

Software-Defined Networking

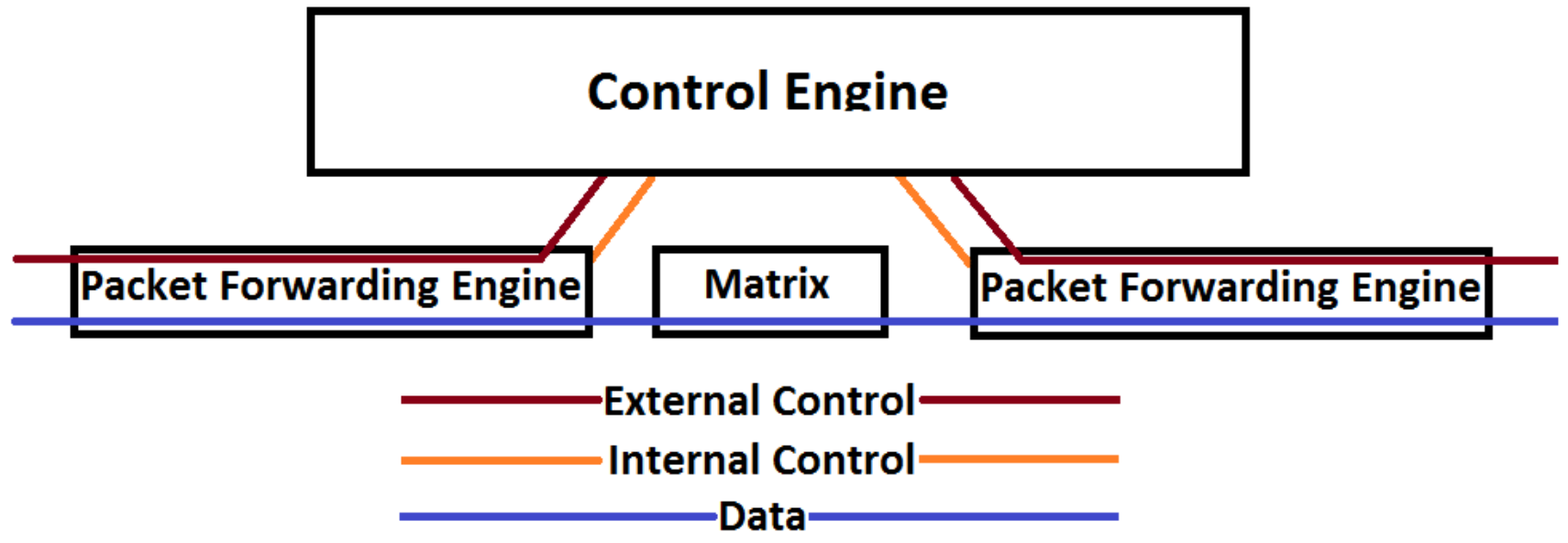
Vladimir Korablev

Введение

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

SDN



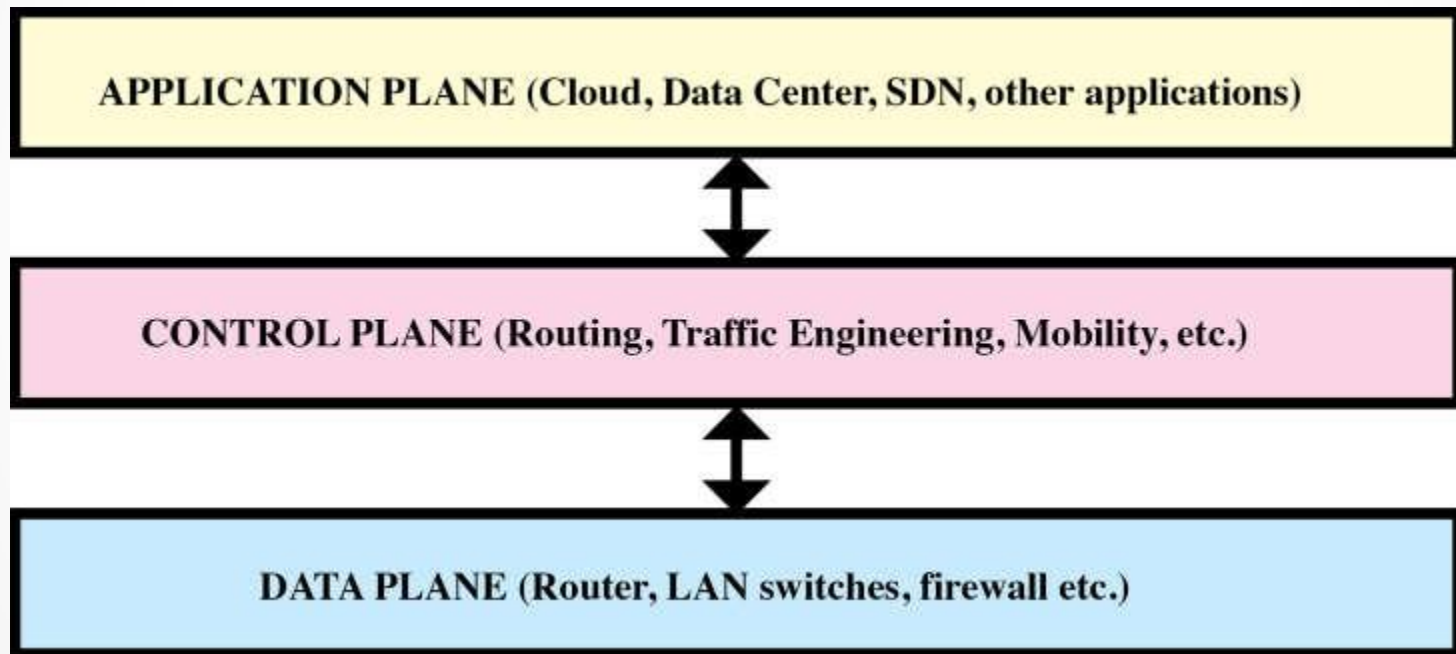


SDN != OpenFlow

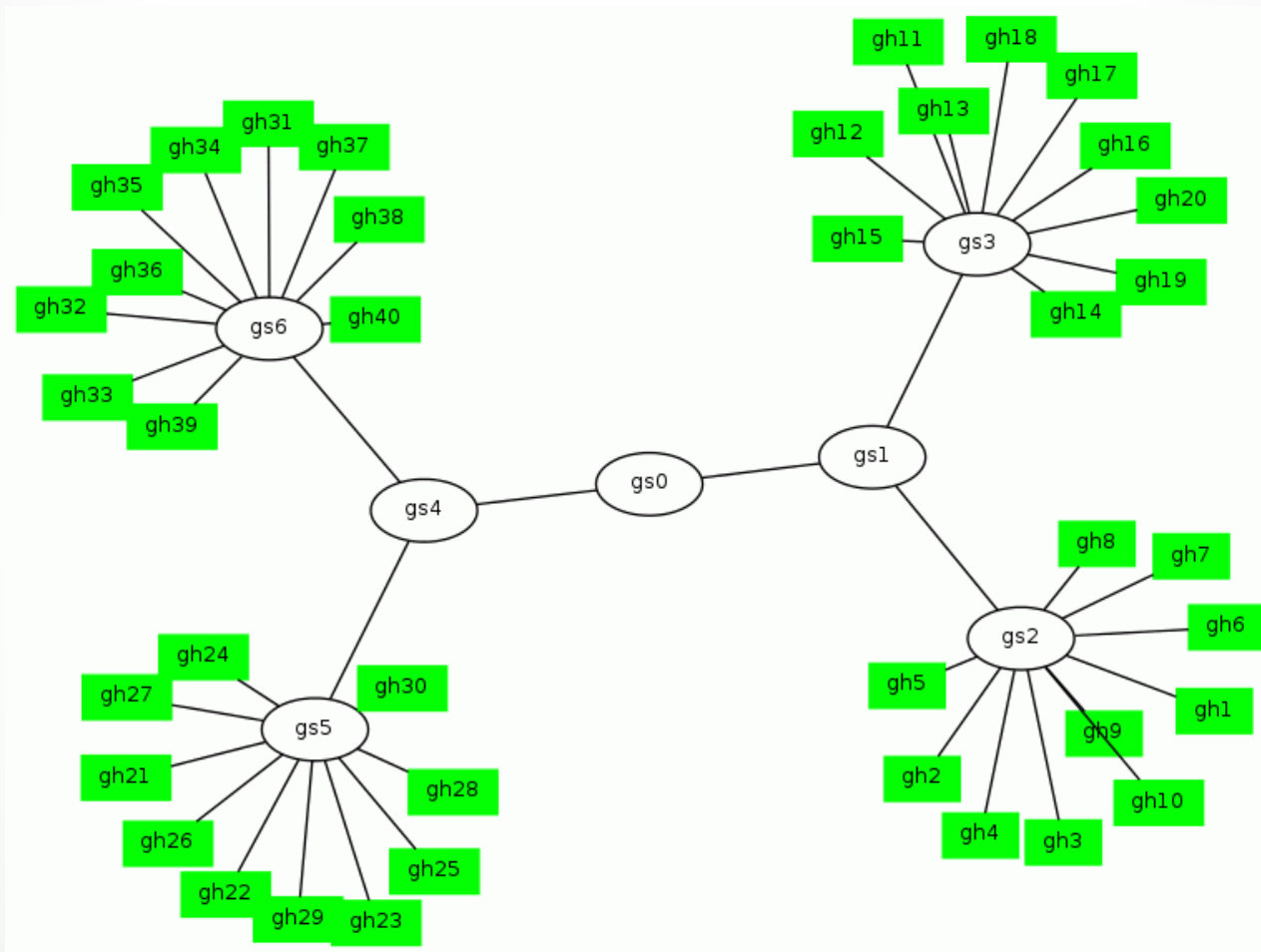
Достоинства SDN

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

Архитектура SDN

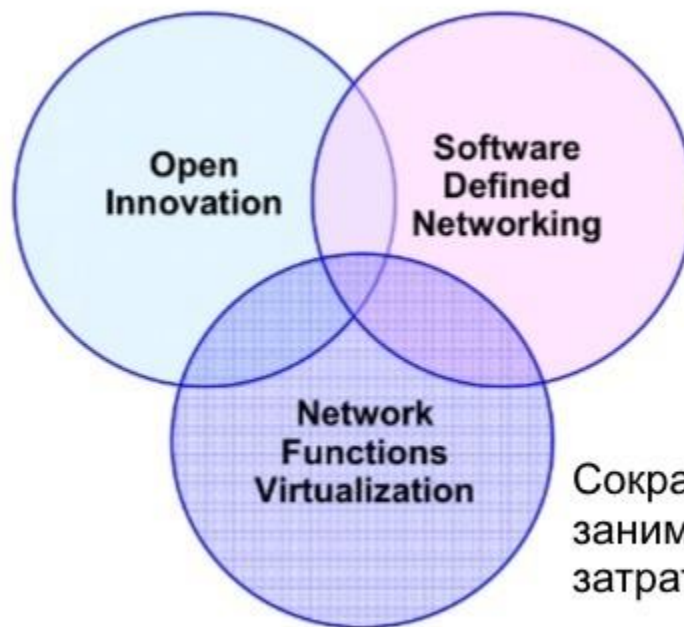


Топология сети



Network Function Virtualization

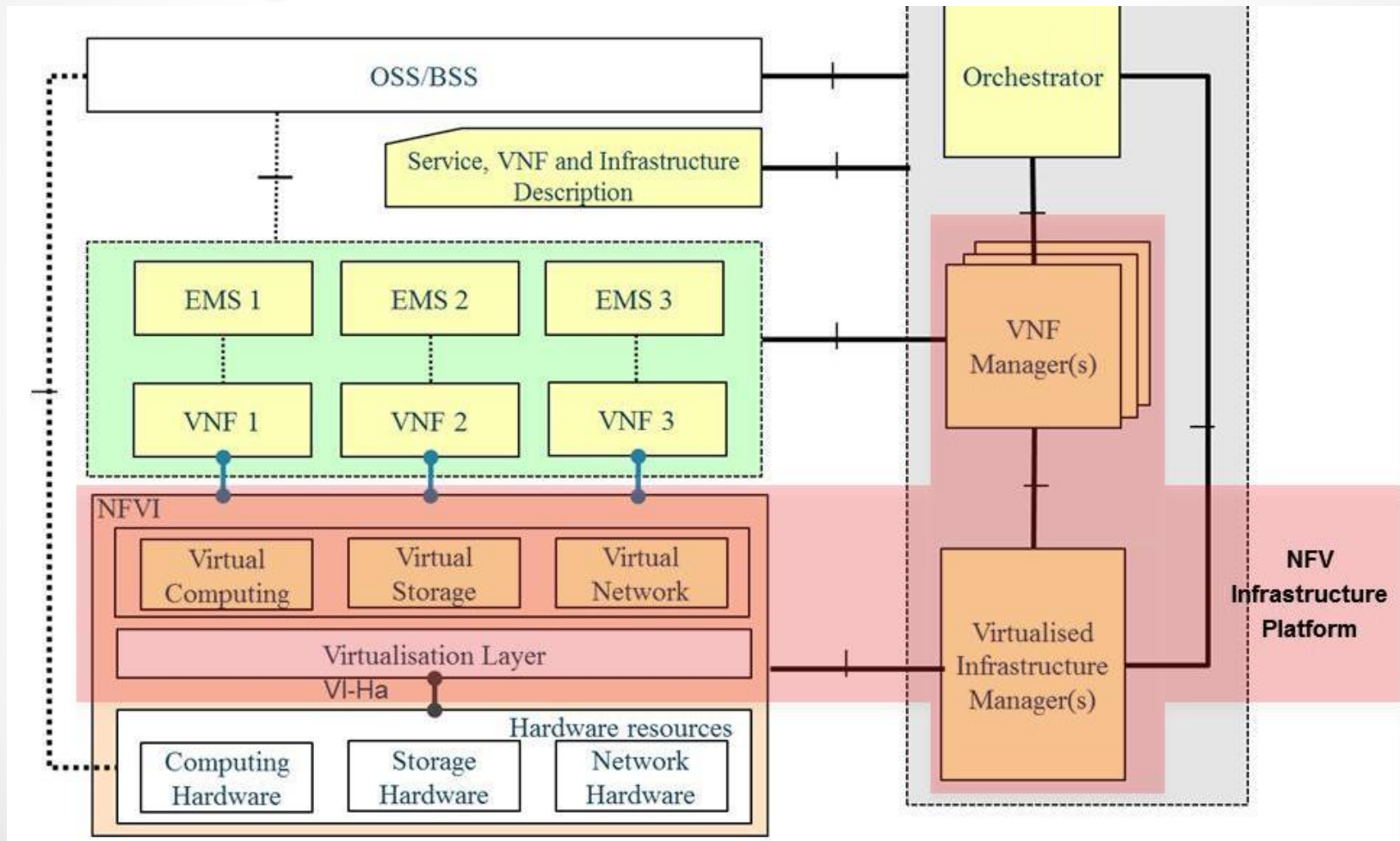
Создаёт конкурентное предложение на базе инновационных приложений

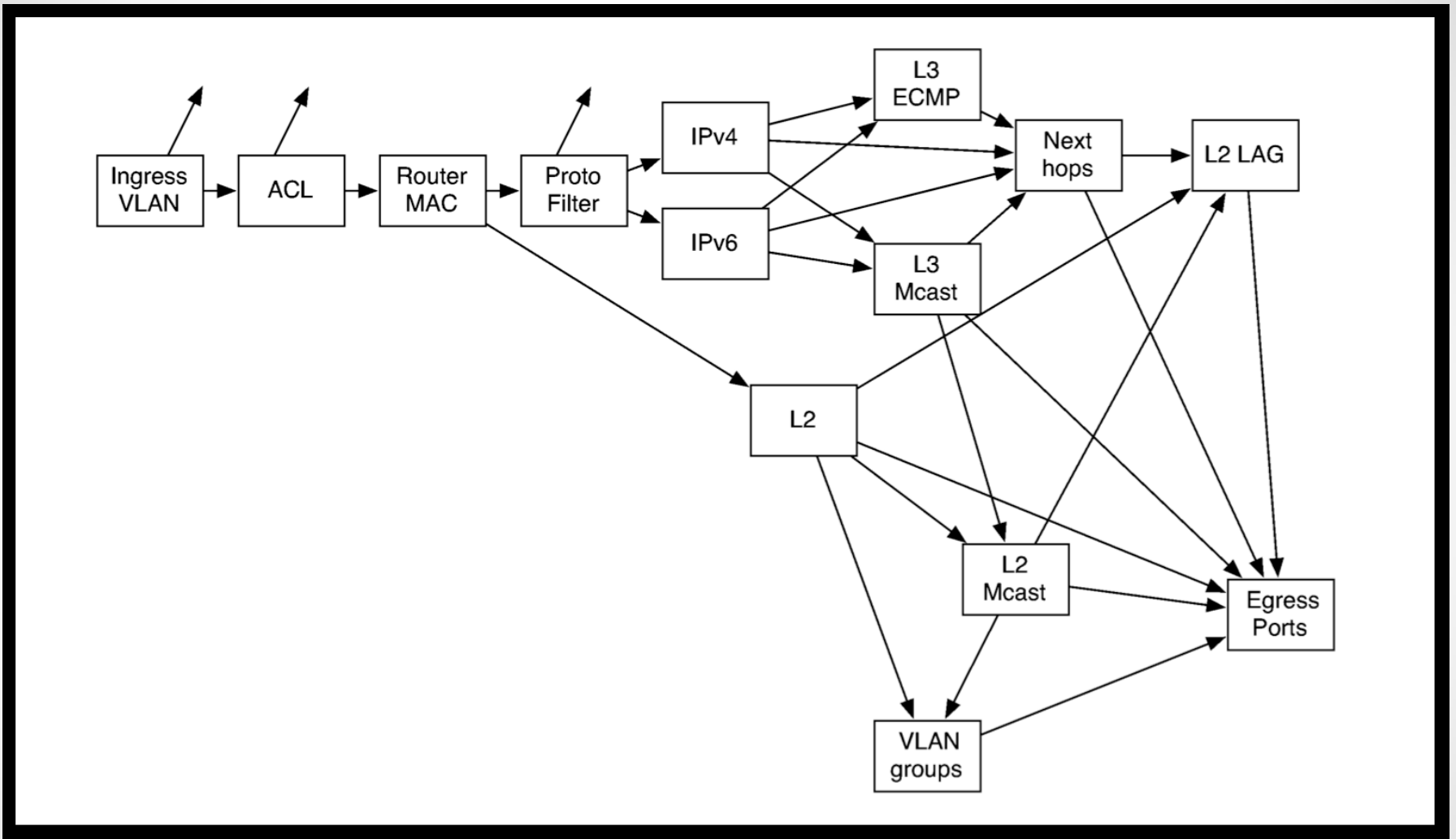


Создаёт абстракцию сети для ускорения инноваций

Сокращает CAPEX, OPEX, занимаемое пространство и затраты энергии

Management and Orchestration





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OpenFlow

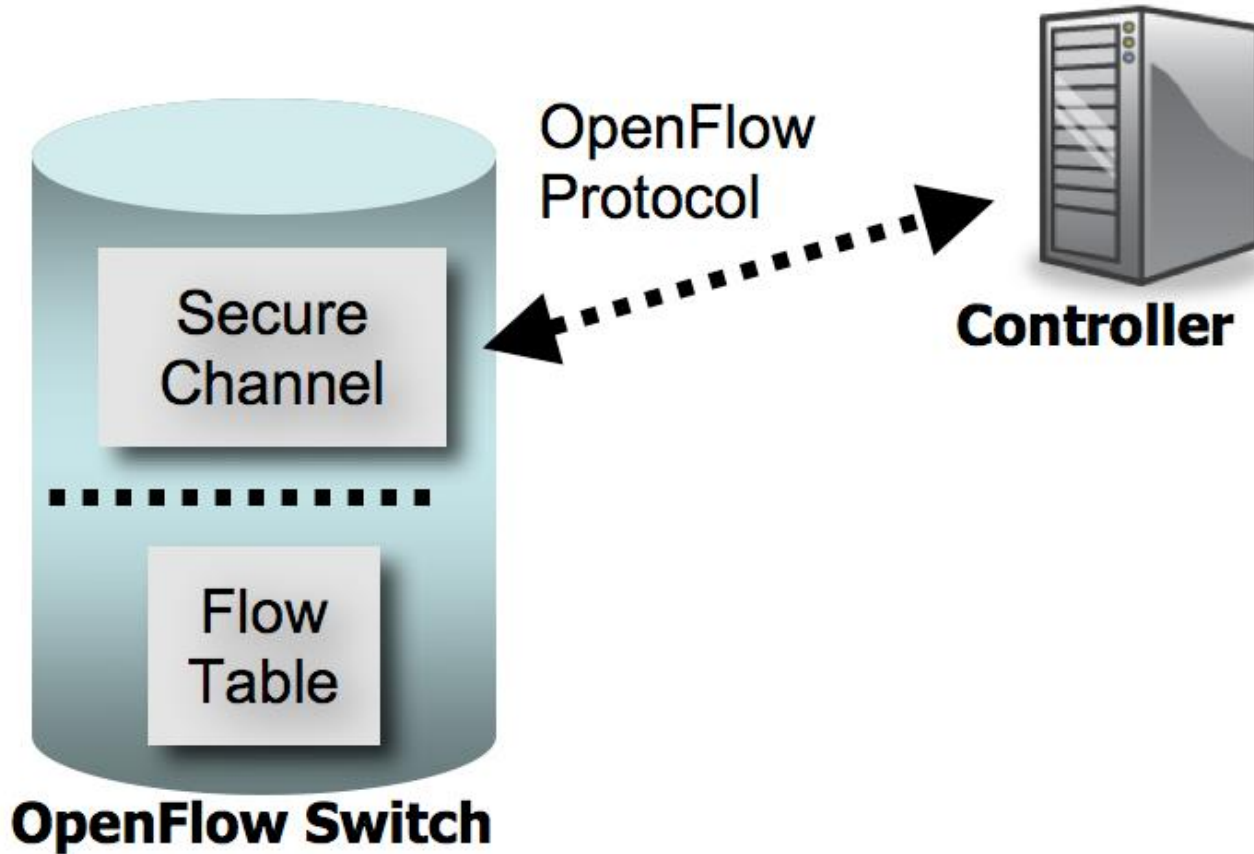
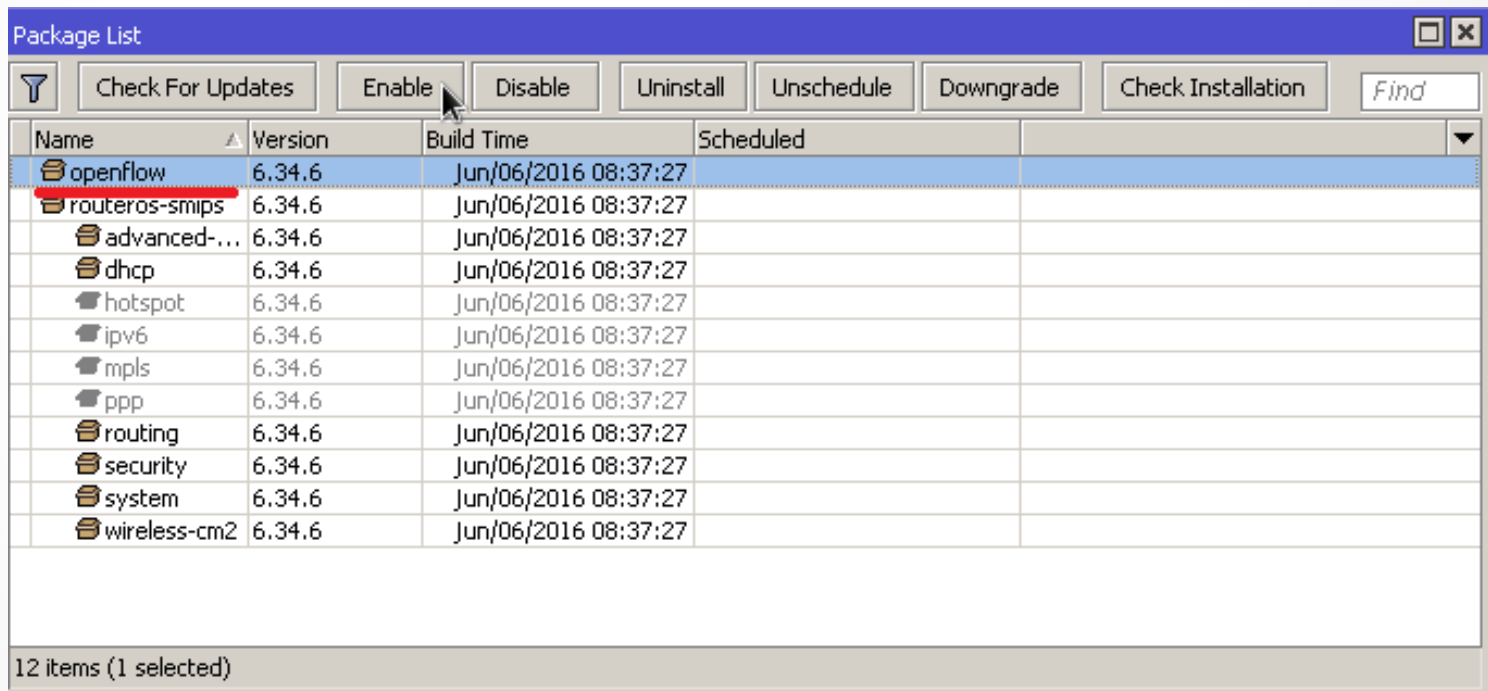


Таблица Lookup

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:



Package List

Check For Updates Enable Disable Uninstall Unschedule Downgrade Check Installation Find

Name	Version	Build Time	Scheduled
openflow	6.34.6	Jun/06/2016 08:37:27	
routeros-smips	6.34.6	Jun/06/2016 08:37:27	
advanced-...	6.34.6	Jun/06/2016 08:37:27	
dhcp	6.34.6	Jun/06/2016 08:37:27	
hotspot	6.34.6	Jun/06/2016 08:37:27	
ipv6	6.34.6	Jun/06/2016 08:37:27	
mpls	6.34.6	Jun/06/2016 08:37:27	
ppp	6.34.6	Jun/06/2016 08:37:27	
routing	6.34.6	Jun/06/2016 08:37:27	
security	6.34.6	Jun/06/2016 08:37:27	
system	6.34.6	Jun/06/2016 08:37:27	
wireless-cm2	6.34.6	Jun/06/2016 08:37:27	

12 items (1 selected)

OF at RouterOS

- 2) Настройка OFSwitch:

The screenshot shows the RouterOS configuration interface for an OpenFlow Switch. On the left is a sidebar menu with options: Switch, Mesh, IP, OpenFlow (highlighted with a red bar), Routing, System, Queues, Files, Log, Radius, and Tools. The main area displays a table of OpenFlow Switches and a configuration dialog for the selected switch 'owsw2'.

Name	Datapath ID	Passive Port	Controllers
owsw2	1/E4:8D:8C:9E:97:68		192.168.0.1

OpenFlow Switch <owsw2>

Name:

Datapath ID:

Passive Port:

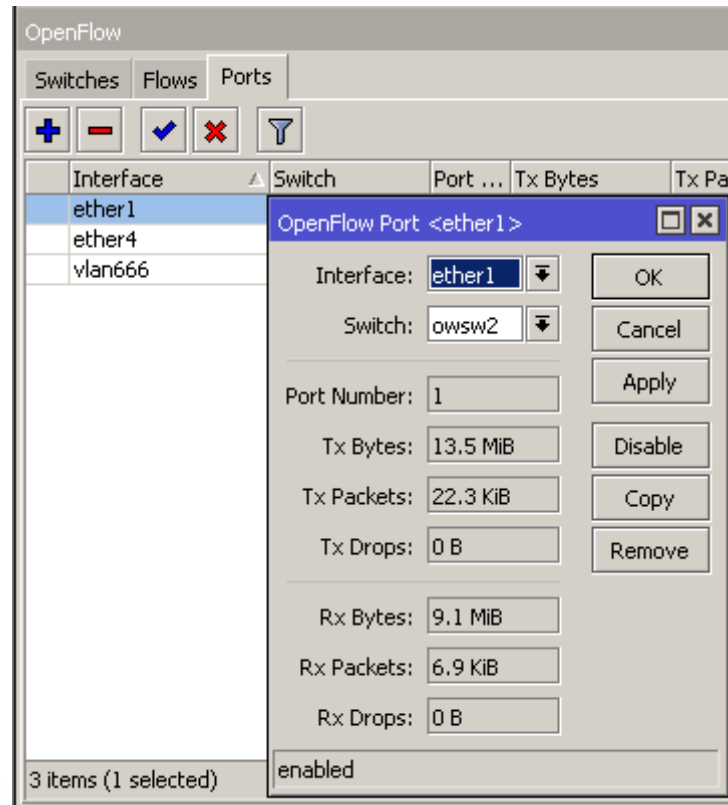
Controllers:

Buttons: OK, Cancel, Apply, Disable, Copy, Remove

enabled

OF at RouterOS

- 3) Добавление портов в OFSwitch:



OF at RouterOS

- 4) Проверяем связь с контроллером:

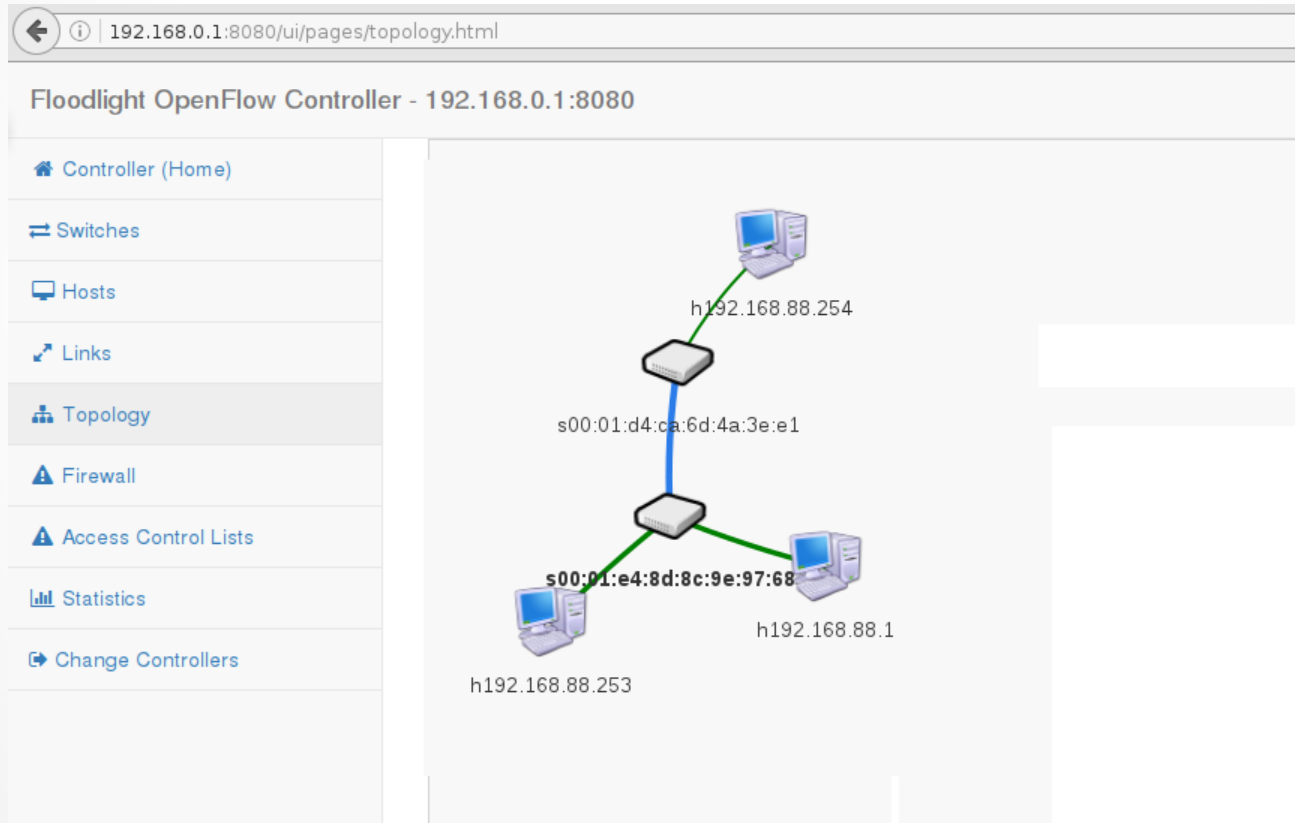
1318	5069.031768924	192.168.0.4	192.168.0.1	TCP	74	38299 → 6633 [SYN] Seq=0 Win=1
1319	5069.031822820	192.168.0.1	192.168.0.4	TCP	54	6633 → 38299 [RST, ACK] Seq=1
1320	5079.041763613	192.168.0.4	192.168.0.1	TCP	74	38300 → 6633 [SYN] Seq=0 Win=1
1321	5079.041813035	192.168.0.1	192.168.0.4	TCP	74	6633 → 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

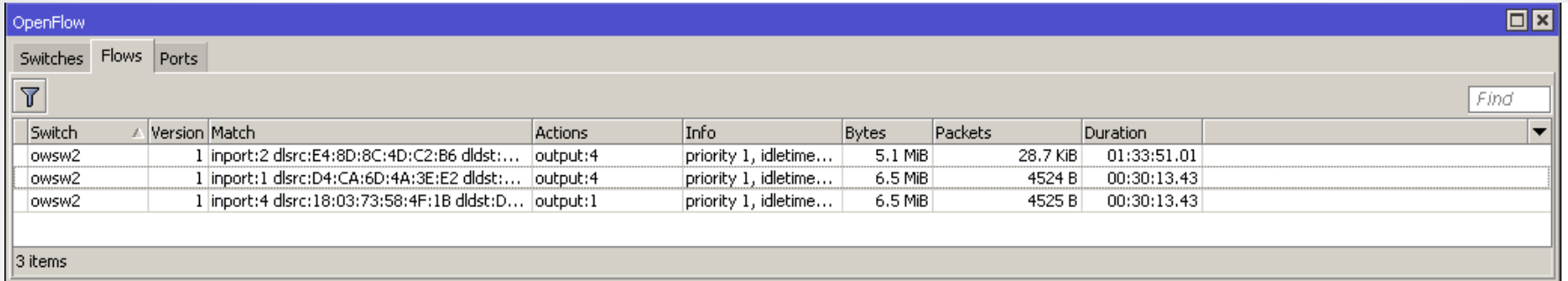
- 3) Список FW-устройств:

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



OpenFlow

Switches Flows Ports

Find

Switch	Version	Match	Actions	Info	Bytes	Packets	Duration
ows2	1	inport:2 dsrc:E4:8D:8C:4D:C2:B6 dldst:...	output:4	priority 1, idletime...	5.1 MIB	28.7 KIB	01:33:51.01
ows2	1	inport:1 dsrc:D4:CA:6D:4A:3E:E2 dldst:...	output:4	priority 1, idletime...	6.5 MIB	4524 B	00:30:13.43
ows2	1	inport:4 dsrc:18:03:73:58:4F:1B dldst:D...	output:1	priority 1, idletime...	6.5 MIB	4525 B	00:30:13.43

3 items

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": "192.168.88.253"}

Actions: "output=4"

Flow 1:

Packet count: "4507"

Matches: {"in_port": "1", "eth_src": "c4:ca:6d:4a:3e:e2", "eth_dst": "18:03:73:58:4f:1b", "eth_type": "0x800", "ipv4_src": "192.168.88.253", "ipv4_dst": "192.168.88.1"}

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": "192.168.88.1"}

Actions: "output=1"

ВЫВОДЫ

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

Спасибо за внимание !

- **Вопросы ?**



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