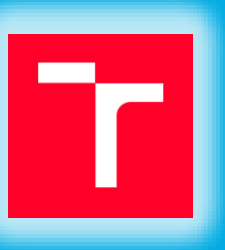

Discovering Neighboring Devices in Network: Development of CDP and LLDP Simulation Modules for OMNeT++

Vladimír VESELÝ,
Tomáš Rajca

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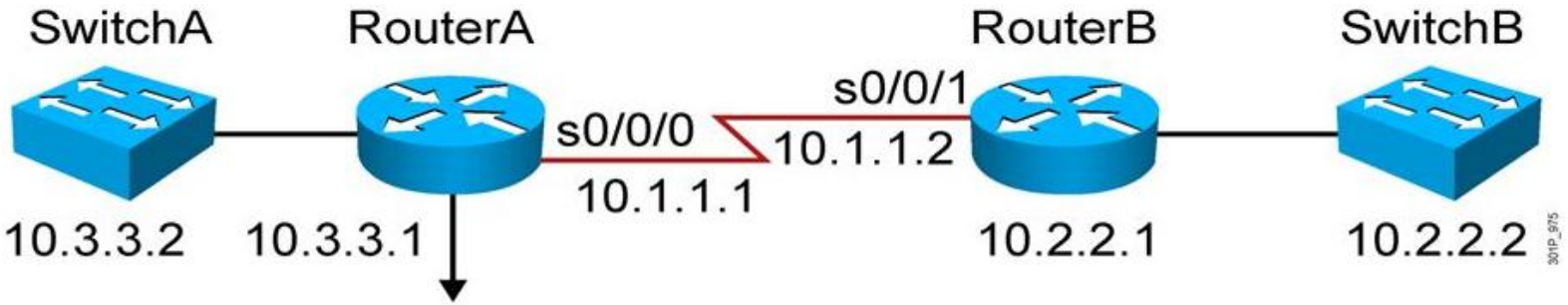
MOTIVATION

- Layer2 discovery protocols are priceless for network monitoring, maintenance, and troubleshooting




```
RouterA# show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater

Device ID    Local Intrfce    Holdtme    Capability  Platform  Port ID
SwitchA          fa0/0          122          S I       WS-C2960- fa0/2
RouterB          s0/0/0          177         R S I      2811      s0/0/1
```

http://slideplayer.com/slide/7077492/24/images/7/USING+THE+SHOW+CDP+NEIGHBORS+COMMAND.jpg

- However, they start to play an important role in the operation of VoIP infrastructure, data-centers and other high-availability networks.

CDP AND LLDP

- Layer 2 discovery protocols have been developed to share information between directly connected devices.
  - They send specific device's information (e.g., device role, interface state, assigned IP address, operating system version, Power over Ethernet capability, duplexness, VLAN configuration, etc.) to neighbors.
- Periodical generation of messages

- **Cisco Discovery Protocol**
  - the very first member of this protocol family
  - dedicated MAC address 01-00-0c-cc-cc-cc

- **Link Layer Discovery Protocol**
  - codified in IEEE standard 802.1AB
  - de facto industry standard for multi-vendor environment
  - dedicated MAC address 01-80-c2-00-00-0e

MESSAGES

- Type – Length –

CDP TLV	
Version	CDP protocol
	Unique ide der
Time To Live	Information is For CDP, rec
Checksum	Message cont
Address	TLV contains
Capabilities	Specifies
Port-Id	String repres
	The label is
Full/Half Duplex	Duplexness o mismatch betv
Native VLAN	TLV hosts cor be used to de
Device-Id	
Location	
Platform	
Software Version	Device's ope
VTP Management Domain	VLAN manag protocol called
IP Network Prefix	On-demand r TLV carries a

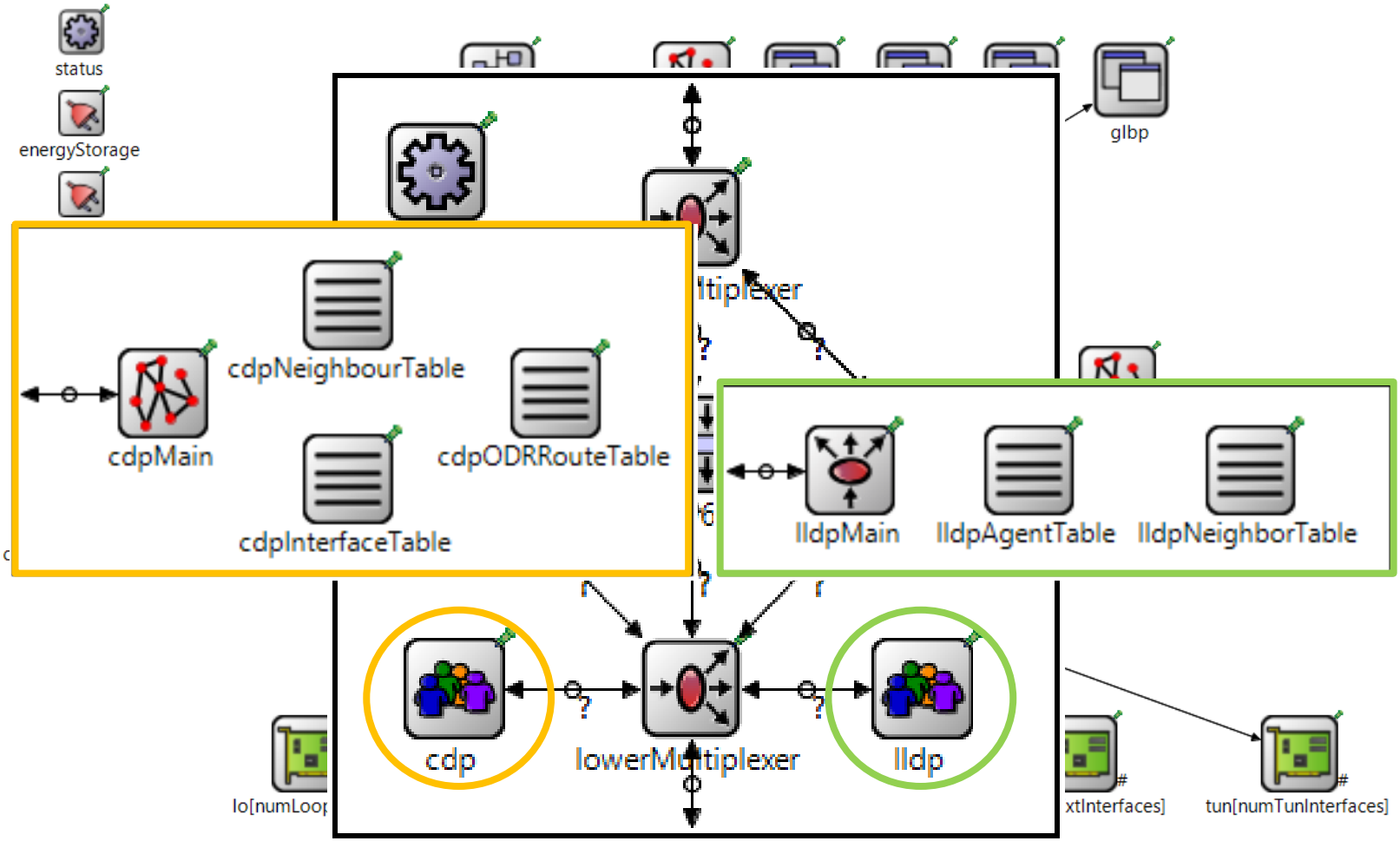
cdp

No.	Time	Source	Destination	Protocol
24	1…	c4:04:08:88:f1:01	CDP/VTP/DTP/PAgP…	CDP
57	4…	ca:01:07:7b:00:08	CDP/VTP/DTP/PAgP…	CDP
110	9…	ca:01:07:7b:00:08	CDP/VTP/DTP/PAgP…	CDP

```
> Frame 57: 350 bytes on wire (2800 bits), 350 bytes
> IEEE 802.3 Ethernet
> Logical-Link Control
v Cisco Discovery Protocol
    Version: 2
    TTL: 180 seconds
    Checksum: 0x9ace [correct]
    [Checksum Status: Good]
  v Device ID: R1
      Type: Device ID (0x0001)
      Length: 6
      Device ID: R1
  > Software Version
  > Platform: Cisco 7206VXR
  v Addresses
      Type: Addresses (0x0002)
      Length: 17
      Number of addresses: 1
    > IP address: 192.168.1.1
  > Port ID: FastEthernet0/0
  > Capabilities
  > Duplex: Full
```

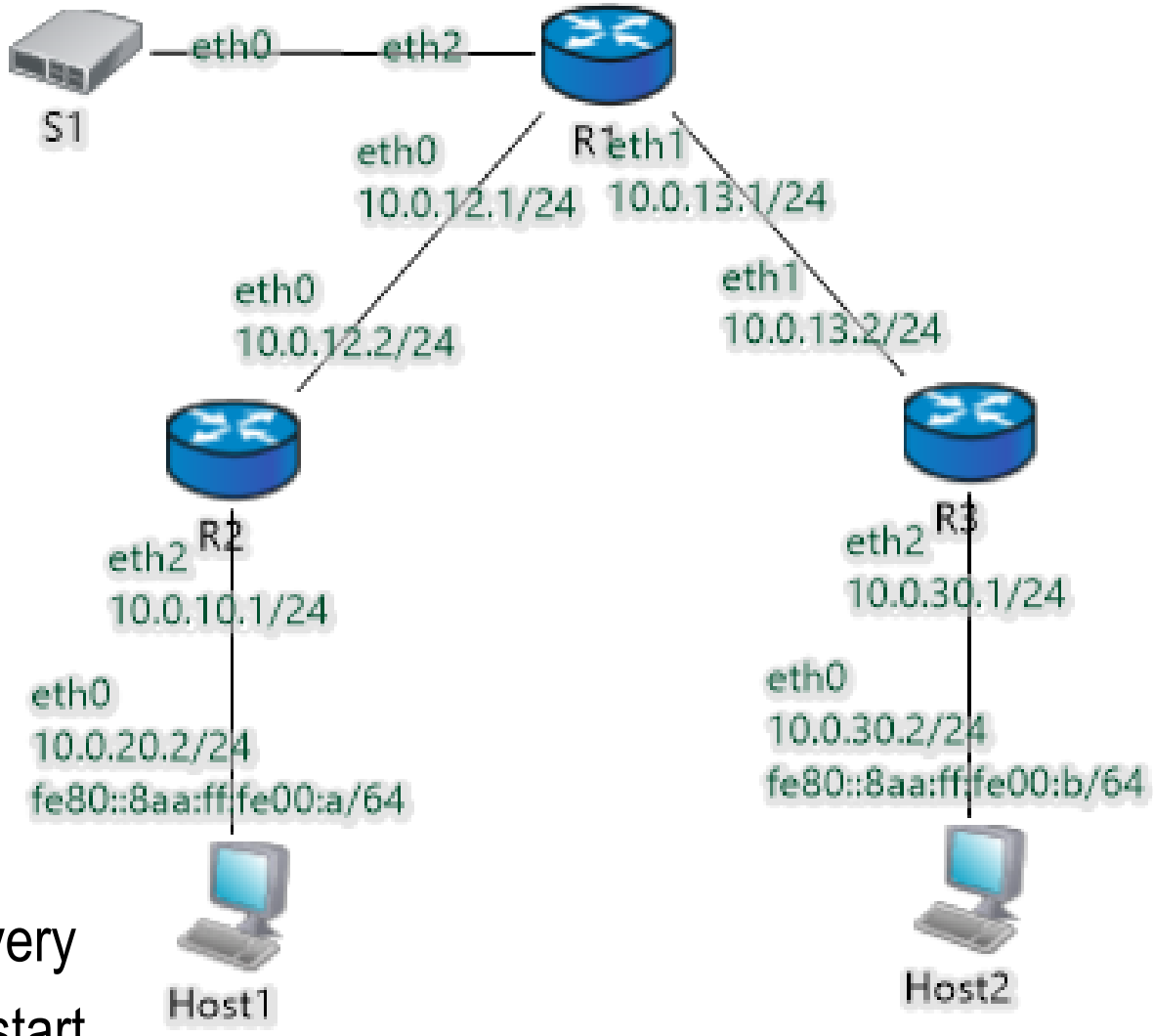
IMPLEMENTATION

- **ANSARouter** and ANSASwitch combine all our functionality



SCENARIO

- Comparing real and simulated network



- Phases:

a) Initial discovery

b) Interface restart

A) Initial discovery

Direction	CDP		LLDP	
	Simul. [s]	Real [s]	Simul. [s]	Real [s]
R1 → R2	0.000	0.300	0.000	1.600
R2 → R1	0.000	5.370	0.000	1.900
R1 → R2	1.000	1.300	1.000	missing
R2 → R1	1.000	6.370	1.000	missing
R1 → R2	2.000	2.310	2.000	missing
R2 → R1	2.000	7.380	2.000	missing
R1 → R2	62.000	57.550	62.000	61.300
R2 → R1	62.000	66.850	62.000	61.400

- Both protocol offer fast-start feature, which speeds up the process of neighbor discovery. During the fast-start, periodic message generation interval is just 1 second. Fast-start lasts for:
  a) three consecutive message updates in case of CDP;
  b) one to eight (by default three) consecutive message updates in case of LLDP.
- Fast-starts happens each time when:
  a) interface restarts in case of CDP;
  b) MIB content changes in case of LLDP standard;
  c) a new end-host is detected, or LLDP-MED TLV is exchanged in case of LLDP implementation by Cisco

B) Interface restart

- This test tracks events bound to the flapping of interface between R1 and R2.
- After the link goes down at $t = 50s$, records expire from tables at $t = 180s$. Then at $t = 200s$ connection is reestablished and CDP/LLDP messages are first to appear on the wire.

Direction	CDP		LLDP	
	Simul. [s]	Real [s]	Simul. [s]	Real [s]
R1 → R2	200.000	199.480	200.000	202.000
R2 → R1	200.000	201.500	200.000	205.000
R1 → R2	201.000	200.500	201.000	missing
R2 → R1	201.000	202.510	201.000	missing
R1 → R2	202.000	201.510	202.000	missing
R2 → R1	202.000	203.510	202.000	missing

SUMMARY

- **Our paper describes a finalized code contribution involving CDP and LLDP simulation modules**
- ANSAINET extends INET with a new L3, L4 sim. modules
  - also added during the previous year HSRP, GLBP
  - for the next year we are finishing OSPFv3 and refactoring of IPv6 stuff in OMNeT++

THANK YOU FOR YOUR ATTENTION! QUESTIONS?

- Reviewers:

1) After the first discovery between R1 and R2 is completed: was any background traffic considered to come in after the link discovery which would affect the delivery of the follow-up discovery messages?
2) Are the LLDP packets missing in any test run or only in the worst case?
3) The test was performed on a small scenario. Were further tests also run on larger scenarios? (in other words, are they any effects which have to be considered in the implementation when considering scalability)?
4) Does the proposed implementation scale to large networks? What's the impact on the simulation performance in this case?
5) In addition, I am missing a discussion on DCBX, which is an enhancement on top of LLDP that enables datacenter bridging extensions such as PFC, ETS, and QCN.
6) There is also some concern that this framework is limited to ANSAINET, which would limit its usefulness for people that are using plain INET.