MOOSE
Multi-level Origin-Organised Scalable Ethernet
draft-malc-armd-moose-00

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Aim: Hierarchical MAC address space

• **Current Ethernet**: manufacturer-assigned MAC address valid anywhere on any network
  – But every switch must store the location of every host

• **Hierarchical MAC addresses**: address depends on location  
  e.g. [switch ID].[port ID].[host ID]
  – Route frames according to hierarchy
  – Small forwarding databases
  – Run a routing protocol between switches
    • One “subnet” per switch – e.g. “02:11:11:00:00:00/24”
    • Don’t advertise individual MAC addresses (cf. TRILL Rbridges)

• **LAAs?** High administrative overhead. So, instead...:
MOOSE

• “NAT for Ethernet”
  – Dynamically allocate hosts hierarchical addresses
  – Perform source **MAC address rewriting** on ingress
  – No encapsulation: no costly rewriting of dest address
  – Looks like Ethernet from outside: **transparent to hosts**
  – We have an OpenFlow implementation
Beyond simple protocols

• Some protocols must be rewritten by switches
  – Anything which puts MAC address in payload
  – ARP, DHCP: trivial for switches to deal with

• Broadcast: unfortunate legacy
  – Propagate broadcast traffic using reverse path forwarding (PIM): no explicit spanning tree protocol

• Multicast and anycast for free
  – (if we use a suitable routing protocol)
  – May be able to convert broadcast into multicast by inferring groups (e.g. DHCP servers) – see SEATTLE
This is ongoing research; comments very welcome

This was a very brief overview: much more detail in draft-malc-armd-moose-00

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• Spare slides follow
Mobility

- If a host moves, it is allocated a new MAC address by its new switch.

- Other hosts may have the old address in ARP caches.
  1. **Forward frames**, IP Mobility style
     (new switch discovers host’s old location by querying other switches for its real MAC address)
  2. **Gratuitous ARP**, Xen VM migration style

```
Host A
  ↓
  ▼
Host B
```

```
Host A
  ↓
  ▼
  GRATUITOUS ARP
```

```
Host A
  ↓
  ▼
  data forwarded by care-of switch
```

```
Host B
  ↓
  ▼
  host relocated to new switch
```

```
Host C
  ↓
  ▼
  gratuitous ARP sent by new home switch
```

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Allocation of host identifiers

• Only the switch which allocates a host ID ever uses it for forwarding
  – More distant switches just use the switch ID

• Therefore the detail of how host IDs are allocated can vary between switches
  – Sequential assignment
  – Port number and sequential portion (reduces address exhaustion attacks)
  – Hash of manufacturer-assigned MAC address (deterministic: recoverable after crash)
Security and isolation benefits

• The number of switch IDs is more predictable by the network admin than the number of MAC addresses
  – Address flooding attacks are ineffective

• Host-specified MAC address is not used for switching
  – Spoofing is ineffective