

2021. 4.

오픈소스 기반 SD-WAN

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JS Lab

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목차

- I. SD-WAN 동향
- II. 오픈소스 SD-WAN
- III. 오픈 SD-WAN 응용 방향

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I. SD-WAN 동향

- SD-WAN Market
- SD-WAN의 진화(클라우드화)
- SD-WAN의 오픈소스 고려

II. 오픈소스 SD-WAN

III. 오픈 SD-WAN 응용 방향

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I. SD-WAN 동향

❖ **SD-WAN 정의: What is SDWAN (Software-Defined Wide Area Network)?** (SDX Central, Marlese Lessing, February 11, 2021)

- It's a software-defined wide area network (SDWAN), is a network that is abstracted from its hardware, creating a virtualized network overlay.
- 에지 접속 추상화 (Edge connectivity abstraction)
- WAN 가상화 (WAN virtualization)
- 중앙 관리 (Centralized management)
- 탄력적 트래픽 관리 (Elastic traffic management)

Marlese Lessing | Studios Editor
February 11, 2021 6:00 AM

SD-WAN Service Components

SD-WAN architecture with MPLS integration. Source: [MEF](https://www.sdxcentral.com/networking/sd-wan/definitions/software-defined-sdn-wan/)

출처: <https://www.sdxcentral.com/networking/sd-wan/definitions/software-defined-sdn-wan/>

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I. SD-WAN 동향

❖ SD-WAN 마켓 뉴스 (2021)

- 클라우드 확장 진행
- 기업을 위한 5G 특화망(Private 5G) 응용
- 원격 사용자를 위한 전용망 구성

오픈소스 응용 가능 분야
(기업용 클라우드, 5G, 전용망)

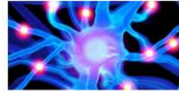
Networking

SD-WAN HQ



Megaport Ties NaaS Platform Into Cisco SD-WAN

NEW News | Tobias Mann | April 2, 2021
Megaport's NaaS offering combines middle-mile transport with edge compute capabilities.



Daily Roundup: VMware Wants to Be 'Central Nervous System' for 5G Operators

NEW News | SDxCentral Staff | April 1, 2021
VMware sees 5G core opportunities, TSMC wants to spend big on chip fabs, and AT&T boosted its SD-WAN security options.



AT&T Adds Cisco Teleworker Into Its SD-WAN Soup

NEW News | Dan Meyer | April 1, 2021
The offer uses a single piece of hardware that includes a full SD-WAN software stack and that ties into an employee's home internet connection.

출처: <https://www.sdxcentral.com/networking/sd-wan/>

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I. SD-WAN 동향

❖ SD-WAN 제조사 시장

- 국내 관련 제조사 시장 확장 가능성 (가상화, 클라우드화)
- 오픈소스 기반 실증 가능

Figure 1. Magic Quadrant for WAN Edge Infrastructure



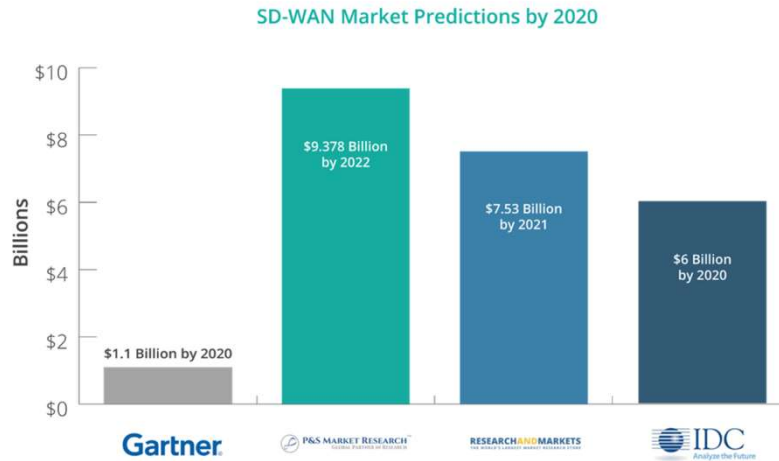
가상화 제조사
보안 제조사
네트워크 제조사

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I. SD-WAN 동향

❖ SD-WAN market by 4 leading analyst firms.



출처: <https://cloudify.co/blog/unlocking-different-sd-wan-solutions-with-open-orchestration/>

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I. SD-WAN 동향

❖ SD-WAN을 위해 오픈소스가 가야 할 길인가? (Is Open Source the Way Forward for SD-WAN?) May 2020, SDx Central

- **The Interoperability Problem: 오픈소스는 호환성 이슈 낮음**
- **Breaking Free: 벤더 락인(Lock-in) 이슈 해결**

“One reason that there are **60-plus SD-WAN vendors** is each of these SD-WAN vendors is not going out and writing their code from scratch. What they’re doing is **they’re going out and taking all these open source components, bundling them together, adding their additional stuff, and selling it as a proprietary solution,**” he said, adding that there is an opportunity to break the cycle and develop an entirely open SD-WAN framework.

출처: SDx Central (<https://www.sdxcentral.com/articles/news/is-open-source-the-way-forward-for-sd-wan/2020/05/>)

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I. SD-WAN 동향

❖ WAN의 진화

- WAN 기술의 단순화를 위해 발전 중
- SD-WAN은 4세대 WAN (플로우 기반 포워딩, 중앙 제어기)
- WAN 설계, 구축, 관리등 전반적인 변화의 발전

NG-WAN	<ul style="list-style-type: none"> • 세션 기반 포워딩 • 자동화와 셀프 드라이빙
SD-WAN	<ul style="list-style-type: none"> • 플로우 기반 포워딩 • 중앙 집중 컨트롤러 (제어기)
Hybrid WAN	<ul style="list-style-type: none"> • MPLS, 인터넷 • GUI 컨피규레이션
WAN Path Control	<ul style="list-style-type: none"> • 정책 기반 포워딩 • 컨피규레이션 스크립트화
WAN Routing	<ul style="list-style-type: none"> • 패킷 기반 포워딩 • CLI 컨피규레이션

출처: 2020 TechVision Research, (www.techvisionresearch.com)

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I. SD-WAN 동향

❖ WAN의 클라우드 네이티브화

출처: <https://github.com/CloudNativeSDWAN>

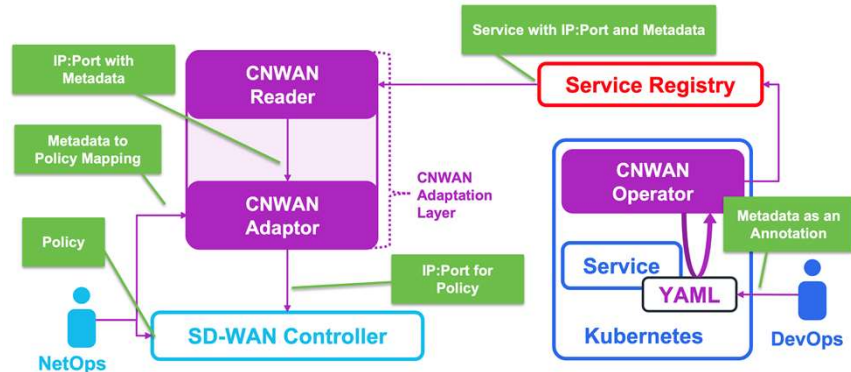
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I. SD-WAN 동향

❖ WAN의 클라우드 네이티브화

- 클라우드 네이티브 서비스 연동
- 클라우드 네이티브화 기능 배포 확장 가능(네트워킹, 보안, 기타)



출처: <https://github.com/CloudNativeSDWAN>

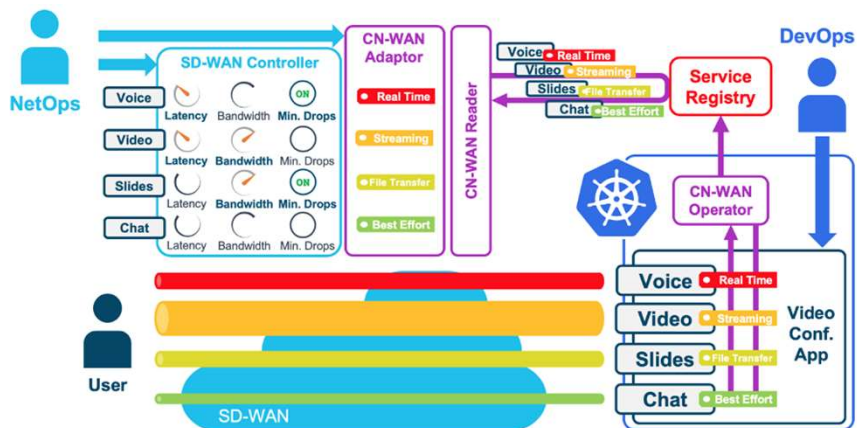
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I. SD-WAN 동향

❖ 제조사 WAN의 클라우드 네이티브화 (CN-WAN)

- 클라우드 네이티브 서비스 사용 중단간 가시화 관리



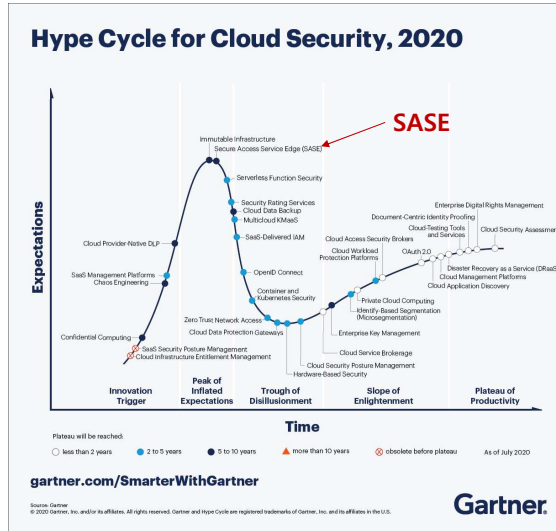
출처: <https://blogs.cisco.com/networking/introducing-the-cloud-native-sd-wan-project>

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I. SD-WAN 동향

❖ Cloud 보안 확장 고려 (SASE: Secure Access Service Edge)



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I. SD-WAN 동향

❖ WANs 과 SD-WAN의 차이점

아키텍처	Today	Tomorrow
보안 모델	경계(Perimeter), Trusted Inside	Zero Trust, 무(無)경계
Routing & SLA	정적(Static) / Based on Link	동적 (Dynamic) / Based on Apps
프로비저닝 (Provisioning)	수동	자동 / Zero Touch
서비스제공자 (Service Provider)	소수 선정 제공사	Any Provider
용량 할당 (Capacity Allocation)	선(先)구매	탄력적(Elastic), On-Demand
전송	MPLS	MPLS, EPL, Internet, LTE, 5G
관리	온프레미스	클라우드
하드웨어	Proprietary	Commoditized (오픈소스 기반)
확장을 위한 요구	지사에서 데이터센터로	클라우드, 모바일, IoT, 에지
설계 기반	Hairpin through Data Center	Direct User to Application
신뢰성	99.9%	99.999%
애플리케이션 가시화	Probe & 3 rd Party Tools	Built into SD-WAN Router

출처: 2020 TechVision Research, (www.techvisionresearch.com)

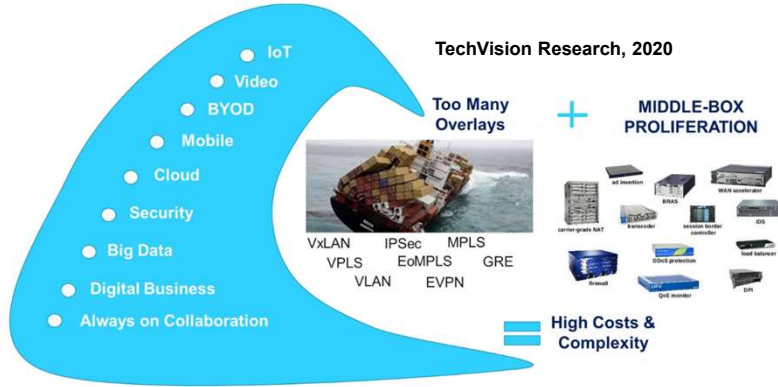
Ethernet private line (EPL)

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I. SD-WAN 동향

- ❖ 엔터프라이즈 인터넷 접속요구와 Multi-Cloud 연계 증가
- ❖ 기존 WAN 네트워크 이슈
 - 엔터프라이즈 서비스의 클라우드 이동
 - 서비스를 위한 중단간 연결 경로
 - Tsunami Converging on Legacy WANs



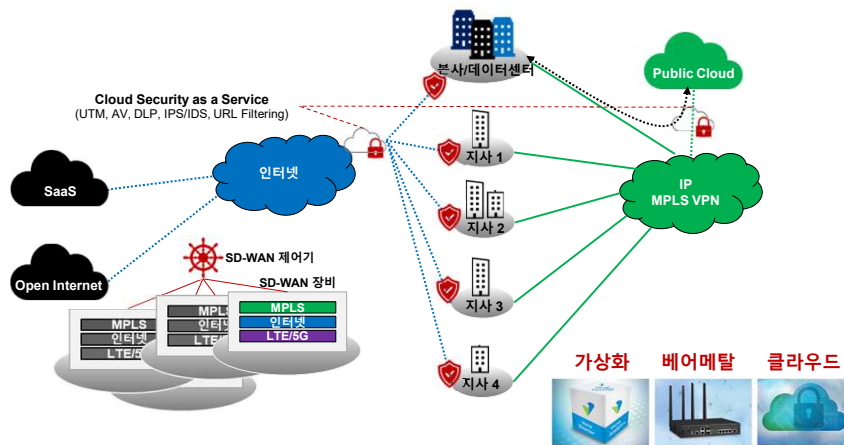
출처: 2020 TechVision Research, (www.techvisionresearch.com)

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I. SD-WAN 동향

- ❖ 제품형태: Appliance(베어메탈, HCI, 가상화, 클라우드) + 중앙 관리
- ❖ 전용 하드웨어 (기업 고객은 하드웨어/소프트웨어 동일 제조사 선호)
- ❖ 권장 하드웨어 (생태계 확장에 유리)



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I. SD-WAN 동향

- ❖ 통신 서비스용 uCPE (Universal Customer Premises Equipment)
- ❖ 통신사의 요구는 기업과 다를 수 있음

- Virtual routers
- Virtual firewalls
- Virtual load balancers
- Virtual WAN optimizers
- SD-WAN routers

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I. SD-WAN 동향

- ❖ SD-WAN vs SASE (Secure Access Service Edge)

- SASE는 클라우드 관점
- SASE는 보안과 네트워킹 도구 모두 고려
- SASE는 하이레벨 트래픽 검사
- SASE is still an emerging technology.

출처: 2019 Gartner

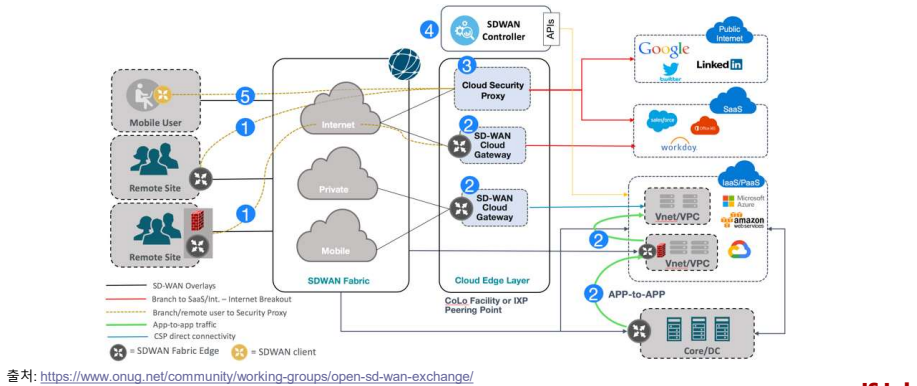
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I. SD-WAN 동향

❖ SD-WAN 2.0 Reference Architecture (ONUG)

- 지사의 클라우드 직접경로 (Branch office direct access to SaaS and IaaS)
- 멀티클라우드 연결 (Multi-cloud attachment to the SD-WAN fabric)
- 지사를 위한 클라우드 보안 (Security for branch offices and the cloud)
- 클라우드 API 제공 (Integrated cloud APIs via SDWAN controllers)
- SD-WAN 클라이언트 (SD-WAN client for end users)

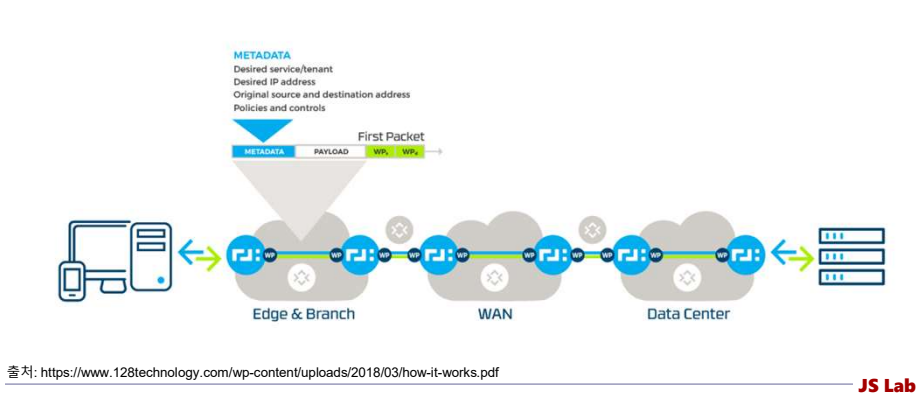


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I. SD-WAN 동향

❖ Tunnel-Free SD-WAN

- Tunnel-free SD-WAN은 SVR(Secure Vector Routing) 사용 (establish unique sessions on the network)
- 캡슐화(encapsulation) 연결보다 대역폭 점유를 적음
- More scalable, dynamic and secure
- Session-aware Data Plane



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I. SD-WAN 동향

❖ Open Source based SD-WAN (예)

- 화이트박스 기반의 하드웨어에 원하는 오픈소스 기능 추가 가능
 - ✓ Application Priority
 - ✓ Multi-link Performance
 - ✓ Stateful SIP Transfer (SST)
 - ✓ Survivability

Session Initiation Protocol (SIP)

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I. SD-WAN 동향

❖ 오픈소스의 역할 (Open Source's Role) – 오픈소스 진영

- 제조사 추가 (Additional Vendors) – 국내 개발가능 사업자
- 낮은 마진 (Lower Margins) – 사용자, 제조사, Managed Services
- 빠른 진화 (Faster Evolution) – 고객 요구 수용 개발 추가
- 보안 (Better Security)
- 호환성 (Better Interoperability)

출처: 2020 TechVision Research, (www.techvisionresearch.com)

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I. SD-WAN 동향

II. 오픈소스 SD-WAN

- 하드웨어
- 소프트웨어
- 통신 환경 오픈소스

III. 오픈 SD-WAN 응용 방향

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II. 오픈소스 SD-WAN

❖ 오픈소스 SD-WAN 하드웨어

- EdgeCore
- Lanner
- Whitebox Solutions™

❖ 오픈소스 SD-WAN 소프트웨어

- FlaxiWAN
- WANOS
- Cloudify
- ONAP
- pfSense
- OPNsense



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II. 오픈소스 SD-WAN

- ❖ SD-WAN 하드웨어 소프트웨어 협력 생태계 조성
- ❖ The uCPE Solutions Catalog

Lanner, Enea and Intel Showcase Firewall Protected Open Source SD-WAN



Virtual Network Functions	Orchestration	White Box Solutions	Semiconductor Vendors
<ul style="list-style-type: none"> • 128 Technology • 6WIND • Accelleran • Citrix • Clavister • FatPipe • flexiWAN • Fortinet • Nuage Networks • SonicWall • Sproute Networks 	<ul style="list-style-type: none"> • Cloudify • Cloudops • Rift • UBiqube 	<ul style="list-style-type: none"> • Advantech • Edgecore Networks • Lanner • NEXCOM • QCT • Silicom • Supermicro 	<ul style="list-style-type: none"> • Ampere • Arm

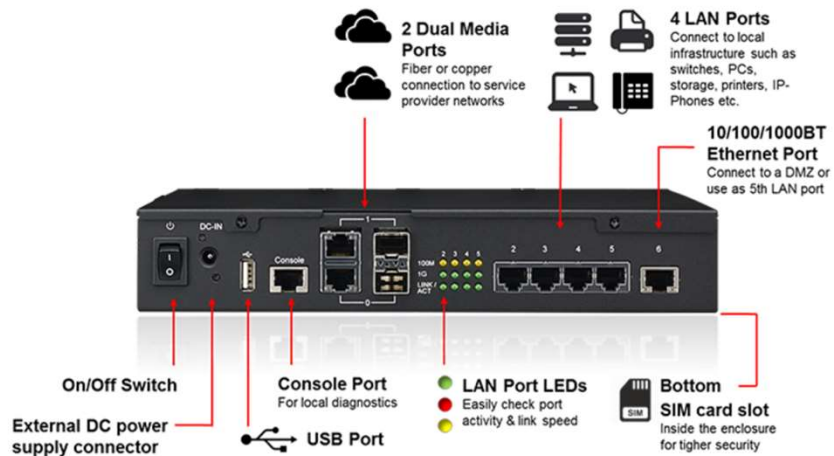
출처: <https://www.enea.com/globalassets/downloads/nfv/the-ucpe-solutions-catalog.pdf>

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II. 오픈소스 SD-WAN

- ❖ SD-WAN 하드웨어 소프트웨어 협력 생태계 조성



출처: <http://www.lannerinc.com/news-and-events/latest-news/lanner-enea-and-intel-showcase-firewall-protected-open-source-sd-wan>

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II. 오픈소스 SD-WAN

❖ 화이트박스 기반 SD-WAN 하드웨어

- uCPE (universal CPE): 저전력 CPU, 이더넷 컨트롤러 내장
- vCPE or virtualized CPE: 가상화, DPDK, QAT



Intel D-1500 Series SoC (Broadwell-DE 14nm)
 Max 32GB DDR4 2133 MHz SODIMM
 Ethernet-
 1x GbE RJ-45/SFP Combo port WAN via 2x Intel I210 Controllers
 1x SFP+ 10 GbE via CPU Ethernet Controller
 8 x GbE RJ45 LAN, thru MRVL 88E6190x supporting 4x POE PSE
 2x mini PCI Express Expansion Slot
 FIPS 140-2 Level 2 in Chassis

Storage-
 1x M.2 SATA SSD
 2x Hot-swappable 2.5" HDD/SSD
 Advanced Technology
 Intel QuickAssist Technology
 Virtualization - VT-d, VT-x, SR-IOV
 Security - H/W TPM 1.2, AES-NI
 DPDK

Data Plane Development Kit (DPDK)

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II. 오픈소스 SD-WAN

❖ SD-WAN 소프트웨어 제조사의 Hardware Partner

- SILICOM
- LANNER
- ADVANTECH



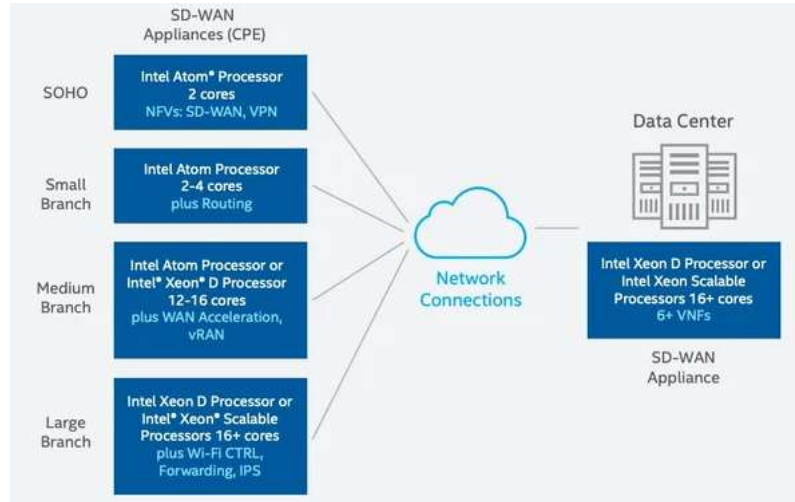
- uCPE with Intel® Atom™ Processor C3000
- Intel® Atom® C3000 System-on-Chip with Intel® QuickAssist Technology at 10Gbps and Intel® AES-NI and VT-d Support
- Supports SR-IOV on all ports by Intel SOC integrated MAC and Intel i350 Ethernet Controller
- Optional dual-SIM, 3G, 4G LTE module and WiFi module
- Optional PoE+ kit to support up to two 25.5W ports

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II. 오픈소스 SD-WAN

❖ 레퍼런스 하드웨어



출처: <https://www.sdxcentral.com/networking/sd-wan/definitions/citrix-sd-wan/>

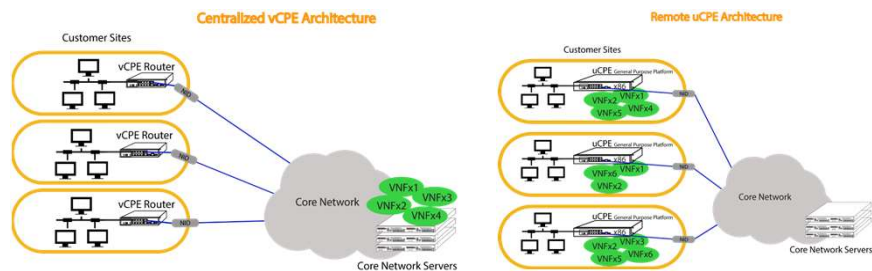
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II. 오픈소스 SD-WAN

❖ 가상화 네트워크 기능 배포 기반 SD-WAN 구성

- 지역 배포 (예): uCPE (universal CPE)
 - ✓ 고사양 SD-WAN 하드웨어
 - ✓ 환경 변화에 따른 설계의 유연성
- 중앙 서비스 (예): vCPE or virtualized CPE
 - ✓ 저사양 SD-WAN 하드웨어
 - ✓ 데이터센터 집중 관리



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II. 오픈소스 SD-WAN

❖ flexiWAN: SD-WAN 오픈소스 소프트웨어

- 클라우드 기반 SD-WAN 컨트롤러 제공

	SHARED ENVIRONMENT	DEDICATED ENVIRONMENT	SELF-HOSTING
Registered flexiEdge Instances	Up to 3	4 - 10	11 - 100
	Free	\$40	\$33
		\$30	\$25
		\$25	\$21
		\$20	\$17
		\$12	\$10
		Contact Us	Contact Us
		START PLAN	APPLY

참조: <https://flexiwan.com/>

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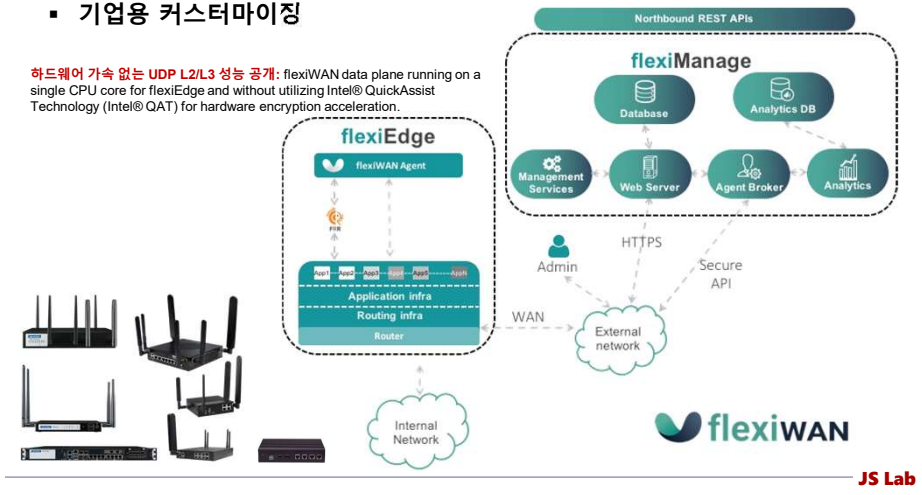
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II. 오픈소스 SD-WAN

❖ flexiWAN: SD-WAN 오픈소스 소프트웨어

- 방화벽, WAN 최적화, 음성/화상 최적화, DPI 등의 제공
- As a Service Cloud Providers
- 기업용 커스터마이징

하드웨어 가속 없는 UDP L2/L3 성능 공개: flexiWAN data plane running on a single CPU core for flexiEdge and without utilizing Intel® QuickAssist Technology (Intel® QAT) for hardware encryption acceleration.

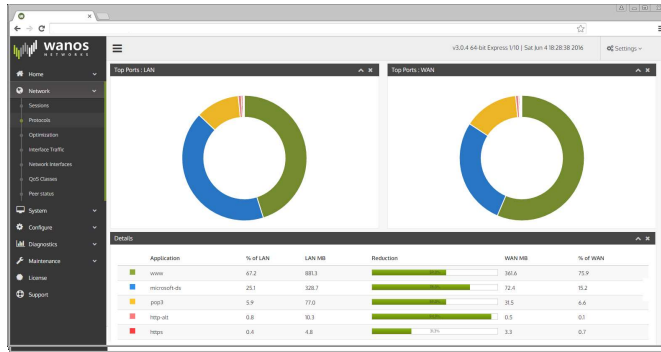


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II. 오픈소스 SD-WAN

❖ WANOS: SD-WAN 오픈소스 소프트웨어

- WAN Optimization: 네트워크 대역폭 사용비 감소와 애플리케이션 가속
- VMware 하이퍼바이저 기반 기능 제공
- ✓ The OVA Image on VMware systems.
- ✓ ESXi 5.1-5.5, Fusion 5-6, Workstation 9-10



OTHER RELEASES
[Update v.4.2.9 Prod](#)
[Update v.5.1.0 Beta](#)
[Free Express v.3.2.3](#)
[Linux Container LXD](#)

MINIMUM REQUIREMENTS
 2 GB Memory
 64 GB Storage
 1-2 Ethernet Interfaces
 2 CPU Threads

RECOMMENDED
 4 GB Memory
 64 GB SSD
 2 Ethernet Bypass Interfaces
 4 CPU Threads

참조: <http://wanos.co/wan-optimization/download/>

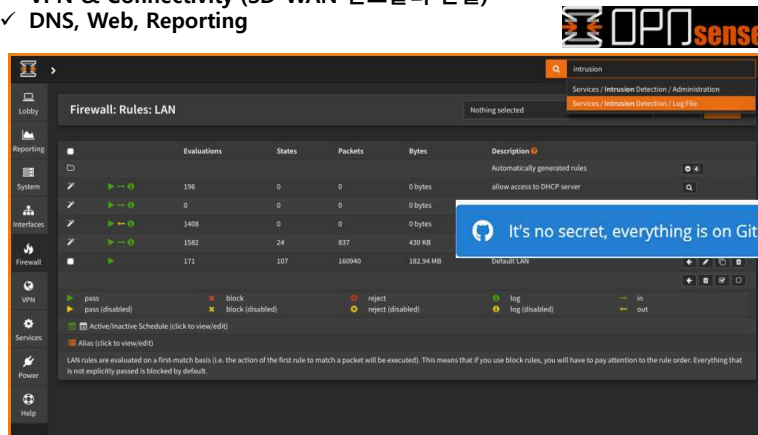
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II. 오픈소스 SD-WAN

❖ OPNsense: SD-WAN 오픈소스 소프트웨어

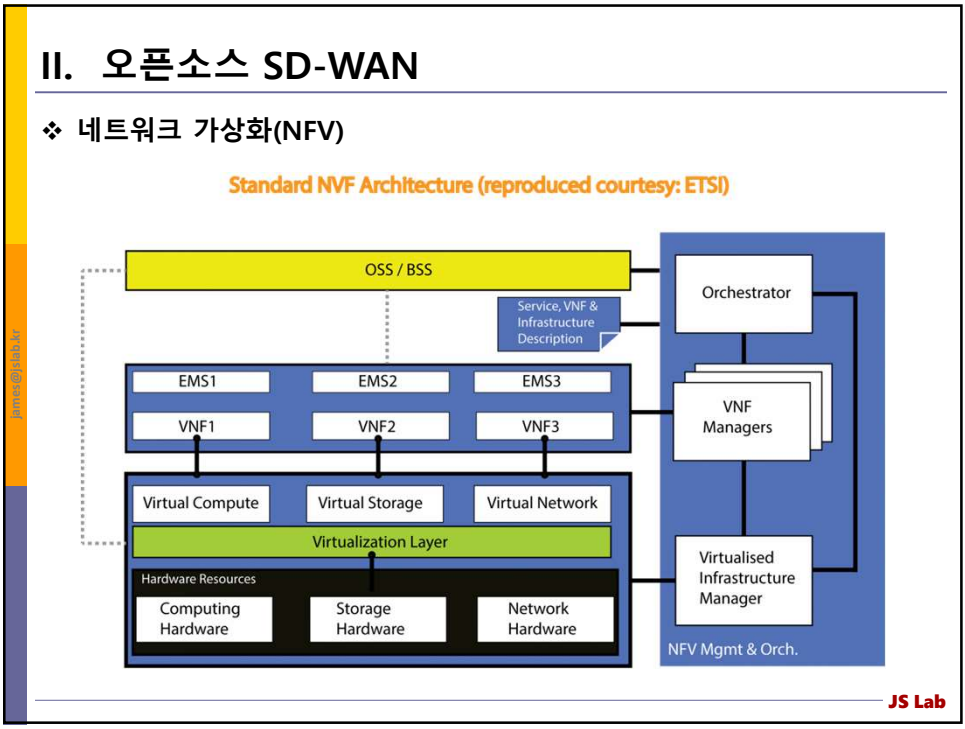
- Community Plugins for SD-WAN
- ✓ VPN & Connectivity (SD-WAN 컨트롤러 연결)
- ✓ DNS, Web, Reporting



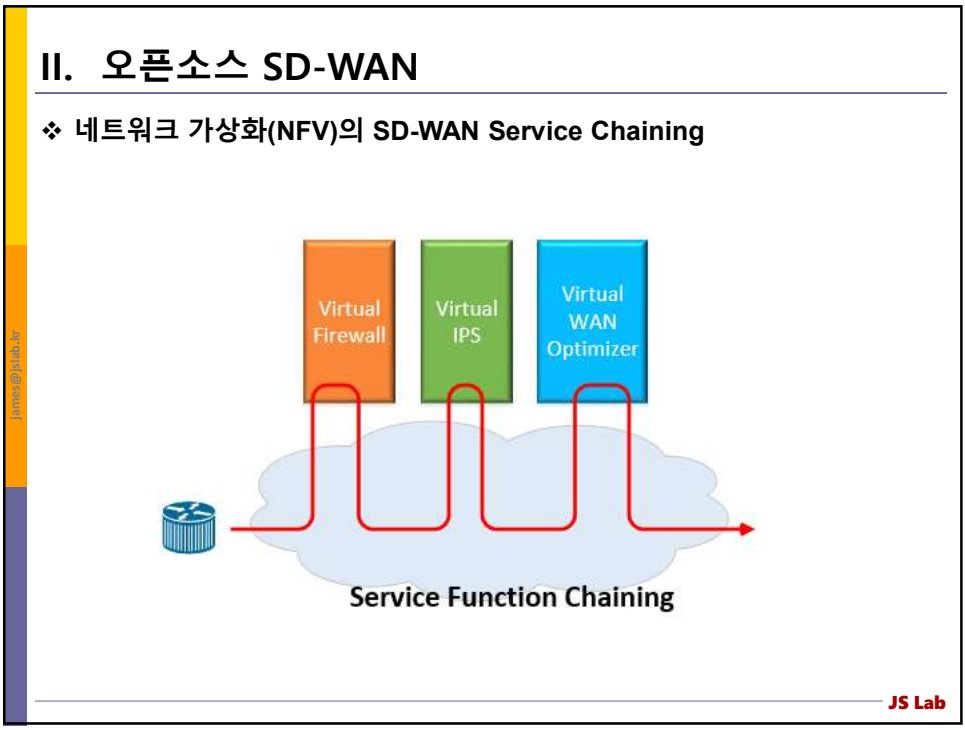
참조: <https://opnsense.org/>

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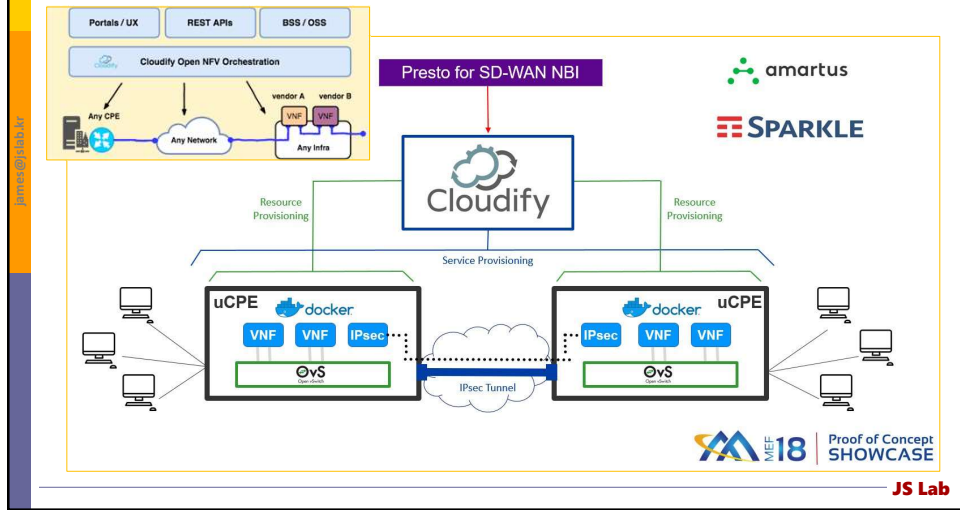
35



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II. 오픈소스 SD-WAN

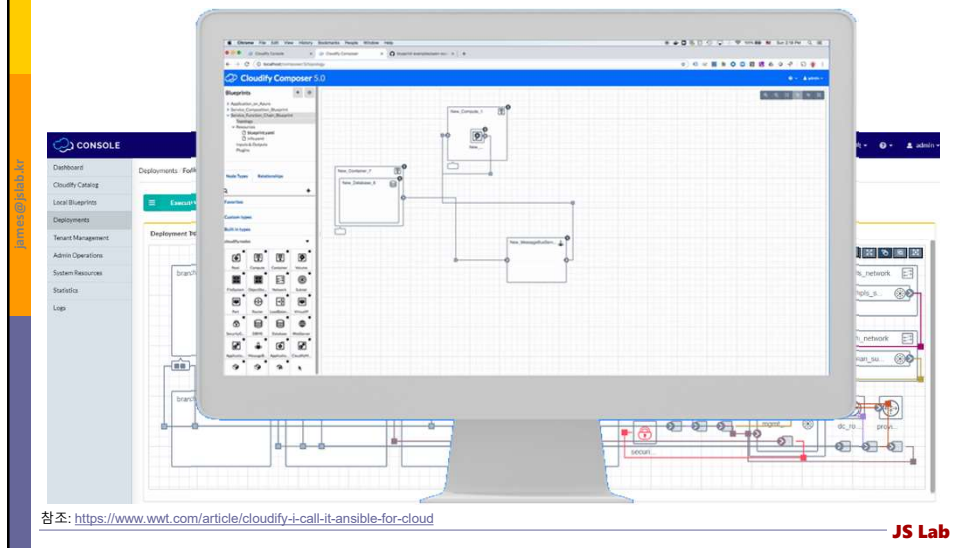
- ❖ Cloudify – Open NFV Orchestration
- ❖ 통신을 위한 오픈소스는 관련사들의 공통 주제를 시험하는 생태계 역할



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II. 오픈소스 SD-WAN

- ❖ Cloudify - Configuration

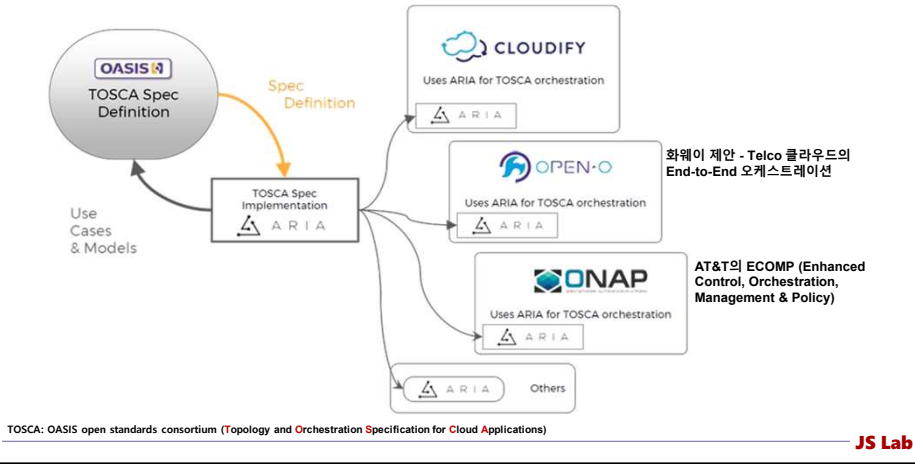


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II. 오픈소스 SD-WAN

❖ 표준 TOSCA 스펙 적용 오픈소스 'ARIA'

1. 오케스트레이션이 TOSCA 프로파일 지원을 위한 Python 라이브러리
2. TOSCA 애플리케이션 생성을 위한 SDK
3. CLI Tools: 오케스트레이션을 위한 TOSCA 템플릿



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II. 오픈소스 SD-WAN

❖ ONAP: Open Networking Automation Platform

▪ SD-WAN Use Case

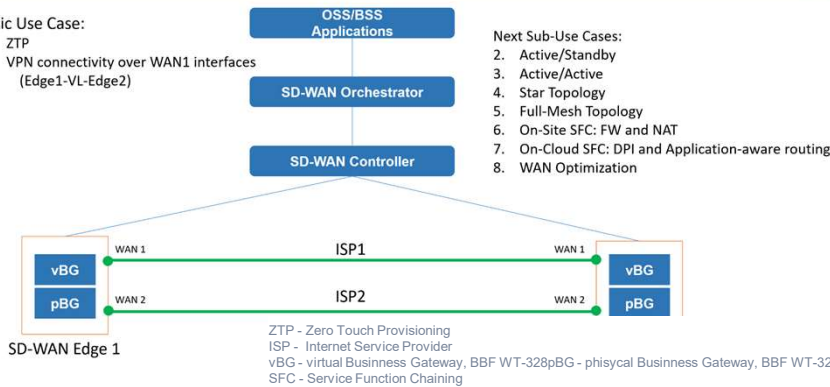
Architecture

1. Basic Use Case:

- ZTP
- VPN connectivity over WAN1 interfaces (Edge1-VL-Edge2)

Next Sub-Use Cases:

2. Active/Standby
3. Active/Active
4. Star Topology
5. Full-Mesh Topology
6. On-Site SFC: FW and NAT
7. On-Cloud SFC: DPI and Application-aware routing
8. WAN Optimization



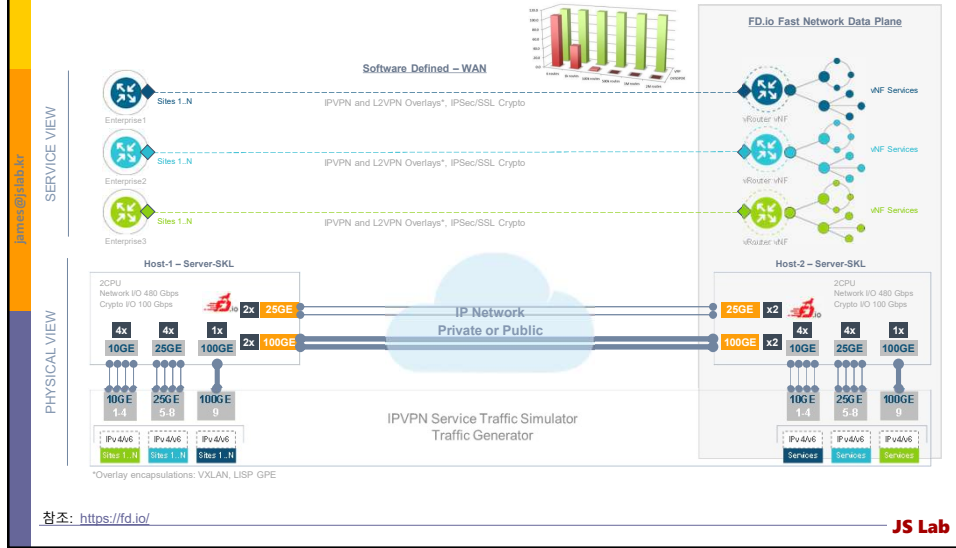
참조: <https://wiki.onap.org/pages/viewpage.action?pageId=11929755>

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II. 오픈소스 SD-WAN

❖ SD-WAN – with FD.io Universal Fast Data Plane



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II. 오픈소스 SD-WAN

❖ SD-WAN 가시화 요소

- 인터넷 심층 가시화(In-depth Internet visibility)
- 언더레이 물리환경 고려 (Ability to drill into the network underlay)
- SaaS 앱 네트워크 가시화 (App-aware network visibility for SaaS)
- 히스토리 관리 (View of historical data-set)
- 장애 확인 용이 (Easy and quick fault isolation): Internal wide area, ISP, IaaS / SaaS?

9 Best Bandwidth Monitor and Network Usage Monitoring Tools

	Free Trial?	Best Use	Visual Analytics	Policy Optimization	Intuitive Use	Bottom Line
SolarWinds Network Bandwidth Analyzer Pack	solarwinds Free 30-day Trial	Bandwidth monitoring and network performance analysis	★★★★★	★★★★★	★★★★★	Robust solution for analyzing network performance and traffic patterns.
SolarWinds NetFlow Traffic Analyzer	solarwinds Free 30-day Trial	Traffic analysis	★★★★★	★★★★★	★★★★★	Ideal for analyzing continuous streams of network traffic and flow data.
Paessler PRTG Network Monitor	PAESSLER Free 30-day Trial	Application monitoring	★★★★	★★★★	★★★★★	A great all-in-one network and application monitoring tool.
ManageEngine NetFlow Analyzer	ManageEngine Free 30-day Trial	Traffic analysis	★★★★	★★★★★	★★★★	Offers a comprehensive, holistic overview of your network traffic with this tool.
SolarWinds Real-Time Bandwidth Monitor	solarwinds Free tool	Bandwidth monitoring	★★★★	—	★★★★★	A simple way to perform interface bandwidth polling.
SolarWinds Network Bandwidth Analyzer Pack	solarwinds Free tool	Bandwidth monitoring	★★★★	—	★★★★	Leverage this platform to see traffic by conversation, app, domain, and endpoint.
ntopng	None	High-level traffic analysis	★★	—	★★★	A straightforward approach to simple traffic sorting and analysis.
Cacti	Free tool	Data logging and graphing	★	—	★★	Dig into graphs to get the high-level bandwidth data you need.
BandwidthD	Free tool	High-level traffic analysis	★	—	★	Traffic analysis without all the bells and whistles.

출처: <https://www.dnsstuff.com/bandwidth-monitor>

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jshlab@jshlab.kr

I. SD-WAN 동향

II. 오픈소스 SD-WAN

III. 오픈 SD-WAN 응용 방향

- 오픈소스
- 10Giga 인터넷
- 퍼블릭 클라우드
- 5G
- SASE

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III. 오픈 SD-WAN 응용 방향

❖ Linux Kernel 4.x 이상의 네트워크 지원

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

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User Space - 프로그램(애플리케이션 코드/라이브러리)

Routing Suite	Orchestration	Automation	Monitoring
	Bridging	VxLAN	Third Party/Customer Applications

Linux Kernel - 시스템 인터페이스/기기 드라이버/일반 서비스

VRF					
VxLAN	MPLS	Routing Tables	ARP Table	Bridge Table	Ethernet Interfaces

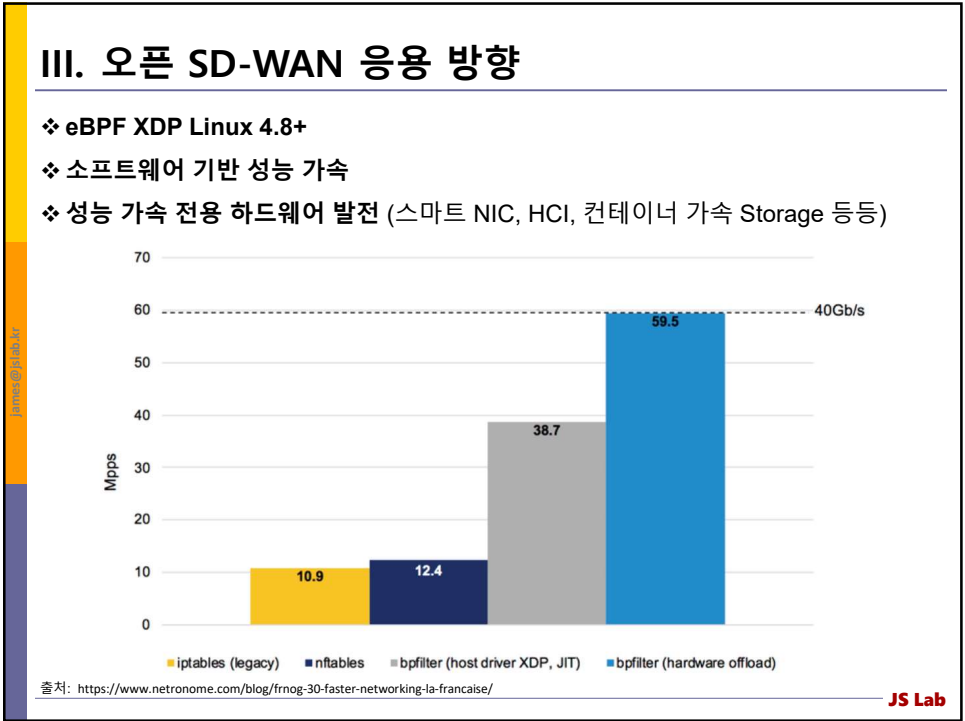
CPU, RAM, Flash, etc. - 하드웨어

```

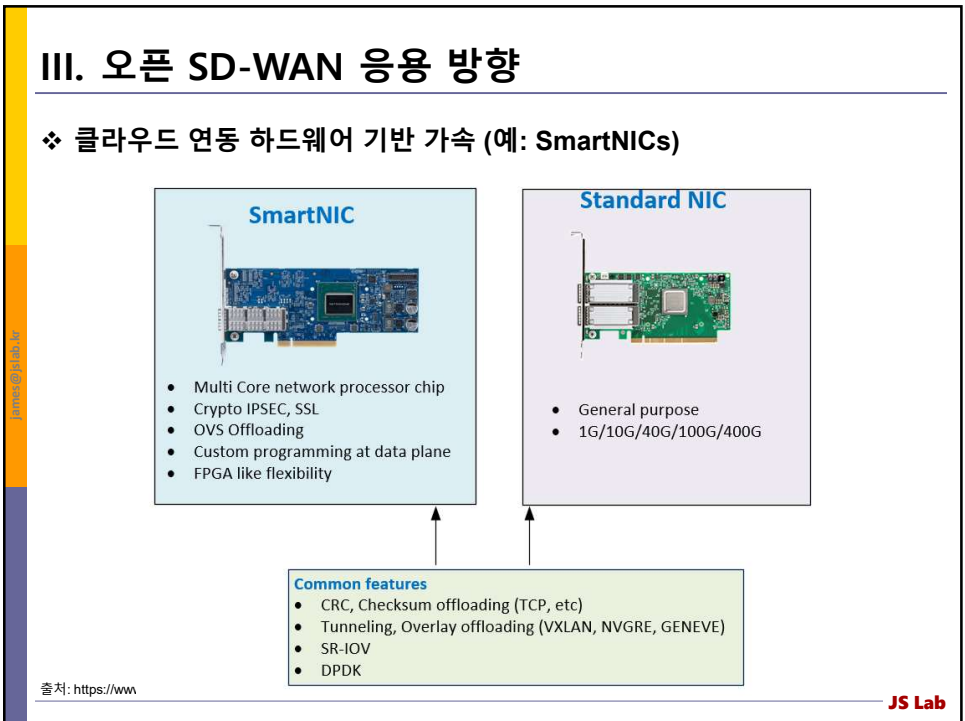
jshlab@ubuntu60:~$ sudo ifconfig
Linux ubuntu60 4.15.0-116-generic #140-Ubuntu SMP Mon Feb 12 21:23:04 UTC 2018 x86_64 x86_64 x86_64 GNU/Linux
                    
```

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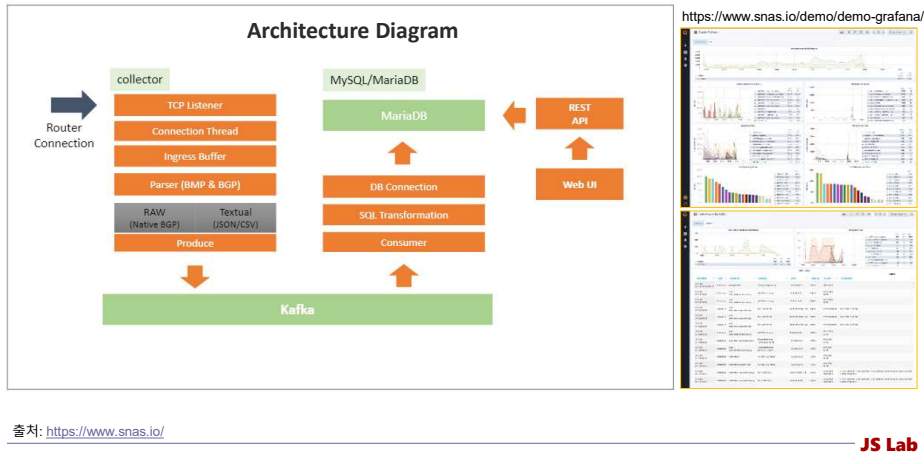
45



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III. 오픈 SD-WAN 응용 방향

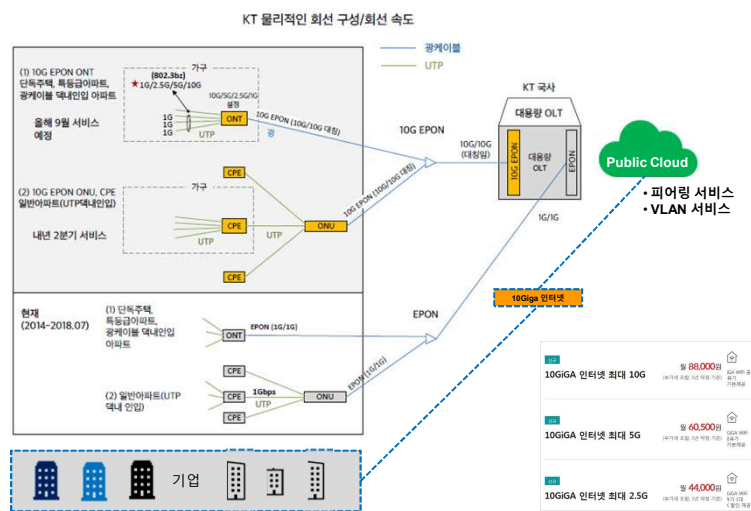
- ❖ 분석 모니터링
- ❖ 예: SNAS (Streaming Networks Analytics System)



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III. 오픈 SD-WAN 응용 방향

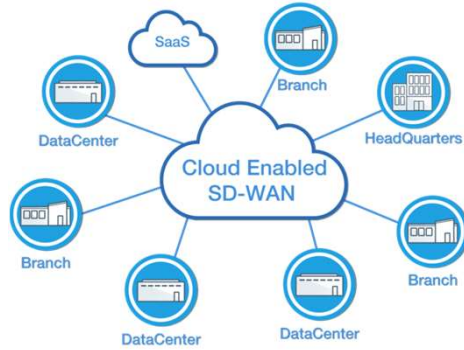
- ❖ 기업형 10Giga 인터넷 확장 중



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III. 오픈 SD-WAN 응용 방향

- ❖ 오픈소스 방화벽 소프트웨어 기반 솔루션의 발전
- ❖ SD-WAN Fabric에 연결하는 멀티/하이브리드 클라우드 환경

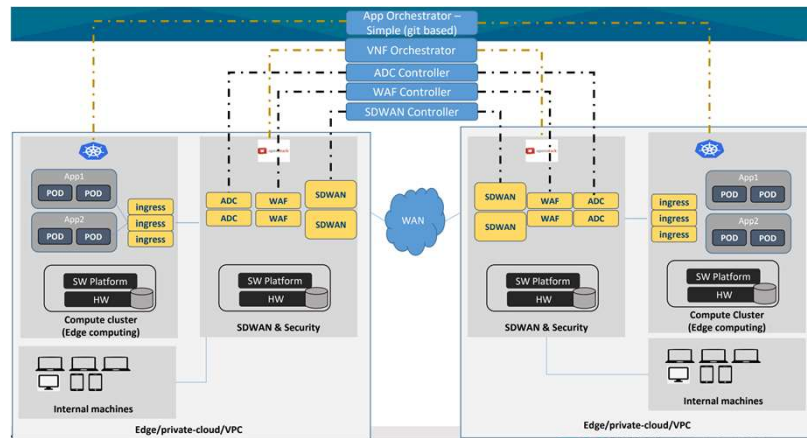


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III. 오픈 SD-WAN 응용 방향

- ❖ ONAP(Open Networking Automation Platform)
- ❖ ONAP은 Kubernetes 기반으로 발전 중
- ❖ ONAP의 SD-WAN over 5G Use Case (El Alto)



참조: <https://wiki.onap.org/pages/viewpage.action?pageId=11929755>

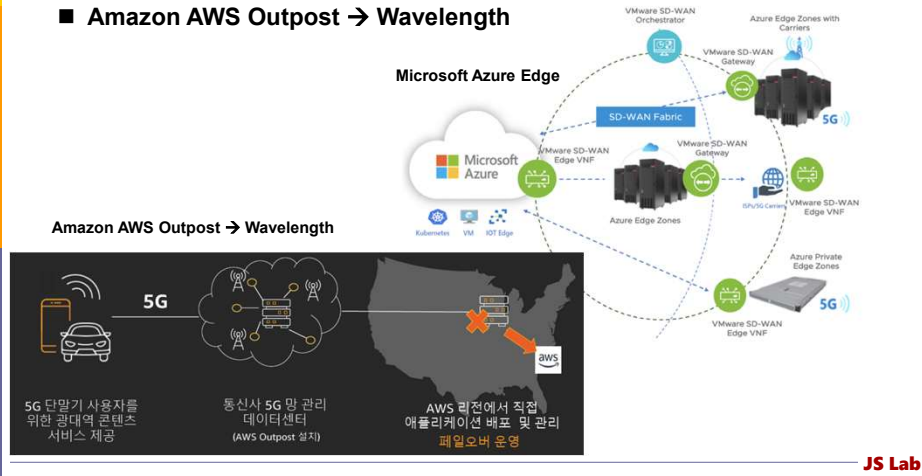
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III. 오픈 SD-WAN 응용 방향

❖ SD-WAN Fabric에 연결하는 에지 솔루션의 5G 통신사 MEC 기반 기업에 설치 (예: AWS와 Azure)

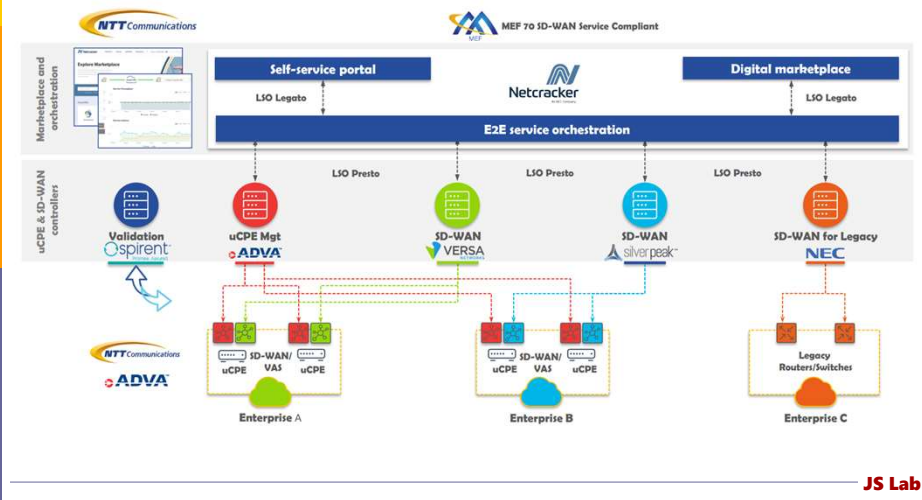
- Microsoft Azure → Edge
- Amazon AWS Outpost → Wavelength



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III. 오픈 SD-WAN 응용 방향

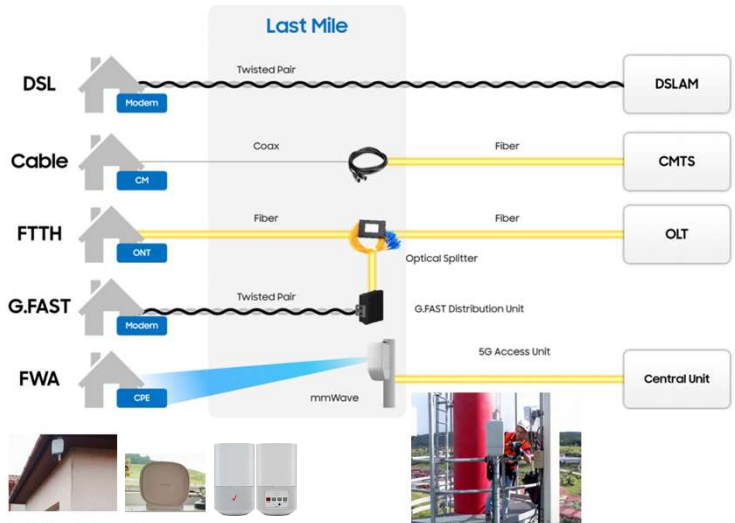
❖ 통신사 기반 SD-WAN PoC(예)
❖ 멀티 벤더 환경



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III. 오픈 SD-WAN 응용 방향

❖ 유선망의 5G 전환 고려 / mmWave FWA (Fixed Wireless Access)



출처: Case study: Orange Romania, Samsung

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III. 오픈 SD-WAN 응용 방향

❖ 4개 지역 연결 5G 테스트베드 진행중



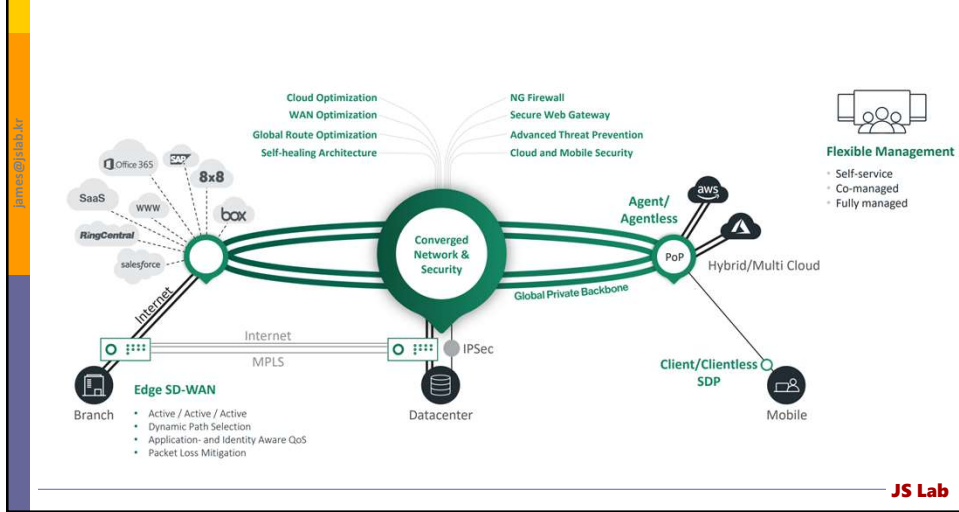
출처: https://www.e4ds.com/sub_view.asp?ch=16&t=0&idx=11618

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III. 오픈 SD-WAN 응용 방향

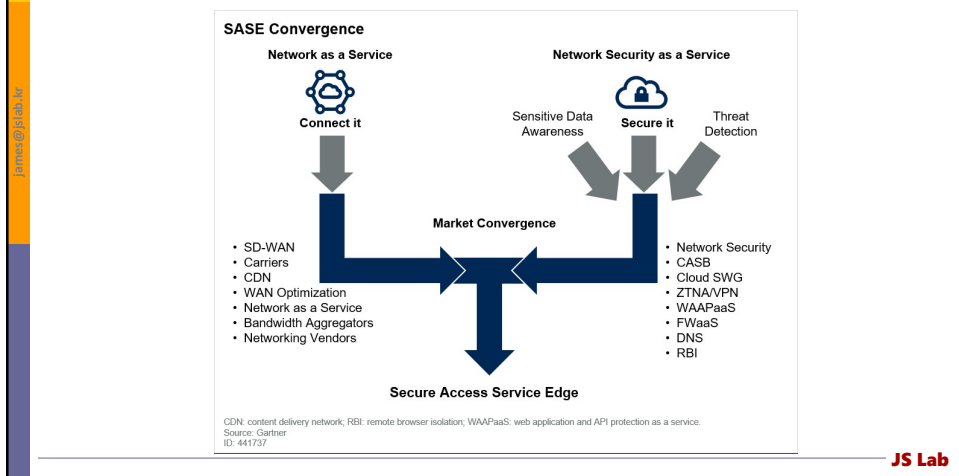
- ❖ SD-WAN 의 멀티클라우드 환경 확장
- ❖ 멀티클라우드 네트워킹 이슈 해결 필요



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III. 오픈 SD-WAN 응용 방향

- ❖ 가트너는 SASE를 독립적인 시장으로 구분 시작
- ❖ Market Trends: How to Win as WAN Edge and Security
- ❖ Converge Into the Secure Access Service Edge, 2019



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III. 오픈 SD-WAN 응용 방향

❖ SD-WAN 응용 가능 오픈 소스

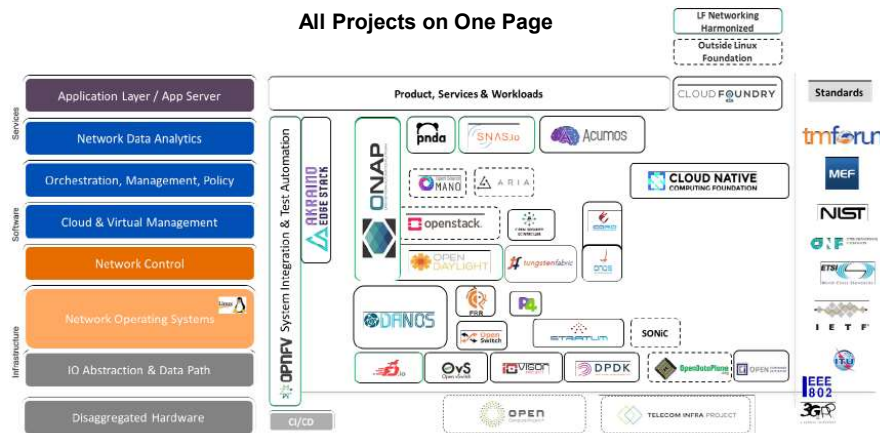
오픈소스 이름	구분	웹서비스 주소
Cloud Router	라우터	https://github.com/cloudrouter/cloudrouter
VyOS	라우터/방화벽	https://www.vyos.io/
Quagga	라우터	https://quaggaproject.org/
DPDK	acceleration techniques	http://dpdk.org
VPP	acceleration techniques	https://fd.io
ONAP	Management & Control	https://www.onap.org
Open vSwitch	스위치	https://www.openvswitch.org
HA Proxy	로드밸런서	http://www.haproxy.org/
pfSense	방화벽	https://www.pfsense.org/
Snort	IDS	https://www.snort.org/
KeyCDN	CDN	https://www.keycdn.com/open-source-cdn

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III. 오픈 SD-WAN 응용 방향

❖ 리눅스재단의 네트워킹 프로젝트

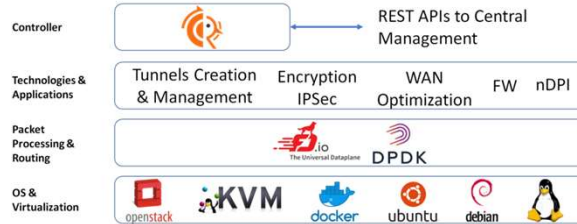
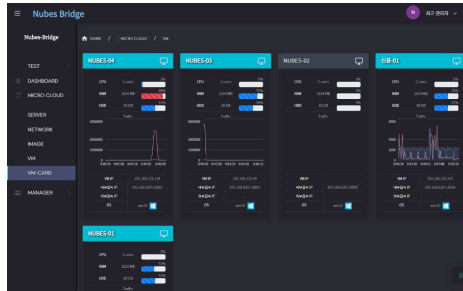


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III. 오픈 SD-WAN 응용 방향

❖ 오픈소스 기반 SD-WAN 모니터링 소프트웨어 (개발 예)

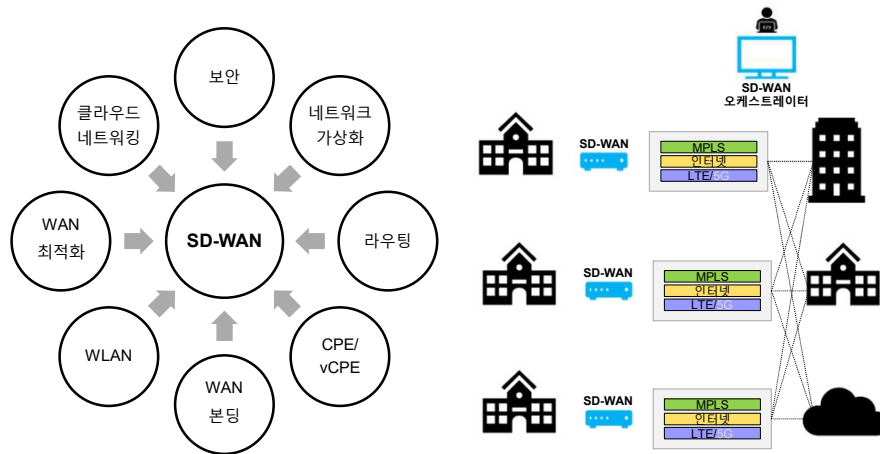


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III. 오픈 SD-WAN 응용 방향

❖ SD-WAN is sometimes viewed as a catch-all marketing term for next-gen enterprise edge solutions (www.sdxcentral.com SDxCentral, 2019)



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