



IEEE 802.1ag Ethernet OAM

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SARA

IEEE 802.1ag standard

- IEEE 802.1ag is used for Connectivity Fault Management
- CFM protocol at Ethernet layer
 - Uses Ethernet frames (ethertype 0x8902)
 - Uses MAC addresses, no IPv4 or IPv6 involved
 - Confined to one broadcast domain
- Support for multi-domain Ethernet networks
- Implemented on Ethernet switches and router Ethernet interfaces

802.1ag Concepts

- Ethernet network split into Maintenance Domains
- 802.1ag frames operate at a certain Maintenance Domain Level (8 levels supported)
- Maintenance Points (interfaces) send and process 802.1ag frames
 - Maintenance End Points (MEPs)
 - Maintenance Intermediate Points (MIPs)
- MEPs and MIPs only interact when configured at the same Maintenance Domain Level
- Interfaces can be a MEP at one level and a MIP at another

IEEE 802.1ag OAM Types

■ Continuity Check (CC)

- Detect loss of connectivity
- Periodic hello messages from MEPs
- Processed by MEPs
- CC frames sent to multicast group, no replies are sent

■ Loopback Message/Reply (LBM/LBR)

- Check for reachability
- Sent manually from MEPs via CLI
- Processed by MIPs/MEPs
- Unicast request, unicast reply

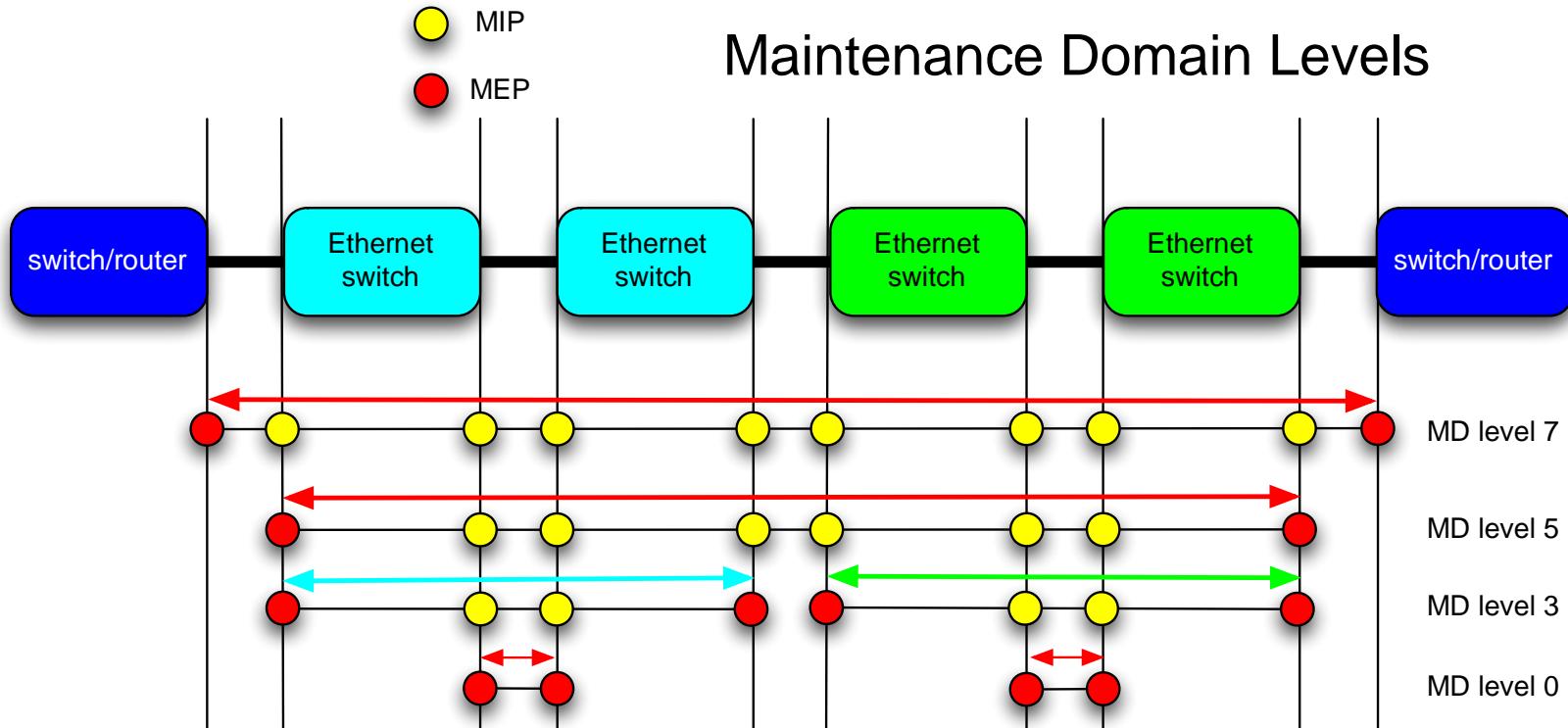
■ Link Trace Message/Reply (LTM/LTR)

- Path information
- Sent manually from MEPs via CLI
- Processed by MIPs/MEPs in path
- Multicast request including TTL, unicast replies

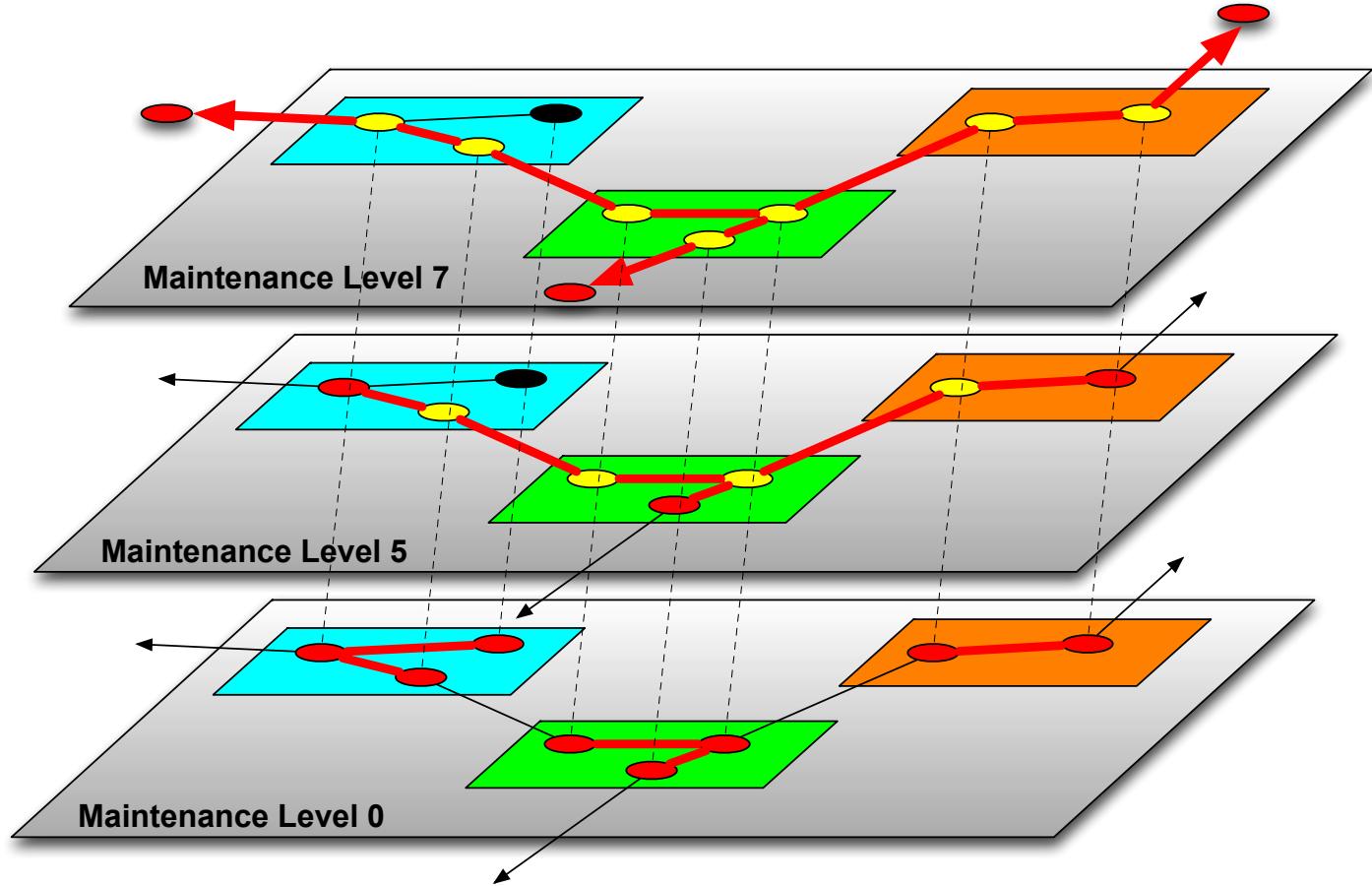
Continuity Check Messages

- Periodic hello messages, supported intervals:
 - 3.33 ms, 10 ms, 100 ms, 1 s, 10 s, 1 min, 10 min
- Maintenance Association with 2 or more MEPs
- No replies sent, only listen to associated MEPs
 - Same Maintenance Association
 - Same Maintenance Domain Name
 - Same Maintenance Domain Level
- Declare link failure when missing 3 consecutive messages

802.1ag MEPs and MIPs



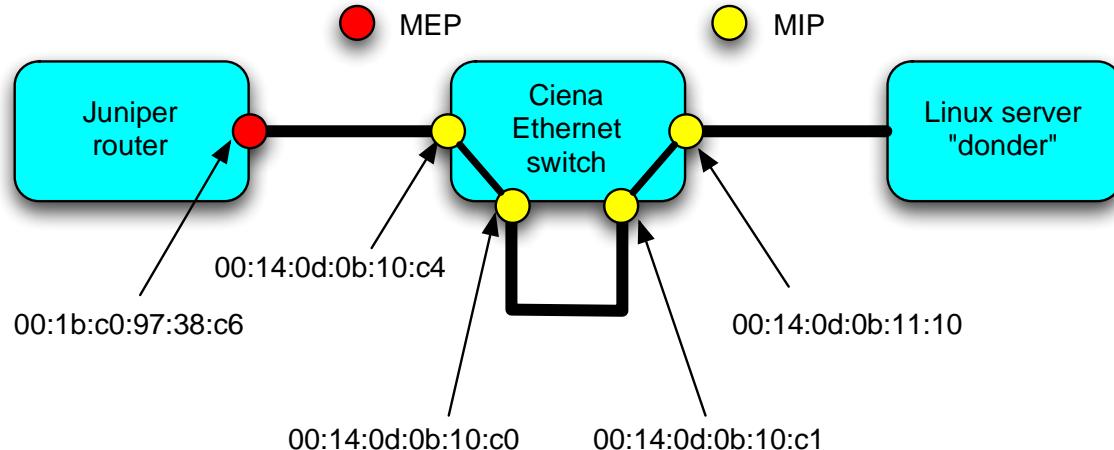
Maintenance Domain Levels



What are the *dot1ag-utils*?

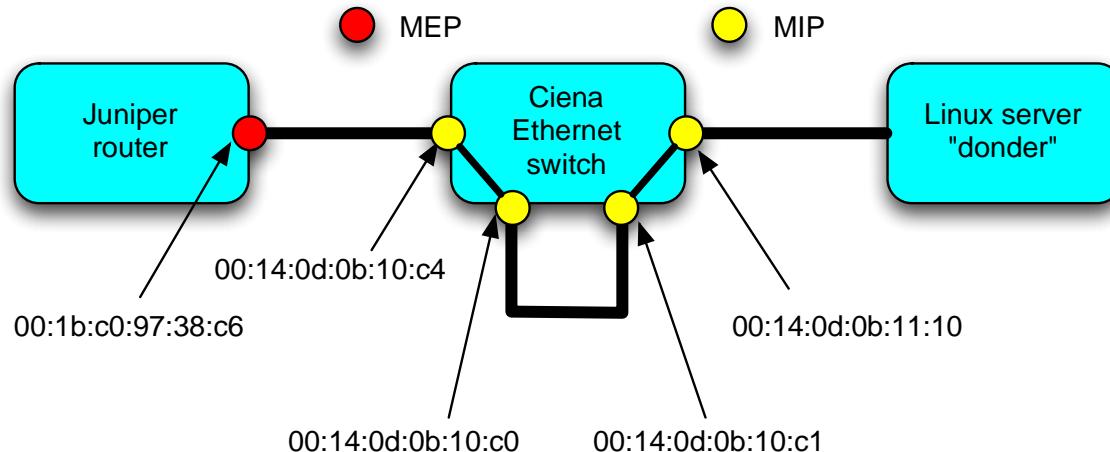
- Open Source implementation of IEEE 802.1ag
 - Simplified BSD License
 - Supported on Arista, FreeBSD, Linux and MacOSX
 - User space implementation
 - Work In Progress
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- Powerful debugging tool for Ethernet based lightpaths, VPNs, etc.
 - No need to configure IP addresses on each VLAN on switches
 - Ping to Ethernet MAC addresses of routers and switches
 - You only need a server and install the software on it

ethping demo



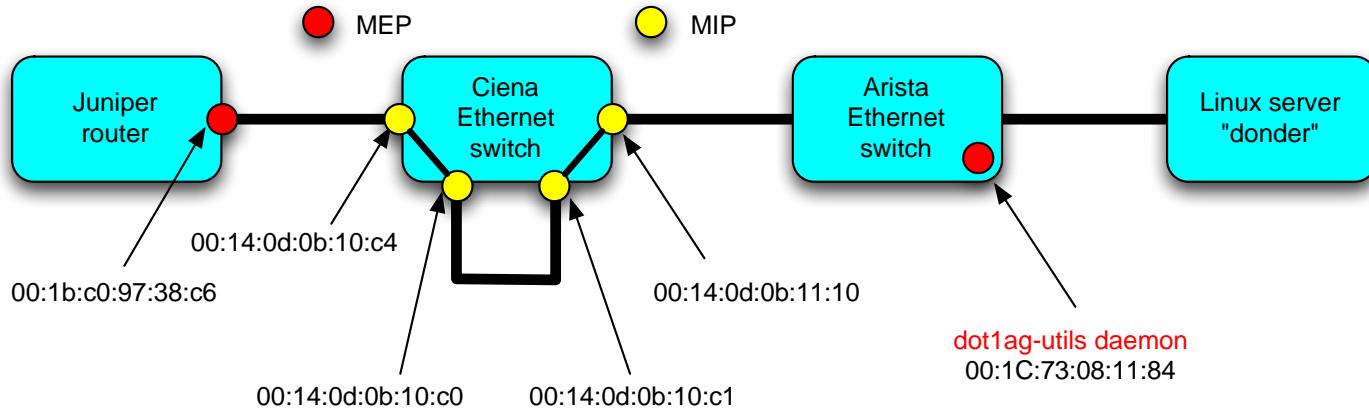
```
root@donder:~# ethping -i eth5 -v 123 -l 7 -c 10 00:1b:c0:97:38:c6
CFM LBM to 00:1b:c0:97:38:c6
60 bytes from 00:1b:c0:97:38:c6, sequence 477635892, 0.839 ms
60 bytes from 00:1b:c0:97:38:c6, sequence 477635893, 0.872 ms
60 bytes from 00:1b:c0:97:38:c6, sequence 477635894, 0.817 ms
60 bytes from 00:1b:c0:97:38:c6, sequence 477635895, 0.829 ms
60 bytes from 00:1b:c0:97:38:c6, sequence 477635896, 0.851 ms
60 bytes from 00:1b:c0:97:38:c6, sequence 477635897, 0.718 ms
60 bytes from 00:1b:c0:97:38:c6, sequence 477635898, 0.713 ms
60 bytes from 00:1b:c0:97:38:c6, sequence 477635899, 0.917 ms
60 bytes from 00:1b:c0:97:38:c6, sequence 477635900, 0.731 ms
60 bytes from 00:1b:c0:97:38:c6, sequence 477635901, 0.713 ms
root@donder:~#
```

ethtrace demo



```
root@donder:~# ethtrace -i eth5 -v 123 -l 7 00:1b:c0:97:38:c6
Sending CFM LTM probe to 00:1b:c0:97:38:c6
ttl 1: LTM with id 1784875395
    reply from 00:14:0d:0b:10:c1, id=1784875395, ttl=0, RlyFDB
ttl 2: LTM with id 1784875396
    reply from 00:14:0d:0b:10:c4, id=1784875396, ttl=0, RlyFDB
    reply from 00:14:0d:0b:10:c1, id=1784875396, ttl=1, RlyFDB
ttl 3: LTM with id 1784875397
    reply from 00:14:0d:0b:10:c4, id=1784875397, ttl=1, RlyFDB
    reply from 00:14:0d:0b:10:c1, id=1784875397, ttl=2, RlyFDB
    reply from 00:1b:c0:97:38:c6, id=1784875397, ttl=0, RlyHit
root@donder:~#
```

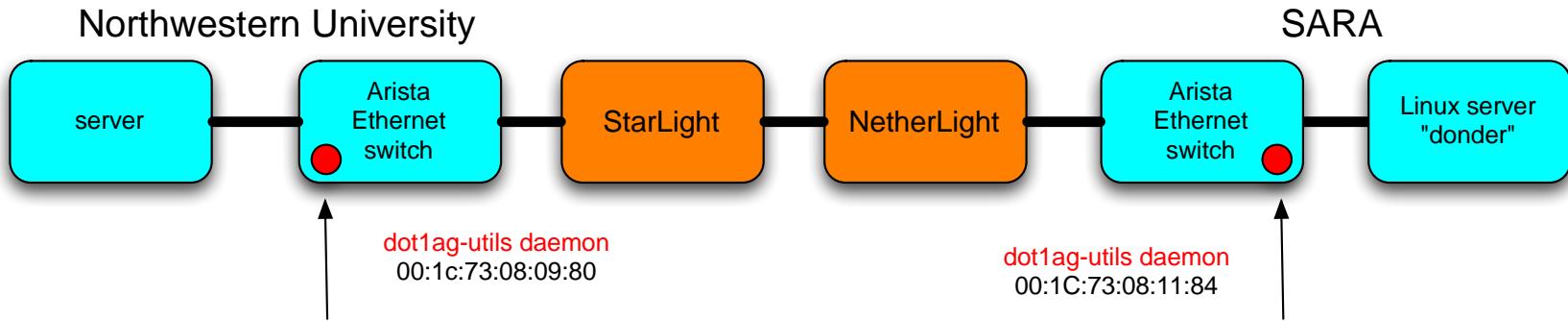
LBM from Juniper to Arista



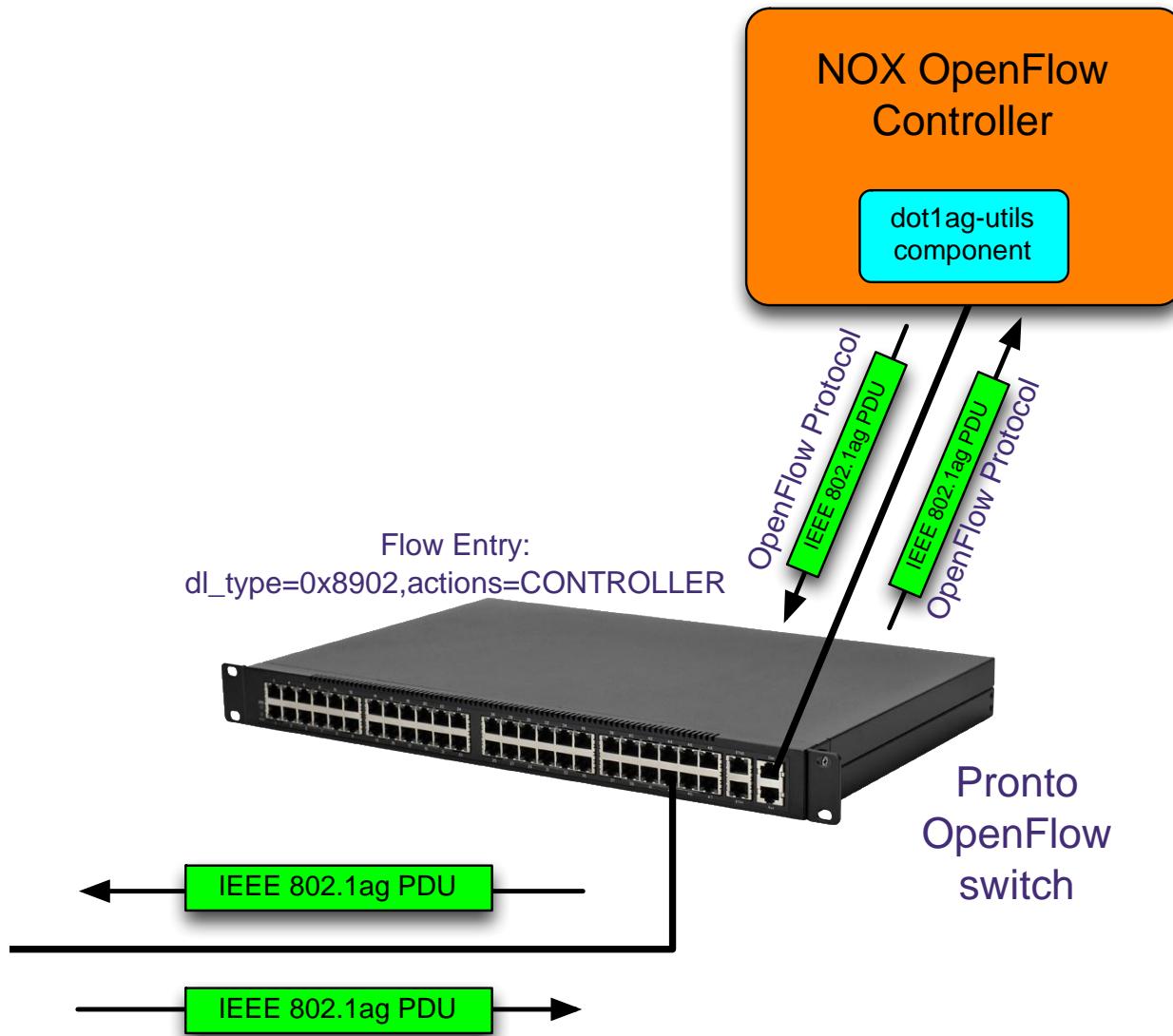
```
--- JUNOS 10.3I built 2011-04-05 18:23:14 UTC
rvdp@re0-ed> ...ntenance-association test 00:1C:73:08:11:84
PING to 00:1c:73:08:11:84, Interface ge-0/3/9.123
64 bytes from 00:1c:73:08:11:84: lbm_seq=81
64 bytes from 00:1c:73:08:11:84: lbm_seq=82
64 bytes from 00:1c:73:08:11:84: lbm_seq=83
64 bytes from 00:1c:73:08:11:84: lbm_seq=84
--- ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
```

rvdp@re0-ed>

ethping Amsterdam to Chicago



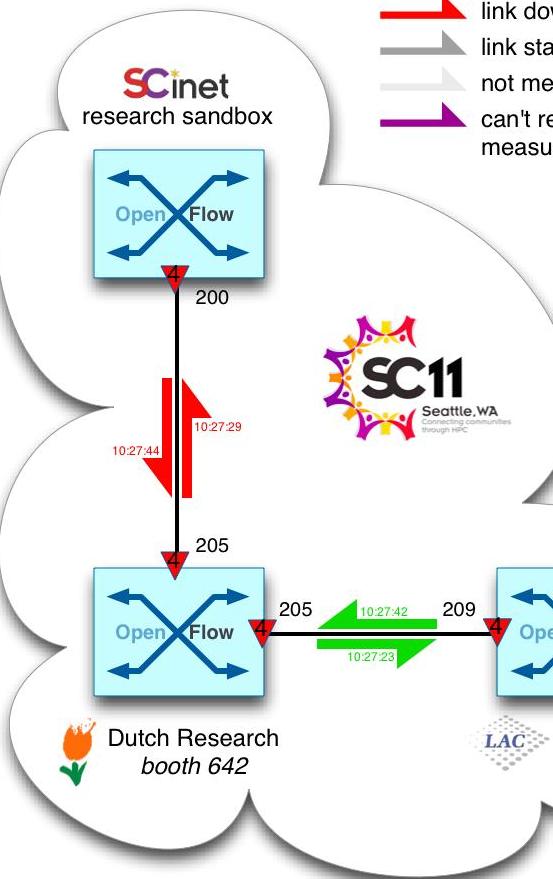
```
donder# ethping -i eth5 -v 400 -l 7 00:1c:73:08:09:80
Sending CFM LBM to 00:1c:73:08:09:80
60 bytes from 00:1c:73:08:09:80, sequence 1114864898, 103.453 ms
60 bytes from 00:1c:73:08:09:80, sequence 1114864899, 103.432 ms
60 bytes from 00:1c:73:08:09:80, sequence 1114864900, 103.439 ms
60 bytes from 00:1c:73:08:09:80, sequence 1114864901, 103.455 ms
60 bytes from 00:1c:73:08:09:80, sequence 1114864902, 103.455 ms
#
```



Ethernet Sandbox

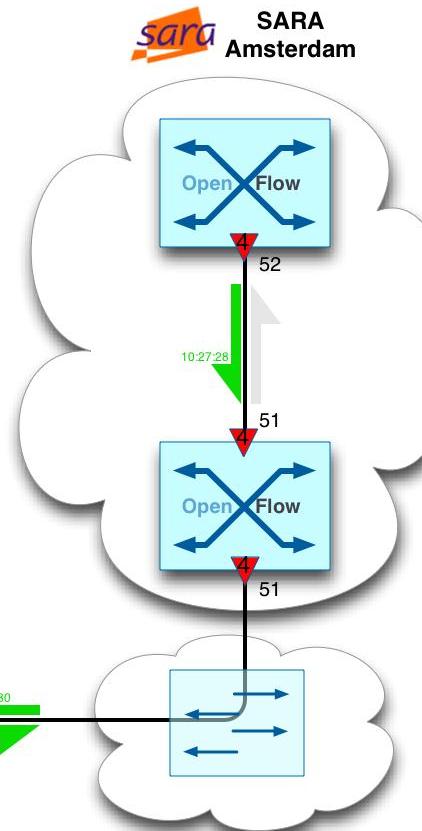
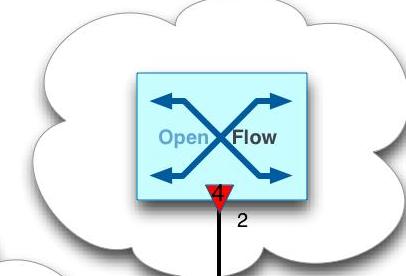
Supercomputing 2011
Seattle

- link up
 - link down
 - link status unknown
 - not measured
 - can't reach measurement point
- MEP
measurement end point



CRC CRC Ottawa

iCAIR iCAIR Chicago



STARLIGHT™
StarLight, Chicago

NL Light NetherLight Amsterdam

More Information

- ▶ Mail to rvdp@sara.nl or nrg@sara.nl
- ▶ <http://nrg.sara.nl/dot1ag-utils>
- ▶ Subscribe to mailman mailing list

