Protocol for Assignment of Local and Multicast Addresses (PALMA)

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IEEE 802.1CQ Scope

- As defined in the PAR:

“This standard specifies protocols, procedures, and management objects for locally-unique assignment of 48-bit and 64-bit addresses to ports in IEEE 802 networks”

Actually, we are working on mechanisms for the distribution of MAC addresses including stateful and stateless procedures, on a per-technology basis. This includes unicast and multicast MAC addresses.

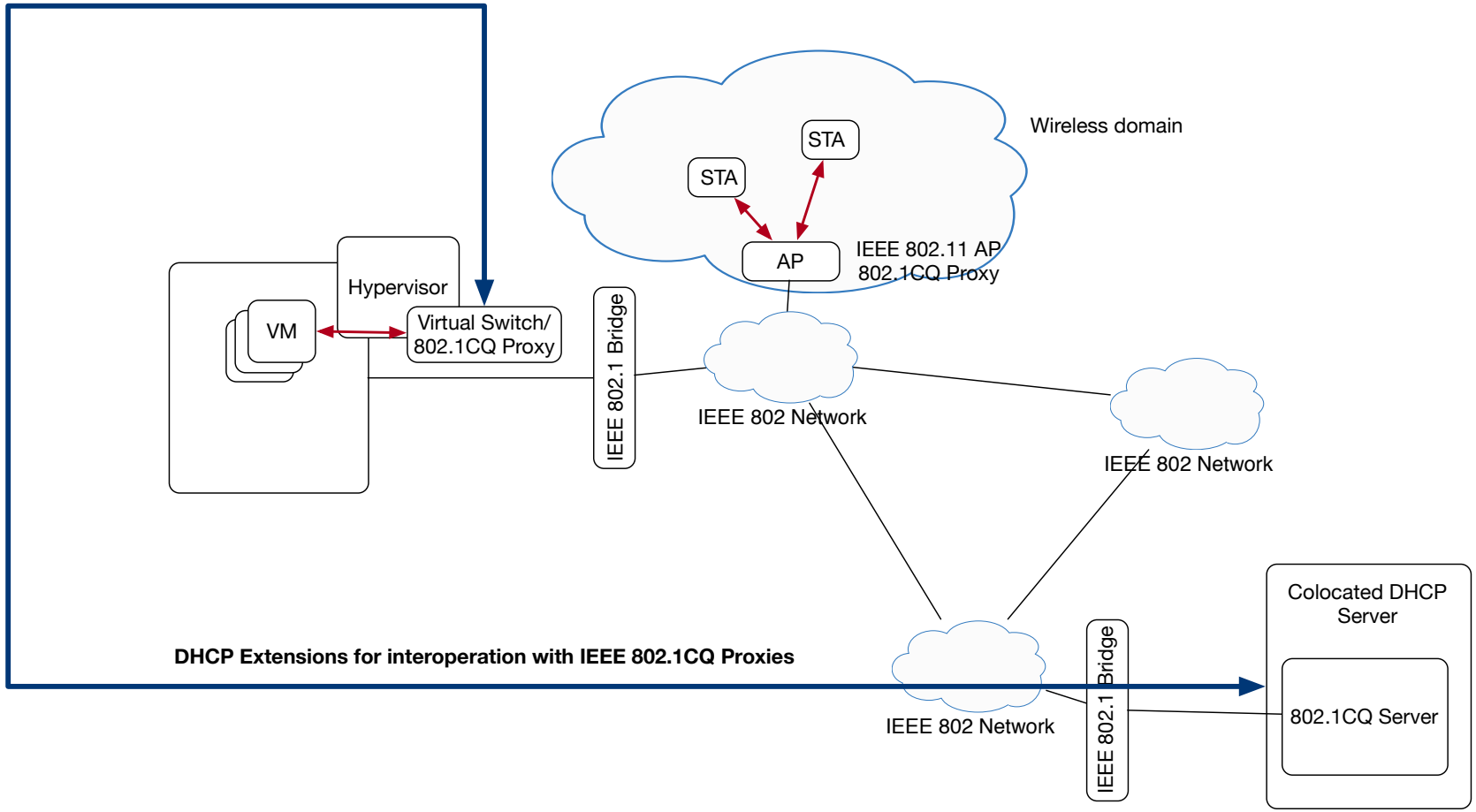
Requirements

- Use-case derived Requirements
  - Stateless/Stateful Assignment of addresses to End-stations
    - 802.11
    - 802.3
    - VMs/Containers
  - Stateless/Stateful Assignment of addresses to Bridges/APs acting as Proxies
    - Including Assignment of groups of addresses
- Non-functional initial requirements
  - The protocol shall ensure uniqueness of assigned MAC addresses in the scope of its operation.
  - The protocol shall ensure the re-assignment of the same MAC addresses during the live time of a session, when re-assignments are taking place. A session is defined as the period of actual or perceived constant connectivity to a network.
  - The protocol shall support the assignment of MAC addresses, which are persistently assigned to single stations.
  - The protocol shall support a preceding authentication procedure.
  - The protocol shall support the derivation of the to be assigned MAC address from the preceding authentication procedure.

Use cases

- We are considering specifically the following scenarios:
  - Virtualization scenario
    - Hypervisor working as a Proxy, provides assignment of local MAC addresses to the hosted virtual machines/containers
  - WLAN scenario
    - Use of proposed protocol for the assignment of MAC addresses prior to association
  - End-user terminals
    - Standard IEEE 802.3 compliant terminals obtaining Local MAC address upon attachment to the network

Network Model



MAC Address Acquisition Protocol (MAAP)

- Defined in IEEE 1722: IEEE Standard for a Transport Protocol for Time-Sensitive Applications in Bridged Local Area Networks
- It is defined to self-claim multicast addresses
- Protocol based on claiming, probe and defend messages
- Acquisition of addresses:
  - Select an address range from the MAAP dynamic allocation pool.
  - Send a series of MAAP_PROBE protocol data units (PDUs) to determine whether the address range is already in use.
  - Listen for MAAP_DEFEND PDUs indicating the address range is in use.
  - Repeat the above steps until an unused address range has been found.

MAC Address Acquisition Protocol (MAAP)

- It assumes the client to have a unicast MAC address
- Protocol defined as a subtype of IEEE 1722 Ethertype
- Similar to IEEE 802.1CQ mandate, but for multicast only and self-claiming:
  - A block of multicast MAC addresses (not in the local space) has been reserved for the use of AVTP.
  - The MAAP specifies a mechanism to allocate multicast MAC addresses dynamically in a specified address range.
  - Any application that uses addresses from the MAAP dynamic allocation pool shall implement the MAAP and MAAP shall be used to allocate these addresses.

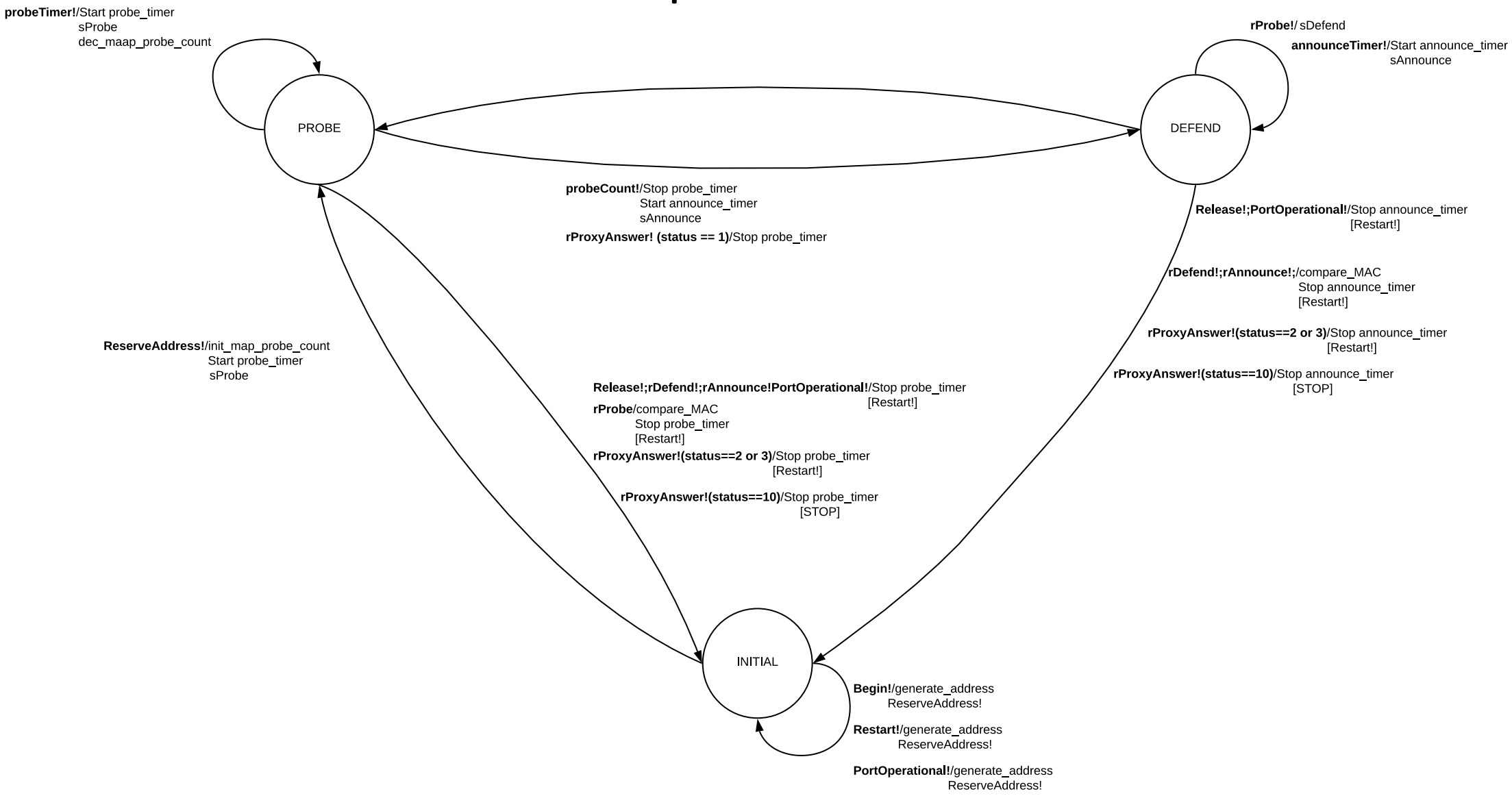
Current IEEE 802.1CQ Proposal

- Protocol for Assignment of Local and Multicast Addresses (PALMA)
- PALMA has two variants:
  - PALMA-C: Self-Assignment Protocol.
    - PALMA-C is largely based on IEEE 1722 MAAP protocol
  - PALMA-S: server-based Assignment Protocol

PALMA-C Operation

- Following the IEEE 1722 concept, PALMA-C is based on a PROBE, ANNOUNCE and DEFEND message exchange.
  - After choosing one MAC address, the station will send multiple PROBE messages to advertise the new address allocation
  - If no response is received, the station will go into ANNOUNCE and DEFEND mode, where it advertises its MAC address allocations periodically.
  - In case a PROBE containing an allocation colliding with any of the owned allocations, the station will answer with DEFEND messages.
  - In specific cases, a Proxy in the network can maintain a record of addresses in use and respond to PROBE messages directly.

PALMA-C Protocol Operation



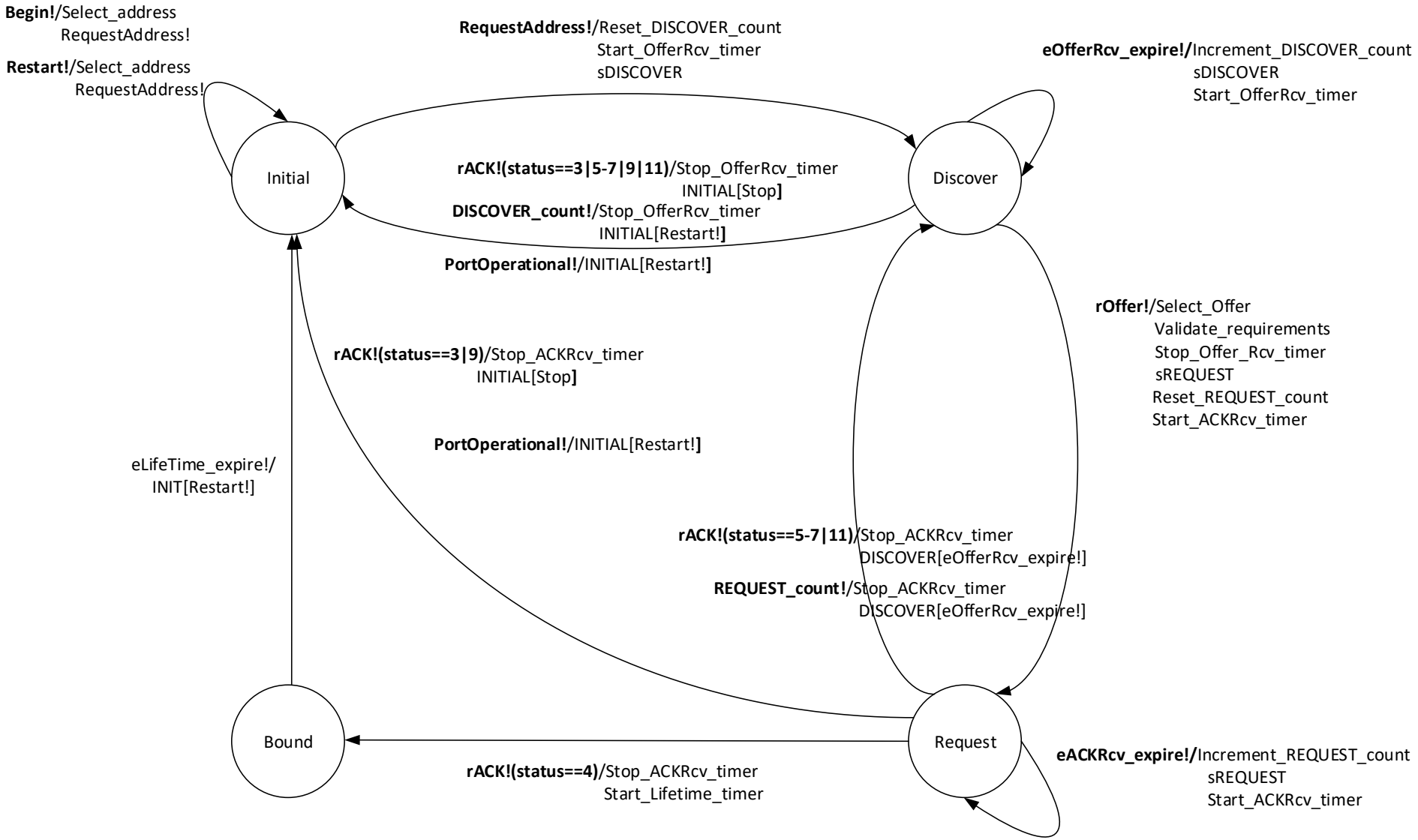
PALMA-C Message Addressing

- PALMA-C makes use of the following rules for addressing:
  - Source MAC address for PALMA_PROBE messages will be chosen randomly from a range specified in IEEE 802.1CQ.
  - Source MAC address for PALMA_DEFEND and PALMA_ANNOUNCE messages will use the MAC Address previously assigned or the EUI-64/48 assigned to the station.
  - Destination MAC address for PALMA_PROBE messages corresponds to the multicast address specified in IEEE 802.1CQ.
  - Destination MAC address for PALMA_DEFEND and PALMA_ANNOUNCE messages correspond to the source MAC address of the PALMA_PROBE message.

PALMA-S Operation

- PALMA-S is used for assign unicast and multicast addresses with clients discovering and requested addresses from a PALMA server(s) or proxy in the network.
- It follows a 4 messages exchange, with DISCOVER, OFFER, REQUEST and ACK messages
- The state machine is based on 4 states: INITIAL, DISCOVER, REQUEST and BOUND

PALMA-S Operation



PALMA-S Addressing

- PALMA-S makes use of the following rules for addressing:
  - Source MAC address for PALMA_DISCOVER messages will be chosen randomly from the range defined in IEEE 802.1CQ.
  - Source MAC address for PALMA_REQUEST messages will use the MAC Address previously assigned or the EUI-64/48 assigned to the station.
  - Destination MAC address for PALMA_DISCOVER messages corresponds to the multicast address specified in IEEE 802.1CQ.
  - Destination MAC address for PALMA_OFFER and PALMA_ACK messages correspond to the source MAC address of the PALMA_DISCOVER message.

Address ranges to be defined in IEEE 802.1CQ

- For the operation of PALMA we need the following reserved addresses:
  - Multicast address for self-claiming and managed operation (may be the same?)
  - Range of addresses to select the source of messages (can be randomly chosen from a range)

Message formats

- Both PALMA variants share the same message format, under a new Ethertype (or subtype).

0							7	8		10	11				15	16														31
subtype								ver			message_type					control_word														
Cookie																Status													
																length													

PALMA Subtype	
PALMA-C	TBD
PALMA-S	TBD

Message formats

Value	Function	Description
0	---	Reserved
1	PALMA_PROBE	Probe MAC address(es)
2	PALMA_DEFEND	Defend MAC address(es)
3	PALMA_ANNOUNCE	Announce MAC address(es)
4	PALMA_PROXY_ANSWER	Answer from proxy regarding Probe messages
5	PALMA_DISCOVER	Request for a MAC address to a Server
6	PALMA_OFFER	MAC allocation offer from the server
7	PALMA_REQUEST	Confirmation of the addresses to be allocated
8	PALMA_ACK	Confirmation of allocation from server to station or error reporting
8-1024	--	Reserved

Message types

Bit	Name	Description
0	AAI	Bit set to 1: Address in the AAI space requested/provided
1	ELI	Bit set to 1: Address in the ELI space requested/provided
2	SAI	Bit set to 1: Address in the SAI space requested/provided
3	Reserved	Reserved for future use
4	64/48 bits	Bit set to 1: 64 bits address requested/provided Bit set to 0: 48 bits address requested/provided
5	Multicast/Unicast	Bit set to 1: Multicast address requested/provided Bit set to 0: Unicast address requested/provided
6	Infrastructure/Station	Bit set to 1: Message source is Server/Proxy Bit set to 0: Message source is an end-node
7	MAC Provided	Bit set to 1: MAC address is provided Bit set to 0: MAC address is not provided This bit is used by a station providing an already used MAC address as hint to a Server.
8	Station ID provided	Bit set to 1: Station ID is provided Bit set to 0: Station ID is not provided
9	Network ID provided	Bit set to 1: Network ID is provided Bit set to 0: Network ID is not provided
10	Code field provided	Bit set to 1: The message contains a code field Bit set to 0: The message does not contain a code field
8	Specific address type	Bit set to 1: Specific address type information is provided Bit set to 0: Specific address type information is not provided
12-15	Reserved	Reserved for future use

Control Word

Message formats

Value	Description
0	Field not used
1	MAC Range not in use
2	MAC Range in use
3	Re-generate addresses in the given prefix and use PALMA-C
4	ACK – Assignment accepted
5	Failure – Assignment cannot be completed
6	Failure – Requested quadrant not available
7	Failure – Requested range not available
8	Offer provided
9	Mandatory use of PALMA-C
10	Mandatory use of PALMA-S
11	Parameter problem
12	Offer Provided - Partial fulfillment
13-15	Reserved

Status codes

Type ID	Description
0	Station ID
1	48 bits MAC Address (Range)
2	64 bits MAC Address (Range)
3	Network ID
4	Specific MAC Range
5	48 bits MAC Range in Conflict
6	64 bits MAC Range in Conflict
7	MAC Address Count
8	Lifetime

Message Options