OCP (Open Compute Project)

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Regional Community Representative OCP Korea

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JS Lab

0. 소개

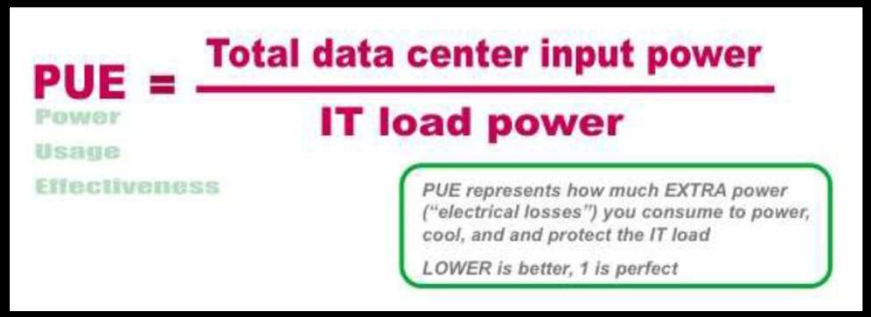
OCP의 시작 배경

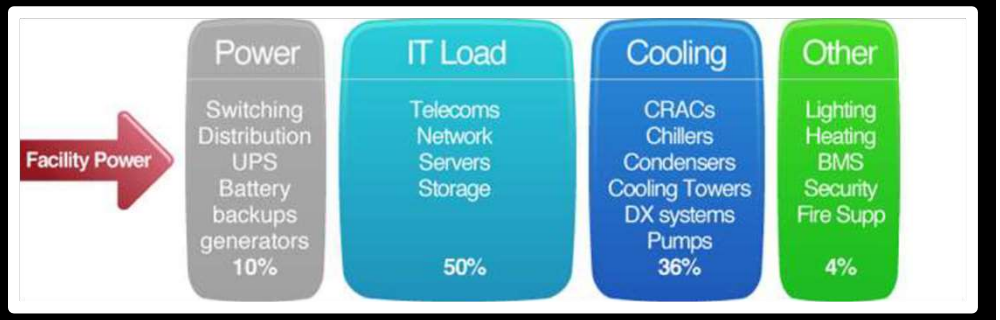
- 페이스북에서 컴퓨팅 인프라 확장을 위해 가장 효율적이고 경제적으로 가능한 방법을 찾던 팀에서 시작
- Clean Slate 로 직접 제작한 서버, 전원공급, 랙, 배터리 백업을 제작
- 적용한 Prineville data center에 38% 에너지 절감과 24% 비용 절감



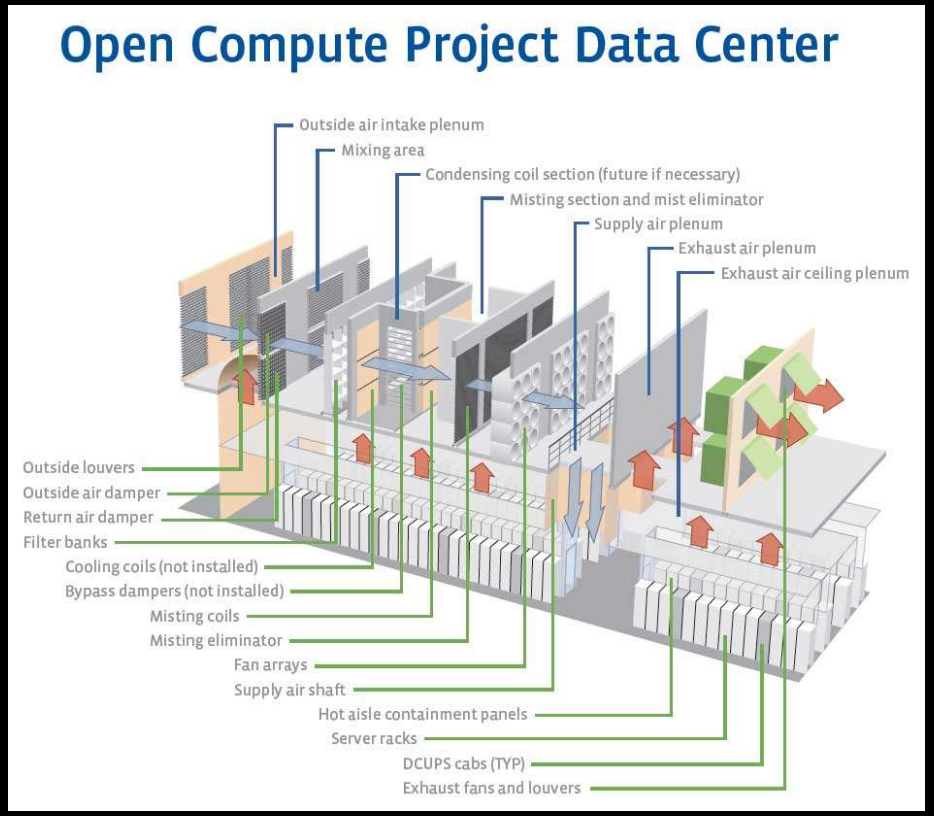
OCP의 시작 배경

- 전기 분배 시스템의 480-volt 사용
- 서버의 효율에 기여 하지 않는 것의 제거
- 겨울에 통로의 더워진 공기를 사무실 난방에 재사용, 외부 공기를 데이터센터 내에 흐르게 함
- 중앙 무중단 전기 공급의 필요성을 제거





All Facebook data centers are 100% OCP



Facebook OCP Prineville DataCenter

PUE = 1.06

Typical DataCenter

PUE > 1.4

OCP의 발전

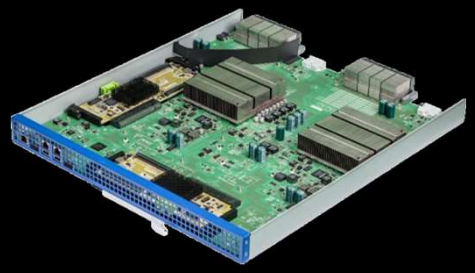
- OEM/ODM은 지적 자산을 소유하나, 로열티나 라이선스 없이 기술사양/설계/내장소프트웨어를 기부

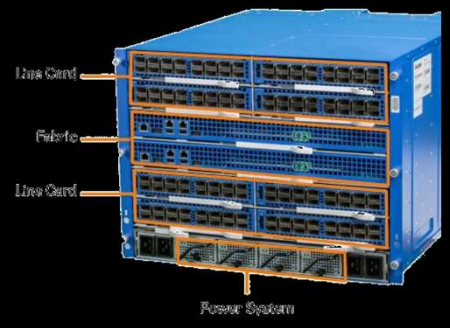
Open Hardware from OCP

- 스위치는 처음으로 2015년 Wedge를 발표하였고, 이후 6-pack과 Backpack등을 발표

6팩 (6-pack)

- ‘6팩 (6-pack)’: 페이스북이 2015년 2월12일 공개





Backpack

- Backpack: 100G Datacenter용

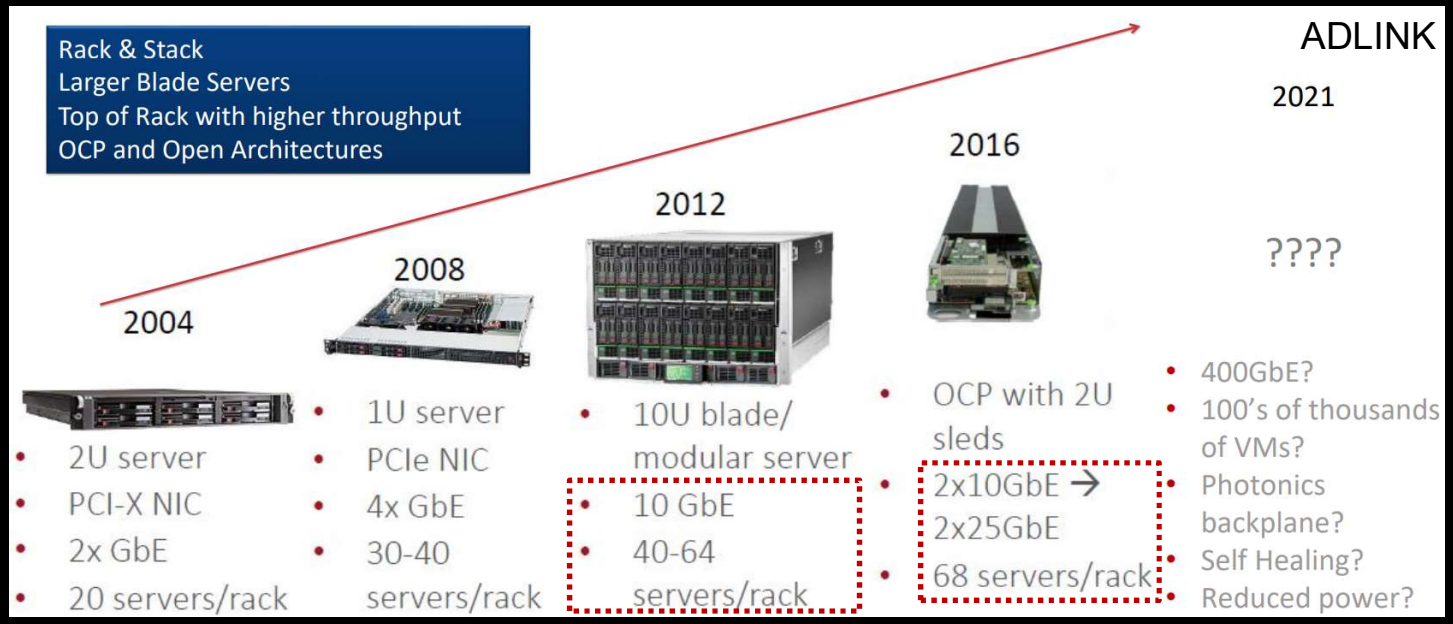
페이스북 서버 타입 (2017)

- 서버의 네트워크 인터페이스 발전 방향 고려 필요

	TYPE I	TYPE III	TYPE IV	TYPE V	TYPE VI	TYPE VII
	WEB	DATABASE	HADOOP	PHOTOS	MULTIPLE SERVICES	COLD STORAGE
CPU	4 x Xeon D-proc	2 x Xeon E5-proc	2 x Xeon E5-proc	2 x Xeon E5-proc	2 x Xeon E5-proc	2 x Xeon E5-proc
MEMORY	32GB	256GB	128GB	32GB	256GB	256GB
STORAGE	1 x 500GB SATA	2 x 3.2TB PCIe Flash	15 x 4TB SAS	30 x 4TB SAS	1 x 2TB SATA	240 x 4TB SATA

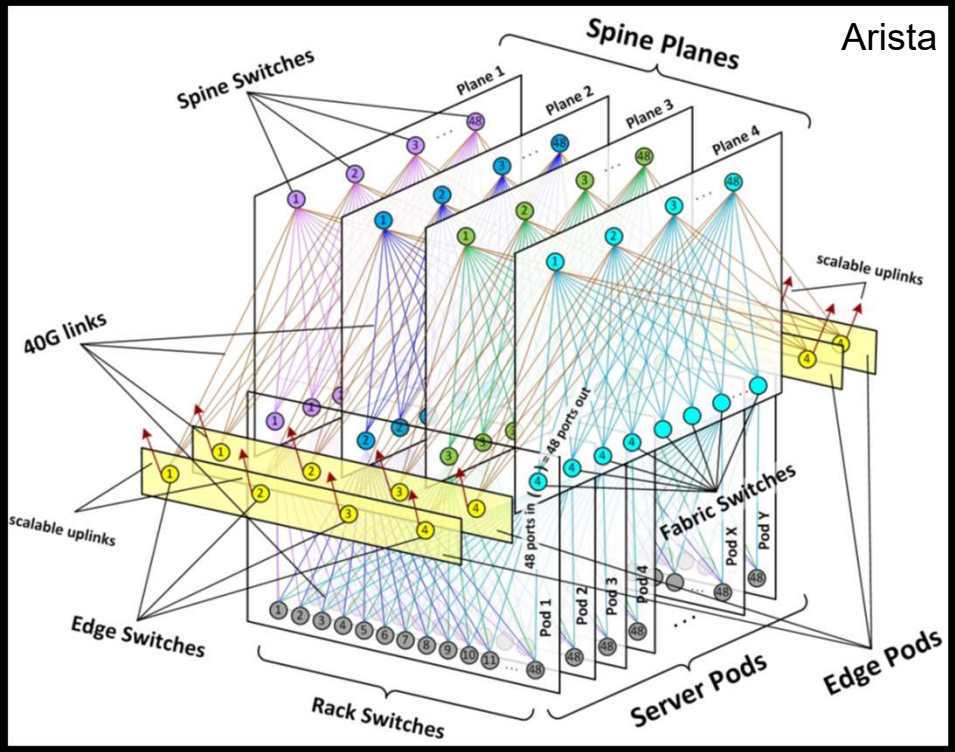
컴퓨팅 하드웨어 발전과 OCP

- 서버 네트워크 연결의 발전 방향 (ADLINK)



페이스북 다계층 Leaf-Spine 패브릭

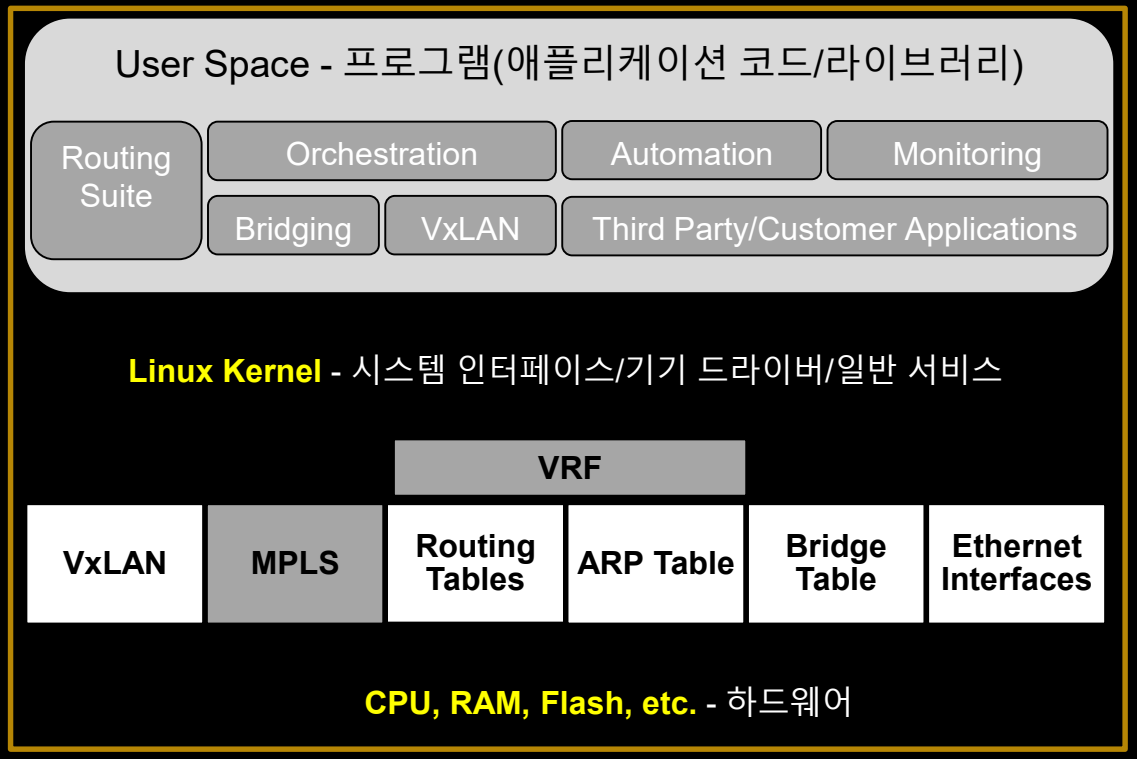
- Layer3 From ToR to Edge
  ECMP Load Balancing
- Flow based Hashing
  Large number of flows
- 40G -> 100G -> 400G
  10X speedup in 5 years
- Consistent Performance
  No more clusters



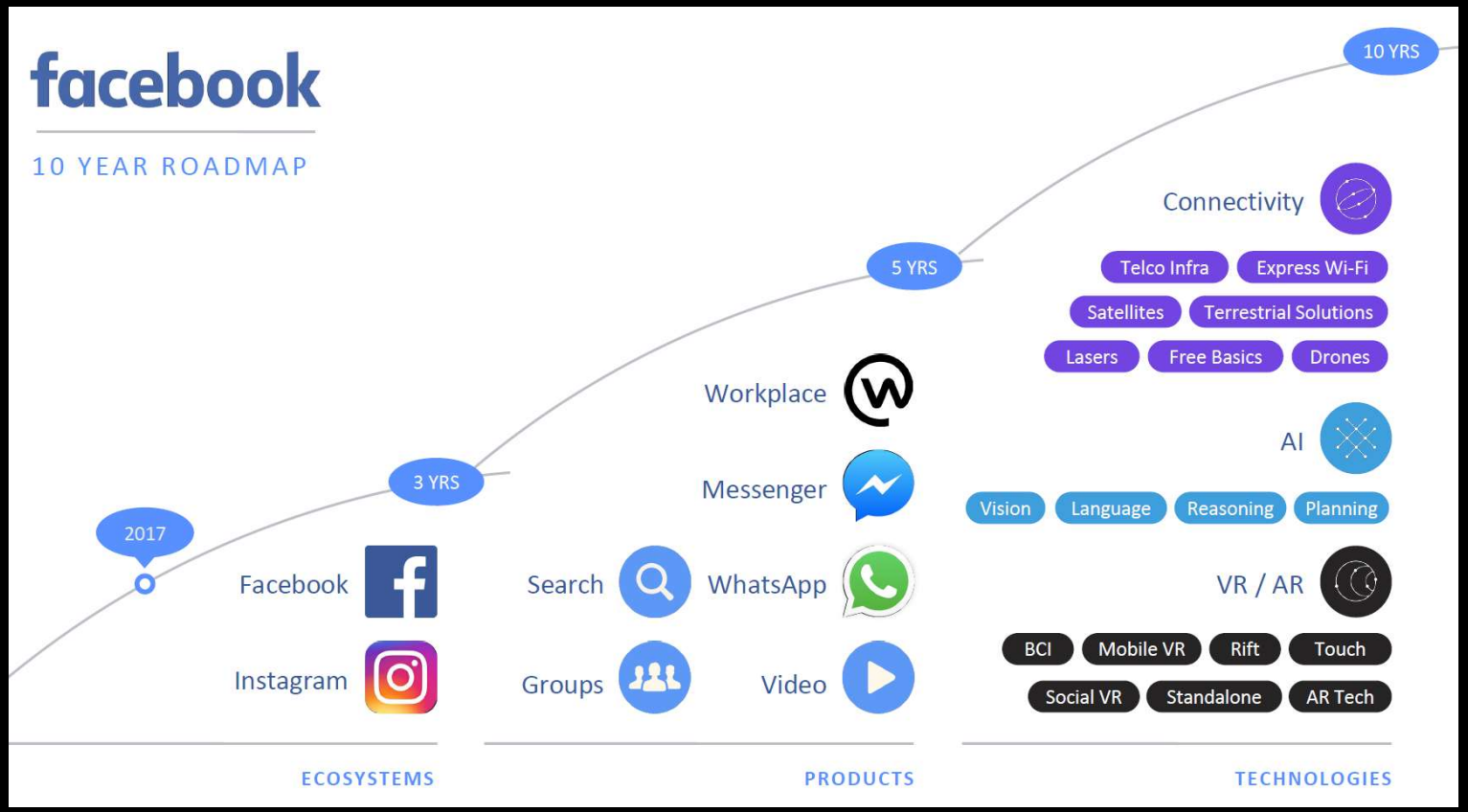
Linux Kernel 4.x의 MPLS 지원

- Linux Kernel 4.x의 MPLS 지원

✓ MPLS LSR 지원: v4.1
✓ LWT / MPLS IP tunnel 지원: v4.3
✓ MPLS multipath 지원: v4.5
✓ MPLS VRF의 IP 명령어 지원

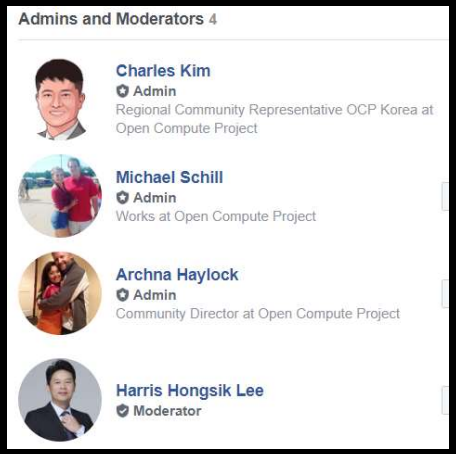


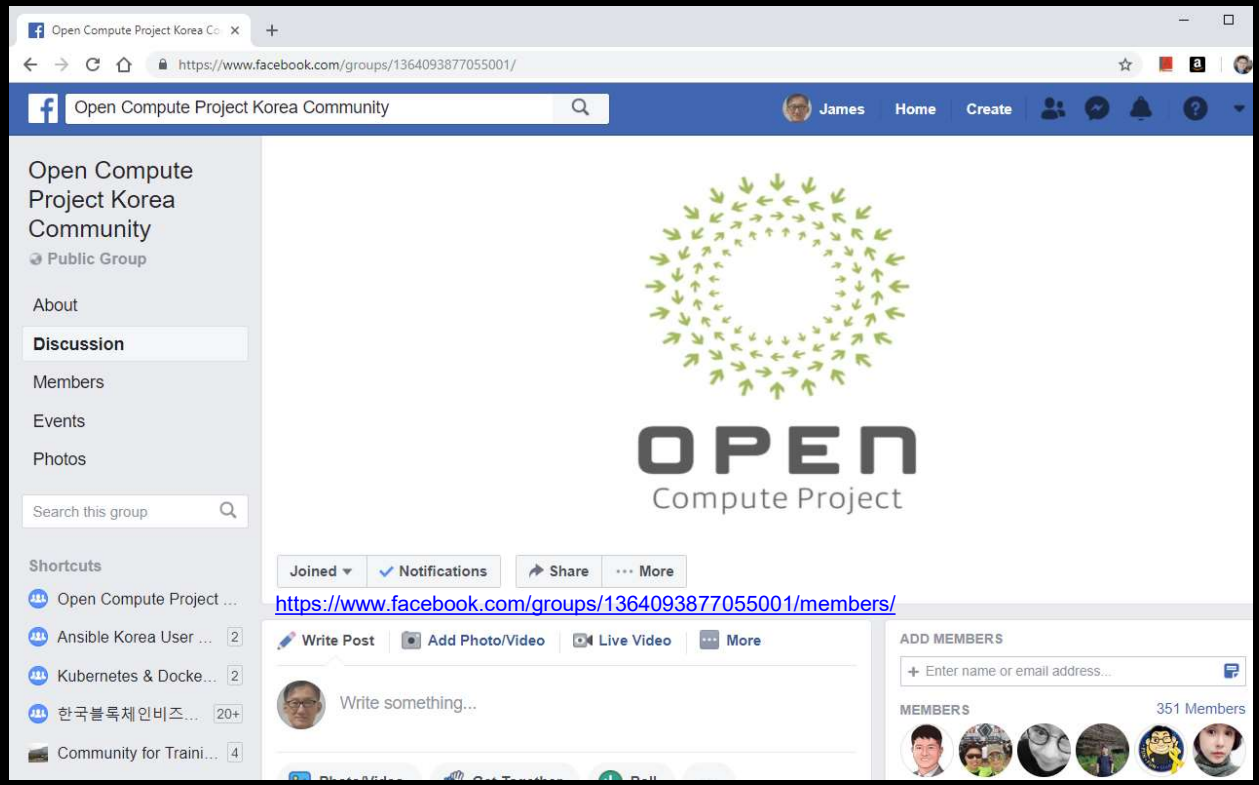
페이스북 로드맵


facebook
10 YEAR ROADMAP
2017
3 YRS
5 YRS
10 YRS
Facebook
Instagram
Search
Groups
Workplace
Messenger
WhatsApp
Video
Connectivity
Telco Infra
Express Wi-Fi
Satellites
Terrestrial Solutions
Lasers
Free Basics
Drones
AI
Vision
Language
Reasoning
Planning
VR / AR
BCI
Mobile VR
Rift
Touch
Social VR
Standalone
AR Tech
ECOSYSTEMS
PRODUCTS
TECHNOLOGIES

OCP Korea Community @ Facebook

- OCP Korea Community
- 2018년 8월 오픈
- 351 Members

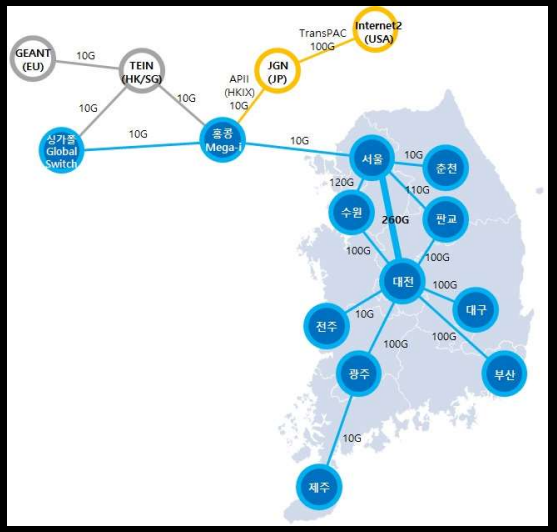


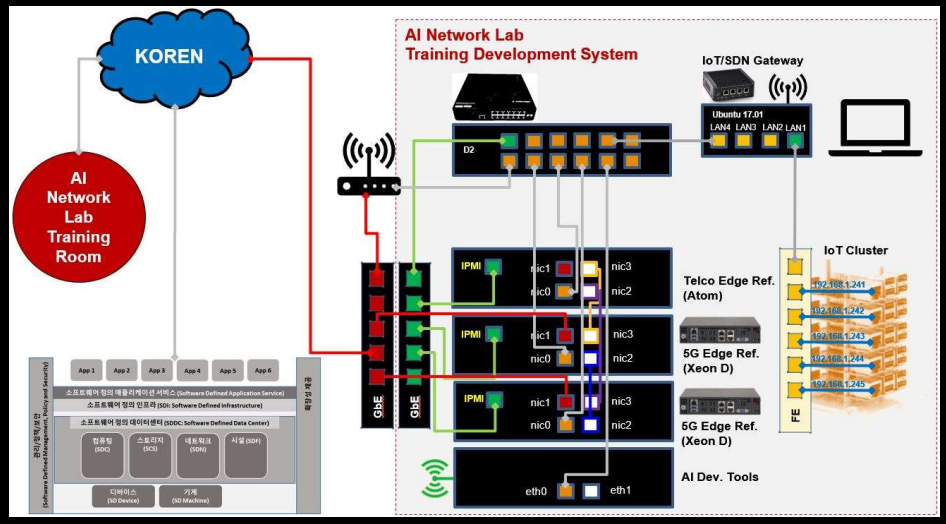


OCP Working Group @ KOREN AI Network Lab

- 워킹그룹 주제 (2018): 엔터프라이즈를 위한 OCP기반 오픈 네트워킹 아키텍처 설계

✓ 엔터프라이즈 시장을 위한 OCP(Open Compute Project)의 네트워킹 프로젝트를 분석
✓ 오픈 기반 소프트웨어 아키텍처 백서 준비





운영자를 위한 SDN/NFV 해커톤 2018 @ KOREN

- 과학기술정보통신부
- ✓ 교육 내용: OpenStack, ONOS(SDN), Container(Docker), Virtual Switch(OVS)
- ✓ 환경: 클라우드 서비스 제공

KOREN AI Network Lab

- 활용 환경

1. OCP 회원들과 커뮤니티

Foundation Staff

Rocky Bullock
Chief Executive Officer

Archna Haylock
Director, Community

Steve Helvie
VP, Channel Development

Bill Carter
Chief Technology Officer

Dirk Van Slyke
Director, Marketing & Communications

Michael Schill
Membership Community Specialist

John Laban
Representative, Europe

Rajeev Sharma
Director, Software & Technologies

Kali Burdette
Manager, Meeting & Events

Nick Bullock
Director, Finance

Foundation Board

Mark Roenigk
Chairman/President
Facebook

- Facebook
- OCP Foundation
- Rackspace
- Microsoft
- Goldman Sachs
- Intel

Joshua Matheus
Goldman Sachs

Jason Waxman
Intel Corporation

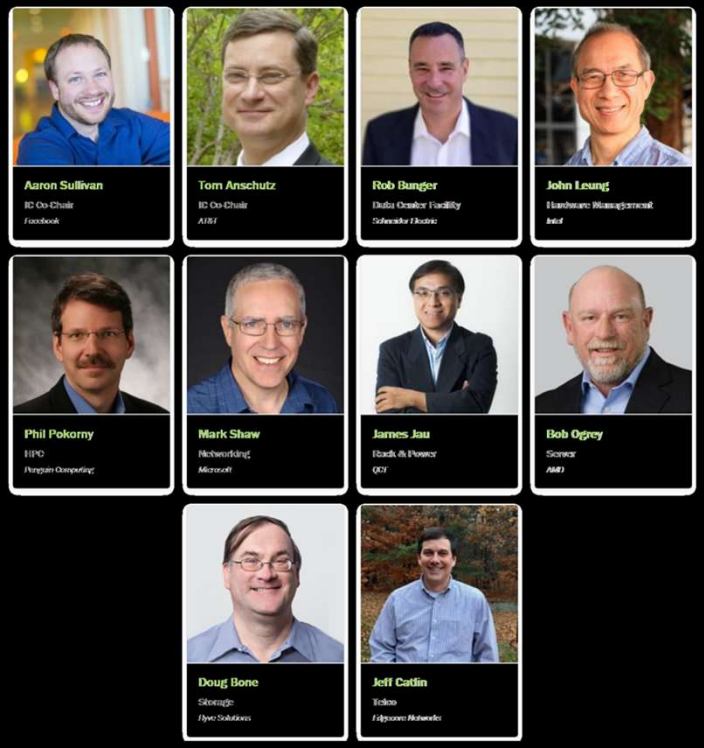
Bill Laing
Microsoft Corporation

Brian Stein
Rackspace

Andy Bechtolsheim
Individual

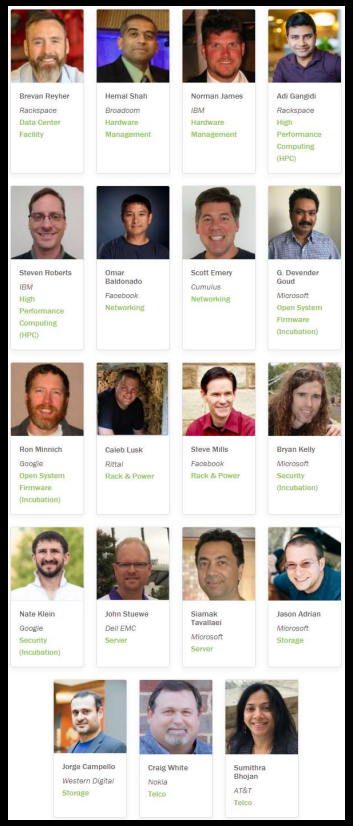
Rocky Bullock
Non-Voting

Incubation Committee



- Facebook
- AT&T
- Schneider Electric
- Intel
- Penguin Computing
- Microsoft
- QCT
- AMD
- Hyve Solutions
- Edgecore Networks

Project Leads



- Data Center Facility
- Hardware Management
- HPC
- Networking
- Open System Firmware
- Rack & Power
- Security
- Server
- Storage
- Telco

OCP Membership Facts

- ~200 Corporate Members
  - Adopters
  - Suppliers (HW and SW)
  - Solution Providers
- 6,000 participants in our community
  - Technical (HW and SW)
  - Sales/Business Development
  - Executives
  - Manufacturing/Process
  - Facilities
  - Academia
- Member Companies from all over the world

OCP Membership Directory: https://www.opencompute.org/membership/membership-organizational-directory

OCP News

COMPANIES > LINKEDIN (ACQUIRED BY MICROSOFT)

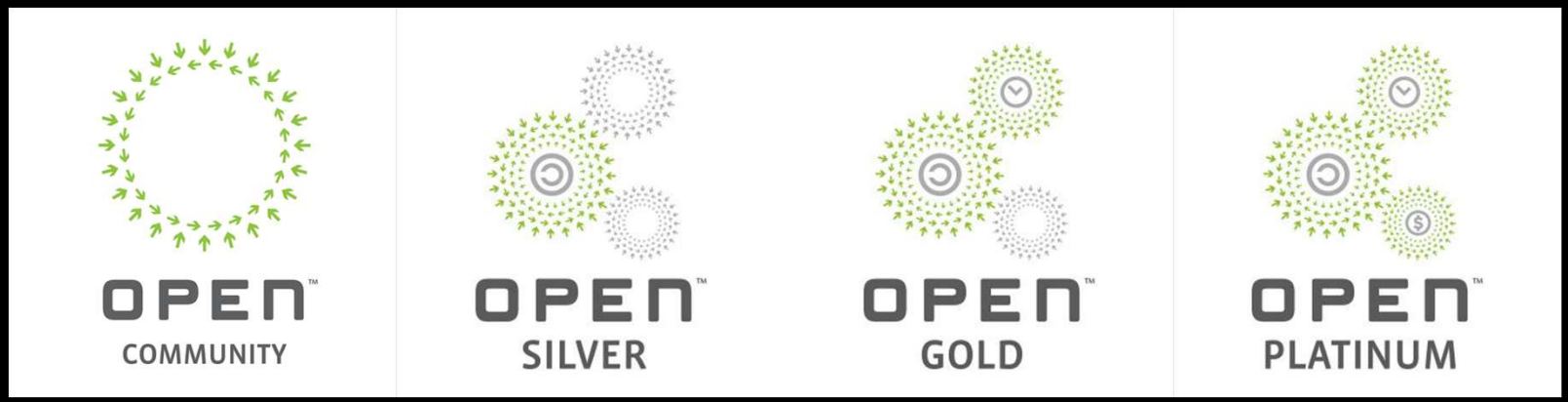
LinkedIn Joins OCP, Continues Open19 Deployment in Its Data Centers

LinkedIn has joined the Open Compute Project, the Facebook-led open source data center initiative • OCP has lots of answers to LinkedIn's questions about scaling its infrastructure to support exponential traffic growth • LinkedIn continues charging ahead with its own open source data center standard, Open19 • While there is

- OCP and Linux Foundation Bring Hardware Together with Software (OCP와 리눅스 재단 협력)
- SAN JOSE, California — Disaggregation of hardware and software has created interest in open source at both layers of networks. But in an acknowledgement that these layers still need to work together, yesterday, the Linux Foundation Networking (LFN) group and the Open Compute Project (OCP) announced they plan to collaborate to harmonize hardware and software.

(Linda Hardesty, March 21, 2018)

OCP Corporate Membership



OCP Membership Benefits

- Connect with other Industry leaders and innovators
- Get access to new industry trends
- Collaborate with like-minded participants to create leading edge solutions to industry challenges.
- Become part of a global community
- Participate in projects that are paving the way and addressing real time concerns of the community.
- Contribute your subject matter expertise while retaining control of your IP
- Showcase your OCP recognized products to potential adopters
- Join the “open” movement to achieve efficiency and growth and make an impact

OCP Community : Projects and SubProjects

SERVER

PCI 3.0 Mezz

NETWORKING

ONL, ONIE, SAI, SONiC,
Campus Branch Wireless

STORAGE

JDA Project

RACK & POWER

Adv Cooling Solutions, Power
Shelf Interoperability

HW MGMT

HPC

TELCO

DC Facility

Modular DC

Open Sys FW

SECURITY

OCP Projects - GET INVOLVED

- Each Project has a charter - READ IT
- Each Project has volunteer leaders - 1 or 2 Project Leads and 1 Tech Steering Committee Rep - INTRODUCE YOURSELF
- Some Projects have 1 or more sub-projects.
- Each Project has a WIKI page. Sub-projects have their own WIKI. - READ IT
- Each Project/sub-project has a mailing list. - JOIN THE LIST
- Each Project/sub-project meets separately for their calls - some are monthly, some are weekly. - ATTEND THE CALLS
- All calls are recorded. - LISTEN IF YOU CAN NOT ATTEND LIVE
- Projects have workshops. - REGISTER FOR WORKSHOPS

From Concepts to Contributions….

PL

Project Community

ICR

Spec
Design
Product
R/A

- From Project Community
- From other Open Orgs
- From Another Community via PL/IC/CTO

- Revisions
- Collaboration with other Project Teams

- IC Vote
- OCP Recognition
- Marketplace if SP

What is OPEN hardware?

Specifications

Design Packages

Embedded SW

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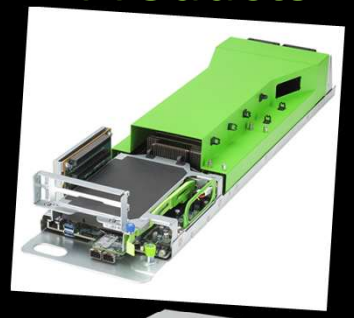
Products



IP retained by OEM/ODM

How this Community Contributes, Collaborates, & Consumes

Specifications

Reference Architecture

Tested Configurations

White Papers

Embedded Software

Design Files

Product Recognition

Case Studies

Workshops Summits

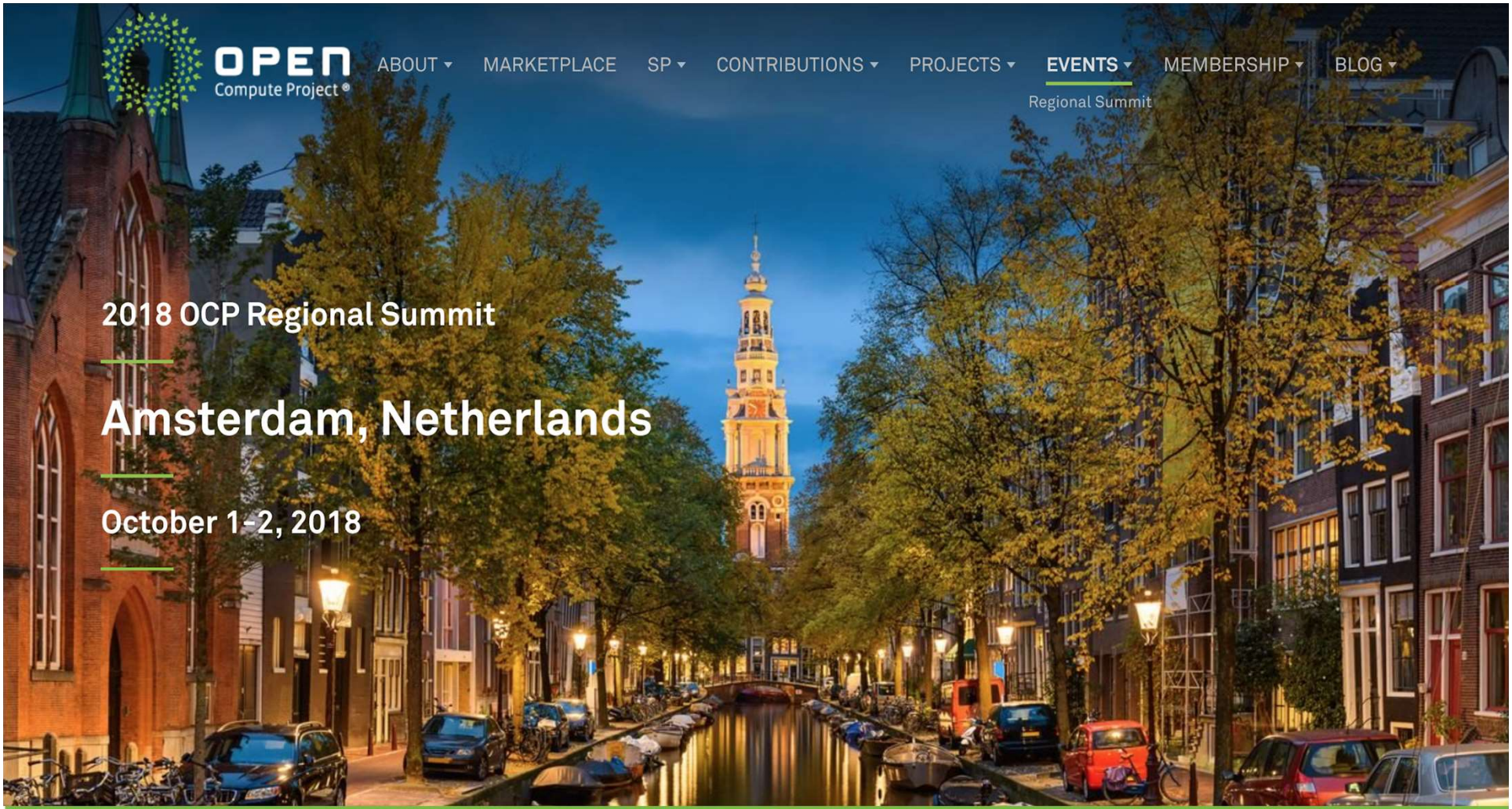
Testimonials Seminars

Videos

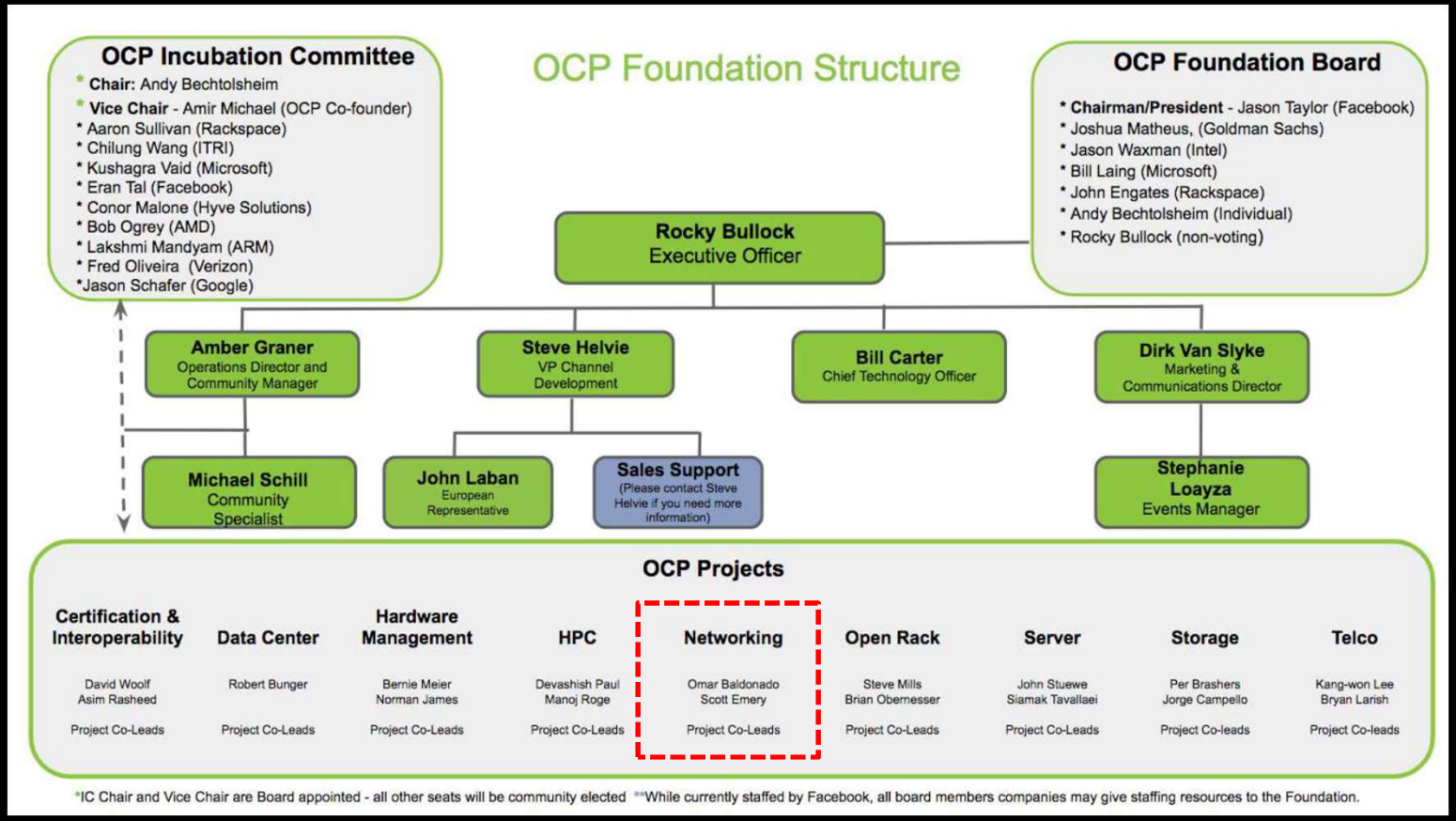
OCP Events

- Rack and Power Engr Workshop - July 24th Fremont, CA @ Delta Electronics US HQ – Workshop will be video-taped and will be available on OCP Past Events Page 1 week after.
- Networking Engr Workshop – Target late Aug, San Jose, CA @ TBD. More info on OCP Events Page.
- IC Meetings occur every 6 weeks – to vote on any upcoming contributions and discuss strategic direction of the projects.
- OCP Regional Summit – Oct 1-2 Amsterdam, The Netherlands. Sponsorships still available and membership discounts are applied (20% for Platinum, 15% for Gold, 10% for Silver, 5% for Community).
- OCP Summit – March 14-15, 2019 San Jose, CA. Bundle Discounts are available if interested in both Europe and US Summits.

✓ 공개 모임 11월/12월 (OCP Working Group @ KOREN AI Network Lab)
✓ 비공개 모임 (제한 없음)

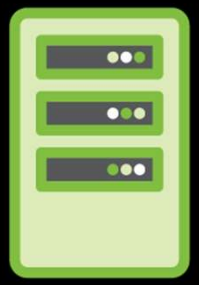

OPEN
Compute Project®
ABOUT
MARKETPLACE
SP
CONTRIBUTIONS
PROJECTS
EVENTS
Regional Summit
MEMBERSHIP
BLOG
2018 OCP Regional Summit
Amsterdam, Netherlands
October 1-2, 2018

OCP 요약


OCP Incubation Committee
* Chair: Andy Bechtolsheim
* Vice Chair - Amir Michael (OCP Co-founder)
* Aaron Sullivan (Rackspace)
* Chilung Wang (ITRI)
* Kushagra Vaid (Microsoft)
* Eran Tal (Facebook)
* Conor Malone (Hyve Solutions)
* Bob Ogrey (AMD)
* Lakshmi Mandyam (ARM)
* Fred Oliveira (Verizon)
*Jason Schafer (Google)
OCP Foundation Structure
OCP Foundation Board
* Chairman/President - Jason Taylor (Facebook)
* Joshua Matheus, (Goldman Sachs)
* Jason Waxman (Intel)
* Bill Laing (Microsoft)
* John Engates (Rackspace)
* Andy Bechtolsheim (Individual)
* Rocky Bullock (non-voting)
Rocky Bullock
Executive Officer
Amber Graner
Operations Director and Community Manager
Steve Helvie
VP Channel Development
Bill Carter
Chief Technology Officer
Dirk Van Slyke
Marketing & Communications Director
Michael Schill
Community Specialist
John Laban
European Representative
Sales Support
(Please contact Steve Helvie if you need more information)
Stephanie Loayza
Events Manager
OCP Projects
Certification & Interoperability
David Woolf
Asim Rasheed
Project Co-Leads
Data Center
Robert Bunger
Project Co-Leads
Hardware Management
Bernie Meier
Norman James
Project Co-Leads
HPC
Devashish Paul
Manoj Roge
Project Co-Leads
Networking
Omar Baldonado
Scott Emery
Project Co-Leads
Open Rack
Steve Mills
Brian Obernesser
Project Co-Leads
Server
John Stuewe
Siamak Tavallaei
Project Co-Leads
Storage
Per Brashers
Jorge Campello
Project Co-leads
Telco
Kang-won Lee
Bryan Larish
Project Co-leads
*IC Chair and Vice Chair are Board appointed - all other seats will be community elected **While currently staffed by Facebook, all board members companies may give staffing resources to the Foundation.

2. 신규 프로젝트, 컨트리뷰션 그리고 …

Our Core Projects



SERVER

NETWORKING

STORAGE

RACK & POWER

Technology & Segments

MANAGEMENT

HPC

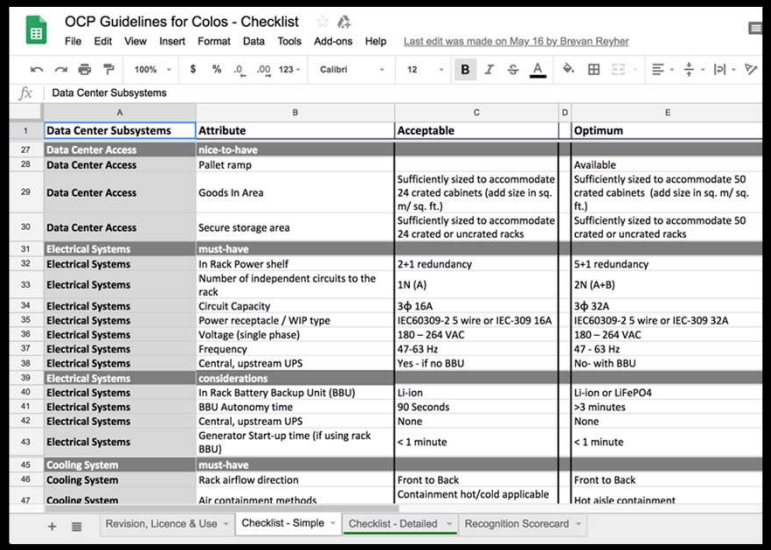
TELCO

DC Facility

OSF

SECURITY

Data Center Facilities Project



	Data Center Subsystems	Attribute	Acceptable	Optimum
27	Data Center Access	nice-to-have		
28	Data Center Access	Pallet ramp		Available
29	Data Center Access	Goods In Area	Sufficiently sized to accommodate 24 crated cabinets (add size in sq. m/ sq. ft.)	Sufficiently sized to accommodate 50 crated cabinets (add size in sq. m/ sq. ft.)
30	Data Center Access	Secure storage area	Sufficiently sized to accommodate 24 crated or uncrated racks	Sufficiently sized to accommodate 50 crated or uncrated racks
31	Electrical Systems	must-have		
32	Electrical Systems	In Rack Power shelf	2+1 redundancy	5+1 redundancy
33	Electrical Systems	Number of independent circuits to the rack	1N (A)	2N (A+B)
34	Electrical Systems	Circuit Capacity	3ϕ 16A	3ϕ 32A
35	Electrical Systems	Power receptacle / WIP type	IEC60309-2 5 wire or IEC-309 16A	IEC60309-2 5 wire or IEC-309 32A
36	Electrical Systems	Voltage (single phase)	180 – 264 VAC	180 – 264 VAC
37	Electrical Systems	Frequency	47-63 Hz	47 - 63 Hz
38	Electrical Systems	Central, upstream UPS	Yes - if no BBU	No- with BBU
39	Electrical Systems	considerations		
40	Electrical Systems	In Rack Battery Backup Unit (BBU)	Li-ion	Li-ion or LiFePO4
41	Electrical Systems	BBU Autonomy time	90 Seconds	>3 minutes
42	Electrical Systems	Central, upstream UPS	None	None
43	Electrical Systems	Generator Start-up time (if using rack BBU)	< 1 minute	< 1 minute
45	Cooling System	must-have		
46	Cooling System	Rack airflow direction	Front to Back	Front to Back
47	Cooling System	Air containment methods	Containment hot/cold applicable	Hot aisle containment

OCP READY™

Mark Dansie, Inflectiontech
Alan Keizer, AFL Hyperscale
Keith Sullivan, CS Squared
Michael J Bailey, Fidelity Investments
Stijn de Kruijf, Royal Haskoning DHV
Robert Bunger, Schneider Electric
Robert Bunger, Schneider Electric
Jason Schafer, Google
John Laban, Open Compute Project
George Cvetanovski, Hyperscalers
David Hall, Equinix
Menno Kortekaas, Circle B

3. OCP 시장 현황 및 적용 사례

The OCP Market

ServerWatch™

Open Compute Project Has Billion Dollar Impact on Server Market

OCPUS18 – OCP Market Impact Assessment

OCP Market Impact Assessment → https://www.youtube.com/watch?v=pdpPKAo-HUY&feature=youtu.be

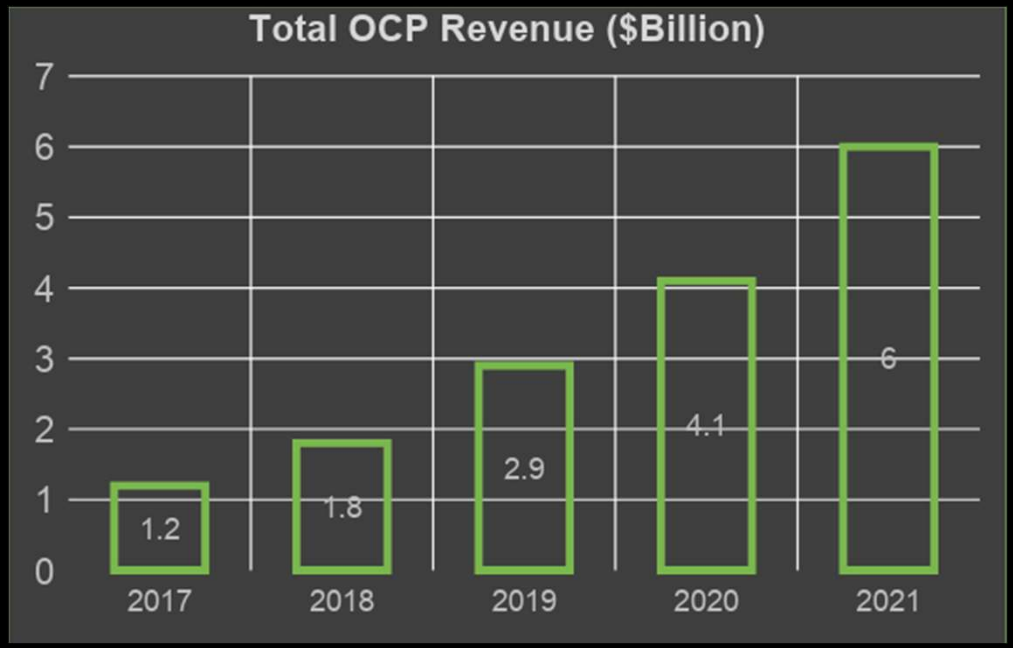
Growth of OCP (for non-board member companies)

Double Digit Growth thru 2021

Americas' CAGR = 47%

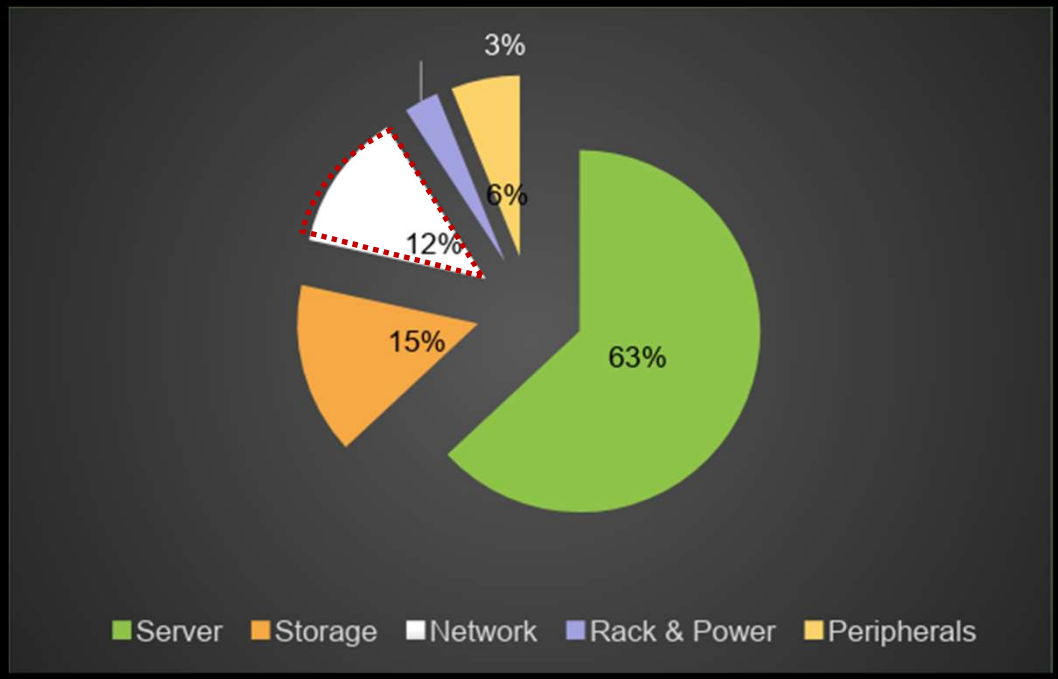
APAC CAGR = 103%

EMEA CAGR = 70%



Growth of OCP (for non-board member companies)

- Servers
- Storage
- Network
- Rack & Power
- Peripherals



Vertical Industry (for non-board member companies)

Tier 2 CSPs explored OCP servers in 2016 and start larger deployments in 2017-2019

Telcos increase POCs in 2017, production trials ramp in 2018, scale deployments 2019+

E-commerce and web-based enterprises

Other segments including Retail & Education expected to become largest enterprise switching subsegment in 2021

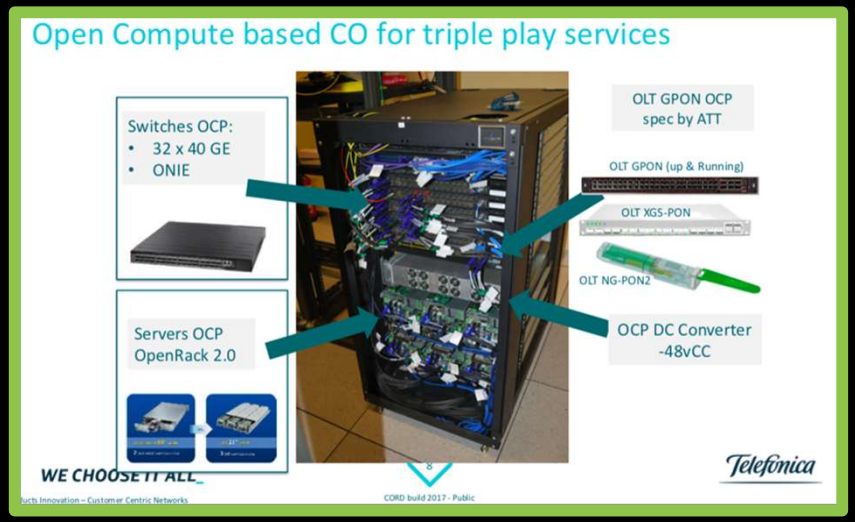
Use Cases for OCP

Business Models Influence by OCP
CORD

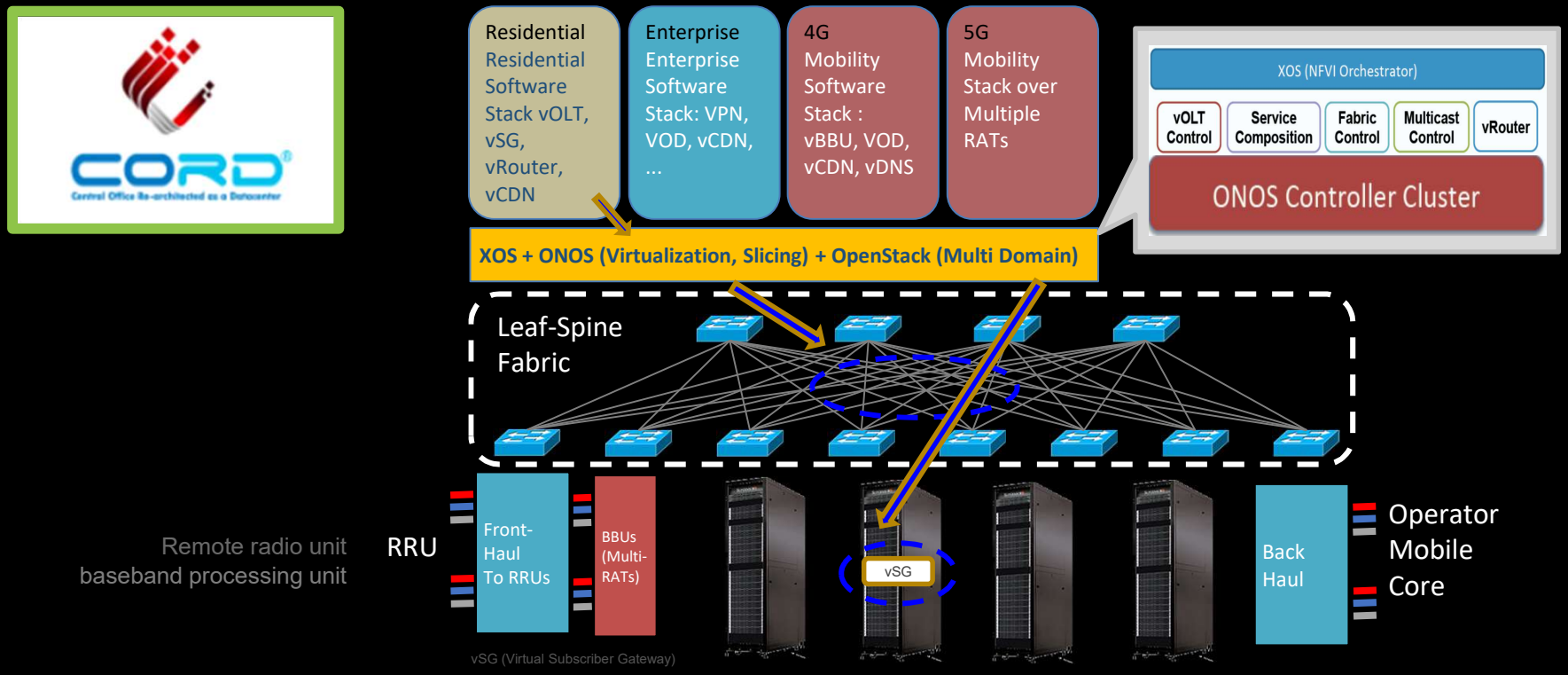
Central **O**ffice **R**e-architected as a **D**ata centre

https://opencord.org/

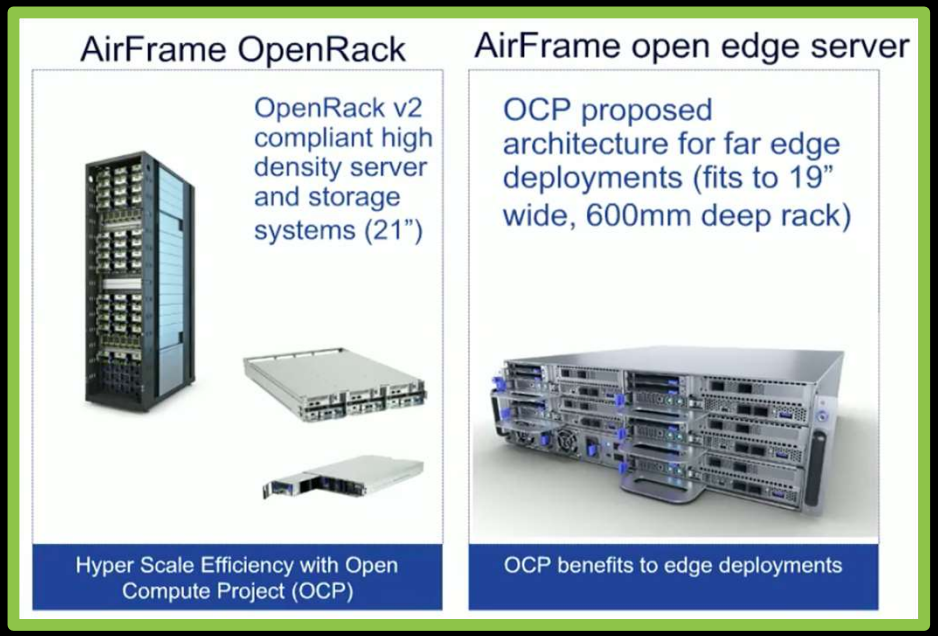
https://opencord.org/wp-content/uploads/2018/01/Day1_Session5_CORD_build-17-Telefonica-use-cases.pdf



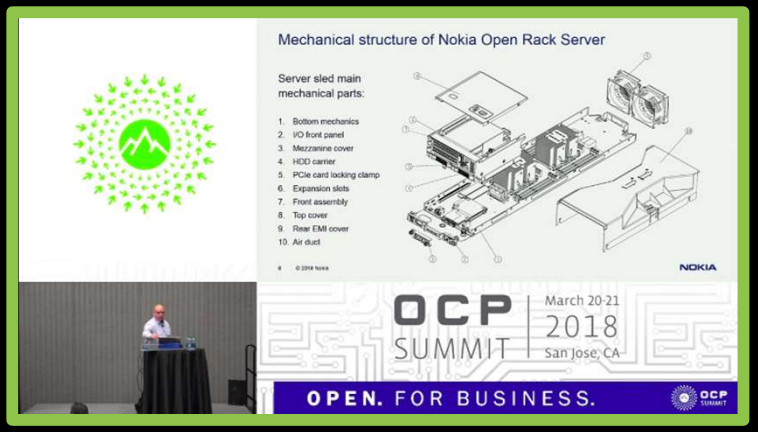
CORD


Residential
Residential Software Stack vOLT, vSG, vRouter, vCDN
Enterprise
Enterprise Software Stack: VPN, VOD, vCDN, ...
4G
Mobility Software Stack : vBBU, VOD, vCDN, vDNS
5G
Mobility Stack over Multiple RATs
XOS (NFVI Orchestrator)
vOLT Control
Service Composition
Fabric Control
Multicast Control
vRouter
ONOS Controller Cluster
XOS + ONOS (Virtualization, Slicing) + OpenStack (Multi Domain)
Leaf-Spine Fabric
Remote radio unit
baseband processing unit
RRU
Front-Haul To RRUs
BBUs (Multi-RATs)
vSG
Back Haul
Operator Mobile Core
vSG (Virtual Subscriber Gateway)

Business Models Influence by OCP Edge Computing



NOKIA



https://www.brighttalk.com/webcast/12229/319957

Business Models Influence by OCP
Large Enterprise

LINX
Est. 1994

https://www.lightreading.com/linx-talks-about-open-networking-and-ocnos/v/d-id/738057

Booking.com

https://www.youtube.com/watch?v=c0Z32UsB5g0

Business Models Influence by OCP Colocation

https://kaodata.com/kao-data-announces-europes-first-data-centre-meet-ocp-design-principles/

KAO DATA

Kao Data Announces Europe's First Data Centre to Meet OCP Design Principles

Open Network 제조사 동향

- **Canonical** announced their official support of Wedge 100 on Ubuntu Core 16, the latest version of their new operating system for cloud and IoT devices. Ubuntu Core supports a number of different network stacks, including FBOSS (Facebook Open Switching System) and SnapRoute as snaps.
- **Cavium** announced a variation of our second-generation top-of-rack switch, Wedge 100C, based on the original Wedge 100 switch specification contributed to the Open Compute Project.
- **SnapRoute** announced the availability of its FlexSwitch software, a micro-services oriented network operating system, on top of the Wedge 100 platform.
- **Barefoot Networks** announced the Wedge 100B series of switches, a new variation of our Wedge 100 platform. There are two switches in this series — a 1RU 32x100GE switch and a 2RU 65x100GE switch.
- **Cumulus Networks** announced that the Cumulus Linux network operating system fully supports Backpack and Wedge 100.
- **Apstra** announced the general availability of the Apstra Operating System™ (AOS)1.1.1, and an integration with Wedge 100. AOS is a vendor-agnostic distributed operating system for the data center network that disaggregates the operational plane from the underlying vendor network operating system and hardware. This is one of the first solutions to provide a simplified way to deploy and operate networks running a variety of operating systems on open switches, as well as more traditional vendor gear.

4. OCP Marketplace

OCP Recognition Marks

OCP Accepted Specification
Open Sourced Design Files

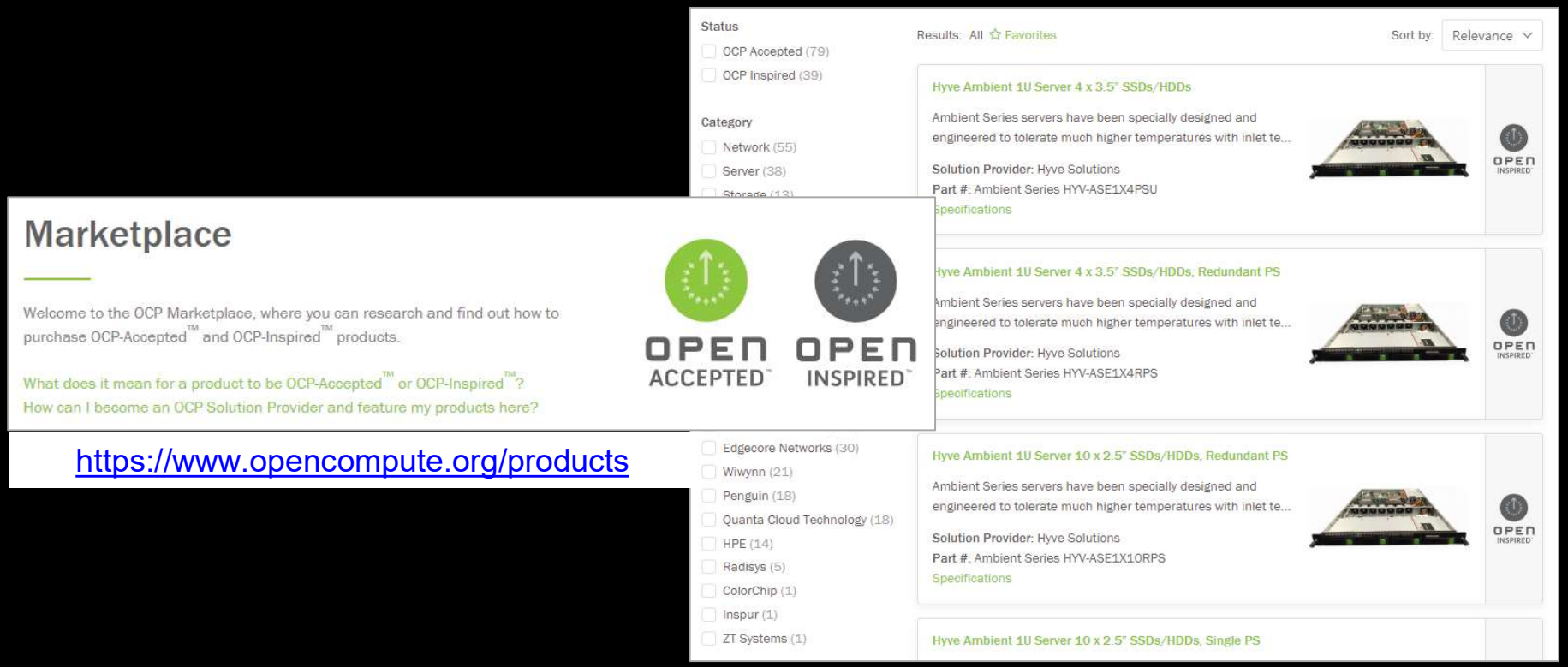
OCP Accepted Specification

Data Centers that meet OCP
Criteria for efficiency & scale

OCP Marketplace:

https://www.opencompute.org/products

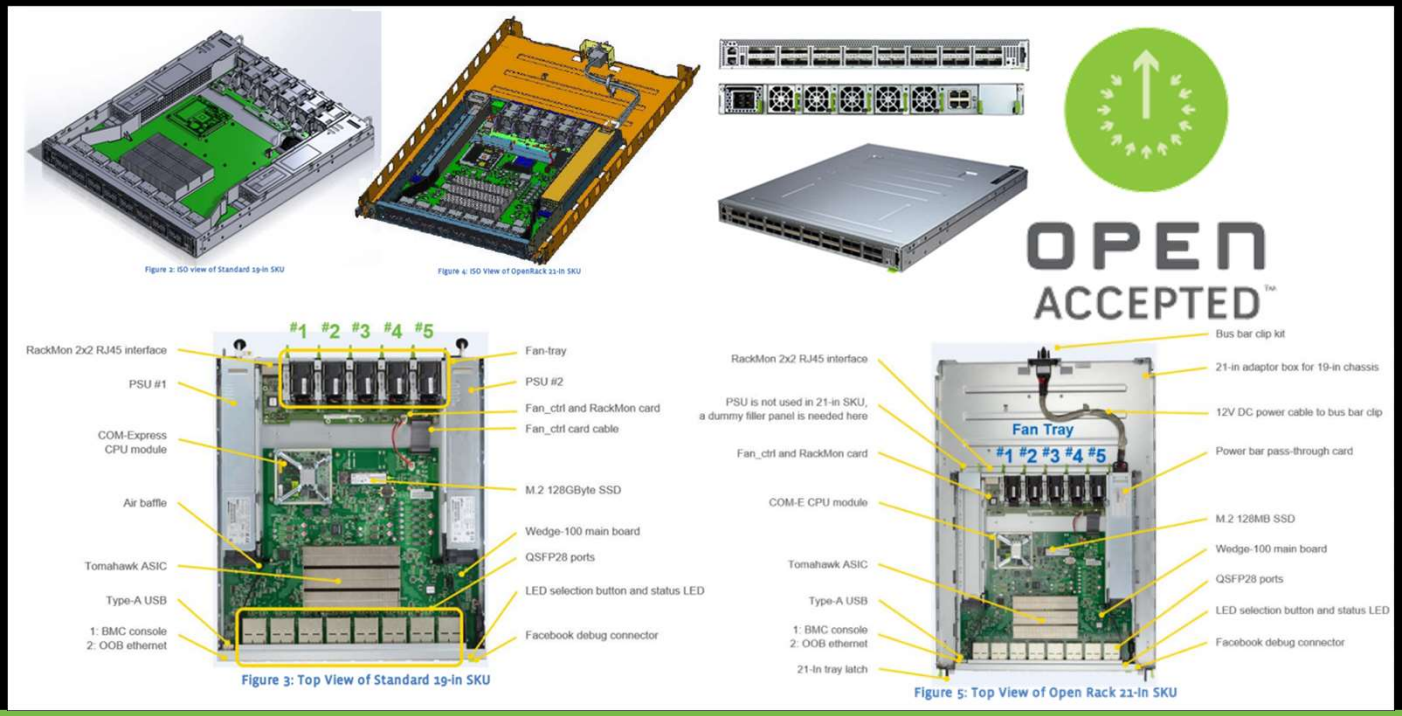
OCP Market Place



https://www.opencompute.org/products

OCP Market Place

- Edgecore Networks Wedge100-32X 100GbE
- Facebook - Wedge-100 Switch (19-in vs 21-in)



OCP Market Place

- Cumulus Express 48-port 1GbE Out-of-Band Management Application Switch - BACK to FRONT

OPEN ACCEPTED™

The Cumulus Linux operating system, installed with an active license key, and bundled with 3-years of support.

OCP Market Place

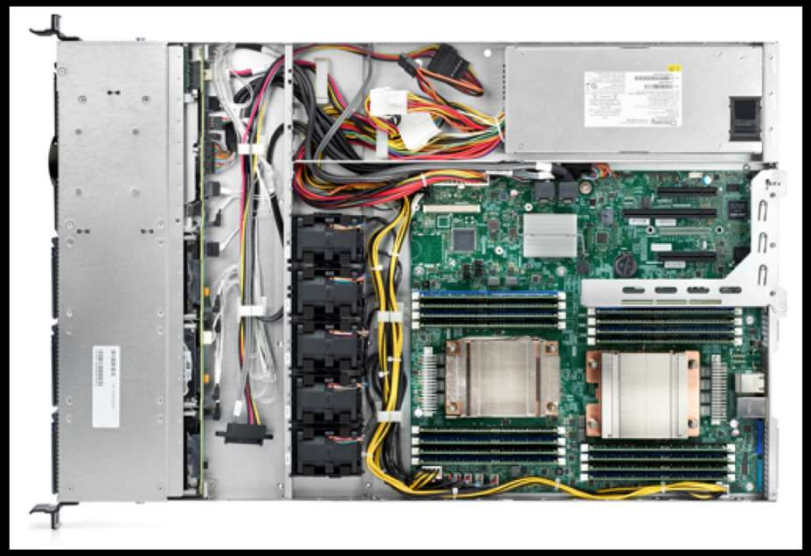
- Microsoft® Olympus Server with Intel® Xeon® Scalable Processor - 1U

OPEN ACCEPTED™

Products that carry the OCP Accepted™ recognition comply 100% with an OCP accepted specification and the design files are open sourced and available.

OCP Market Place

- HPE Cloudline CL2100 G3 1U Server

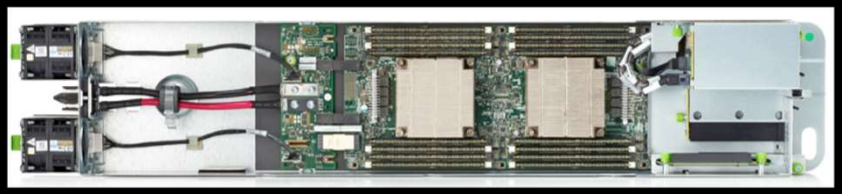


OPEN INSPIRED™

Products that carry the OCP Inspired™ recognition comply 100% with an OCP accepted specification and are available from a Gold, Silver or Platinum member of OCP.

OCP Market Place

- HPE Cloudline CL7100 G3 Compute Sled for Open Rack



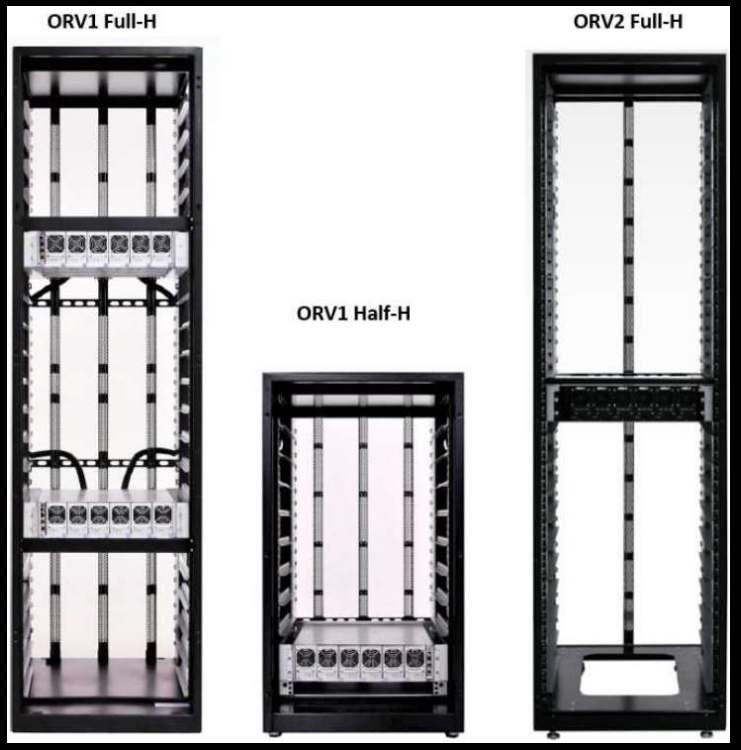
OPEN INSPIRED™

A rack scale solution that includes support for up to 30 disk drives in a JBOD configuration, power shelf (12 KW), Open Compute Rack (21 in.) and HPE Altoline Switches.

OCP Market Place

- New 48V OCP Open Rack v2
- Advantages of 48V

- Eliminates tight bus voltage requirements
- Smaller/Cheaper bus bar & connectors (lower current)
- More efficient rectifiers (fewer power step-downs)
- No additionals powe converter required for the batteries
- Easies to scale up to higher power (24-36KW)
- Support up to 60 nodes per rack



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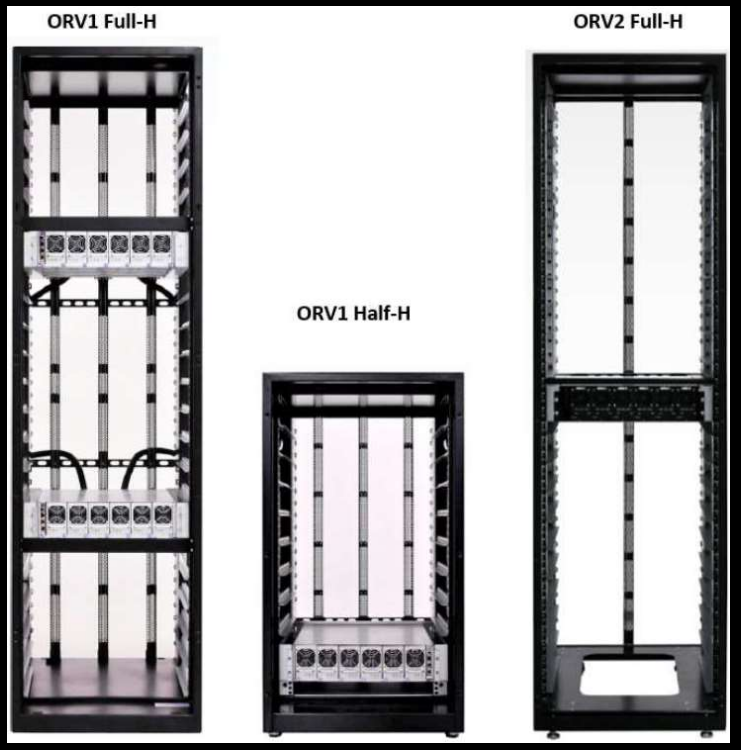
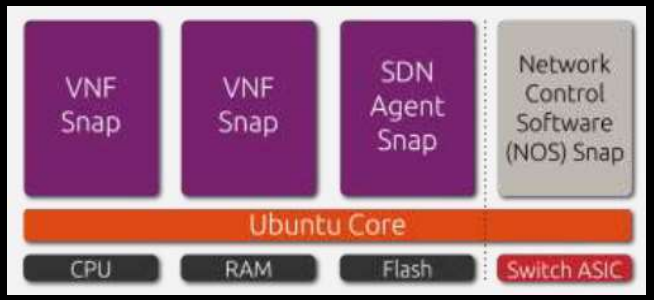
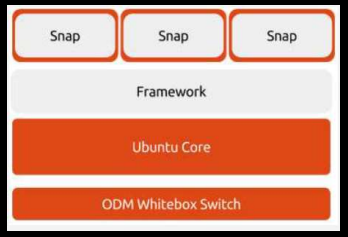


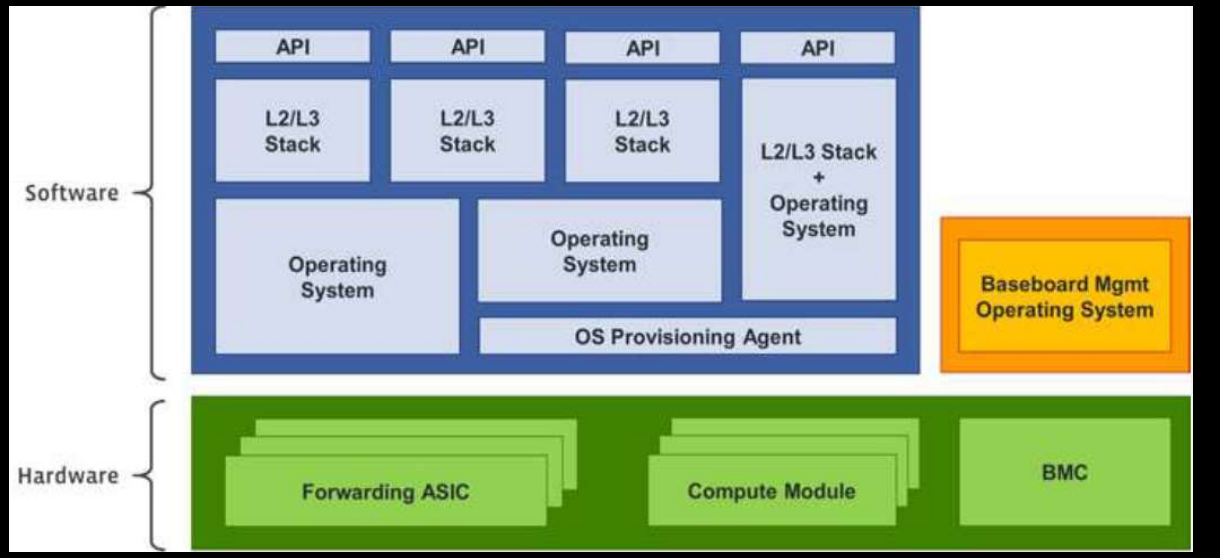
5. Software Architecture

Open Network

- White Box Switches idea

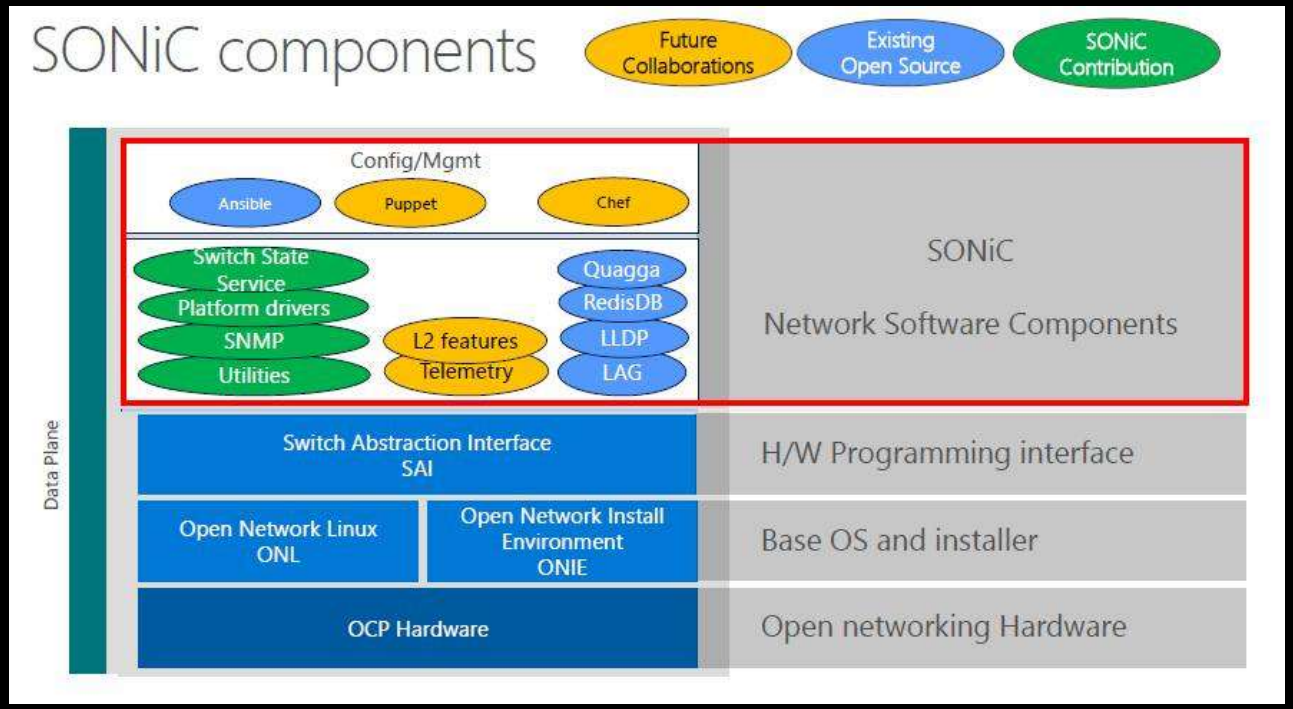






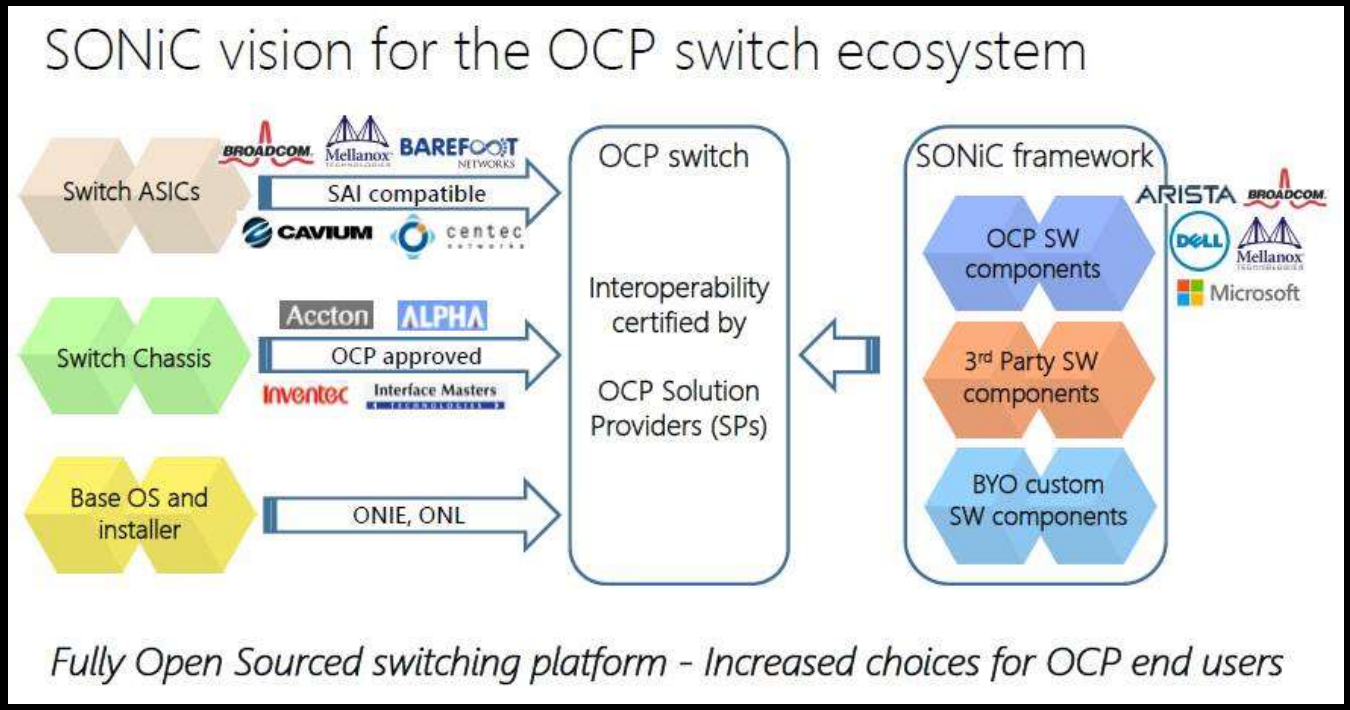
SONiC

- SONiC (Software for Open Networking in the Cloud)



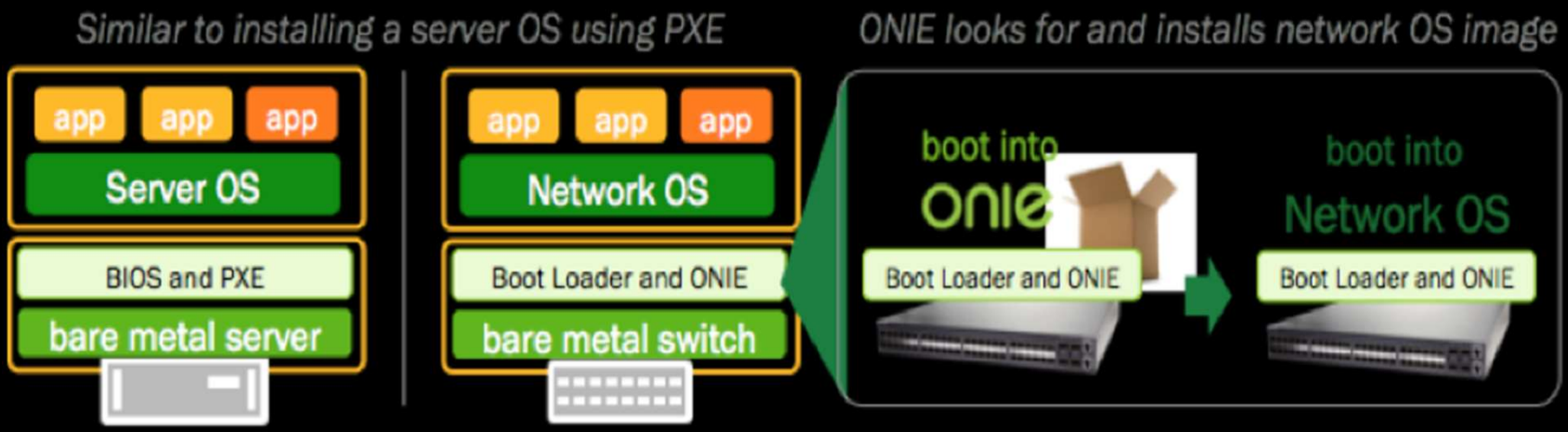
SONiC 생태계

- SONiC (Software for Open Networking in the Cloud)



ONIE

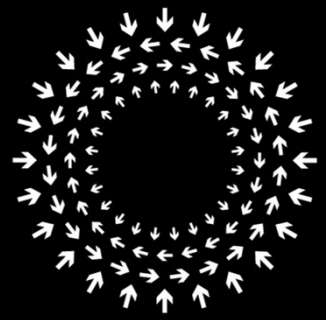
- ZTP and Automation



NOS

- OpenSwitch v.s. ONL (Open Network Linux)

OpenSwitch (ops) http://www.openswitch.net/	Open Network Linux (ONL) http://opennetlinux.org/
Features / Functionalities	
Open NOS with full L2/L3 Switching Feature. Routing / OpenFlow agents are included.	Open Platform Distribution for NOS. Routing / OpenFlow agents NOT included. (only samples)
Target Hardware	
OCP (Open Compute) switch, Bare metal (White Box) Switch	
Contributors	
Hewlett Packard, Accton, Broadcom Intel, Qosmos, VMWare, Arista	Big Switch Networks (Initial Source Code Contributor), Pica8, Accton
License	
Apache License, v. 2.0	Eclipse Public License and GPL for Kernel



감사합니다!