

Netcracker

Cross-Domain Service Orchestration

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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.

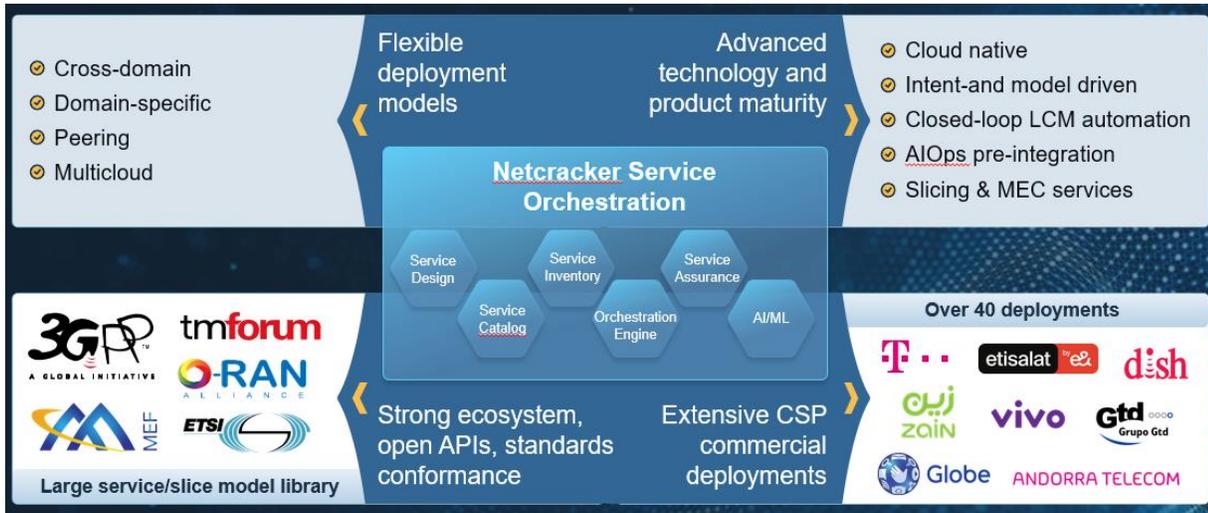
In this profile we look at how **Netcracker** delivers those cross-domain capabilities. Appledore will cover individual domains (e.g.: cloud native orchestration for datacenters and edge), SDN, and SDWAN in related but separate research tracks.

NETCRACKER SERVICE ORCHESTRATION SOLUTION

The heart of Netcracker has long been inventory-driven fulfilment. Today, in the emerging telco cloud environment, orchestration assumes that place at the heart of Netcracker’s Network and Service Automation (what Appledore defines as “NAS”) solutions. This capability is based on Netcracker’s latest modular Digital OSS suite and serves at the heart of their Open RAN, SDN, NaaS and other packaged solutions. According to Netcracker, it is a key investment area and represents extensive new code. Specifically we can say that it includes many components built using container-based microservices and that orchestration is driven by service/network models, rules and other algorithms (more on those later).

The diagram below, courtesy Netcracker, illustrates their CDSO solution in the larger context. It is worth noting that Netcracker positions the software both for key domains and across them, yet maintaining domain independence. The various industry standards and associations allude to the functional fit and pre-integration that applies across domains, but often also specifies support for domains (slicing, MEF, ...). The primary difference between intra-domain and inter-domain orchestration is the models and rules created/on-boarded.

Figure 1: Netcracker Service Orchestration Can Manage Within Domains and Across them



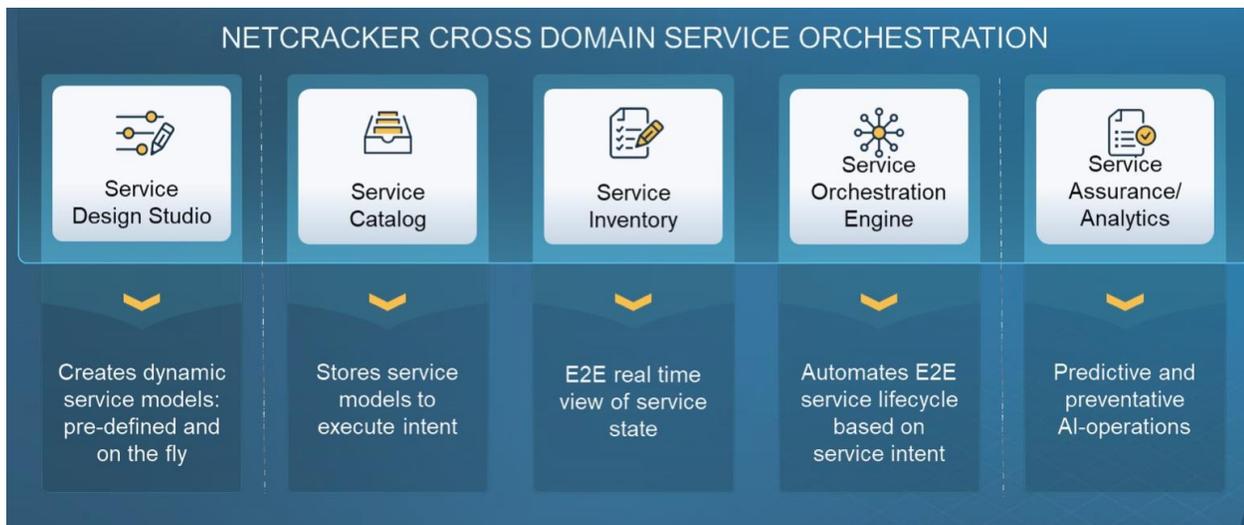
Source: Netcracker

Netcracker Service Orchestration operates both in domains and across them. This plays to Netcracker’s historical strength, which is taking on an end-to-end project, often for SPs without the resources (or desire) to manage multiple suppliers or do the overall project themselves. Netcracker claims wide support for open APIs and various industry initiatives – including TMF, ETSI, 3GPP, O-RAN and MEF.

While Netcracker advocates its ability to manage domains themselves, they also have proven integration with a number of third-parties, including SDN controllers, elements/network management systems. We documented their end-to-end solution for “SDWAN++” in a profile not long ago (available on Appledoreresearch.com).

The diagram below illustrates the five primary functional models within Netcracker’s Service Orchestration suite. The modules may be delivered independently, as is evidenced by Netcracker’s support for, for example, the TMForum Catalog API. That said, Netcracker’s traditional business focus has always concentrating on delivering larger turnkey projects that utilize combinations of its software. It is worth noting design linkages, including the catalog models (which define the intent for a given service) matching to the orchestration engine which has algorithms/rules to interpret intent and find specific solutions.

Figure 2: Functional Software Modules within Netcracker Service Orchestration



Courtesy: Netcracker

Competition and Market

Netcracker competes with a wide range of competitors, large and small. These range from the major NEPs (**Ericsson, Nokia, Huawei** ...), to large IT firms (**HPE, IBM, Oracle**, ...) to other telecom ISVs (**Amdocs, Blue Planet***, ...) 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

Netcracker has long been an independent subsidiary of **NEC corporation**. This association is looser than the management software divisions of many NEPs and yet, Netcracker has gained benefit from close work with NEC and its large customers, such as NTT early in the days of virtualization, to gain real-world experience that shaped its product capabilities, and infused its professional services with practical experience.

While Netcracker has the ability to dive down into network domains, the real focus of Netcracker Service Orchestration, and we note this is a traditional focus of theirs, is enabling end-to-end services. Historically that often meant surrounding a specific technology's (e.g.: consumer broadband) network operations with all of the commercial and operational tasks necessary to mechanize the process, ensure billing, etc. Today, that will increasingly mean abstracting multiple domains and linking them together to enable complex network services, and as we look forward, innovation. Tomorrow's innovation, in Appledore's opinion, will doubtless demand the integration

of SPs’ network assets (as “NaaS”) with domains and assets outside their network, specific to various verticals. Here, Netcracker is well positioned, both product/technically, and with their project and services focus.

Netcracker’s various Network and Service Automation and BSS solutions can be sold and deployed either on-site as licensed software, or in public clouds, or in public clouds “aaS”. They specifically note support for AWS, Azure and Google Cloud Platform environments.

ARCHITECTURE AND CAPABILITIES

Netcracker Service Orchestration is, according to extensive documentation from Netcracker, an entirely new approach to fulfillment, and one consistent with Appledore’s recommended industry best practices to achieve elegant automation.

At the heart of automation and innovation are a few core design principles that permeate everything; domain driven design, loose coupling, model driven orchestration, intent based operation, and all wrapped into a single orchestration method that supports network resources and services through the entire lifecycle from fulfilment, to healing and scaling – which, done right, become cases of re-fulfillment. While these appear to be the weeds, they are not – they are the roots that will allow healthy growth. Without them, an SP will degenerate back into spaghetti code, and crushing re-integration and maintenance burdens.

Netcracker calls out the following characteristics, which we will comment on.

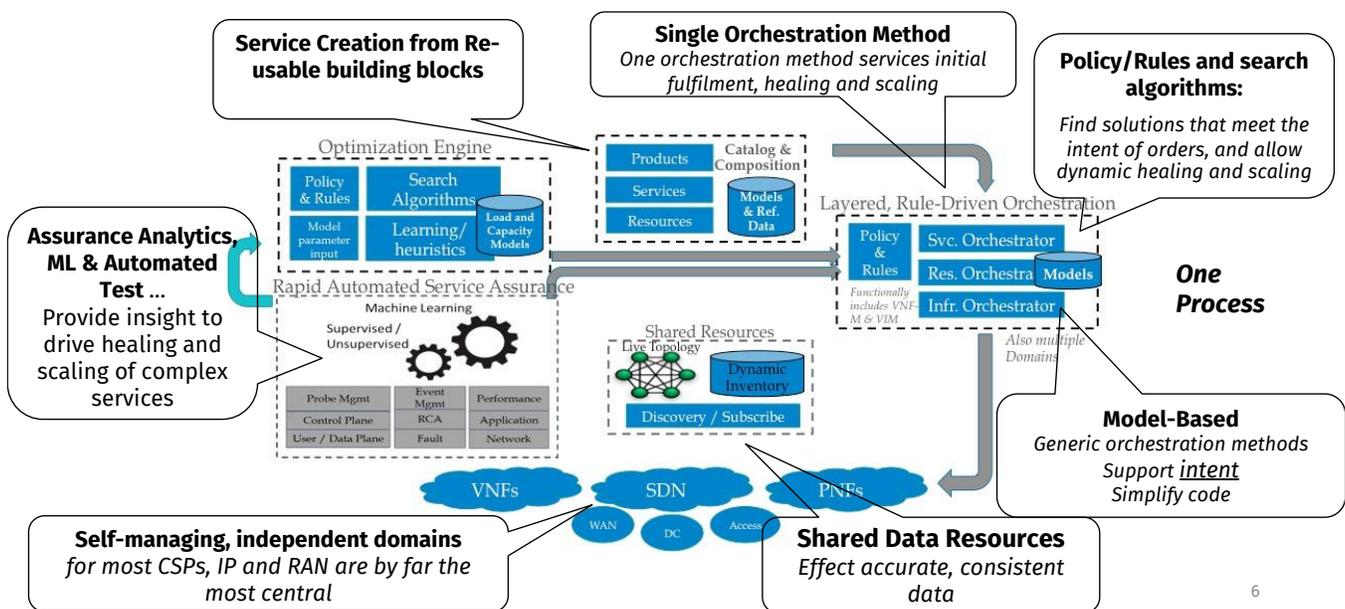
Characteristic	Appledore Commentary
Automated design and LCM in closed loop: Services, slices, MEC services	Netcracker indeed operates a single closed loop for all LCM processes. Handling of all LCM is essential for automation. A single process/method is essential for simplification and to adhere to well proven control theory methods.
Intent-based orchestration	Netcracker utilizes intent both within domains and across them. They also claim to have developed a combination of an ontology (deterministic dependency graph) and ad hoc ML that provides a powerful abstraction, yet clearly constrains choices such that intent may be successfully fulfilled.
Large catalog of service and slice models	Pre-built templates simplify the development of common service types, and likely greatly reduce errors. It also acts as a method of ensuring complete operational models, which was an early learning of Netcracker’s association with a large customer.
Open APIs between components compliant with standards	Open APIs are critical at many layers – north to orders and BSS, south to autonomic domains (they can’t be autonomic without loose coupling, now can they?!). This also eliminates a significant custom effort that often results in ongoing maintenance of proprietary efforts.
Cloud-native	Cloud native has two aspects. Yes, the software itself is cloud native which means it can operate in shared datacenters, scale well, etc. But more importantly, Netcracker supports cloud-native operations for network workloads and services – the focus of this document.

Characteristic	Appledore Commentary
Pre-integrated with AI-Ops	Netcracker has pre-integrated with its own AIOps components and with all major AI-Ops vendors. Use cases such as preemptive maintenance, anomaly detection on various network segments, optimization suggestions and RAN optimization (including rApps) are supported out of the box.

Commentary: Appledore Research; Characteristics: Netcracker documentation

The diagram below, from our research, provides an objective check on these characteristics. It documents many of the best practices that we believe are important for long term automation, agility, and to reduce the huge complexity and maintenance most SPs experience in their legacy OSS. These are adopted from other industries, including ballistics, robotics etc. Netcracker documents support for each of these, sometimes using slightly different terminology. Yet the points are the same – domains manage themselves, orchestration provides the intent, code is minimally deterministic, the code is common while models determine behavior, and a single closed loop handles all life cycle actions etc.

Figure 3: Appledore Research Best Practices for Orchestration and Automation



Source: Appledore Research

The Magic Behind Netcracker’s Intent

Intent is easy to say, and harder to accomplish. It challenges engineers to pass by the simple “configure it this way”, and boil things down to what really matters – to the customer (e.g: performance) and to the SP (e.g.: cost, load balancing). From these minimum necessary constraints, some magic must find real-world solutions that meet all the criteria. Netcracker was particularly specific about how they accomplish this.

According to Netcracker, they have implemented:

“A unique way to implement intent using ontology, which does not depend on static or manual task modelling, and a unique method to execute the implementation using a scalable choreography engine, enabling dynamic intent execution.”

Netcracker continued, saying:

“While an AI/ML approach seems to be the most popular solution, the greatest drawback is the need to train the AI/ML models with environment-specific data which takes time. Netcracker created a hybrid approach that incorporates AI/ML learning but also streamlines automation by using a formalized knowledge/experience (ontology).”

Our research across many suppliers and CSPs indicates that ML is actually used quite sparingly *within the real-time orchestration loop*, and is mostly used in the “slow loop” to slowly find new correlations, anomalies, etc. The “fast” loop is most often rules trees and/or related search algorithms. Our best take, reading into their explanation, it appears that Netcracker define intent as a set of dependencies, and solve it with algorithms that either search or span logic trees (Appledore’s guess, now confirmed by Netcracker). They also claim to apply ML to the problem, presumably to learn both good solutions and unsuccessful solutions to various intent (also Appledore’s guess). The point however is that Netcracker have gone to some depth to make intent work, and to explain it. They also claim to have a low-code approach to defining/creating intent service models. This is particularly valuable since, in our major research on intent we note how it can meet the technical definition of intent while being either “good” or bad”. I can intend to hit the ball up the 3rd base line (good). I can also intend to swing at X speed, Y milliseconds early to accomplish this (needlessly specific; bad). Getting that level of abstraction from the imperative can occur at any level – and choosing the wrong one invites error.

Standards and open APIs

Netcracker is embracing standardized and abstracted methods of interfacing to systems North, South, East and West. A high level map of compliance is in Figure 1 above. A more detailed list, without an effort to be exhaustive, includes the 3GPP network slicing model including NSMF, NSSMF, and NFMF. Slicing, while “RAN-ish” is consistent with Cross-Domain Service Orchestration, since network slices are likely to be at the heart of many enterprise private networks and customized services, especially in the growth areas of IoT. Netcracker also supports TMForum Service Catalog (TMF 633), Service Inventory (TMF 638), Resource Inventory (TMF 639), Activation and Configuration (TMF 640), Service Ordering (TMF 641), and Service Qualification (TMF 645), as well as MEF Legato, Interlude (which in turn use TMF envelopes) and Presto. These interfaces provide the integration points for service and ordering parameters, and to external reference data such as catalog entries. By using APIs three benefits are realized: simpler implementation, less maintenance, and looser coupling (also impacting less maintenance).

Netcracker has existing support for a range of domain controller and vendor product controllers such as SDWAN, security, transport controllers, RAN controllers from major and significant niche players. Netcracker provides the following (incomplete list of...) examples: ONAP, ONOS, OSM,

Huawei NFV-O, OpenDaylight, Juniper NorthStar, Juniper NSO, Juniper MIST, Juniper CSO, Juniper JunosSpace, Nokia NFM-P/T, Nokia NSP, Cisco NSO, Huawei NCE, Ciena BluePlanet MCP and MDSO, Cisco ONC, Versa SD-WAN Director, Fortinet FortiManager, Nokia Nuage, Vmware NSX, ADVA Ensemble Controller, Affirmed UnityCloud, Casa Systems Axyom 5G, Metaswitch Fusion Core, Nokia SDM, Nokia 5G Core etc. Being a dynamic list, it is likely to be out of date beyond the publication date of this report, so we point interested users to Netcracker's website documentation.

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 five 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, many 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 Netcracker's progress in the CDSO market, specifically those deployments that meet Appledore's criteria for modern, next-generation and cross-domain service orchestration. According to Netcracker, since 2019, they have 44 deployments of CDSO at CSPs across all regions, including multiple commercial projects for the same customer¹. All therefore represent Netcracker's E2E Service Orchestration solution as represented herein; is cloud-native, microservices-based, intent based etc. Approximately 40% of deployments are cross-domain and

¹ This raises a question, more for CSPs than for Netcracker, of why there would be multiple projects with independent CDSO solutions for different technologies and services, if CDSO is intended to be the point where agile innovation can occur across existing domains and technologies.

the rest are multilayer/domain and multivendor within a specific domain related to services and slices (not at the resource or controller level). The most popular domain today is the orchestration of multivendor SD-X (WAN/LAN/WiFi) for the B2B market. Appledore notes this is consistent with our findings and SDWAN/ "new enterprise" research stream. Of these, 28 were entirely new projects to Netcracker, and the balance were upgrades of previous generation orchestration/fulfilment.

Figure 4: Illustrative projects/deployments (all since 2019)

Operator	Project Focus/Scope
DT – Network Automation	Multi-vendor, multi-layer transport and transport service automation. Includes both CDSO layer, and transport-domain layer orchestration, supporting multiple IP and optical vendors. IP is direct via Netconf; optical is via SDN controllers due to the unique attributes of most optical equipment.
DT – B2B Edge (“SDWAN+”)	Automate SD-WAN/LAN/WiFi service provisioning and lifecycle management, with AI-driven alerts and diagnosis across end-to-end source-to-destination path. Vendors include Juniper in the SDx layer.
Etisalat Multi-Layer Slice Management	Comprehensive solution showcasing Netcracker’s ability to perform everything from order management, through cross-domain orchestration, and into domain orchestration – yet maintaining the layering and loose coupling internally. Flow extends functionally from digital order through predictive assurance and healing of multi-vendor network slices.

Source: Appledore Research, Netcracker

The Broader Package: A rich set of services, and a broad portfolio

Netcracker can and does provide CDSO on its own, and yet that misses Netcracker’s focus and strengths. From where we sit, Netcracker differentiates in the delivery of complete solutions, de-risking and reducing the complexity of many moving parts (vendors). One aspect of this is their huge inventory of OSS and BSS that can be brought to bear, both at domain layers (as noted above), at the CDSO layer, in AIOps and in BSS (OM and Billing). The second way they distinguish themselves is with the services, both project-related and technical, to help both build and train their customers. Their focus on a comprehensive method for modeling services and service components (which after all are just smaller services) in order to simplify the implementation of intent is a good example. Netcracker claims to have learned a lot about modeling and operations early, as they worked jointly with a large anchor SP, to learn the ropes of virtualization and LCM orchestration.

This combined with an extensive library of already-integrated controllers and vendors is an intangible that must be considered, especially by other than the largest SPs.

APPLEDORE ANALYSIS

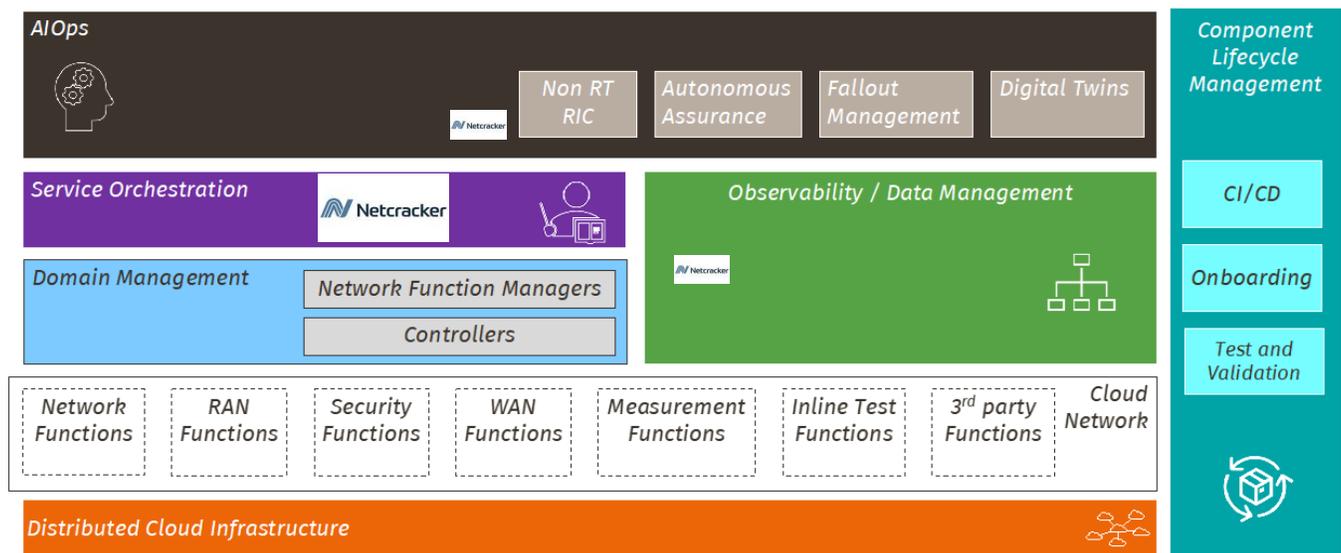
Netcracker has a long history, from inventory, to fulfilment, to turn-key solutions, and yet is entering a new phase with modern orchestration technology. At first blush this is far less services-intensive – which is where Netcracker traditionally made its money. But on closer examination, the path to the telco cloud is a long and complex one, with plenty of work to go around. It looks like Netcracker has traded services building custom deployments, for services building better models, training customers in the ways of DevOps, and in the ways of model-driven services. We believe that ideally this is an industry story, not just a Netcracker one, and can only be a good thing for agility, innovation and long term competitiveness of the SP industry.

Netcracker sits in an unusual position as technically a NEP (owned by NEC) and yet with its origins as an ISV and operating entirely independently. Except... early on they had the luxury of working closely with NEC and a Tier-1 client to work out some of the issues in the seismic transformation from static, physical networks to dynamic, cloudified ones. And that cloudification includes things that remain as PNF, but are liquid in their configurability – such as the most advanced IP and optical gear.

With some vendors it is easy to say “yes, they do orchestration, but really only in these domains” or “yes, they do orchestration, but really only focus on the near-BSS functionality”. Netcracker is more complex, operating in both spheres, although their history points to a business and service level focus, while their ownership to a network level focus.

In the Appledore Network Automation Software Taxonomy diagram below, Netcracker’s Service Orchestration occupies the service orchestration box. We also note that the same product, with different models, is employed in domain orchestration for both transport/IP and cloud-native workload management, and illustrate the related service dependency graph and AIOps (for healing, scaling) as supporting, optional, functionality.

Figure 5: Netcracker Service Orchestration in the context of the Appledore NAS Taxonomy



Source: Appledore Research

SWOT

Strengths

- All the key concepts and best practices covered.
- Modern architecture supporting CI/CD.
- Broad portfolio.
- Strong professional services support.
- Strong support for intent – both at domain layers and across domains.
- Hands on experience with NEP parent and early innovating SP.
- Credible references globally, solid volume of CDSO and domain SO deployments.

Weaknesses

- Others seem to have better support for SI or DIY delivery.
- Far weaker network pull-through from NEC, compared to some others.
- Is history obscuring their modern orchestration story?

Opportunities

- Loyal customer base willing to take the Cross Domain and modernization journey with Netcracker.
- Strong sales machine.

Threats

- Threats from above where the Tier-1 market is increasingly crowded, and below, where the smaller SPs may risk reduce via pre-integrated NEP solutions, some of which have made significant strides.
- Not unique to Netcracker, all players are challenged by the increased number of credible players, including giant IT firms.

SUMMARY

In the end, Netcracker aspires to exactly the goals we see for CDSO – the ability to create and dynamically manage new services, to expose APIs/NaaS to 3rd party innovators, and to deliver a high level of automation. Their work to simplify intent *at the cross-domain service layer* illustrates at minimum that they recognize this opportunity and need. Netcracker supports a wide range of standards/APIs as well as having a significant library of integrations – most of which are in the end, domains.

Netcracker remains Netcracker, and therefore is not a specialist on CDSO only. They maintain a broad portfolio and apply not only their CDSO assets but also charging, AIOps and other assets both at the CDSO level and within domains, calling out RAN and cloud specifically – but also providing an example in the multi-layer, multi0-vendor transport arena.

We are pleased to see their adherence to modern best practices and that they avoid traditional imperative methods, tight coupling and silos. In this crowded market there are “horses for courses” as the saying goes, and Netcracker makes a strong case where complex services, innovation and project delivery are all priorities.

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