Independent market research and competitive analysis of next-generation business and technology solutions for service providers and vendors

HEAVY READING

WHITE PAPER

An Open Path to Software-Driven Service on Demand

A Heavy Reading white paper produced for Fujitsu

FUJITSU

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OPERATOR REQUIREMENTS & CHALLENGES

Innovation in the cloud era has accelerated. Networks need to adapt quickly to changing capacity and applications demands. To be more competitive, network operators must be able to introduce services to market rapidly, and quickly remove them if they don't succeed – like the Webscale Internet providers do. Consumer and business customer requirements have also changed dramatically: Applications are hosted in the cloud, and customers require connectivity and network services on demand with a high quality of service.

In this environment, operators have clear network requirements, including:

- faster provisioning, deployment and upgradeability for network services;
- network and service flexibility to recognize and respond to changes in traffic and customer demands dynamically;
- unprecedented levels of interoperability across technologies, domains and carriers;
- lower total cost of ownership (TCO), including capex and opex contributions; and
- the ability to migrate to the future mode of operations (FMO) without stranding legacy networks and services.

This white paper provides a practical analysis of how network operators can address the challenges and demands posed by on-demand connectivity and services. The approach includes multi-domain and multi-vendor connectivity services that are delivered on demand, and enabled by automated, open interfaces and technologies. The analysis is anchored in the recent MEF17 Ethernet Services on Demand proof of concept (PoC) that was supported by AT&T, Orange and Colt, as well as multiple hardware and software suppliers.

PROMISE OF OPEN ARCHITECTURES IN ADDRESSING CHALLENGES

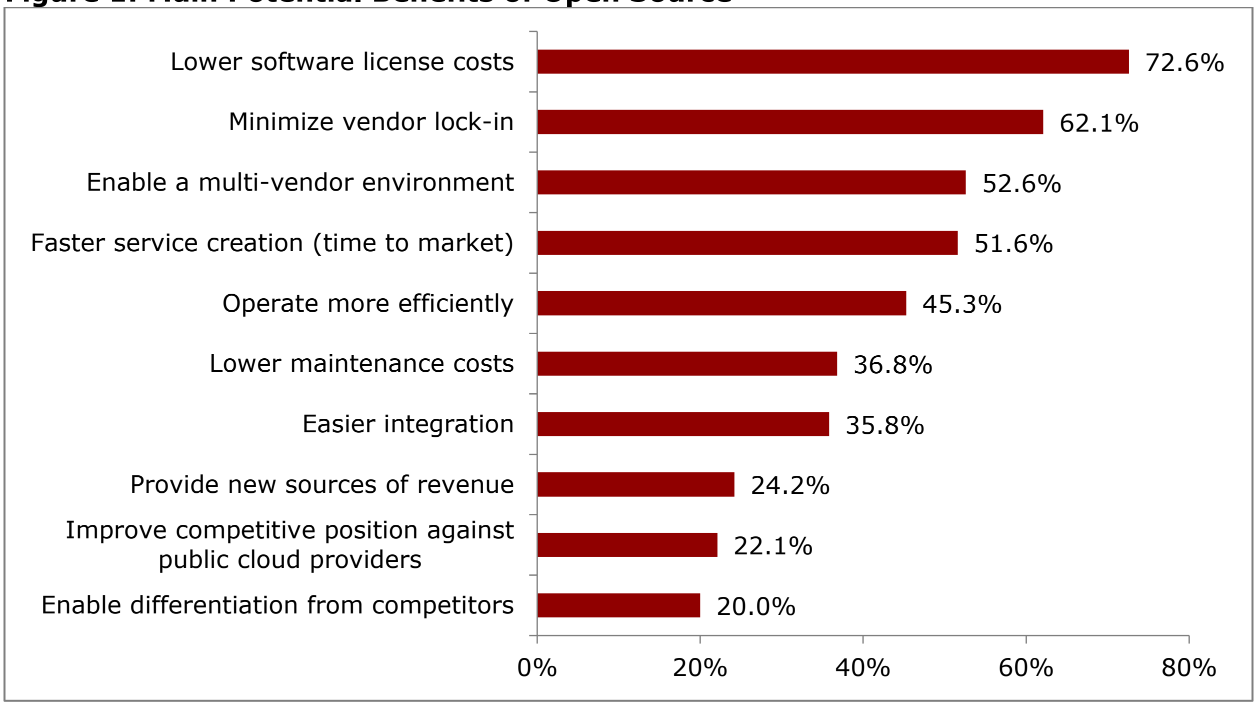
In the rapidly evolving and increasingly connected global operator environment, open architectures are needed more than ever before. Interoperability within an operator's network enables operators to break away from the individual vendor roadmaps and cycles. Building open interfaces across vendors, domains and network layers within an operator allows operators to advance their networks and processes more quickly and customize their network evolution to their specific market needs. More significantly, open interfaces pave the way for the automation of processes and interactions across vendors, domains and network layers that is essential for their success and survival.

The same values hold true as operators communicate with other network operators across geographies. Interoperability across business functions and service functions is required for on-demand services to extend from one operator to another. Standardized, open interfaces are the means to achieve this operator-to-operator interoperability in an on-demand world.

Rise of Open Source Contributions

Open source is rising as a key means of achieving openness at all levels. Significantly, operators increasingly view open source projects as a key means of achieving the interoperability benefits traditionally gained through consensus-driven standards organizations. In a 2017 Heavy Reading survey, operators reported the primary potential benefits of open source as lowering software license costs, minimizing vendor lock-in, enabling multi-vendor environments, and speeding service creation and time to market (see **Figure 1**). Excluding software license costs, the remaining top benefits are all benefits historically achieved through industry standardization.

Figure 1: Main Potential Benefits of Open Source



Source: Heavy Reading 2017 Open Source Survey; N=95

While it is early days, it should be clear to anyone that the telecom open source movement is not a fad. Prominent open source examples in telecom today include OpenStack, Open Platform for NFV (OPNFV), OpenDaylight, Open Network Automation Platform (ONAP), MEF Lifecycle Services Orchestration (LSO), Telecom Infra Project (TIP) and Open-RAN, among others. This paper focuses on ONAP and MEF LSO.

MEF17 SERVICE ON DEMAND POC AS PROOF POINT

Multiple carriers and vendors partnered to develop a PoC using the MEF's LSO Reference Architecture at the MEF17 conference in Orlando, Florida. The PoC focused on stabling on-demand Ethernet services connectivity across carriers while maintaining full automation. The PoC had two major parts, which we describe in this section.

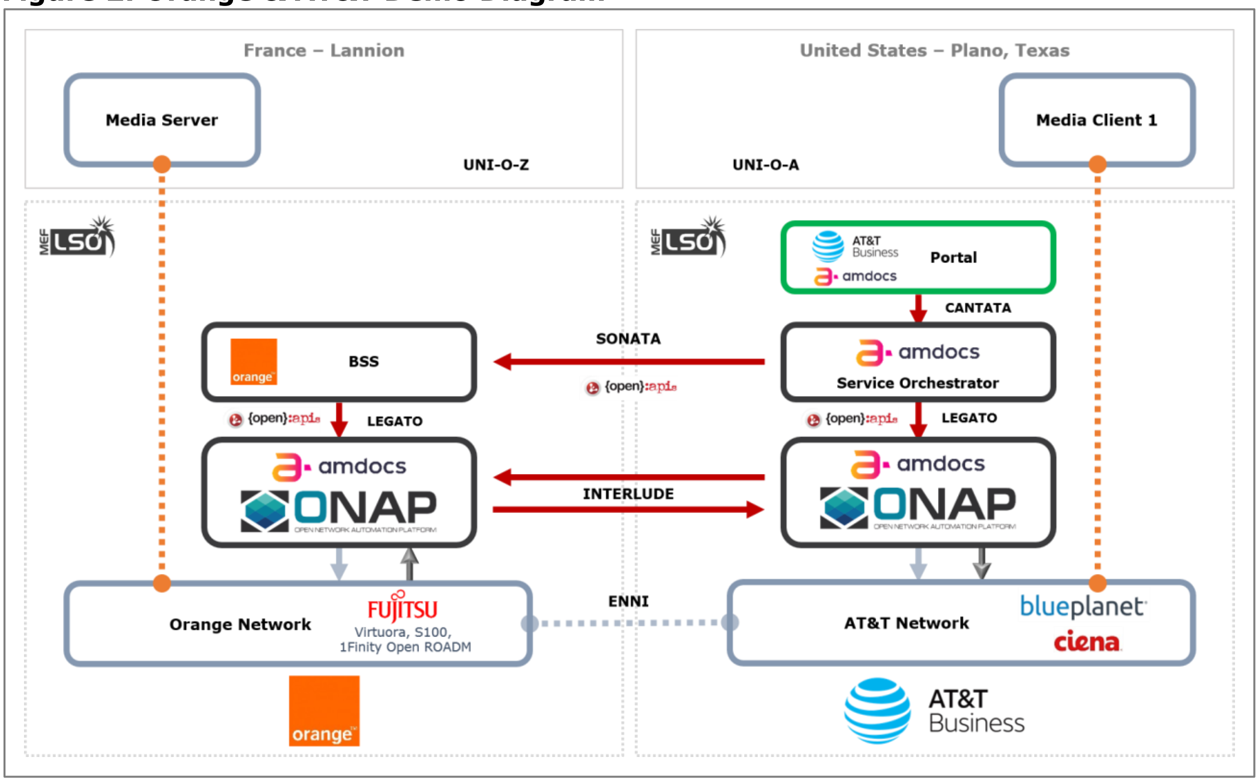
Part 1: E-LINE Service on Demand

This demo involved AT&T as the network service provider in the United States and Orange as the access provider in France and was supported by Ciena, Fujitsu and Amdocs on the supplier side.

In this scenario, an enterprise customer requested an elastic bandwidth service to be set up between its two locations – one in Lannion, France, and the other in Plano, Texas. The service is a point-to-point E-Line connection with a standard bandwidth of 2 Mbit/s and a burst capability up to 50 Mbit/s.

Ethernet services on demand are available today for services that remain within the service provider's network. The challenge introduced in the PoC is that the on-demand service must traverse networks from two different operators (Orange and AT&T). **Figure 2** depicts the Ethernet on-demand connectivity between Orange and AT&T.

Figure 2: Orange & AT&T Demo Diagram



Source: AT&T, 2017

For cross-carrier on-demand services, standardization is required, and this is where the MEF LSO application programming interface (API) work is critical. AT&T Domain 2.0 Principal Member of Technical Staff Andy Mayer described two primary areas of inter-carrier interaction in the PoC that he labeled "product" and "service." Products are what enterprises order, and business support system (BSS) functions are relevant here, including billing and order management. The MEF's Sonata API standardizes the BSS functions across carriers to automate this process.

Operators provision services based on the products ordered, and this requires an additional carrier-to-carrier operations system interaction, served by ONAP in this demo. The MEF's Interlude API standardizes and automates this process. Finally, a third standard API is required for internal communications between ONAP and each operator's BSS above it. Although this communication is internal, the API is necessary because BSSs are unique to each carrier. The MEF's Legato API addresses BSS/ONAP communication.

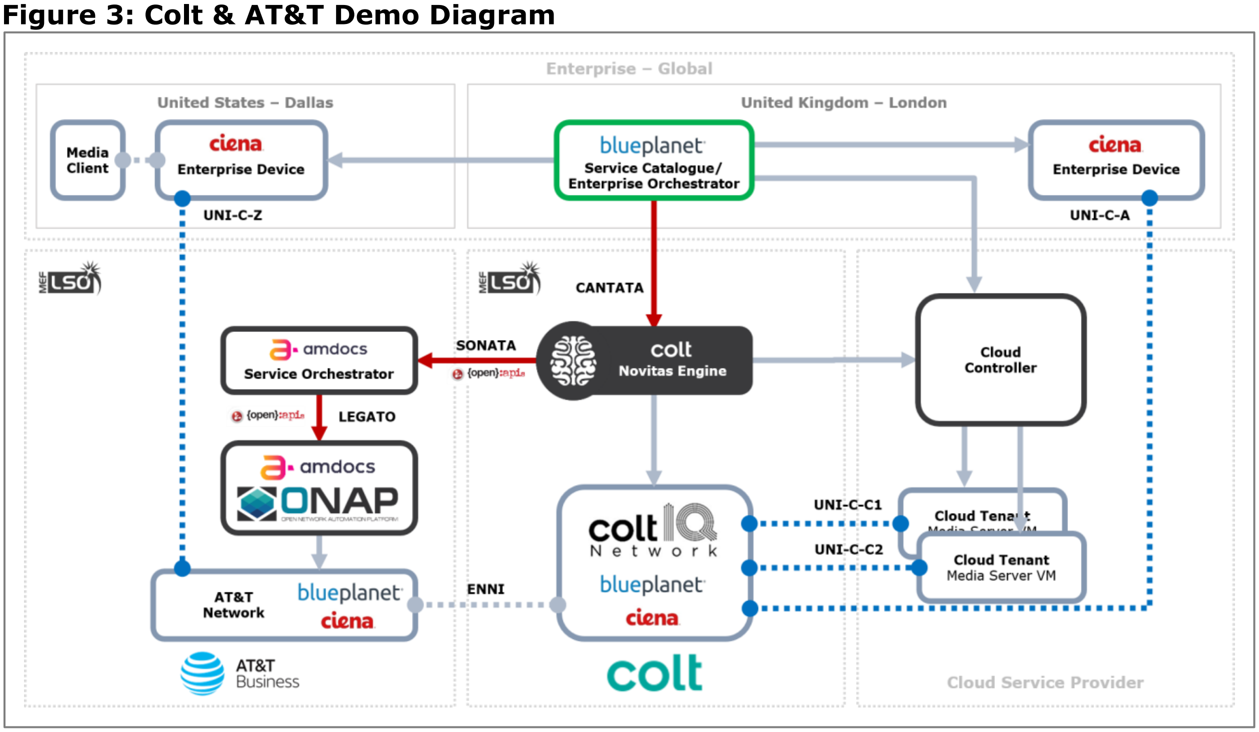
In addition to establishing basic on-demand connectivity, Part 1 also demonstrated the use of microservices delivering "closed loop automation," meaning a full cycle of detection, diagnosis and resolution of a network issue without any manual intervention through the cycle. In this case, once the connection was set up, the organizers injected packet loss into the access network that exceeded the negotiated SLA threshold.

The Fujitsu microservice residing in ONAP collected real time E-Line performance data from Fujitsu's SDN solution, the Virtuora Network Controller. The microservice performed network analytics to trigger a threshold notification alarm to resolve the network issue by requesting increased bandwidth for the duration of the on-demand service. When the traffic patterns returned to the minimum threshold, the microservice process reverted the network to the original state – again with no human involvement.

Part 2: E-LINE With Cloud on Demand

Part 2 of the demonstration involved AT&T as the U.S. access provider, but this time working with Colt as the enterprise service provider in the U.K. This PoC was supported by Ciena on the supplier side and tied into the Amazon Web Services (AWS) cloud. **Figure 3** depicts the Colt and AT&T cloud connectivity demo.

Figure 3: Colt & AT&T Demo Diagram



Source: Colt and AT&T, 2017

The Colt-AT&T demo also had two parts. The first scenario was like the AT&T/Orange demonstration. Here, an enterprise required on-demand Ethernet connectivity between one office located in the U.K. and a second office located in Plano, Texas. While Colt's orchestration software can already provision Layer 2 connectivity between Colt on-network locations, this request covered both Colt's network and a third-party network, in this case AT&T. The MEF's Sonata API was used to automate the commercial interaction between the two BSSs, allowing for the provisioning of the service in less than five minutes.

The second part of the demonstration linked an enterprise customer directly to the AWS. The synopsis is a Colt U.K. customer is opening a new branch office in Plano, Texas. The customer already has direct cloud connectivity from the London office to AWS, but they now need to connect the new Dallas office to the Amazon cloud.

Colt peers with AWS at collocation facilities, and, in this case, connects to the Dublin, Ireland, facility. The MEF Sonata API is once again critical for BSS-BSS interaction between Colt and AT&T. For the Colt-Amazon connectivity, however, Sonata does not apply, and Colt used AWS APIs to connect to the AWS cloud.

KEY OPEN TECHNOLOGY COMPONENTS & ROLES

MEF LSO APIs

The MEF is focused on standardizing open APIs for interoperability between different management systems within services providers (i.e., north-south interfaces) and between different service providers (i.e., east-west interfaces). The rationale is that on-demand services can never truly be automated end-to-end if manual intervention is required at steps along the way – whether that involves crossing from one carrier to another, or even traversing different domains (and management systems) within a carrier. "Lifecycle Service Orchestration" seeks to capture the full cycle or end-to-end aspects of the mission. The MEF's LSO work is initially focused on Layer 2 Ethernet services, but the organization intends to extend the interfaces across other connectivity service types as the interfaces mature.

Under the LSO umbrella, the MEF is working on several open APIs to automate interaction between management systems at different touch points in the service cycle, namely:

- **Sonata** standardizes the exchange of business-level information across different service providers (east-west), including addressing, quoting, ordering, contracting and invoicing. Historically, this business information exchange has been a manual negotiation activity between providers that prevented on-demand connectivity between carriers (barring individually contracted bilateral agreements). Sonata was a critical interface demonstrated in both the Orange and AT&T PoC and the Colt and AT&T PoC. Sonata is also the furthest along of the MEF LSO interfaces, and is currently available to service providers in its first release.
- **Interlude** standardizes the exchange of service-level information across service providers (east-west), including performance level and assurance data needed for scaling bandwidth up and down as required. Interlude was used to exchange operational data across carriers in the AT&T and Orange PoC. Interlude was not specifically part of the Colt and AT&T PoC, but Colt told Heavy Reading that Interlude is critical for them as well. Work on Interlude is just beginning.
- **Legato** standardizes internal communications between ONAP and the OSSs above (a north-south API). It's important because more operators are adopting ONAP, and each operator has a proprietary OSS that must connect. Orange and AT&T both used Legato to connect ONAP implementations to their OSS. The MEF Legato specification is close to completion, and is expected to be included in ONAP's next release (Beijing).
- **Cantata** applies to exchange of business/product information between the service provider and its enterprise customer and is analogous in role/function to Sonata. Colt demonstrated Cantata in the demo.

ONAP (Open Source) & Microservices

A part of the Linux Foundation, the Open Network Automation Platform (ONAP) is an open source-based project for orchestrating NFV networks and managing virtualized network functions (VNFs). ONAP was formed in March 2017 with the merger of the AT&T-led ECOMP project and the Chinese operator-led Open-O Project.

As the merged entity, ONAP has been gathering support among major vendors and, most significantly, Tier 1 network operators globally. The recent addition of Verizon as a Platinum member brings the operator member count to 16 (of which eight are Platinum), including China Mobile, China Telecom, Reliance Jio, Orange, Turk Telekom and Vodafone, in addition to AT&T and Verizon.

In Part 1 of the MEF17 PoC, both AT&T and Orange used ONAP for orchestration. Orange's ONAP implementation controlled Fujitsu's Virtuora SDN solution in Orange's network, and AT&T's ONAP instance controlled the Ciena elements in AT&T's network via the Ciena Blue Planet orchestrator.

In addition, ONAP was required for the microservices closed loop automation demonstration. The Fujitsu-developed microservice was embedded in AT&T's ONAP instance and used the ONAP utilization data to monitor the customer circuit within AT&T. The microservice provided real-time network monitoring and analytics to detect the traffic surge, and then initiated the request to boost bandwidth. As described earlier, the Interlude API was used to transmit the request across the carriers' ONAP implementations.

Open ROADM With SDN Control

Started by AT&T, Open ROADM is a multisource agreement (MSA) that defines interoperability specifications for ROADMs, including the specifications for the ROADM switches as well as transponders and pluggable optics. On the software side, Open ROADM defines interoperability for YANG data models. For hardware, Open ROADM seeks to source individual line components from different suppliers to yield the lowest possible costs for each. For software, Open ROADM brings the photonic layer under interoperable SDN control, such that multi-vendor optical connects can be centrally controlled.

The Open ROADM MSA has gained operator traction among Tier 1s, and now includes as members KDDI, Orange, Rostelecom, SK Telekom, Saudi Telecom Company, Deutsche Telekom and TIM, in addition to AT&T.

In Part 1 of the MEF17 PoC, Orange used Fujitsu disaggregated ROADM elements set to the Open ROADM spec and operating under SDN control from the Virtuora SDN solution. Virtuora also directly controlled Orange's Ethernet switches and coordinated with ONAP orchestration.

While Open ROADM was not the central theme of this PoC, its inclusion demonstrated three important network activities:

- Operation of a commercial photonic network under an open SDN controller
- Coordination of commercial photonic network with ONAP orchestration, via SDN control
- How VNFs and physical network elements can be coordinated together to provision automated services on demand, in this case using ONAP as the master orchestrator between physical and virtual elements

Open Source Integration Services

Heavy Reading operator survey data shows that the lack of skills required to operate open source is the biggest obstacle to deploying software based on open source. Research also shows that operators are hesitant to take on open source software "as is," as the community software often lacks required features, needs a level of customization, and comes unsupported. Here we see a growing need for third-party open source software integration support, from companies with unique expertise in open source that are also able to provide ongoing support for network operators.

In the MEF17 PoC, Amdocs served this critical software integration role. Key integration roles for Amdocs in the PoC were:

- Building the order orchestration, customer portal and ONAP instance turn-up for AT&T
- Building the order orchestration and ONAP instance turn-up for Orange
- Integration of the Fujitsu microservice application within Orange's ONAP instance

We make two key points regarding the service integration role in this demo. First, the integrator's ONAP expertise was instrumental in building the demo quickly. From start to finish, it took a small team two and a half months to put the demo together. Second, the combination of open source software with third-party integration is a powerful one that will serve as the model for many open source deployments going forward. The MEF17 PoC shows the power and necessity of this integration.

NEXT STEPS & CONCLUSIONS

A successful PoC shows both the value of emerging technologies and identifies further work needed for widespread commercialization. Proof points validated in the MEF17 Ethernet Services on Demand PoC included open source orchestration software, microservices enabling closed loop automation, open and disaggregated hardware under SDN control and coordination among SDN controllers, higher-layer orchestration systems and operator OSSs/BSSs.

Achieving multi-vendor and multi-operator interoperability requires open interfaces between management systems across service providers and within service providers. MEF's LSO work is a critical contribution to standardization in this area. The required interfaces are in early stages, and continued work and expanded industry cooperation will be needed. Expansion beyond Ethernet services will also be required.

Finally, in addition to LSO interface standardization, we emphasize the role that software integration services will play in open source commercialization moving forward (addressed by Amdocs in the MEF17 PoC). Integration services performed by third parties are a means to bring open source innovations into commercial networks quickly, and while keeping costs down. Operators must realize that such expertise is available to accelerate their plans.