Proposal for IEEE 802.1CQ-LAAP

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Background

- IEEE 802.1CQ aims at defining mechanisms for mac address distribution and automatic configuration in the SAI space
- Two mechanisms to be defined:
  - MAC address self-assignment (Claimed)
  - Server/Proxy based assignment
    - This will require of synchronization mechanism between Server and Proxies
- **The aim of this contribution is to propose a general mechanism for address assignment, based on IPv6 SLAAC and DHCP**
  - Detailed in the contribution, messages and rules for sending them

Self-assignment of MAC addresses

- Node self-assigns a MAC address
  - From previously defined space:
    - Good: Easy to configure
    - Bad: Cannot follow a given MAC address assignment in the network, e.g., follow semantics in the network
  - From pool advertised by the network
    - Good: Can follow the structure of MAC addresses defined by the network
    - Bad: Needs of extra messages to carry on this advertisement

Claiming Address Space TLV

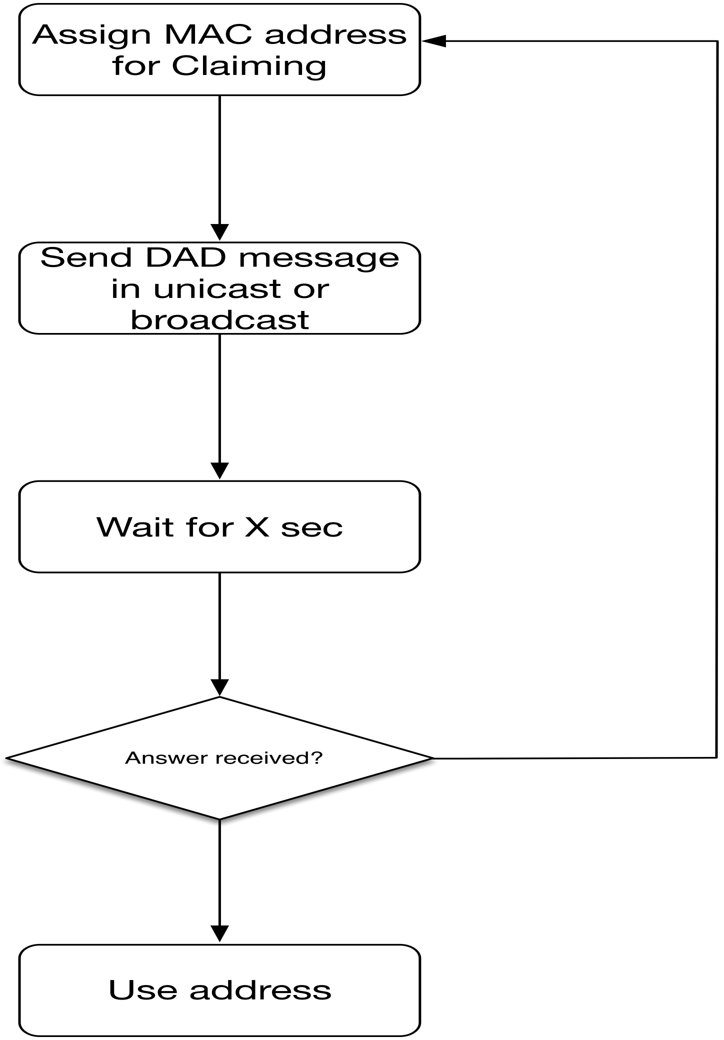
- Aim: Advertise pool of addresses a station can use for self-assignment

TLV Type (7 bits)	TLV Information String Length (9 bits)	Claiming Allowed (1 bit)	Number of Prefixes provided (1 Octet)	Length MAC address (1 bit)	Prefix (variable)	Prefix Length (1 Octet)	Padding (Variable)

- A prefix in this message means a MAC address and a number of bits that must remain constant of the MAC address provided, e.g., MAC/24
- Claiming Allowed bit indicates if claiming is allowed in the network
- Number of prefixes means number of the next 3 fields provided
- Length MAC address indicates if the address provided is 48 or 64 bits
- Prefix indicates MAC to be used as basis
- Prefix length indicates number of bits that must remain fixed in the claimed address

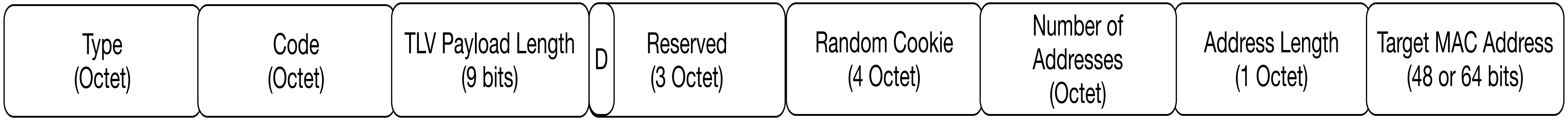
Self-assignment: Duplicate Address Detection

- Procedure similar to IPv6 DAD, send a probe, wait for answer
- What is the destination address to use?:
  - **Use of broadcast address (ff:ff:ff:ff:ff:ff).**
    - Flood
  - **Unicast to the MAC address claimed.**
    - Flood if address does not exist
  - **Use of a multicast group**, such as the one used for the solicited multicast in IPv6. When a station self-assigns a MAC address, then it joins a multicast group such as the 33:33:xx:xx:xx:xx, where the last 4 bytes correspond to the last 4 bytes of the self-assigned MAC address. This might lead to spanning tree problems if the address is duplicated
- In all cases the source MAC address will be set to the claimed unicast address or to the broadcast address (as recommended by IEEE RA for NULL addresses).


Assign MAC address for Claiming
Send DAD message in unicast or broadcast
Wait for X sec
Answer received?
Use address

Self-assignment: Possible DAD message

- Different possibilities for encapsulation
  - LLDP
  - LLC/SNAP



Type (Octet)

Code (Octet)

TLV Payload Length (9 bits)

D

Reserved (3 Octet)

Random Cookie (4 Octet)

Number of Addresses (Octet)

Address Length (1 Octet)

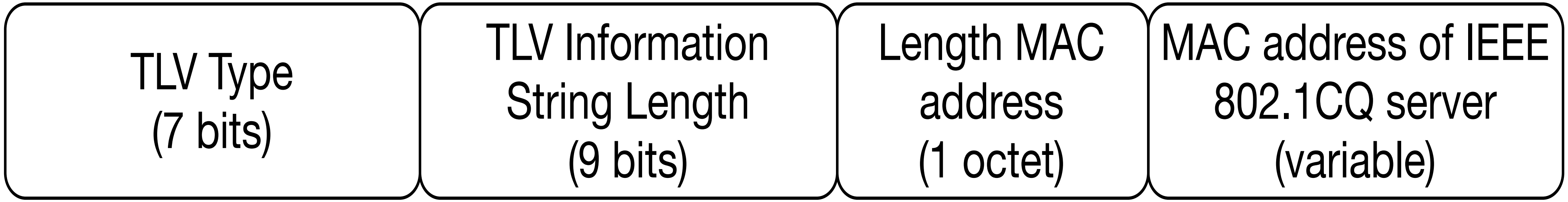
Target MAC Address (48 or 64 bits)

  - DAD procedure is based on the sending of the DAD request, with the D bit set to 0 and wait for some time (to be defined) until a DAD request, with D bit set to 1, is received or the timer expires.

  - In case multiple addresses are claimed, the station may choose between using 1 message per address sent in unicast or a bulk message sent to broadcast. Unicast answers are expected for each duplicated MAC address detected.

Server based assignment

- In order to request a pull of MAC addresses the station requires to know the address of the Server/Proxy to request the addresses
- An advertisement message is required:



TLV Type (7 bits)

TLV Information String Length (9 bits)

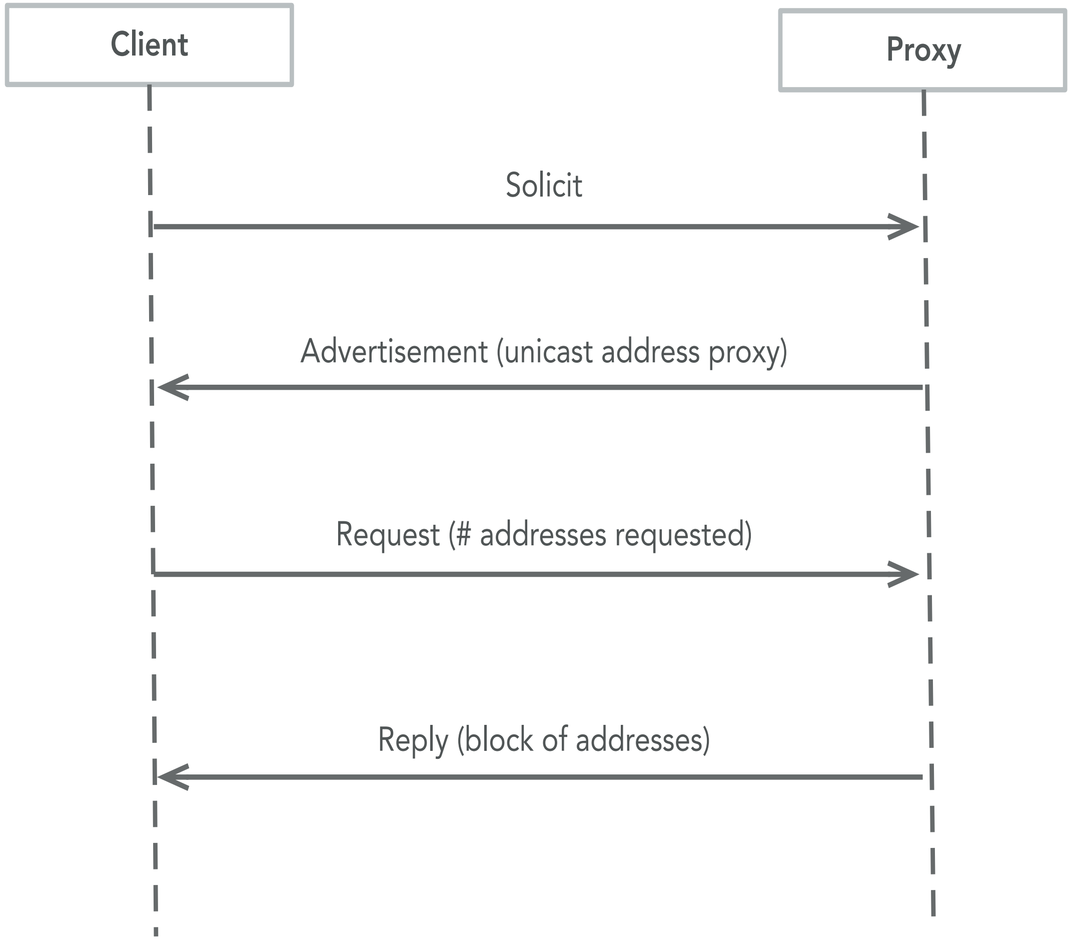
Length MAC address (1 octet)

MAC address of IEEE 802.1CQ server (variable)

- Encapsulation can be done through LLDP or SNAP/LLC

Server based assignment: Procedure

- Once the LAAP Server/Proxy has been identified the procedure shown is followed:
  - Solicit: A client sends a Solicit message to locate servers.
  - Advertise: A server sends an Advertise message to indicate that it is available for LAAP service, in response to a Solicit message received from a client.
  - Request: A client sends a Request message to request MAC address assignment.
  - Confirm: A client sends a Confirm message to any available server to determine whether the addresses it was assigned are still appropriate to the link to which the client is connected.
- We should follow DHCP guidelines, that are proven and well tested


Client
Proxy
Solicit
Advertisement (unicast address proxy)
Request (# addresses requested)
Reply (block of addresses)

Server based assignment: Procedure

- We should think on adding the following functionality to the LAAP server
  - Renew: A client sends a Renew message to the server that originally provided the client's addresses and configuration parameters to extend the lifetimes on the addresses assigned to the client.
  - Rebind: A client sends a Rebind message to any available server to extend the lifetimes on the addresses assigned to the client; this message is sent after a client receives no response to a Renew message.
  - Reply: A server sends a Reply message containing assigned addresses and configuration parameters in response to a Solicit, Request, Renew, Rebind message received from a client. A server sends a Reply message in response to a Confirm message confirming or denying that the addresses assigned to the client are appropriate to the link to which the client is connected. A server sends a Reply message to acknowledge receipt of a Release or Decline message.
  - Release: A client sends a Release message to the server that assigned addresses to the client to indicate that the client will no longer use one or more of the assigned addresses.
  - Decline: A client sends a Decline message to a server to indicate that the client has determined that one or more addresses assigned by the server are already in use on the link to which the client is connected.
  - Reconfigure: A server sends a Reconfigure message to a client to inform the client that the server has new or updated configuration parameters, and that the client is to initiate a Renew/Reply transaction with the server in order to receive the updated information.

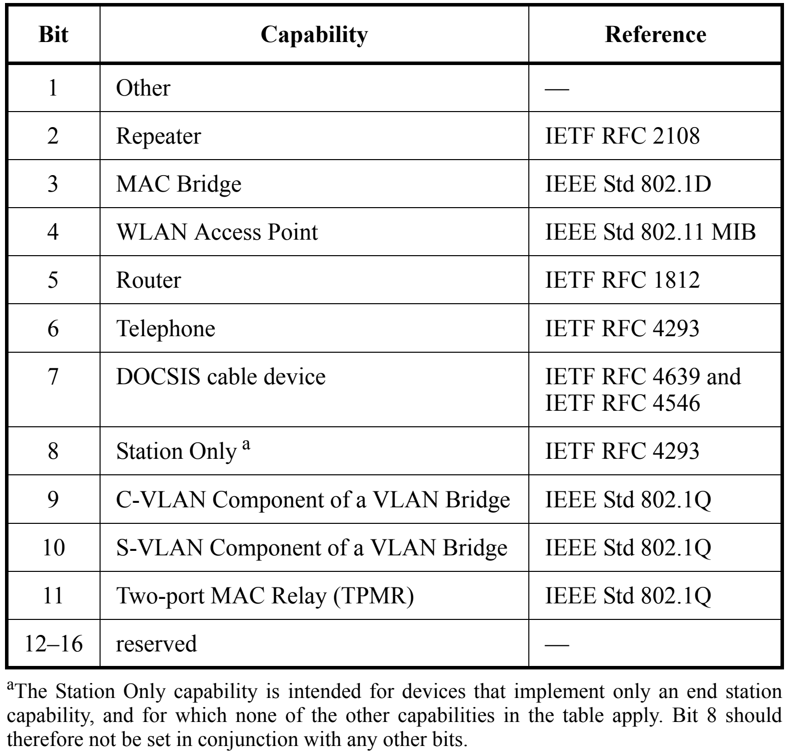
Server based assignment: Addressing

- For all messages exchanged with the Server, the following rules should apply:
  - Destination address must be chosen between the one received in a Server/Proxy LLDP TLV or a well known address defined in the standard. This well-known address can be, for example, the address 33:33:00:00:01:02, which corresponds to the multicast MAC address mapping of the IPv6 address ff02::1:2 (all DHCPv6 agents). In this way, a LAAP server can be collocated with a DHCPv6 server.
  - Source Address: The station must use a randomised address following the policy as defined with the Claiming Address Space TLV.
- Messages can be encapsulated following:
  - Extend LLDP TLVs to provide the functionality. This has the drawback that standard LLDP is not forwarded by bridges, hence we will need to use any of the extensions defined that support this.
  - Definition of new LLC/SNAP protocol.
  - Use of Edge Control Protocol (ECP), as defined in IEEE 802.1Q.

Advertisement of IEEE 802.1CQ use in the network

- The network should advertise it is using LAAP
- This can be done extending LLDP System Capabilities TLV (802.1AB)

12	IEEE 802.1CQ enabled network	IEEE 802.1CQ



Bit	Capability	Reference
1	Other	—
2	Repeater	IETF RFC 2108
3	MAC Bridge	IEEE Std 802.1D
4	WLAN Access Point	IEEE Std 802.11 MIB
5	Router	IETF RFC 1812
6	Telephone	IETF RFC 4293
7	DOCSIS cable device	IETF RFC 4639 and IETF RFC 4546
8	Station Only [a]	IETF RFC 4293
9	C-VLAN Component of a VLAN Bridge	IEEE Std 802.1Q
10	S-VLAN Component of a VLAN Bridge	IEEE Std 802.1Q
11	Two-port MAC Relay (TPMR)	IEEE Std 802.1Q
12–16	reserved	—

[a] The Station Only capability is intended for devices that implement only an end station capability, and for which none of the other capabilities in the table apply. Bit 8 should therefore not be set in conjunction with any other bits.