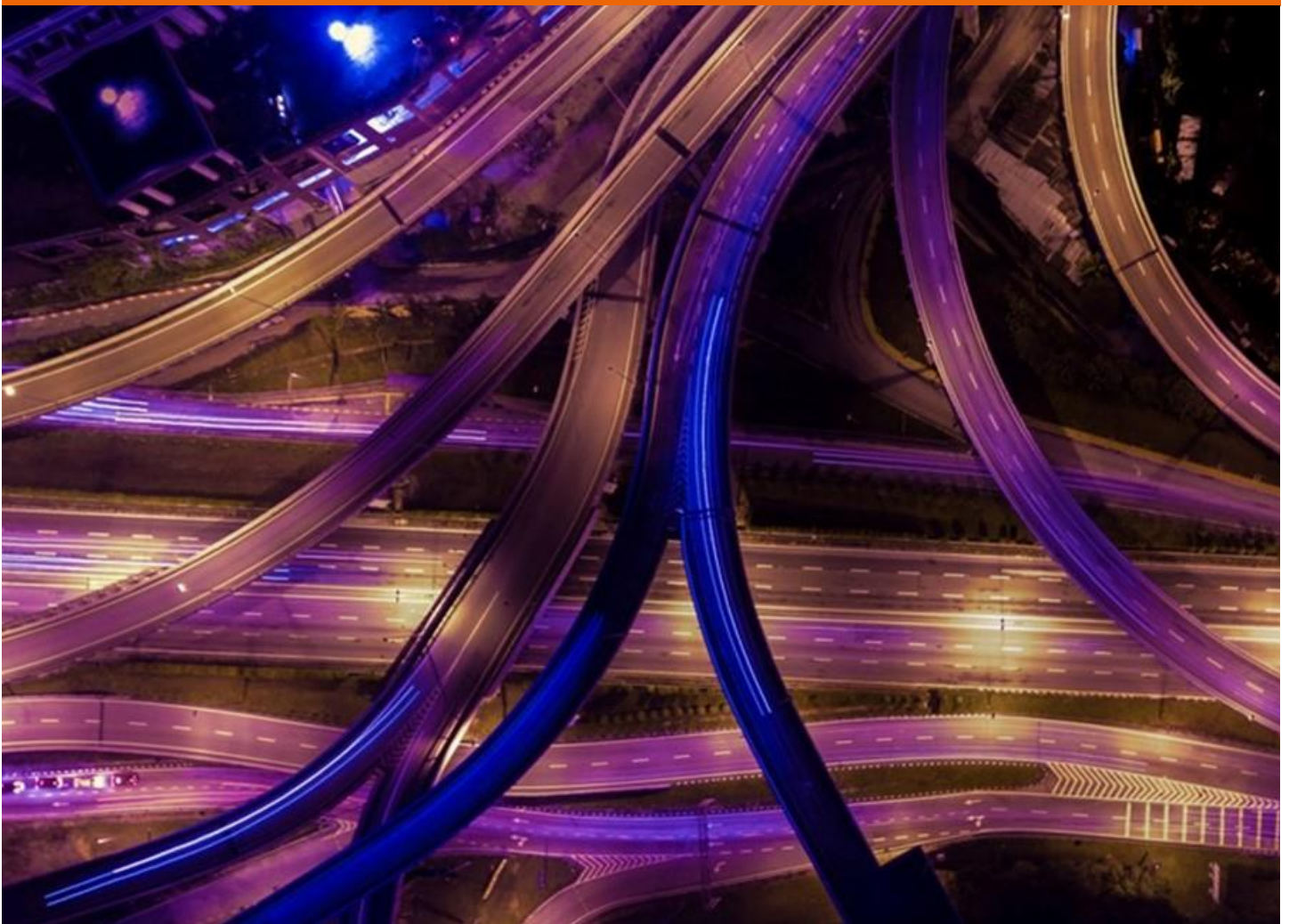


Netcracker

Network Domain Orchestration

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Published by Appledore Research LLC • 44 Summer Street Dover, NH. 03820

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Publish date: 4/17/2023

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INTRODUCTION

This solution profile is part of a series that accompanies our new market outlook report on automation in the transport domain. This research looks at the state of the art in automating IP/Optical (“transport”) networks and services. Our focus is on L2/L3 services, but with full observability of Layers 0/1. This profile focuses specifically on Netcracker’s Network Domain Orchestration (“NDO”) solution for transport domain(s) automation.

Our research on transport is part of Appledore’s focus on the software, technology and processes that will be necessary to transform networks and services from their static and labor-intensive current state to a dynamic, often cloudified, and highly automated future state. We believe that the objective of automation must be far broader and more strategic than mere cost reduction. Rather, automation must also enable an increase in agility and cost-effective innovation in the emerging digital economy. Appledore is conducting complementary research in the areas of end-to-end service innovation, the automation of data centers and telco cloud infrastructure, and Open RAN. Critical to, and supporting all of these, is our research stream in AI-Ops and the application of machine learning (ML) to all domains.

Without IP/optical domain automation; network slicing is impractical, service providers will forego significant new revenues in the enterprise WAN segment, and new innovative services will languish either because they are too difficult to design, too slow to introduce, or too costly to introduce and deliver. IP/optical automation will also be critical to efficient deployment, configuration and life cycle management of C-RANs and Open RANs.

Appledore’s taxonomy for network automation software (“NAS”) specifically relies on autonomic and independent domains – linked together by capabilities such as componentized catalogs and E2E Service Orchestration. Each of these domains implements its own automation and typically orchestration – delivered by specialists in that particular domain (IP, optical, Radio/RAN, etc.). Netcracker supports layers 1-3 with full correlation and therefore contextual life cycle management.

We encourage readers to first read our [Market Outlook on Transport Domain Automation](#).

NETCRACKER CORPORATION

Netcracker is a wholly owned subsidiary of NEC Corporation, operating as an independent entity, with its own headquarters and leadership team in greater Boston, USA. Netcracker began as an independent ISV, later acquired by NEC. On the other hand, Netcracker has benefited from close association with NEC on network technologies such as SDN and early work on NFV, in association with large NEC CSP customers. That said, Netcracker strongly defends its independence and its validity as a relatively neutral, multi-vendor ISV.

Netcracker has long been one of the few firms that maintains a “complete stack” with meaningful portfolios in all aspects of operating a public telecom network and business, including network automation, traditional OSS, order and catalog management, revenue management, and customer experience management. Within network automation software (“NAS”) Netcracker has strong assets

in network data management; orchestration, and AIOps, enabling them to fully “close the loop”. Netcracker also cover the major technology/network domains including “end-to-end” orchestration as well as orchestration / automation within key areas of RAN, Transport, and datacenter/cloud. This profile concentrates on the transport macro-domain.

Facts & Figures

As a wholly owned subsidiary, Netcracker does not release its own financial data, and NEC does not break it out as a line item. Therefore, we do not have specific data on their revenue. However, Appledore estimates that across its many segments, Netcracker maintains one of the largest revenue bases in the industry – along with leading NEPs and other broadly based telecom ISVs.

Unlike many competitors, most of Netcracker’s development and growth over the decades has been organic, rather than led by acquisition. Netcracker says it has made significant investments in modern foundations for its orchestration and automation solutions, as well as next generation revenue management and order management. Certainly their document and explanations attest to this.

Strategy

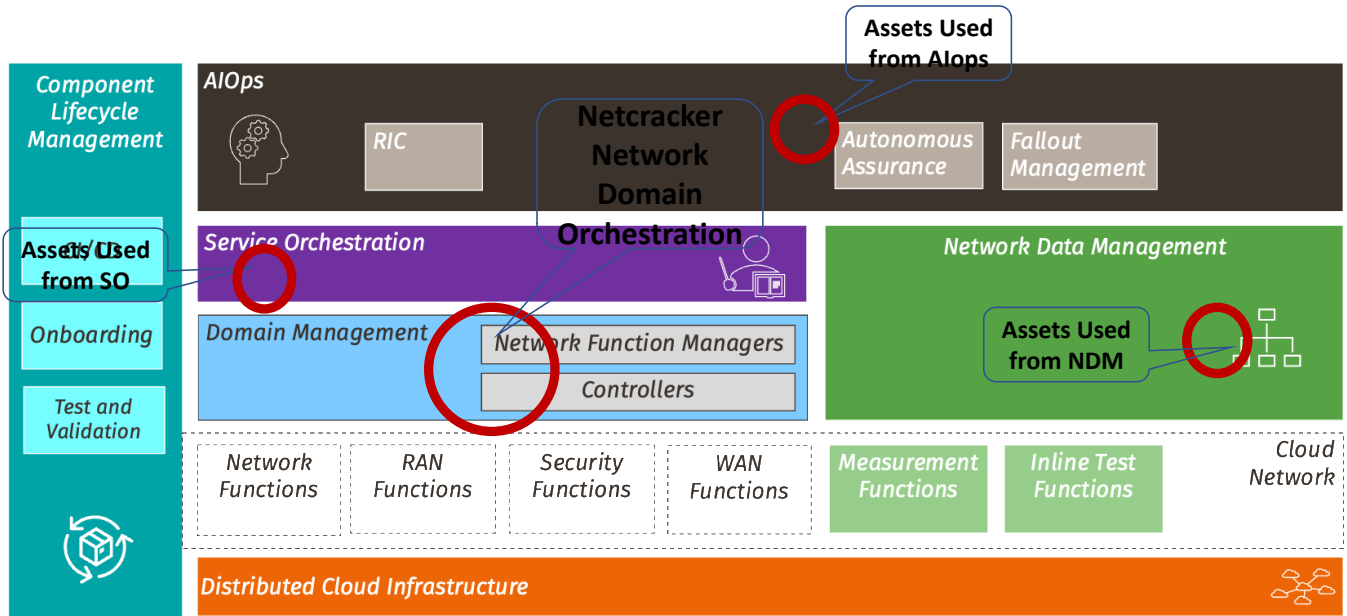
Netcracker positions itself as a market-leading ISV, distinguished by its commitment to rich multi-vendor operations, a holistic view of operations (in this case including multi-layer contextual automation), strong inventory/topology/dependency, and a modern, intent-based, closed-loop technology foundation. We will expand on these below.

Netcracker also focuses on solution delivery, in effect “solving problems” rather than selling software. This is evident in their investment in services, deployment tooling and the ability to train customers on new methods, modelling, etc., with the intention of then turning over those deployments to SP self-management. Netcracker often tackles a specific use case, with the goal of making that use case the basis of a new flexible platform. An example is their solution for SDWAN service, which is really a multi-service, multi-domain, multi-vendor E2E SO solution. That profile, along with other similar profiles, is available [here](#).

As a solution-oriented company, the majority of Netcracker’s products are delivered directly by Netcracker, combined with its extensive delivery services and tooling.

Finally, Netcracker draws on its broad portfolio for each of its domain solutions. For example, Network Domain Orchestration, Netcracker’s branding for this solution, includes adjacent functionality from Network Data Management (inventory, topology, multi-layer dependency, fault and performance data collection), from AIOps (analytics, root cause determination, ML), and of course form the core of orchestration and policy to create their solution. This contrasts with others, some of whom create unique solutions or rely on third parties for at least some aspects of Network Data Management (evolved inventory) and AIOps.

Figure 1: Netcracker builds solutions with assets from across their portfolio



Source: Appledore Research

The diagram above illustrates both where NDO fits in Appledore’s taxonomy, and also how Netcracker re-purposes componentry from its broad portfolio to create solutions. See below for Netcracker’s graphical view of this solution to information on several embedded functions.

SOLUTION DESCRIPTION

Netcracker provides a good overview of how they position their product. Since it is straightforward, sticks to facts, and communicates their objectives directly, let’s begin there:

“Netcracker positions its Network Domain Orchestration (NDO) solution as the unifying automation layer across a complex landscape of multiple vendors, multiple layers (IP/MPLS, optical and microwave), and multiple systems (SDN Controllers, NMS systems, IP/MPLS systems, BSS later etc.) Our solution is equally applicable within a layer (e.g. multiple IP/MPLS vendors) as well as multivendor across multilayer IP/MPLS, optical and microwave. We work directly with IP/MPLS systems or via their NMS systems. For optical systems, which are extremely complex, we work via the NMS or SDN Controllers.” – Netcracker briefing document to Appledore, Oct 2022

This positioning gets to Netcracker’s intended differentiation – support of multiple vendors, and across multiple transport layers from L0 → L3. We will add that it supports a wide range of services/use cases from enterprise broadband, MPLS, carrier ethernet, X-haul (internal services), core configuration etc.

Relative to competitors, Netcracker’s solution is very comprehensive. There may be arguments for modular best of breed as well, but this comprehensive package is consistent with Netcracker’s

positioning as a solution firm, presumably de-risking, lowering complexity and solving problems. Transport NEPs position similarly, and often tout their deep knowledge of and integration with their own hardware – taking the complexity and risk reduction a step further, but, Netcracker might argue, at the expense of independence and practical multi-vendor integration and abstraction. A typical concern of CSPs is that such an abstraction may limit the vendor-specific functionality, and therefore jeopardize the automation of their operations. However, Netcracker states (contractually) that vendor-specific functions are always supported as needed, either part of the product roadmap or within delivery project adaptation for minor features.

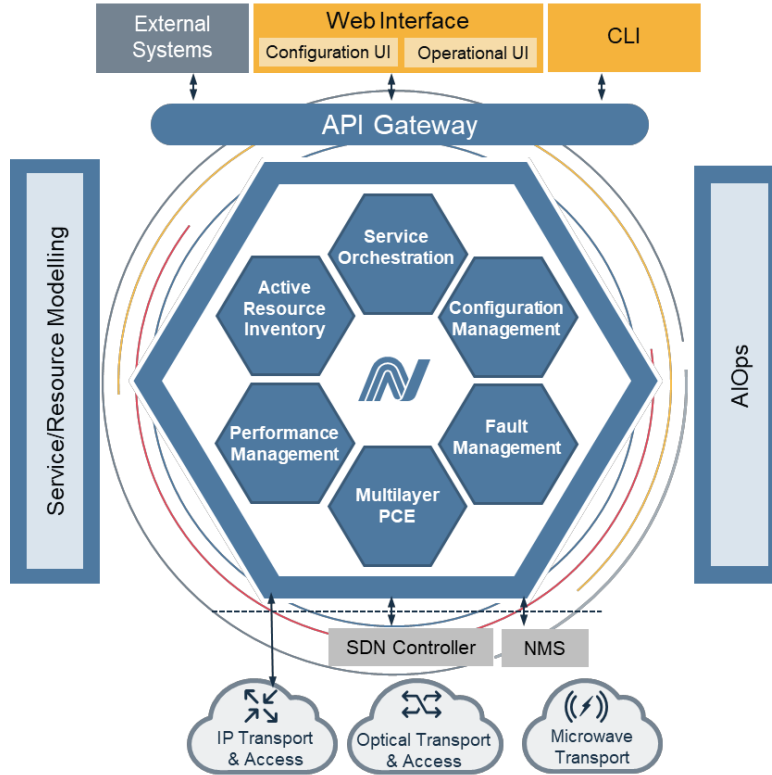
On the multi-vendor front, Netcracker emphasizes several key points. First, they interface directly with multiple vendor's network functions (elements) using YANG and Netconf, and do not depend on vendor EMSs (although they can support those if required). They tout a rapid YANG development tool, and in practice a library of 150,000 unique network elements. (It is unclear what sets of variants add to such a large number). Finally, they claim support (among these 150k) for a long list of vendors' EMS/NMS systems: Juniper NorthStar, Juniper JunosSpace, Nokia NFM-P/T, Nokia NSP, Cisco NSO, Cisco ONC, Huawei NCE, ADVA Ensemble, Ciena MCP and Blue Planet MDSO. Multiple equipment models have been onboarded for direct operations, such as latest Cisco ASR9k, ASR 88xx, CRS16, Juniper MX 480/960, vMX, PTX 5k/10k, QFX 5100/5200, Nokia 7750, Huawei 12704, 93xx, (and many other older models).

NDO also operates across all transport and "IP" layers, from L0 → L3. This capability allows NDO to select paths that meet constrained needs, such as physical route diversity or legal requirements to stay within or avoid certain jurisdictions. Netcracker also allows for dependency association both up and down the layers, such that failures at one layer may be immediately correlated with results or root causes. This capability comes from Netcracker's assets in Network Data Management (including resource and service **inventory**. Netcracker began life as, in effect, an inventory/topology company and continues to emphasize that heritage, even as "inventory" is being deeply disrupted by autonomic domains (like this one) and real-time dynamic changes/network behavior. Real world caveat (noted by Netcracker): While they support path computation for both optical and IP multilayers, it must be understood that the ability to compute and place paths for the IP layer is relatively new in the industry and relies on a set of modern technologies such as segment routing.

Finally, Netcracker emphasizes the twin (and inter-dependent) capabilities of their automated / autonomic, closed-loop, and intent driven operation. One point made is that Netcracker includes all the components necessary, such as the inventory and assurance assets (part of Appledore's Network Data Management segment) and AIOps assets noted above. The other point is Netcracker's "significant" investment in modern orchestration (as contrast with deterministic, branching-logic workflow). The NDO solution is driven by abstract, intent-defined models, and the specific actions determined by rule-driven orchestration "methods" that find compliant solutions. Netcracker claim to have invested heavily in a unique ontology to enable such searching and solution-finding. We wish to acknowledge the clear and very complete documentation that Netcracker provided to Appledore on this topic.

Below is a functional, graphical representation of the solution, courtesy Netcracker. It illustrates the underlying functionality that is brought together to make it operate. Omitted include the tools to create native YANG models.

Figure 2: Netcracker Network Domain Orchestration Solution showing embedded capabilities



Source: Netcracker

Use Cases and Focus

Netcracker’s NDO solution is aimed at medium to larger service providers; those with the need for multi-vendor support and the ability to invest in such. Solutions typically take the form of reference data; (models, rules, and likely some incremental micro services to complete the package).

The list of supported use cases includes the following. Note many more use cases could be supported with the proper reference data and workflows. Typically, these are combined as needed for a service provider, and include necessary features beyond the core.

- IP Broadband
- Network slicing (transport segments)
- MPLS
- IP-VPNs
- Bandwidth On Demand (dynamic bursting, adjusting)
- Automated Path Computation
- Metro Ethernet / MEF Use Cases

- X-Haul

Another way of viewing NDO's completeness or "scope" of automation is presented in the following, abstracted from Netcracker's briefing documentation. NDO:

1. **Automatically discovers the transport network layers** and builds the resulting multi-layer topology, for optical and "IP" networks (L1-3). It subsequently uses this to correlate services across layers for both intelligent provisioning (PCE) and assurance/ root cause analysis.
2. **Transport Network infrastructure management.** Provisioning, configuration and automated mass rearrangement of line cards, IP and OTN trunks and foundational equipment configuration.
3. **Service Management.** NDO automates the full life-cycle of IP and OTN services across the pre-existing infrastructure (above). This includes path computation, provisioning, healing (when identified, see below), and capacity management (scaling insights, bulk services migration). It employs intent based methods that allow for selection of the best fit solution from many possibilities. Weights may be used to emphasize one intent over another (e.g.: price vs performance constrained by minimum latency and maximum price). Maintains dynamic service inventory of "as assigned" for future life cycle operations.
4. **Network and Service Assurance and AIOps.** NDO, utilizing Netcracker components or talking its feed from 3rd party or existing "assurance" functions, collects network data, builds trends, identifies both faults and threshold crossings/approaches, automatically determines impacts / inheritance (both "up" and "down" the graph dependency), and feeds this data back into NDO for corrective action. Specifically, this means healing and / or scaling as the SLA and logic dictates. NDO is capable of automating multiple changes to accomplish this – for example, moving services "A" and "B" to accommodate the healing of "C".

Netcracker's NDO inherits all of the capabilities inherent in Netcracker's service orchestration foundation ([profiled here](#)), including a purpose built ontology to enable intent-driven operations, a rich set of both standards based and open APIs, both northbound and southbound; a low-code development environment; a micro-services based software foundation; and a rapid resource adapter development environment.

MARKET IMPACT

For the purposes of this profile and the associated market outlook report, we focus only on those deployments of Netcracker that support automaton within the L1→3 transport layers, branded as Network Domain Orchestration. NDO has been in existence since 2018, with its first major CSP deployment in 2019. It supports a variety of use cases and automation scenarios, some highlighted in the table below.

Netcracker attests to 11 NDO deployments (all NDO deployments meet our transport domain automation definition). They include network infrastructure management, service management (WAN services) and x-haul management. The table below highlights their deployments.

Operator	Netcracker Service offerings
Transport Automation Deployments	11 deployments at public Service Providers
Deutsche Telekom (Germany)	<p>At DT, Netcracker’s highest visibility and most comprehensive deployment, NDO performs multi-layer discovery L1-3; configuration of IP/optical infrastructure; provisioning of IP/MPLS and optical services, and assurance of both the underlying infrastructure and services. All activities reported are real-time and automated.</p> <p>Cisco, ADVA, Juniper, Huawei and Ciena are supported.</p> <p>OPEX savings are quoted as 45-54% for IP provisioning and 60-90% for Optical/OTN.</p>
Dish Networks	Automates Dish’s backhaul, including automating planning, ordering (wholesale), including both IP and optical layers. Intent based provisioning and configuration of all cell site and datacenter (core) routers to create slices. Orders wholesale services using APIs.
Swisscom	Multi-vendor discovery and inventory of Swisscom’s consolidated IP and optical networks, both access and core.

Source: Netcracker

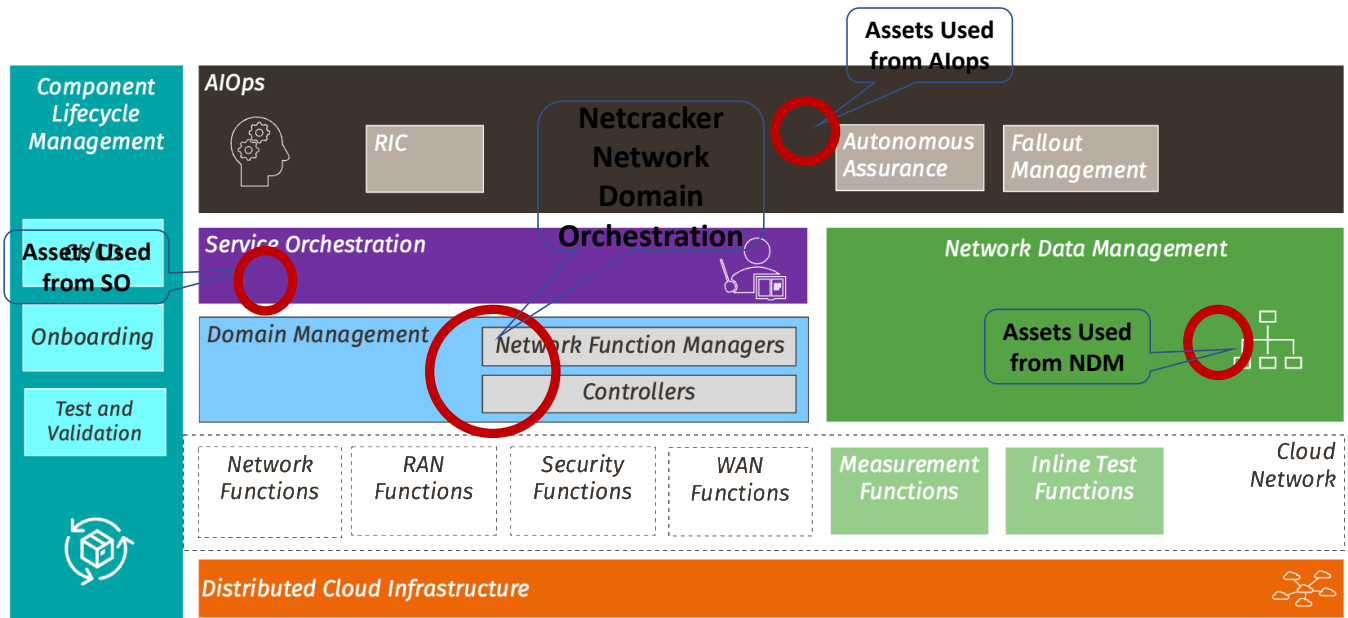
APPLEDORE ANALYSIS

Network Automation Software Taxonomy position

Appledore’s network automation software taxonomy defines a forward-looking set of market segments for automation software. These segments replace traditional “OSS” segments, which are obsolete, and in our opinion do not represent going forward market buying behaviors. Besides being highly modular, our taxonomy emphasizes the existence of many technology domains -- each of which should be self-managing including self-automating. Generally referred to as "domain driven design" this approach simplifies the addition of new vendors and technologies, and greatly simplified upgrades with minimal reintegration -- if any at all.

Netcracker’s NDO transport automation solution forms one of these self-managing domains. It is shown below (repeat of above for convenience), as one of many domains linked together by end-to-end service automation. Some of Netcracker’s broader portfolio of software modules appear in other parts of the taxonomy where they play a functional role in the NDO solution. This illustrates some key points about Netcracker’s NDO; it is a very complete solution and it re-uses foundation Netcracker functionality and adapts it to the transport domain fundamentally through reference data (models, etc.).

Figure 3: Netcracker NDO in the context of Appledore's NAS taxonomy



Source: Appledore Research

NDO ticks all of our operational and technology “best practices” boxes. It provides automation both of lifecycle phases, and also manages automation across layers. It supports multiple vendors both natively and through proprietary NMS adaptation. It supports a wide range of both open in standards-based interfaces and APIs. Finally, it is a modern software (micro-services based, CI/CD operations, reference data driven, ...) design that simplifies going forward actions and is highly configurable. In particular Netcracker went to great length to document and defend their intent-based operations, with excellent illustrative use cases (very comprehensive and showing a solid understanding) and documentation (to the degree reasonable for proprietary technology) of their underlying ontology, developed specifically to enable intent-based operations which demand a unique balance of constraints and flexibility to match SLA-like needs. It should be noted that Netcracker NDO is not a *stand-alone* Transport Network Controller, but a use case of a more extensive multi-technology and multi-use case orchestration/automation solution. It does not collect all the possible information about the network or technology, but only data that is required to execute its tasks including representing topology, performing service lifecycle management or assuring operations.

Netcracker also demonstrates solid deployment success, with 11 public network operators, several of them Tier 1/advanced Tier 2, and all squarely within our “transport domain” focus. Deutsche Telekom in particular illustrates comprehensive automation across life cycle phases, services, and layers.

SUMMARY

Netcracker's NDO is a comprehensive ISV solution to automate the IP/Optical macro-domain, either as a sub-domain (including X-haul, etc.) or as the primary enabler of services in transport-centric enterprise serving CSPs. It derives from Netcracker's overall orchestration solution (readers may wish to see our profile on the cross-domain service orchestration solution, which contains additional analysis that largely applies to NDO as well).

NDO has many capabilities to recommend it, from intent-driven life-cycle automation, to optical topology awareness, to proven multi-vendor integration, and support for ordering services from CSP partners (out of region, etc.)

Finally, deployments with prominent global operators demonstrates market support for NDO.

Insight and analysis for telecom transformation.

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