Software-Defined Networking

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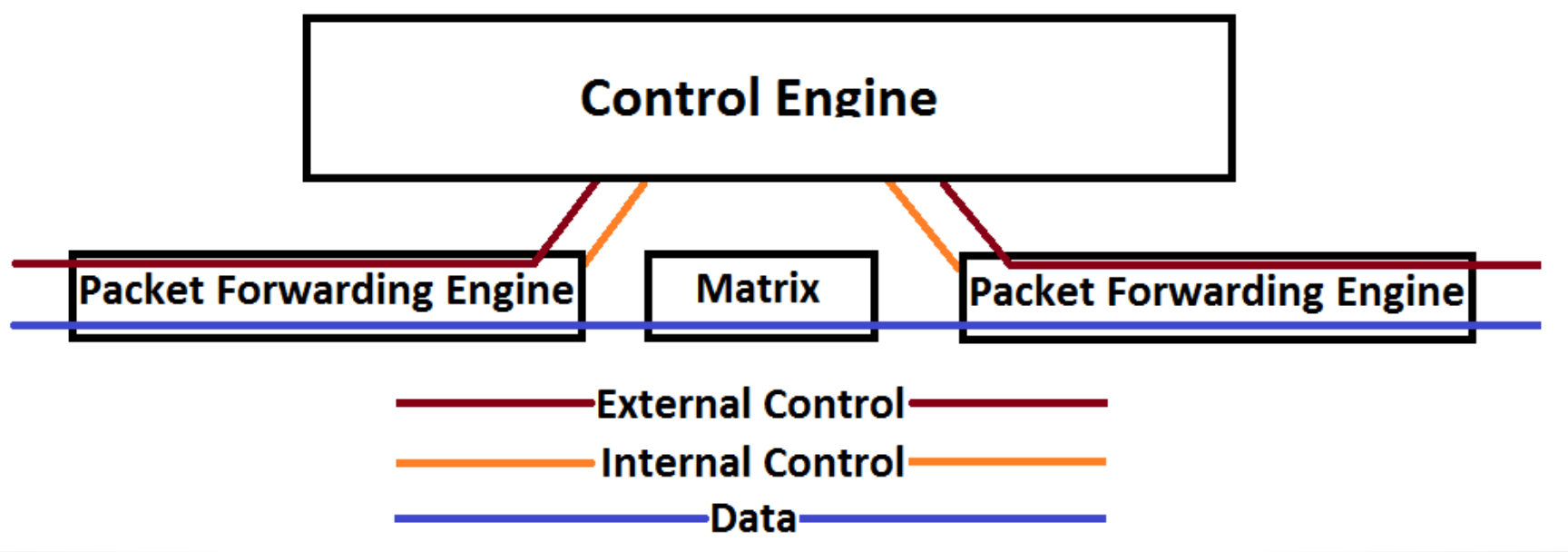
Введение

- **Основные проблемы современных сетей:**
  - Сложность
  - Отсутствие масштабируемости
  - Невыразительность
  - Отсутствие оптимизации в использовании возможностей сетевого оборудования
  - Зависимость от вендора
  - etc…

SDN


CONTROL PLANE
Предоставляет данные для построения таблиц форвардинга
DATA PLANE
Направляет данные, согласно таблицам форвардинга
FRAMES IN
FRAMES OUT

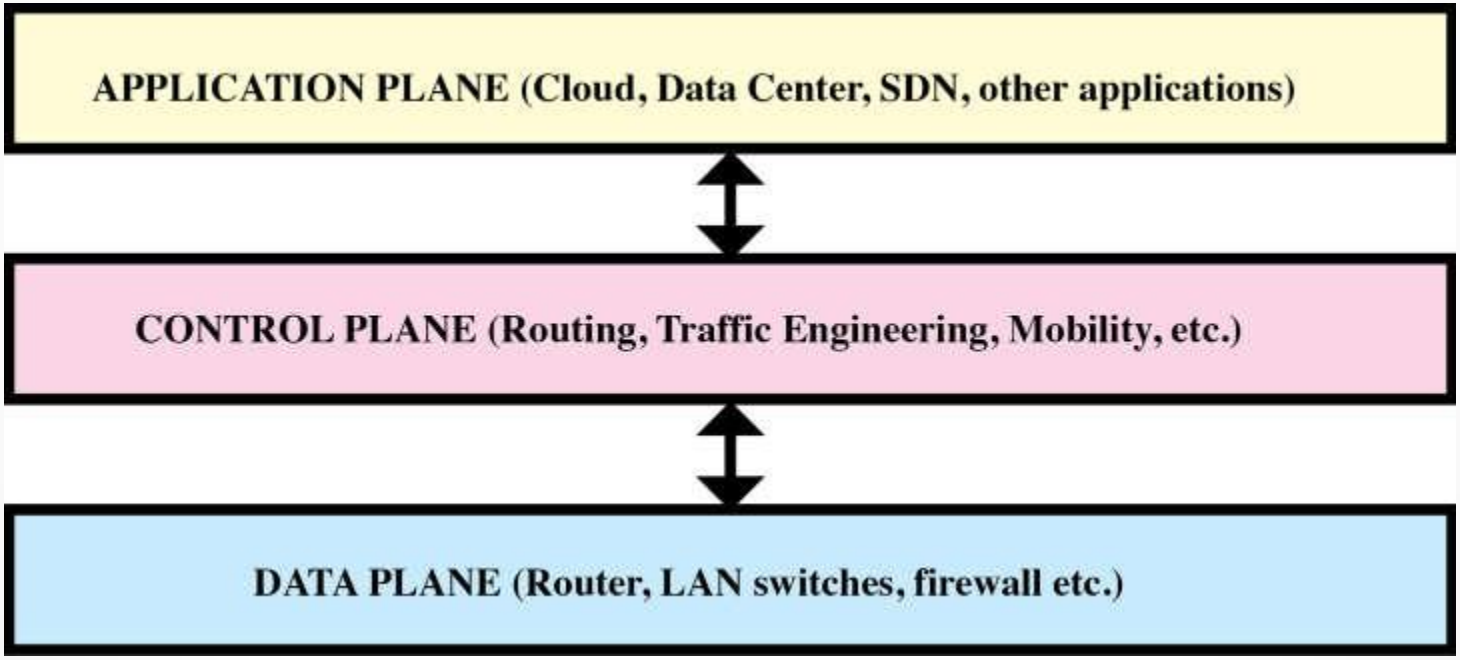

Control Engine
Packet Forwarding Engine
Matrix
Packet Forwarding Engine
External Control
Internal Control
Data

SDN != OpenFlow

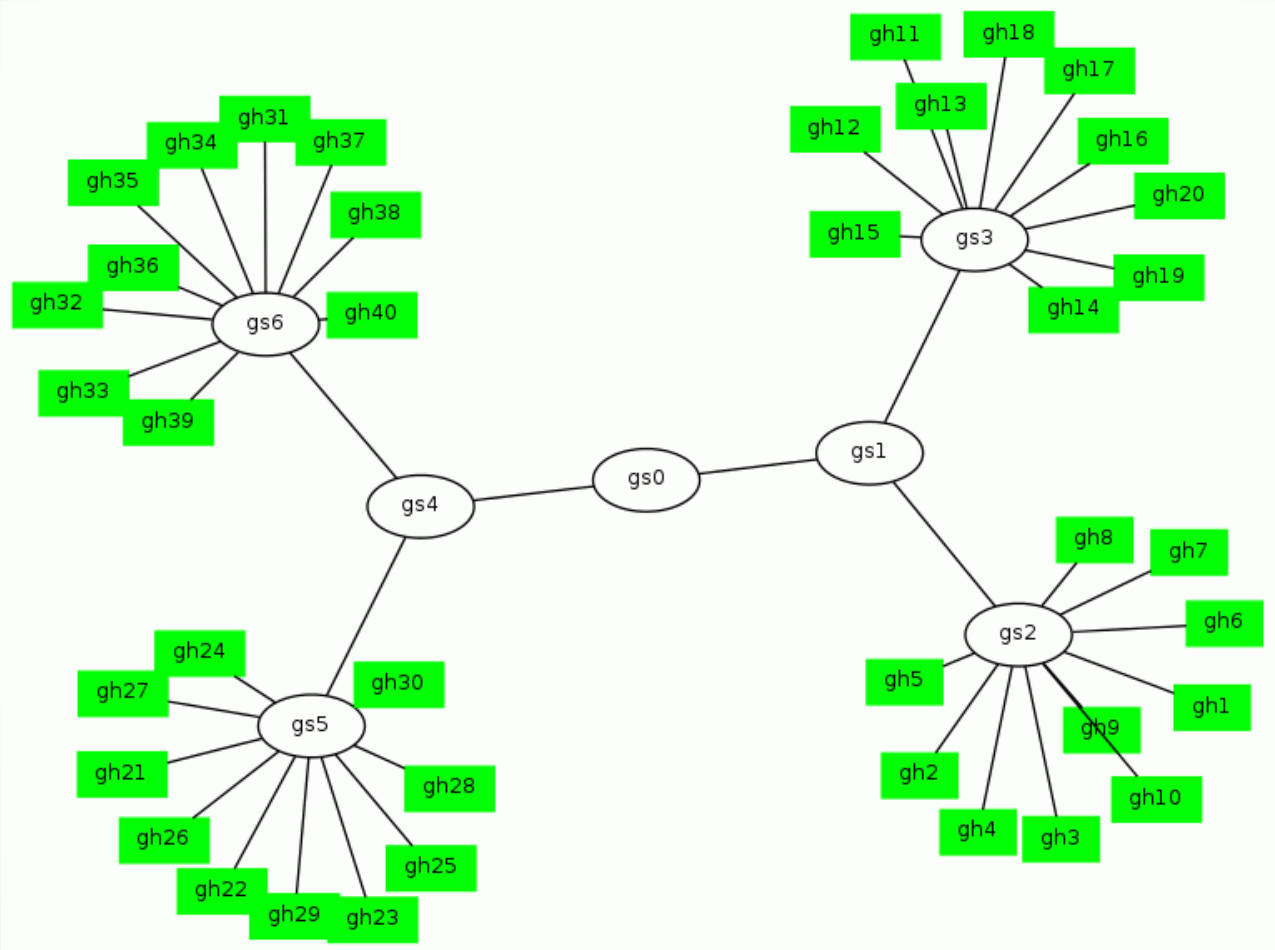
Достоинства SDN

- Независимость от вендора
- Программируемость
- Гибкость
- Масштабируемость
- Упрощенная топология сети
- etc…

Архитектура SDN

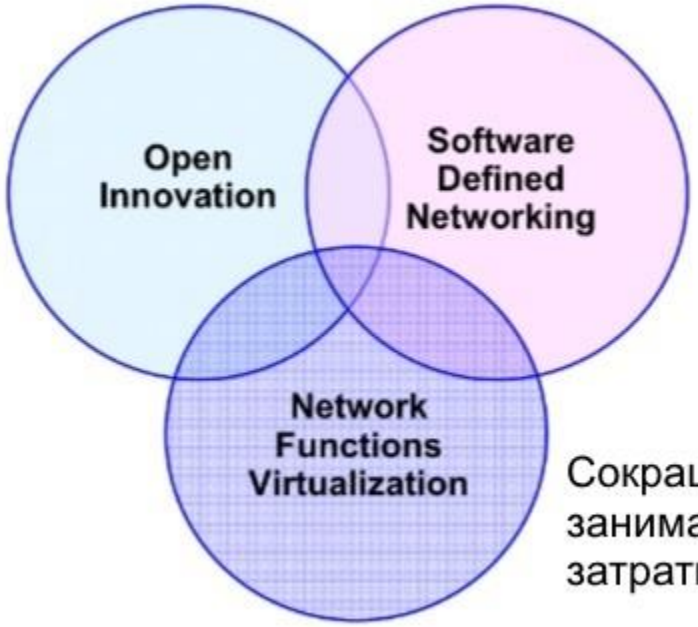


Топология сети



Netrwok Function Virtualization

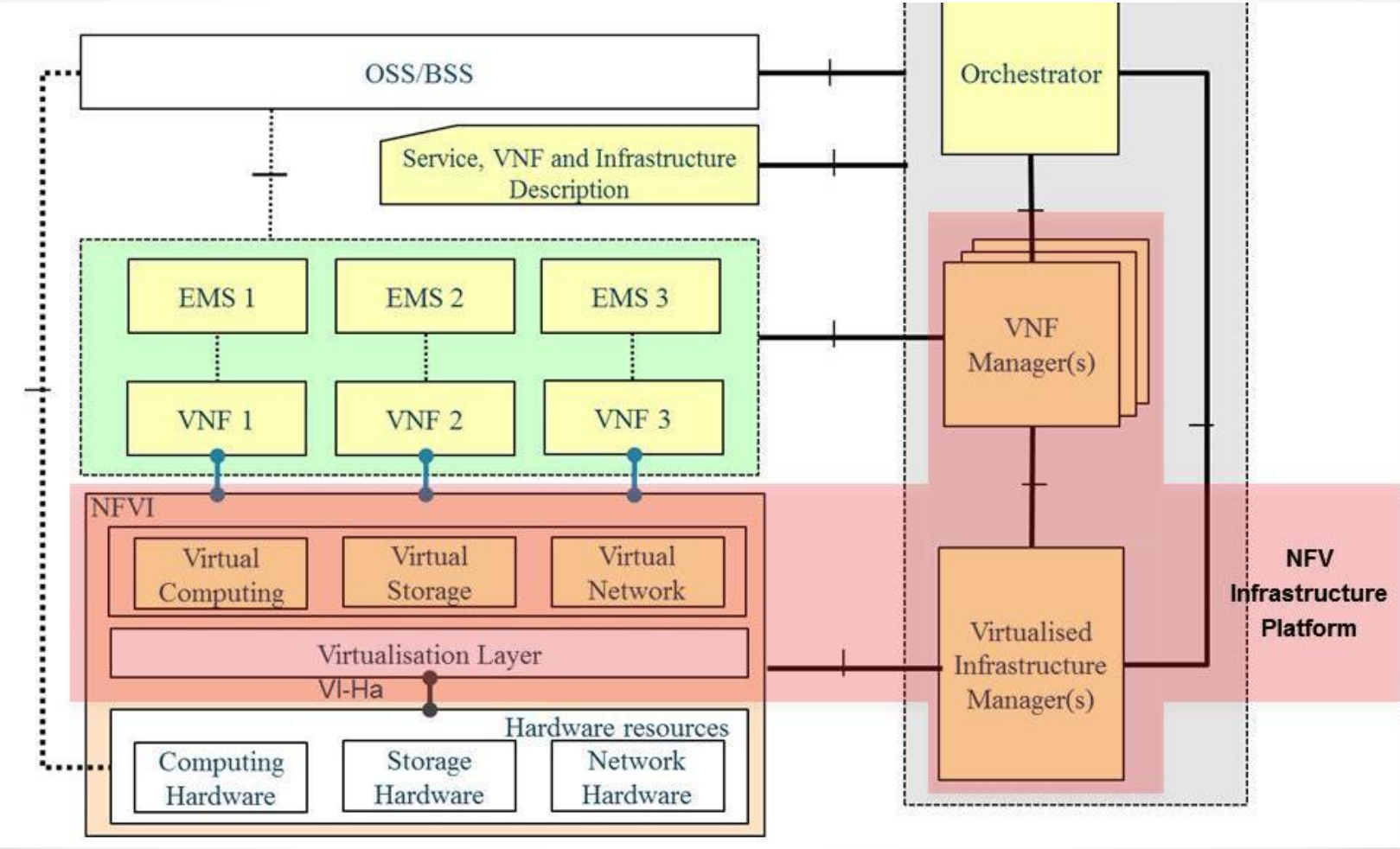
Создаёт конкуретное предложение на базе инновационных приложений

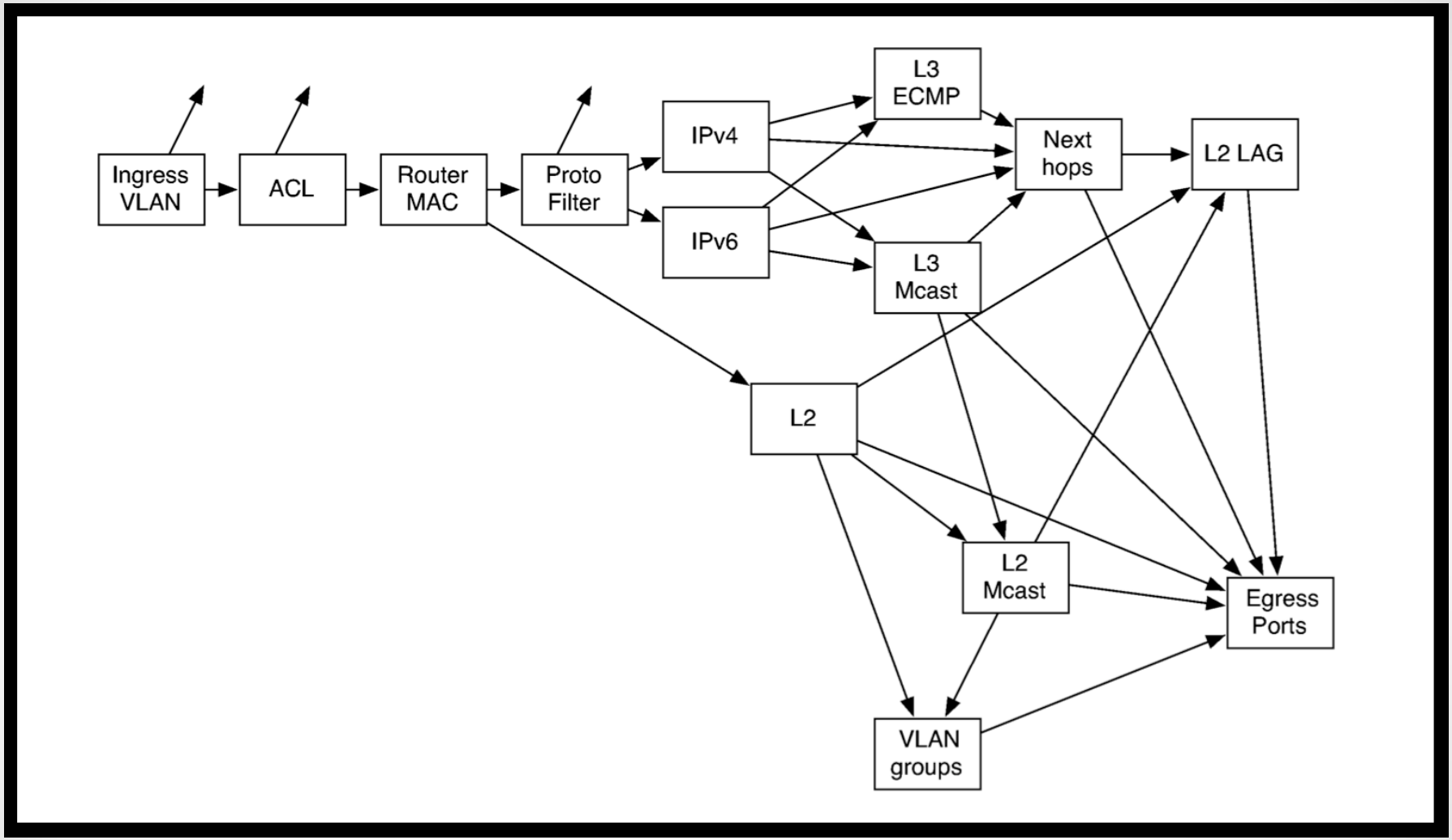


Создаёт абстракцию сети для ускорения инноваций

Сокращает CAPEX, OPEX, занимаемое пространство и затраты энергии

Managment and Orchestration





OpenFlow

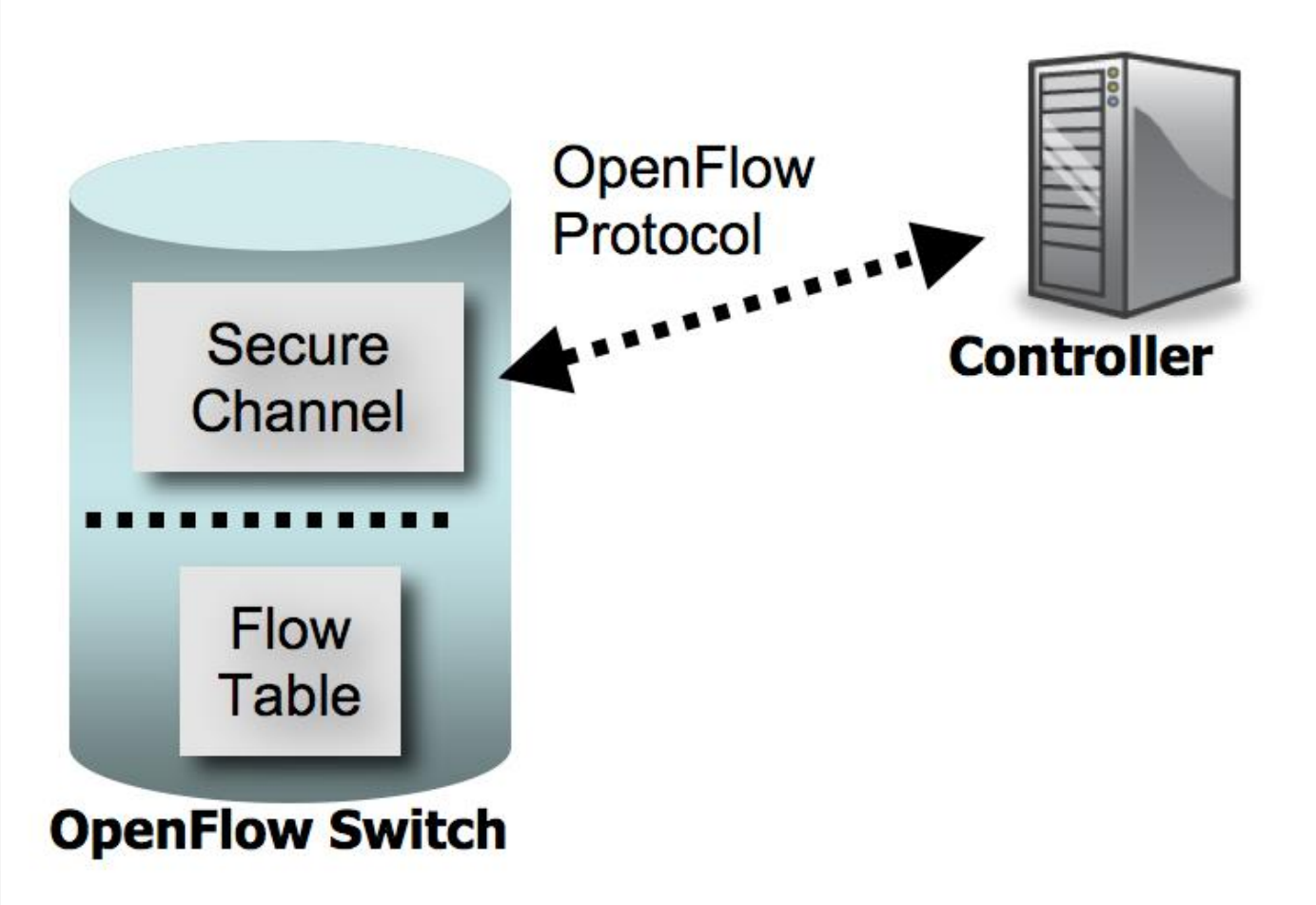
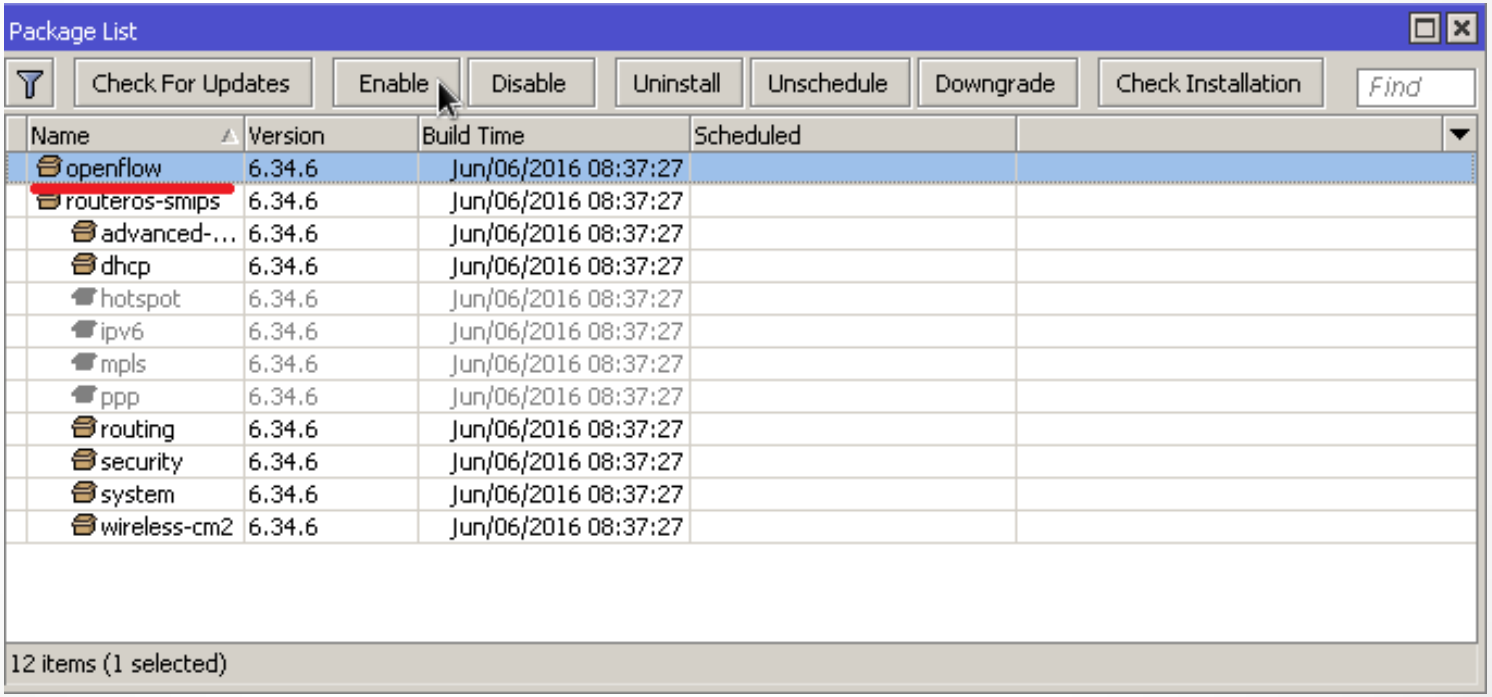

OpenFlow
Protocol
Secure
Channel
Flow
Table
Controller
OpenFlow Switch

Таблица Lookup

Port	Src MAC	Dst MAC	VLAN ID	Priority	EtherType	Src IP	Dst IP	IP Proto	IP ToS	Src L4 Port ICMP Type	Dst L4 Port ICMP Code	Action	Counter
*	*	0A:C8:*	*	*	*	*	*	*	*	*	*	Port 1	102
*	*	*	*	*	*	*	192.168.*.*	*	*	*	*	Port 2	202
*	*	*	*	*	*	*	*	*	*	21	21	Drop	420
*	*	*	*	*	*	*	*	0x806	*	*	*	Local	444
*	*	*	*	*	*	*	*	0x1*	*	*	*	Controller	1

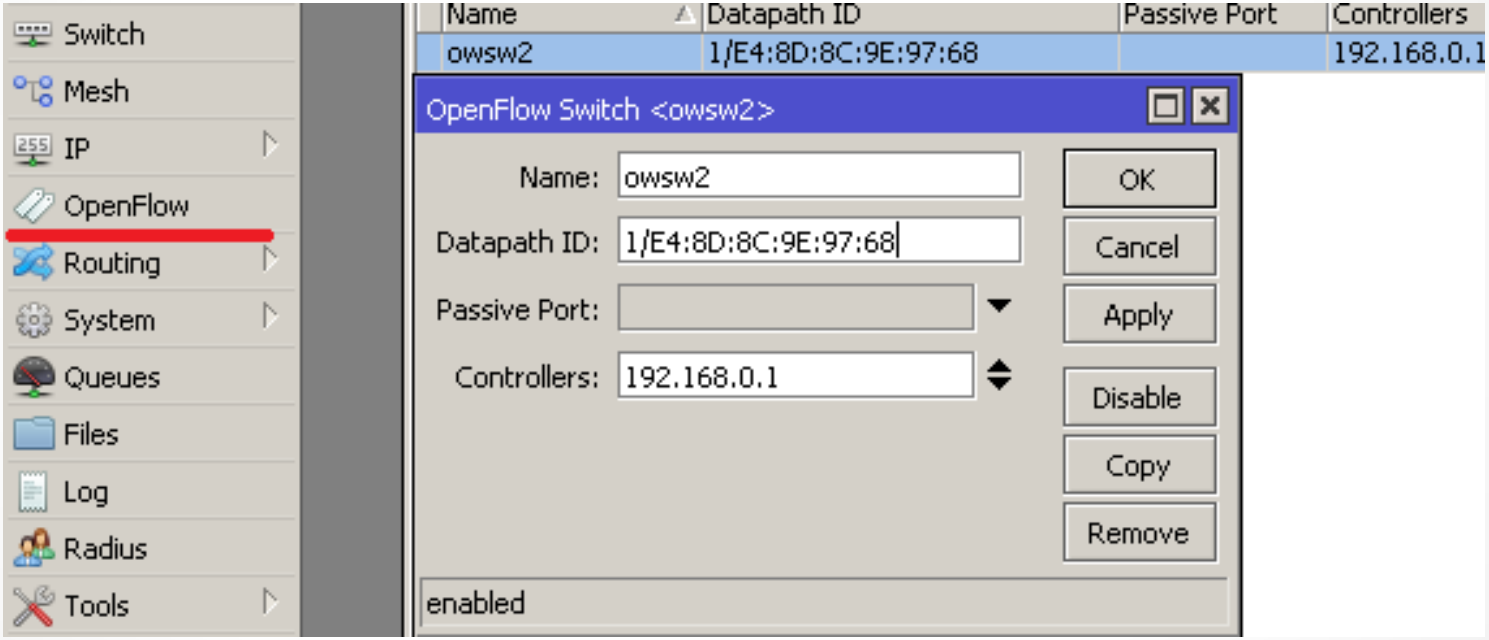
OF at RouterOS

- 1) Установка OpenFlow Package:



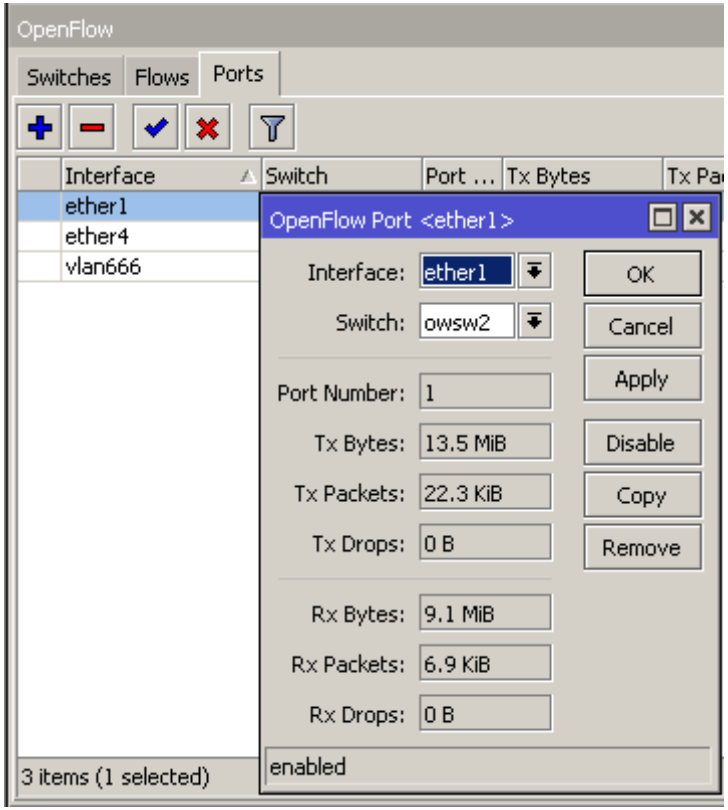
OF at RouterOS

- 2) Настройка OFSwitch:



OF at RouterOS

- 3) Добавление портов в OFSwitch:



OF at RouterOS

- 4) Проверяем связь с контроллером:

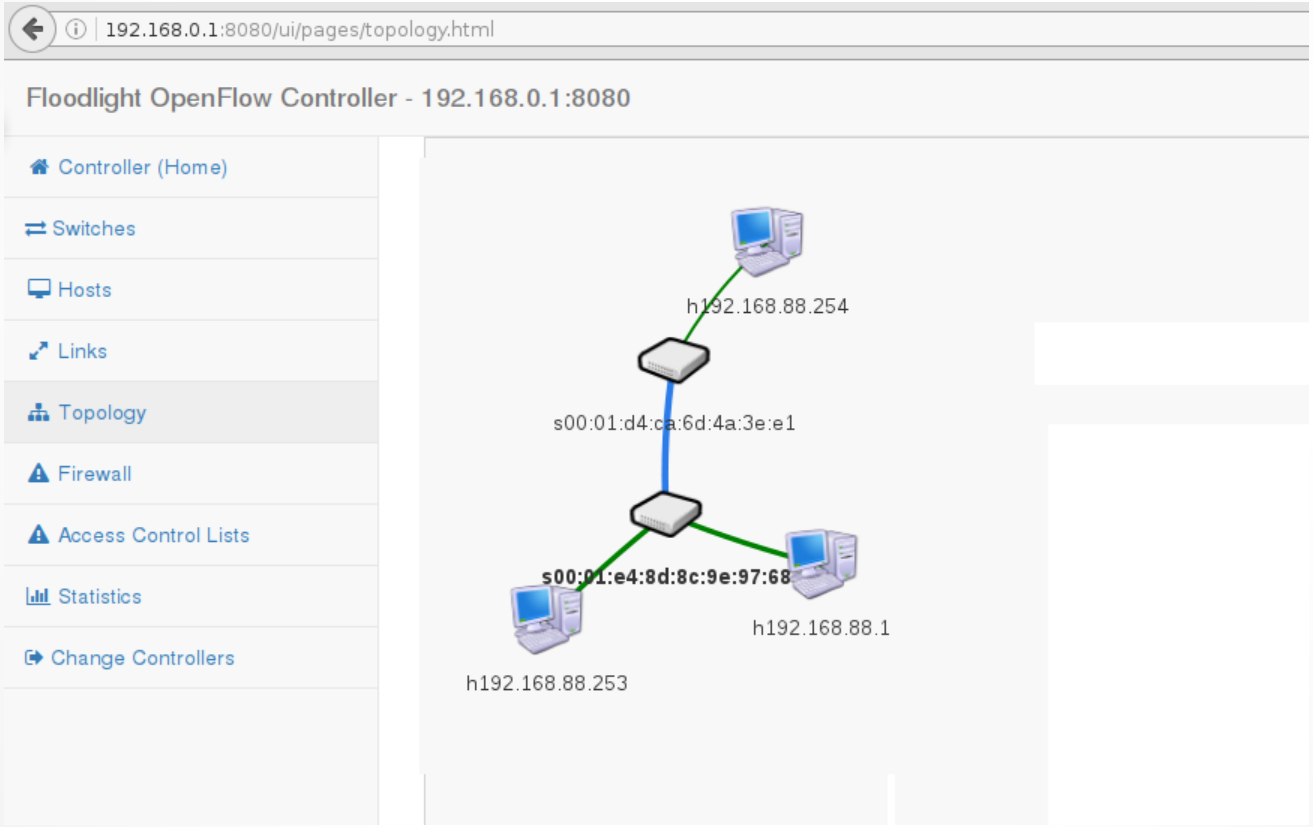
1318	5069.031768924	192.168.0.4	192.168.0.1	TCP	74 38299 → 6633 [SYN] Seq=0 Win=1
1319	5069.031822820	192.168.0.1	192.168.0.4	TCP	54 6633 → 38299 [RST, ACK] Seq=1
1320	5079.041763613	192.168.0.4	192.168.0.1	TCP	74 38300 → 6633 [SYN] Seq=0 Win=1
1321	5079.041813035	192.168.0.1	192.168.0.4	TCP	74 6633 → 38300 [SYN, ACK] Seq=0
1322	5079.042126266	192.168.0.4	192.168.0.1	TCP	66 38300 → 6633 [ACK] Seq=1 Ack=1
1323	5079.042361629	192.168.0.4	192.168.0.1	OpenFlow	74 Type: OFPT_HELLO
1324	5079.042375100	192.168.0.1	192.168.0.4	TCP	66 6633 → 38300 [ACK] Seq=1 Ack=9
1325	5079.241867841	192.168.0.1	192.168.0.4	OpenFlow	74 Type: OFPT_HELLO
1326	5079.242230047	192.168.0.4	192.168.0.1	TCP	66 38300 → 6633 [ACK] Seq=9 Ack=9
1327	5079.279882668	192.168.0.1	192.168.0.4	OpenFlow	74 Type: OFPT_FEATURES_REQUEST
1328	5079.280291502	192.168.0.4	192.168.0.1	TCP	66 38300 → 6633 [ACK] Seq=9 Ack=1
1329	5079.280498337	192.168.0.4	192.168.0.1	OpenFlow	194 Type: OFPT_FEATURES_REPLY
1330	5079.280511322	192.168.0.1	192.168.0.4	TCP	66 6633 → 38300 [ACK] Seq=17 Ack=
1331	5079.426343215	192.168.0.1	192.168.0.4	OpenFlow	94 Type: OFPT_GET_CONFIG_REQUEST
1332	5079.426909652	192.168.0.4	192.168.0.1	OpenFlow	74 Type: OFPT_BARRIER_REPLY
1333	5079.426934624	192.168.0.1	192.168.0.4	TCP	66 6633 → 38300 [ACK] Seq=45 Ack=
1334	5079.427222223	192.168.0.4	192.168.0.1	OpenFlow	78 Type: OFPT_GET_CONFIG_REPLY
1335	5079.427232092	192.168.0.1	192.168.0.4	TCP	66 6633 → 38300 [ACK] Seq=45 Ack=
1336	5079.481503179	192.168.0.1	192.168.0.4	OpenFlow	78 Type: OFPT_STATS_REQUEST
1337	5079.482569234	192.168.0.4	192.168.0.1	OpenFlow	1134 Type: OFPT_STATS_REPLY
1338	5079.482616242	192.168.0.1	192.168.0.4	TCP	66 6633 → 38300 [ACK] Seq=57 Ack=
1339	5079.666324472	192.168.0.1	192.168.0.4	OpenFlow	86 Type: OFPT_VENDOR

POX

```
POX 0.2.0 (carp) / Copyright 2011-2013 James McCauley, et al.
INFO:host_tracker:host_tracker ready
INFO:core:POX 0.2.0 (carp) is up.
INFO:openflow.of_01:[e4-8d-8c-9e-97-68|1 2] connected
INFO:openflow.of_01:[d4-ca-6d-4a-3e-e1|1 1] connected
INFO:host_tracker:Learned 532771577436008 1 d4:ca:6d:4a:3e:e2
INFO:host_tracker:Learned 532771577436008 1 d4:ca:6d:4a:3e:e2 got IP 192.168.88.253
INFO:host_tracker:Learned 532771577436008 2 e4:8d:8c:4d:c2:b6
INFO:host_tracker:Learned 532771577436008 2 e4:8d:8c:4d:c2:b6 got IP 0.0.0.0
INFO:host_tracker:Learned 515440858775265 1 18:03:73:58:4f:1b
INFO:host_tracker:Learned 515440858775265 1 18:03:73:58:4f:1b got IP 192.168.88.254
INFO:openflow.discovery:link detected: e4-8d-8c-9e-97-68|1.4 -> d4-ca-6d-4a-3e-e1|1.4
INFO:host_tracker:Learned 532771577436008 2 e4:8d:8c:4d:c2:b6 got IP 192.168.88.1
INFO:openflow.discovery:link detected: d4-ca-6d-4a-3e-e1|1.4 -> e4-8d-8c-9e-97-68|1.4
```

FloodLight

- 1) Топология:



FloodLight

- 2) Клиентские устройства:

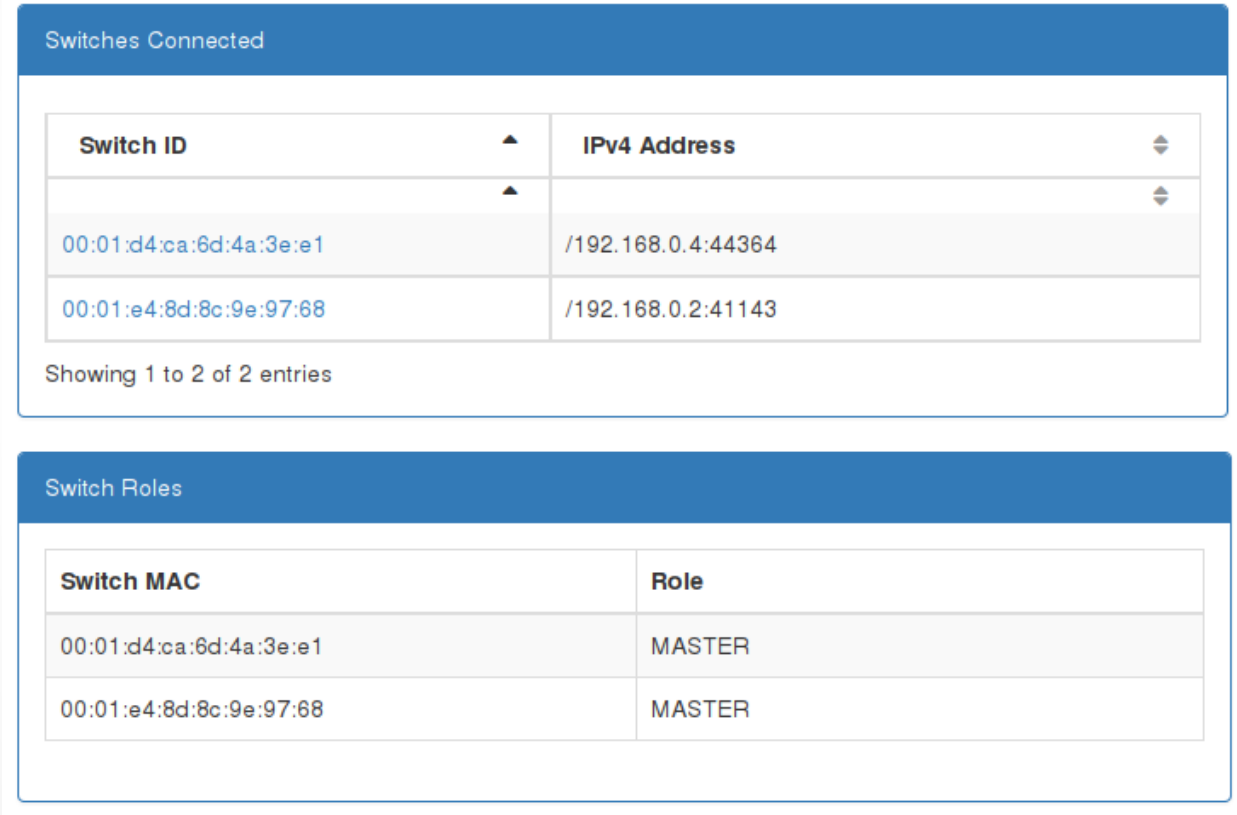
Hosts Connected

MAC	IPv4 Address	IPv6 Address	Switch	Port	Last Seen
18:03:73:58:4f:1b	192.168.88.254	fe80::291b:b3ae:aaac:2c80	00:01:d4:ca:6d:4a:3e:e1	1	1475128481865
d4:ca:6d:4a:3e:e0					1475126917851
d4:ca:6d:4a:3e:e2	192.168.88.253		00:01:e4:8d:8c:9e:97:68	1	1475128481863
d4:ca:6d:4a:3e:e3					1475122884761
e4:8d:8c:4d:c2:b6	192.168.88.1		00:01:e4:8d:8c:9e:97:68	2	1475128477243
e4:8d:8c:9e:97:69	192.168.0.2				1475126911455

Showing 1 to 6 of 6 entries

FloodLight

- 3) Список FW-устройств:



Switches Connected

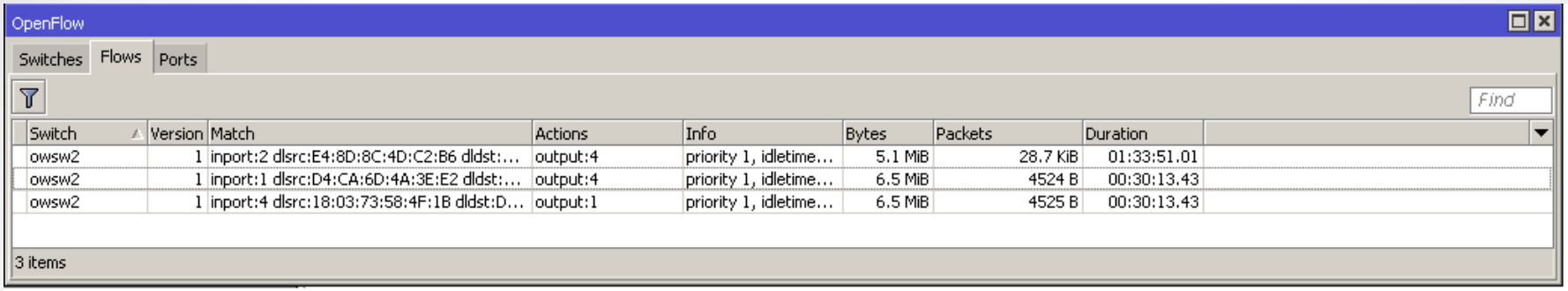
Switch ID	IPv4 Address
00:01:d4:ca:6d:4a:3e:e1	/192.168.0.4:44364
00:01:e4:8d:8c:9e:97:68	/192.168.0.2:41143

Showing 1 to 2 of 2 entries

Switch Roles

Switch MAC	Role
00:01:d4:ca:6d:4a:3e:e1	MASTER
00:01:e4:8d:8c:9e:97:68	MASTER

Flows




```
Flow 0:
  Packet count: "29322"
  Matches: {"in_port":"2","eth_src":'e4:8d:8c:4d:c2:b6',"eth_dst":"18:03:73:58:4f:1b","eth_type":'0x800',"ipv4_src":"192.168.88.1","ipv4_dst":"192.168.88.25
  Actions: "output=4"
Flow 1:
  Packet count: "4507"
  Matches: {"in_port":"1","eth_src":'d4:ca:6d:4a:3e:e2","eth_dst":"18:03:73:58:4f:1b","eth_type":"0x800","ipv4_src":"192.168.88.253","ipv4_dst":'192.168.88.
  Actions: "output=4"
Flow 2:
  Packet count: "4508"
  Matches: {"in_port":"4","eth_src":'18:03:73:58:4f:1b","eth_dst":"d4:ca:6d:4a:3e:e2","eth_type":"0x800","ipv4_src":"192.168.88.254","ipv4_dst":'192.168.88.
  Actions: "output=1"
```

Выводы

- **SDN это круто**
- **SDN + NFV это очень круто**

Спасибо за внимание !

- **Вопросы ?**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