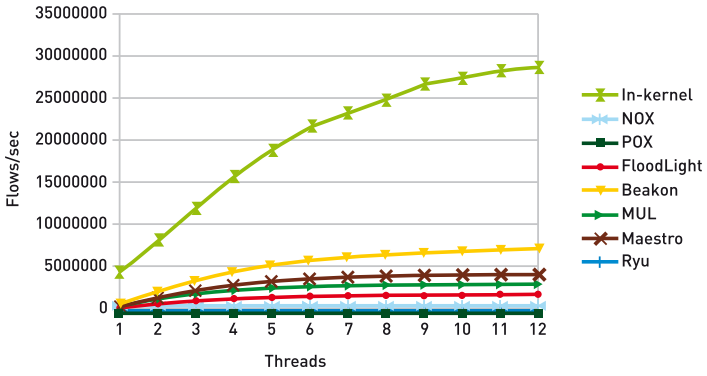
APPLIED RESEARCH CENTER FOR COMPUTER NETWORKS

ARCCN OpenFlow Controller

ARCCN Controller is a high performance OpenFlow controller for enterprise and small datacenters networks leveraging capabilities of modern multicore and multiprocessors contemporary servers. It has wide range of network applications.

Description	Specifications
OpenFlow	• Version 1.3
Performance	• throughput: 25 000 000 flows per second • latency: 45 us
Scalability	• scales to 1000 switches
Functionality	• L2/L3 forwarding • QoS • multipath forwarding • virtualization of network resources • anti-DDoS • monitoring • load-balancing • traffic filtering • authentication • SPAN-ports • NAT • ARP • DNS • DHCP • BGP • verification and troubleshooting • OpenStack plugin
Reliability and security	• Correct processing of malformed OpenFlow messages. • Protection against attacks from data plane.
Configuration tools	• Command line interface • Web interface

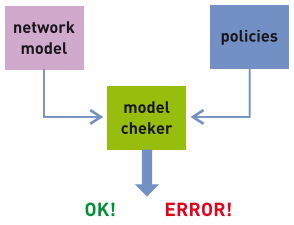


In-Kernel	45
NOX	91
POX	323
Floodlight	75
Beacon	57
MuL	50
Maestro	129
Ryu	105

The minimum response time (10^{-6} secs/flow)

Vermont: Dynamic Verifier for Forwarding Policies

Vermont is responsible for verifying if the current network state fits the high-level policies entered by the network administrator. The current network state are continuously updated into network model which dynamically over the time checking against policies written on specific formal languages. The system is mainly designed for OpenFlow networks. Nevertheless it might work with any Netflow data.



Examples of forwarding policies:

- "no external flow passes through the border switch",
- "any pair of hosts in office is connected",
- "there is less than five hops between any host pair",
- "no external flow reaches office mail server",
- "any external flow should go through the DPI server",
- "no packet reaches its original state"
- "No flows connects hosts in different departments"
- "Host A is unable to connect host B until host B tried to connect A before"
- "All routes are 5 hops length"

Example 1

```
// State cycle detector
aux: lead_to_state_cycle(Initial) :=
                    In(Initial) and Exist[y:
                                R_tc(Initial,y) and
                                Exist[z: R_tc(y,z) and y == z]
                               ];
main: no_state_cycles() :=
  Forall[x:
not lead_to_state_cycle(x)];
```

Example 2

```
/* Find packets which are able to reach switch A (dpid = 7) in 8 to 10 hops without
crossing switch B (dpid = 16)
*/
main: unsecure_flow(X) :=
In(X) and EReach[y:
                    (R_step(X,y) and not y.w == "f0"){8,10};
                    y.w == "07"  ];
```

EasyWay: Simplifying and automating enterprise networks administration with SDN/OpenFlow

EasyWay
simplify your network management

EasyWay is a next generation of SDN/OpenFlow-based network management system for Enterprise networks:

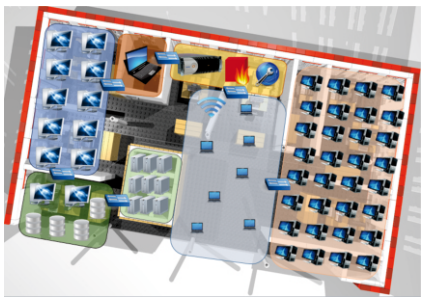
1. Make network manageable without manual access to network elements.
2. Introduce high level abstractions for network administration.

Problems Network administrators

Modern enterprise network infrastructure is very complex: a lot of network elements, complicated topology, different routing and security policies.

Challenges of network administration:

- manual translating high-level policies to low-level commands for routers and switches;
- configuring network elements from black console terminals with hundreds of commands;
- limited number of tools for network debugging like ping, tcpdump, traceroute;
- additional trainings for each new vendor.



Traditional Network Management Systems are designed just to monitor activity of discovered network devices using SNMP protocol: topology, utilization, throughput, latency.

Key Features

Easyway is a first sematic network management system where network operators works with high level terms of “names”, “groups”, and “paths” instead of low level IPs, subnets, and routes.

NAMES. Working with understandable names associated with the hosts is much easier for the operator than keeping in mind their IP or MAC addresses.

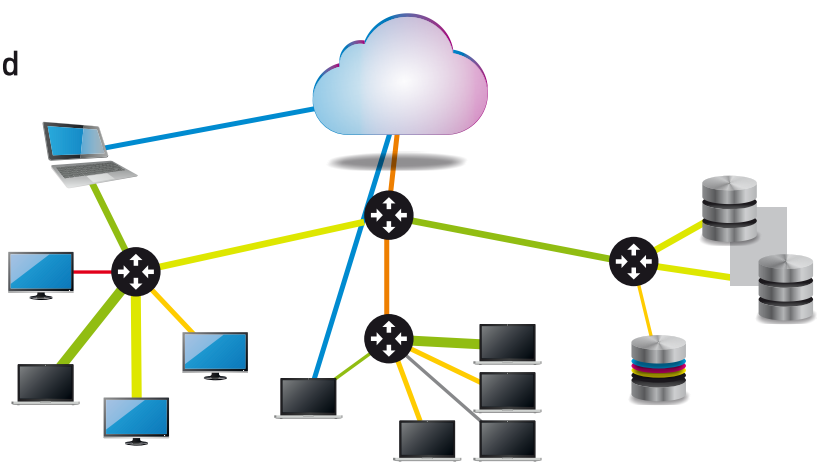
GROUPS. Hosts might be combined into groups in case we need to specify the same policy for them. E.g. “the machines in the classroom have access only to the Internet”.

PATHS. Instead of configuring routes for each single device in the network, the operator can “draw” the paths between groups and hosts through the whole network specifying who can talk with whom.

EasyWay has user-friendly web-based interface.

Main features are:

- Topology discovery
- Network monitoring
- Naming
- Grouping
- Path selection



Applied Research Center for Computer Networks (ARCCN) - is a research project for the development of technologies and products for next-generation computer networks in Russia. ARCCN was established in February 2012.

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