

# NFV MANO: Competitive Dynamics and Solution Assessments

Snow, David | December 23, 2016

Market Assessment



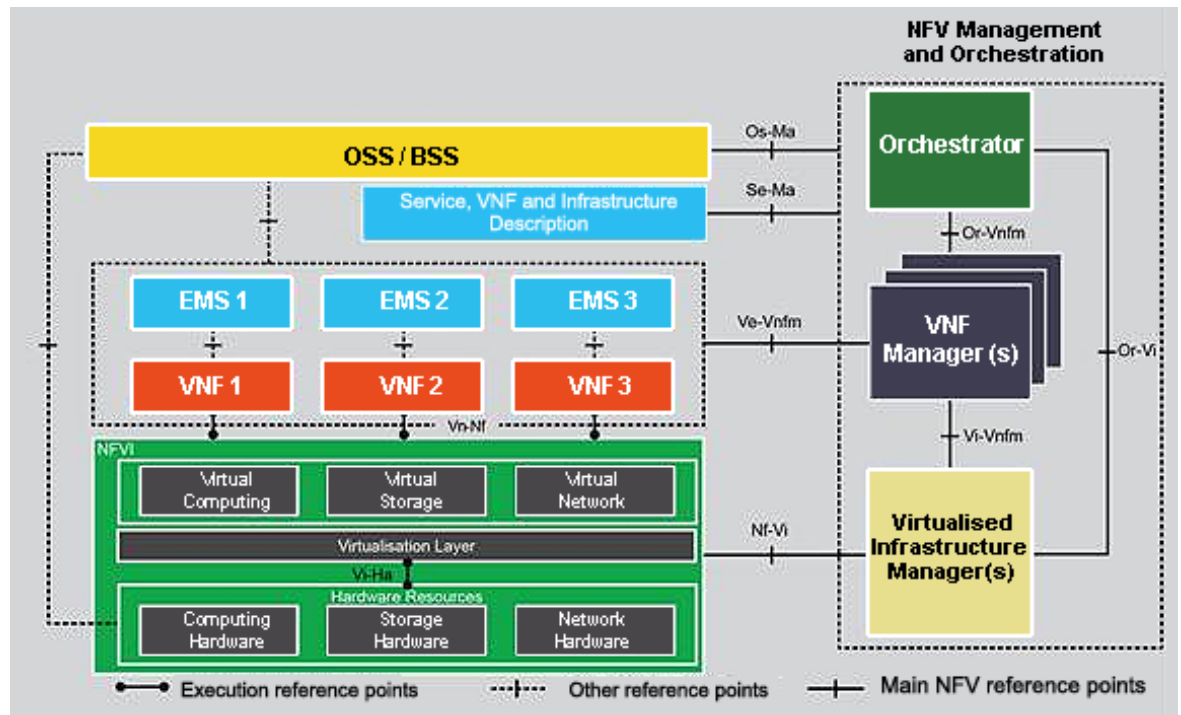
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**Summary**

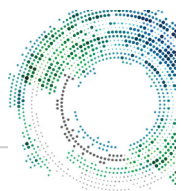
## Market Definition

Network functions virtualization (NFV) is considered by operators and vendors alike to be the most important transformation that the network industry has undertaken in its history. NFV promises to provide operators with the ability to deliver increased service revenues, automate many if not all network functions, reduce the cost of the infrastructure needed to support new services, and provide the scale needed to meet exploding traffic demands. The next-generation service delivery architecture requires an effective network infrastructure that supports network functions and services with typical carrier-grade attributes such as guaranteed SLA performance, reliability and elastic scaling. The following reference architecture outlines the key building blocks that must work in concert to support carrier-grade virtualized network services.

## ETSI NFV Reference Architecture:



This report, one of four, focuses on NFV management and network orchestration (MANO), which includes the NFV orchestrator (NFVO) and the virtual network function manager (VNFM). The NFV infrastructure (NFVI)/virtualized infrastructure manager (VIM), and software defined network (SDN) controllers are



addressed in separate reports.

### State of the Market

Our analysis indicates that NFV MANO solutions have progressed considerably over the past 18 months – many operators are transitioning, with the help of vendors, from proofs of concept (PoCs) to trials, and many are now addressing the practicalities of launching commercial services. Some indeed have progressed further and launched commercial services, such as virtualized voiceover-LTE (vVoLTE), mostly at VIM levels of orchestration but increasingly at the VNFM and NFVO level, despite the lack of definitive ETSI MANO specifications.

This report provides a description and comparison of various leading MANO solutions based on a number of operator buying criteria, each supported by a number of high-level solution metrics. While this report focuses on the NFVO and VNFM, NFV MANO cannot simply be relegated purely to a discussion of this functionality alone.

- The NFVO has multiple interfaces, but one of the most critical is with the carrier OSS to oversee service provisioning and assurance and in some cases provide end-to-end service orchestration (SO) – a topic which continues to attract much discussion and debate.
- The VNFM remains fluid in terms of its functionality in relation to what the virtual network functions (VNFs) do for themselves, what element management and network management systems (EMS/ NMS) already provide and additional VNFM functionality provided by the NFVO or independent VNFM suppliers. In some instances VNFMs include NFVO functions to compensate for the lack of an NFVO, and/or orchestrate other VNFMs. For a comparison of independent VNFM offerings please see **Independent Generic VNF Managers: Competitive Dynamics and Solutions Assessments , December 1, 2016.**

### NFV MANO: Defining the Market

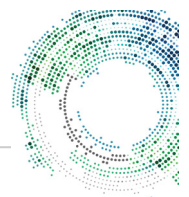
Before assessing solutions or products, Current Analysis identified the factors that are important to carriers in procuring MANO solutions to support the rollout of their NFV-based services. These criteria, listed below and defined more rigorously in a later section, have been used to assess the various major vendor solutions available today:

- *Overall Solution Portfolio*
- *Functional Support*
- *Integration & Interworking*
- *VNF & Network Service Support*
- *Deployability*

#### Drivers

### Market Drivers

- The NFV MANO market attracts vendors from multiple domains. While network core and telco IT players have been natural contenders, new “pure-play” and cloud management platform vendors are also addressing the market.
- The ETSI NFV ISG continues to refine and deliver increasingly detailed NFV MANO specifications,



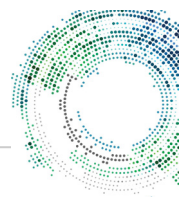
driving multi-vendor interoperability, addressing new areas such as security and licensing, and providing more guidance for VNF vendors.

- The strengthening (and code-delivery) of carrier-driven open source MANO projects such as Open Source MANO (OSM) and OPEN-O during 2016 and AT&T ECOMP open sourcing (due in Q1 2017) provide an alternative sourcing option for carriers to gain experience with MANO.
- As the NFV MANO market develops, focus is shifting around the MANO stack. Initial concerns were located at the infrastructure management (VIM) level for service availability, but then switched to the NFVO/OSS interface for service assurance. Current MANO focus is on the NFVO/VNFM interface to help ease the process of multi-vendor VNF onboarding.
- Despite the inherent complexity of NFV MANO and the heady mix of carrier-driven, standards-driven and open source-driven inputs into the market, almost all vendor NFV MANO solutions assessed have made solid progress over the last six months.
- While most live NFV deployments employ orchestration at the VIM level only, VNFM-level orchestration is growing rapidly and some NFVO-level orchestration including integration with carrier OSS/BSS is now fully operational, at least on a per service basis.

### Selection Criteria and Product Development

As indicated above, any practical NFV MANO assessment begins by identifying the major factors important to carriers in a procurement process, and the criteria on which they will base a decision to purchase. Each criterion is assessed using a combination of vendorsupplied responses to metrics requests from *Current Analysis*.

- *Solution Portfolio*: The breadth of a vendor's MANO portfolio is initially assessed in ETSI architectural terms and includes the vendor's support for the VNFM and NFVO. However, experience has shown that more MANO functions and more functional decomposition are needed than ETSI currently specifies, so new portfolio components have emerged. For example, the VNFM includes variants such as a generic VNFM (VNFM-G) to orchestrate simple VNFs and application-specific VNFs (VNFM-S) for more complex VNFs or VNF/PNF combinations. Other vendor variants include element management system (EMS)/VNFM combinations. Some NFVO solutions also differentiate between resource or domain orchestration (NFV-RO/DO) and service orchestration (NFV-SO), supporting service level functions such as provisioning, configuration, cross-domain orchestration and assurance. All in all, the breadth of a vendor's MANO portfolio demonstrates its ability to help carriers address orchestration challenges at individual VNF, network and service levels in both a pragmatic and evolutionary manner.
- *Functional Support*: While the breadth of a vendor's MANO portfolio is important, so too is the quality of its orchestration. This will largely depend on the orchestration technologies employed, principally policy management and analytics working in a closed loop. While policy management is usually MANO vendor-specific, some operators look for continuity with their existing service assurance analytics providers and call for MANO vendors to integrate third-party analytics functionality with their NFVO. The NFVO is also accumulating more network responsibility such as for NFV security and/or VNF licensing orchestration, although vendors differ on the extent to which they are implicit or explicit requirements; standardization work has only recently started in these areas. There are now attempts, via industry initiatives such as Open Source MANO (OSM) and OPEN-O, to introduce open source software functionality into MANO and to include SO functions. A vendor's MANO offering can therefore also be assessed in terms of its openness and the sophistication of its orchestration and supporting technologies.
- *Integration & Interworking*: MANO, of course, is only one part of a carrier's complete NFV installation. It is therefore imperative that a high degree of interface flexibility and proven interworking is supported



in order to avoid vendor lock-in and enable MANO solutions to integrate into an existing carrier environment. As the diagram above shows, major MANO interfaces are with the various forms of NFVI, VIM and SDN controllers (not shown) that provide operating platforms and networking resources. In the case of the NFVI, the ability of MANO to service enhanced platform awareness (EPA) requests is also a key requirement to address the high media traffic and strict latency requirements of carrier networks. In addition, NFV installations are more often than not required to interwork with existing physical network functions (PNFs) in hybrid (PNF/VNF) carrier networks, for which the end-to-end network and service level orchestration is required. Due to the “zoo of orchestrators” issue, where carriers find that each vendor VNF is delivered with its bespoke VNF, interoperability with third party VNFs is also a growing requirement. Finally, integration with OSS/BSS systems are necessarily within the scope of any MANO interoperability assessment to ensure that the chosen MANO solution fits within the carrier’s wider telco IT systems environment required to support commercial NFV-based service rollout.

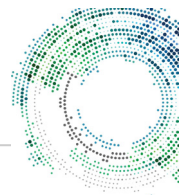
- *VNF & Network Service Support:* NFV MANO’s ultimate end goal is to instantiate and orchestrate an assorted portfolio of VNFs from multiple vendors into a commercial network service across a distributed network infrastructure. To this end, we have assessed the capability of a vendor’s MANO offering to support this objective through the various stages of VNF management, from initial VNF onboarding, VIM level orchestration, VNF lifecycle management and orchestration by the VNF, and network service orchestration from the NFVO. The latter can also include the orchestration of PNF elements for a hybrid network service. As a measure of this, we also assess support for “complex” network service orchestration use cases like VoLTE.
- *Deployability:* Finally, the ease with which a vendor’s NFV MANO offering can be deployed in a carrier environment is assessed. This is based on the vendor’s deployment metrics, which also help validate its interoperability credentials. However, it also includes analysis of how the carrier itself can be supported by the MANO vendor in terms of bringing pre-onboarded and pre-validated VNFs from not only the MANO vendor but, more importantly, third party VNF suppliers. Most vendors have set up NFV ecosystems, developer portals and supply professional services to facilitate this process. Going one step further, MANO vendors also need to assist the carrier with the capability to easily create, modify and deploy (and eventually retire) new services in a “DevOps” fashion.

### Competitive Matrix Summary

Since the first formal assessment of vendor MANO offerings in June 2016, the Current Analysis’ NFV MANO competitive matrix summary has been extended and enhanced as follows:

Competitive Matrix: Expanded Scope

- ADVA (Ensemble), Ciena (Blue Planet), Gigaspaces (Cloudify Telecom Edition) and RIFT.io (RIFT.ware) have been added to the matrix.
- The separation of Service Orchestration, NFVO and VNF functionality within the vendor’s MANO portfolio has been assessed.
- Active participation of a vendor in open source MANO projects and the incorporation of open source MANO software into products been assessed.
- The NFVO’s capability to manage third party VNFs has been assessed.
- The NFVO/VNF’s capability to manage complex hybrid network services has been assessed.

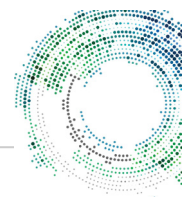


**Competitive Matrix Summary**

Due to the added vendor and metrics complexity, the competitive matrix has been rationalized to more of a “heat map” representation, with less textual content.

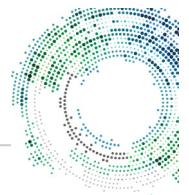
- Metric cells remain color-coded, highlighting above average (green), below average (red), and average (yellow) rankings.
- For all but the “Solution Portfolio” metrics, text is only added to cells with above (green) or below (red) average rankings.
- Average (yellow) rankings do not attract any text; absence of text does not imply weakness, simply expected or average capability.

	ADVA	AMDOCS	Ciena	CISCO	ERICSSON	GIGASPACE	HPE
<b>SOLUTION PORTFOLIO</b>							
<b>NFV Orchestration (NFVO)</b>	Ensemble Orchestrator	Network Cloud Service Orchestrator / Active Inventory	Blue Planet	Network Cloud Services Orchestrator	Cloud Manager	Cloudify / Aria	NFV Director
<b>Service Orchestration (SO)</b>	Ensemble Orchestrator	Network Cloud Service Orchestrator	Blue Planet MDSO	Network Cloud Services Orchestrator	Cloud Manager	Cloudify / Aria	Service Director
<b>VNF Management (VNFM)</b>	Ensemble Orchestrator	Network Cloud Service Orchestrator	Blue Planet	Elastic Services Controller	Cloud Manager / Network Manager	Cloudify / Generic / VNFM	NFV Director
<b>FUNCTIONAL SUPPORT</b>							
<b>Policy &amp; Analytics</b>							
<b>Security &amp; Licensing</b>	Very comprehensive			Very comprehensive			Security Strategy
<b>Data Models, Open Source and / or Other Differentiating Functionality</b>		AT&T ECOMP				Open Source Aria/TOSCA	
<b>INTEGRATION &amp; INTERWORKING STATUS</b>							
<b>VIM, NFVI &amp; EPA</b>							
<b>VNFM &amp; SDN Controllers</b>							
<b>OSS, BSS and Service Orchestrators</b>						OPEN-O	
<b>VNS &amp; SERVICE SUPPORT</b>							



<b>VNFs Onboarded (VM)</b>	37 3P	5 own, ~40 3p			>5 own, 1 3P		>60 own, 20 3P
<b>VNFs Validated (VNFM)</b>		Undisclosed					
<b>Complex Network Services Orchestrated (VNFMNFO)incl hybrid</b>							
<b>DEPLOYABILITY</b>							
<b>Operator &amp; VNF Developer Support Strengths</b>					No Vendor ecosystem	Cloud-native VNF Program	OpenNFV
<b>Live VNFM Deployments (Own and 3rd party VNFs)</b>		Undisclosed					
<b>Live NFVO Deployments &amp; OSS Integrations</b>	1 live development not integrated with OSS	Undisclosed	13 live deployments including NFVO and OSS integration			10-20 live deployments including NFVO and OSS integration	

	HUAWEI	NETCRACKER	NOKIA	ORACLE	RIFT.IO	ZTE
<b>SOLUTION PORTFOLIO</b>						
<b>NFV Orchestration (NFVO)</b>	CloudOpera Orchestrator NFV-RO	RT MANO Network Orchestration	CloudBand Network Director	Network Service Orchestration Solution	RIFT.ware NFVO	vManager (RO)
<b>Service Orchestration (SO)</b>	CloudOpera Orchestrator NFV-SO	End-to-End Service Orchestration	CloudBand Network Director	Rapid Service and Order Delivery Solution	RIFT.ware NFVO	vManager (SO)
<b>VNF Management (VNFM)</b>	CloudOpera Orchestrator CGM	RT MANO VNF Management	CloudBand Application Manager	Network Service Orchestration Solution / Application Orchestrator	RIFT.ware VNFM	vManager (VNFM-G)
<b>FUNCTIONAL SUPPORT</b>						
<b>Policy &amp; Analytics</b>	Carrier-level Policy	Closed Loop Automation & Assurance				Network Slicing
<b>Security &amp; Licensing</b>		Very comprehensive				
<b>Data Models, Open Source and / or Other Differentiating Functionality</b>					Open Source MANO (OSM)	



INTEGRATION & INTERWORKING STATUS						
VIM, NFVI & EPA			EPA with 3P NFVI Blueprints			
VNFM & SDN Controllers	Extensive 3P VNFMs					Extensive 3P VNFMs
OSS, BSS and Service Orchestrators		Business Enablement Applications				Extensive 3P OSS & BSS
VNS & SERVICE SUPPORT						
VNFs Onboarded (VM)		> 10 own, 125 3P	20 own, 30 3P			
VNFs Validated (VNFM)		As above				> 110 (own and 3P)
Complex Network Services Orchestrated (VNFMNFO) incl hybrid					No hybrid service support	vEPC, vVoLTE, 5G Network Slicing
DEPLOYABILITY						
Operator & VNF Developer Support Strengths		NG Vendor Ecosystem VDOC	CloudBand Ecosystem & Cloud Verification Testing			
Live VNFM Deployments (Own and 3rd party VNFs)	47 own, 14 3P		22 own, 12 3P (all VNFM-G)	Undisclosed	Undisclosed	
Live NFVO Deployments & OSS Integrations		24 live deployments including NFVO and OSS integration		Undisclosed	Undisclosed	10 live deployments including NFVO and OSS integration

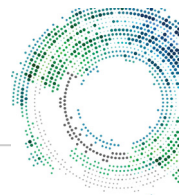
Abbreviation: “3P” (Third Party)

**MANO: Competitive Positioning and Assessment**

For all the assessed vendors, an overall Current Analysis ranking (Vulnerable, Competitive, Strong, Very Strong, Leader) has been assigned, supported by a justification and recommended vendor actions where appropriate:

*ADVA:*

ADVA’s Ensemble Orchestrator portfolio performs solidly across all dimensions of this assessment, supporting all the key functional building blocks of the ETSI NFV MANO architecture with strong support for security and VNF licensing. It is also one of a growing number of “pure play” NFV MANO vendors not supplying their own VNFs, and therefore focuses intensively on supporting VNFs from third-party vendors. Ensemble Orchestrator has an active NFV partner ecosystem and has onboarded a significant number of



VNFs to VIM level, using its own VNFM and integrated a number of third party VNFMs. In terms of complex network service orchestration, Ensemble Orchestrator supports vIMS, vEPC and vSBC functions but does not go as far as orchestrating more complex services such as vVoLTE at a network service level. It does, however, support a wide variety of vCPE use cases including hybrid PNF/VNF orchestration. ADVA's Ensemble Orchestrator currently operates an "all-in-one" NFV MANO solution with embedded VNFM capability, but the company is planning to break out this functionality in the future which may increase the attractiveness of the portfolio. ADVA should consider strengthening its service orchestration to keep in step with rivals, and needs to show more public live NFVO deployments including integration with customer OSS.

*Amdocs:*

Amdocs was one of the first companies to highlight the importance of continuous real-time fulfillment and assurance of NFV-based services using its "Sensei" technology which makes extensive use of policy. Amdocs' Network Cloud Service Orchestrator (NCSO) provides tight integration with Amdocs' telco IT assets, and the company has developed an extensive NFV partner ecosystem with a wide variety of third-party VNFs. That said, Amdocs has been hindered by disclosure policies on the number of VNFs actually onboarded, tested to the VNFM level and in interworking with third party VNFMs and OSSs. However, Amdocs' flagship partnership contract with AT&T for ECOMP systems integration in July 2016 and management of ECOMP's impending release into open source in Q1 2017 significantly endorses and strengthens Amdocs' overall offering. Nevertheless it is not yet clear how this will impact Amdocs' existing NCSO product and whether it will help break down what so far has been a more monolithic NFV MANO offering than most.

*Ciena:*

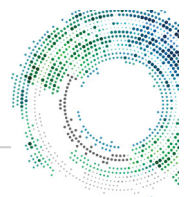
Ciena's Blue Planet portfolio performs solidly across all dimensions of this assessment, supporting all the key functional building blocks of the ETSI NFV MANO architecture with a longstanding emphasis on service orchestration. It is also one of a growing number of "pure play" NFV MANO vendors not supplying their own VNFs and therefore has a major focus on supporting VNFs from third party vendors. Blue Planet has an active VNF partner ecosystem and a DevOps Toolkit for operators. In terms of traction, Blue Planet has flagship presence in Orange Business Services, a long-term relationship supporting CenturyLink, and a strong overall NFVO deployment count including customer OSS integrations. While Blue Planet is normally deployed as an "all-in-one" NFV MANO solution, the product's micro-services architecture allows functionality to be packaged and deployed as needed and the company plans to break out its embedded VNFM into a standalone capability.

*Cisco:*

Cisco's Network Services Orchestrator (NSO) NFVO was derived from its acquisition of Tail-f Systems and, together with its Elastic Services Controller (ESC) VNFM, represent the company's primary ETSI-compliant MANO assets, forming part of its wider Evolved Services Platform (ESP) NFV offering. As part of its MANO offering, Cisco has also added its Virtual Topology System (VTS) to enhance its SDN control capabilities, and equipped its MANO offering with security and licensing orchestration to a greater degree than most other compared offerings. However, when it comes to MANO deployments at various orchestration levels, the company is unable to disclose any quantitative information, though the company points toward work with high profile operators in the U.S. and Europe. Cisco needs to provide more visibility of its MANO offering in live operation supporting third-party VNFs to validate and demonstrate the competitive advantages of its solution.

*Ericsson:*

The Ericsson Cloud Manager (ECM) is surrounded by market leading products in both network and telco IT (OSS/BSS) domains. As such, the company's offering is well placed to bring the best of both worlds into





its NFV MANO offering and help carriers bridge the divide. Ericsson has clearly adopted an evolutionary rather than revolutionary approach to NFV MANO, for example by merging VNFM with EMS functionality in the Ericsson Network Manager (ENM) easing operator challenges in multi-vendor VNF management and hybrid network operation. Nevertheless, despite significantly ramping up the number of ECM commercial “full stack” contracts during 2016, the company reports very few third party VNFs onboarded and orchestrated in a live network compared with rivals. Ericsson needs to increase that number and consider the advantages of launching its own multi-vendor VNF ecosystem to avoid ECM being portrayed as a platform for Ericsson VNFs only.

#### *Gigaspace:*

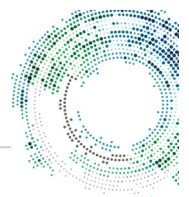
Gigaspace's Cloudify Telecom Edition is a “pure play” orchestration framework using the community-led ARIA TOSCA project as the core of its NFV-RO and NFV-SO offerings. Cloudify can also serve as a generic VNFM and all components can be deployed individually or together. Cloudify is an open source offering, a key orchestration component of the OPEN-O project, and, according to the company, is also being used as part of the offerings of other vendors in this comparison, in a large US operator's solution, and by an increasing number of system integrators. Consequently the volume and variety of VNFs onboarded to, and network services orchestrated by, Cloudify is not only large, but also unknown. Nevertheless, information available puts Cloudify at generally the same level of deployment as vendors rated Very Strong and above in this comparison. Gigaspace is also driving VNF onboarding by helping VNF vendors transition to a cloud-native architecture under the Cloudify Cloud-native VNF Program.

#### *HPE:*

With the advent of an increasing number of “pure play” and open source-based MANO vendors, HPE is no longer the only vendor in this comparison that does not include its own VNFs in its overall NFV solution. Nevertheless, being one of the first to adopt this stance enabled HPE to differentiate itself at an early stage toward carriers and VNF vendors alike in endowing its NFV Director NFVO and VNFM with multi-vendor VNF credentials from the outset. HPE's OpenNFV vendor ecosystem has been running for around two years, including VNF (and VNFM) onboarding, validation and multi-level VNF certification aiming to provide operators with close to an “app store” experience. However, HPE traction has been less apparent over the past six months, although it previously claimed multiple live NFVO deployments interfacing to third party carrier OSSs. There is also one key area which HPE has been notably slow to address: NFV security. NFV Security is now receiving attention in the standards bodies and HPE needs to identify its strategy and plans to support this requirement.

#### *Huawei:*

Huawei's NFV MANO offering is increasingly positioned as a distinct element of its overarching Infrastructure Enabling System (IES), branded as “CloudOpera.” The CloudOpera Orchestrator NFV-RO (Resource Orchestrator), NFV-SO (Service Orchestrator) and CGM (Cloud Generic Manager) VNF Manager work into the CloudOpera ICT Orchestrator (ICT-O) which orchestrates across all cloud, SDN/NFV and legacy network resources. As a result, Huawei's NFV MANO Policy and Analytics solution benefits from a wider orchestration perspective than most and is also capable of interworking with third party policy and analytics packages at various levels of the architecture. Huawei has been careful from the outset to promote the multi-vendor capabilities of its offering and, for example, is involved in third party VNF and VNFM interworking projects in China with other major vendors in this comparison. Third party interoperability has also translated into a high number of live deployments orchestrating third party VNFs to VNFM level. Nevertheless, while Huawei also has a high number of live NFVO deployments, they are “full stack” (orchestrating only Huawei VNFs) and integration with third party OSS is limited to a single instance.



*Netcracker:*

Netcracker emerged as the overall leader in the first formal comparison of vendor MANO offerings in June and has maintained this position six months later. While the company's telco IT portfolio and Agile Virtualization Platform (AVP) is dauntingly complex, there can be little doubt as to its comprehensiveness in providing a platform capable of supporting almost every aspect of the carrier NFV MANO journey. Netcracker's NFVO and VNF, located in the Hybrid Operations Management (HOM) suite, are among the most functionally sophisticated of compared vendors. Nevertheless, it is the operational wrap and the onboarding of a very high number of third party VNFs, Netcracker's "next generation" Partner Ecosystem and orchestration at VNF level and above which fuels the company's leading position. Netcracker has carried these capabilities forward into multiple live MANO deployments at NFVO level, including integrations with carrier OSSs and strong BSS integration features. However, while Netcracker's AVP together with its services offering is very comprehensive, it may also be too heavyweight for smaller carriers.

*Nokia:*

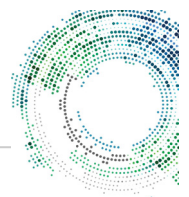
Among compared solutions, Nokia's CloudBand remains one of the clearest in terms of maintaining the functional separation between NFVO, VNF and OSS/EMS components. Its VNF, the CloudBand Application Manager, is one of the few compared products operating as a standalone VNF for both the company's own and partner VNFs, providing it with enhanced VNF-G credentials. Nokia has also focused on easing the VNF onboarding process for both VNF vendors and carriers by addressing prerequisites such as multivendor NFVI validation, EPA support and VNF templating using open source tools. Nokia's CloudBand NFV Ecosystem is likely the longest running and best known in the industry and along with its VNF onboarding focus has helped in enabling a high number of live third party VNF deployments. However, when it comes to interfacing to existing carrier OSSs, Nokia appears to be behind the curve; this is now the area in which Nokia needs to show traction.

*Oracle:*

Oracle Communications' Network Service Orchestrator (OC NSO) delivers all expected functionality, being surrounded by Oracle's wider portfolio of NFV offerings including OSS and NFVI. NSO is showing steady traction as a multi-vendor VNF platform, onboarding an increasing number of third party partner VNFs, and capable of orchestrating complex network services such as VoLTE and VoWiFi. Oracle also clearly distinguishes between customer- and network-facing orchestration functions and has shown practical innovation around the management of composite (combined PNF/VNF) network functions in its VNF-S, the Oracle Communications Application Orchestrator (OCAO). It has been active and customer-driven in the integration of specific third party analytics packages into its orchestration schema. While deployment successes at either VNF and/or NFVO levels are undisclosed, conversations with officials indicate an increasing market "pull" for NSO; proof points are still required to validate NSO's interoperability with third party OSSs.

*RIFT.io:*

RIFT.io's RIFT.ware is a "pure play" NFV platform offering for "network service virtualization" (NSV) designed to ease and speed up the process of onboarding and managing third party network functions and services. In terms of the ETSI NFV MANO architecture, RIFT.ware supports the NFVO and VNF functions but both are tied very closely to a hyperscale multi-VIM approach. In terms of MANO functional support RIFT.io is one of best balanced offerings in this comparison across the policy, analytics, security and licensing dimension. RIFT.io is a founding member and seed code provider to the ETSI-aligned Open Software MANO (OSM) project, in which it operates as the NFV-SO into Telefónica's NFV-RO and Canonical's Juju VNF. While OSM provides RIFT.io with significant exposure to a large number of operators and VNF vendors, the RIFT.ware commercial version assessed in this report is not yet in live deployment or supporting hybrid network (PNF/VNF) orchestration. However, according to the company, RIFT.ware is currently deployed in five Tier 1 service provider network PoCs, with two expected to become commercial in



Q1 2017.

*ZTE:*

Like Huawei, ZTE's MANO offering has only recently become more visible to the wider market, firstly through PoCs and then through large Chinese operator engagements. ZTE's overarching MICT-OS solution includes the NFV MANO "vManager" which supports NFVORO, NFVO-SO and VNFM-G/S functionality, deployable together or individually. vManager has been successful in onboarding and orchestrating a high number of third party VNFs to VNFM level and in orchestrating high complexity network services, including hybrid operation, even venturing into the 5G network slice management domain. ZTE is also one of the few vendors to reveal its offering interworks with third party OSSs from multiple rivals in this comparison and a number of homegrown OSS/BSS from operators. Since the June assessment, ZTE's offering has made greater strides in almost every dimension of the NFV MANO segment than rivals and appears no longer confined to a domestic setting in order to demonstrate its solution attractiveness. Nevertheless, it now needs to ramp up live deployments of vManager with more Tier 1 operators outside China.

### **MANO: Looking Forward**

The results of this second solution level assessment of vendor's offerings show that the competitive landscape reflects the ongoing contest between network, IT and cloud management vendors to own the NFV MANO space. It also shows open source MANO projects beginning to impact some vendor solutions and the emergence of more "pure-play" vendors. While player rankings remain relatively evenly distributed, irrespective of domain, the range has narrowed as some vendors that lagged in June have made up ground. However, it needs to be remembered that this snapshot still reflects a "starting position" in what will be a long race. When the next assessment is made, we will be looking for the ways in which vendors are reacting to the open sourcing of AT&T's ECOMP, efficiency gains in the VNF onboarding process and, of course, success in MANO deployments supporting live multi-vendor VNF service rollouts.

