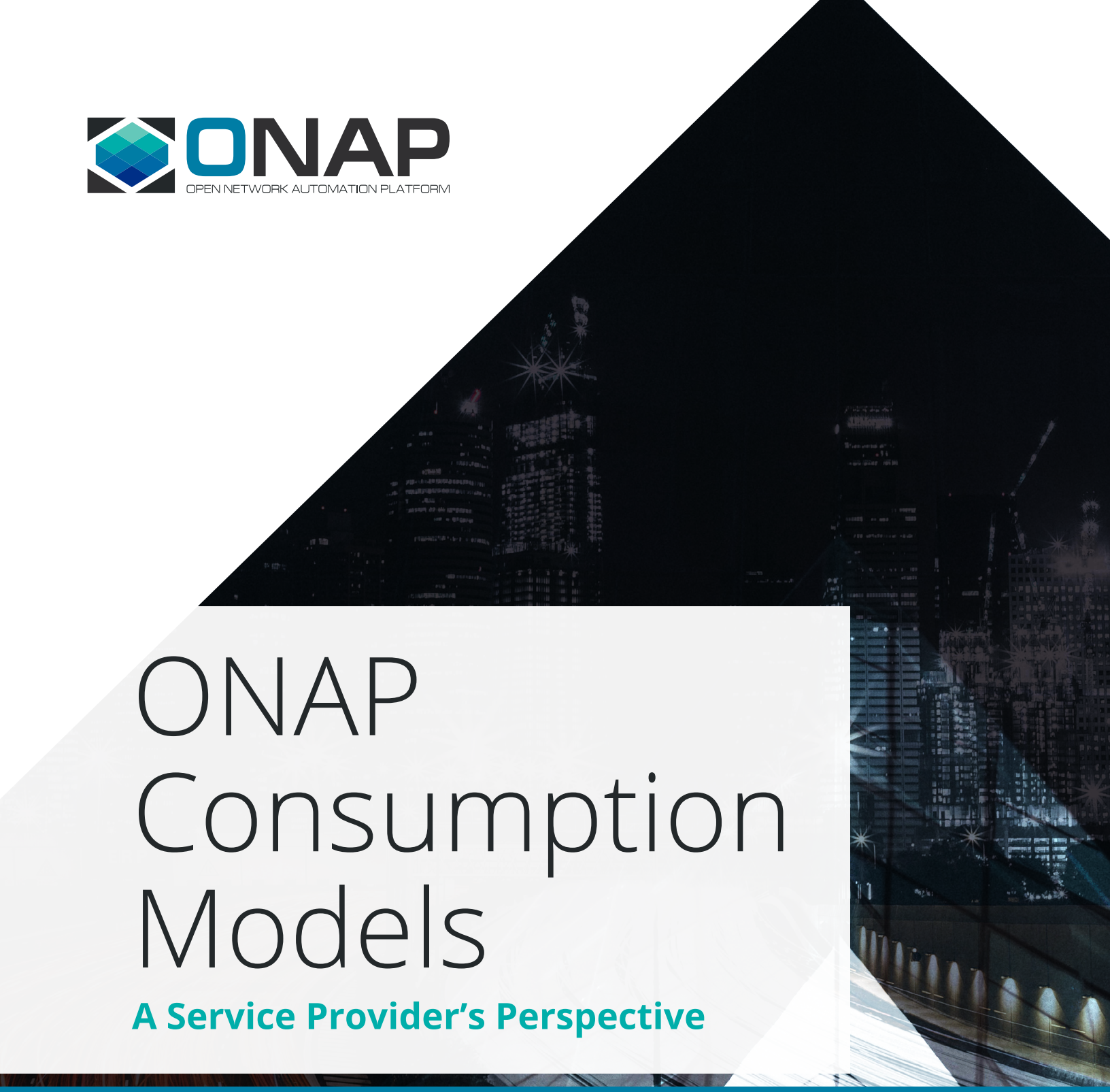

ONAP Consumption Models

A Service Provider's Perspective

By LFN End User Advisory Group (EUAG)

June 2020

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Introduction

Open source projects are a powerful way to crowd-source, co-create, and evolve consensus on emerging technology areas. For clarity, open source software is a software for which the source code is publicly available, or is open for others to consume, if they comply with the relevant licence and consumption obligations.

For Communications Service Providers (CSPs), the choice of software often comes down to the two options below or a combination thereof.

Proprietary Software or **Open Source Software**

CSPs see them differently, mainly on around the following points:

- **Underpinning functionality and technology** vs. **service and support wrap**
- **Exposure** to a vendor vs. a community collaboration
- **Thought leadership** of a vendor vs. **Collective Intelligence** of the Industry, or a de-facto standardization
- **Pace** and a say in feature development & evolution
- Ability to influence or inputs into **roadmaps and plans**
- **Capex vs. Opex** (Note: Open Source ≠ Free/Cheap)
- And many more…

There have been a number of comparisons and studies done on the different approaches that vendors and open source communities take; however, there is not a lot of information readily available around how should CSPs make themselves ready for consuming an extensive project like Open Networking Automation Platform (ONAP). There have not been that many open source programs in our collective history, to the scale and nature of the likes of ONAP.

This paper attempts to cast light on consumption aspects of ONAP—what are the challenges, key considerations, models and references—as well as the opportunities for CSPs looking at projects like ONAP.

The End User Advisory Group (EUAG) was created by LF Networking (LFN) to share views, challenges, and best practices between user organizations; highlighting new areas of opportunity

for the developer community. EUAG is made of individuals from end user organizations, including telecommunications carriers, cable companies, network providers, and compute or storage service providers. In this paper we broadly refer to this group as CSPs.

As the voice of end user, the EUAG supports the vision of ONAP and its adoption in the industry as well as contributes use cases and requirements to the project that deliver maximum value to the industry as a whole.

The EUAG's ONAP working group is the author of this paper, sharing views on the most important considerations, opportunities, and impediments towards a seamless end user adoption of ONAP.

2. Purpose of This White Paper

We are increasingly living in a "Now Economy," everyone expects everything to be instant and in real time. Delays and long turn-around times are increasingly becoming bottlenecks for a seamless digital experience for consumers. Agility with nimbleness, and efficiency with speed, which are required for disruptive digitization, ultimately enable a smart society across a wide range of verticals including health, education, tourism, scientific and technology research, and more. Considering the importance and value derived from infrastructure modernization, CSPs are undergoing major transformation programs embracing Cloud, deploying NFV and SDN, and are on a journey towards launching 5G. These new initiatives are impacting technical architectures and creating new business models and services which a DSP (digital service provider) needs to meet the demands of "Now Economy" consumers.

Network providers are adopting the technologies and methodologies that web-scale companies have used to make their operations more flexible and efficient. The CSPs are evolving these new capabilities to fit the demands of a large network infrastructure that needs to be highly resilient and incorporate multiple data centers that span vast areas of geography. Delivering excellent customer experience while becoming more efficient and ultimately making the network transparent to users and consumers is key. Technology and infrastructure modernization have gravitated from hardware towards software and this points the needle towards the "**As a Service**" construct. The software-based model evolves the platform concepts of service design, deployment, and management towards a new agile paradigm, which promptly reacts to customer needs on while optimizing costs.

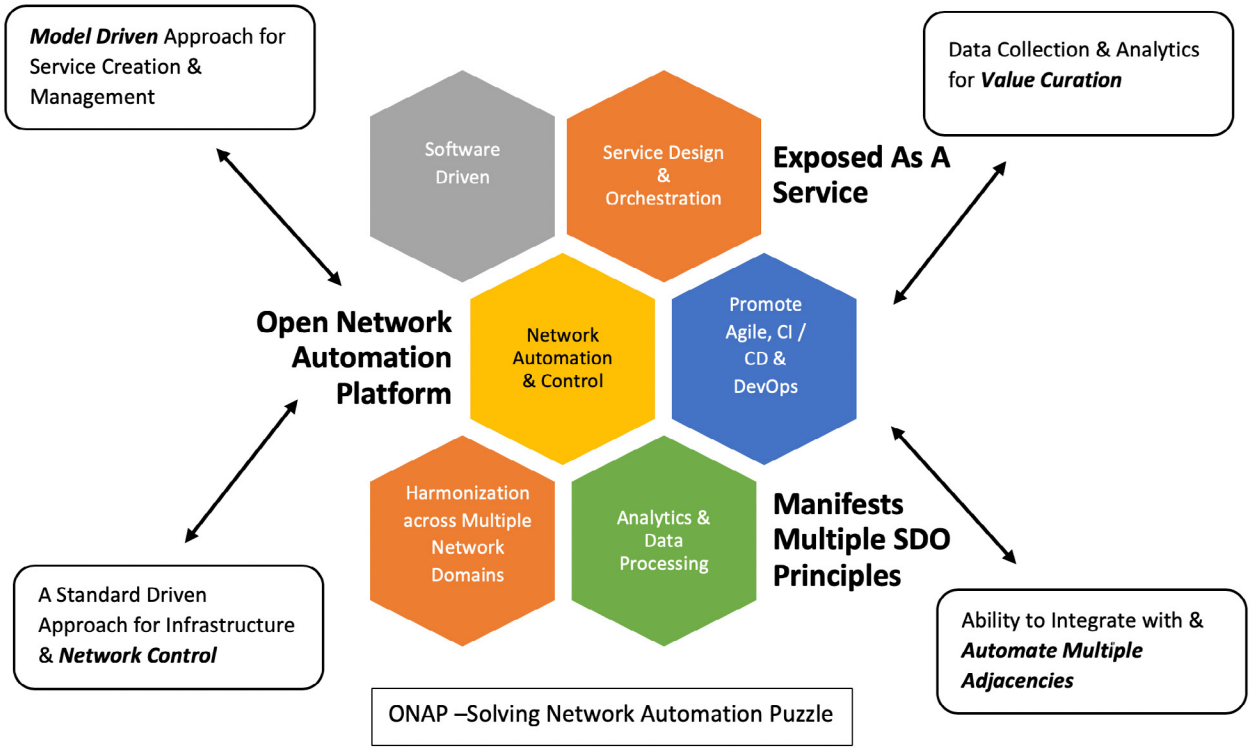
A platform that is based on open standards and is completely software driven. Such a platform will have certain key features (to list a few):

- ✓ **As a Service Exposure – API Driven,**
- ✓ **Service Orchestration – Intent Based Workflows,**

- ✓ **Template Based Service Design – Design Time Excellence,**
- ✓ **Data Analytics – Enable New Use Cases,**
- ✓ **Network and Application Controllers – Automation of Core Network Elements,**
- ✓ **Operational Tools – Ease of Operating Networks of the Future**

Availability of such a platform helps communication providers with their required business transformation and to address the operational pain points of coordinating and automating management of cloud, networking, and application workloads in both physical and virtual environments.

When the communications industry embarked on its journey towards this transformation, there was broad industry consensus on open source principles to deliver increasing value. However, it is also a reality that the presence of so many open source initiatives in each domain makes it difficult to properly evaluate and benchmark vendor products and select carrier-grade and cloud native solutions. ONAP aims to complement efforts by various standards organizations (e.g. ETSI - MANO, ZSM, MEC; 3GPP - 4G, 5G, Radio; MEF, TMForum); as well as other open source initiatives like the OPNFV Verification Program (OVP) as well as others to accelerate market adoption and provide feedback to those organizations. ONAP combines innate SDOs knowledge and experience with the collaborative innovation and openness offered by open source projects. There is also a concurrent deepening of collaboration in SDN/NFV standards/open source communities, and this harmonization effort is paving the way towards software driven networking innovation.



Over last three years, the LFN Community has been building ONAP release by release, with direct participation from many CSPs along with crowd sourcing from many vendors contributors and other community members.

Primarily, ONAP's development is focused on these areas:

- **Technical Robustness** of the Platform & Use of Modern Software Development Practices
- **Functional Maturity** of the Platform, Primarily Encompassing Network Automation Scenario / Journeys Supported for As Many Domains as Possible
- **Operational Readiness** of the Platform, Aligning with Future of Networks & How to Operate Them

As the ONAP platform has evolved and matured, there's an opportunity for greater adoption by across the CSP landscape. **The purpose of this paper is to help provide guidance to CSPs who are considering adopting ONAP.** There are several ways in which ONAP can be consumed (i.e., should it be a system integrator led activity or should an in-house software development team be created or or are there other models that should be evaluated). For the scope of this paper, the focus will be on the CSP's point of view, and which factors they should consider when adopting ONAP and choosing a consumption model.

As part of this exercise, the LFN EUAG undertook a comprehensive CSP survey focussed on the CSP approach to ONAP and this white paper has curated the results to create a general overview of ONAP consumption models.

3. Options and Analysis of Consumption Models

The future services of a digital CSP will be very different from those existing today. Understanding of those requirements are fundamental to enable service providers and businesses to develop, deploy, and scale next-generation networks and services. Future services delivery must be automated, flexible, and reliable that can scale massively without any coupling with the underlying infrastructure. It is for these reasons that ONAP has gained significant traction in the recent years delivering value to end users through service delivery simplification, cost reduction, and agile services creation. CSPs and other active members of ONAP project are now experiencing and learning to use and integrate ONAP in their existing environments.

Physical, virtual, and cloud native networks will need to coexist for the foreseeable future. Key services need to be created across modern and legacy networks, so ONAP has to be able to interoperate with legacy network, EMS / NMS, OSS / BSS systems to deploy services across the

hybrid networks while also utilizing private and public cloud capabilities. Starting from key use cases to deliver prompt value, ONAP ultimate goal is to act as an end-to-end global service management platform to design and deliver services and to operate a hybrid network across data centres in an efficient manner.

There are multiple aspects that CSPs should consider while deciding to integrate ONAP into their existing environments. Some of these considerations are:

- ✓ Integrated solutions with carrier-grade versions of individual ONAP modules
- ✓ Service models, applications, and micro-services built to run in ONAP environments
- ✓ Compliant networking infrastructure (physical/virtual), including PNFs, VNFs, domain controllers, etc. that can plug into ONAP
- ✓ Operational changes which are required to run and manage ONAP
- ✓ Set of developers, testers and designers required to deliver and operate services though ONAP
- ✓ Ensuring ONAP is a secure product by design and striking a fine balance between services they want on ONAP while keeping ONAP on the current version of release
- ✓ and many other such considerations

It can be complex to introduce ONAP into an existing service provider environment. The challenge will not be just to manage this incremental shift towards adopting ONAP components, but also in having them co-exist with existing management systems. The ONAP framework is reusable and its capabilities for management and operations, automation, AI/ML, adaptive policy, information models, and service orchestration. These are candidates for future use in service models and use cases which can enable other industry verticals as well.

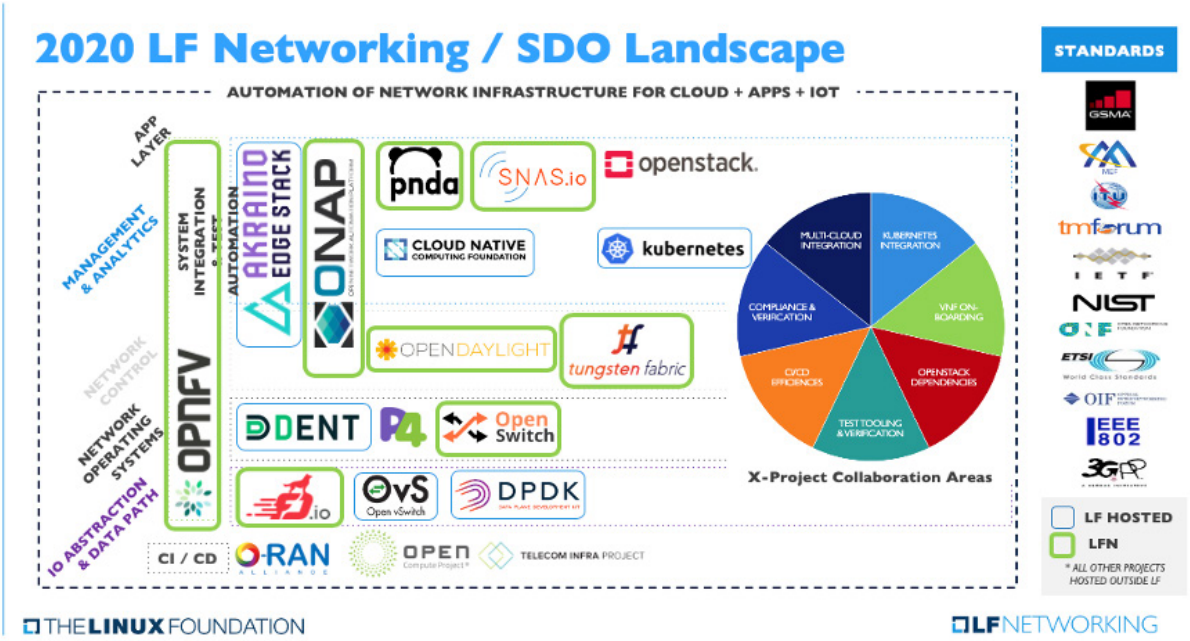
ONAP is a modular project that meets the requirements of many CSPs (especially in brownfield situations, which many of the providers are in) that have in their networks a high level of legacy and industry standard dependencies. Imagining various service providers'starting points, if we can define ONAP's evolution to address this integration conundrum, this should address inter-operability across EMS, NMS, OSS as well as the BSS; and this is the path of least resistance to increase the adoption and presence of ONAP platform. We think a series of artefacts showing possible integration scenarios and patterns assuming various external / existing systems in a typical service provider domain will provide confidence and a suggested way to proceed.

ONAP and SDO Alignment

Several CSPs have a strong dependency on standard solutions and it is usually a common strategy for a collaborative network (e.g., 3GPP compliant solutions or GSMA aligned specifications). SDOs can assist with architecture, quality, and interoperability of open source projects, as well as enhance the overall vitality of the mobile value chain.

A recent ONAP whitepaper[1] on harmonizing open source and standards makes a case for solving core technical issues and presents a vision of 5G slicing with ONAP.

The ONAP community is aware of the importance of this collaboration and works diligently to maintain alignment and coordination. Indeed, the following diagram developed by LFN provides an overview of current landscape and relationship among open source projects and SDOs:



ONAP is a framework, which can work as a deployable platform or as a reference framework because it highlights the best developmental capabilities of all relevant SDOs. Following this two-pronged approach may be the best direction for a symbiotic future and will enable the industry to select and combine different solutions and modules from different vendors aligned to the ONAP framework achieving agility, efficiency and robustness required for service management of future network services.

Quick wins and Commercial Models for ONAP

As is the case with all new technology adoption, the community is defining the minimum viable product for ONAP as a deployable solution to drive a positive business case. This will allow different adoption levels for ONAP based on the CSP's organization maturity and business drivers for transformation. Defining the phases of ONAP adoption is vital for a CSP. The ONAP EUAG community believes a tiered approach could be a good start. Below are a few things to consider:

1 Harmonizing Open Source and Standards: A Case for 5G Slicing:
https://www.onap.org/wp-content/uploads/sites/20/2020/03/ONAP_HarmonizingOpenSourceStandards_031520.pdf

a. Start the journey from the bottom up to solve integration and interworking issues of south bound and NE's with ONAP first—how and what can be integrated with ONAP

b. Followed by a "Service Management" initiative to orchestrate and deliver model driven services and

c. For exponential value creation, CSPs should look at operational efficiency combined with ML and AI in their domains and ultimately closing the loop

A project like ONAP can be "consumed" within a CSP in multiple ways:

a. **"Complete Autonomy Model":** Build software & domain competency and deliver ONAP in-house

b. **"Complete Out-Sourcing Model":** Engage with a system integrator / principal who can do it for the CSP

c. **"Semi Out-Sourcing Model":** Look for licensed, professionally supported distribution of ONAP

d. **"Standards-based Reference Implementation":** Look at ONAP as a reference implementation, and choose a partner / vendor which does similar or all of the same functionalities

Below table provides certain arguments of each model stated above:

ONAP Consumption Model	Perceived Positives	Perceived Challenges	Some Examples
"Complete Autonomy Model" Build software & domain competency & deliver ONAP in-house	• CSPs are in complete control of the code • If ONAP out of the box functionality is not suited, CSPs can customize / enhance / change it • CSPs becomes more open source software culture oriented • CSPs will have to be much more involved in forum & exchange of information, contributions, involvements increase	• Identifying software capabilities & building teams takes time & effort • Mind sets need to evolve • Operating model (in fact, entire organizational construct) needs alignment to open source software way of thinking, which may be challenging	Early CSP Adoptions of ONAP are in AT&T, Bell Canada, Orange and it is an evolving list

ONAP Consumption Model	Perceived Positives	Perceived Challenges	Some Examples
"Complete Out-Sourcing Model" Engage with a System Integrator / Principal Vendor who can do it for them	• This is an outsourced model, where an identified System Integrator / Principal Vendor takes the ownership of development, testing & deployment. CSPs are still in control, but are doing it in a "Delegated" mode • Risk of delivery problems reduces, since professional System Integrators / Principal Vendors do "Delivery" for a living, they are more mature by design	• CSPs have to keep track of changes, identify possible enhancements, requirements and get them delivered via identified System Integrator / Principal Vendor • Complacency may creep in if the "Delegated" partners are doing most of the heavy lifting—CSPs may become too dependent	Early System Integrators out in ONAP's support are likes of Amdocs, Accenture and the list is evolving
"Semi Out-Sourcing Model" Look for professionally supported distribution of ONAP	• Similar to OpenStack distributions which are out there, ONAP can potentially have "Distro" professional outfits who would provide a hardened (tested, fit for purpose) and well-maintained software asset which can then be: • Developed in house, or • An external System Integrator / Principal Vendor can do it for CSPs, or • The "Distro" providing professional outfit can do it as part of their "Professional" services • Onus of keeping up with community workings, bug fixes in "Productized" version of ONAP, etc. can be taken care by "Distribution" Providing Professional Outfit	• If chosen delivery option is not the same as the professional outfit, friction in delivery may creep in, managing multiple teams may provide a little challenging • Wholesome commitment of professional outfit to ONAP may need some monitoring and constant alignment	An initial distro option is Aarna Networks and the list is poised to grow

ONAP Consumption Model	Perceived Positives	Perceived Challenges	Some Examples
"Standards-based Reference Implementation" Look at ONAP as a reference implementation, and choose a partner/ vendor which does similar or all of the same functionalities	• There are multiple SDOs that ONAP adheres to, e.g. TMF, 3GPP, ETSI, GSMA etc., this model absolves CSPs from asking a la-carte SDO compliance to vendors while choosing their products; and instead places ONAP as a referenceable architecture (and for compliance) in front of vendors and get a product that best complies to standards • Depending on the chosen vendor, strengths of the vendor and upkeep of the application is completely owned by the vendor	• Software culture needs to be more closely monitored • Dependency on vendor still high, it may not be a challenge in all cases and may turn out to be a strength depending on an individual CSP's strategy	Many CSPs are ow quoting ONAP compliance while selecting automation & service management platforms. Note: This saves them from quoting compliance to multiple SDOs and provides a common interpretation of compliance & code quality.

4. ONAP CSP Survey & Key Findings

In Q1 of CY 2020, the LFN EUAG undertook a comprehensive survey to better understand its members' status and plans for deploying ONAP within their networks. The questionnaire contained 15 questions covering:

a. Deploying ONAP

b. Community Participation

c. Interoperability

d. ONAP Use Cases / Service Scenarios

e. Traditional OSS / Other systems integration with ONAP

The questions were around common themes that CSPs should generally consider while developing plans to consume ONAP. The survey results provide a snapshot of the current state of ONAP adoption, the patterns CSPs have (or plan to) follow for their ONAP deployments, as well as the current and planned use cases / service scenarios that CSPs are considering. The results include feedback from both CSPs who have already adopted ONAP in production as well as those who are still in the process of developing their adoption plans.

Key Findings

1. ONAP Consumption and Deployment – Status & Future

a. ~45% of CSPs responding indicated that ONAP is already in production or have current plans to put ONAP into production within a year.

b. Another 36% of survey respondents are currently conducting lab evaluations or plan to begin lab evaluation of ONAP

c. No CSPs responded that they do not plan to adopt ONAP in production or the lab within the next year while 18% of CSPs were not sure or were unable to share a response.

Approximately 80% of the responding CSPs have said they range from having a deployed version of ONAP in production to they have plans to begin lab evaluations of ONAP and no one has said they are not planning to adopt ONAP. This shows that among the LFN EUAG members who responded, ONAP is clearly a part of their network plans, with CSPs taking material steps to increase the level of ONAP adoption in the near term.

"While nearly half of CSPs surveyed have concrete plans to adopt ONAP in production, there are several continuing to evaluate in the lab. The EUAG recommends that the ONAP community explore whether there are specific focus areas (e.g., further simplifying deployment, improving quality, etc.) that could increase adoption in production. To further accelerate the adoption of ONAP, EUAG should further explore what is hampering CSPs efforts in deploying ONAP."

2. For CSPs who are consuming and have plans for deployment, what components of ONAP are they planning to use

a. 9% of the CSPs are planning to deploy a complete and common ONAP-based platform for all the service scenarios

b. The majority (55%) plan to introduce mature ONAP components (e.g., APP-C, DCAE, SO, etc…) one-by-one on a per application scenario basis (means use case like CCVPN, VoLTE, etc.), with special focus on interoperability between newly introduced components and existing OSS

c. Another 9% planned to rebuild a common network management architecture independent of the service scenarios in future and introduce partial mature components from the ONAP community as required

d. Another 27% had uncertain plans or were otherwise not able to share a response

"Further study could be undertaken to determine what is propelling uptake of certain ONAP modules and which use cases prompt deployment of which ONAP modules—this would provide very useful information for other communities on prioritization & improvements."

3. What ONAP consumption model are CSPs planning on

With respect to CSP's ONAP adoption plans, each operator had different consumption models and strategies, each of them with its own advantages and unique features that are most suitable to their specific circumstances. The LFN EUAG has classified these approaches into four basic types (there are multiple models beyond the survey responses):

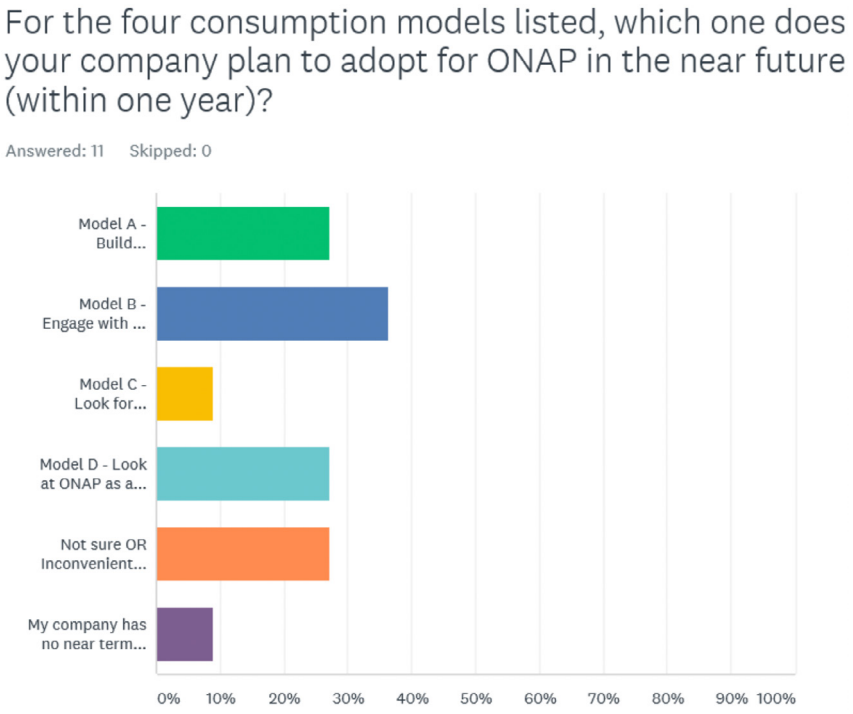
- Complete Autonomy Model
- Complete Out-Sourcing Model
- Semi Out-Sourcing Model and
- Standard-based Reference Model

a. **Complete Autonomy Model:** Build competency and deliver ONAP in-house, in which the CSP conducts product-based R&D based on community code for its own production adoption, 27% of CSP respondents choose to adopt this model.

b. **Complete Out-Sourcing Model:** Engage with a System Integrator / Principal Vendor who can do it for them, in which an identified System Integrator / Principal Vendor takes the ownership of development, testing and deployment. CSPs are still in control but are doing it in a "Delegated" mode, which accounts for 36% of CSP respondents.

c. **Semi Out-Sourcing Model:** Look for distribution by professional outfits, in which the CSP purchases an open source service provider's community-based product support service along with the distribution, which accounts for 9% of CSPs surveyed.

d. **A Standards-based Reference Model:** Look at ONAP as a reference implementation, and choose a partner/vendor which does similar or all of the same functionalities, in which the CSP refers to the open source architecture and implementation specifications, and purchases compliant software products from vendors, accounting for 27% of the surveyed CSPs.



Key point to note from survey:

- ~27% of respondents were not sure of their plans or were otherwise unable to share
- ~9% indicated no near-term plans to adopt ONAP

The feedback from the survey shows an equal split across the consumption model choices. Approximately a third favour a "Complete Out-Sourcing Model", while about a quarter are planning on the "Complete Autonomy Model" and "The Standards Reference Model" respectively. An interesting observation here is that the CSPs are almost equally split amongst the very different models. This shows that ONAP can be used "In House" but there is also enough interest in ONAP to create a support community of vendors that will assist CSPs. This should allay any inhibitions that vendor community may have on ONAP.

"To serve the widest set of CSP deployment plans, the LFN EUAG recommends that the ONAP community should enable all of these consumption models.".

4. What deployment patterns do CSPs plan to follow

There are different deployment patterns for deploying ONAP. For this survey, the LFN EUAG has defined the following three basic deployment patterns:

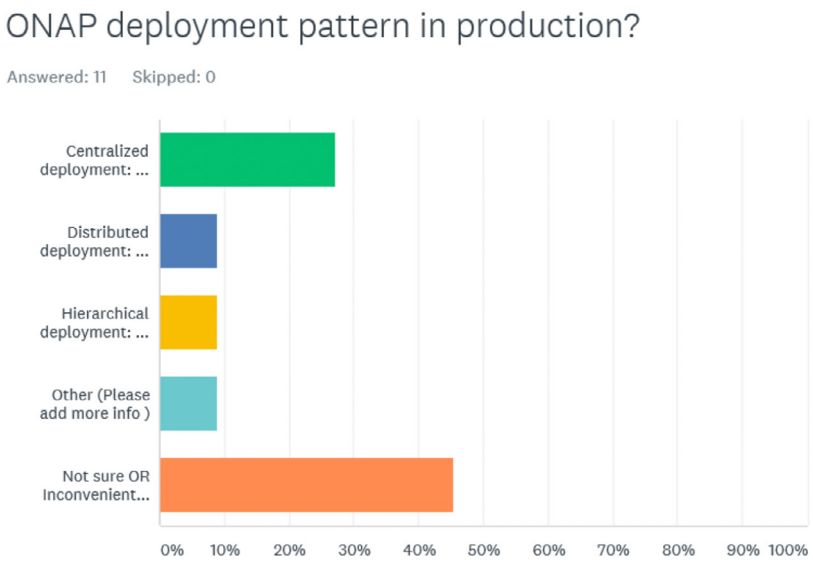
a. Centralized Deployment: One logical copy of ONAP for the entire network, which accounts for 27% CSPs in the survey results.

b. Distributed Deployment: One logical copy of ONAP for each managed domain or network domain, 9% CSPs choose this pattern.

c. Hierarchical Deployment: One logical copy of ONAP for each geographical area, under the supervision of another upper-layer ONAP, which is responsible for end-to-end service provisioning and communication with traditional OSS, which accounts for 9% of surveyed CSPs.

~45% of CSPs said they were uncertain or were otherwise unable to respond to this question.

"While the centralized deployment pattern received the most responses, given the variation and lack of clear feedback, the ONAP community should provide a flexible and decoupled architecture that allows CSPs to choose different deployment patterns."



5. How do CSPs collaborate with vendors for design, development, and deployment

a. 9% of CSPs who responded indicated that an In-house team is responsible for design, development, deployment, testing, and operation of ONAP

b. 27% of respondents indicated that CSPs and vendors collaborate in design, development, and testing, while the CSP is responsible for deployment and operation

c. 36% of respondents indicated that CSPs publishes their own requirements specifications (e.g. technical architecture, functional requirements, interface protocols, information models etc...) for procurement from vendors, with consideration on community adoption/ compliance and the CSP is responsible for test, deployment and operation

d. 18% of respondents indicated that CSPs publishes their own requirement specifications (e.g. technical architecture, functional requirements, interface protocols, information models etc…) for procurement from vendors, without consideration of community adoption or compliance. Here the CSP is responsible for test, deployment, and operation.

e. CSPs publish their own requirement specifications (e.g. technical architecture, functional requirements, interface protocols, information models etc.) for procurement from vendors, without consideration of community adoption or compliance. CSPs are responsible for test, deployment and operation, accounting for 18% of respondents.

f. Not sure or Inconvenient to disclose represent 9% of respondents.

The CSPs participating in ONAP's development, deployment, operation, and testing accounts for more than 90% of total surveyed, and most of them are at least involved in the deployment, operation, and testing processes.

"Community may undertake creation of a consumption model vs. deployment model matrix; along with statistics & patterns for various activities done by participating CSP, vendors / system integrators; which could be a community asset for CSP end users for reference while deciding on ONAP adoption approach."

6. What services do CSPs use/plan to use ONAP to support

For different consumption models and deployment patterns, CSPs who are deploying ONAP have several service scenarios / use cases that they are focussing on.

Use Case / Service Scenarios	Deployment proportion in production	Proportion of future proposed services	Service maturity index (% of services in production divided by % of future proposed services)
Transport VPN	18%	45%	40%
Wireline Layer1-3	27%	55%	50%
L3VPN	9%	18%	50%
SD-CPE (uCPE)	9%	18%	50%
Mobility	36%	65%	57%
SD-WAN	27%	45%	60%

Use Case / Service Scenarios	Deployment proportion in production	Proportion of future proposed services	Service maturity index (% of services in production divided by % of future proposed services)
Voice	27%	36%	75%
Security	9%	9%	100%
L2VPN	9%	9%	100%

In the above list, the service maturity index reflects the maturity extent of the current services. Note: the Maturity Index is the proportion of serives in production divided by the proportion of future propsed services. The services with lower index maturity have greater potential for automation, and the services with higher index maturity have relatively less automation elbowroom. From the perspective of different services and their maturity, the more mature services are Security and L2VPN; while SD-WAN, uCPE, Voice and Mobility have some maturity in deployment, although many CSPs will still put more efforts on these services in future. Overall deployment in production is relatively immature; services with higher potential for future automation include Transport VPN, Wireline Layer1-3, L3VPN, and SD-CPE. Transport VPN has the lowest maturity, so ONAP community could focus more on deployment methods for this type of service in future. Wireline Layer1-3 has lower maturity compared with some other services. Although it has the same maturity as the other two types of services (L3VPN, SD-CPE), its future focus index is reaching 54%, which is relatively high, and that would mean these could be important focus areas for ONAP community.

"The EUAG did the survey with a limited set of services / use cases presented to CSPs and some open-ended questions on this area. The current CSPs' focus seems to suggest a propensity towards newer services, which has more scope for automation, which ONAP has to offer. The EUAG believes that ONAP has to evolve to a platform where it can act as an enabler for future services, even for services or use cases that are yet to evolve."

7. ONAP and Integration with Existing OSS

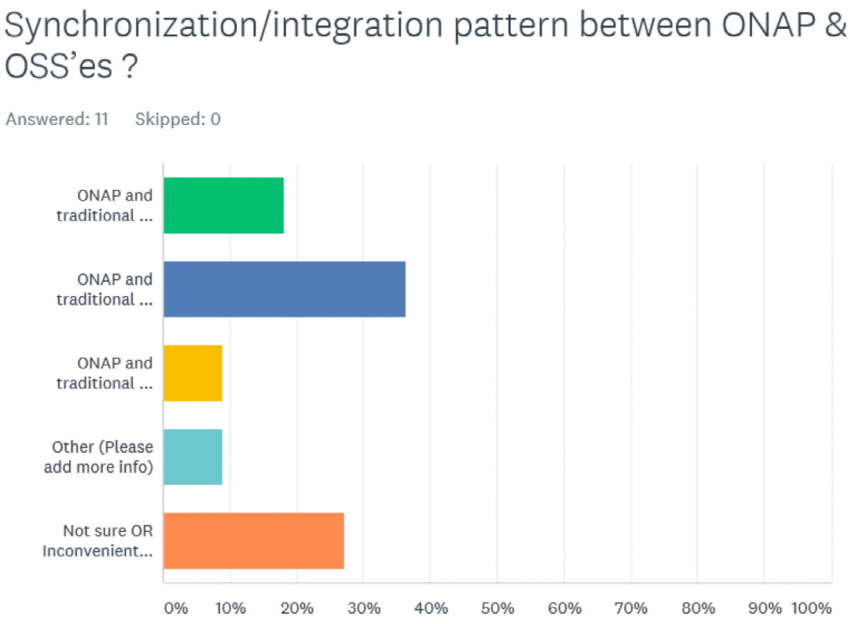
For ONAP based service scenarios and use cases, for existing network elements (NE) and new NE management methods, 18% of CSPs said that ONAP would only manage and deploy new NE, and more than 80% of CSPs indicate that ONAP will manage both existing and new NE. For different types of network elements management methods, more than 90% of CSPs said that their ONAP platform deployment would be integrated with their existing OSS, and 9% of CSPs said they were not sure whether they would adopt an integration approach to manage different types of network elements.

For different types of NE management methods, most CSPs indicated that they would choose to integrate ONAP with the existing OSS system, which is realistic to protect and leverage their investments. For CSPs who have chosen to integrate with existing OSS, the current integration patterns include the following:

a. ONAP and traditional OSS manage different management objects, are constructed separately, operate independently of each other, are responsible for end-to-end service provisioning and alarm performance monitoring respectively. 18% of CSPs respondents chose this method.

b. ONAP and traditional OSS manage different entities, are built separately, while ONAP is responsible for directly managing new network elements and providing unified information to traditional OSS for end-to-end service provisioning. This accounts for 36% responses.

c. ONAP and traditional OSS manage different management objects, are built separately, while OSS is responsible for directly managing traditional network elements and providing unified information to ONAP for end-to-end service provisioning, which accounts for 9% responses.



In addition, 9% of CSPs said that they would decide different integration methods based on different situations and use cases, instead of using a single integration solution; some CSPs have expressed uncertainty about the current integration methods or are unwilling to discuss. CSPs who are not sure or willing about the integration account for 27% of respondents.

The feedback of integration patterns is relatively scattered. Each type of pattern has more than one operator's preference. Among them, the solution that ONAP will be responsible for directly managing—new network elements and providing unified information to traditional OSS for end-to-end service provisioning—is a common integration solution commonly referenced by many CSPs.

"The EUAG survey has stated the obvious, CSPs are unclear about how to protect their existing investments in existing OSS as in some cases there is duplicity in functionality provided by ONAP and OSS. A key aspect that the ONAP community must ensure is how various southbound and northbound integrations can work. Additionally, on a best effort basis, a series of artefacts explaining a few OSS functions & how can ONAP play an integrated value-added role would be useful."

8. Organizational Models

There are different models for CSPs to organize their working teams who are involved in ONAP. This survey defined 3 basic working models for the CSP in-house teams: A) independent model, B) loosely coupled model and C) tightly coupled model.

a. The Independent model means the operator's internal community and product teams, as well as operation teams, are independent from each other with no internal regular communication and common planning;

b. While in loosely coupled model, community and product teams, as well as operation teams, are independent from each other, but have internal regular communication and coordinated planning;

c. In the tightly coupled model, community, product, as well as operations teams are all part of a single working group, or internal organization, that make plans collaboratively.

In the survey results, nearly half (45%) of CSPs have adopted the loosely coupled model, which accounted for the largest proportion; the independent model and tightly coupled model accounts for 9% each respectively. The remaining 36% were not sure or could otherwise not share a response.

"This point does not directly translate into a recommendation; rather, this it clearly shows that the ONAP community has a very

important responsibility to help CSPs adopt the most suitable model that works for them—none of which can be singled out as the best or worst. Ultimately, each CSP has to work in their own model with as much support that ONAP the community can extend."

9. For what Network Function Operations will CSPs use ONAP?

There are many ways to use ONAP and not all CSPs plan to use it for all the types of operations that it supports. The survey calls out six major types of operations that it can provide and asks CSPs what they are currently using and what they plan to use in the future. The results are show in the table below.

Network Function Operation Type	Currently Using	Plan to use
NF Instantiation	45%	82%
NF Configuration	45%	82%
NF Change Management	27%	45%
NF Monitoring	36%	63%
NF Control Loop	36%	55%
Other/None (Not in production)	55%	36%

The responses to these questions are fairly balanced overall, but the results suggest the CSPs that are using or plan to use ONAP in production more are interested in the Service Delivery (instantiation, configuration) aspects than the service assurance (monitoring, control loop) capabilities provided by ONAP.

"CSPs are currently using or planning to utilize the full range of ONAP service delivery and service assurance capabilities for network functions with, at least initially, somewhat more focus on Service Delivery aspects."

5. Conclusion, Recommendations and Observations

As is evident from the paper and the output of the survey on ONAP consumption models and the ecosystem surrounding adoption of ONAP, this is clearly not an easy topic. There is no single and correct answer to the challenge of choosing a right consumption model. There are several choices and dependencies, each with different trade-offs, and what works and is most suitable for one CSP may be vastly different for another CSP.

As can be seen from divergences in the survey answers, there is a lot of fragmentation in the vision from various CSPs, it is perhaps because most of them are in the early stages of deployment. The way the questions were designed, they were representing a mix between current to short term and medium to long-term perspectives for different questions.

The LFN EUAG has multiple recommendations and observations that has come out from this survey, which are summarized in the table below.

Survey Topic	Observation / Recommendation
ONAP Consumption and Deployment: Status and Future	While nearly half of CSPs surveyed have concrete plans to adopt ONAP in production, there are several continuing to evaluate in the lab. The EUAG recommends that the ONAP community explore whether there are specific focus areas (e.g., further simplifying deployment, improving quality, etc.) that could increase adoption in production. To further accelerate the adoption of ONAP, the EUAG should further explore what is hampering CSP efforts in deploying ONAP.
For CSPs who are consuming and have plans for deployment, what components of ONAP are they planning to use	Further study could be undertaken to determine what is propelling uptake of certain ONAP modules and which use cases prompt deployment of which ONAP modules. This would provide very useful information for other communities on prioritization and improvements.
What ONAP consumption model are CSPs planning on	To serve the widest set of CSP deployment plans, the LFN EUAG recommends that the ONAP community should enable all of these consumption models.
What deployment patterns do CSPs plan to follow	While the centralized deployment pattern received the most responses, given the variation and lack of clear feedback, the ONAP community should provide a flexible and decoupled architecture that allows CSPs to choose different deployment patterns.
How do CSPs collaborate with vendors for design, development, and deployment?	The community may undertake creation of a consumption model vs. deployment model matrix; along with statistics and patterns for various activities done by participating CSPs, vendors, and system integrators; which could be a community asset for CSP end users for reference while deciding on their ONAP adoption approach.

Survey Topic	Observation / Recommendation
What services do CSPs use or plan to use ONAP to support	The EUAG survey contained a limited set of services / use cases and select open ended questions put in front of CSPs whose focus seems to suggest a propensity towards newer services, which have more scope for automation. The EUAG believes that ONAP has to evolve to a platform where it can act as an enabler for future services, even for services or use cases that are still evolving.
ONAP and Integration with Existing OSS	The EUAG survey has stated highlighted that CSPs are unclear about how to protect their existing investments in existing OSS as in some cases there is duplicity in functionality provided by ONAP and OSS. Key aspect that ONAP community must ensure is how various southbound and northbound integrations can work. Additionally, on a best effort basis, a series of artefacts explaining a few OSS functions & how can ONAP play an integrated value adding role would be useful.
Organizational Models	This point does not directly translate into a recommendation; rather, it clearly shows that the ONAP community has a very important responsibility to help on multiple fronts. As stated in above sections, to help CSPs adopt the most suitable model that works for them—none of which can be singled out as the best or worst. Each CSP has to work in their own module with ONAP community support.
For what Network Function Operations will CSPs use ONAP?	CSPs are currently using or planning to utilize the full range of ONAP service delivery and service assurance capabilities for network functions with, at least initially, somewhat more focus on Service Delivery aspects.

Appendix: Examples of Similar Initiatives

ONAP has no direct parallel as such, but if when mapping the project categories to a number of other open source initiatives, they would most likely fall in the following area:

a. **Network Automation Focused Projects** (Example - Open Daylight / Tungsten Fabric / Open Stack / OSM and more)

b. **Network Analytics and Data Focussed Projects** (Example - PNDA / SNAS / Open Source Solutions from Hyper-Scalers, and more)

ONAP is a combination of both (a) and (b).

Network Automation Focused Projects			
openstack.	OPEN DAYLIGHT	tungsten fabric	Open Source MANO
OpenStack is a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter, all managed and provisioned through APIs with common authentication mechanisms. A dashboard is also available, giving administrators control while empowering their users to provision resources through a web interface. Beyond standard infrastructure-as-a-service functionality, additional components provide orchestration, fault management and service management amongst other services to ensure high availability of user applications. Learn More: www.openstack.org	OpenDaylight (ODL) is a modular open platform for customizing and automating networks of any size and scale. It was designed from the outset as a foundation for commercial solutions in existing network environments. ODL provides a flexible common platform underpinning a wide variety of applications and use cases. Learn More: opendaylight.org	Tungsten Fabric is an open source project built using standards-based protocols and provides all the necessary components for network virtualization and network security. Components of the project include an SDN controller, virtual router, analytics engine, published northbound APIs, hardware integration features, cloud orchestration software, and an extensive REST API. Learn More: tungsten.io	OSM is delivering an open source Management and Orchestration (MANO) stack aligned with ETSI NFV Information Models. As a community-led community, OSM offers a production-quality MANO stack that meets CSPs' requirements for commercial NFV deployments. Learn More: osm.etsi.org

Network Analytics Focused Projects		
pnda	SNAS.io	**Open Source Solutions from Hyper-Scalers**
PNDA is a Linux Foundation Networking (LFN) integration project that creates a best-in-class platform for big data analytics of network data. The PNDA community integrates select Apache Hadoop and other (non-Hadoop) open source projects to produce a tuned and tested platform with the necessary management tools and dashboards for production deployment. PNDA lets you shift your focus from creating a big data stack to building analytic applications. Learn More: pnda.io	The Streaming Network Analytics System (SNAS) project is a framework to collect, track and access tens of millions of routing objects (routers, peers, prefixes) in real time. It is an open platform for streaming, storing and providing live routing and load data to SDN and NFV applications. SNAS identifies changes, performs de-duplication and conditions the data to then allow users to interact, visualize and analyze BGP data. SNAS enables real-time predictions by combining streaming and stored aggregate data. Learn More: snas.io	Companies like Google, Amazon and Microsoft are excellent examples of how an organisation can use open source software and networking technologies to meet a diverse range of scalability and automation needs. Fortunately, the approaches they've used to achieve success also scale down, as well as up, and can be applied in an enterprise environment. The networks of the hyperscalers are highly automated and make extensive use of APIs. Their infrastructure and applications are deeply integrated, enabling not only the rapid and efficient scaling of their network infrastructure, but of the applications supported by that infrastructure. *Source: ITProPortal, Jan 31, 2020: How 'hyperscalers' – such as Google and Microsoft –are using Open Networking to scale in the enterprise:* www.itproportal.com/features/how-hyperscalers-such-as-google-and-microsoft-are-using-open-networking-to-scale-in-the-enterprise/

Credits

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Common Terms

LFN: Linux Foundation Networking

EUAG: End User Advisory Group

CSP: Communication Service Providers

DSP: Digital Service Provider

ETSI: European Telecommunication Standards Institute

MANO: Management & Orchestration

ZSM: Zero Touch Service Management (An ETSI initiative)

MEC: Mobile Edge Compute

3GPP: 3rd Generation Partnership Project

4G / 5G: 4th Generation Mobile System / 5th Generation Mobile System

MEF: Metro Ethernet ForumTMforum – Tele Management Forum

EMS / NMS: Element Management Systems / Network Management Systems

OSS / BSS: Operational Support Systems / Business Support Systems