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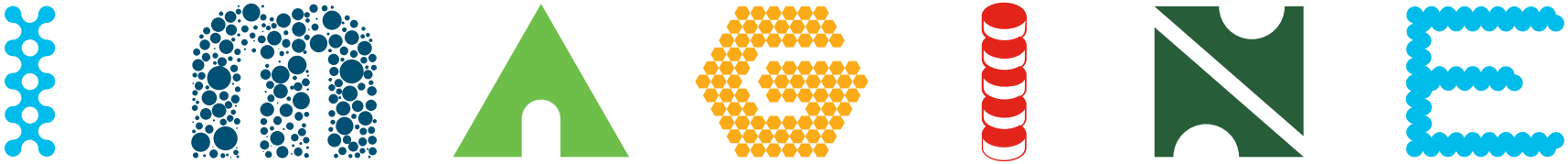
January 28 - February 1, 2019 • Barcelona

cisco



INTUITIVE

BRKSPG-2698

Disaggregating Network Devices and Software :

A reality check !

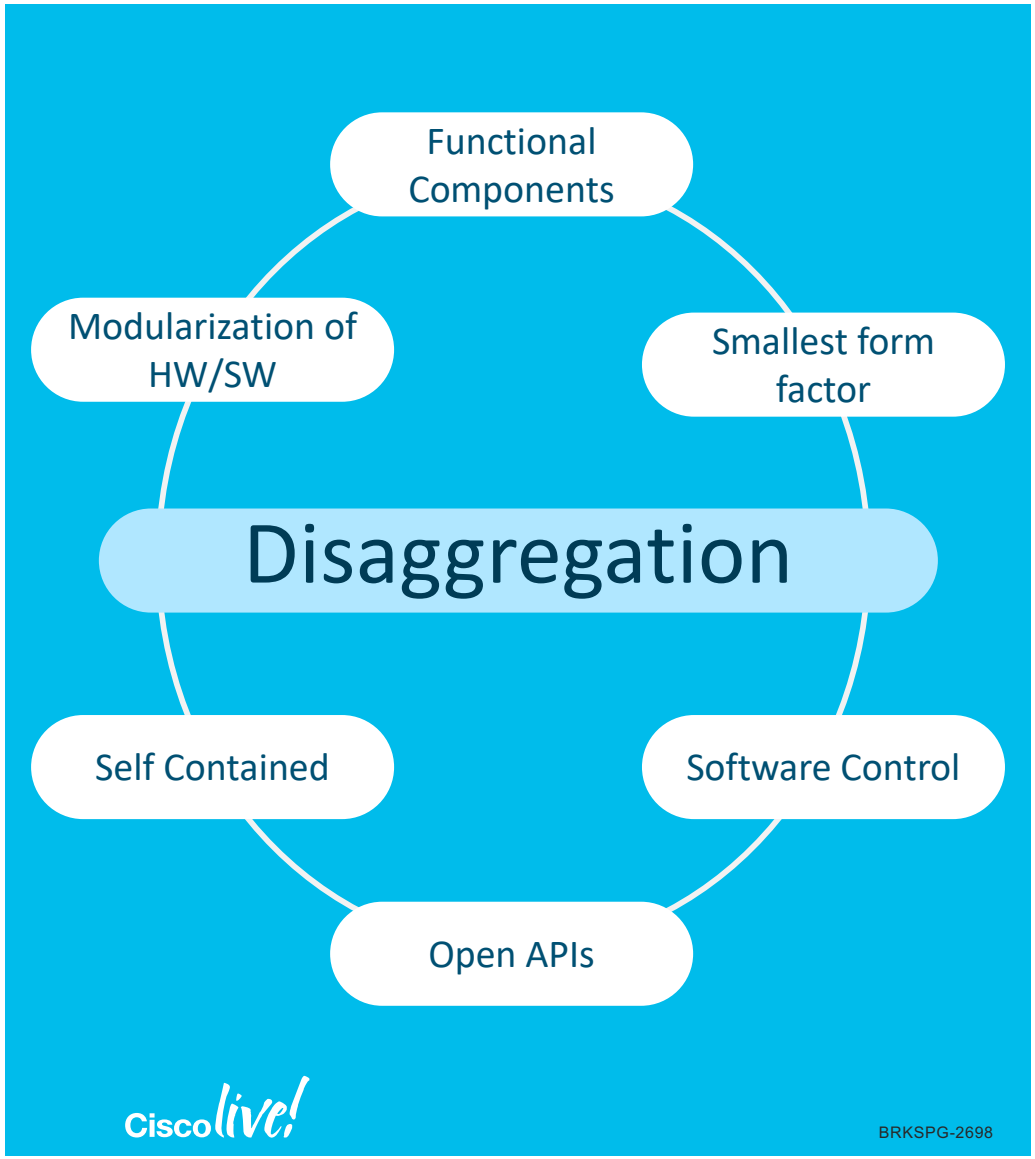
Steve Iatrou, Senior Solutions Architect

Syed Hassan, Senior Solutions Architect

In cooperation with Mikhail Korshunov, Technical Marketing, SPBU

Agenda

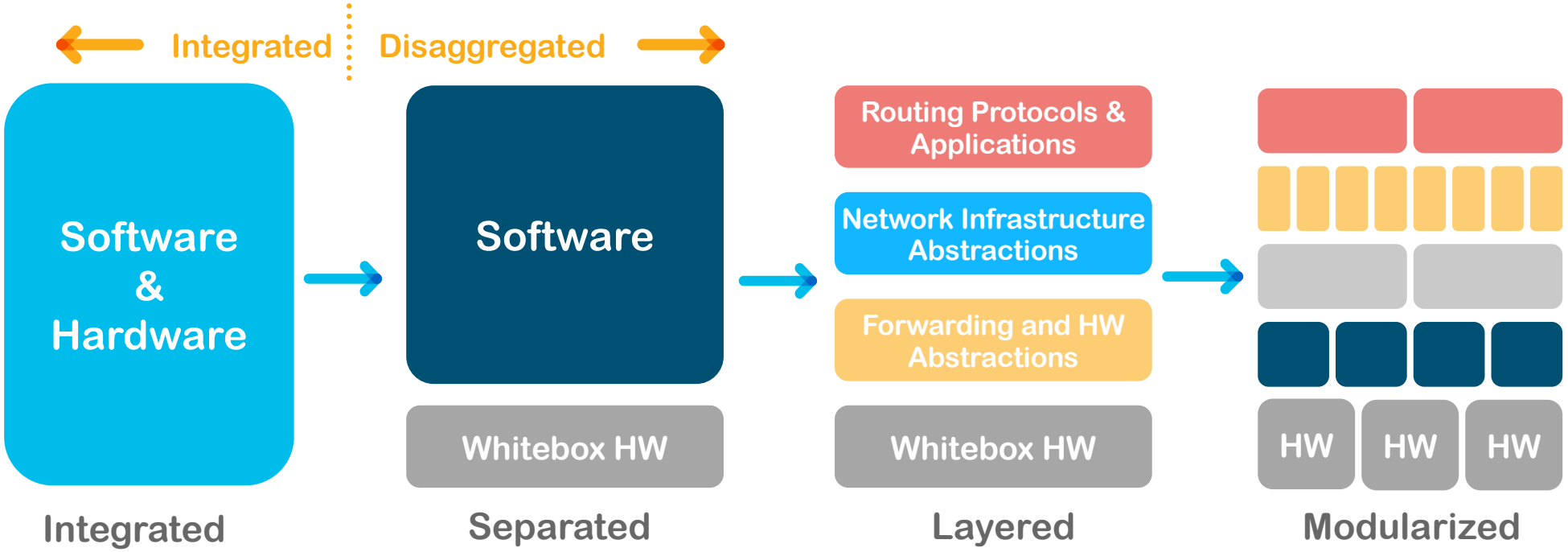
- Introduction
- Market Driver of HW/SW Disaggregation
- Delayering the integrated router
- Cisco ISO XR on 3rd HW
- Implications and lessons learnt
- Summary



*"The separation of networking equipment into **functional components** and allowing each component to be individually deployed. Ideally, provided in the **smallest form factor** capable of delivering a specific function. Equipment should be **self-contained**, required no additional common equipment to operate, and incorporate **open APIs** to enable **Software control**"*

Source : "Charting the Path to Network Automation and Disaggregation: Carrier SDN Survey Analysis" ; Heavy Reading ; February 2018

Disaggregation Changes The Value Proposition

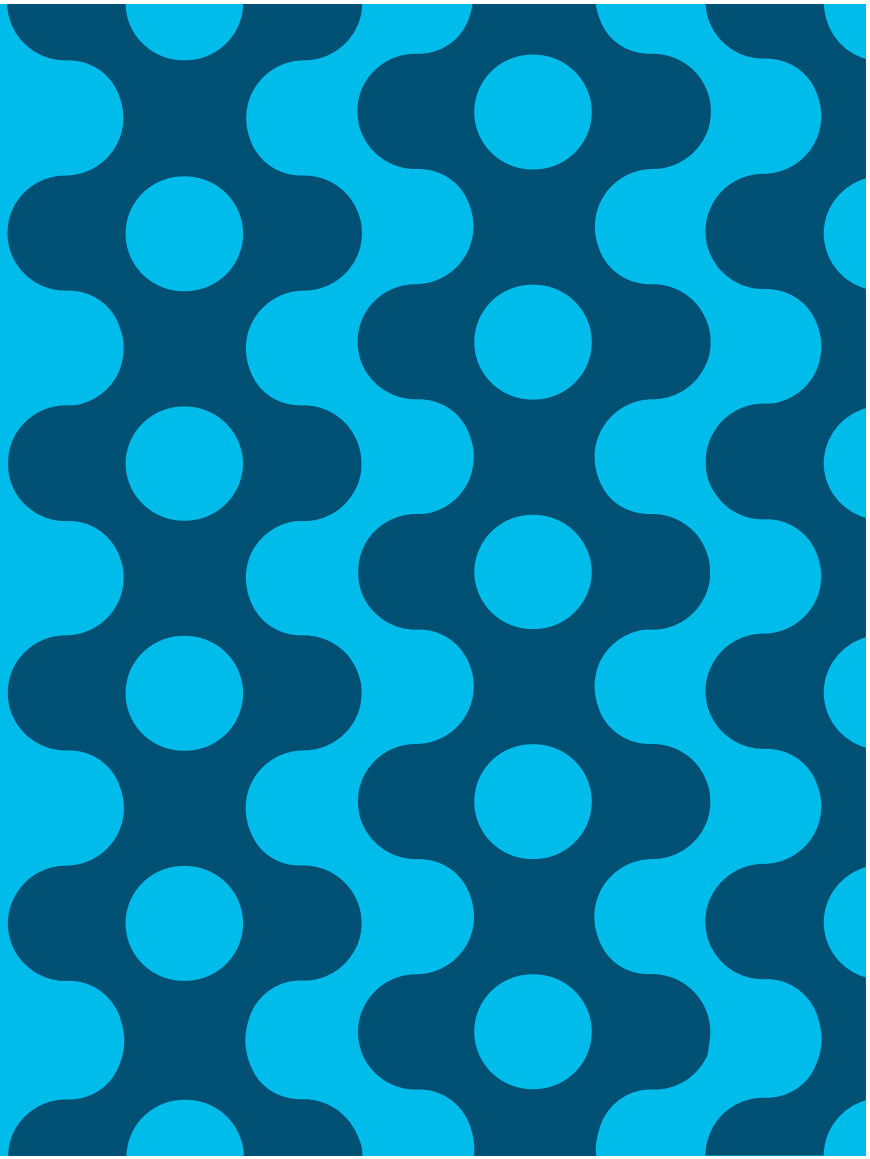


- Rich Feature Set
- Wide Range of HW Form Factors
- Pre-integrated / pre-tested
- Single Touchpoint Support

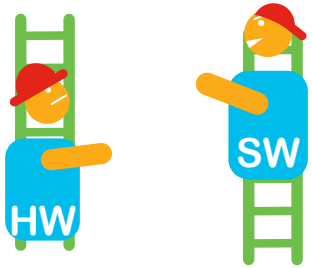
Value Proposition

- SW Feature Development Speed
- HW Platform Independence
- Cost efficiency
- New Operating Paradigms

Market Drivers

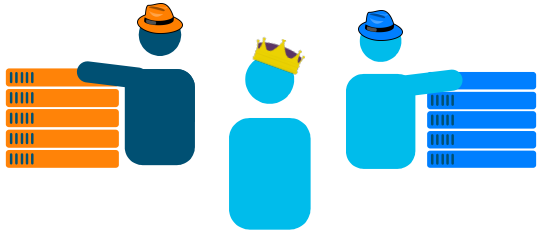


The Promise of Disaggregation

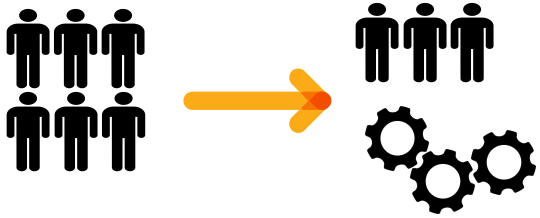


Rate of Innovation :
Decouple SW and HW roadmaps

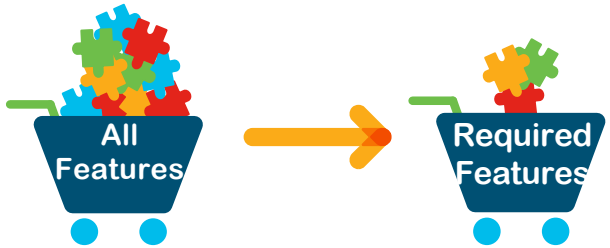
Cost Efficiency:
Standardization, open source, commoditization reduces costs



Vendor Independence :
Customers can source from a diverse supplier market



New Operating Paradigm :
Automated, “Machine first”, API driven



Design Flexibility :
Deploy (test, certify) only what you need

The Web Segment is paving the way

Web Players Redefining DC

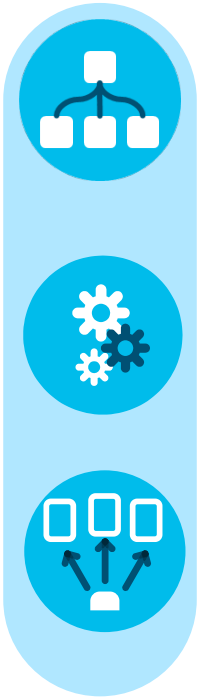
SPs are taking notice (Investing in NOS vendors)

Operating Efficiency

Becoming the dominant criteria

Machine First Design

Obviate human operation & management touchpoints



Architecture

Scales horizontally, open & interchangeable, disaggregated

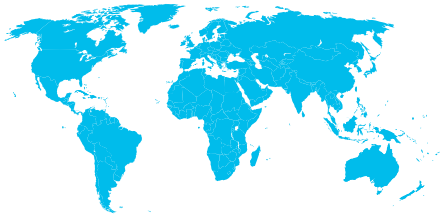
Components

Low cost hardware, modular software

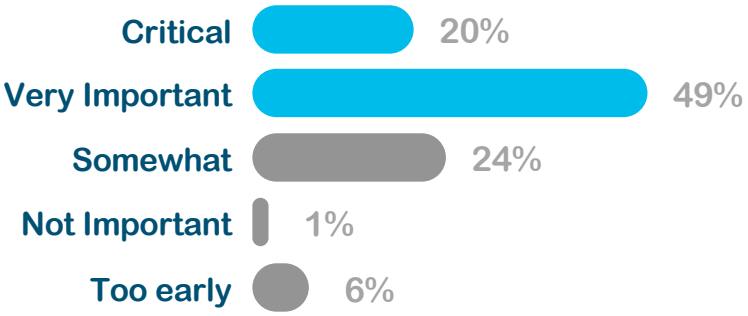
Microservices Architecture

Applications developed as loosely coupled services connected via APIs

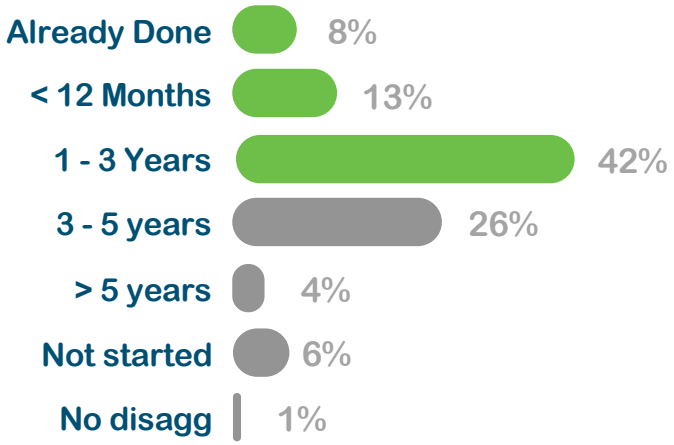
SP Disaggregation Survey Analysis



Disaggregation Importance to SPs



Disaggregation Timeline for Deployment

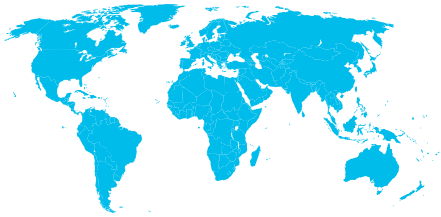


69 % deem disaggregation "critical" or "very important"

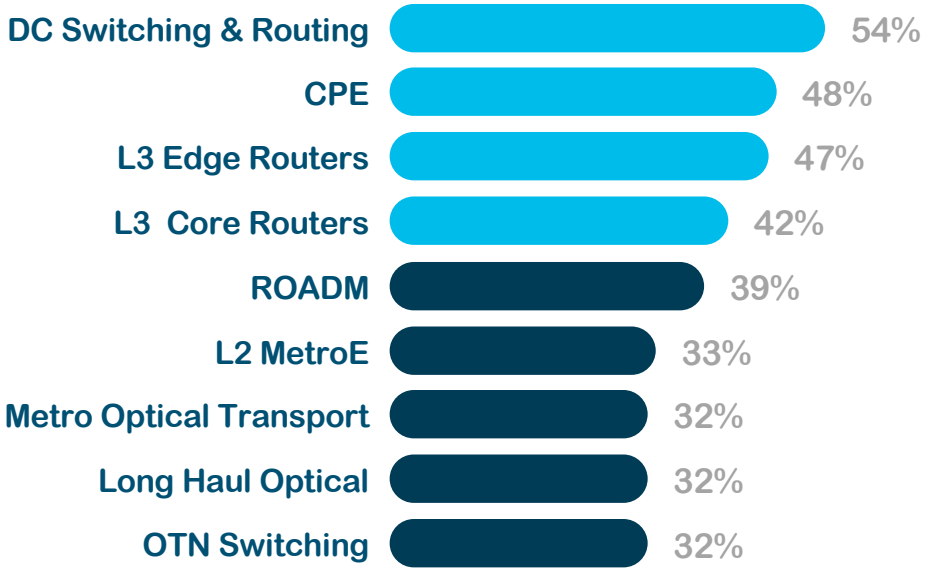
63 % will have deployed disaggregated systems over the next 3 years

Source : "Charting the Path to Network Automation and Disaggregation : Carrier SDN Survey Analysis" ; Heavy Reading ; February 2018
N=137 respondents

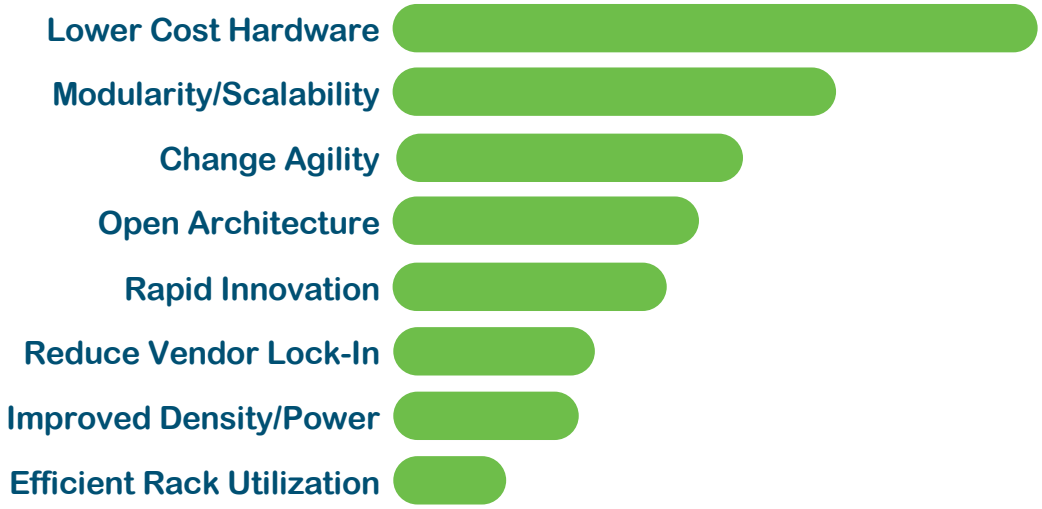
SP Network Functions & Benefits



Most Important Functions



Benefits for Operators



IP equipment in the top 4 !

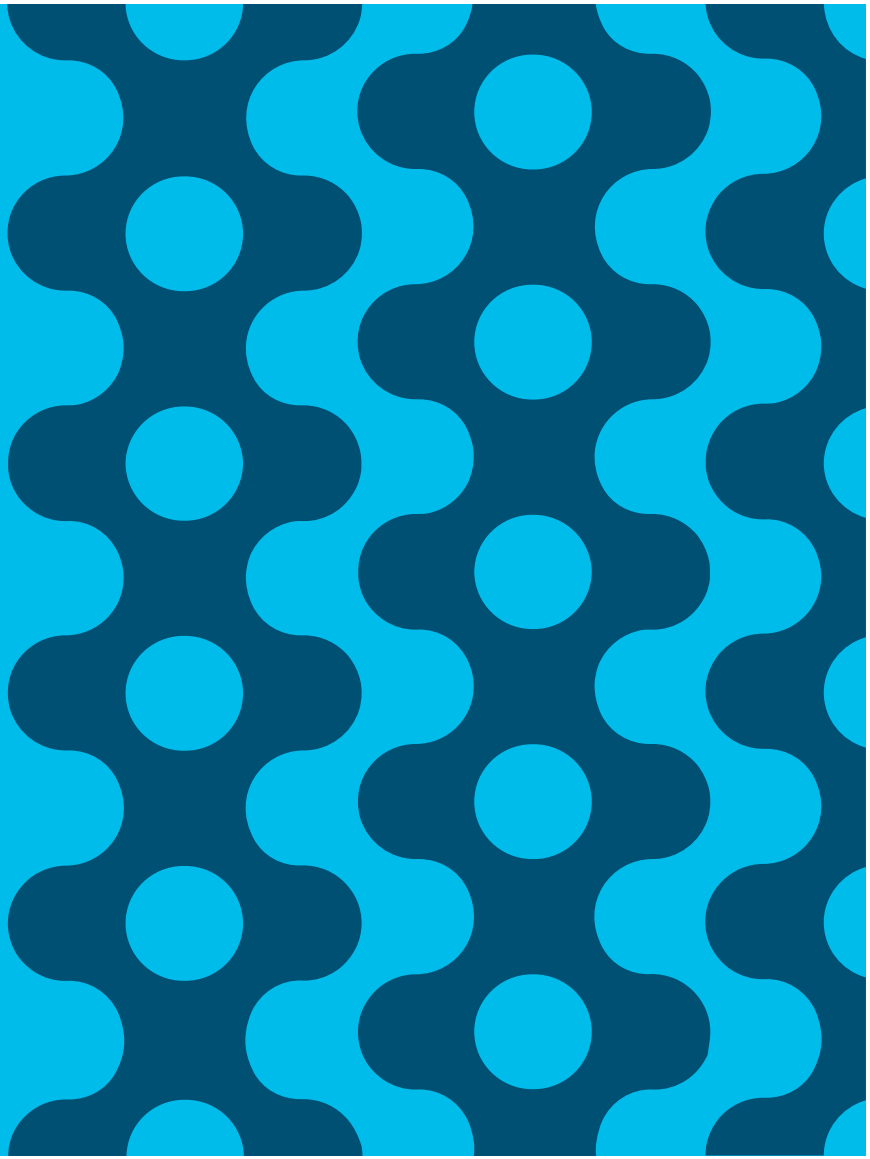
Cost optimization dominates

Source : "Charting the Path to Network Automation and Disaggregation : Carrier SDN Survey Analysis" ; Heavy Reading ; February 2018
N=137 respondents

Customer Profiles

Adopters	Explorers/Skeptics	Disbelievers
• Unsatisfied with HW vendor Velocity, Pricing, Flexibility • Want to avoid Vendor Lock-in • Long-term vision around commoditization	• Believe Capex savings potential in disaggregated solutions for HW and SW • Exploring overall operational cost savings with disaggregation	• Happy with Integrated Solutions • Not a believer in overall cost savings by adapting a disaggregated solutions

Delayering the Integrated Router



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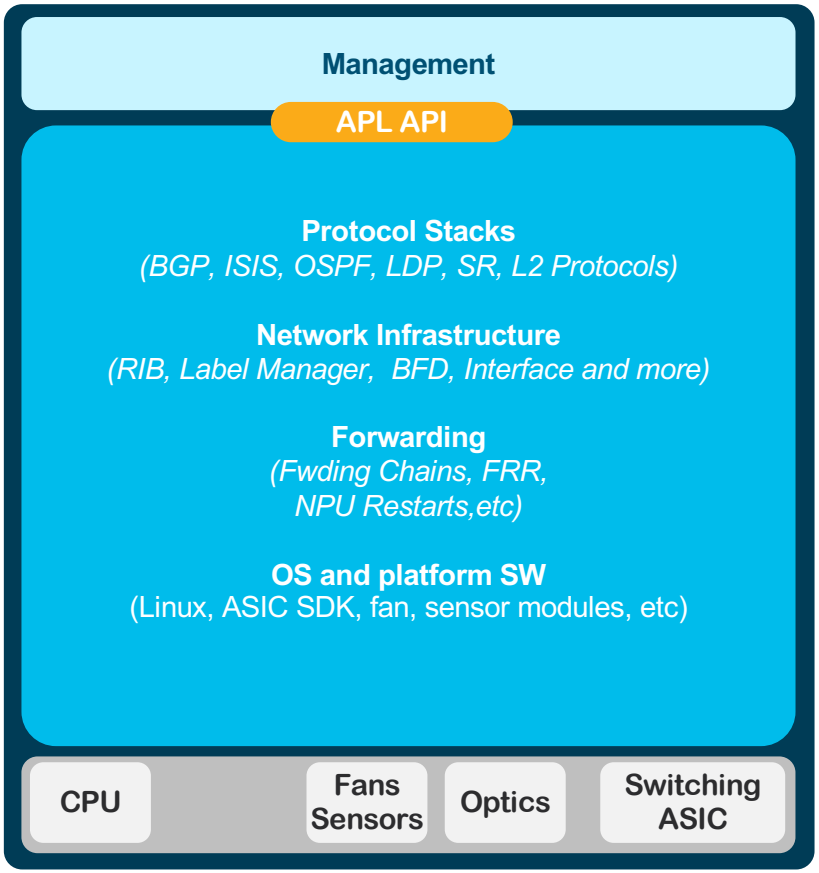
De-Layering The Network Stack

A Typical Integrated Router

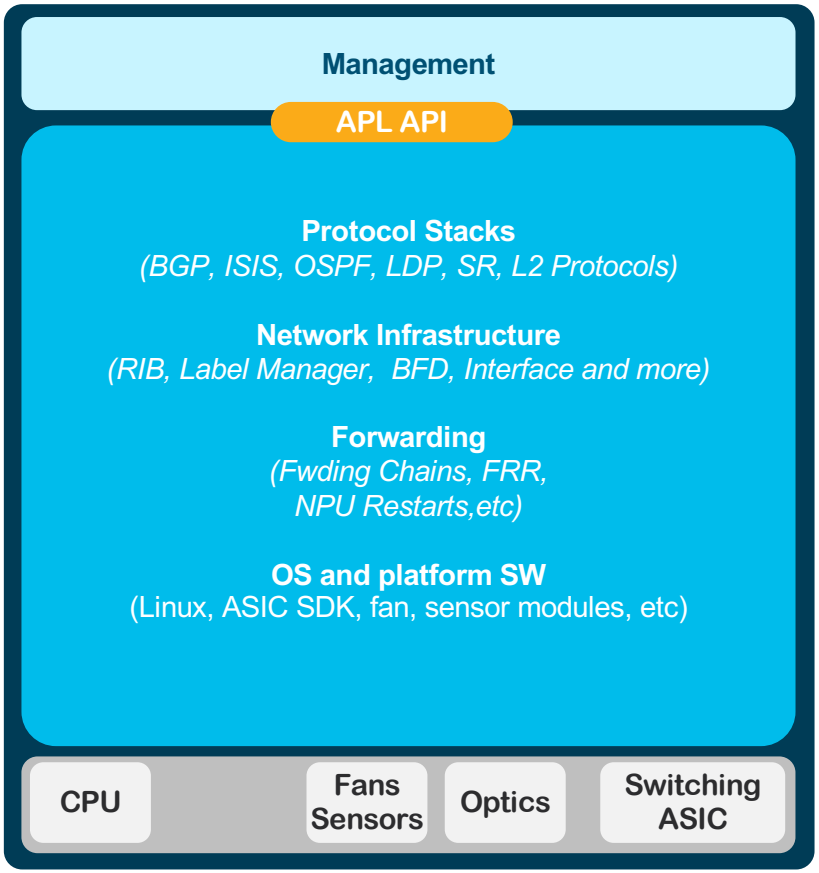
Application/Protocol Layer
APIs into the Control (e.g. (BGP, IGP, SR) and Management Plane (e.g CLI, Netconf, SNMP, Syslog, SSH)



De-Layering The Network Stack

High Level Value Proposition

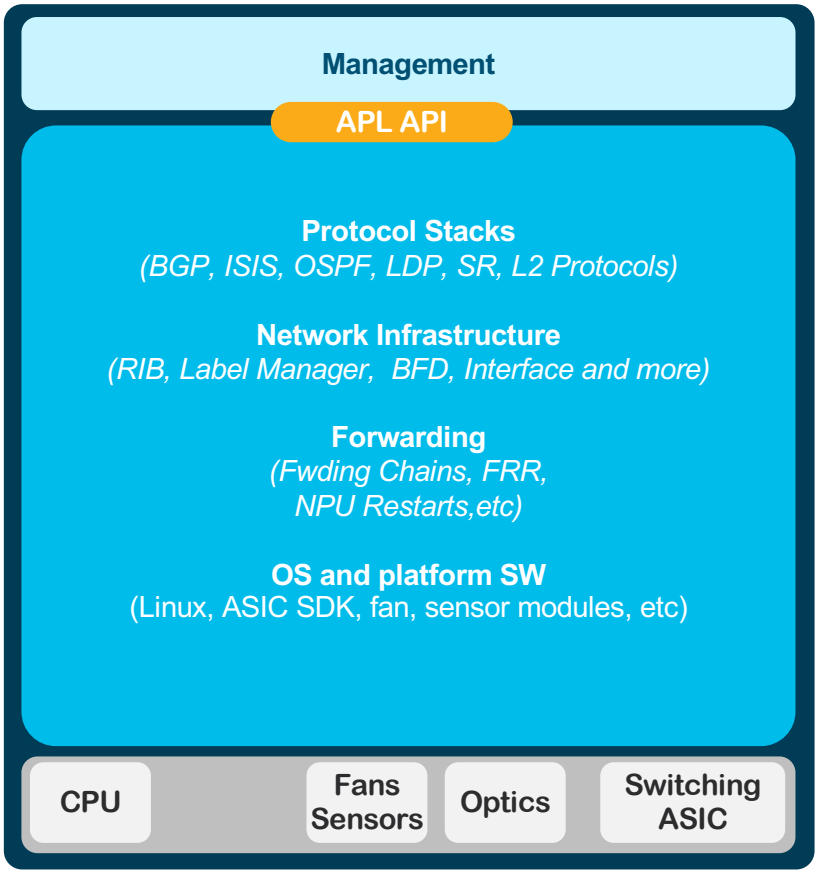
- Rich Feature Set
- Wide Range of HW Form Factors
- Pre-integrated / pre-tested
- Single Touchpoint Support



De-Layering The Network Stack

Usual Concerns Related to Integrated Systems

- Rich Feature Set
- Wide Range of HW Form Factors
- Pre-integrated / pre-tested
- Single Touchpoint Support

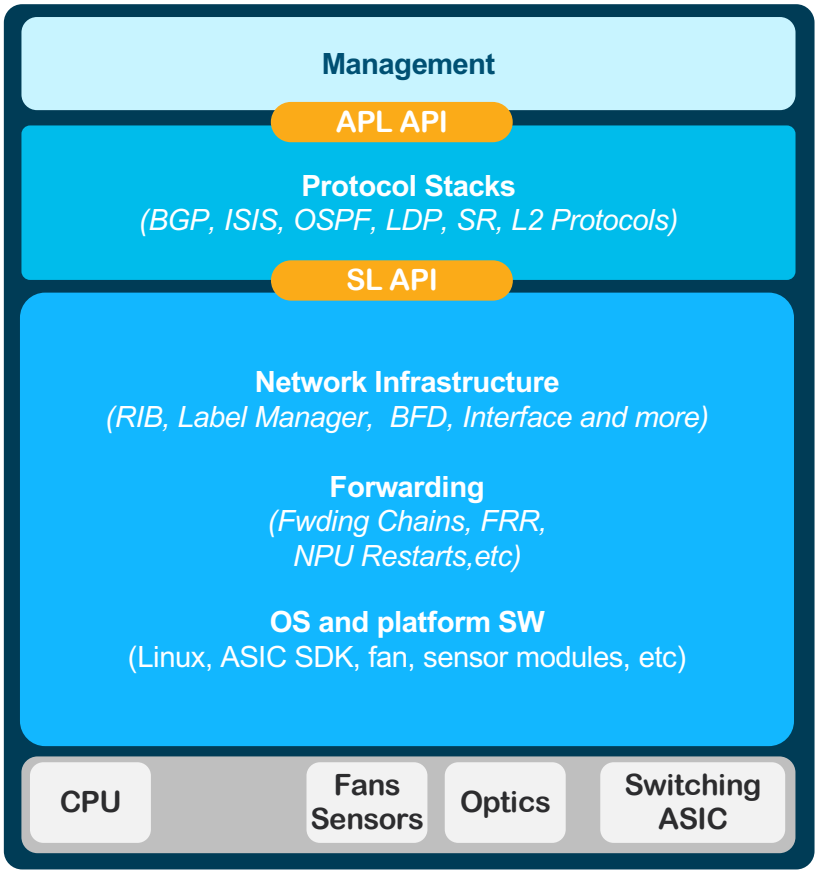


- Slower Feature Development
- HW and SW Vendor Lock
- Mostly Proprietary Solutions
- Higher Cost

De-Layering The Network Stack

Phase 1 : Exposed Direct Access to the Forwarding Plane

Application/Protocol Layer
APIs into the Control (e.g. BGP, IGP, SR) and Management Plane (e.g CLI, Netconf, SNMP, Syslog, SSH)

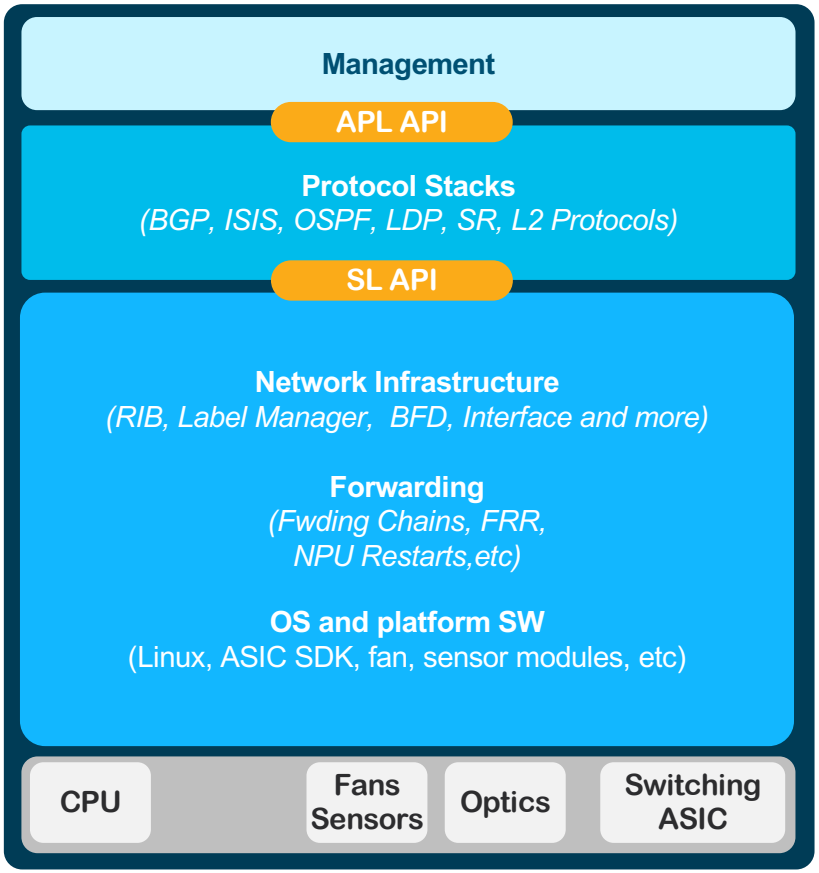


Service Adaptation Layer (Cisco)
Enables dynamic, programmatic control. Build & extend the device's control plane functionality.

De-Layering The Network Stack

Phase 1 : Exposed Direct Access to the Control Plane

Application/Protocol Layer
APIs into the Control (e.g. BGP, IGP, SR) and Management Plane (e.g CLI, Netconf, SNMP, Syslog, SSH)



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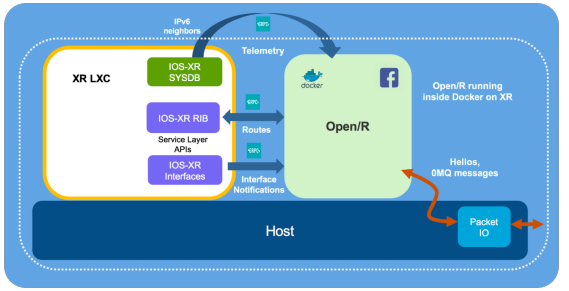
Enables dynamic, programmatic control. Build & extend the device's control plane functionality.



e.g : Open/R integration with XR

De-Layering The Network Stack

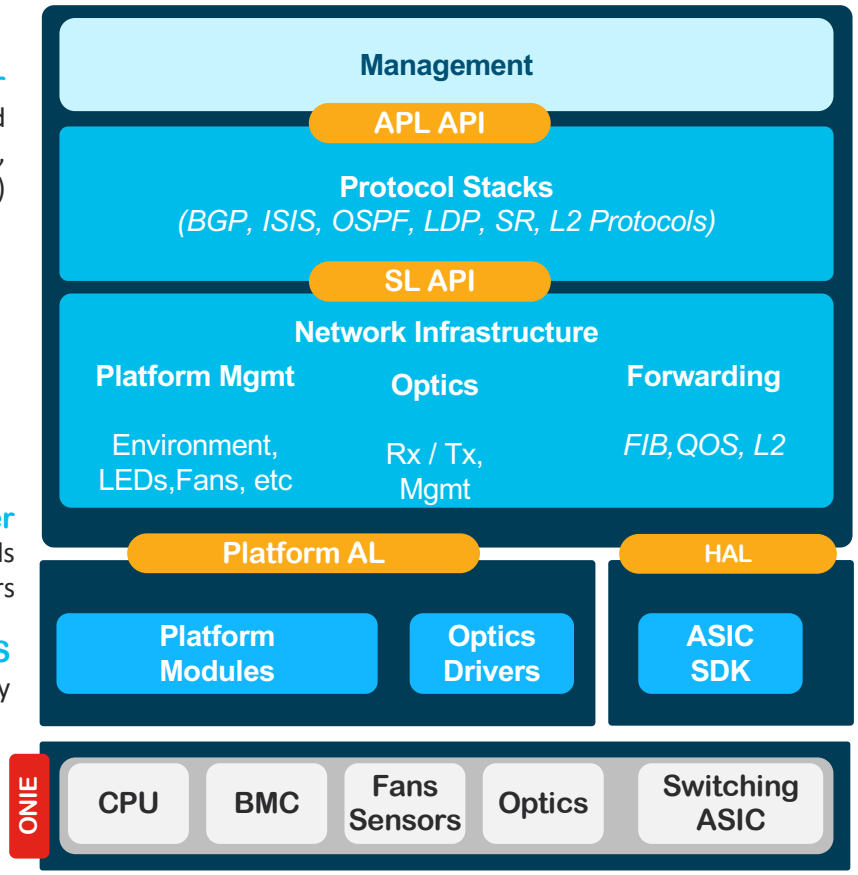
Phase 2 : Complete Separation Between SW and HW

Application/Protocol Layer
APIs into the Control (e.g. BGP, IGP, SR) and Management Plane (e.g CLI, Netconf, SNMP, Syslog, SSH)

Platform Abstraction Layer
API to underlying platform environmentals
Access to the optics drivers

Open Network Linux Base OS
No routing/switching capability

ONIE
Invoked to install NEW NOS package



Service Adaptation Layer (Cisco)
Enables dynamic, programmatic control. Build & extend the device's control plane functionality.

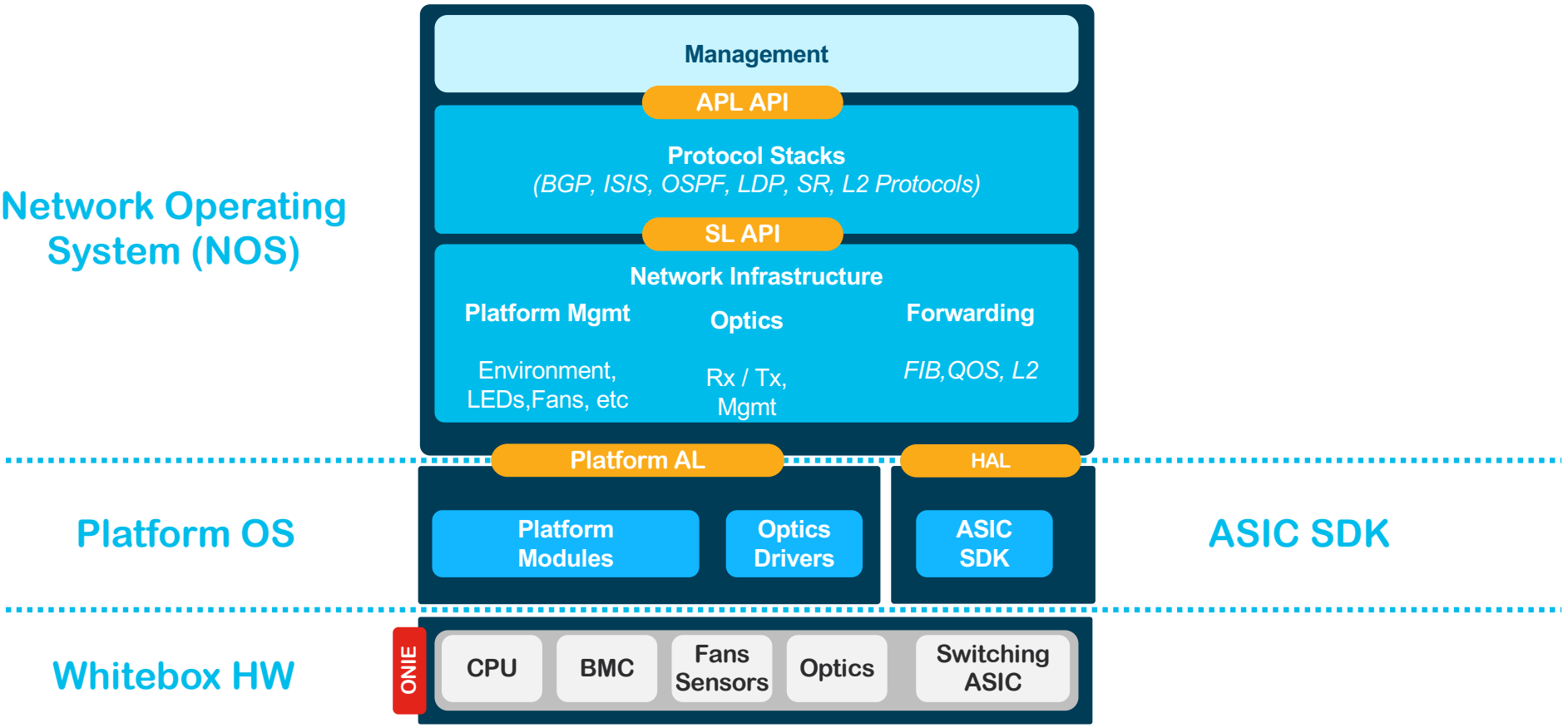
HW Abstraction Layer (HAL)
Standardised interface between to SDK e.g. :
- Switch Abstraction Interface (SAI)
- OpenNSL (BDCM)
- Open Forwarding Abstraction (Cisco)

Switching ASIC SDK
Allows interaction directly with switching silicon

Hardware
Barebones switch, minimal SW install environment (ONIE)

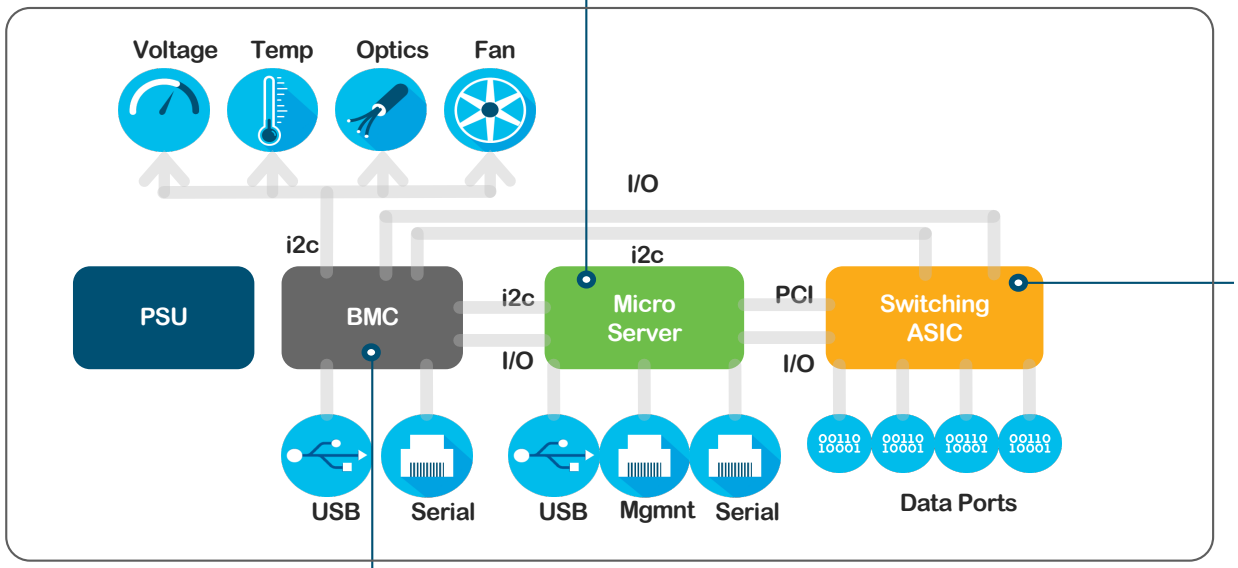
De-Layering The Network Stack

The Three Main Components of a Disaggregated System



What Is A White Box?

- Controls Switch ASIC
- Usually Intel SoC
- Older use PowerPC
- Only basic boot strap SW (e.g. ONIE)



- Broadcom, Mellanox, Centec, Cavium, Barefoot
- Requires vendor specific SDK and driver to drive ASIC

- Optional
- Management & Monitoring
- Usually proprietary SW
- Facebook has OpenBMC

Typical Whitebox – What do you get?

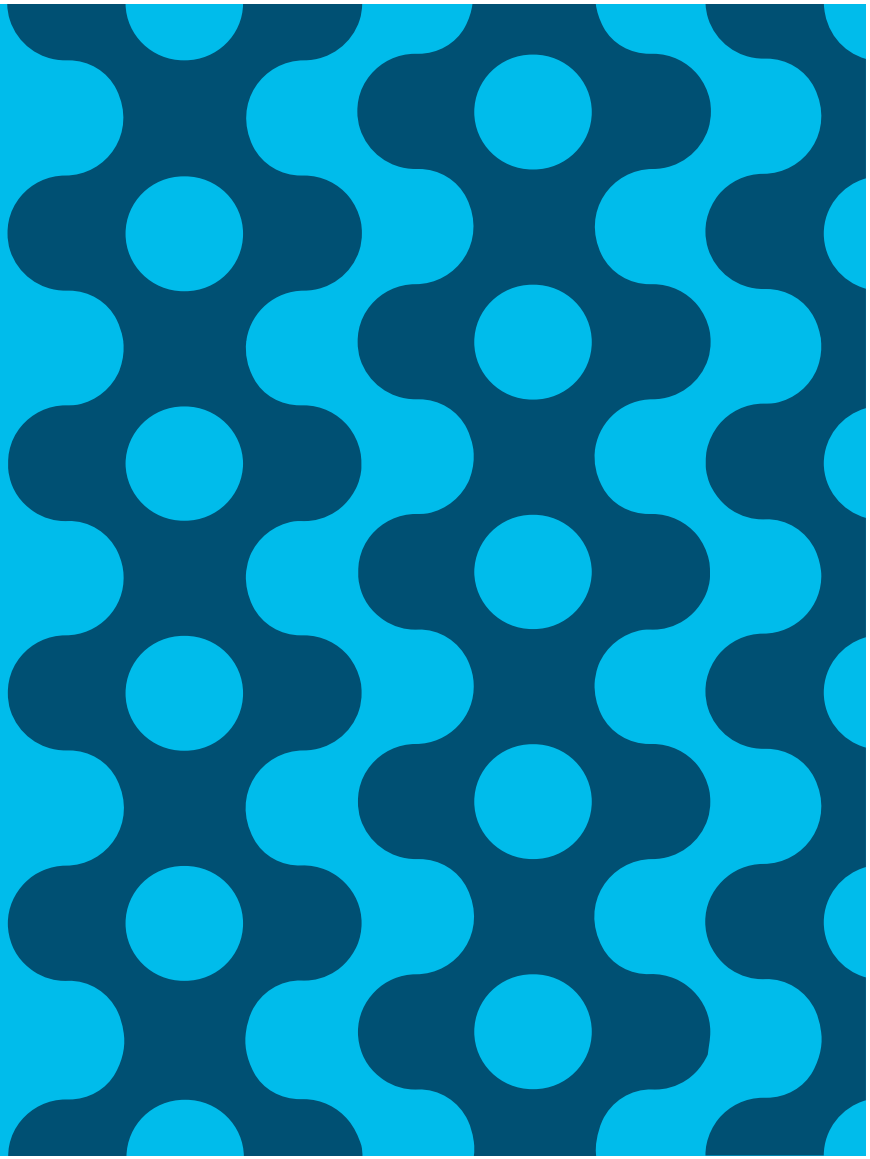
Switching Hardware

NOS Installer

- Generally, HW vendors do not provide any switching/routing stack
- ONIE* is the only SW installed to bootstrap switch
- NOS must be selected and purchased separately
- Whitebox must be certified for the by NOS vendor
- The NOS is usually provided as an ONIE boot image

*Open Network Installation Environment

Let’s get specific now …



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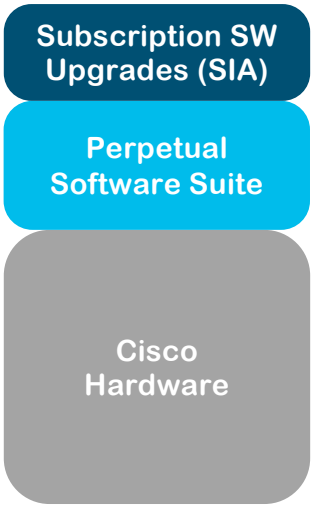
Cisco Software Only Models

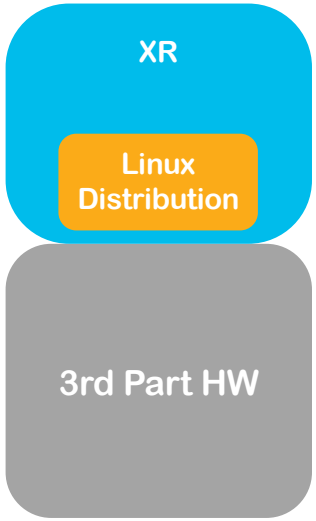
Full Stack

Cisco SW & HW but not bundled together



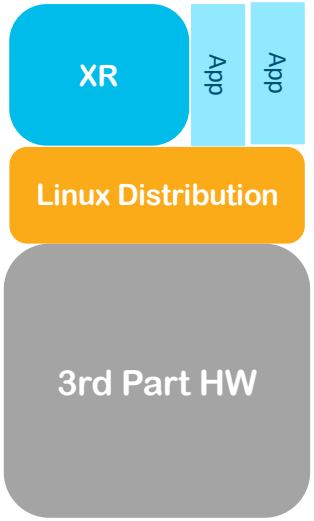
"SW Only Model"

IOS-XR offered as a SW only Running on *verified* 3rd party HW

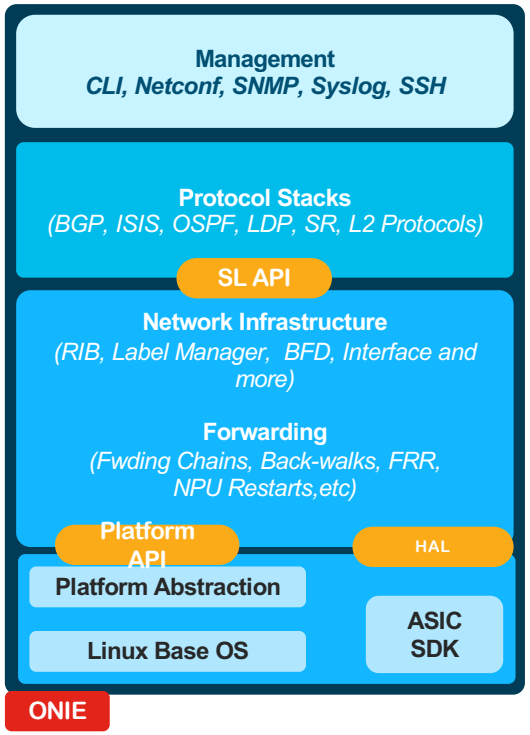


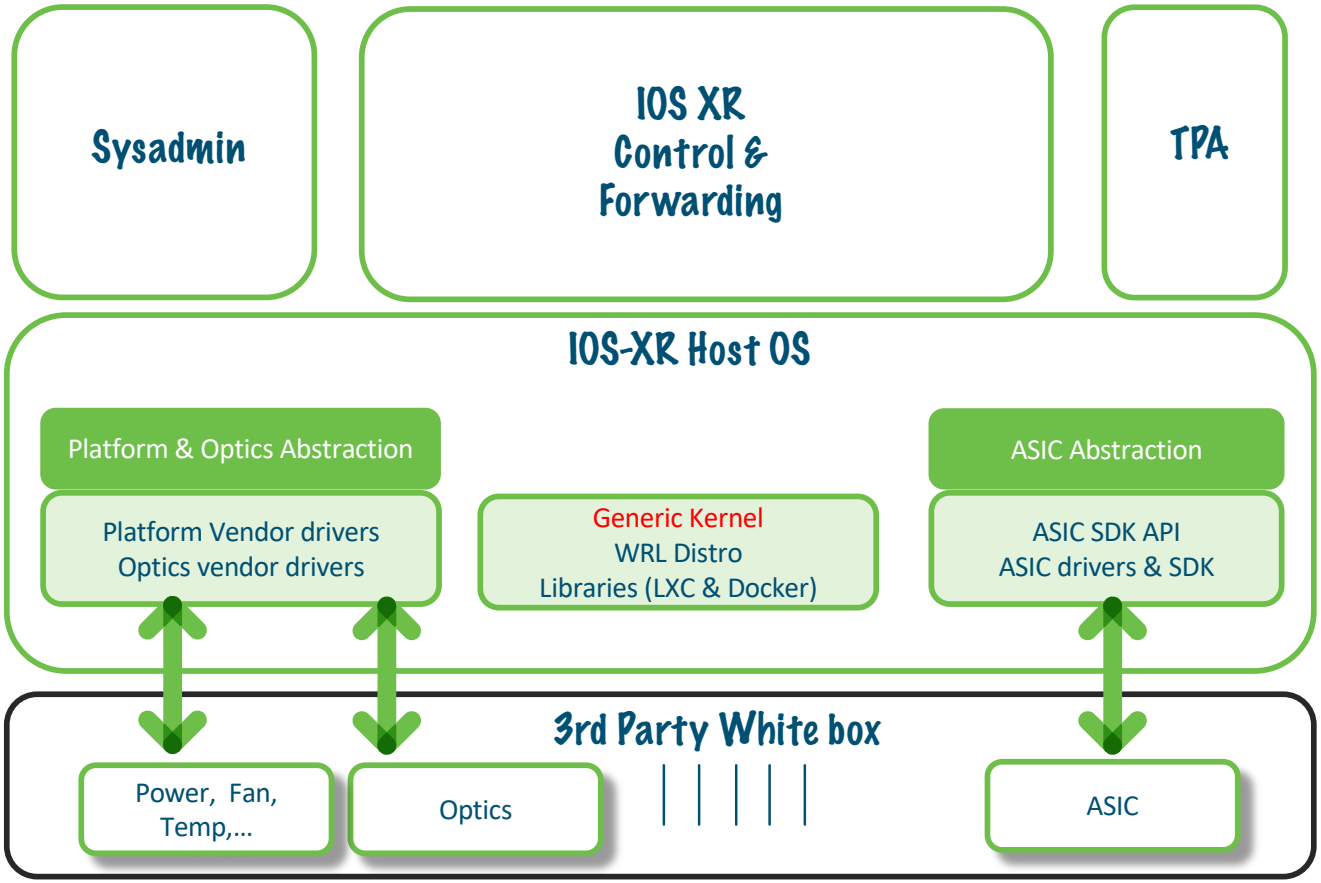
"XR Only Model"

IOS-XR offered as a SW only Running on *verified* Linux Distro on top of *verified* 3rd party HW



IOS XR on a White Box





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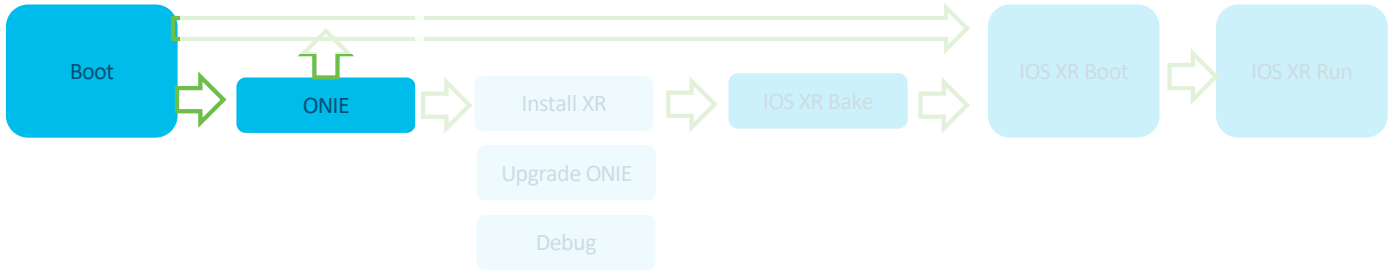

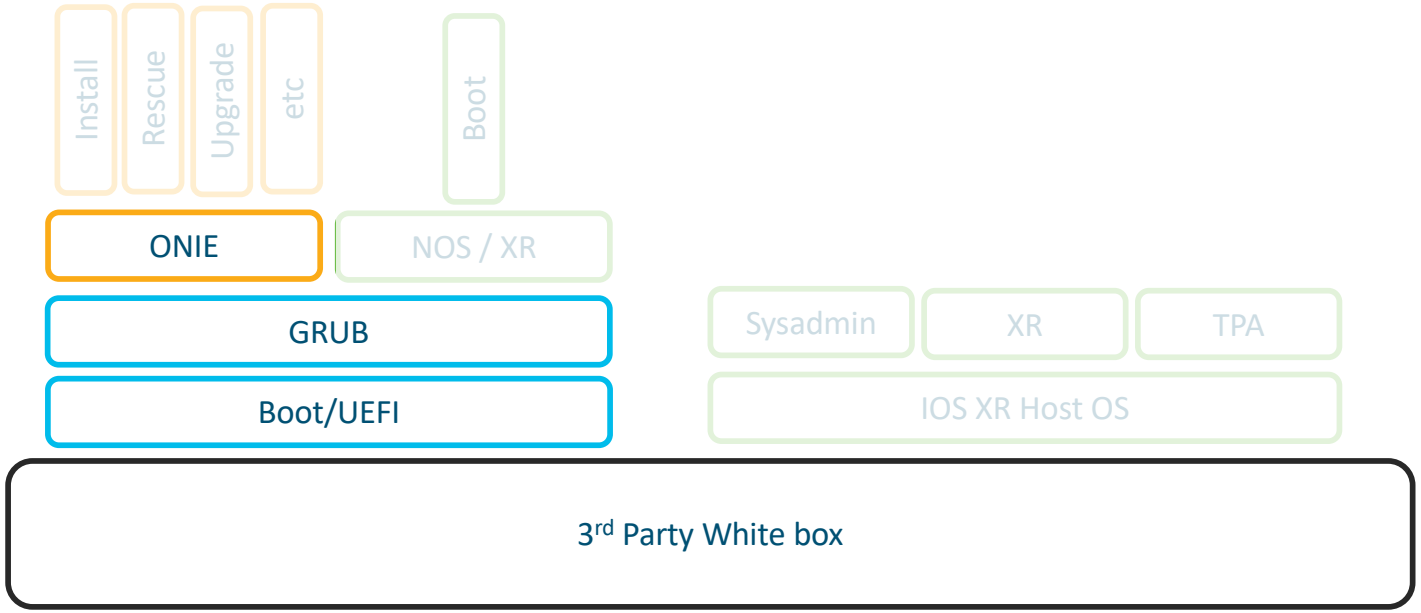

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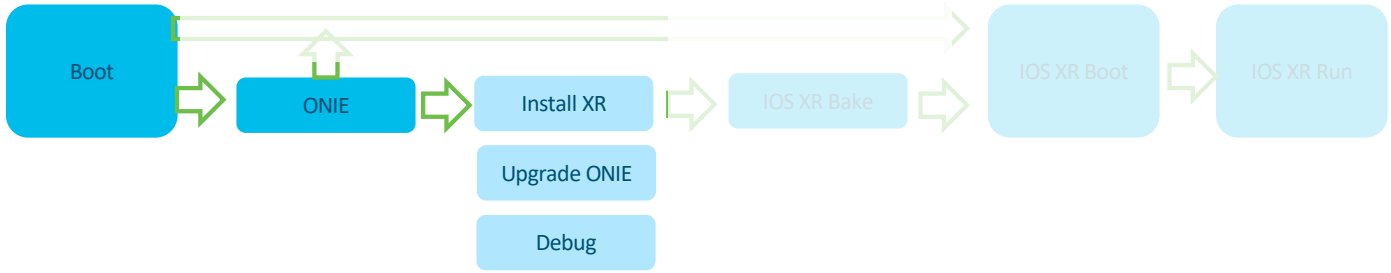

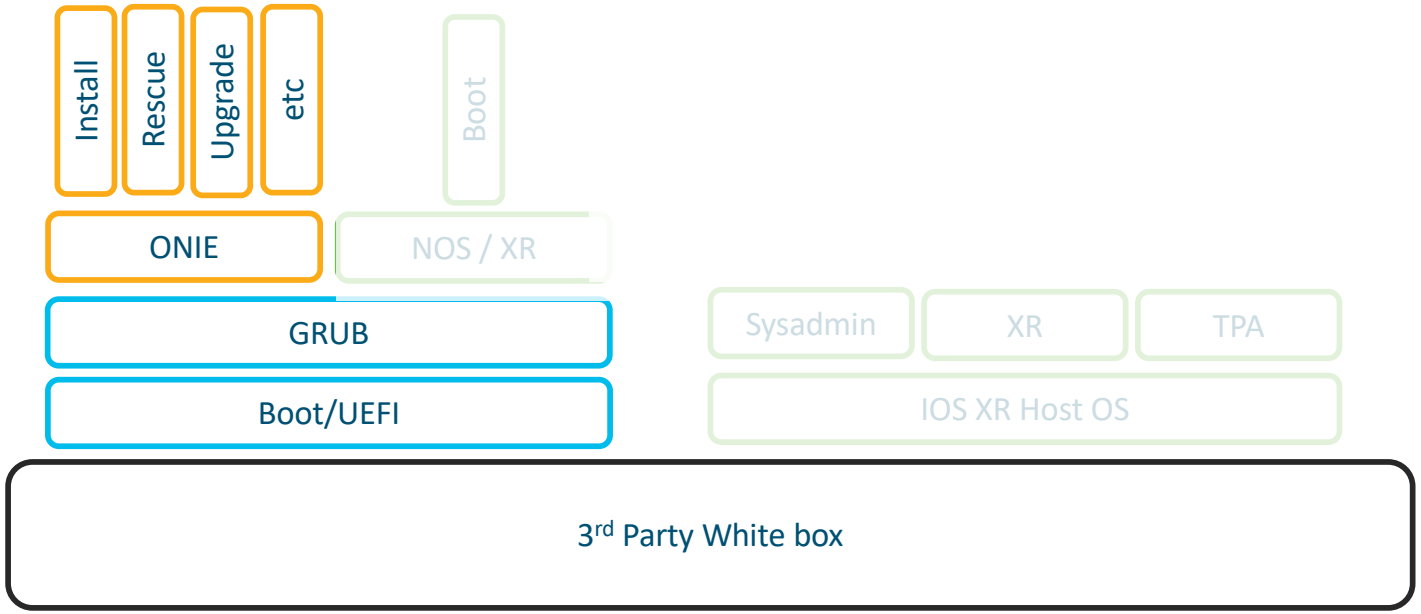

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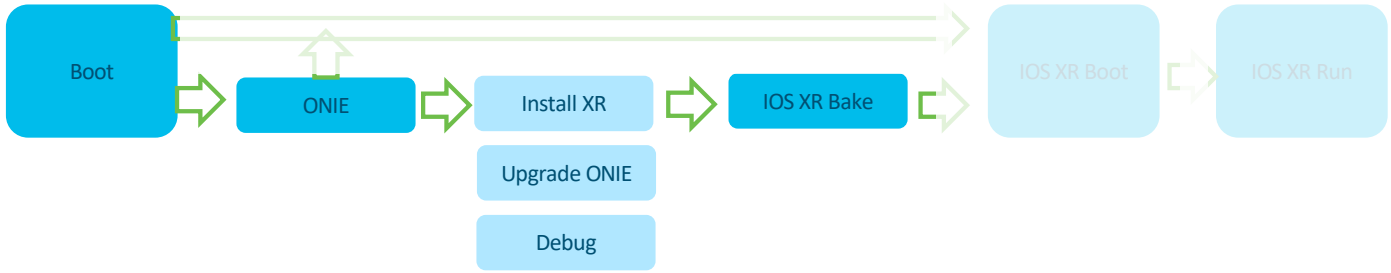

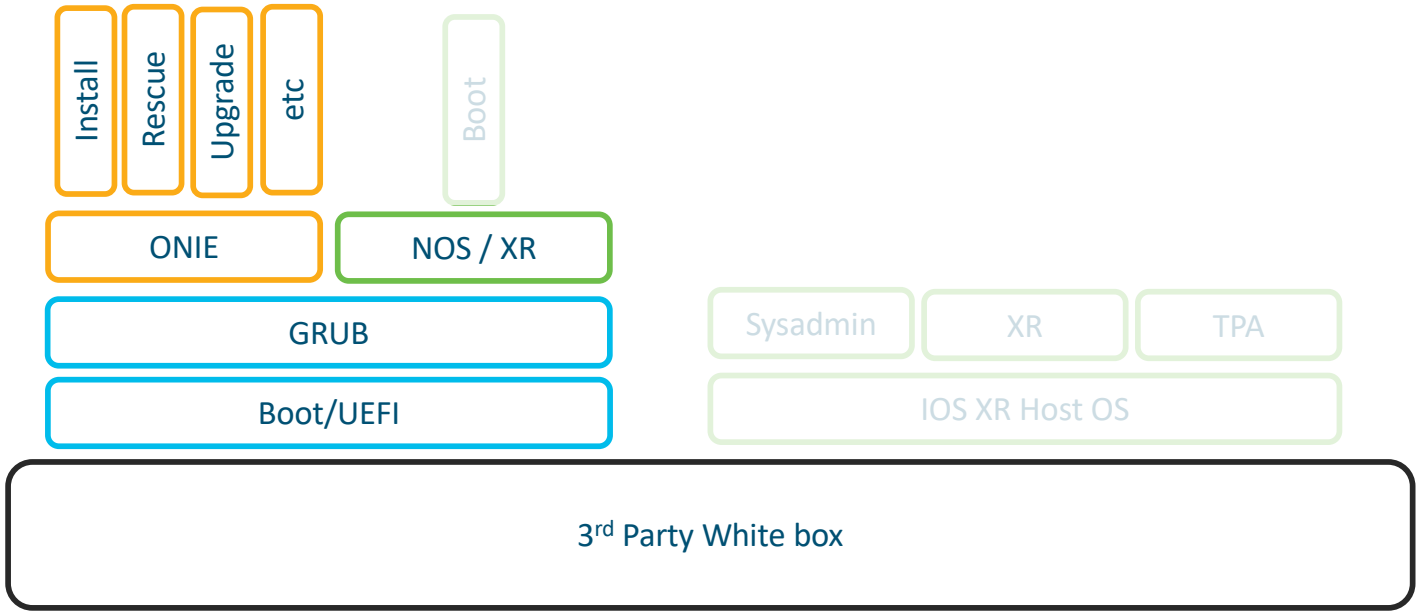

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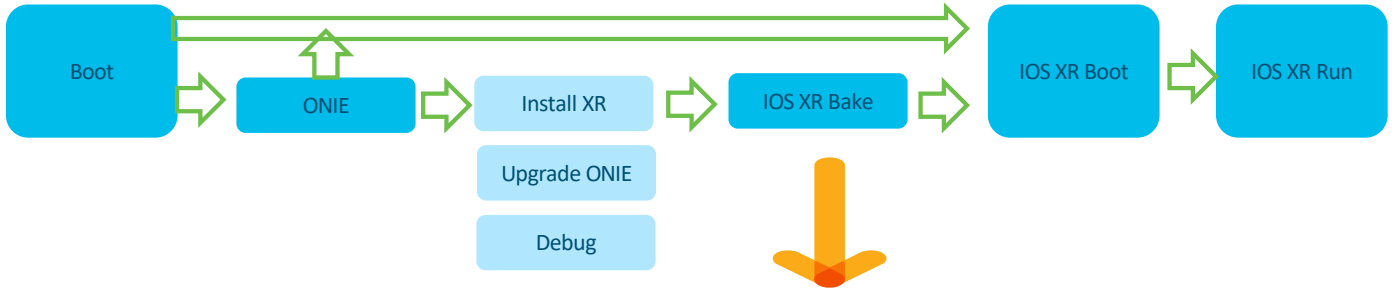
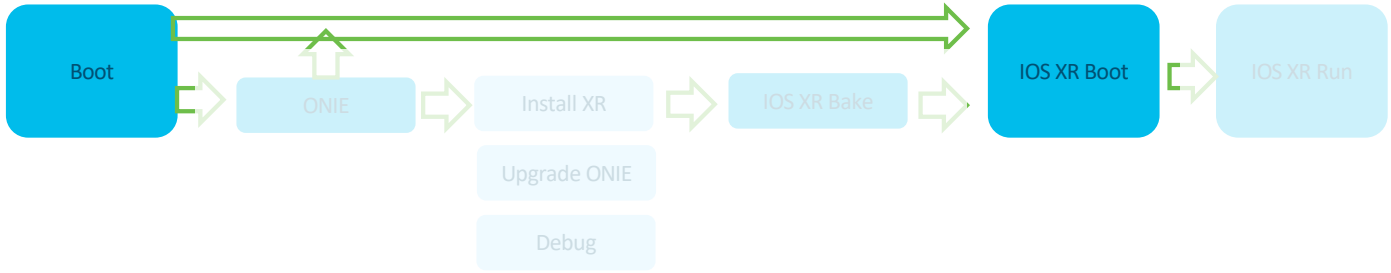


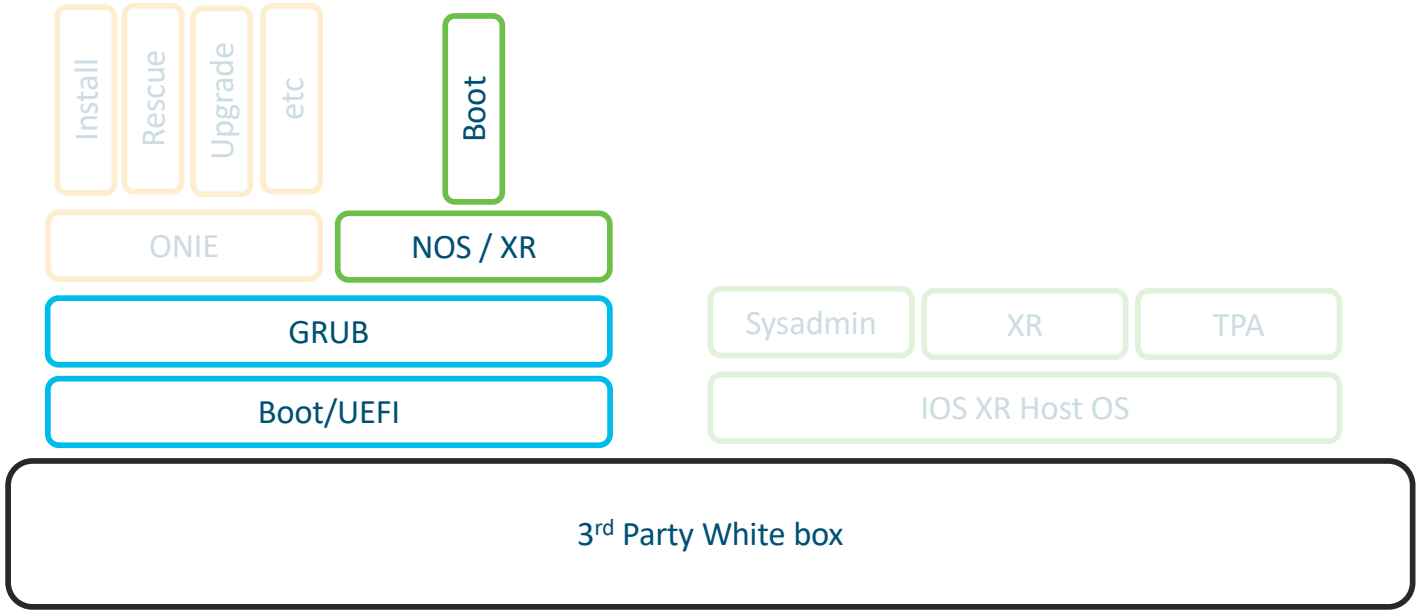

```
                                                        ONIE: OS Install Mode ...

                                                        Platform  : x86_64-accton_as7816_64x-r0
                                                        Info: Mounting kernel filesystems... done.
Info: Mounting ONIE-BOOT on /mnt/onie-boot ...
Info: Making NOS install boot mode sticky.
Installing for i386-pc platform.
Installation finished. No error reported.
Info: Using eth0 MAC address: 3c:2c:99:1d:7e:71
<snip>
ONIE: Using DHCPv4 addr: eth0: 172.18.1.53 / 255.255.255.0
<snip>
Please press Enter to activate this console. Info: eth0:  Checking link... up.
Info: Trying DHCPv4 on interface: eth0
ONIE: Using DHCPv4 addr: eth0: 172.18.1.53 / 255.255.255.0
```

```
Info: Attempting http://172.18.1.249/XR/LATEST/iosxrwb-full-x.installer ...
ONIE: Executing installer: http://172.18.1.249/XR/LATEST/iosxrwb-full-x.installer
installer: computing checksum of original archive
installer: checksum is OK
```

IOS XR on a White Box





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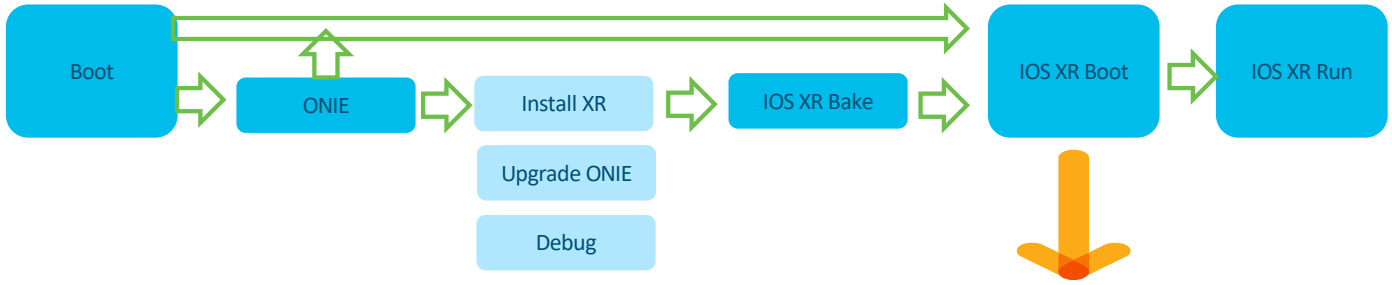
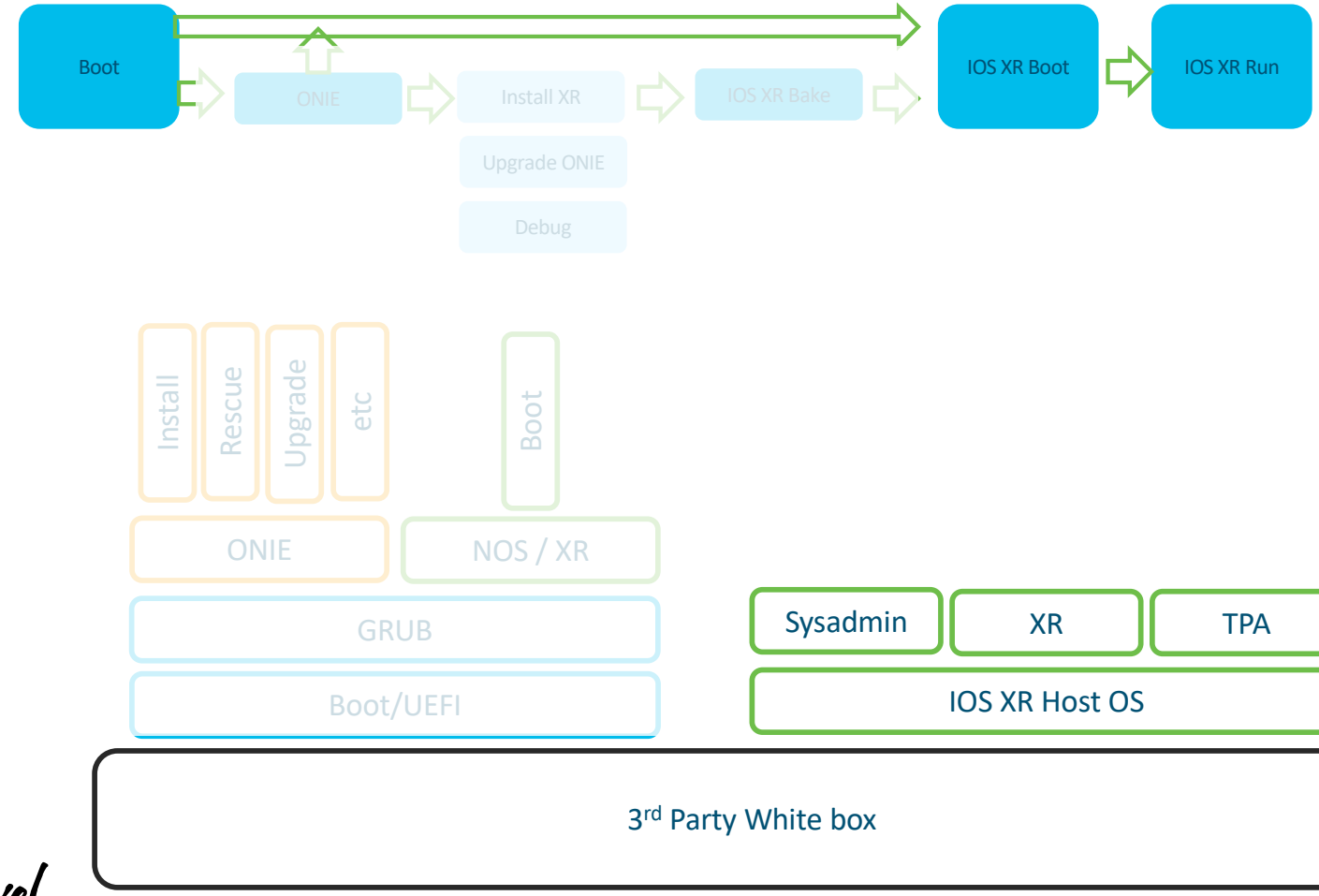


ROUTER

```
  Booting `eXR'
                                                          Loading eXR ...


                                                          [    0.503276] Created proc for
bigphysarea
[    1.655990] i8042: No controller found
Switching to new root and running init.
tar: ./tmp: time stamp 2018-06-12 19:02:50 is 1607139.920533994 s in the future
Sourcing /etc/sysconfig/udev
Starting udev: [  OK  ]
Starting udev
Populating dev cache
Running postinst /etc/rpm-postinsts/100-dnsmasq...
<snip>
Fri May 25 04:37:18 UTC 2018: Preparing disk for PLATFORM=iosxrwb:
Fri May 25 04:37:18 UTC 2018: Secondary disk is not present
```

IOS XR on a White Box



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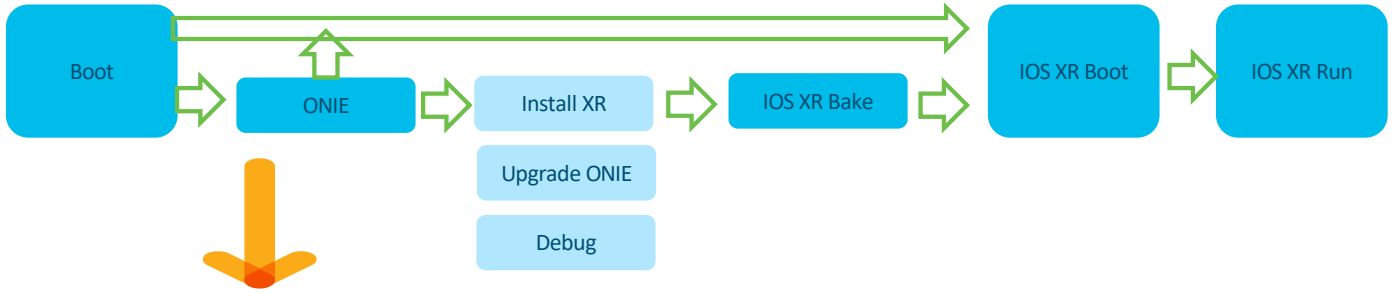


```
                      GNU GRUB  version 2.02~beta3

+----------------------------------------------------------------------------+
|*eXR                                                                        |
| ONIE                                                                       |
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|                                                                            |
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|                                                                            |
|                                                                            |
+----------------------------------------------------------------------------+

     Use the ^ and v keys to select which entry is highlighted.
     Press enter to boot the selected OS, `e' to edit the commands
     before booting or `c' for a command-line.
     The highlighted entry will be executed automatically in 2s.
```
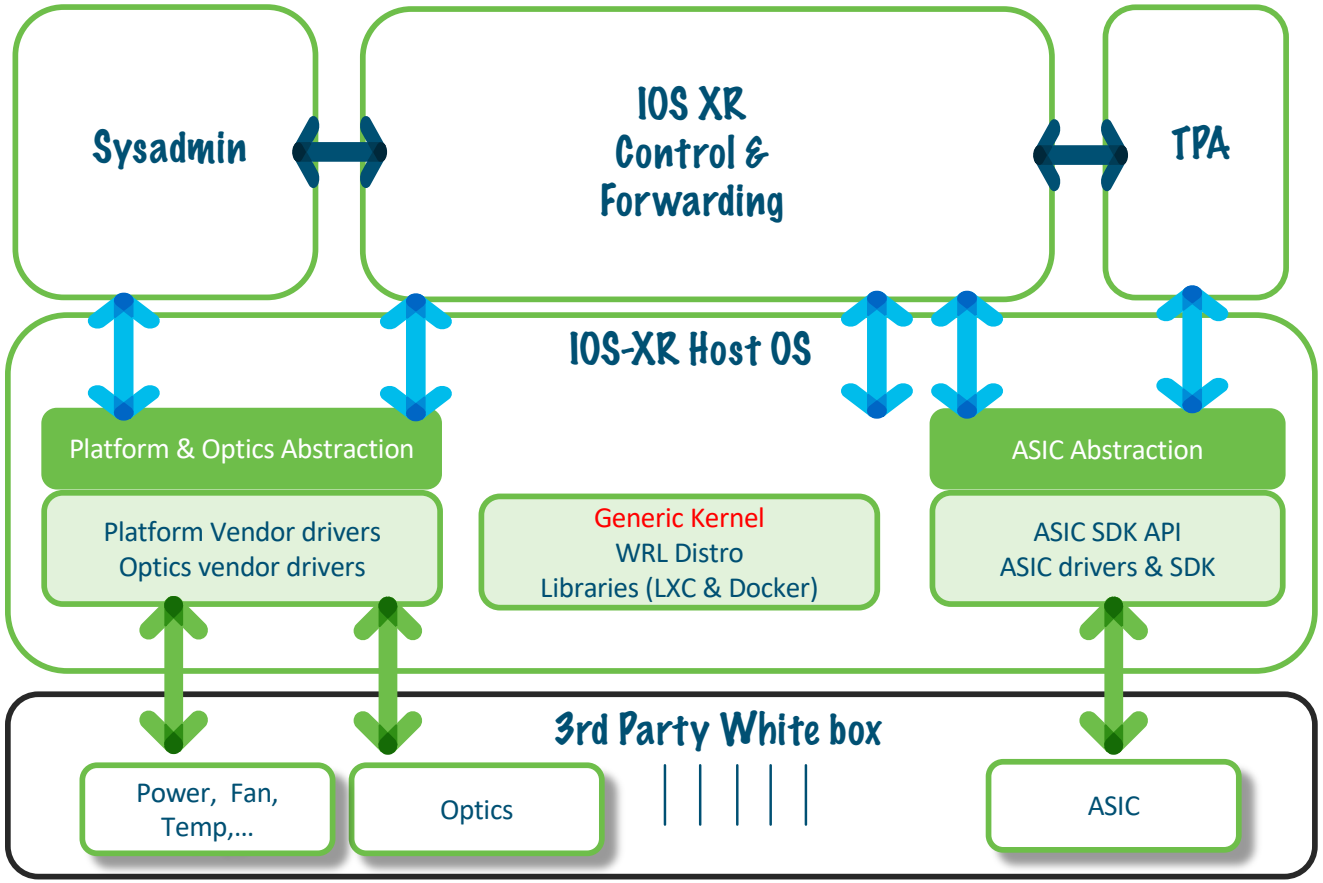

IOS XR on a White Box



IOS XR on Whitebox - Commands

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IOS XR on a White Box

```
RP/0/RP0/CPU0:WB3#show ver
Sun Dec  2 08:07:33.966 UTC
Cisco IOS XR Software, Version 6.5.2.24I
Copyright (c) 2013-2018 by Cisco Systems, Inc.


Build Information:
 Built By     : ahoang
 Built On     : Wed Dec 12 21:25:01 PST 2018
 Built Host   : iox-ucs-021
 Workspace    : /auto/iox-ucs-021-san1/nightly/r65x_18.12.12C/iosxrwb
 Version      : 6.5.2.24I
 Location     : /opt/cisco/XR/packages/


cisco Accton_as7816_64x () processor
System uptime is 4 days 17 minutes


RP/0/RP0/CPU0:WB3#
```

IOS XR on a White Box

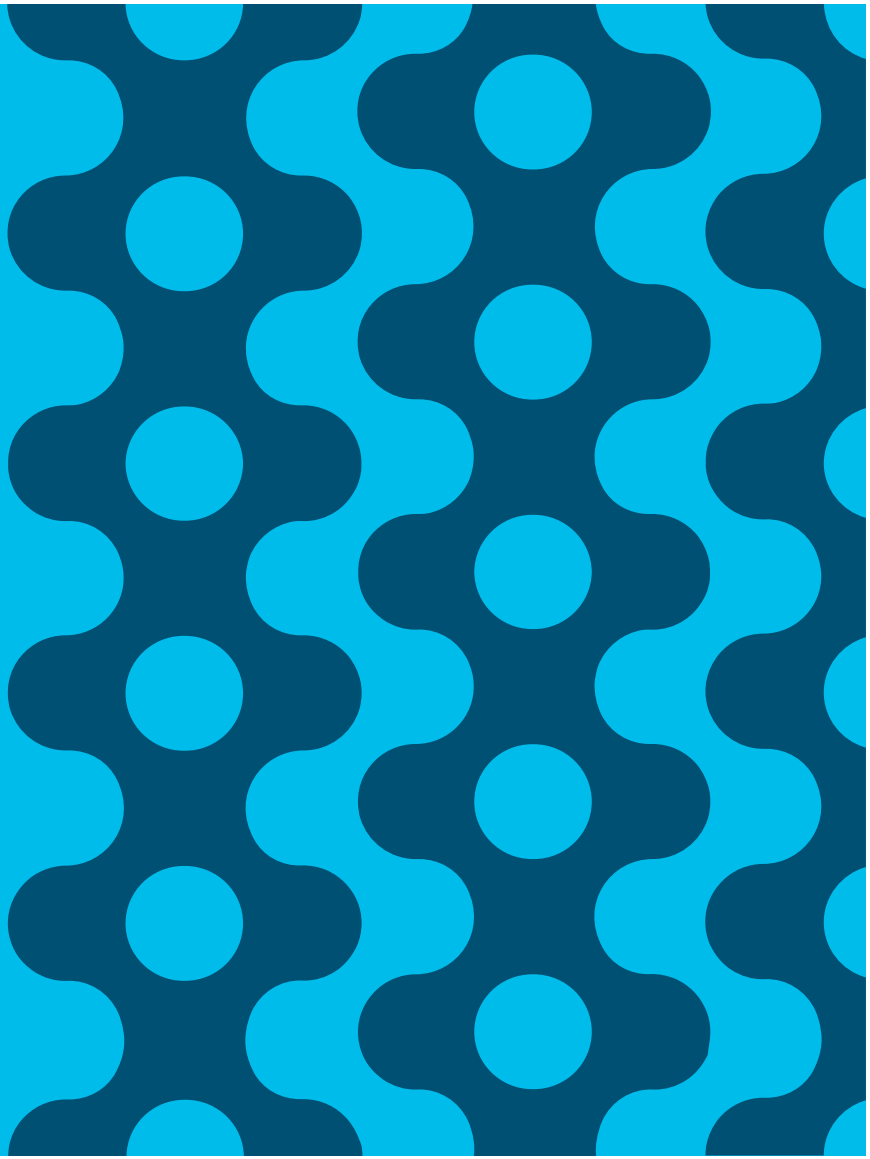
```
RP/0/RP0/CPU0:WB3#show platform
Sun Dec  2 08:08:04.702 UTC
Node              Type                       State            Config state
--------------------------------------------------------------------------------
0/RP0/CPU0        7816-64X-O-AC-F(Active)    IOS XR RUN       NSHUT
0/FT0             7816-FN-BK                 OPERATIONAL      NSHUT
0/FT1             7816-FN-BK                 OPERATIONAL      NSHUT
0/FT2             7816-FN-BK                 OPERATIONAL      NSHUT
0/FT3             7816-FN-BK                 OPERATIONAL      NSHUT
RP/0/RP0/CPU0:WB3#


RP/0/RP0/CPU0:WB3#show ip int br
Sun Dec  2 08:08:19.538 UTC


Interface                      IP-Address      Status          Protocol Vrf-Name
Loopback0                      6.1.1.107       Up              Up       default
FortyGigE0/0/0/0               192.107.200.107 Up              Up       default
FortyGigE0/0/0/1               unassigned      Shutdown        Down     default

<snip>
```

Ecosystem



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The Ecosystem …

Illustrative. Non exhaustive

Network Operating System (NOS)

Platform OS

Whitebox HW

Cisco live!

SP & NOS/SW Vendor Investments/Partnerships

AT&T purchased Vyatta Open-Sourced to OCP as DANOS [1,2]

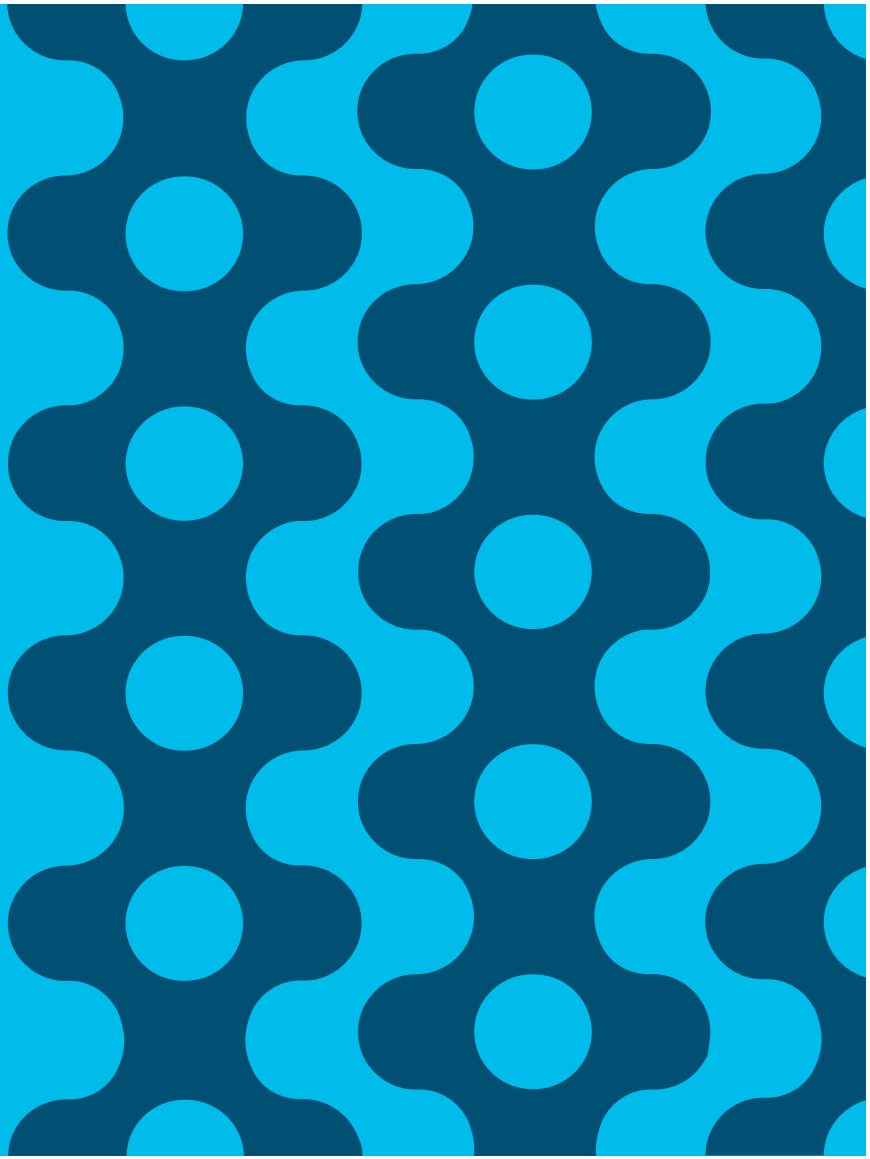
DT partnering with rtBrick for Access 4.0 [3]

Telstra Ventures invested US$43M in Cumulus (33% holding) [4]

Reliance buys Radisys to compliment RJIO SW disagg efforts [5]

1. https://about.att.com/story/att_to_acquire_vyatta_software_technology_from_brocade.htm
2. https://www.sdxcentral.com/articles/news/atts-dnos-morphs-linux-foundations-danos/2018/03/l
3. https://layer123.com/sdn-presentations/2-Wednesday.zip (Presentation RX14833)
4. https://www.itnews.com.au/news/telstra-ventures-backs-cumulus-networks-481705
5. https://www.sdxcentral.com/articles/news/reliance-industries-buys-radisys-for-about-67-million/2018/07/

Lessons Learnt



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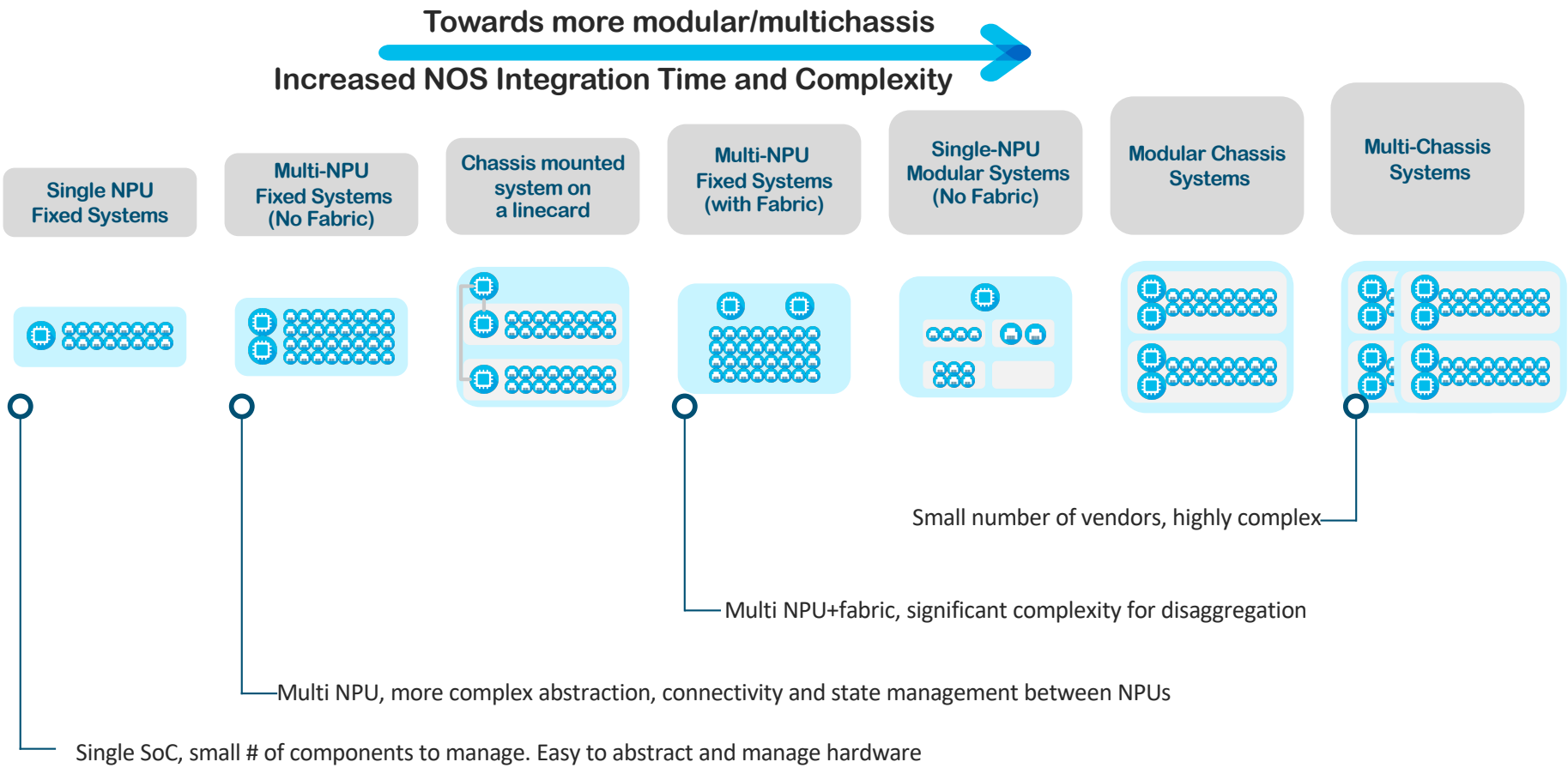
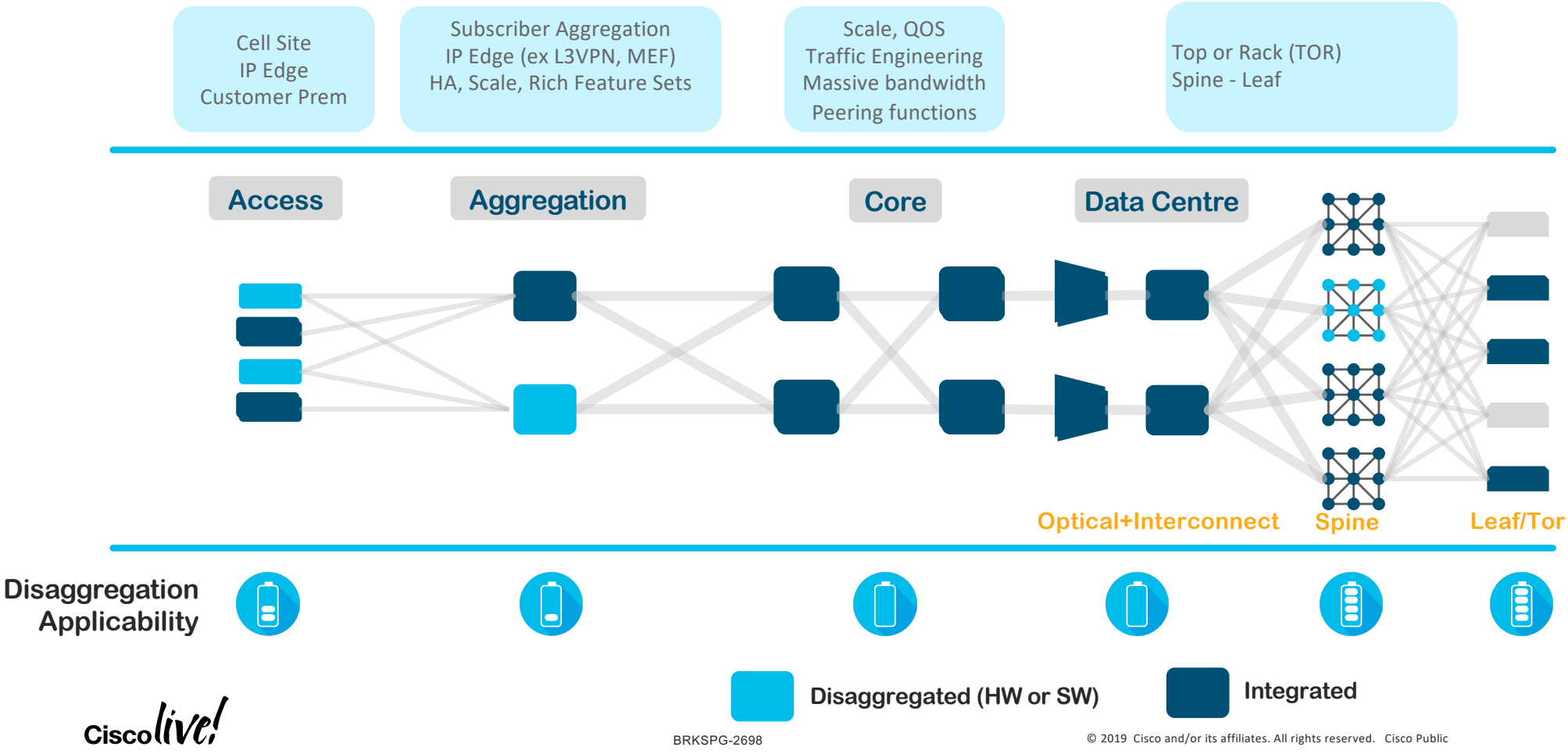
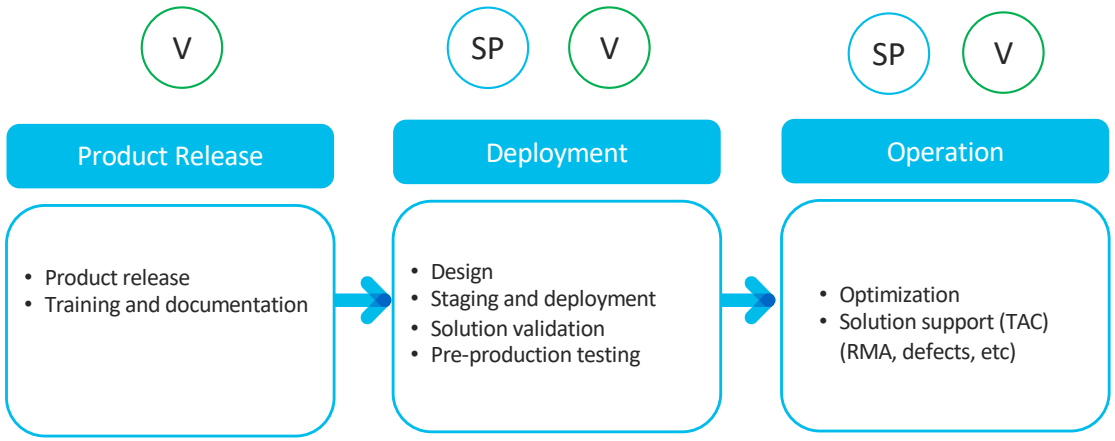
Routing System Form Factors And Disaggregation



Disaggregation Applicability

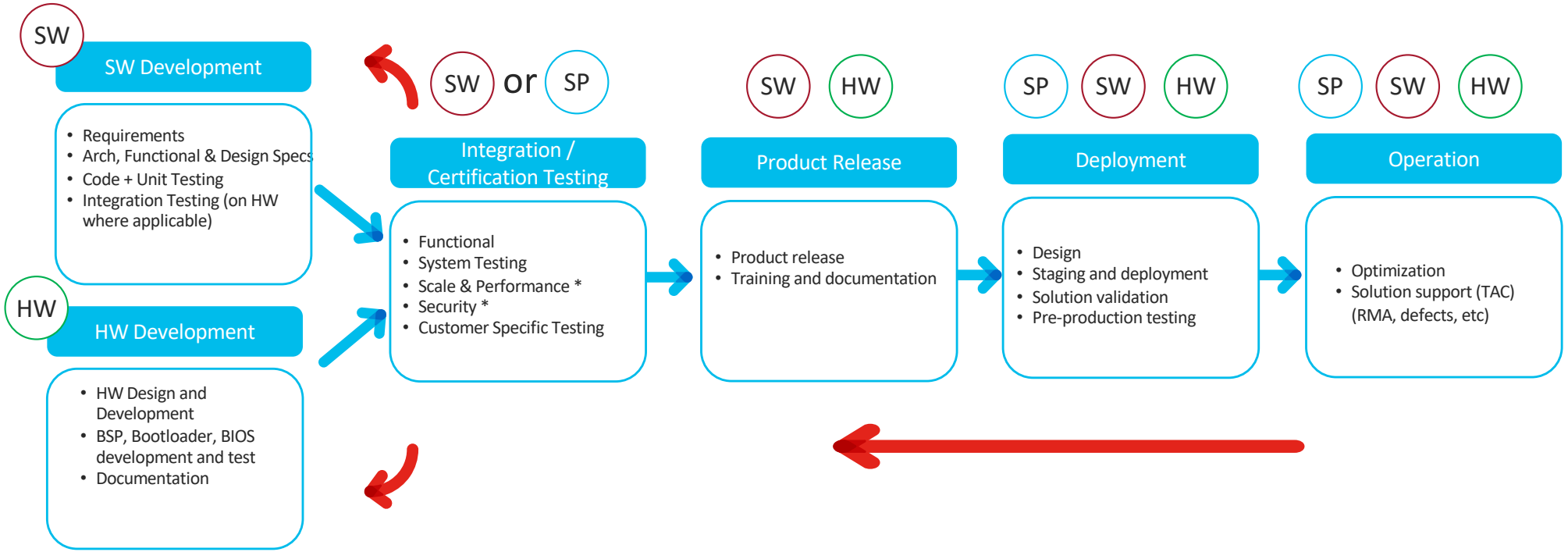


End to end deployment process



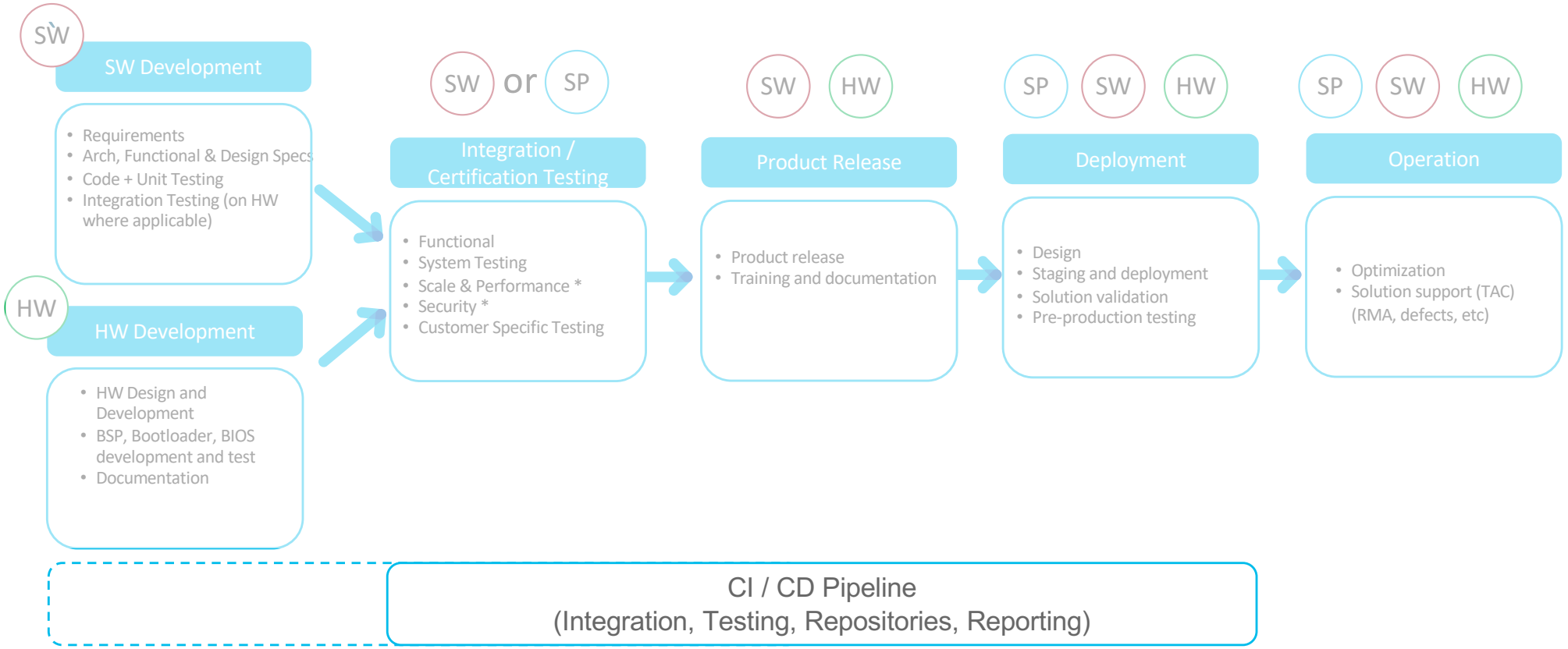
SP Service Provider / Customer
V Vendor

End to end development and deployment process

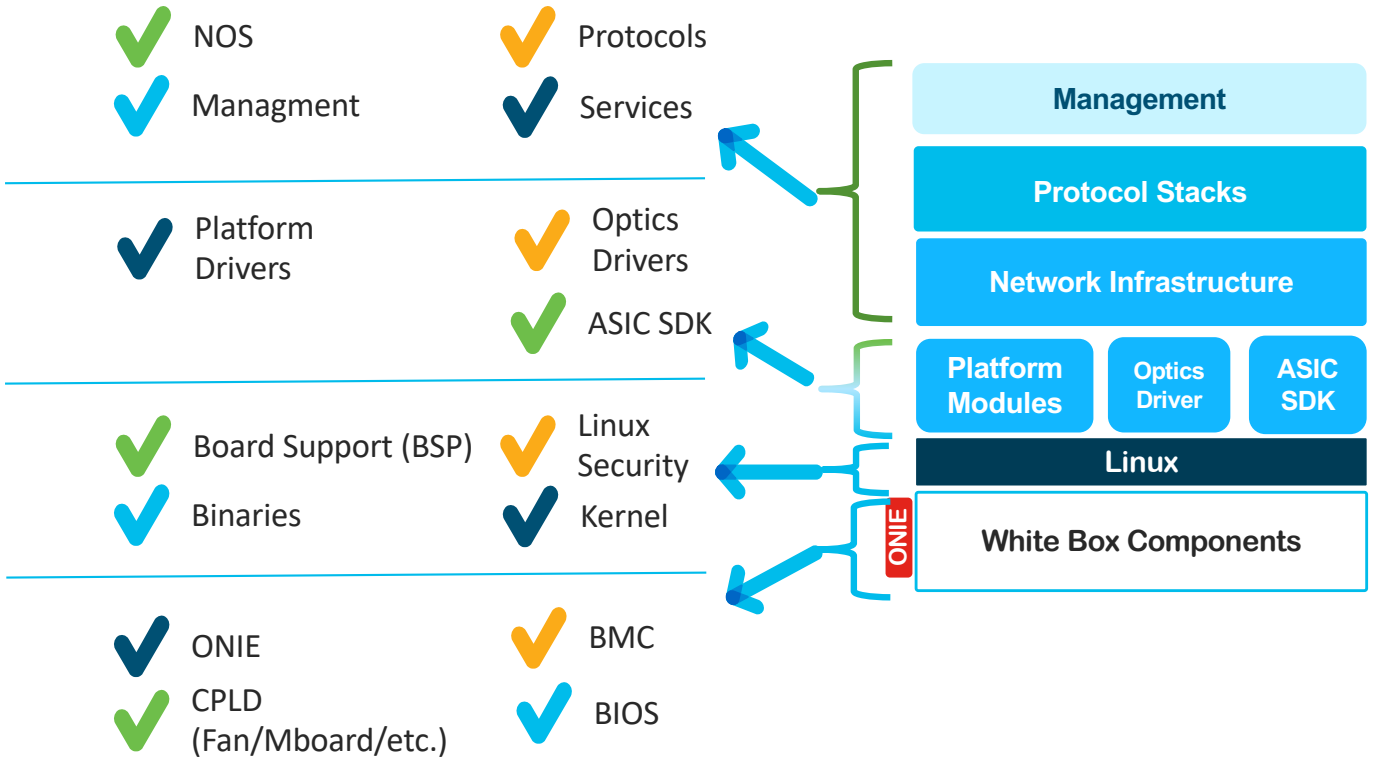


SP Service Provider / Customer
HW HW Vendor
SW SW Vendor

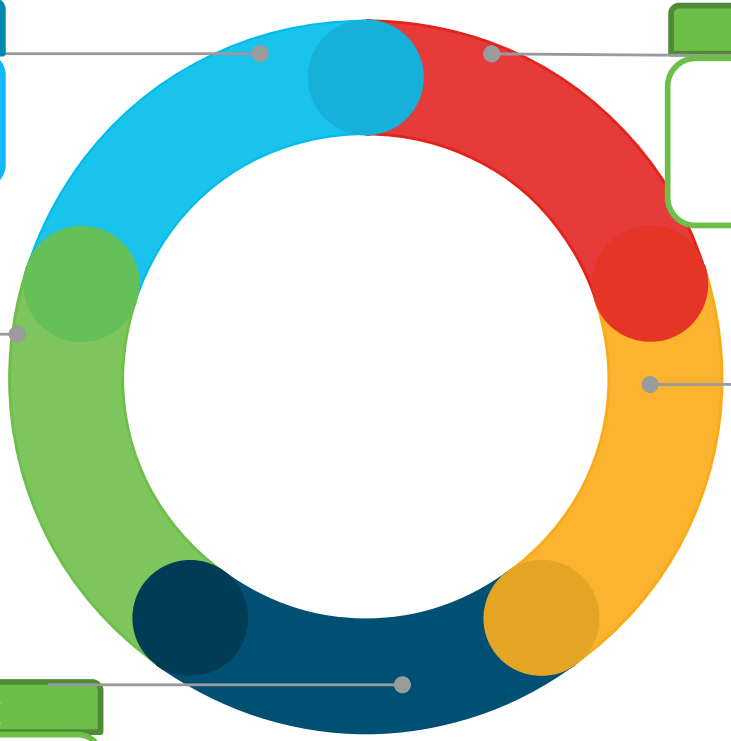
Operating Model Implications



Integration Implications



Trust & Security: End to End



Protocol

IPSec
Secure BGP/IGP
SSH

Hardware

Trust Anchor Module (TAm)
Secure Unique Device Identity (SUDI)

Runtime

LPTS,
DDoS, CoPP
SELinux
Integrity Measurement(IMA)

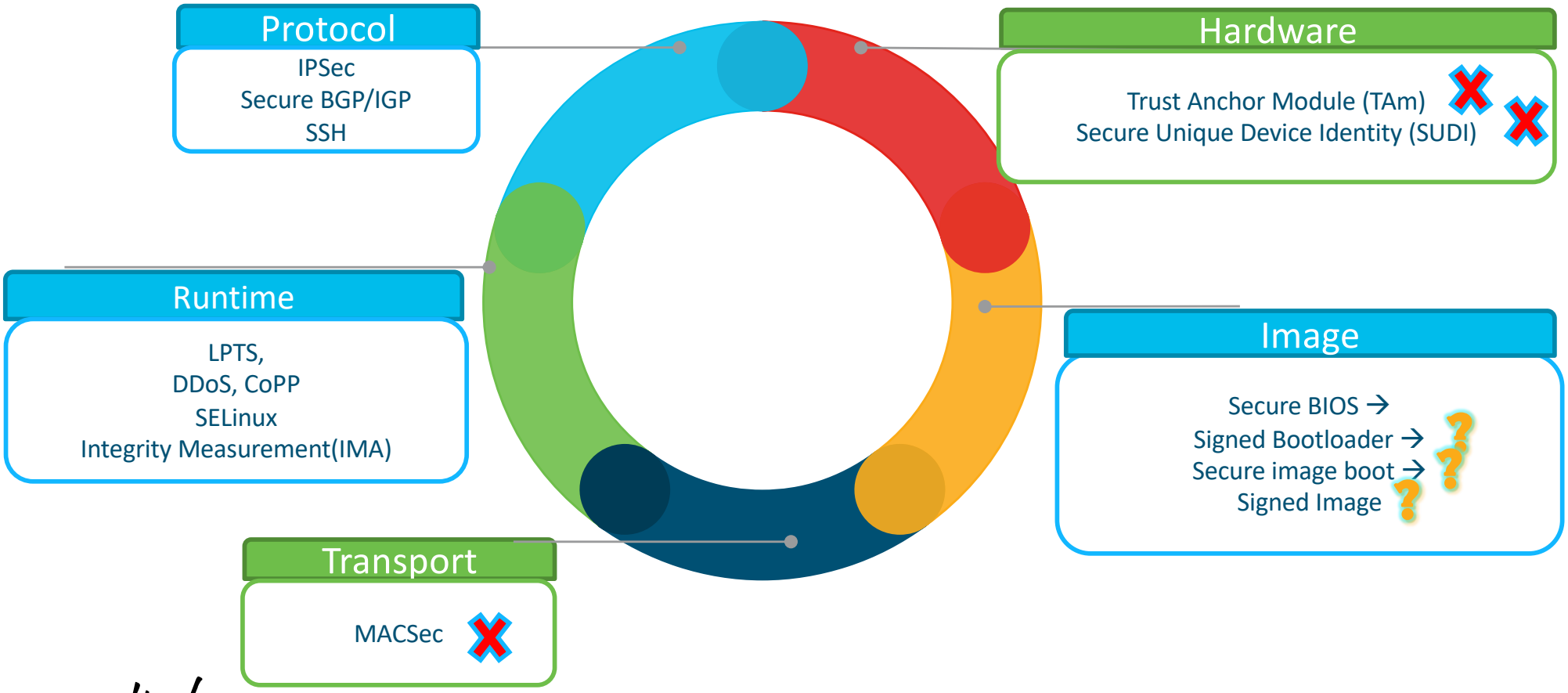
Image

Secure BIOS →
Signed Bootloader →
Secure image boot →
Signed Image

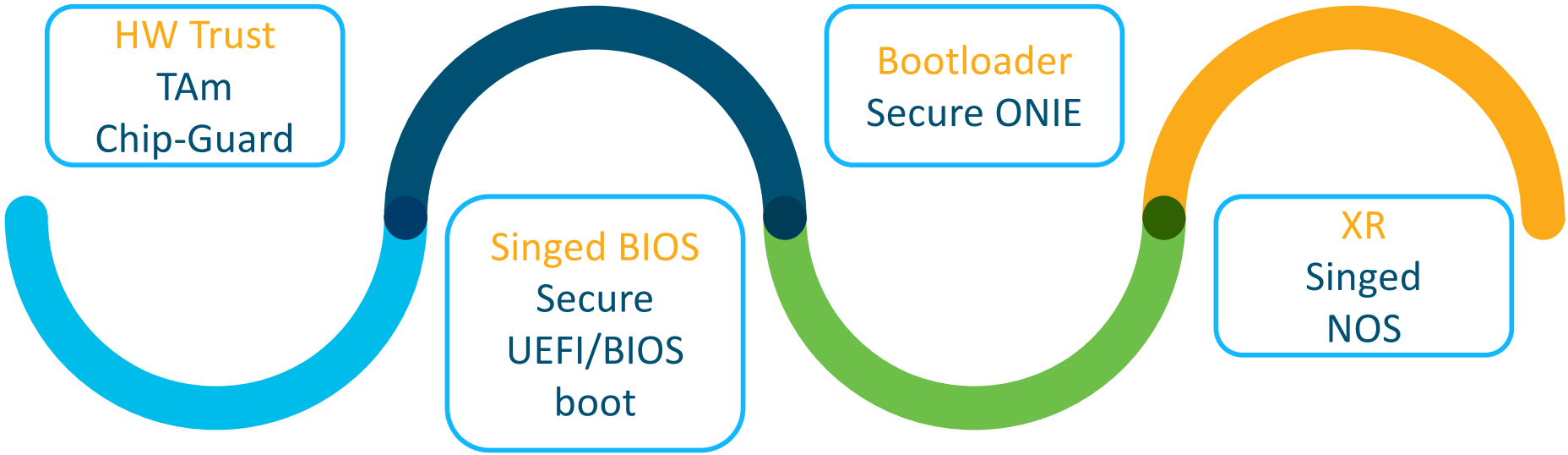
Transport

MACSec

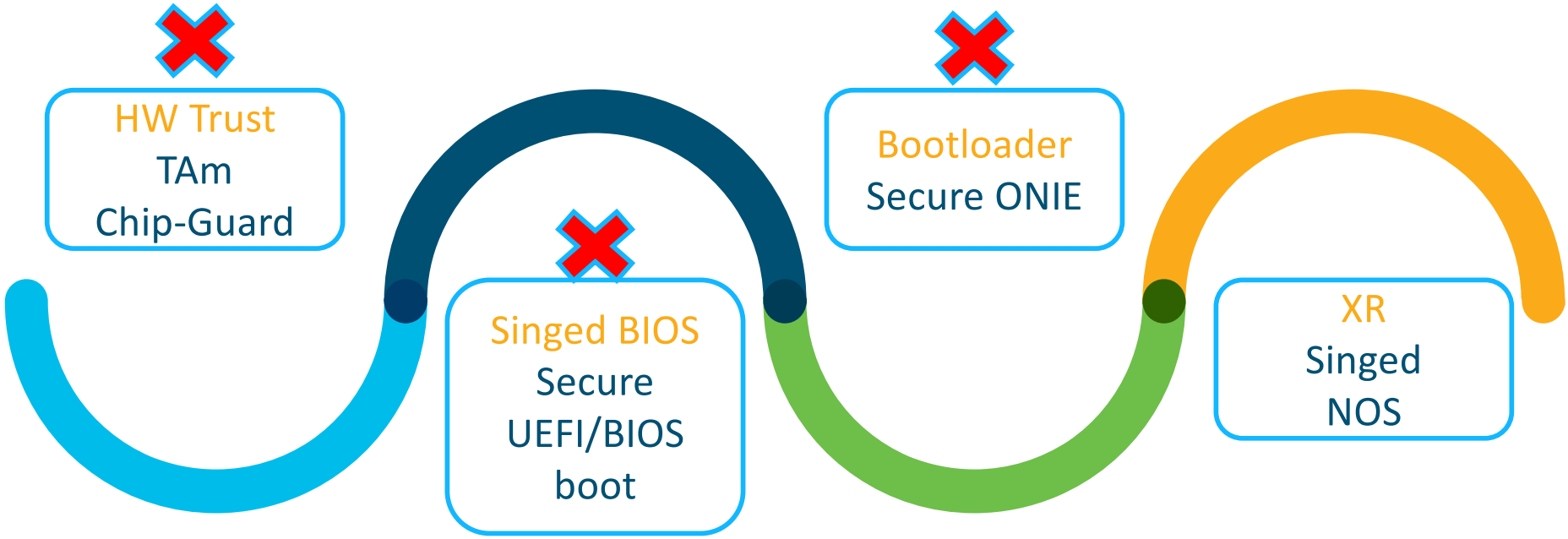
Trust & Security: End to End



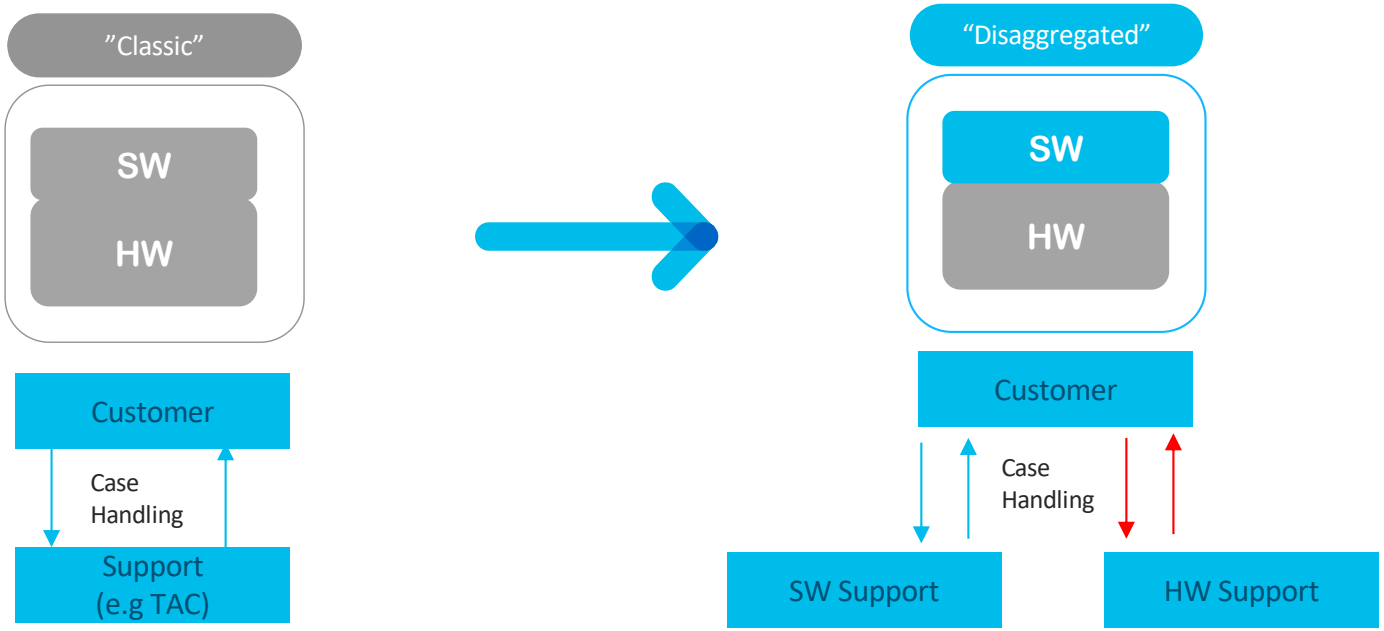
Secure Boot



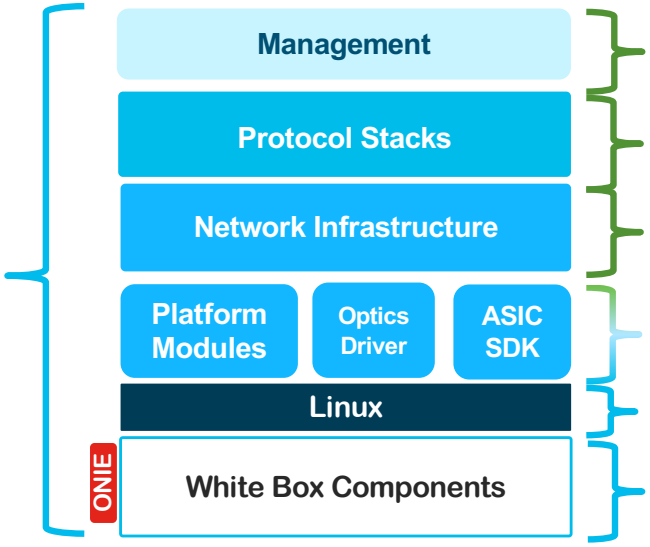
Secure Boot

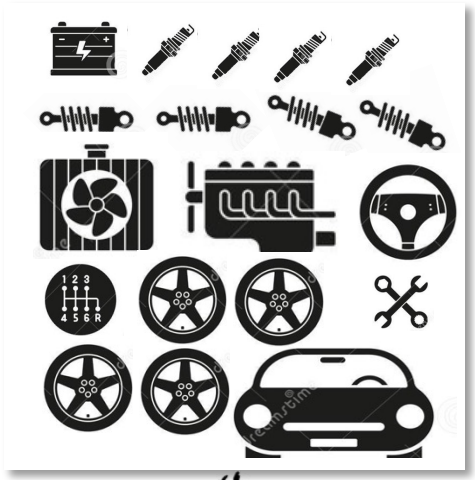


Support Model Implications



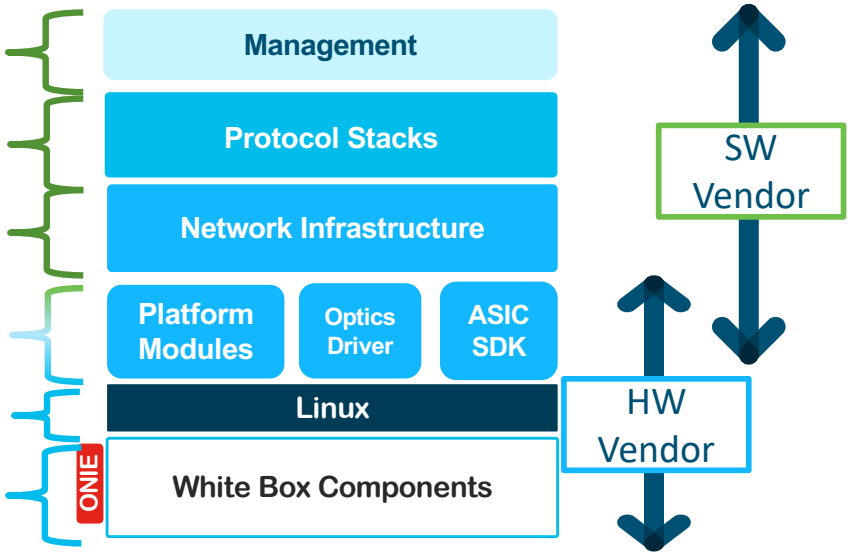
Serviceability





Serviceability

- Management Design and Implementation
- Protocol Debugging & Design
- Network Infra Debugging & Issues
- SDK & Driver Issues
- Linux Updates & Issues
- HW Issue Debugging Troubleshooting



Summary

Cisco View

Disagg => Diff Value Proposition

Separates value from components and modules

Not Just Web Players

Business and operational benefits may be universally appealing across SP and ENT

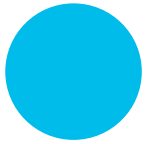
Cisco Strengths

Cisco offers strong value including component IP, supply chain, and services capabilities

Accessing New TAM

Supports recurring services and SW revenue – New markets for disagg stacks and SI services

Summary



Network disaggregation is real and happening

Disaggregation is :

- Separation of HW from SW
- Delayering the SW stack

Increased flexibility and options

- e.g. HW, NOS, ASIC

Increased complexity and cost

- Integration, Support, Serviceability, Security

Thank you

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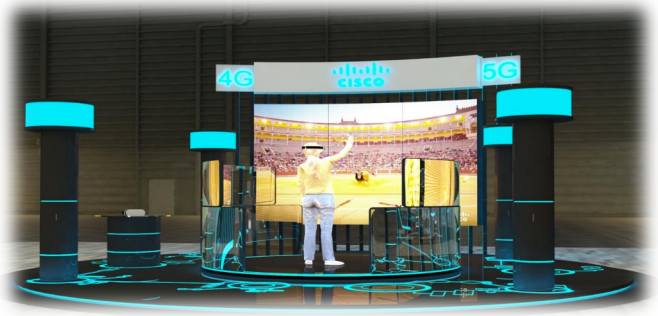

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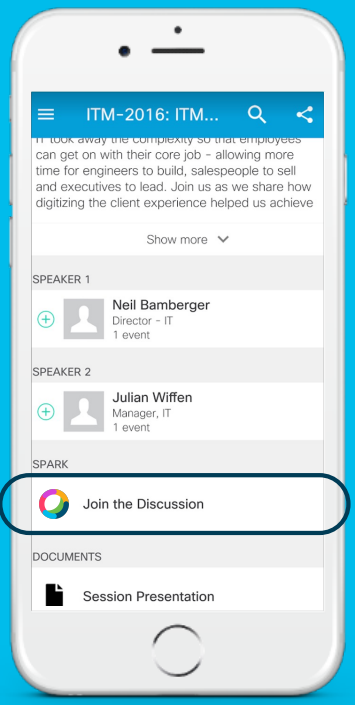

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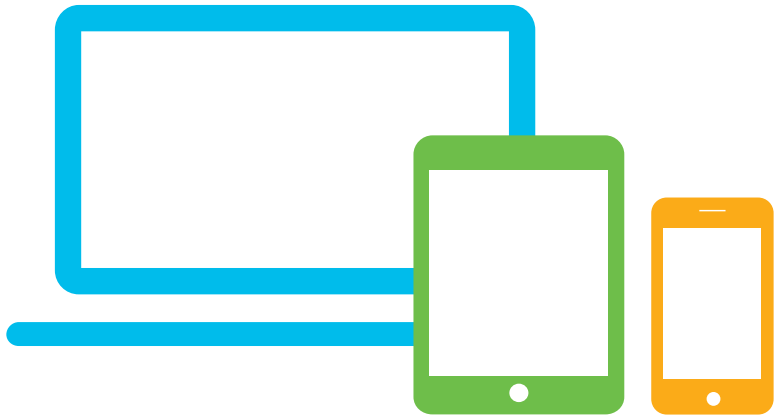

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