Semantic Address with P802.1CQ

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What is a Semantic Address

- A Semantic Address carries parsable content that extends device identification with additional functionality and information.
- Examples
  - FC ID
    - FC(Fiber Channel) uses FC ID for efficient forwarding
      - FC also has WWNN/WWPN(64bit) which is like global MAC address using as device identification
    - FC ID contains physical location as semantic content
      - 24bit : domain ID + area ID + port ID
      - FC ID is allocated by FLOGIN procedure: switch allocate FC ID to host when host connects to network

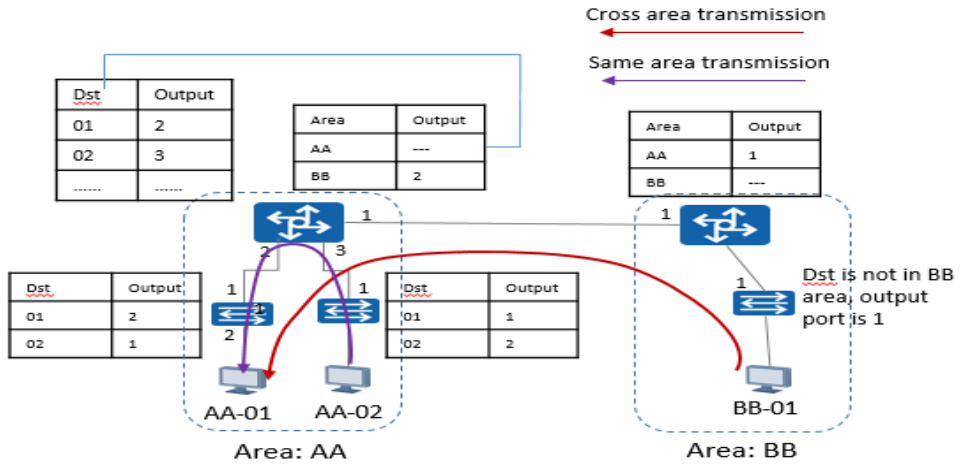
Upper 8 bit	Middle 8 bit	Lower 8 bit
Domain ID	Area ID	Port ID

  - IP address
    - Network layer uses IP address for efficient forwarding
    - IP address contains logical location as semantic content
      - 32bit (v4): network ID + host ID
      - IP address is usually allocated by DHCP server

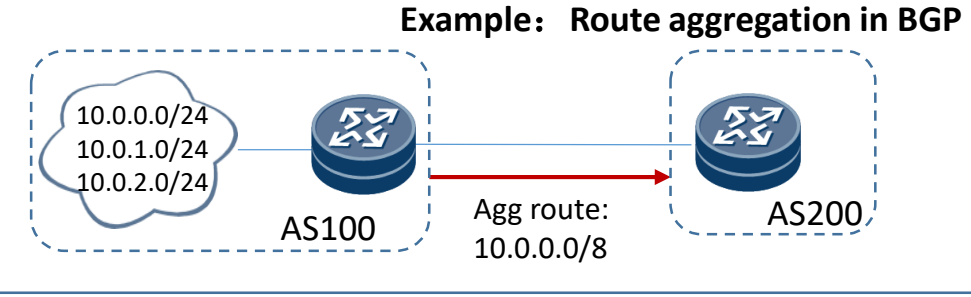
	8 bit	8 bit	8 bit	8 bit
Class A	Network ID	Host ID		
Class B	Network ID		Host ID	
Class C	Network ID			Host ID

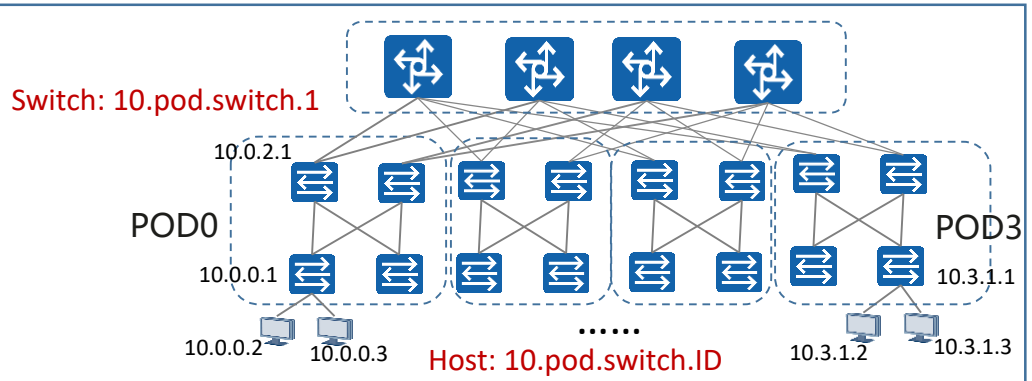
Semantic Address is Beneficial

- Semantic content in the address field has a number of benefits.
  - Improves forwarding performance
    - Reduced size of forwarding table(number of entries)
    - Reduced size of each entry
  - Improves routing protocol
    - Route aggregation to decrease router workload and save bandwidth
    - Load balance routing in regular topology
  - Helps diagnostics and access control
    - Easier to trace the misbehaving user



Example： Forwarding table





Example： Load balance routing in Fat-Tree topology

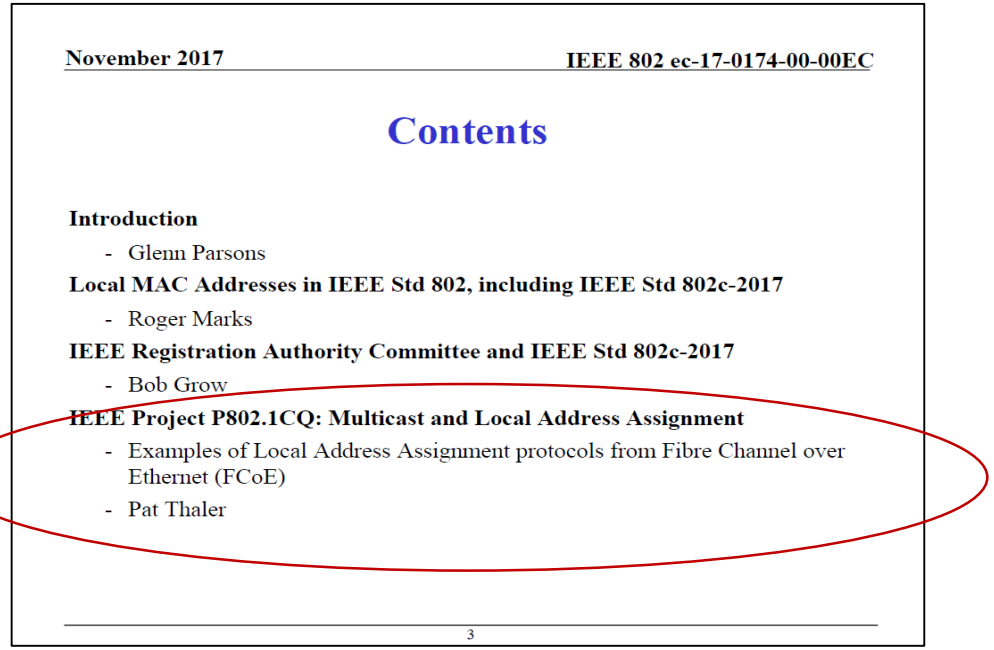
(Sigcomm 2008: A Scalable, Commodity Data Center Network Architecture)

P802.1CQ Recap

- .1CQ draft suggests semantic content for local MAC address
  - 4.2 Trend and use cases
    - *<<Editor's note: Dynamic, software-defined addresses, with structured, parsable semantic content; useful for improved routing; device authentication, etc.>>*
  - 8. SAI Addressing Structure
    - "In some cases, an SAI assignment protocol may assign the SAI so as to convey specific information. Such information may be interpreted by receivers and bridges that recognize the specific SAI assignment protocol, as identified by the subspace of the SAI. The functionality of receivers and bridges that do not recognize the protocol is not affected. SAI address formats, and their interpretation, are outside the scope of this standard but may be specified in other IEEE 802 standards."
  - 9. Bridge behavior
    - *<<This is related to the quote from IEEE 802c: "In some cases, an SAI assignment protocol may assign the SAI so as to convey specific information. Such information may be interpreted by receivers and bridges that recognize the specific SAI assignment protocol, as identified by the subspace of the SAI.">>*

P802.1CQ Recap

- The IEEE 802 tutorial mentions hierarchical address with semantic content as potential applicability
  - IEEE 802 tutorial “Local MAC Addresses in the Overview and Architecture based on IEEE Std 802c” was organized in Nov, 2017.
    - P802.1CQ introduction is part of it.
    - One possibility for people to consider is hierarchical address with position information for forwarding decision.



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Contents

Introduction
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Local MAC Addresses in IEEE Std 802, including IEEE Std 802c-2017
- Roger Marks

IEEE Registration Authority Committee and IEEE Std 802c-2017
- Bob Grow

IEEE Project P802.1CQ: Multicast and Local Address Assignment
- Examples of Local Address Assignment protocols from Fibre Channel over Ethernet (FCoE)
- Pat Thaler

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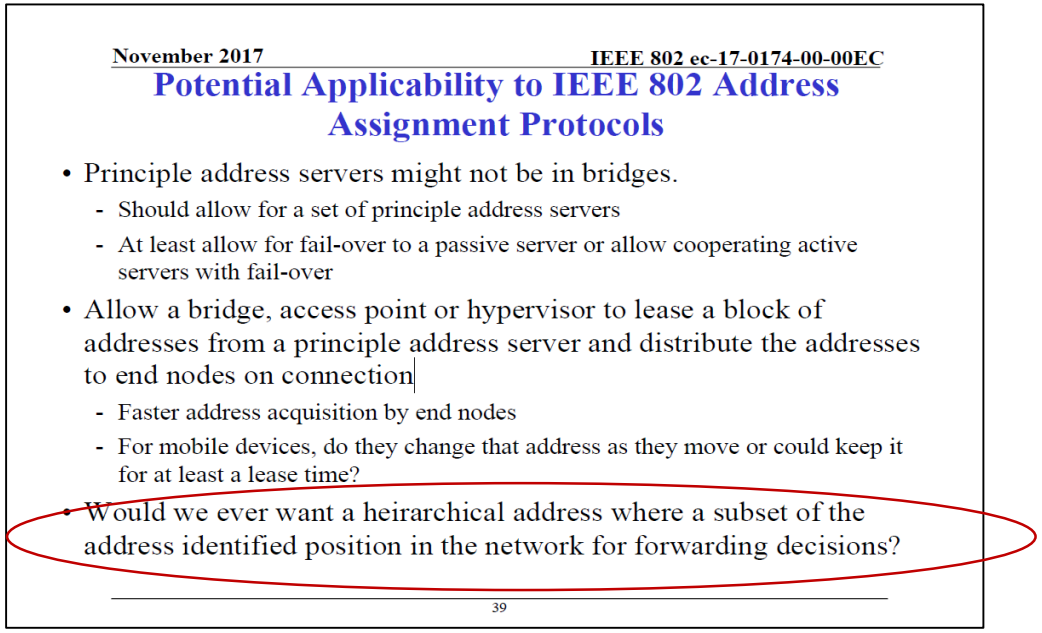

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Potential Applicability to IEEE 802 Address Assignment Protocols

- Principle address servers might not be in bridges.
  - Should allow for a set of principle address servers
  - At least allow for fail-over to a passive server or allow cooperating active servers with fail-over
- Allow a bridge, access point or hypervisor to lease a block of addresses from a principle address server and distribute the addresses to end nodes on connection
  - Faster address acquisition by end nodes
  - For mobile devices, do they change that address as they move or could keep it for at least a lease time?
- Would we ever want a heirarchical address where a subset of the address identified position in the network for forwarding decisions?

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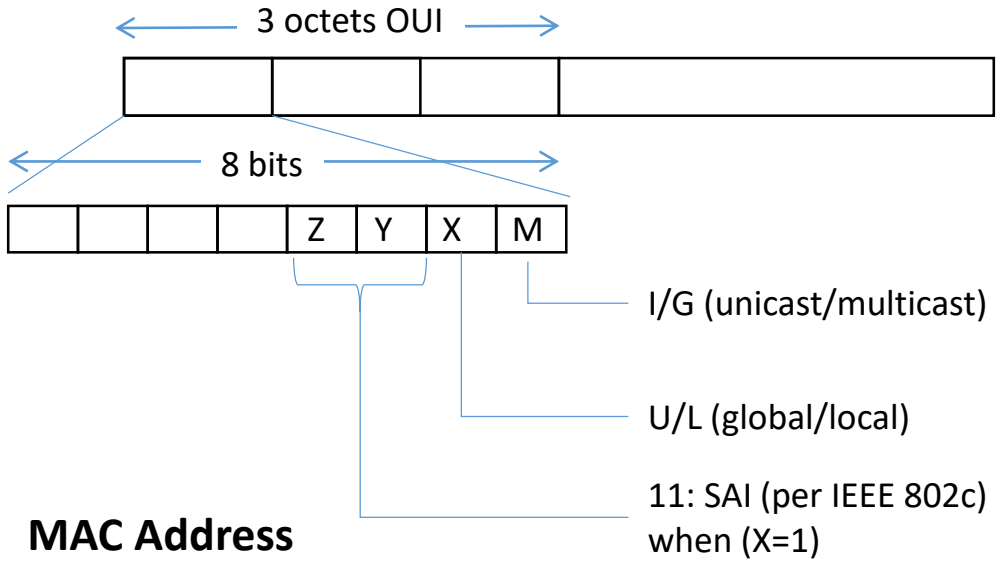
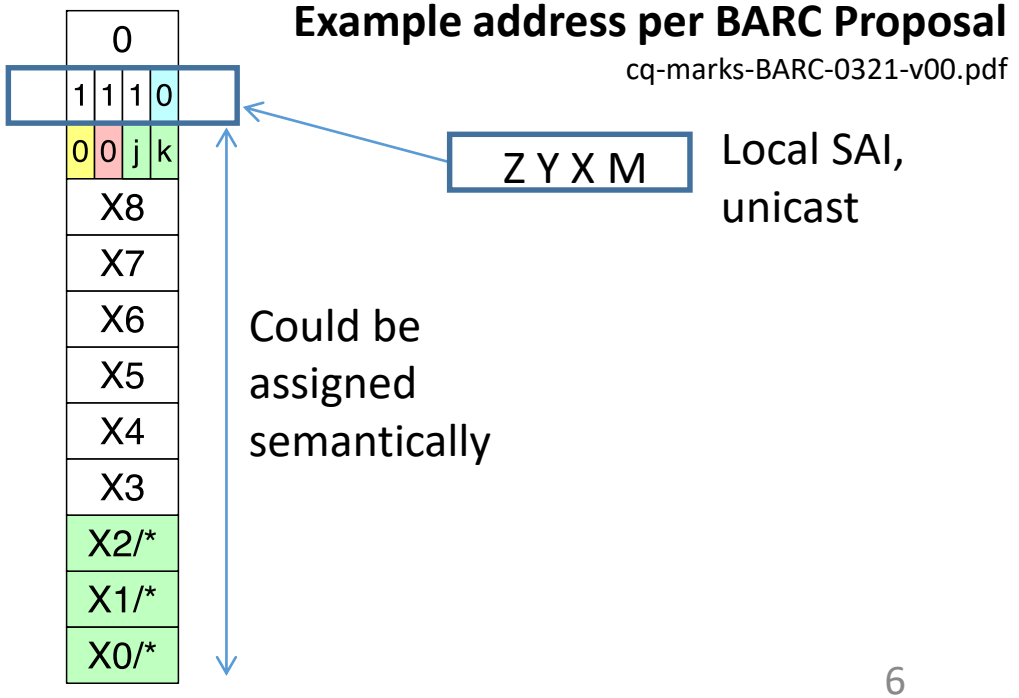
P802.1CQ Recap

- Global MAC address includes minimal semantic content.
  - Globally unique, assigned to device when manufactured
  - Represents only the device identity
    - 2 bits are for MAC address type classification, 46 bits as device identification.
- Local MAC address is flexible
  - Locally unique, could be dynamically assigned when device is on network
  - 2 bits specify type of local MAC address
    - SAI is a standard-assigned address, per IEEE Std 802c; 802c says "Specification of the use of the SAI quadrant for SLAP address assignments is reserved for the standard forthcoming from IEEE P802.1CQ."
  - BARC supports structured address assignment.
    - Address type can be recognized by system to know how to interpret the semantic content, so to process the local MAC address in different ways



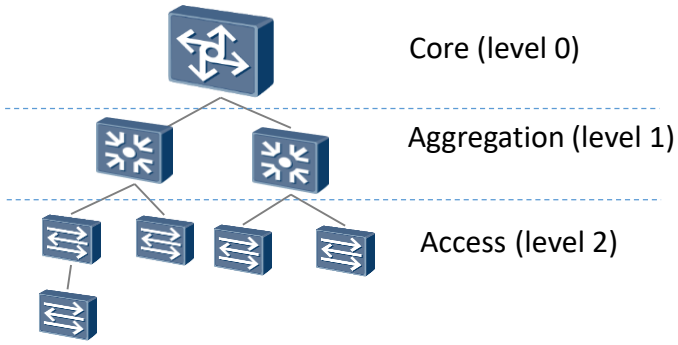
Example address per BARC Proposal

cq-marks-BARC-0321-v00.pdf

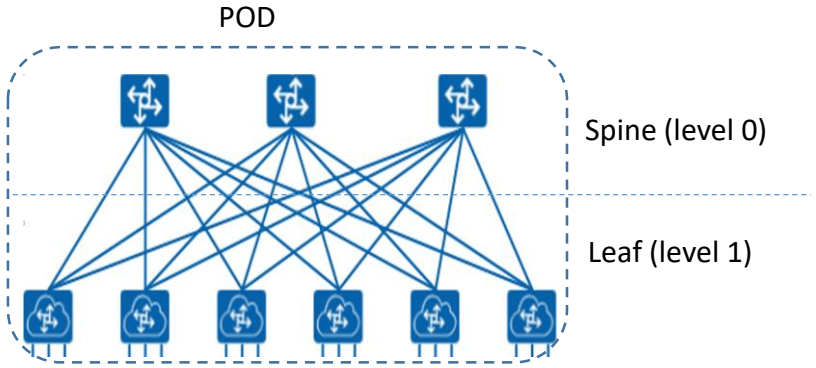


Use Case: Location-Based Semantic Local MAC Address

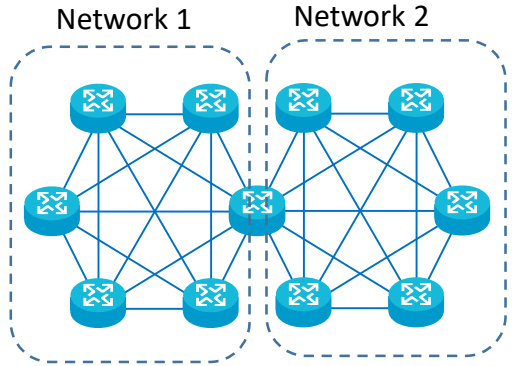
- Include location information as semantic content in local MAC address
- Location information could be structured based on network topology
  - Some examples of structured location information



Level ID + Switch ID + Port ID



POD ID + Switch ID + Port ID



Network ID + Host ID

- Bits for location information are used for forwarding
  - Support hierarchical forwarding table lookup to improve L2 forwarding efficiency
    - Several level forwarding table, with smaller size of each entry.
  - Possible to develop efficient routing protocols to support L2 multiple path and scale L2 network

Proposed Changes in .1CQ

- Clause 4.2 Trend and use cases
  - Demonstrate semantic address design in industry and their benefits.
  - Add location-based semantic local mac address as use case, showing address structure design examples and potential benefits to L2.
- Clause 6 PALMA / BARC
  - Specify an assignment protocol to support hierarchical structured addresses.
    - Current BARC could assign structured block addresses.
  - Specify that an assigned address contains semantic content
    - Current BARC could use MBI/RABI type to identify semantic content.
- Clause 9. Bridge behavior
  - Describe how a bridge recognizes the semantic content (aligned with BARC design)
  - Generally describe how semantic addresses support a new way of bridge forwarding and new routing protocols.
    - Defining a new mechanism is out of .1CQ scope.

Next Steps

- Prepare comments when .1CQ opens next TG ballot.
- Based on WG interests, bring more contributions with more examples of the use case and its benefits.

THANKS!