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# IBM Cloud Pak for Network Automation

## 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 **IBM**, with its *Cloud Pak for Network Automation ("CP4NA")* 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.

## IBM CLOUD PAK FOR NETWORK AUTOMATION

IBM's Cloud Pak for Network Automation ("CP4NA") represents a significant shift in product strategy for IBM, moving them from being primarily an integrator in this space, to having an off-the-shelf telecom orchestration product.  Moreover, it looks to be a very strong first entry into the space, with the ability to disrupt incumbents. Significantly, this product also falls in a new business unit.  Think: Big Blue startup.

IBM "clouds" the distinction between *end-to-end service* orchestration and *cloud domain* orchestration. Like HPE, they emphasize the nature of their platform, the GUI innovation environment, its fitness for both cross-domain and especially cloud-domain service, and the benefits of a consistent modeling and operational environment, at least across E2E and the cloud (CNF) domain.

In describing CP4NA, IBM tell a very compelling story of intent-based operations, including a fully closed loop that utilizes intent as a natural method of healing – the proper approach per control theory.  IBM is the orchestration suppler/partner to **Dish Networks**, one of the few greenfield 5G operators attempting to re-write the book on agility and cost. It is still too early to determine how successful Dish and IBM will be.  Beyond Dish, IBM has an additional four deployments, all of which check the key boxes for next gen and cross-domain – a very fast start for a new player.

IBM also emphasize something that few do, yet Appledore believe will be increasingly important going forward: the automation of testing as part of normal life-cycle operations.  Testing has typically been a costly, slow, labor-intensive activity saved for deeper insights.  Modern technology – from the virtualization of test heads to the ability to automate scripts and identify necessary scenarios – is changing this.  IBM emphasize that testing and validation are key parts of their overall solution strategy – whether verifying a service at turn-up or investigating the performance of specific components as part of diagnosis.  This is but one of many ways that automation may be applied to save labor, improve service quality and clarify understanding of networks' performance and the underlying causes.

Process automation is central to the maximization of service innovation, and to the minimization of operational cost. Automation involves continuous data inputs and orchestrated intent to meet business outcomes. Through this automation, **IBM Cloud Pak for Network Automation** helps CSPs manage the exponential complexity of the cloud network, and shortened (down to a few seconds) containerization lifecycles.

*IBM Cloud Pak for Network Automation* is an AI-powered service orchestrator that enables automation of network operations with the help of advanced analytics, AI and ML. IBM says it enables CSPs to transform their networks, evolve to zero touch operations, reduce OPEX and deliver services faster in real time. IBM *Cloud Pak for Network Automation* belongs to the IBM Cloud Pak portfolio. *IBM Cloud Pak for Network Automation* is a unified management solution to support transformation of CSPs telco networks into disaggregated, fully automated, cloud-native platforms, and is supported by an open ecosystem that enables rapid onboarding of VNFs and CNFs.

**Figure 1: IBM Network Automation Portfolio**
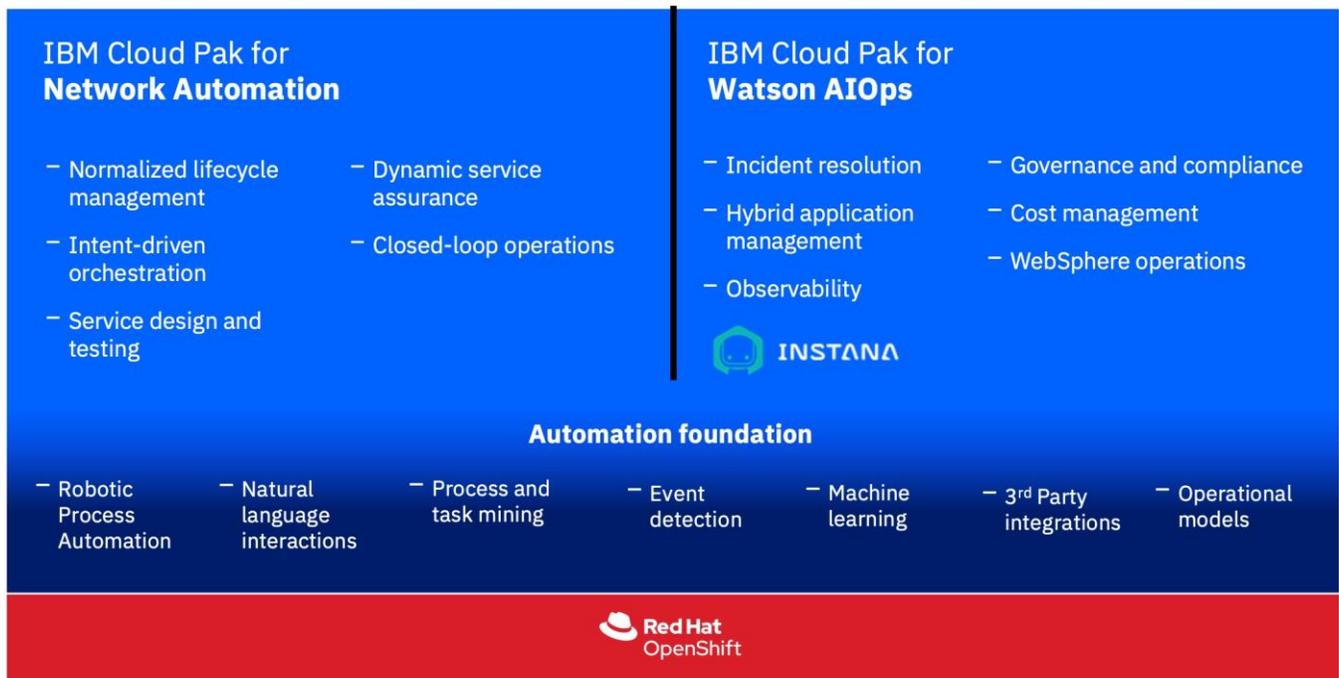


*Source: IBM*

## Competition and Market

IBM CP4NA 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 (**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

IBM appears to be positioning Cloud Pak for Network Automation in two important roles; first, as a *cloud-native CNF* orchestrator, and second as a highly flexible and automated *service* orchestrator. IBM emphasize a consistent modelling and operational environment – regardless of what the CNF or service is.  Concentrating on these two functional areas plays to IBM's strengths as an IT/computing leader, and as a well-established and resourced systems integrator with experience working across disparate systems.  IBM appears to be concentrating on Open RAN, vRAN and associated network slicing – all areas where cloudification is strong, as opposed to core transport areas where "big iron" still holds a lead in terms of throughput and price/performance and optical where virtualization is not practical (x86 can't emulate glass ☺).

IBM brands CP4NA as "AI enabled", and this has basis in their portfolio.  IBM's two flagship network automation offers are Cloud Pak for Network Automation (fundamentally orchestration) and Cloud Pak for Watson AIOps ("CP4WAIOps").  They emphasize the strong, yet modular, connections and pre-integration that exists, and intent for ML and AI to play an increasing role in the healing, scaling and optimization processes over time.  This, of course, leverages IBMs fundamental research into AI (Watson), which is a rare asset.

By way of contrast, IBM is partnering with firms in the transport management space, in particular **Cisco**, with whom they have announced a go-to-market and deployment partnership (integrating with Cisco CrossWork).

The launch of CP4NA represents a change of direction for IBM, which has been an SI in the orchestration and "end-to-end OSS" space for decades, but has not introduced a fully developed orchestration product. We can speculate that IBM sees the market shifting toward its IT strength, and plans to also leverage its global leadership in ML and AI to achieve automation. In fact, IBM's promotional materials refer to CP4NA as "AI-enabled".

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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.

**Relevant Acquisitions**

Acquisitions have played an important role in this rapid ascension to a strong role in CDSO product. In the last few years, IBM have made the following acquisitions that strengthen their CP4NA play:

- **Red Hat (2019,** for $34 billion) needs little introduction.  Red Hat provides IBM gravitas in cloud native infrastructure and its *OpenShift* Kubernetes-based container platform can integrate into IBM's Cloud Pak product suite.

- [**Accanto Systems**](#) (2020)  Acanto's *Stratoss* Lifecycle Manager delivers automation for cloud-based networking, and is itself cloud native.

- **Turbonomic (2021)** among other capabilities, monitors application's resource utilization and performance, providing input for AIops within the lifecycle.

- **Volta Networks (2021)** provides distributed management of network routing, to support IBM's strategy for leadership in network automation and analytics.  How this relates to IBM's transport domain partners is unclear.

IBM clearly positions as vendor-independent. In fact, their cloud-native platform purports to break the silos of NEP CNFs running on NEP NFVI managed by NEP VNFMs – and exchanges it for a consistent, generic automation and deployment environment.

# IBM CP4NA – ARCHITECTURE AND CAPABILITIES

## Context

Below, courtesy IBM, we see a contextual diagram that illustrates where CP4NA concentrates and where it interfaces to other systems.  It is important to also note IBM's *Cloud Pak for Watson AIOps* (to the right, in IBM Blue) which is a critical component and potential differentiator for IBM.  As in Appledore's Closed Loop Taxonomy, IBM's CP4WAIOps provides the insight to guide optimization, healing and scaling and to identify abnormalities in the network and services.  The original orchestration method (models, algorithms) then takes 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. In IBM's own words:

> *"These same algorithms are used whether the system is instantiating a service for day 1 or performing day 2 changes in response to user or system-generated changes."*

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

Above CP4NA/CP4WAIOps we see order management, driven by a catalog.  Below, we see the various domains including RAN domain(s), Transport Domains and various proprietary clouds (in this case VMware and AWS called out).  This is consistent with Appledore's belief in domain-driven design and their loose coupling via intent.

**Figure 2: IBM Cloud Pak for Network Automation in larger NAS Context**
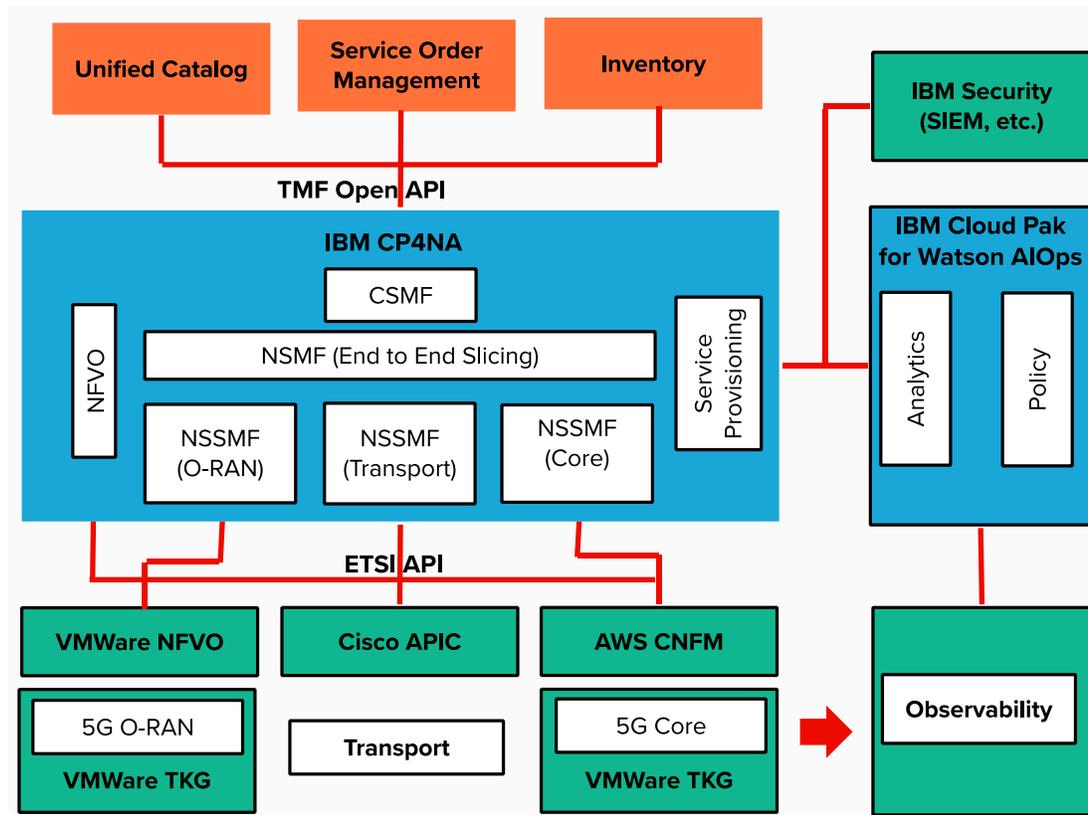


*Source: IBM*

## Functionality

IBM *Cloud Pak for Network 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:

- **Normalized lifecycle modeling** – standardized operations for all network services and network functions to enable model-driven automation.

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

- **Service design and testing automation** – automation for the service and its underlying resources for test, pre-production, and production environments.

- **Closed-loop operations** – automated feedback loops between assurance and orchestration to enable zero touch operations.

IBM *Cloud Pak for Network Automation* is an open, cloud native, technology/vendor agnostic solution. This means it is applicable to a wide range of applications across industries. IBM 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. IBM *Cloud Pak for Network Automation* is a fully containerized solution. By being container-based, CSPs can fully benefit from the future container-based architecture of 5G, underpinned by automation at scale.

IBM Cloud Pak for Network Automation provides a full suite of automation and AI features to orchestrate, operate and optimize multivendor network functions and services to enable autonomous operations. Using advanced analytics, machine learning (ML) and AIOps it can discover changing network patterns and trends; allowing the optimization of network performance with minimized human intervention, and to support dynamic fast-changing virtual or container network services.

Use cases for IBM *Cloud Pak for Network Automation* include:

- Network site deployment - helping to standardize and automate cloud buildout across multivendor infrastructure.

- vRAN/Open RAN - Turnkey deployment and management of open and virtualized RAN across multi-vendors.

- 5G Network Slicing - automated lifecycle management for new enterprise 5G virtual network services on top of a shared physical infrastructure.

**Figure 3: IBM Collage of Capabilities toward Network Automation**
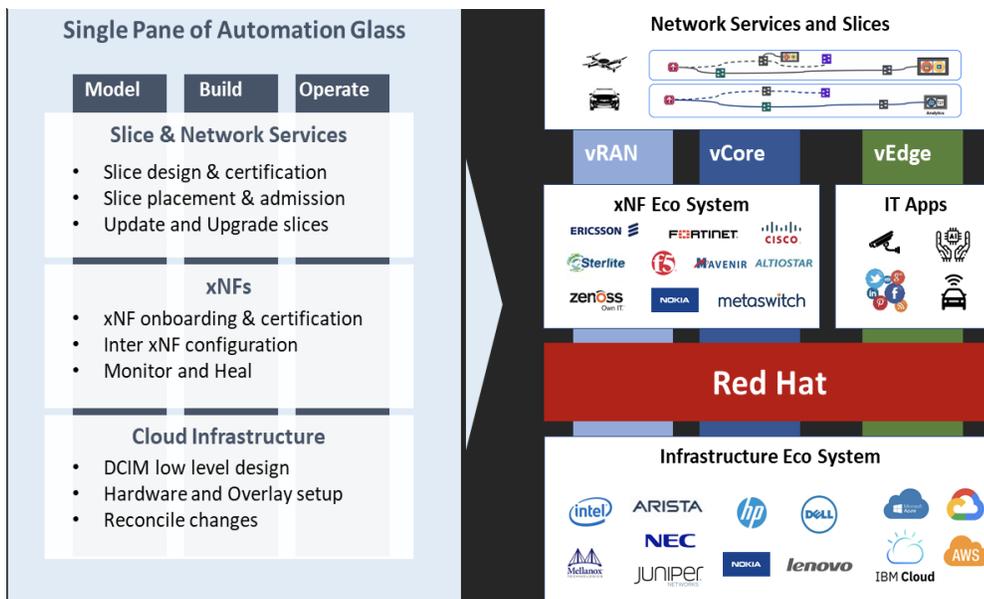


*Source: IBM*

IBM *Cloud Pak for Network Automation* provides a set of lifecycle management tools that automate the full lifecycle of all network cloud component piece parts. IBM CP4NA provides tooling that models, builds, and operates services across their complete lifecycle. It supports services built on traditional network hardware and on virtualized network function software.

IBM CP4NA (see figure above) provides tools that can automate the lifecycle of all network layers in the network cloud stack:

- Cloud infrastructure: data center inventory tools capture the intended low-level design of network cloud site infrastructure, auto provisioning the hardware and software components of the platform ready for target network function workloads.

- Network Functions (xNFs): auto onboarding and certification of vRAN and Core network function software packages, ensuring their individual and collective operational behaviors perform as expected.

- Slices & Network Services: modeling the intended network service or slice topology and auto-stitching and updating xNF across thousands of sites to ensure network services are always operational.

IBM CP4NA leverages IBM's heritage in cloud operating models and its supporting technologies and methods that enable hyperscale levels of automation. IBM is aiming to extend this to enable the same zero touch operational benefits in 5G network cloud environments.

CP4NA provides the following core capabilities:

- **Declarative AI-driven automation:** Allows a user to create a desired network topology and let the "machine" figure out how to realize it and maintain it over time.

- **Single pane of glass:** A single tool to coordinate automation tools ensuring that there is no automation gaps, and ensuring a cloud like experience for the full network stack.

- **Automated certification and behavior testing:** Automated testing of the functional and operational behavior of hardware and software components individually and collectively, running simulated traffic and injecting failures to ensure service is not seriously impacted.

- **AI driven change management:** AI based identification of faults or anomalies, the auto-diagnosis of remedies with automated resolution to the network.

IBM 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. IBM's use of ML and AI in closed loops is claimed to be relatively advanced, which, given IBM's research in Watson, is not a great surprise. The diagram below, courtesy IBM, illustrates how ML/AI in "CP4WAIOps" instructs the closed loop:

**Figure 4: IBMs AIOps Logical Flow. Note feedback arrow to CP4NA implementing automation**
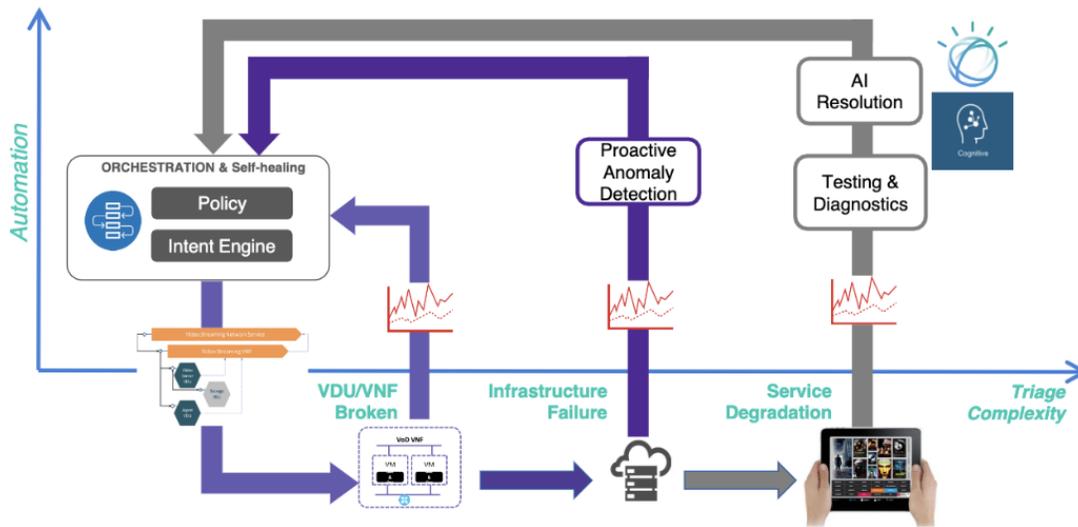


*Source: IBM*

A Cross-Domain Orchestrator is reactively 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. IBM claims both a large library of integrations (including pre-built and tested CNF/NF models) and extensive support for standards including most of the MEF and TMF families that apply, including catalog support, inventory & order handling from the TMF, and Sonata/Legato from the MEF. They claim to support 5G slicing use cases, including at Dish, and have enhanced support for ETSI standards.

**Figure 5: Library of Pre-Onboarded Partners (Supported environments, NFs, models)**



*Source: IBM*

## 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 IBM's progress in the CDSO market, specifically those deployments that meet Appledore's criteria for modern, next-generation and cross-domain service orchestration.  In IBM's case, there is no "legacy" CP4NA, so all of their deployments meet our technical criteria. The following, per IBM, best capture their market success specifically in *service* or *cross-domain* orchestration.

**Figure 6: IBM CP4NA Market Deployments, as of EoY 2021**

| Operator | Service Supported |
|---|---|
| **Dish Networks (USA)** | Slicing Orchestrator for a greenfield, cloud-native, ultra-low latency 5GSA nationwide deployment, working also with domain orchestrators in datacenter/cloud and transport. |
| **UK Service Provider (NDA)** | IBM CP4NA is the service orchestrator, delivering a new multicloud connectivity automation use case, with zero-touch provisioning helping a UK based CSP rapidly deploy SD-WAN, MEC and uCPE services and applications.  Domain managers subtend to CP4NA. |
| **Telefonica Spain** | CP4NA along with CP4WAIOps, is being used as the network-service orchestrator to rollout a fully virtualized, fully automated multi-vendor 5G service built on an open platform. The combined orchestration/assurance (AIOps) platform validates vendor workloads in the lab and then automatically deploys them into production based on CI/CD pipelines. This project is in delivery phase. |
| **TIMEdotcom** | IBM CP4NA, with CP4WAIOps is replacing existing systems to deliver on-demand  (service in minutes) service activation and ongoing closed-loop lifecycle management of multivendor enterprise services. IBM is delivering a solution that covers both design phase (CP4NA) with automated onboarding and CI-CD runtimes, and then operational life-cycle with both CP4NA and CP4WAIOps.<br><br>For this client, the declarative programming model enables moving focus from managing networks to managing automations, leading to significant opex savings in production including:<br>• service activation in minutes for all the business services across a multi-vendor ecosystems.<br>• 82% less effort in service onboarding testing<br>• less than 10 mins per ticket spent from more than 90 mins (due to low code automation). |
| **USA Service Provider (NDA)** | In this case PoC, IBM is acting as the slicing NSMF and Cisco as the transport domain NSSMF. The two are delivering a software engineering approach to network slice automation, applying declarative/intent-based models and orchestration to both slice and transport management. |

*Source: Appledore Research, IBM*

## The Broader Package: The Resources of IBM's SI Behemoth

Until a few years ago IBM sold itself as the firm with the techno-professional resources to make others' software work efficiently.  Now they can offer the same capabilities in support of their own product(s).  Ina twist of irony, IBM's lead customer, Dish, is acting as its own SI, and with a long list of moving parts to coordinate.  Yet was can safely assume that IBM has resources globally, and with a breadth of capabilities from process transformation to implementation.

## APPLEDORE ANALYSIS

IBM, in a very brief time, has vaulted itself from a non-player to arguably a leader in CDSO, and from a "few, huge, relatively staid, managed projects" to a operational-technological revolutionary – solidly behind autonomic closed loops, intent based models, ML/AI and cloud native operation (which, in truth rolls up the former attributes).  Appledore was impressed with both the content and the quality of IBM's answers to our extensive research questionnaire, and also with the live, interactive briefing we took with them.  We note we have also folded in in data from their briefing regarding Dish networks deployment and relationship/ oppress release with Cisco/Crosswork on which they also briefed us.

IBM certainly has the resources to impact the industry, yet in this segment, has punched beneath its weight for decades. That is changing, fast.  We believe that there is a segment that wants more change, and faster, than most established suppliers are geared up for.  Note this is not necessarily a criticism of those suppliers; rather it is a recognition that suppliers "give their customers what they want" – and SPs often want low risk, and measured change.

Like a few others, IBM'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.  Yet IBM's list of commercial projects is impressive for this early stage.

In the Appledore Network Automation Software Taxonomy diagram below, IBM's CP4NA occupies the *service* orchestration box.  We also note that the same product, with different models (e.g.: TOSCA+, YANG), is employed in the management of CNFs – or it can work with dedicated third parties.  CP4NA integrates to external components (AIOps, Network Data Management, order management, BSS) from IBM (especially its CP4WAIOps) or from others, and interacts with myriad and growing domain controllers/orchestrators, especially in the transport area.

**Figure 7: IBM CP4NA in the context of the Appledore NAS Taxonomy**
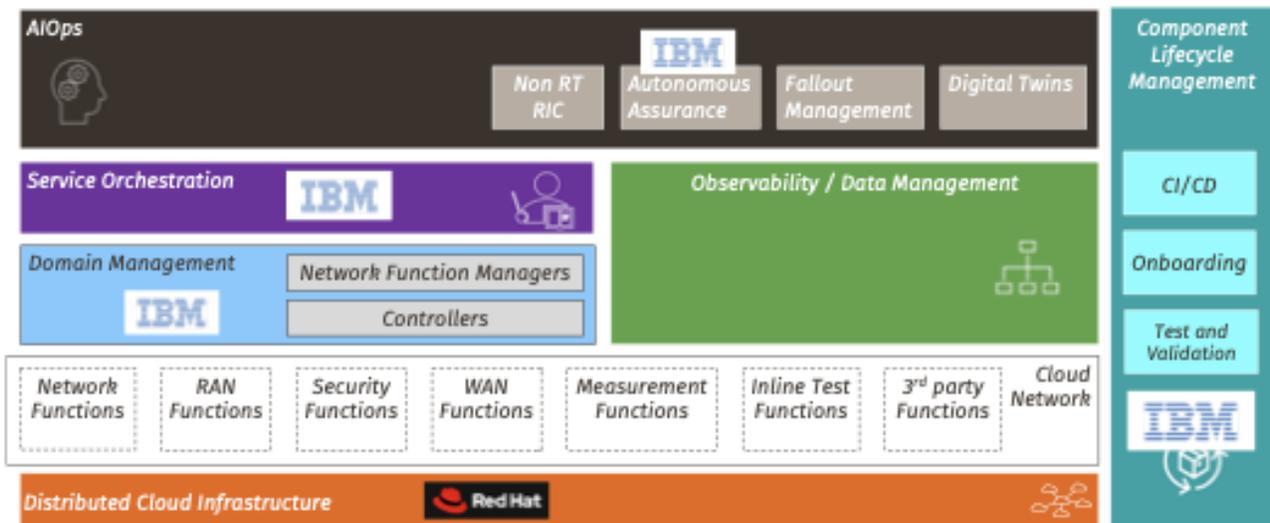


*Source: Appledore Research*

## SWOT

**Strengths**

- Fully cloud native solution.

- Enables automation beyond day 1 instantiation with day 2 scaling and healing.

- Declarative, intent-based orchestration definition.

- Strong reference customers at Telefonica and Dish.

- Strong integration with Red Hat distributed cloud infrastructure.

- Strong integration with [Cisco Crosswork transport domain orchestration](#).

- Strong integration with AI/ML methods via CP4WAIOps.

- Extensive standards support and library of pre-integrated partners.

**Weaknesses**

- Revolutionary approach to automation could mean conservative CSPs choose evolutionary path with existing OSS and network equipment vendors.

- IBM as a non-traditional OSS fulfilment provider may be perceived as a greenfield solution and difficult to integrate with legacy brownfield OSS.

**Opportunities**

- Opportunity to up-sell *Cloud Pak for Network Automation* to  the large base of CSPs already adopting the Red Hat OpenShift platform, as well as to those using other multi-cloud infrastructure platforms.

**Threats**

- Conservative CSPs, with limited product innovation, will not see the full benefits of the IBM approach. Danger that traditional OSS fulfilment models continue to dominate, and IBM CP4NA benefits of flexibility and agility are not recognised.

- Smaller CSPs may choose solutions from their NEPs to reduce integration costs, innovation costs and risk.

- IBM tells a very strong story, but faces many competitors who have upped their product games in the last 18 months.

## SUMMARY

IBMs Cloud Pak for Network Automation is an exciting and relatively new entry into this marketplace. It distinguishes itself with its highly modern technical abilities, consistent modeling and operational model regardless of underlying technology, and its "sister" product, Cloud Pak for Watson AIOps. Rather than trying to "do everything" we applaud IBM's focus on cross-domain and service orchestration, along with support for underlying cloud resources.  These are consistent with IBM's pedigree and assets.

Cloud Pak for Network Automation has come out of the blocks running.  IBM documents 5 significant carriers with commercial deployments and an advanced-stage PoC. So its newness shines as a strength and not a sign of being unproven in the marketplace.

IBM emphasizes many technological attributes, from cloud-native, to intent based operations, to ML/AI.  Two critical take aways exist. First, these are all important for agility and effective automation – and are documented as so as part of Appledore's cloud-loop best practices.   Second, everything in IBM's presentations, deployments and documentation indicates that they are deeply ingrained, not buzzwords that may or may not have deep support in reality.  We wonder if IBM's IT history and in fact *lack* of legacy experience here frees them from the bonds of past operations methods – that are un-learned hard[2].

When one's remit is rapidly creating end-to-end services across domains, rapid integration and loose coupling are essential. CP4NA supports a wide range of TMF, MEF and 3GPP standards, and has a long list of existing integrations – discussed above.

We believe IBM has a bright future, especially as the promise of automation via CP4NA and CP4WAIOps becomes more of a proven, use-case-rich, reality.

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[2] Interested in old practices that are dying far too hard?  Read our oldie-but-goodies "OSS Sea Change" and "Cloud Native: The Revolution is Postponed"

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