2. Enable User-manager




```
/user-manager
set certificate=*0 enabled=yes
```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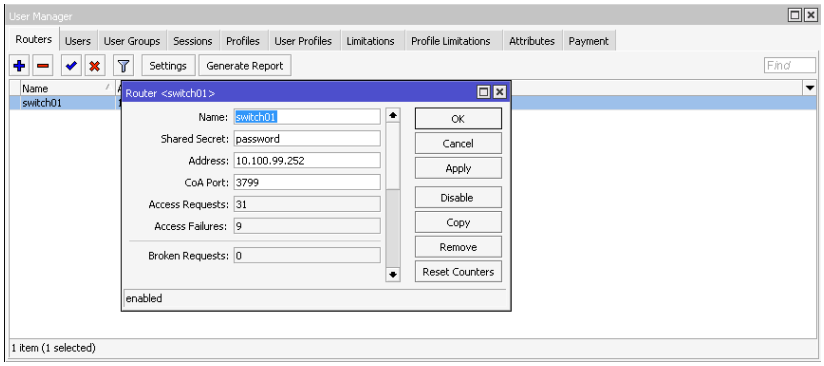
User manager Setup

3. Add a ‘router’ for the authenticator




```
/user-manager router
add address=10.100.99.252 name=switch01 shared-secret=password
```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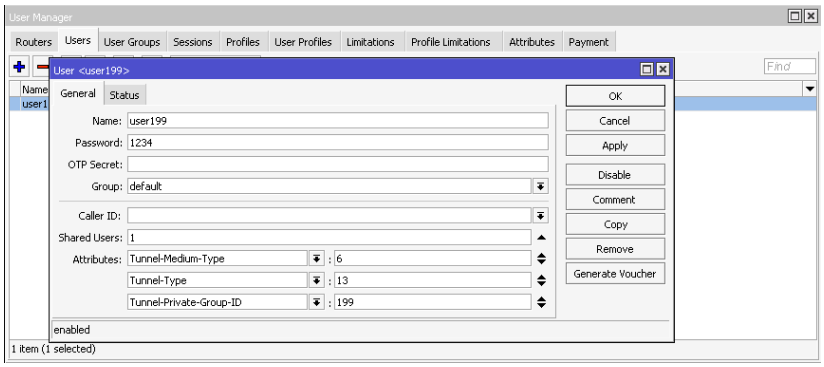
User manager – Create Users

4. Create users and set Radius Attributes




```
/user-manager user
add attributes=Tunnel-Medium-Type:6,Tunnel-Type:13,Tunnel-Private-Group-ID:199 name=user199
password=1234
```

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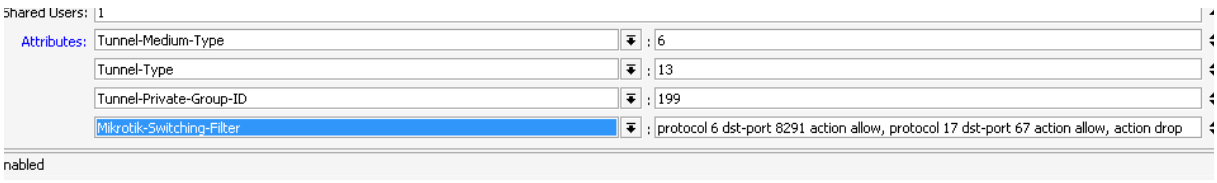
User manager – Create Users

- Create user with radius attributes for switch rule




```
/user-manager user
add attributes="Tunnel-Medium-Type:6,Tunnel-Type:13,Tunnel-Private-Group-ID:199,Mikrotik-Switching-
Filter:protocol 6 dst-port 8291 action allow, protocol 17 dst-port 67 action allow, action drop"
name=userACL password=1234
```

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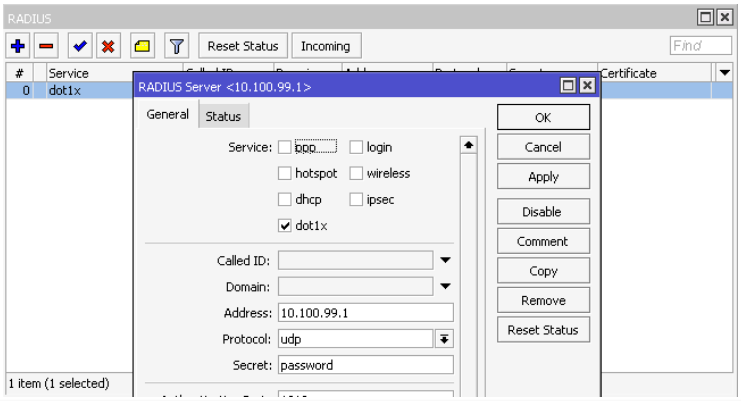
Authenticator – Radius Client

- Add a radius client to point to the Authenticator server




```
/radius
add address=10.100.99.1 service=dot1x src-address=10.100.99.252 timeout=3s
```

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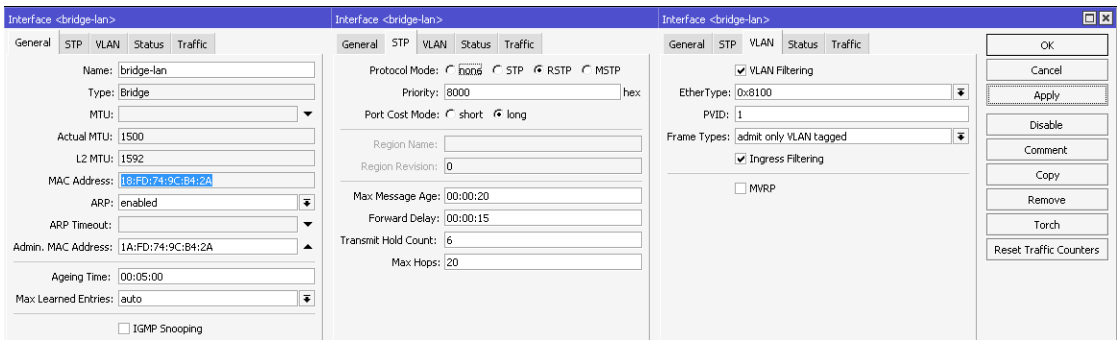
Authenticator – Bridge Configuration

- Create a bridge running RSTP and VLAN Filtering




```
/interface bridge add admin-mac=1A:FD:74:9C:B4:2A auto-mac=no frame-types=admit-only-vlan-tagged
protocol-mode=rstp name=bridge-lan vlan-filtering=yes
/interface vlan add interface=bridge-lan name=vlan199 vlan-id=199
/ip dhcp-client add interface=vlan199
```

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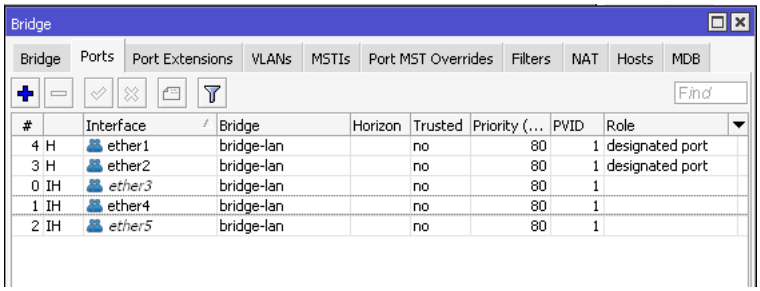
Authenticator – Bridge Configuration

- Add interfaces as bridge ports




```
/interface bridge port
add bridge=bridge-lan interface=ether1
add bridge=bridge-lan interface=ether2
add bridge=bridge-lan interface=ether3
add bridge=bridge-lan interface=ether4
add bridge=bridge-lan interface=ether5
```

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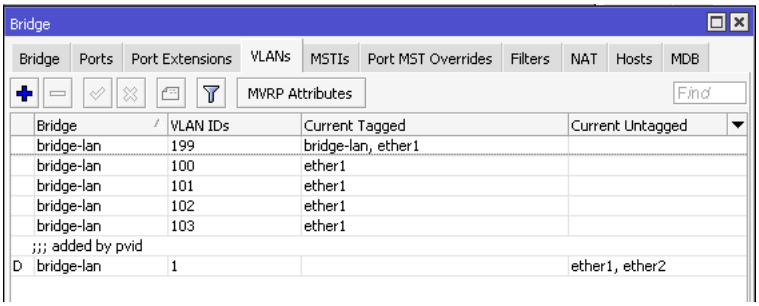
Authenticator – Bridge Configuration

- Add VLANs to bridge




```
/interface bridge vlan
add bridge=bridge-lan tagged=bridge-lan,ether1 vlan-ids=199
add bridge=bridge-lan tagged=ether1 vlan-ids=100
add bridge=bridge-lan tagged=ether1 vlan-ids=101
add bridge=bridge-lan tagged=ether1 vlan-ids=102
add bridge=bridge-lan tagged=ether1 vlan-ids=103
```

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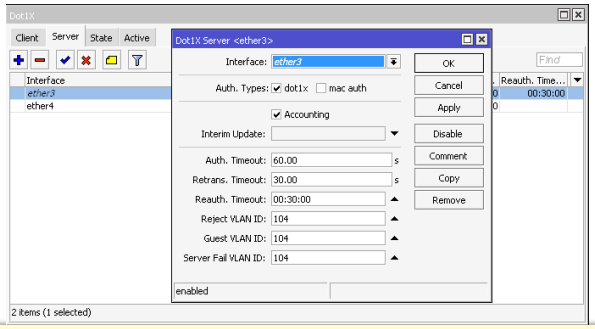
Authenticator – dot1x Server

- Set dot1x server to run on the required ports. Set any failback vlans as needed




```
/interface dot1x server
add guest-vlan-id=104 interface=ether2 reauth-timeout=30m reject-vlan-id=104 server-fail-vlan-id=104
add guest-vlan-id=104 interface=ether3 reauth-timeout=30m reject-vlan-id=104 server-fail-vlan-id=104
add guest-vlan-id=104 interface=ether4 reauth-timeout=30m reject-vlan-id=104 server-fail-vlan-id=104
add guest-vlan-id=104 interface=ether5 reauth-timeout=30m reject-vlan-id=104 server-fail-vlan-id=104
```

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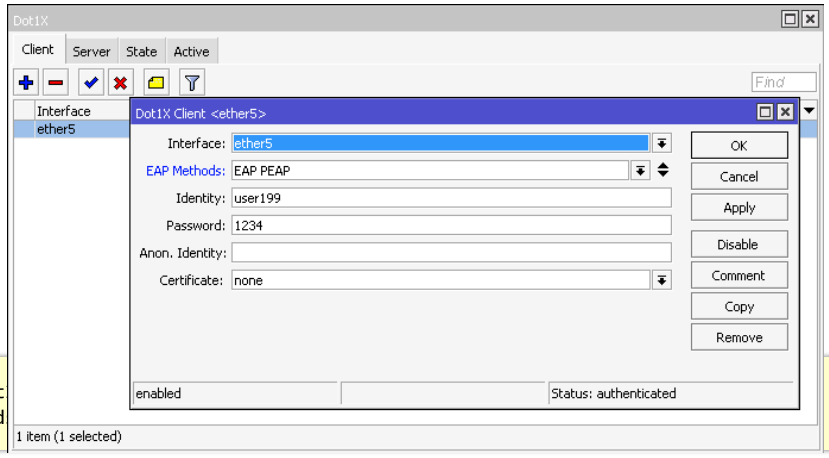
Supplicant (Client) – Dynamic VLAN




```
/interface dot
add eap-method
```

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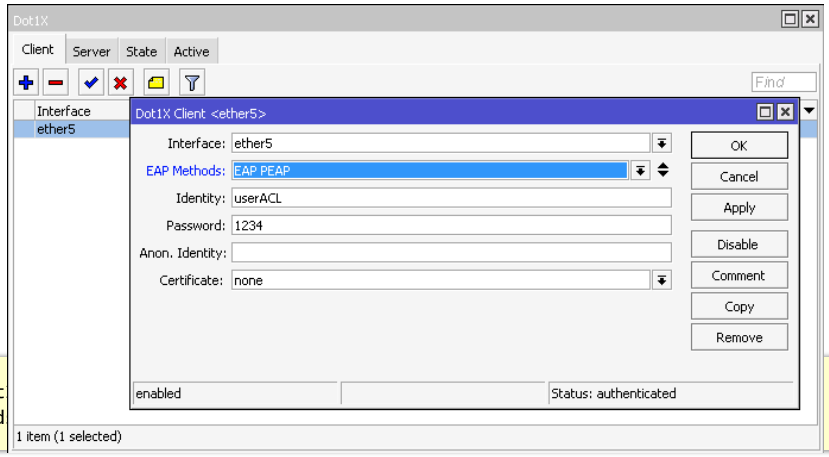
Supplicant (Client) – Dynamic ACL




```
/interface dot
add eap-method
```

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Results

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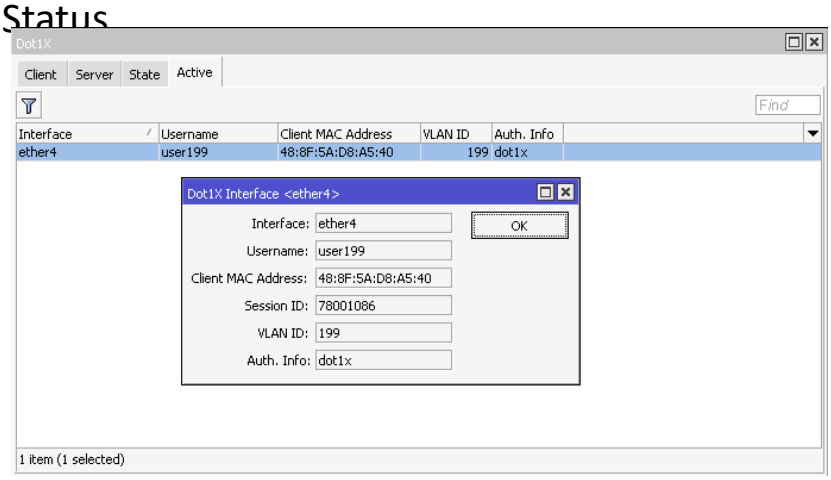
Supplicant (Client) – Dynamic VLAN

- Dot1x Status



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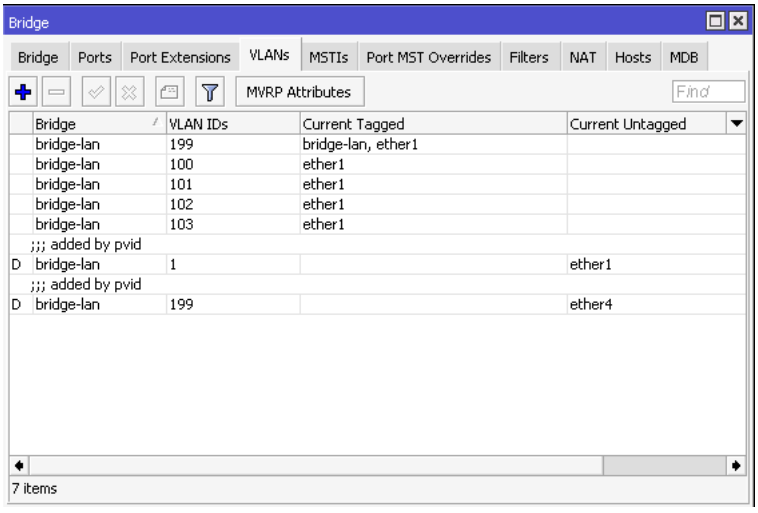
Supplicant (Client) – Dynamic VLAN

- Bridge VLAN



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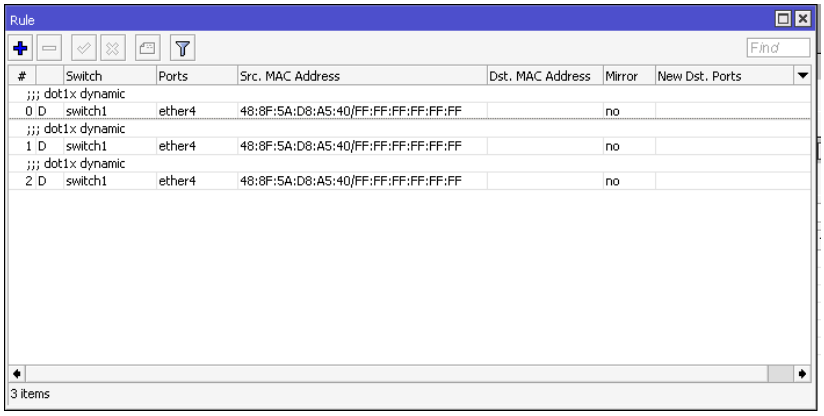
Supplicant (Client) – Dynamic Switch Rule

- Bridge VLAN



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Thank you for Listening

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References

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