open labs
An Altice Labs Company

Cognitive ops services

ASOP; Cognitive network planning & design; Provisioning process; Assurance; Cognitive operations

White paper

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Introduction

The communication/digital service providers (CSP/DSP) are always on a challenge between giving the best service to the customer, reduce costs, evolve the technology and build their network faster than its competitors. As networks are becoming more and more complex, the human effort has proved to be insufficient to deal with this complexity increase. With the current tools and platforms, mostly human-driven, it is hard for operations to keep their goals at a high level of quality, speed/time-to-market and satisfaction while reducing the costs. Computational processing is cheaper, more powerful and incomparably faster when compared with human resources, and consequently, CSP/DSP are now looking towards automation to cope with it.

Network operations, such as planning and construction, are complex by nature, and network maintenance tasks are becoming more effort-consuming. With the help of artificial intelligence (AI), and particularly with machine learning (ML) techniques, it’s possible to trust machines on planning and designing the network. This level is achievable by using multiple datasets or conditions from business/operations support systems (B/OSS) to build the network by itself and deliver it to construction on the field.

Designing provision or other operational processes on service providers' ecosystems is currently a manual process performed by engineers and analysts that tailor B/OSS to a particular operational and technological reality. Both continuous delivery (CD) and continuous integration (CI) provide the framework for the CSP/DSP to be fast and reliable on the delivery of process improvements. Nevertheless, those improvements are designed solely by humans that are looking at process analytics, trying to find patterns and refinement opportunities. Using the tools already available today (strong analytics, a centralized service and resource catalogue, the CD/CI framework, and a multipurpose and multi-technology workflow engine) AI/ML can be used to automate B/OSS process improvement. One significant advantage is being able to deliver an impressively efficient continuous improvement framework that can have a dramatic effect on operational costs, resource usage and service deployment time.

Today's network/service operation centres (N/SOC) are still very reactive, but the shift to a proactive mode has already begun. By using AI/ML, it's possible to gather and process network data in real-time and automate network functions, enabling faster decisions. By using these techniques to find patterns and anticipate network issues, a self-healing network can be set up for the customers' service to be fixed before the customer is even impacted [1]. These fixes can be applied automatically, or semi-automatically after validation from a network engineer. Another use-case of AI/ML is the ability to distinguish between real problems, that must be addressed, and noise, which can be ignored, helping human operators to focus their attention where needed.

The future of operations is intended to be data-driven, autonomous, and intelligent – in one word, cognitive. To cope with these requirements, inventory, fulfillment and assurance domains on OSS must evolve in that direction, creating an agile, flexible and cognitive-infused architecture. It is also essential to consider critical business use cases that can take advantage of AI and in particular, ML.

In the next sections, we will present a brief insight on how AI/ML can help OSS make the change to cognitive. We will also introduce the target architecture to achieve it and describe three use cases that apply to the OSS domains that unleash the potential of cognitive operational service.

Towards a cognitive network planning, fulfillment and assurance

Both AI/ML and cognitive computing rely on the use of a machine's capacity to learn from past experiences. However, the main difference is that AI/ML makes use of its detailed inspection to automate the decision, while cognitive computing provides insights to an operator so a better-informed decision can be made [2].

CSP/DSP must move from a reactive to a proactive, predictive, and cognitive operations mode through the adoption of AI/ML in network operations. Doing so would significantly lower operational expenditure, improve customer satisfaction and enhance resource utilization [3].

Figure 1 illustrates the ongoing evolution of how to perform actions, from a rule-based approach to an AI/ML scenario. Regarding the existing rule-based automation, operators handle the information provided by the intelligence information systems and perform actions based on it. That same data can be used to decide on how to automate actions using fixed rules. Using AI/ML automation allows for the use of self-improving models to enable machines to suggest actions to the operators or even to perform them autonomously.

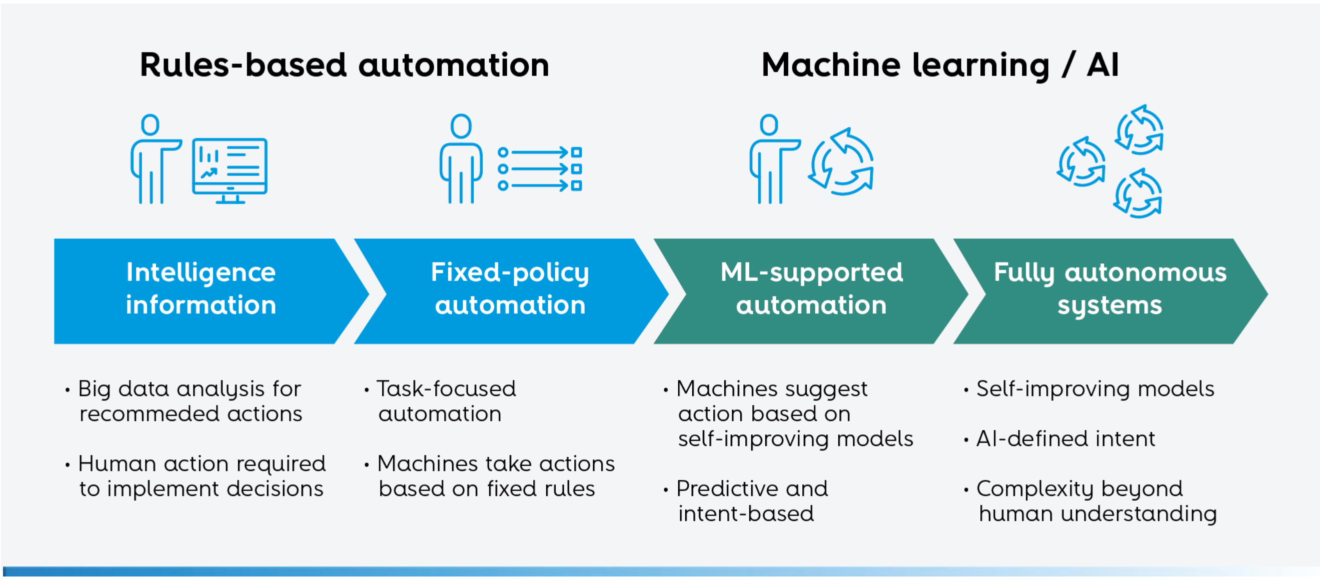

Figure 1 – Proactive to cognitive evolution. Source: [4] (adapted)

On the inventory domain, the core of engineering in a communications network is the technology-independent question: how to plan, design and upgrade the network to its maximum capacity, to meet customer needs and reduce costs? In the network design problem, associated with this question is also the need to decide the link capacity to find a solution with minimum effort and cost.

Network planning tasks consider the type of technology, the number of customers/services to attend, and the experience of the designer to plan the best routes and reduce the bill of materials (BOM), while keeping in mind that more recent network designs are more easily updatable. From the network operator perspective, the main goal is, invariably, to maximize net revenue, i.e. the revenue generated by customers minus equipment, software and operational costs of the network. It’s of paramount importance for the network operator to plan the detailed evolution of investments over time as accurate as possible, which not only maximizes the net revenue but also creates a significant advantage over the competitors [5].

In the fulfillment domain, the best way to know if the organization has a well-implemented process is when no one notices its presence. Most of the time, provisioning and other related operational processes are invisible to customers, operators, technicians and other parties that make use of it. Typically, they are noticed only after a complaint from any of those parties, and some detailed analysis detects a problem. On the other way, automated and comprehensive processes are one of the main building blocks of a fully automated telco operation. They represent the means by which autonomous and closed-loop operations can effectively perform the changes that are going to improve the network and the customer’s services.

With cognitive operations, assurance systems can continuously sensor the network and autonomously trigger diagnostics whenever a fault or degradation occurs. If the system is confident about the accuracy of the diagnostic, the automated resolution process can be triggered. The resolution must be confirmed once again by another automatic diagnostic process.

To achieve these goals, change the actual architectures to a new concept based on services is a mandatory task. The autonomous service operations platform (ASOP) architecture main objective is to serve that purpose.

The ASOP architecture

ASOP is Altice Labs reference OSS functional architecture for product and solution implementation, represented in the following **Figure 2**.

This architecture is microservices-based and cloud-ready, following an everything-as-a-service (XaaS) model that includes, among others, inventory-as-a-service, fulfillment-as-a-service and assurance-as-a-service, privileging the use of open source software and products.

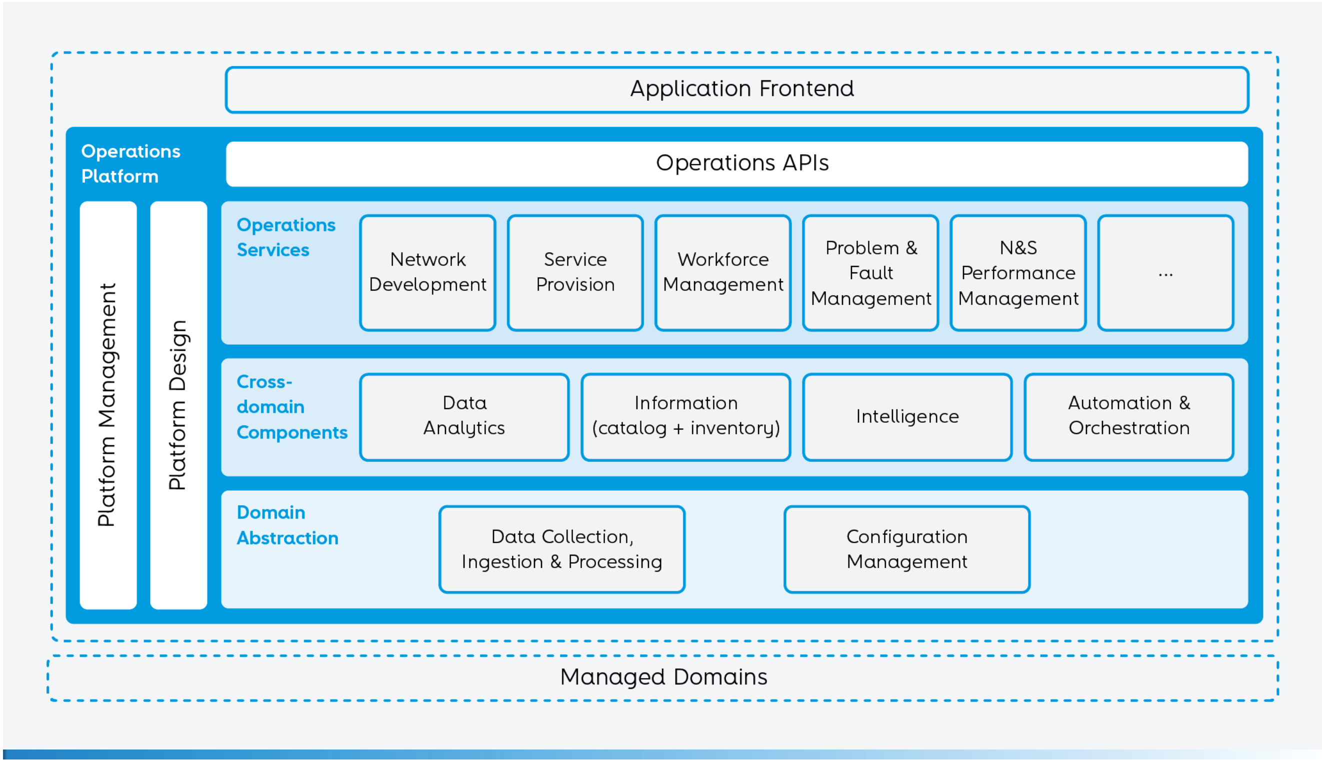

Figure 2 – ASOP Functional Architecture

ASOP serves both physical and virtualised managed domains, like network elements (NE), network management systems (NMS), virtualised infrastructure managers (VIM), software-defined networks (SDN), etc.

The platform comprises several l main layers and components, which are presented on the next page.

Operations APIs

The API layer, based on TM Forum Open APIs to increase systems interoperability

Platform design

This component provides support for onboarding new use cases

Domain abstraction

Consists of a group of components that abstract the managed domain, including Data Collection, Ingestion & Processing, and Configuration Management components

Cross-domain components

This layer comprises general-purpose building blocks to support OSS services, like Data Analytics, Information (catalog+inventory), Intelligence, and Automation & Orchestration components

Platform management

Manages infrastructure and application lifecycle

Application Frontend

The presentation layer, including graphic users interfaces (GUI) and other user interfaces

Operations Services

This layer offers a set of the essential OSS services that deliver value to telcos and address their operational needs, including Network Development, Service Provision, Workforce Management, Problem & Fault Management, and Network and Services (N&S) Performance Management components, among others

All ASOP components can be organized to respond to various functional use cases, and deliver the existing functions provided by the current OSS domains as well as new scenarios like cognitive operations. Some use cases that will be described more thoroughly in the next sections.

The cognitive network planning and design use case

As referred before, inventory may have many challenges that can be solved using a cognitive approach. In this section, we will focus on a particular use case of network planning and design. Many organisations consider fibre-based access networks as a major solution to make the most out of the higher-speed available for service usage. Fibre-based networks can be delivered to customer premises through point-to-point (P2P) and point-to-multipoint (P2MP) technologies, which increase the difficulty of planning and design the network, due to the large number of variables to consider. So, to create a cost-effective gigabyte passive optical network/fibre-to-the-home (GPON/FTTH) requires considering as many factors as:

- headend position;
- optical splitter position;
- maximum splitter ratio;
- optical distribution point position;
- maximum distance;
- routes;
- number of surveys to attend;
- accomplish the optical budget.

The two main advantages of automating/optimising network design are minimising the capex and reducing time-to-create from days to hours, and as so, using a cognitive AI-based approach allows the operator to automate the process of planning and design the network. **Figure 3** depicts the process. In this use case, the input data can be the headend position, optical splitter position, etc. Business rules may be the optical budget, or cost of construction, among others. Then, by parsing the information and compute it using an AI/ML approach, the operator will have the hardcopy outputs to analyse the results and change them if needed.

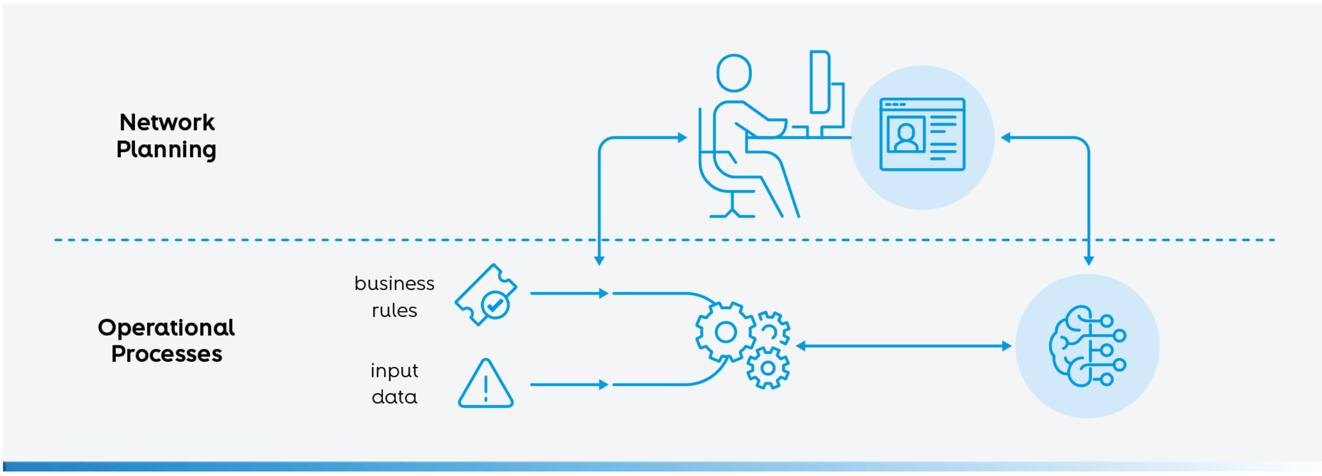

Figure 3 – Data flow

More generally, the system's input data can come from a geographic information system (GIS) database or other sources. This input data contains the infrastructure information: roads, installation points, routes, surveying, among others. Business rules define cost constraints (on placing cable, ducts, equipment, etc.), and the desired ratio of coverage customer.

Given the inputs and business rules, the information is parsed and prepared to be computed by AI/ML algorithms that will give the operator multiple possibilities of how to design the network. The outputs consist of a presentation of the georeferenced view, and the auto-generated results (like the surveying, routes, cable network, optimised BOM, etc.) of the desired network. The operator can change what is presented or even alter business rules and make other adjustments, to have different solutions. The acceptance and adaptations of each project will feed the AI/ML engine to improve the outcome of next projects, leading to a "smarter" process.

The ASOP components needed in this use case are the **Network Development**, as the main operation service component, and the cross-domain components **Data Analytics** and **Information (catalog+inventory)** for providing the necessary inputs and business rules. The **Intelligence** component is responsible for information parsing and computation to produce the desired outputs.

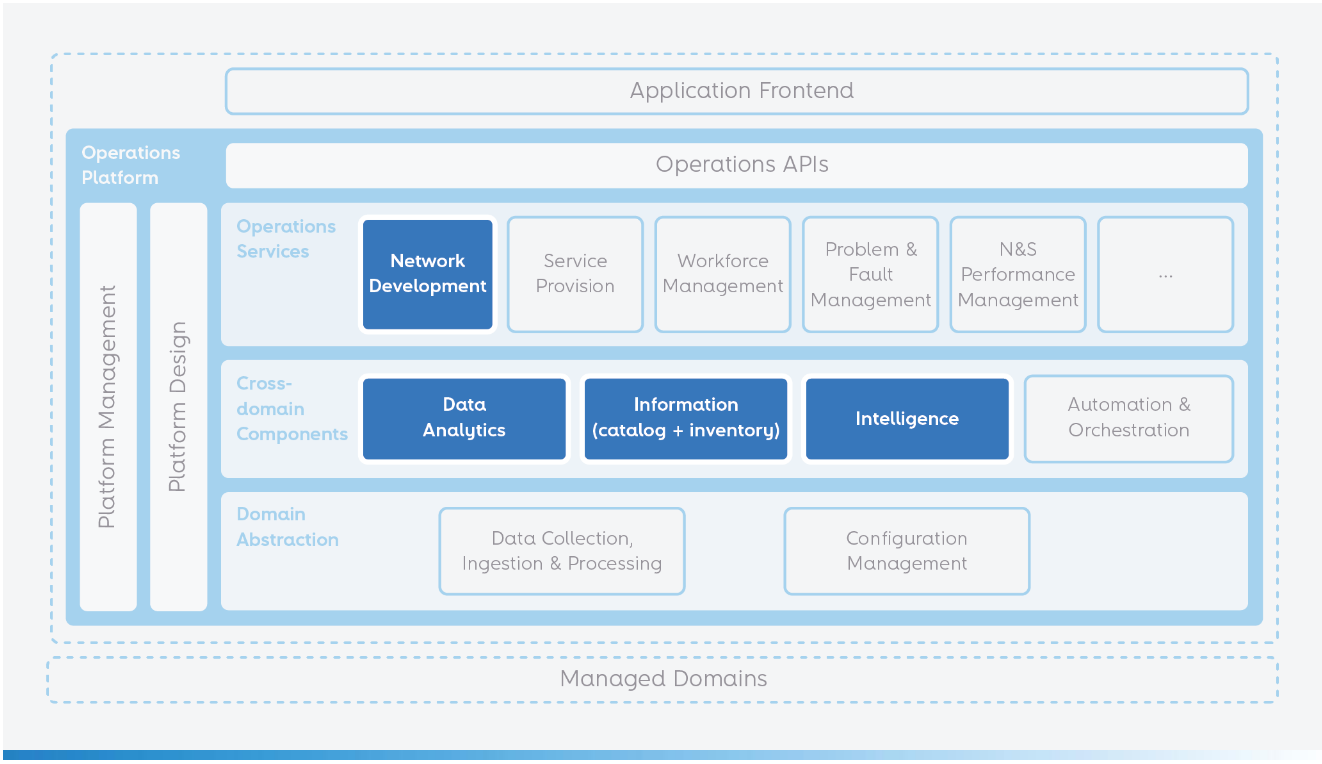

Figure 4 – ASOP modules used in the cognitive network planning and design use case

The provisioning process optimization use case

Provisioning processes are a critical component of the CSP/DSP ecosystem. They ensure that service instance creation, modification, and termination are successful and done in the most efficient way possible. These processes must be resilient enough to withstand any performance issue, failure or unforeseen behaviour of any of the systems with which they interact. Those systems include other CSP/DSP support systems, service platforms and the managed network that delivers the services to the customers. Additionally, all processes that are related to the workforce must be bulletproof to ensure they spend the least amount of time in the customer premises, to minimize the inherent costs, but also to increase customer satisfaction.

Currently, all these processes and their improvements are designed by analysts and engineers, experts in this field of work. But although having access to a rich set of tools that make their job easier, this is always done through manual analysis. Another aspect is that these processes, being so elaborated and mission-critical, are not modified unless it is absolutely necessary due to the associated risks of such changes.

By introducing the concepts of CI/CD to the design, it is possible to automate the process development and release it faster. The process designers are responsible for the management of the CD pipeline, as depicted in **Figure 5**.

The objective of cognitive process optimization is to allow these improvements to be added using an automated approach, shifting from a reactive to a proactive perspective, as mentioned before. This shift is achieved via AI/ML, by continuously monitoring the overall performance of the processes associated with on-boarded services, and issuing improvement suggestions to the process designers along with the justification for these suggestions [6]. For example, an improvement can be changing the order in which specific network elements are configured, or adjust a simple communication timeout. If the designer approves the change, it will be propagated directly to the pipeline and deployed into the live environment.

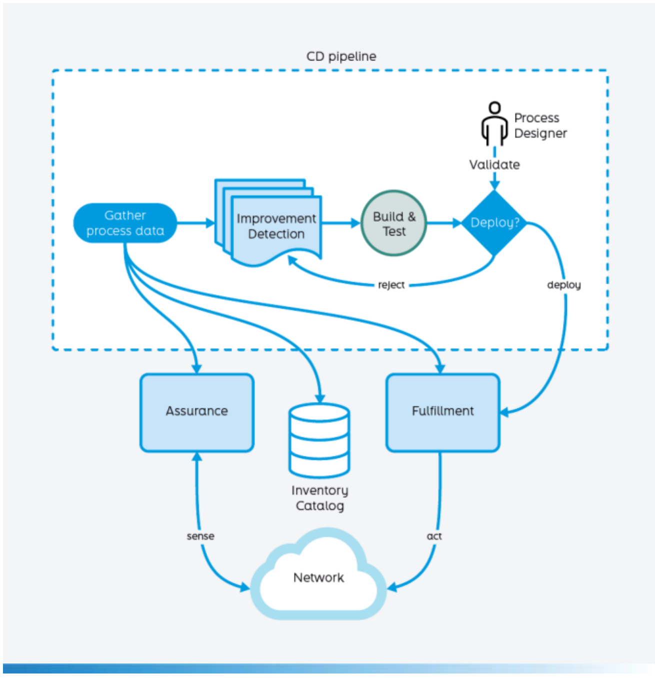

Figure 5 – CD Pipeline

Engineers and analysts responsible for those processes will have access to a potent tool to aid them in the difficult task of process optimization, being able to focus more on the validation and approval of the suggested improvements rather than discovering and implementing these improvements themselves.

Figure 6 highlights how this use case maps on the components provided by ASOP. **Service Provision**, from the operation services domain, holds the knowledge on how to manage a service for a specific client. **Data Analytics**, **Information (catalog+inventory)**, and **Automation & Orchestration** components, on the cross-domain components layer, are used to contextualize the network data with the entities and the executed processes, along with their results. Finally, the **Intelligence** component identifies and detects the improvements that can be added to the **Automation & Orchestration** component. As for the abstraction domain, the **Configuration Management** component can be affected by any identified improvement in its own processes. Finally, the **Platform Design** component allows for the onboarding of any entity or workflow change resulting from any improvements, and aids in its deployment.

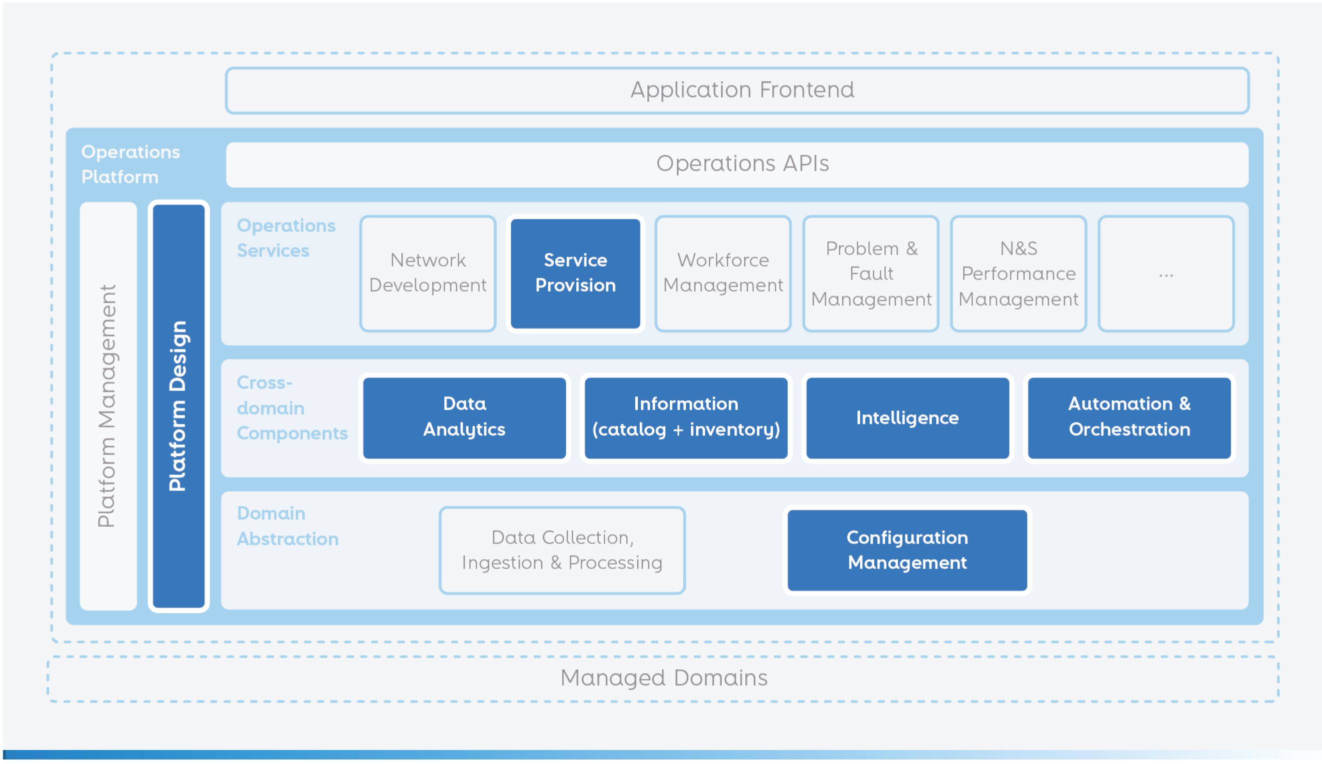

Figure 6 – ASOP modules used in the provisioning process optimization use case

The closed-loop use case: from sensing to acting through 360-degree vision

It is undeniable that our world is continuously changing and the dynamics in which we spend our daily lives will take us into unimaginable paths. New technologies like 5G and mass internet of things (IoT) devices will introduce new paradigms in the assurance field, supported by increasingly virtualized and programmatic networks and a massive array of data analytics. The most advanced NOC have started, in recent years, the path of automation, but supported by basic rules and constraints. Nonetheless, this automation is not yet able to, autonomously, detect the cause of a failure, trigger more advanced troubleshooting processes or even act on the network to provide a better quality of experience.

If, on the one hand, network operators are incessantly overflown with information such as alarms, performance measures, network topology, network and service transactional data, on the other, they suffer the absence of an effective way to diagnose and resolve issues rapidly. Without a quick and effective diagnose, mean time to repair (MTTR) is penalized and can cause not only network and service unavailability but also affect customer's satisfaction. For example, in a typical scenario, a network operations engineer must access multiple systems and knowledge bases to diagnose a problem and to identify the root cause. Simultaneously, network technicians must search if there is already a trouble ticket (TTK) opened for that problem and, if not, a TTK must be created. Additionally, the right resolution must be applied or, if not possible, the ticket must escalate to the next support tier. Not only is this process lengthy, inefficient and tedious, but it also presents a more dramatic issue – it's not scalable [7].

Faced with this dilemma, cognitive operations appear as a new era and the necessary path to take. In this new paradigm, the implementation of closed loops enables the full path automation, from sensing to confirming and then to acting.

Network technician's workforce is supported by a new set of exceptional tools that will [7]:

- Be able to predict problems before they impact customer service;
- Provide an integrated 360-degree view of the problem, with details of the alarms, performance measures, related TTKs, recent change requests on the component, weather information, social buzz, service impact analysis and more (as shown on **Figure 7**);
- Track actions that are taken autonomously on the network by reconfiguring or repairing in case of failure;
- Access advanced troubleshooting issues that autonomously diagnose problems by pointing to root causes and possible action for resolution;
- Make use of bots that guide the screening and resolution process.

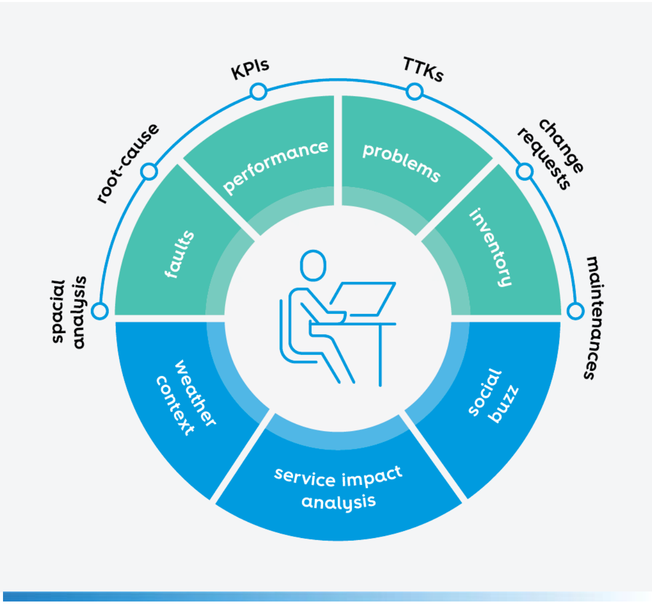

Figure 7 – 360-degree view

From sensing to acting, the whole process can be completely autonomous or require human action in case of uncertainty or confirmation of the next step to take.

However, the decision to depend on whether or not a human intervention is necessary should be based on analytical criteria and the level of confidence, which can be obtained from the feedback of the sense-act-confirm cycle. If this value is above a predefined threshold, full automation is suggested. On the other hand, a degradation on this rate might indicate that the flow may require a human review.

This use case illustrates the potential of the new ASOP architecture by taking advantage of most of its modules, as shown in **Figure 8**.

Regarding the operations services level, the 360-degree view takes advantage of the **Workforce management**, **Problem & Fault Management** and **N&S Performance Management** components. In the cross-domain components level, all modules are employed in the sense-act-confirm cycle. As far as abstraction domain is concerned, **Data Collection**, **Ingestion & Processing** is involved in making data available to the operations services layer. The **Configuration Management** component is one of the inputs of the 360-degree view.

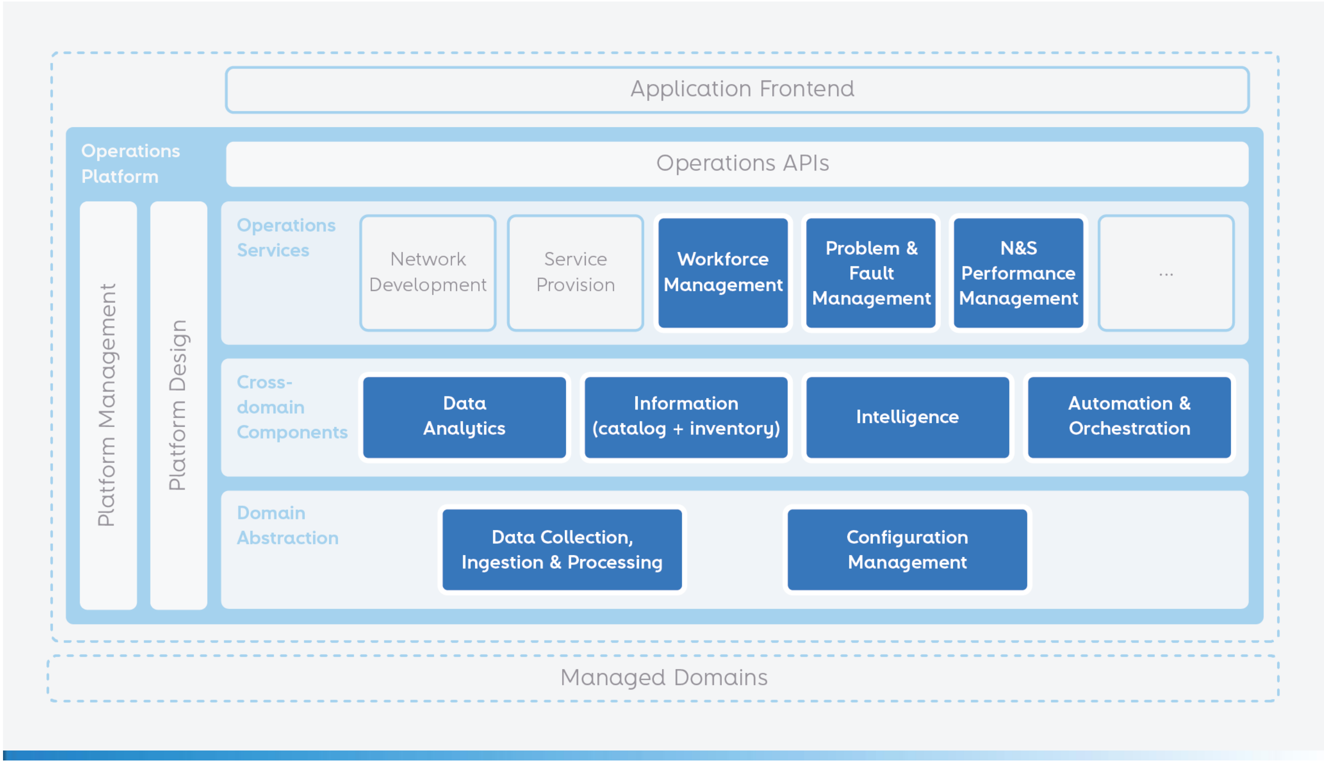

Figure 6 – ASOP modules used in the provisioning process optimization use case

Conclusion and future work

Tomorrow's network management systems will undoubtedly need to be able to auto-provision, auto-scale and auto-heal for the telco industry to lower costs and improve performance. The changes will happen through a closed-loop process that collects data, identifies problems, recommends or makes decisions, and then takes action [8].

This evolution is vital, but it is not possible without a shift from reactive operations to proactive ones, from those to a predictive understanding, and subsequently to cognitive operations.

Nevertheless, cognitive operations are not the last stage. Instead, they are the intermediate step between predictive and prescriptive ones. The major difference between these two concepts is that while the previous forecasts the potential future outcomes, the latter helps you draw up specific recommendations. In fact, prescriptive operations use predictive ones to arrive at the different options available along with their anticipated impact on specific key performance indicators [9].

The adoption of ASOP's architecture is a crucial stage to guarantee that there is a functional alignment between all the components to attend any future technological challenge. This architecture will allow the creation of new tools for decision support while creating new value. Such is the ultimate paradigm of cognitive organizations: to be self-organized, data-driven, intelligent, adaptable to change and eventually autonomous. In this new generation, operators need not only to be intelligent and highly autonomous but also lean, agile, predictive and showing real-time awareness.

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Authors

Carlos Guilherme Araújo

Product Manager

Altice Labs, Portugal

carlos-guilherme-araujo@alticelabs.com

https://www.linkedin.com/in/guilherme-araújo/

Gonçalo Nuno Gaspar

Team Leader and Software Engineer

Altice Labs, Portugal

goncalo-n-gaspar@alticelabs.com

www.linkedin.com/in/goncalo-gaspar

João Tiago Guerrinha

Product Manager

Altice Labs, Portugal

joao-t-guerrinha@alticelabs.com

www.linkedin.com/in/littlewar

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An Altice Labs Company

+55 11 3888-2644
www.openlabs.com.br
comercial.brasil@openlabs.com.br