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VMware Telco Cloud Automation

Cross-Domain Service Orchestration

Author: Grant Lenahan – Principal Analyst

Appledore RESEARCH

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INTRODUCTION

This profile is one of many in a series that accompanies our research stream on Cross-Domain Service Orchestration.

Two of the key strands of Appledore's research are the need for **innovation and automation** – and that there are right and wrong ways to approach each. Innovation is not only about technology, but also about of *commercial* innovation. Myriad new revenue opportunities, from IoT, to private 5G, to "digital services" depend on new business models and the ability to quickly and inexpensively combine communications capabilities with those of industrial and commercial verticals. For example, CSPs must be able to sell "as-a-Service" and also to increasingly consume external capabilities "as-a-Service", based on business need. In our recent research on Telco as a Platform, we looked at the opportunity from the disaggregation of telco, outlining how telco in the future will increasingly be built from ecosystems of platforms, each providing disaggregated components of network.

Cross Domain Service Orchestration is the single process that will create these new, end-to-end services and unlock incremental revenues. To accomplish this, orchestration must facilitate the agile combination of pre-existing "services" from within a telco *and from many external partners*. In this way, pre-built, pre-tested and loosely coupled building blocks become the basis of rapid innovation. By way of example, we are already seeing this model generate market success in the **revitalized enterprise market**, with SDWAN, public cloud, broadband "underlay", private enterprise resources and on-demand cloud-based network functionality chained together, dynamically. While built from the same "building blocks", each of these customers' environments are unique, and in fact change dynamically. The market for private 5G, "network slices" and servicing IoT consortia all promise similar opportunity with similar operational needs.

The common thread across all of these is that we cannot anticipate future services. Corollary to that, there will be many combinations and permutations of services that must be created and managed. Much of this innovation may occur outside our industry's control – by innovative enterprises and System Integrators in healthcare, automotive, advanced manufacturing, etc. Operational platforms must prioritize easy, fast and cheap innovation.

Simultaneously, new network technologies promise flexibility and efficiency one the one hand, and vastly greater complexity on the other. Both demand automation to first rein in cost, and then to achieve the cost improvements possible through cloud native and configurable, smart technologies such as 5G, SDN, SDWAN and others.

These concepts are becoming widespread, and endorsed by standards, although the face of each "standard" looks different. The MEF (Legato and Sonata), TMF (APIs, Open Digital Ecosystem), and 3GPP (network slicing) are all working on implementations that focus on re-usable components, customized services, and integration with components in the outside world. This is true progress, and like most progress, is slightly messy if you look too closely and take each too literally. Yet we observe clear direction.

The cross-domain orchestration market is embryonic, and like all new markets, many suppliers are competing, and following different playbooks. NEPs come from one perspective, traditional "OSS" ISVs from another, the IT heavyweights from a third, and finally, there are several new disruptive entrants with unique propositions. Over time the market will work out what works, and what is popular. The critical take-away is that understanding the market may be more about "what are your needs and abilities as a CSP?" than about "which vendor does it best and cheapest?". Why? Because there is not one answer or one approach (so far) that fits the needs of all. We strongly encourage interested readers to read our major Market Outlook Report, which dives into this market and forms a foundation within which this and other profiles are best read.

In this profile we look at how **VMware**, with its *Telco Cloud Automation* product, proposes to deliver these capabilities. Appledore will cover individual domains (e.g.: cloud native orchestration for datacenters and edge), SDN, and SDWAN in related but separate research tracks.

VMWARE TELCO CLOUD AUTOMATION

VMware "*Telco Cloud Automation*", introduced within the last two years, builds on existing orchestration capabilities that VMware has developed to manage workloads and network services in cloud environments, both those that utilize its own virtualization/cloudification technology, and across clouds. This is VMware's multi-cloud approach.

In supporting myriad network functions, workloads, services as well as supporting those across diverse cloud infrastructures (public cloud, virtualization platforms, virtualization approaches . . .) VMware believes that they bring a key capability to the table – the ability to operate myriad environments relatively transparently. They also claim that this provides them proven credibility – and that integrating up is easier than learning to go down the stack, into the quagmire of different platforms with different characteristics.

Yet in doing so they are entering a new world of different challenges, as the leading CDSO players have an entirely different set of experiences, and strengths - ones based on service operations, existing integrations to many domains/vendors, and integration to systems and processes, in both "OSS" and "BSS" (to use old terminology) that pose different issues than virtualization infrastructure. So, as always, there will be different horses for different courses, as the old saying goes.

VMware's strength is that they grew up in the virtualized world, and live and breathe its idiosyncrasies. They will no doubt leverage their deep knowledge of their own software, and the requirements and data capabilities of others'.

The diagram below illustrates the basic capabilities of VMware Telco Cloud Automation. It is worth noting that VMware position this well beyond cross-domain service orchestration; and we believe in fact some of those external capabilities, which draw on VMware's extensive experience in infrastructure and virtualization, across suppliers, are their true strength.

Figure 1: VMware Telco Cloud Automaton overview
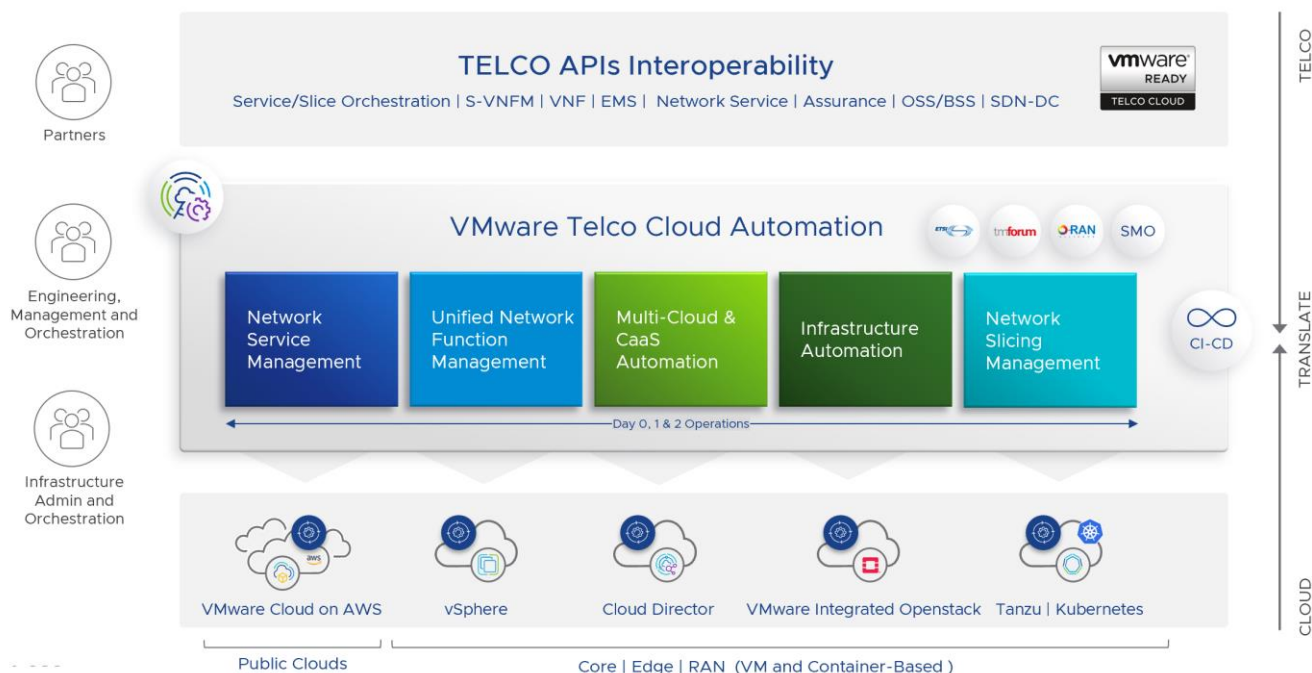
Source: VMware

Competition and Market

VMware Telco Cloud Automation competes with a wide range of competitors, large and small. These range from the major NEPs (**Ericsson**, **Nokia**, **Ciena Blue Planet**[1], **Huawei** …), to other large IT firms (**IBM**, **HPE**, **Oracle**, …) to telecom ISVs (**Amdocs**, **Netcracker***, …) to the many specialists and innovators that are not only challenging, but in some cases establishing significant beachheads (**Itential**, **Inmanta**, …).

As we discuss at length in our recent Market Outlook Report on the Cross-domain *Service* Orchestration market, we are seeing significant segmentation with players that offer different combinations of product strengths and delivery/services strengths, such that choice is often a matching of a supplier's packaging and emphasis to a CSP's unique needs and aspirations.

Positioning and Strategy

VMware's orchestration platform, initially aimed at existing virtualized workloads, cloud native workload and network-service orchestration, is a new entrant to the market, only a couple of years

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[1] Blue Planet while part of a transport NEP, is organized as an independent division, and comes from an ISV heritage.

old. And only more recently have VMware expanded their ambition to apply this orchestration platform to the cross-domain service environment.

To understand VMware's capabilities and their unique positioning it's useful to think of the basics of VMware's business. First and foremost, they are a virtualization player in both the VM and increasingly in the cloud native container space. Moreover, as an independent vendor to a very wide range of telcos and enterprises, they have deep experience and deployments on many cloud environments. These include a multitude of hardware platforms public cloud providers and NEP-delivered platforms. VMware tout this is a strength and we agree. In fact, they regularly use the term "multi cloud" and emphasize their strength abstracting those differences and allowing operators and services to work in a heterogeneous environment.

VMware are now positioning their orchestration platform to support service orchestration across domains. Again, they draw on experience since VMware is also a significant player in the SDWAN domain, in the datacenter SDN domain, and in the security domain which (when combined with cloud native underpinnings and cloud native functionality that may be chained with those) starts looking a lot like an end-to-end service orchestration environment. VMware also orchestrates virtual core and RAN domains. It is common for non-supplier ISVs to tout their independence as a virtue, and in one way it is. Yet there is also little doubt that understanding the capabilities of domain managers, including the many proprietary examples (prevalent in SDWAN and optical) can be an asset as well, and one that can be applied to other suppliers' domain controllers. True to their "network workload" roots, VMware particularly emphasize their support for the 3GPP slice management functionality as one of the use cases in which they perform cross domain service orchestration. VMware also support O-RAN, TMF and other standards. MEF support, if we read correctly, is curiously absent. There is no doubt that they can perform it in a less standardized environment as well which is often necessary.

Picking up on the capabilities noted above, VMware emphasizes that they are taking a "productized" approach to the market, meaning VMware products pre-integrated with VMware infrastructure, plus certification of non-VMware network functions through the company's *Ready for Telco Cloud program*. VMware contrast this with a more traditional integration-first approach to the market. Appledore does wish to caution that nearly everyone at least claims to be making this shift and one or two already have made it.

ARCHITECTURE AND CAPABILITIES

Context

Below, courtesy VMware, we see a contextual diagram that illustrates where Telco Cloud Automation concentrates and where it interfaces to other systems. As in Appledore's Closed Loop Taxonomy, VMware's Telco Cloud Automation performs automated healing and scaling using *the original orchestration method* (models, algorithms) taking corrective action only on the impacted segment of a service or workloads (for instance) of a cloudified resource. To those familiar with control theory this may seem obvious, but historically has not been common in telecom.

Fortunately, this behavior is more and more commonplace among leaders.

The diagram below illustrates how VMware views their Telco Cloud Automation portfolio in the larger context. They call out support for network slices, O-RAN, and multi-layer orchestration. But it's worth noting the variety of domain they choose to illustrate "below" Telco Cloud Automation – a wide variety of virtualized environments based on geography (core vs edge), business model (owned vs public cloud) and virtualization technology. Given that virtualization is VMware's first name, and they have as much or more experience across environments as anyone in telco, this ought to come as no surprise. Playing to your strengths is always a good plan.

Figure 2: VMware Telco Cloud Automation in larger NAS Context
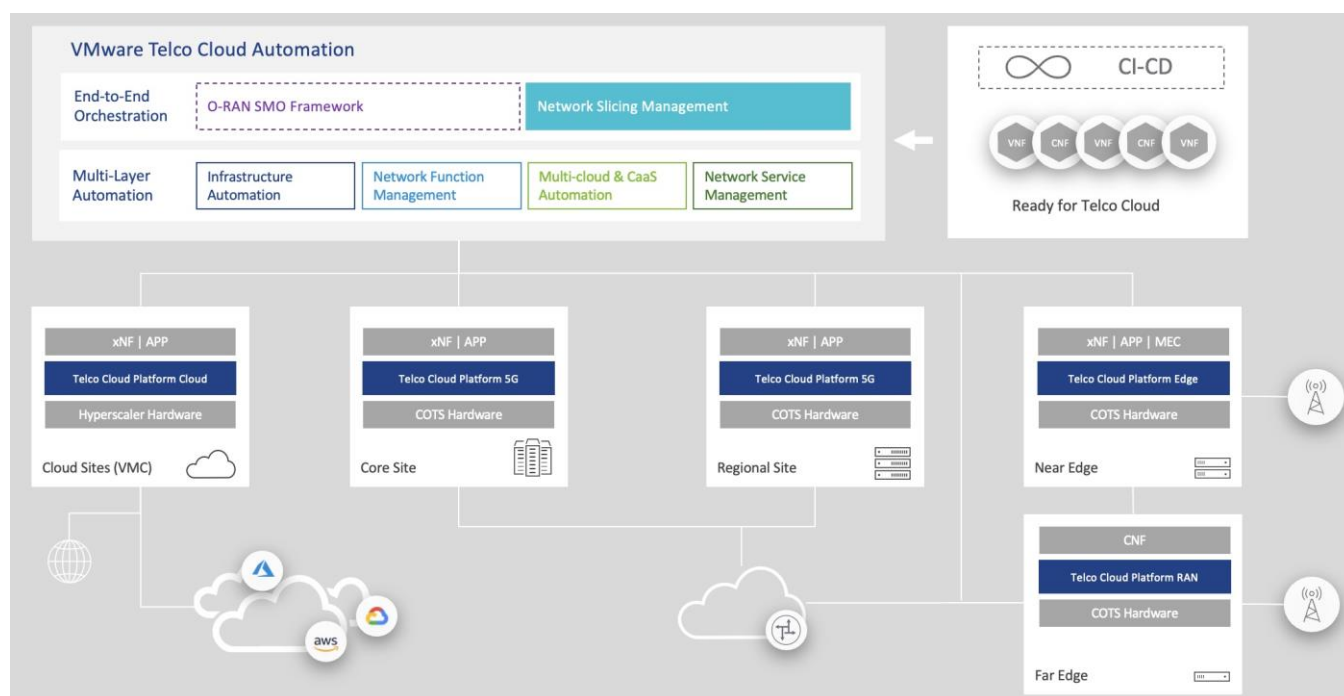
Source: VMware

Functionality

VMware *Telco Cloud Automation* is a service orchestrator that enables CSPs to rapidly design, deploy, configure, and manage network functions, network services, and cloud infrastructure. It provides a combination of intent-driven orchestration and DevOps tooling with four distinct operational foundations:

- **Intent-driven orchestration** - modelling the desired service operational state, rather than pre-programmed workflows.

- **Closed loop operation** – leverages the declarative models to allow the original process to heal and scale, given new assurance or infrastructure state information. Automated feedback loops between assurance and orchestration to enable zero touch operations.

VMware Telco Cloud Automation is an open, cloud native, technology/vendor agnostic solution. This means it is applicable to a wide range of applications across industries. VMware is looking to support a CSP in moving to cloud native networks and gaining the business benefits of cloud native: innovation and reduced operational cost.

VMware's *Telco Cloud Service Assurance* complements Telco Cloud Automation to provide an intelligent closed-loop. Together, Telco Cloud Automation and Telco Cloud Service Assurance offer a full management solution for VNFs, CNFs and NSs; including, inventory, orchestration, LCM, monitoring, configuration management, reporting and fault RCA. VMware Telco Cloud Automation can also integrate with other assurance solutions as desired by customers.

VMware *Telco Cloud Automation* focuses on the creation and management of:

- Virtualized and cloud native, multi domain workloads, resources and network services across differing infrastructures.
- Service chains.
- Network slices.

VMware Telco Cloud Automation supports**:**

Service chaining and network service lifecycle management.

- onboarding of network services artifacts or the ability to design entirely new templates.
- design of custom automation workflows through an easy-to-use designer.
- Chaining of VNFs and CNFs(including composite).
- Matches available network resources to service requirements and automatically customizes the underlying Kubernetes clusters/nodes and infrastructure to suit the service software needs.
- Day 0-2 operations supported include MANO standards functions (heal, scale, etc.) and custom workflows defined by end-user or 3rd party vendors.

3GPP standard-compliant Network Slicing management

- plan, design and instantiate end-to-end network slices across the RAN, edge, core and transport network domains.
- enables CSPs to unify these domains and close the gap between the endpoint consumed services and the required network resources, from physical or cloud infrastructure.
- CSMF, NSMF and NSSMF components of network

Agility and Service Innovation

- Telco Cloud Automation is designed with a product approach instead of a traditional integration-intensive one.
- Support for many domains/vendor VMware Ready for Telco Cloud program (certifying SOL001/4 compliance and LCM operations).
- Industry standards, including ETSI, 3GPP, TMF, and O-RAN
- Visual composer to create network services and network slices across domains

Support for "aaS" Exposure

- The Telco Cloud Automation network slicing module will support the standard CSMF interfaces to connect the order management with the network available resources, offering the "aaS" model for provisioning network resources of the specific use case requirements.

A Cross-Domain Orchestrator is relatively useless until integrated to domains and to other critical NAS and BSS to handle orders, issue declarative sub-orders, and capture intelligence on which to act. VMware claims both a large library of integrations (including pre-built and tested CNF/NF models) and extensive support for standards.

API Support (Southbound)

- Telco Cloud Automation integrates with AWS and Nokia's CBAM. Telco Cloud Automation supports ETSI SOL003 and ETSI SOL005 for domain and S-VNFM integration levels. The NSSMF integrates with NSMF through standard 3GPP APIs.

Telco Cloud Automation supports out-of-the-box ETSI SOL005 and TMF APIs as northbound interfaces. The CSMF will support TMF 641, TMF 633, and TMF 638 APIs

- VMware also has a robust group of network function partners certified on its technology (250+ network functions certified from all major equipment providers). As part of Telco Cloud Automation's efforts, many of these partners now integrate their VNFs and CNFs to both automation and infrastructure layers of the Telco Cloud (refer to the VMware Telco marketplace below for all certified partners).

The diagram below, also courtesy VMware, illustrates the features that they feel are noteworthy, within each of several automation areas. It is worth noting that they call out not only *what* they do, but often *how* they implement/accomplish it.

Figure 3: VMware Telco Cloud Automation automation packages and featured capabilities


Source: VMware

Closed Loop Automation and intent-based operation:

VMware implements the key best practices that Appledore recommends for automation, including model-based operation, declarative (intent-based) operation, domain-driven design, and a single platform for fulfilment/healing/scaling. The diagram below, Appledore's high level reference for closed-loop best practices, calls out some of these, and the "whys". VMware claims to accomplish each.

Figure 4: Appledore Research best practices for Closed-Loop-Automation
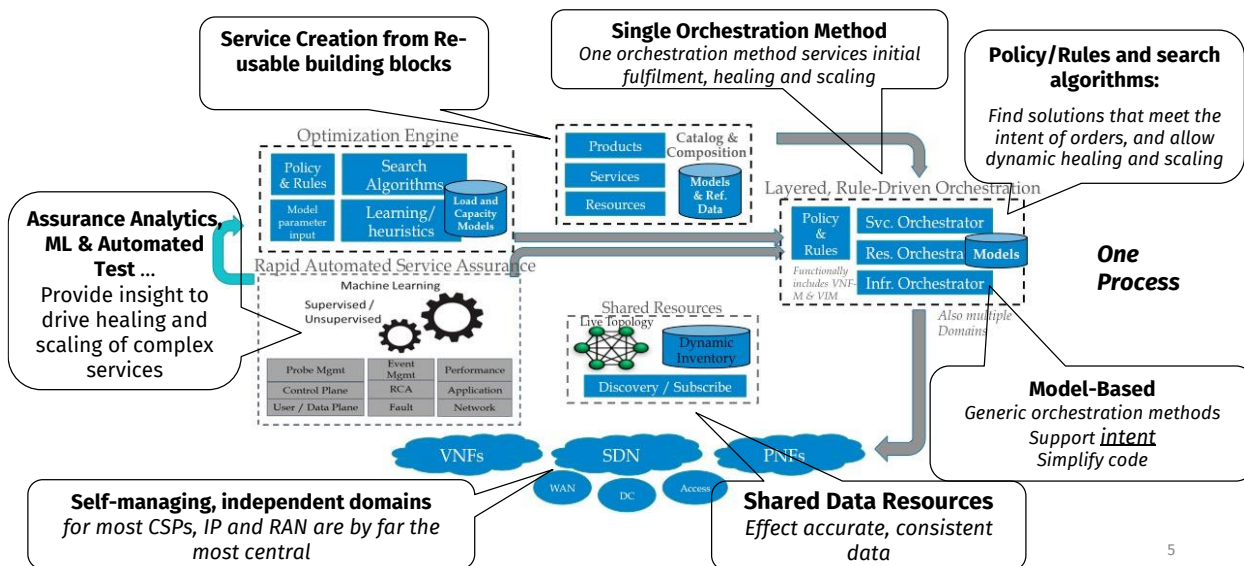
Source: Appledore Research

MARKET IMPACT

Cross Domain Orchestration: An embryonic market in transition

The cross-domain service orchestration market is embryonic but forecast to grow rapidly over the next 5 years. This is in part explained by the innate conservatism of CSPs, combined with the very real complexity of their network and operational environments. This creates an apparent paradox for those who scrutinize this market. On one hand, the vast majority of suppliers claim very advanced technology and capabilities that support automation, and the quality of responses over the past 2+ years has risen dramatically – from primarily workflow-based solutions to true, intent-based, closed-loop capable, solutions. Yet, on the other hand, the reality of commercial deployments does not yet demonstrate these levels of sophistication. We are clearly on a journey, and operators are proceeding cautiously. To be fair, such radical change is not only complex, but also labor-intensive, so this ought not be entirely surprising.

From the examples we have seen *across all suppliers*, operators are testing technology before they turn on full automation and, so far, are orchestrating across only a limited set of domains. As further evidence, back in 2018 we noted that while many leading CSPs had big plans to transform their SDWAN businesses into dynamic, multi-service, on-domain powerhouses, in reality they initially had no automated cross-layer assurance, nor automated healing – to say nothing of proactive healing! The good news is that by the time we revisited in 2020, many of these omissions were implemented or in the process of being implemented. The bottom line is that we must treat these evolutions as works-in-progress and anticipate course and speed with confidence that the industry will in fact continue to progress.

The table below provides evidence for VMware's progress in the CDSO market, specifically those deployments that meet Appledore's criteria for modern, next-generation and cross-domain service orchestration. In VMware's case, there is no "legacy" *Telco Cloud Automation*, so all of their deployments meet our technical criteria. We note that Telco Cloud Automation was introduced initially with a focus on multi-cloud domain management, and only recently is being positioned in CDSO. The market evidence, therefore, is understandably thin. We will monitor how this progresses over the next 18 months. IN the table, we note a consistent pattern: while there are no "CDSO" deployments (using our common criteria), VMware is specifically selected and deployed to meet two goals. First, cloud native workload and NF operation. Second, abstraction and unification across multiple datacenter infrastructures from different vendors and possibly employing different virtualization technologies. We include the market examples below since those underlying infrastructures, while all the "cloud/datacenter" domain, represent such potentially differing granular operations. Therefore when VMware Telco Cloud Automation, when managing VNF/CNF workloads, is performing a "domain" abstraction and automation function. And in the end, this is VMware's core competency. Its never bad to play to your strength.

Figure 5: VMware Telco Cloud Automation CDSO Market Deployments, as of EoY 2021

Operator	Service Supported
Dish Networks (USA)	Multi-cloud, cloud-native abstraction and orchestration. While an impressive and forward looking deployment this is only marginally CDSO – if we call multiple vendors of datacenter abstraction "domains". The CDSO in Dish is IBM.
Telia	Similarly, VMware has been selected below the CDSO layer, to abstract various infrastructure and create a common cloud-native resource management layer for Telia. In Telia's words: "Telia has selected VMware Telco Cloud Platform as the common network horizontal digital platform on top of which 4G and 5G core network functions—both virtualized and containerized – will run. It is a cloud-native platform that enables Telia to rapidly deploy and efficiently operate multi-vendor CNFs and VNFs with agility, scalability and resilience."
Vodafone	The press release headline says it all: "Vodafone Selects VMware for Automation and Orchestration of all Workloads Running on Core Networks Across Europe"
Others Under NDA	Additional customers in Europe, Latin America and APAC.

Source: Appledore Research, VMware

APPLEDORE ANALYSIS

VMware, is aggressively expanding from being a "virtualization infrastructure" player, next into the management of virtualized infrastructure (which Appledore terms "DCI" in our network automation software "NAS" taxonomy), and now is expanding up the stack into slice, network service and cross-domain service orchestration.

In a slight over-simplification, suppliers are either expanding "down" from positions in BSS and service order handling, or "up" the stack, typically from network functions –or in VMware's case, network virtualization infrastructure. Top-down players leverage their understanding of commercial and operational processes. NEPs leverage their deep knowledge of how network kit (at least their own) works, and how to best manage it. VMware is taking a slightly different track, and leveraging their knowledge of how virtual infrastructure works, and their familiarity with many different flavours of virtualized infrastructure, including:

- Their own, as well as 3rd parties
- VMs as well as containers
- On-prem datacenters as well as public cloud facilities
- Major datacenters as well as edge

VMware play in each of these spaces, and credibly claim familiarity with each, and. – disbelief suspended -- the ability to normalize them such that operations can exist without seems across these multiple clouds. Very few firms can compare to the on the ground experience that VMware has with myriad forms of network virtualization.

As of today, most of VMware's orchestration deployments focus on managing hybrid cloud environments – their core strength. VMware's own "market evidence" use cases confirm this (see table above) and in fact, VMware labels it support for network slices as a roadmap item, apparently in the lab and testing today. Especially, as slicing comes online in their solution and as their cloud domain deployments prove their worth, there is nothing to stop VMware from expanding up the stack. IN fact, several prominent firms believe that it may be more practical to "aggregate up" toward end-to-end services, than to somehow anticipate and normalize all the functions, a priori, from the top down.

Like a few others, VMware's platform is pretty much all-new, and therefore legacy free. By the same token, it is all new and therefore probably still a work in process, gaining features, and deployment references, over time.

In the Appledore Network Automation Software Taxonomy diagram below, VMware's Telco Cloud Automation today occupies the *cloud domain* orchestration box, and handles pieces of the *cross-domain or service* orchestration box. In all of VMware's deployments today, they sit one layer below a true CDSO system (e.g.: IBM at Dish). Yet that may change with time, and with proven success. The CDSO market is still young, growing and full of opportunity for disruption.

Figure 6: VMware Telco Cloud Automation in the context of the Appledore NAS Taxonomy
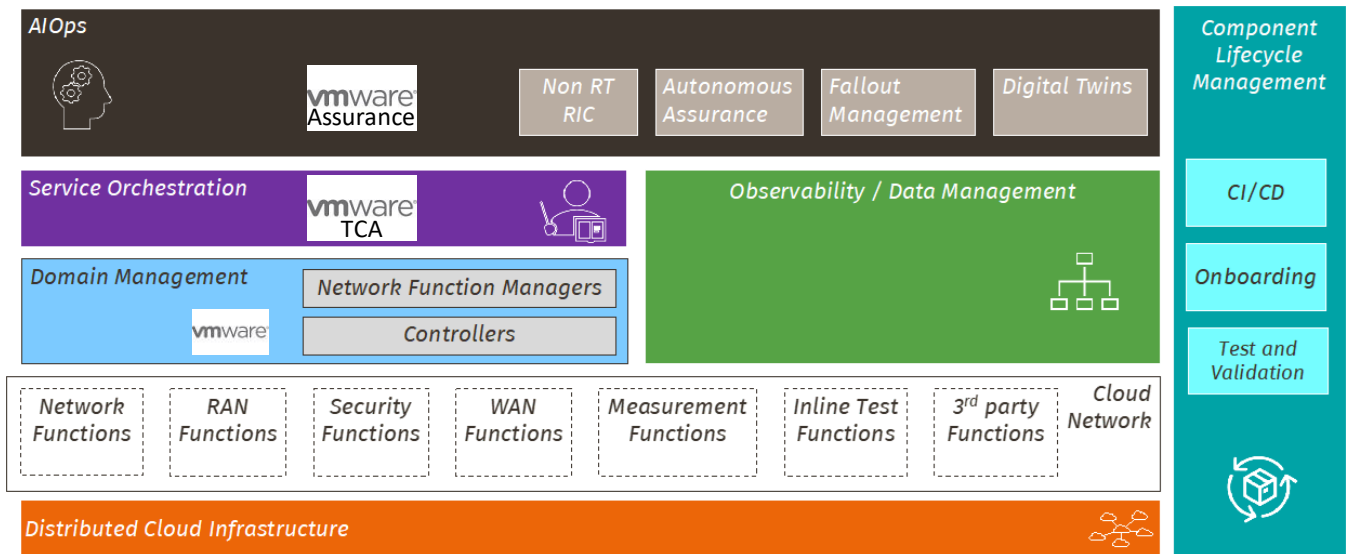
Source: Appledore Research

SWOT

Strengths

- Strong profile and credibility among senior IT buyers.
- Already engaged in high-profile programs, specifically Dish.
- Relationships with NEPs and other complementary players.
- Modern cloud native solution, supporting closed loops and declarative models.

- Familiarity with multiple underlying cloud platforms.
- familiarity with VMware networking products including SDWAN controller.

Weaknesses

- No "true" CDSO deployments as of today, although several multi-cloud abstractions.
- Less visible experience in managing legacy domains.
- May have fewer off-the-shelf adapters that CSPs like to see.
- Inexperience with the broader picture of OSS, BSS and especially legacy infrastructure.
- Limited field deployment resources especially with NAS/OSS?BSS expertise.

Opportunities

- Together with adjacent tier-1 vendors, establish a de facto standard stack of pre-integrated software.
- Opportunity to grow from extensive cloud domain deployments, up the stack. It is unclear where the natural point to stop is.

Threats

- VMware faces competition from more players and segments than have traditionally played in service orchestration
- Competitors will no doubt paint VMware as a lower level plumbing company, blocking upward expansion. Are they right?

SUMMARY

VMware, over a period of only a half dozen years has transformed itself from a virtual machine infrastructure vendor, into a cloud-native leader that delivers cloud-native across infrastructures, SDN infrastructure (NSX), SDWAN infrastructure (VeloCloud) and a range of security capabilities from the cloud and delivered as part of their SDWAN solutions.

In the management (NAS) domains VMware's multi-cloud abstraction and operation is particularly interesting. It is both *critical* (to unify infrastructure, simplify operations, and enable the "law of large numbers"), and *credible* – since VMware itself has learned about multi-infra abstraction as it transitioned from VMs to containers, with coexistence, over the years. They have expanded this to other suppliers' infrastructure as well as public cloud infrastructure.

CDSO appears to be their next target. Certainly VMware has a base of expertise from its own SDN/WAN transport portfolio, combined with its cloud-native NF management depth. To a large degree their success, or failure, will be driven by an external market choice: "will service orchestration follow the top down model, or the bottom-up model?". The latter favors suppliers such as VMware. There too is a third path: a hybrid of layer orchestration – which we are beginning to see evidence of, including in places such as Dish Networks, which has a collection of orchestrators.

Regardless, Telco Cloud Automation offers many virtues. It is cloud native; it is intent based; it supports many standard interfaces out of the box, along with many NFs and partners pre-integrated. VMware certainly "gets" virtualization (including cloud native operations) – which was a question with many traditional telco OSS vendors early on at least.

Yet, in the end, we wonder if VMware is best served by doubling down on its strengths (cloud resource and NF operations), leveraging their proven abstraction and unification, or trying to move up another layer into a very crowded field? Over time the market will speak, but often the most successful firms are good at knowing their strengths, focusing on them, and exploiting them.

Regardless, VMware's orchestration bears attention, whether in the cloud domain or beyond.

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@AppledoreVision

Appledore Research

www.appledoreresearch.com

info@appledorerg.com

+1 603 969 2125

44 Summer Street Dover, NH. 03820, USA

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