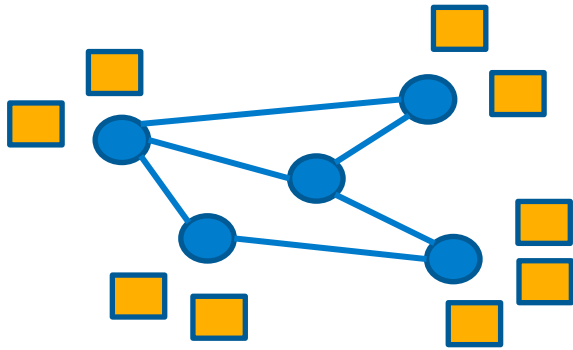MAY 18-20
2021 P4
Workshop
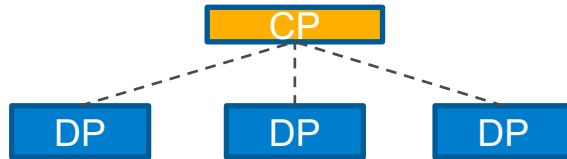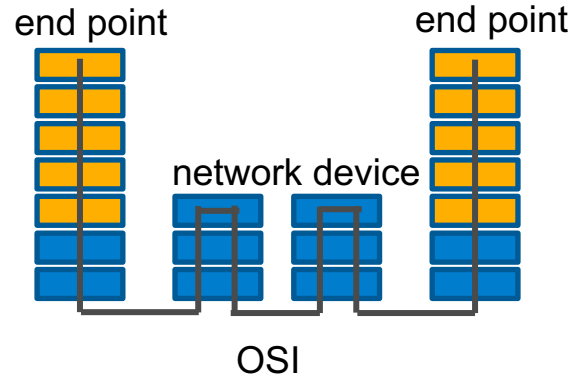Hosted by ONF

Programmability and Networking
Why do we bother?

Pere Monclus
VMware

What is Networking?

End point / Network

Data Plane / Control Plane separation

OSI

Network has always been 'programmed'

In the DP, why programmability?

1) Complex or "slow" functionality
2) Feature not mature or well defined
3) Innovation

CPUs	FPGAs	NPUs	Multicore	Programmable Switch	Smart NIC / DPU

Cost of Programmability decreasing!!!

In the DP, why not programmability?

1) Performance / Power / Cost
2) Latency

ASICS

Cost of ASICs increasing!!!
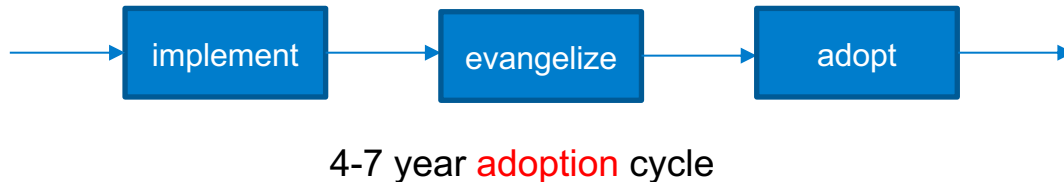
What to do <u>without</u> programmability?

- Force everybody too agree before implementing

IETF/IEEE → implement → adopt

4-7 year innovation cycle

VERY LIMITED INNOVATION
and only few can do it
(clear roadmap)

What to do <u>with</u> programmability?

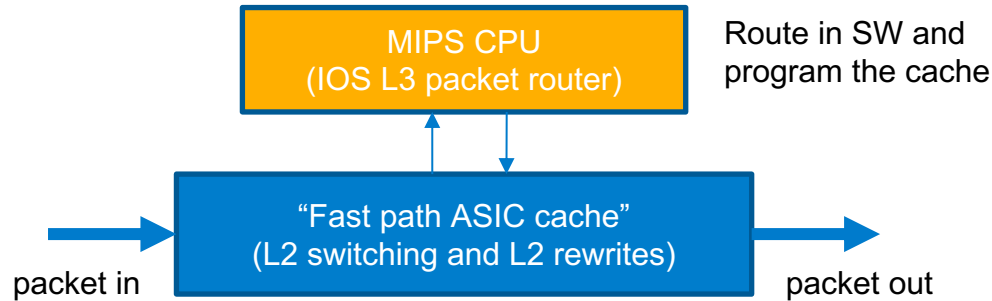- Innovate and evangelize

implement → evangelize → adopt

4-7 year adoption cycle

EXPLOSION IN INNOVATION
and everybody can do it
(market confusion)

Early successes of Programmability in the DP

Cisco Catalyst 5000, year 1999

MIPS CPU
(IOS L3 packet router)

Route in SW and
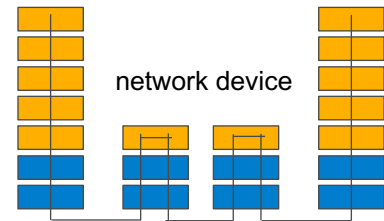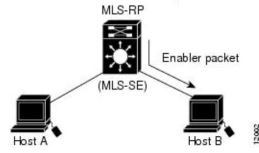program the cache

packet in

"Fast path ASIC cache"
(L2 switching and L2 rewrites)

packet out

Because the Catalyst switch has learned
the MAC and VLAN information of the MLS-RP,
the switch starts the MLS process for the Layer 3
flow contained in this packet, the *candidate packet*

MLS-RP

Candidate packet
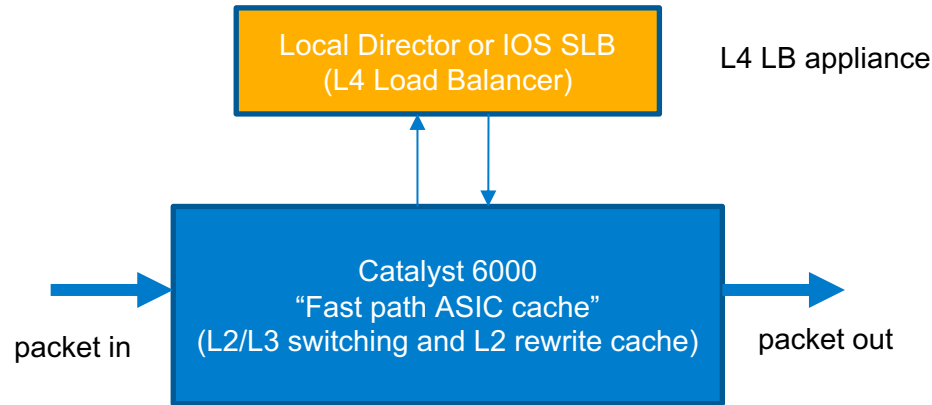
(MLS-SE)

Host A   Host B
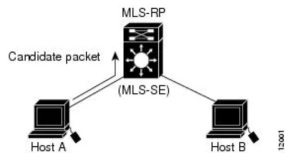
The MLS-RP routes this packet to Host B. Because the
MLS-SE has learned both this MLS-RP and the Layer 3
flow in this packet, it completes the MLS entry in the
MLS cache. The first routed packet is called the
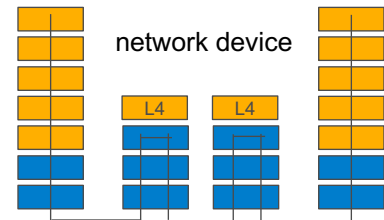*enabler packet*

MLS-RP

Enabler packet

(MLS-SE)

Host A   Host B

network device

https://www.cisco.com/en/US/docs/ios/lanswitch/configuration/guide/lsw_ml_sw_over_support_TSD_Island_of_Content_Chapter.html

Focus: SPEED

5

Early successes of Programmability in the DP

Cisco Local Director and Catalyst 6000, year 2000

Local Director or IOS SLB
(L4 Load Balancer)

L4 LB appliance

Catalyst 6000
"Fast path ASIC cache"
(L2/L3 switching and L2 rewrite cache)

packet in

packet out

network device

L4   L4

Focus: SPEED

https://www.cisco.com/web/offer/localdirector/docs/lodir_rg.htm
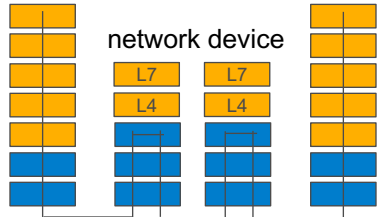https://silo.tips/download/cisco-ios-server-load-balancing-and-the-catalyst-6000-family-of-switches

Early successes of Programmability in the DP
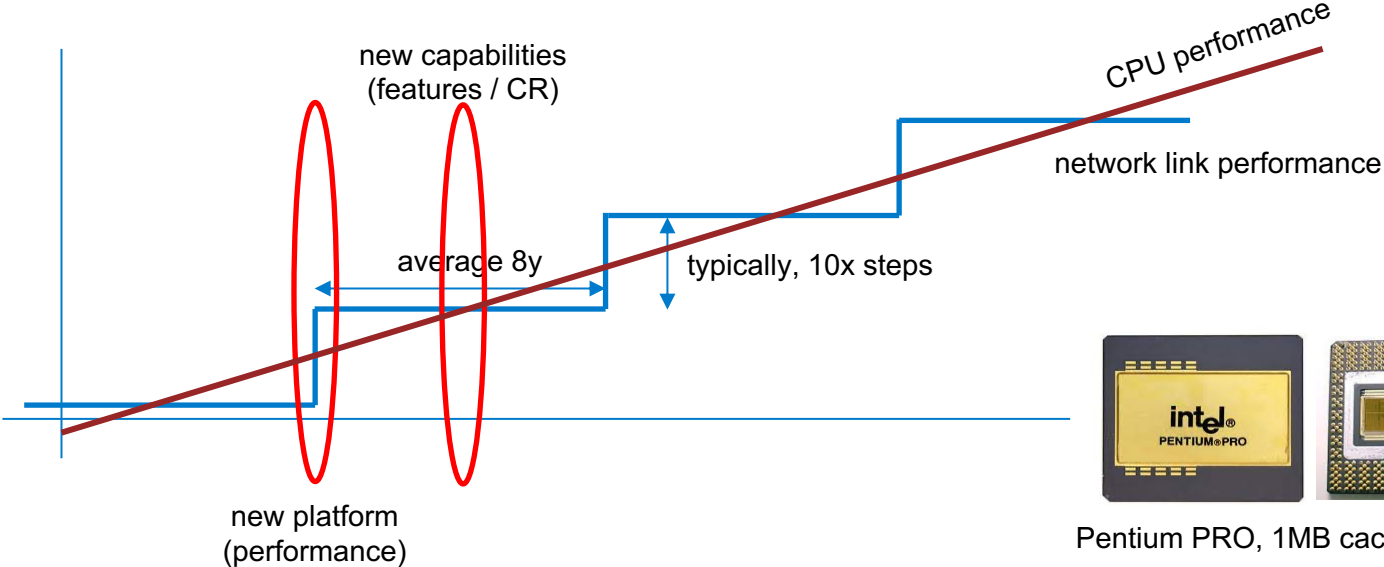
Cisco Firewall Service Module, 2001
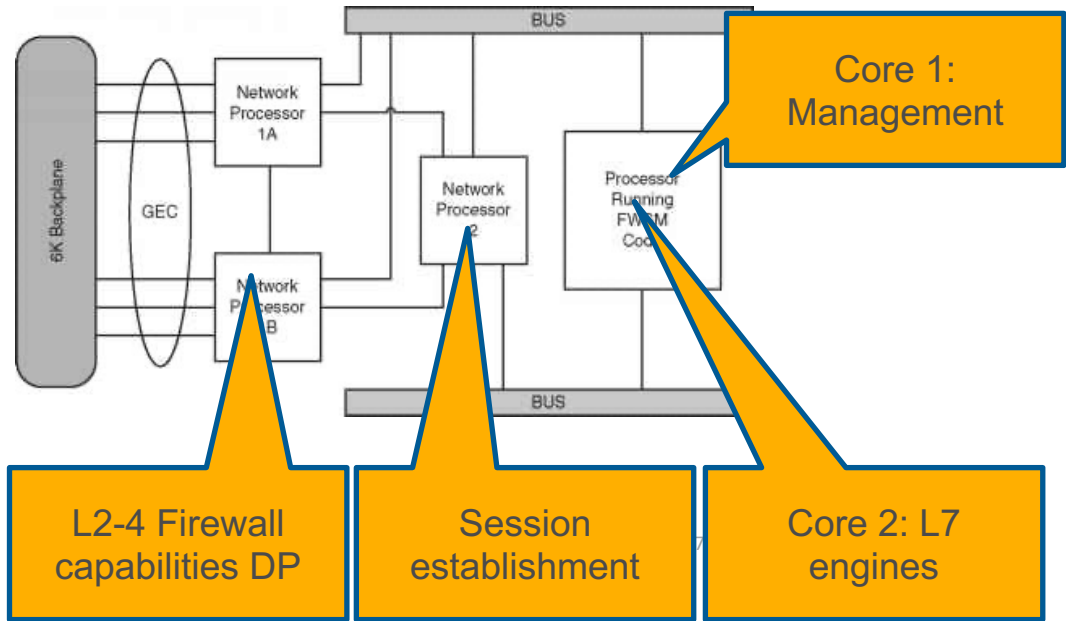
NPUs and a wave of programming innovation

Core 1: Management

L2-4 Firewall capabilities DP

Session establishment

Core 2: L7 engines

network device

Focus: NEW CAPABILITIES

https://www.ccexpert.us/interface-vlan/overview-of-the-firewall-services-module.html

Programmability and technology

new capabilities
(features / CR)

CPU performance

network link performance

average 8y

typically, 10x steps

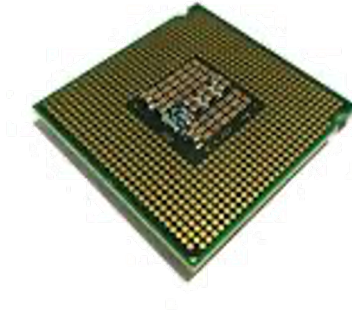new platform
(performance)

Pentium PRO, 1MB cache, year 1995

Networking is memory, more than compute

But… what happens when we aggregate?

vs

Solving the performance problem

new capabilities
(features / CR)

CPU performance

network link performance

average 8y

typically, 10x steps

new platform
(performance)

Pentium PRO, 1MB cache

Networking is memory, more than compute

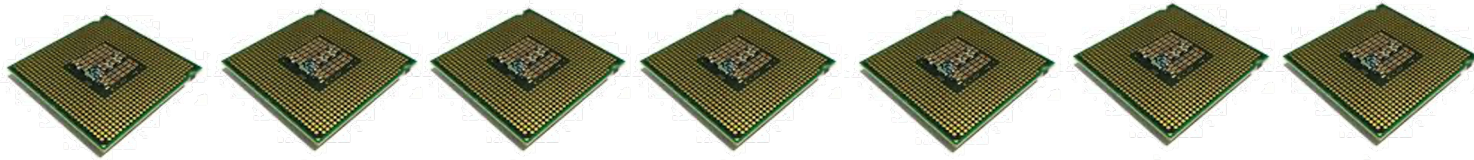Scale Up

Scale Out
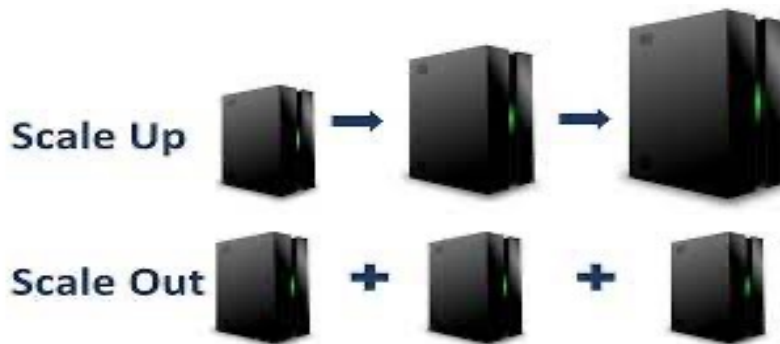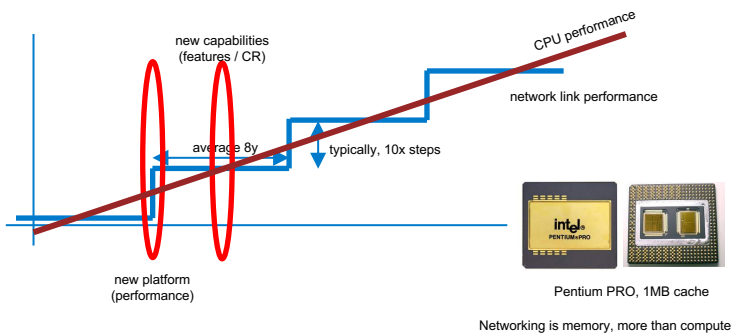
Solving the Aggregation problem
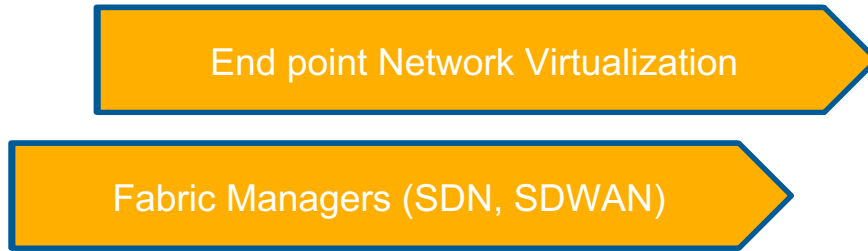

in the network

at the edge

The modern SDN wave

1. Control Plane / Data Plane Separation
                        +
2. Data plane abstractions (Open Flow, SAI, IOvisor-eBPF, …)

End point Network Virtualization

Fabric Managers (SDN, SDWAN)

3. Programable Data Paths (P4, eBPF, …)

      - Bringing innovation in both approaches of the network
      - From Networking to…. IO

Programmability? Who? How?

End point Networking Experts

Core Networking Experts

… many others

Compilers, abstractions, tools

| CPUs | FPGAs | NPUs | Multicore | Programmable Switch | Smart NIC / DPU |

Lot of work and maturity still needed…

Programmability and Networking
Why do we bother?

Things that would have not been possible without this last wave of networking innovation

1. Self healing networks
2. Automation/Self provisioning of the network
3. Cloud
4. DevSecOps / Agility in enterprises
5. E2E ZT security
6. …

Thank You!