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Pentesting in SDN

Owning the controllers

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Who Am I?

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Conviso Application Security

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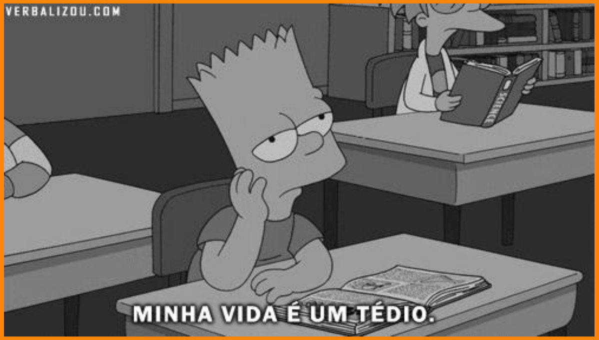
- Network (traditional)
- SDN Overview
- Threat Vectors
- Pentesting
- Defense
- Future

Traditionally...

- Specific Vendors;
- Scalability;
- Complexity;
- Hardware Focus;
- Interoperability;
- etc...



https://33.media.tumblr.com/tumblr_m8gl3iiTk51qjve0go1_500.gif

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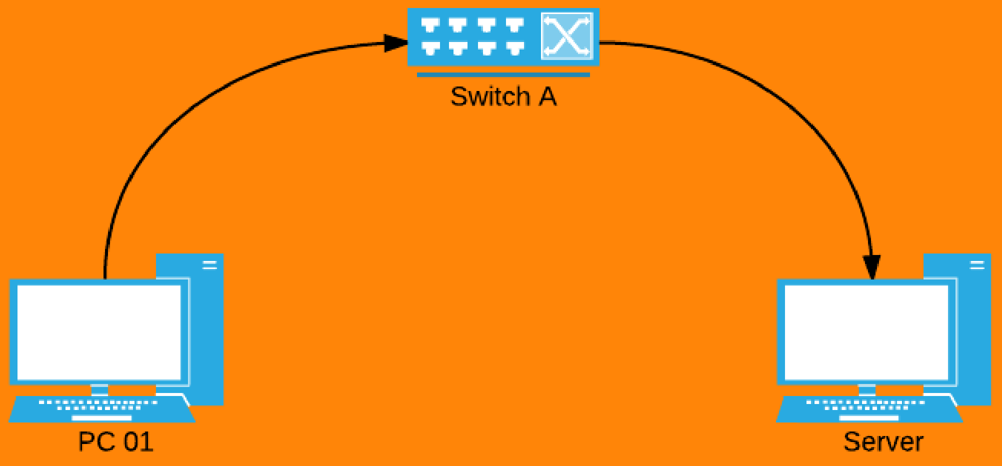
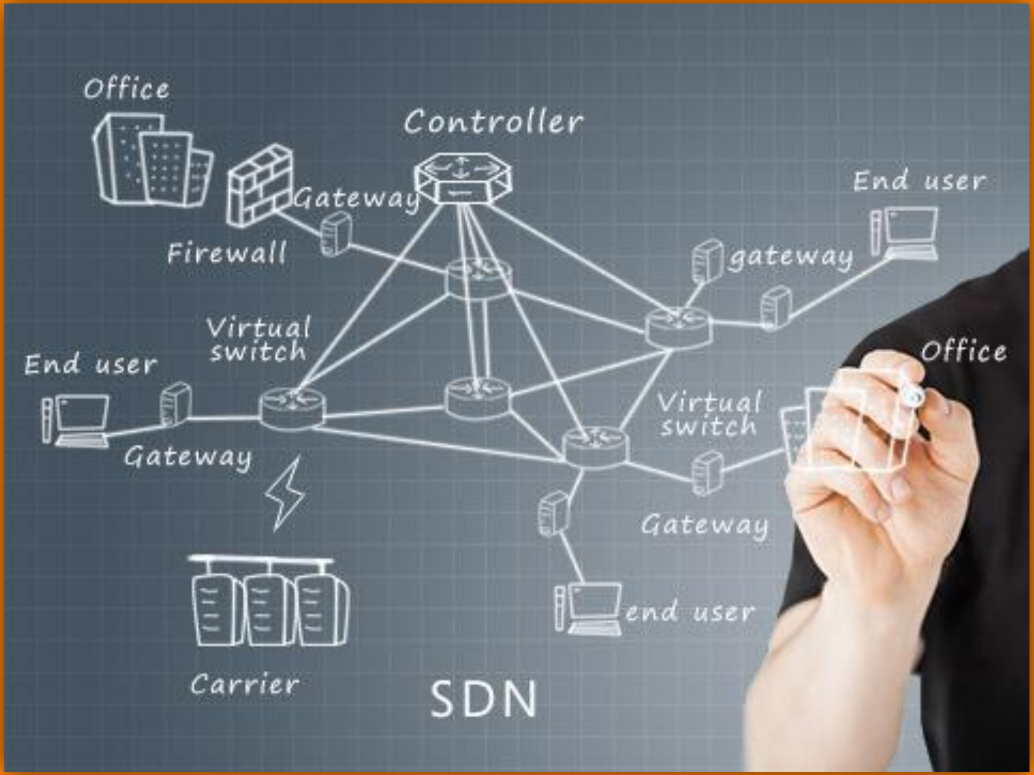
Classical Model



1. Package sent to the switch.
2. Switch looks in their polices.
3. Switch forwards the packet to the server.

SDN (Software Defined Network)



http://www.algoblu.com/en/image/sdn_1.jpg

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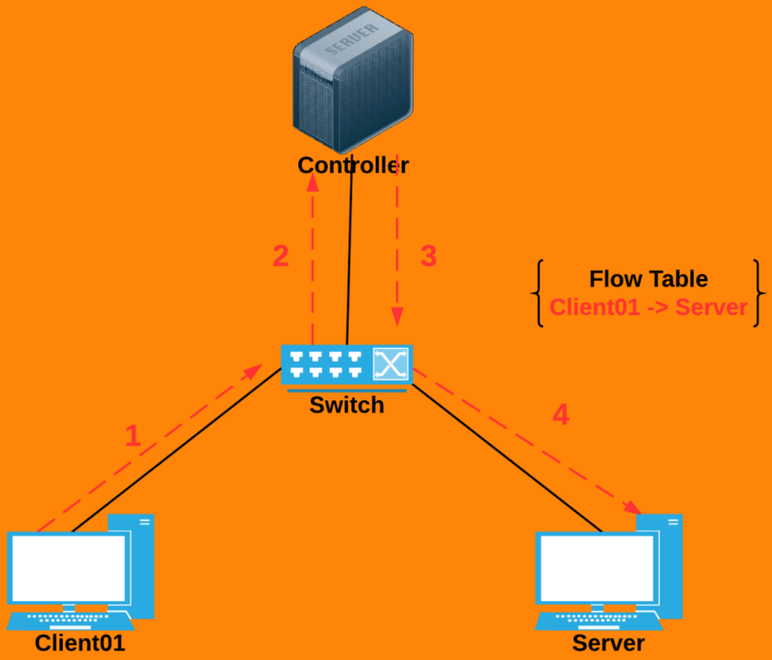
SDN: Architecture

Data Plane & Control Plane

"SDN isn't a technology, it's a architecture".

SDN: Technical



1. Packet is sent to the switch.
2. Packet header is extracted and sent to the controller.
3. Controller (check) adds a new flow in the switch table.
4. Switch forwards the packet to the server.

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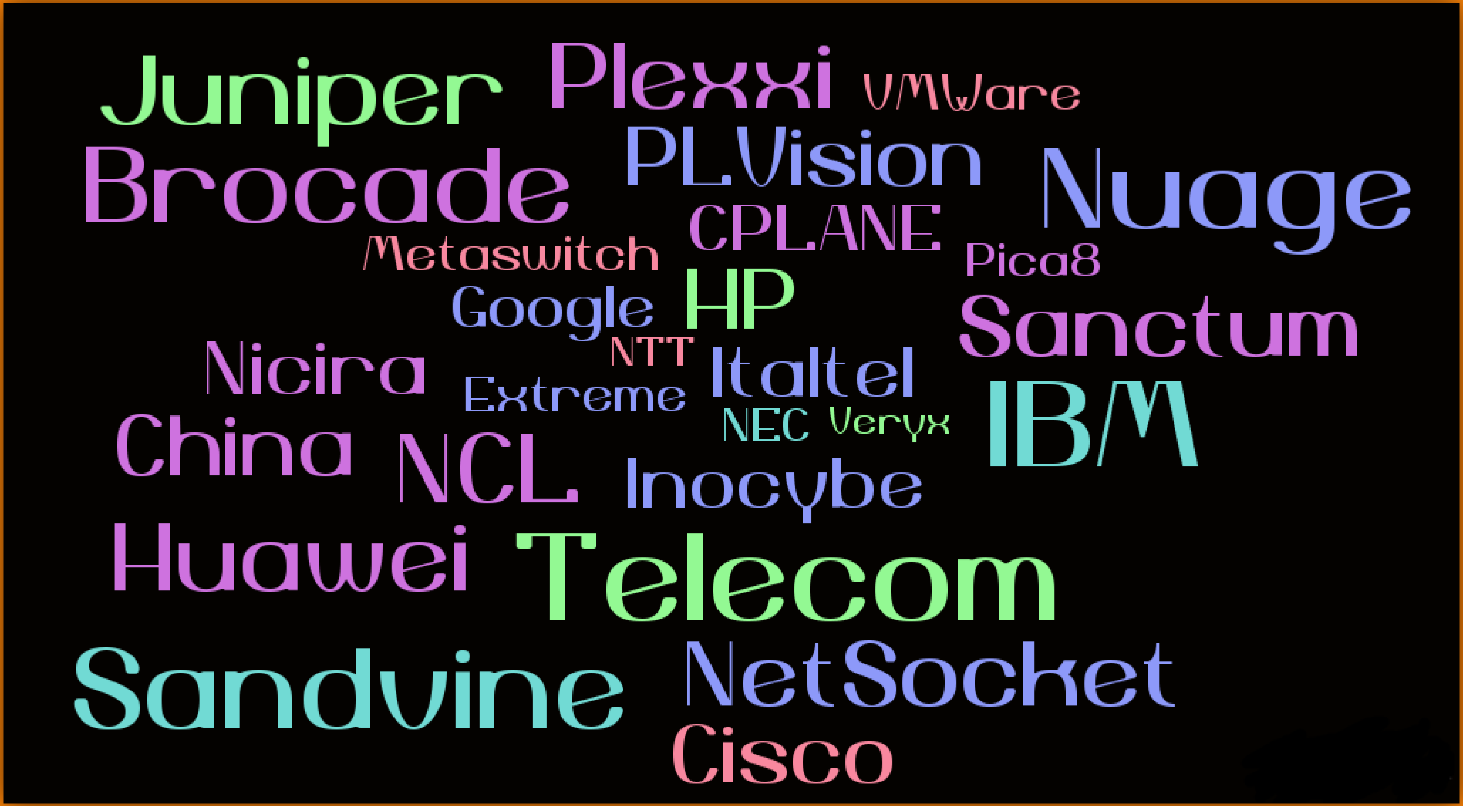
Vendors



Juniper Plexxi VMWare

Brocade PLVision Nuage

Metaswitch CPLANE Pica8

Google HP

Sanctum

Nicira NTT Italtel

Extreme

NEC Veryx IBM

China NCL Inocybe

Huawei Telecom

Sandvine NetSocket

Cisco

"SDN is just a fad..."

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Controllers

- Commercial
  - HP VAN SDN
  - Juniper Contrail
  - Oracle SDN
  - Cisco XNC
  - Huawei POF

- Open-Source
  - Mininet
  - OpenDayLight
  - FloodLight
  - Juniper OpenContrail

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OpenFlow

- Communication between the controller and the switch (logical/physical).
- Routing flow based.
- Secure channel for transmission.
- Allows for programming “Flows“ (traffic type);
- Allows for switching different network layers to be combined;
- Not limited by the platform or be enforced by the protocols.

“SDN != OpenFlow”

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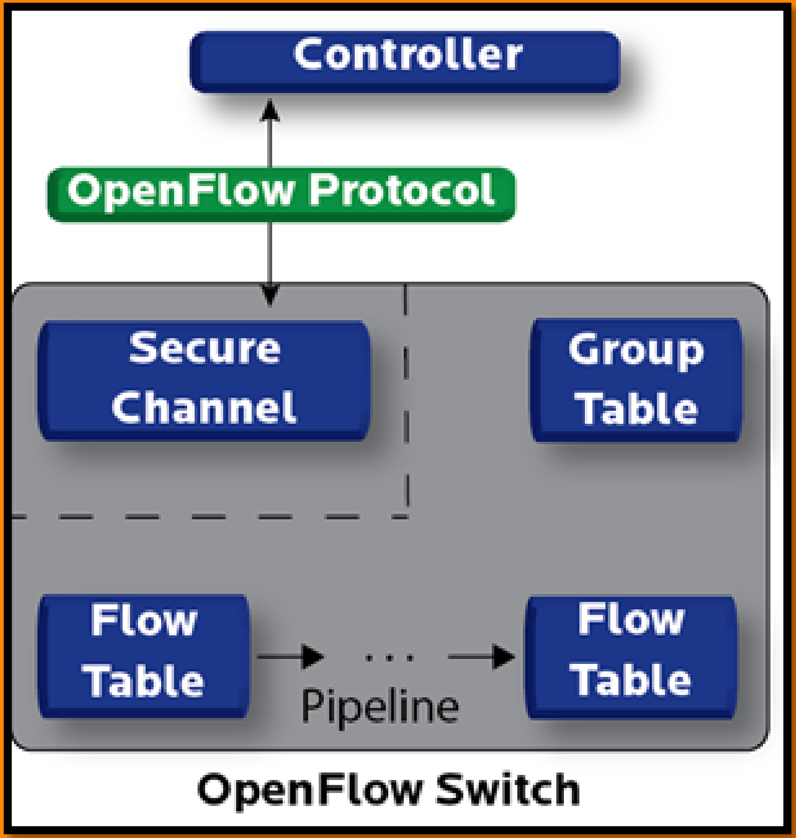
OpenFlow (internal)



https://www.sdncentral.com/wp-content/uploads/2013/04/figure1.png

It's time for revision!

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DEMO 1

SDN overview with mininet

"Why set up your network if you can program it?"

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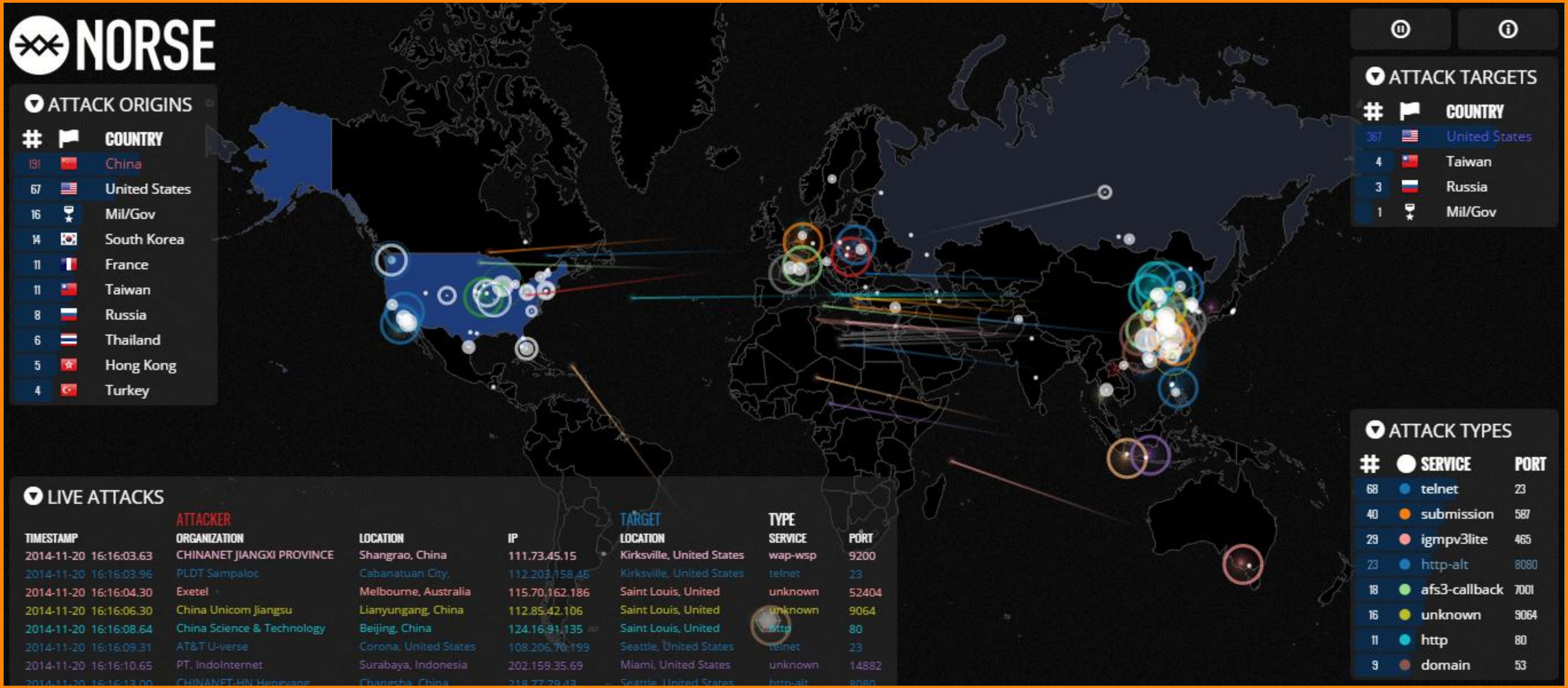
Threat Vectors



NORSE

ATTACK ORIGINS

#	COUNTRY
191	China
67	United States
16	Mil/Gov
14	South Korea
11	France
11	Taiwan
8	Russia
6	Thailand
5	Hong Kong
4	Turkey

ATTACK TARGETS

#	COUNTRY
367	United States
4	Taiwan
3	Russia
1	Mil/Gov

ATTACK TYPES

#	SERVICE	PORT
68	telnet	23
40	submission	587
29	igmpv3lite	465
23	http-alt	8080
18	afs3-callback	7001
16	unknown	9064
11	http	80
9	domain	53

LIVE ATTACKS

	ATTACKER			TARGET	TYPE	
TIMESTAMP	ORGANIZATION	LOCATION	IP	LOCATION	SERVICE	PORT
2014-11-20 16:16:03.63	CHINANET JIANGXI PROVINCE	Shangrao, China	111.73.45.15	Kirksville, United States	wap-wsp	9200
2014-11-20 16:16:03.96	PLDT Sampaloc	Cabanatuan City,	112.203.158.46	Kirksville, United States	telnet	23
2014-11-20 16:16:04.30	Exetel	Melbourne, Australia	115.70.162.186	Saint Louis, United	unknown	52404
2014-11-20 16:16:06.30	China Unicom Jiangsu	Lianyungang, China	112.85.42.106	Saint Louis, United	unknown	9064
2014-11-20 16:16:08.64	China Science & Technology	Beijing, China	124.16.91.135	Saint Louis, United	http	80
2014-11-20 16:16:09.31	AT&T U-verse	Corona, United States	108.206.70.199	Seattle, United States	telnet	23
2014-11-20 16:16:10.65	PT. IndoInternet	Surabaya, Indonesia	202.159.35.69	Miami, United States	unknown	14882
2014-11-20 16:16:13.00	CHINANET-HN Hengyang	Changsha, China	218.77.79.43	Seattle, United States	http-alt	8080

map.ipviking.com

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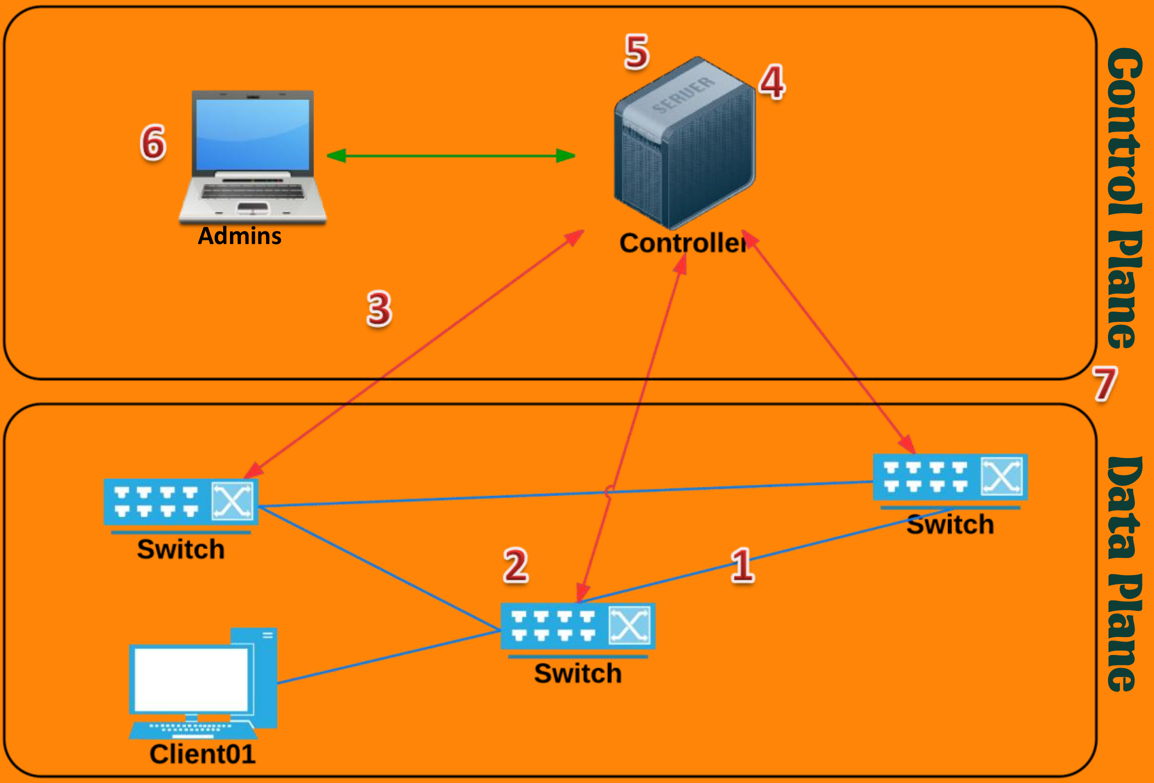
Vectors!



↔ Admins Management (SSH!?)

↔ Control Plane (OpenFlow)

↔ Data Plane (logical/physical connections)

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Attacks!

1. Fake/Hijacked traffic flows.
2. Switch vulnerabilities.
3. Vulnerabilities on Control Plane communications.
4. Controller vulnerabilities.
5. Untrusted apps/plugins on controller.
6. Vulnerabilities on admin computer.
7. Lack of resources for security analysis.

Specific to SDN

Attacks!

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Pentesting...

1. Identify controllers.
2. Enumerate configs.

Default Ports

Controllers:

- FloodLight/Mininet/Pox/POF/HP VAN port 6633.
- Oracle SDN port 6522.

Management Interface:

- FloodLight port 8080.
- OpenDayLight Web Interface port 8080.
- HP VAN SDN & IBM SDN-VE port 8443.
- Cisco XNC HTTP (8080) and HTTPS (8443).

It’s time for revision!

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DEMO 2

sdn_enum_controllers.rb

https://github.com/espreto

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Authentication

Default passwords:

FloodLight = floodlight:<null>

OpenDayLight = admin:admin

HP VAN SDN = admin:skyline

Juniper Contrail = admin:contrail123

IBM SDN-VE = admin:admin

Cisco XNC = admin:admin

REST APIs

- FloodLight port 8080
  - (http://localhost:8080/wm/core/controller/switchs/json)
- OpenDayLight port 80/8080
  - (http://localhost/rest/v1/model/controller-node)
- HP VAN SDN port 35357/8443
  - (https://localhost:8443/sdn/v2.0/auth)
- Juniper Contrail port 8081/8082
  - (http://localhost:8081/analytics/uves)
- IBM SDN-VE port 8443
  - (http://localhost:8443/one/nb/v2)
- Cisco XNC port 8080
  - (http://localhost:8080/controller/nb/v2/monitor)

It's time for revision!

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DEMO 3

sdn_enum_configs_api.rb

https://github.com/espreto

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It's time for revision!

TELECURSO 2000

DEMO 4

sdn_hp_change_pass.rb

https://github.com/espreto

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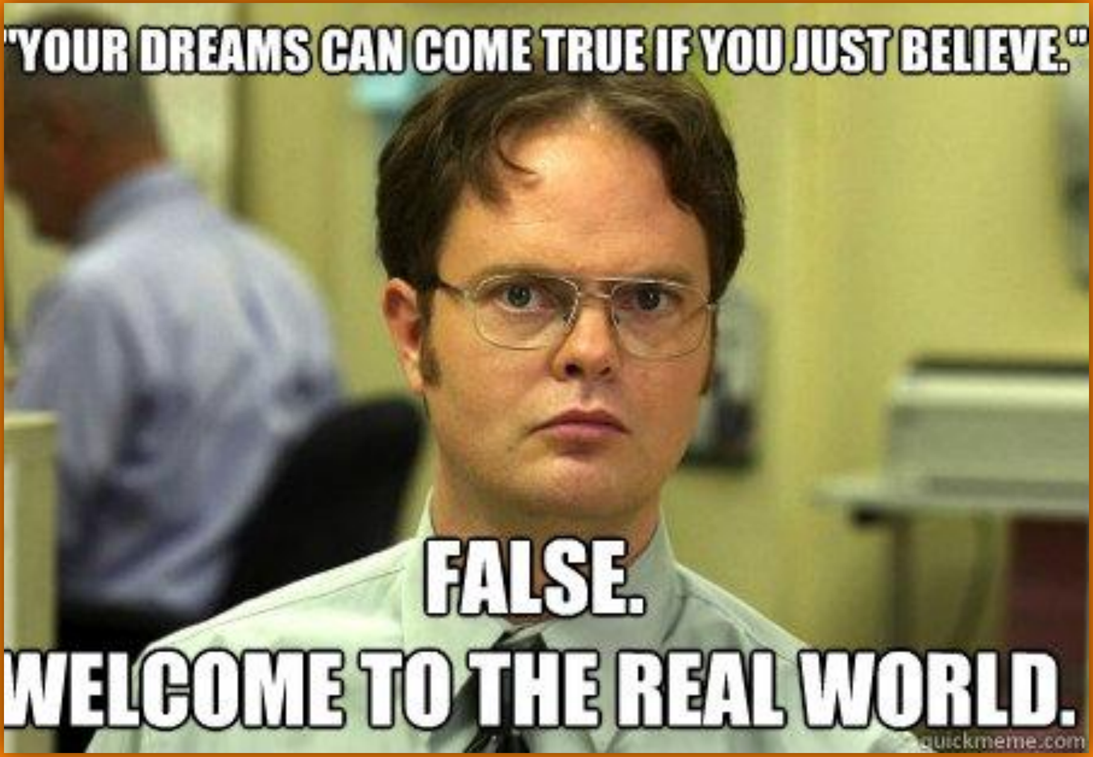
Real World...


"YOUR DREAMS CAN COME TRUE IF YOU JUST BELIEVE."
FALSE.
WELCOME TO THE REAL WORLD.
quickmeme.com

http://cdn.business2community.com/wp-content/uploads/2014/08/real_world_dwight_meme.jpg

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Try Hard

- VLANs?
- IDS/IPS?
- NAC?
- Etc, etc, etc...

Look:
idle_timeout, hard_timeout, rtt values, etc.

“Packet Analysis is your best friend”.

Defense

- Apply controls in CP and DP;
- Restrict access APIs;
- Audit internal malicious activity;
- Plugins/Applications that add levels of security;
- Hardening;
- Secure Development Lifecycle (SDLC);
- Specialized intrusion tests;
- Others...

"Security must not be optional".

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Future...

...of this research:

- Coordination of CVEs with vendors; \o/
- Advanced research with SDN;
- Donations of Switches (OpenFlow supported); ☺
- Create a group to share information;
- And...

"Opportunities are usually disguised as hard work, so most people don't recognize them".
Ann Landers.

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Questions?

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