# A brief introduction to Software Defined Networking

HEPIA
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# Contenu

Software Defined Networking, quid est ?

Why do we need Software Defined Networks

Software Defined Networks Active Areas Today

Network Automation

# Software Defined Networking, quid est ?

- Today (2019) the term it is still very much in the process of definition. The exact définition changed several times since the orignal proposition from Martin Casado  in 2007.

- Martin Casado, the inventor of SDN in 2013 : *« I actually don't know whan SDN means anymore to be honest ».*

- *« SDN is like Cloud was nearly a decade ago before we knew about different type of Cloud such as IAAS, PAAS and SAAS »* (Jason Edelman, network programmability and automation, 2018).

# Software Defined Networking, quid est ?

SDN is a network architecture that enable the application to tailor the network. Depending on the applications, anybody can think about how to design the network for his application !
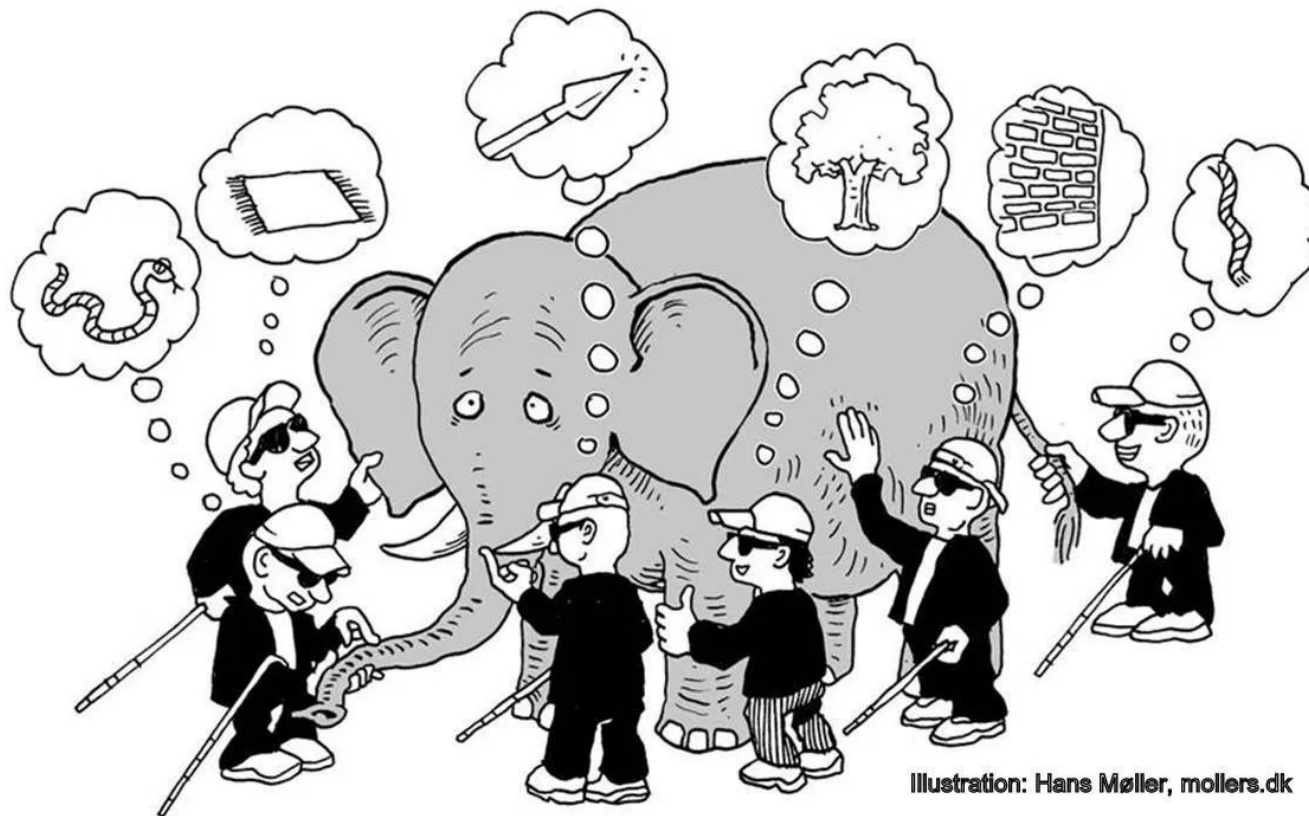


Illustration: Hans Møller, mollers.dk

# Software Defined Networking, quid est ?

Rather than looking at the definition lets have a look at why we need to a network that is defined by the application/by the software today.

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# Why do we need Software Defined Networks Todays?

Most of the networks are still configured with a CLI running on each device and is configured individually or with custom written scripts :



```
1994
Router> enable
Router# configure terminal
Router(config)# enable secret cisco
Router(config)# ip route 0.0.0.0 0.0.0.0 20.2.2.3
Router(config)# interface ethernet0
Router(config-if)# ip address 10.1.1.1 255.0.0.0
Router(config-if)# no shutdown
Router(config-if)# exit
Router(config)# interface serial0
Router(config-if)# ip address 20.2.2.2 255.0.0.0
Router(config-if)# no shutdown
Router(config-if)# exit
Router(config)# router rip
Router(config-router)# network 10.0.0.0
Router(config-router)# network 20.0.0.0
Router(config-router)# exit
Router(config)# exit
Router# copy running-config startup-config
Router# disable
Router>
```

Terminal Protocol: **Telnet**

```
2014
Router> enable
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```

Terminal Protocol: **SSH**

Source : Big Switch Networks

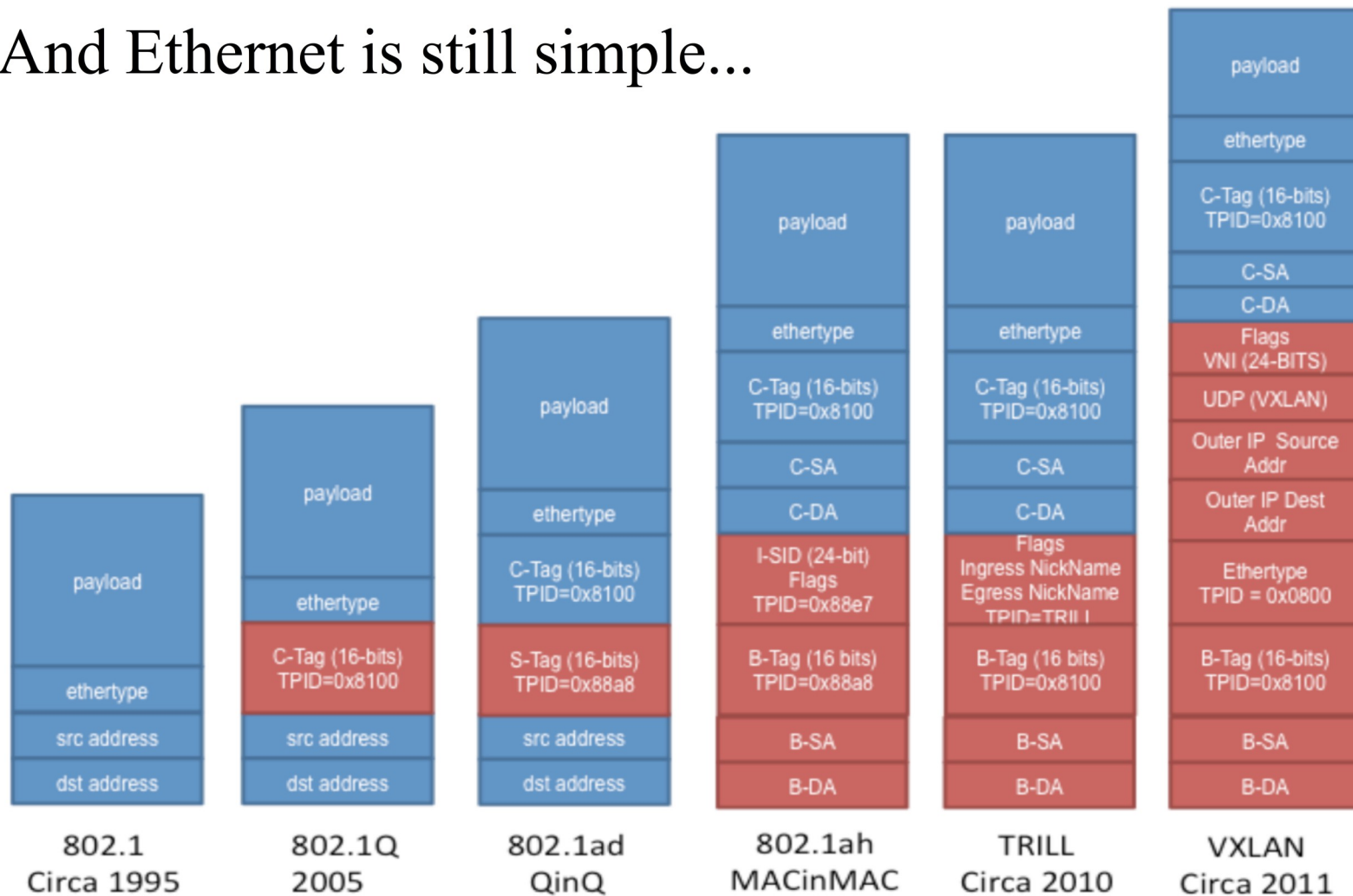# Can you imagine managing this using the CLI ?
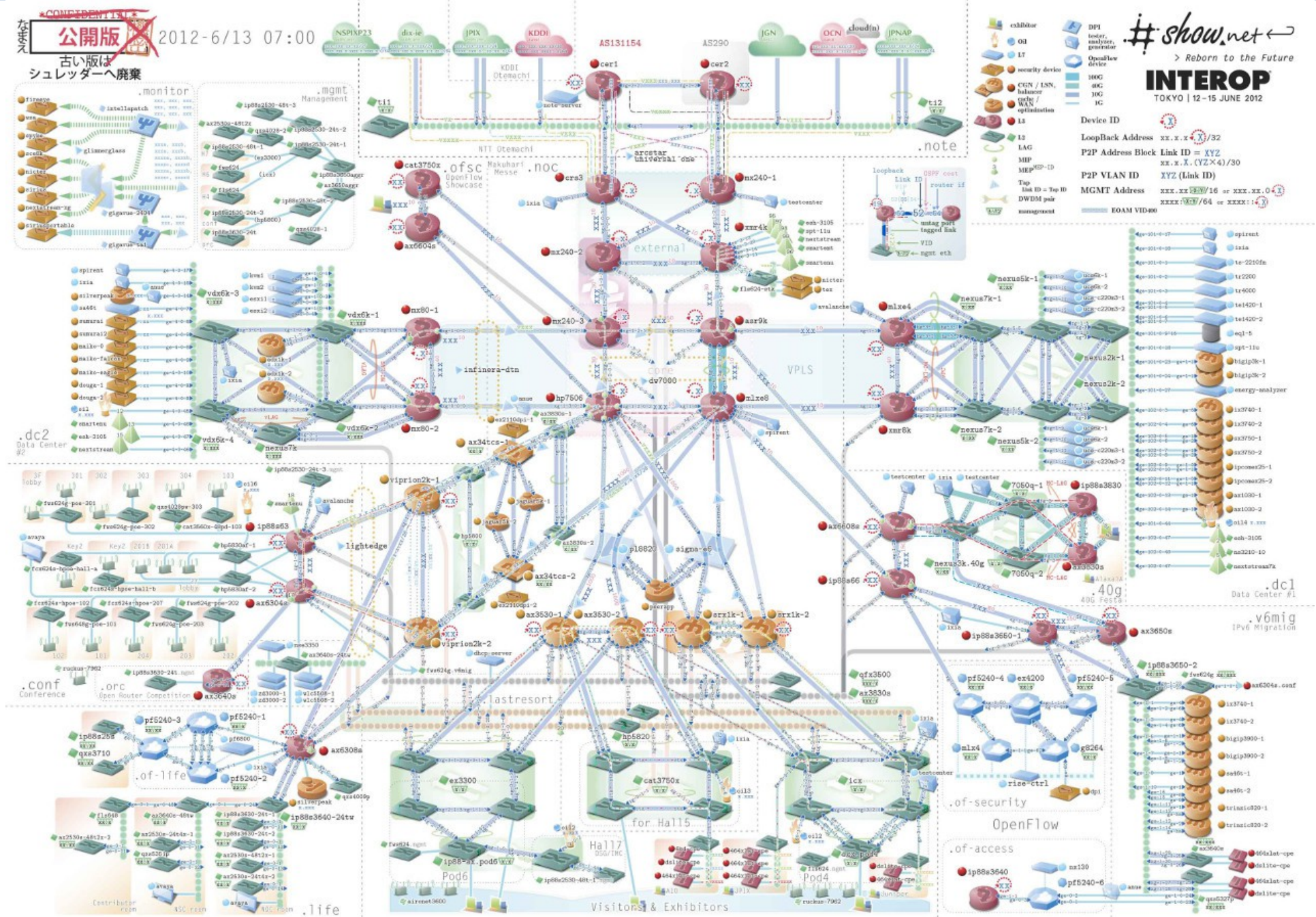
# Why do we need Software Defined Networks Today ?

The networking field only grew so much because there are people out there mastering complexity :

And Ethernet is still simple...



| 802.1 Circa 1995 | 802.1Q 2005 | 802.1ad QinQ | 802.1ah MACinMAC | TRILL Circa 2010 | VXLAN Circa 2011 |

# Why do we need Software Defined Networks Today ?

But mastering complexity is not the same skill as extracting simplicity (Scott Shenker)

Robustness vs Complexity « System view » From Dave Mever (2011)



Increasing number of protocols, configurations and interactions
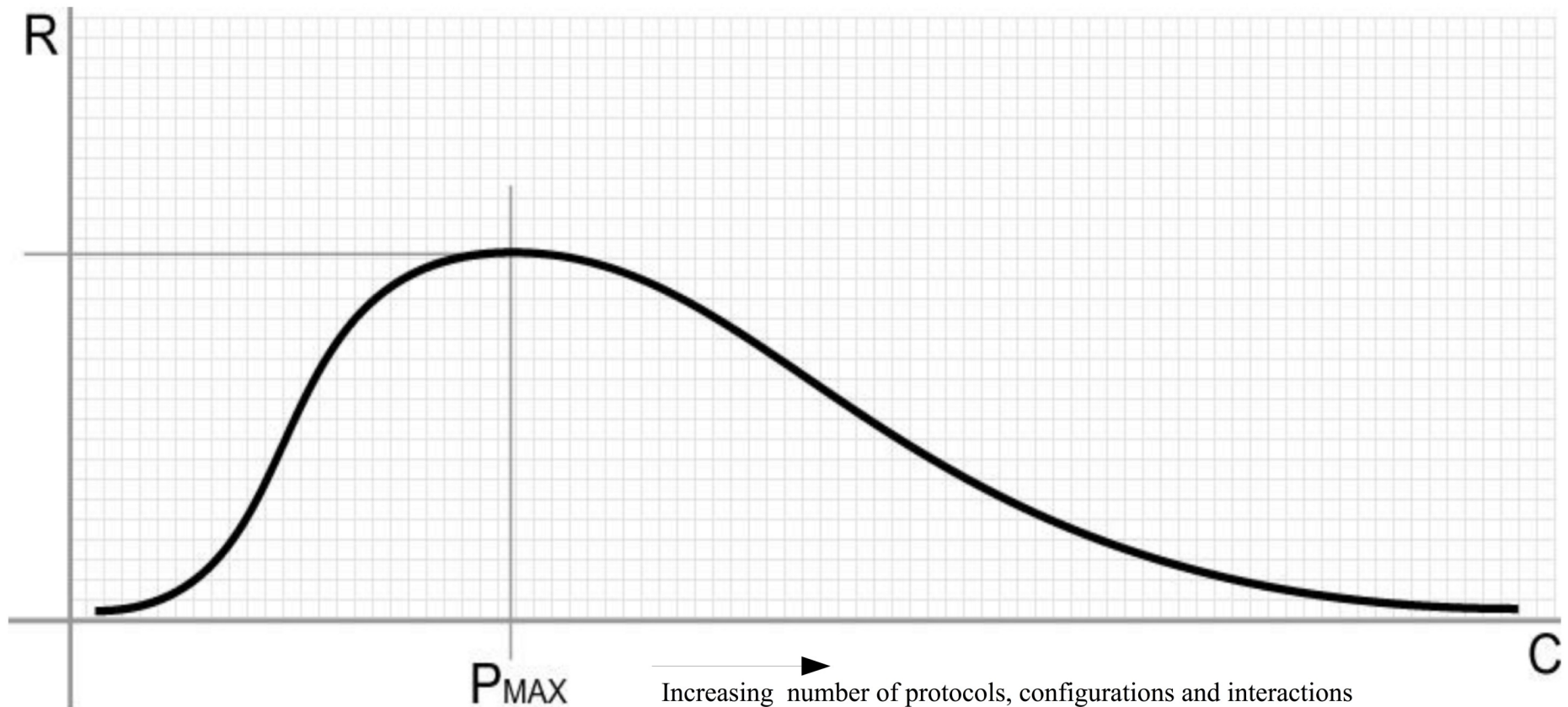
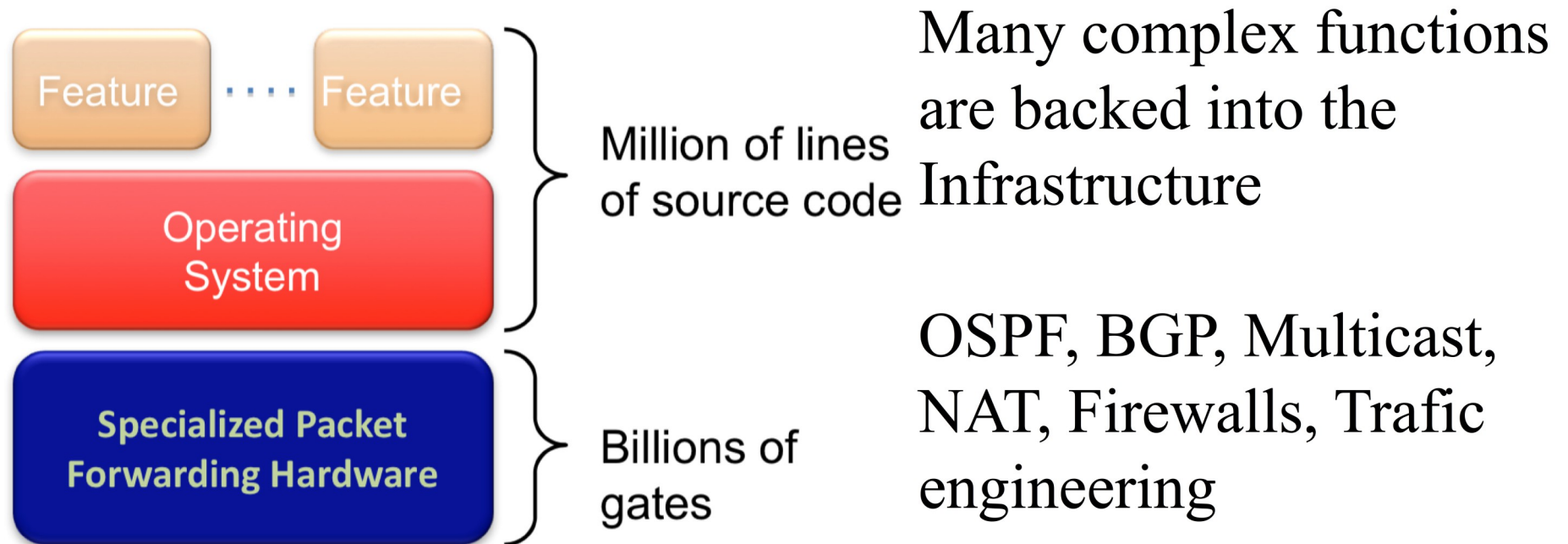## Typical registration on a WLAN :
## (From Dave Meyer, 2011) :

During registration, systems are scanned for known vulnerabilites. If the scan reveals vulnerabilites, the user is presented with these vulnerabilites and given an opportunity to update the system. The firewall for the network allows traffic to get to the appropriate update servers for Microsoft and Apple. The registration VLAN uses a firewall to block network traffic to unregistered desktops. ¨

However, the firewall allows Web and secure Web (i.e., port 80 and 443) traffic to pass so that desktop machines can reach update sites. Various routers and switches are employed to facilitate creating the VLANs necessary for the needed networks. The local switches determine which VLAN for each machine that joins the network.
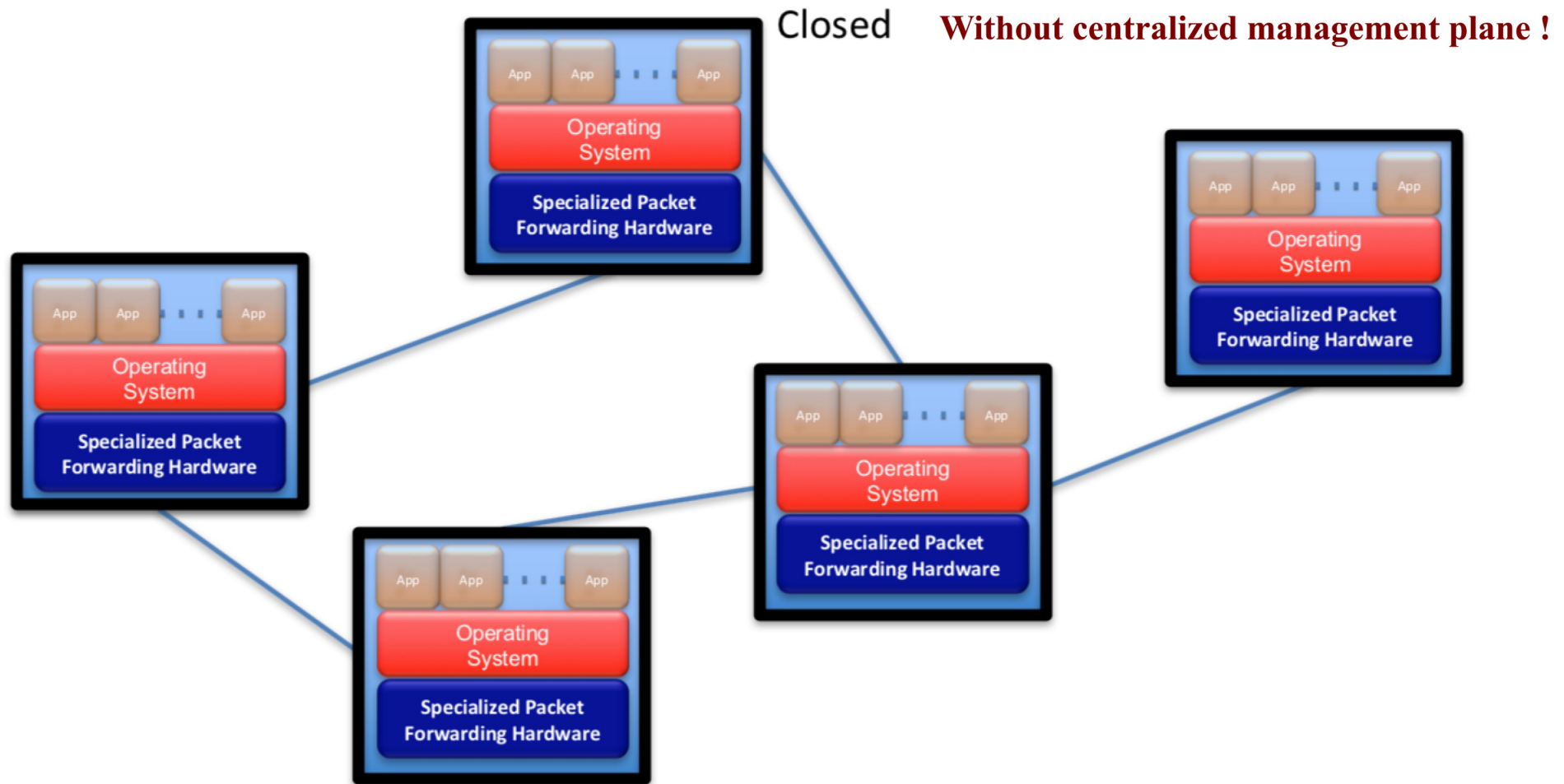
The switch will download VLAN maps periodically from a VMPS. Unknown MAC addresses are assigned to the unregistered VLAN and known MAC addresses are placed onto the appropriate subnet. VMPS periodically downloads the VLAN maps from the registraUon server. Network security is enforced by creating ARP tables that map each MAC address to it registered IP and pushing that table to each router.

## Limitations of current networks



Many complex functions are backed into the Infrastructure

OSPF, BGP, Multicast, NAT, Firewalls, Trafic engineering

Slide from OpenFlow/SDN Tutorial Srini Seetharaman, Deutsche Telekom , Sillicon Valley Innovation Center

# Why do we need Software Defined Networks Today ?

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Even if not completely implemented today, the goal of SDN is to provide an abstraction to manage  the growing complexity of

- Distributions of states in the network

    – Do you remember   exactly how BGP/OSPF/RIP/EIGRP are  storing their routing states?)

    – Will you remember it at 3  am when there will be a critical network outage and you are called in emergency to fix it ?

- Data forwarding based on the network header définition.

- Network equipments monitoring and configuration.

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# Software Defined Networks active areas

A bit of history first :

- 2007 : The Stanford Clean slate team starts an ambitious research
        goal : how should the Internet look in 15 year from now ?
- 2007 : Martin Casado, a graduate student publish a paper that proposes
         the « Ethane » network architecture. He starts a company
         named Nicira networks with Nick Mkeown and Scott Schenker.
- 2008 : Openflow, one of the major protocol that started the SDN
        revolution is published as a research idea.
- 2009 : Openflow 1.0 is published
- 2010 : Big switch networks is funded with Guido Appenzeller and Kyle
        Forster.
- 2011 : The open networking fundation (Deutsche Telecom, Facebook,
        and Microsoft) is created.
- 2012 : Nicira is bought buy VMware for 1.23 billions. VMware
        NSX is basically what emerged from this acquisition.
- 2013 : Google announce avoir déployé en production un réseau basé sur Open
        flow appelé B4
- 2014 : Cisco launches DevNet under the direction of Susie Wee with the
        goal to bring the community of networking and developpment together
- 2016 : The Open Networking Fundation publishes the Cord architecture

# Software Defined Networks active areas

OpenFlow was the first to catch the industry (many switches from industry are now a built-in openflow fabric available).  Network functions.

Network virtualisation and Controller networking is driven by the Data Center Industry, where the need for a programmable network is crucial to manage thousands of  interconnected Virtual machines (VMWare is the big player here)

Network automation are driven by big names network devices builder like Cisco and Juniper


- Openflow

- Network Functions Virtualisation

- Network virtualisation => Become synonymous with SDN

- Controller Networking

- Network Automation

- SD-Wan

# Software Defined Networks active areas

Martin Casado, Open Networking Summit 2017 :

The two use cases of Network Virtualisation are

- Network Automation (40 % of the market)
- Network Security (40 % of the market)

The rest is used for multi-tenant Data Center use cases.

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