Executive Summary

While the world is increasingly more connected, Communication Service Provider (CSP) internal systems and processes seem disconnected. Often when a service is deployed between locations spanning multiple geographies, CSPs often have to cooperate, given the need for local presence.

In an ideal scenario, CSPs adopting the same open API standards provided by the TM Forum can leverage uniform outbound connectors (or Service Ordering Platforms) to serve customers and partners. Anuta Networks ATOM makes this process easy by offering tools that allow CSPs to automate network functions.

Challenges

- Although they have diverse management styles and methodologies, various CSP operational domains, such as Transmission, IP, Radio, Wired, and Wireless environments, must collaborate to supply services.
- Business domain functions must also communicate with Operational Domain Managers to understand resources, inventory, and deliverables to build new services that span multiple domains.
- Operational Domain Managers in various organizations are at different maturity levels, and business teams are under constant pressure to enhance existing and create new/ services and [or] products at pace with demand.
- Building service catalogs and delivering services to current and future customers is human-centric, error-prone, and time-consuming.

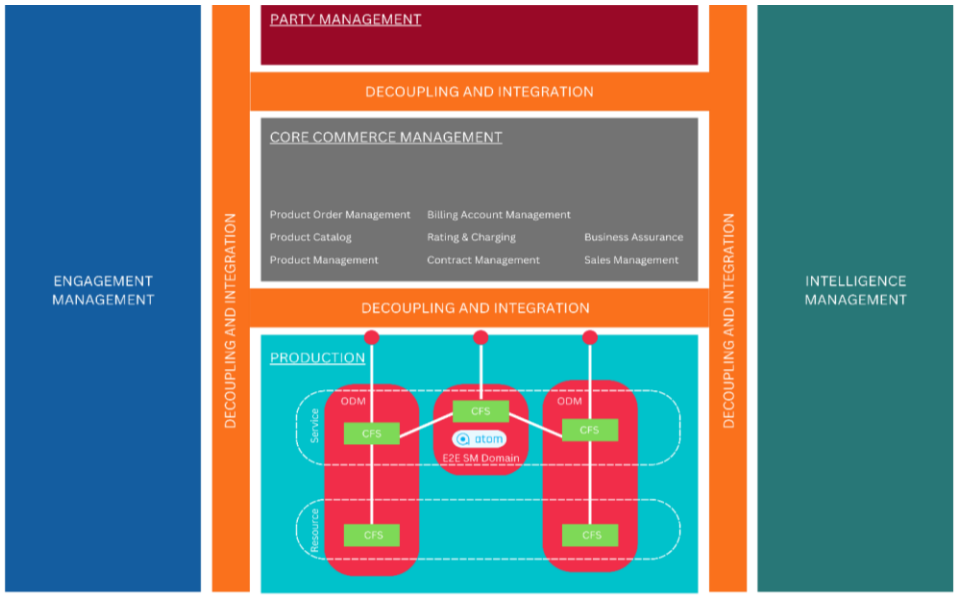
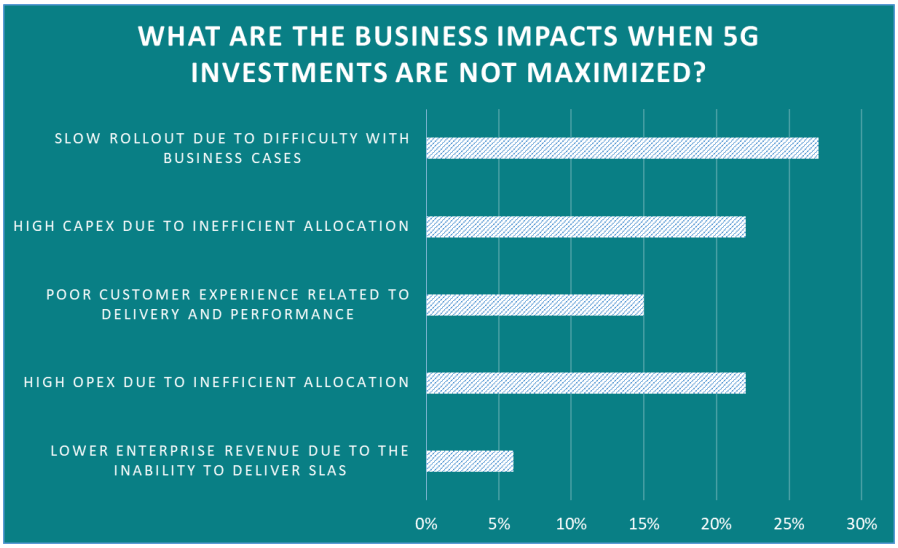


Fig: TMF Open Digital architecture focusing on PRODUCTION and CORE COMMERCE MANAGEMENT domains

- To deliver an end-to-end service that involves the configuration of devices and knowledge of resources belonging to different operational domains, the need for an E2E Service Domain Manager is critical.
- The E2E Service Domain must deliver a system that not only interacts with business functions but also offers different operational domain controllers, devices, and databases for CSPs to quickly build new service offerings and deliver them at scale.
- CSPs often partner with each other to deliver a service that spans continents. In such a scenario, CSPs' inner workings must be synchronized to facilitate services on respective platforms effortlessly.
- CSPs must address Network as a Service (NaaS) as an evolving trend more aggressively to make it a broad implementation rather than a solution only implemented on a small scale.

According to a recent survey report from TMF, *"Perhaps the most immediate issue for some CSPs is that 5G deployments are too slow, too expensive, or detrimental to customer experience. About a quarter of the CSPs we surveyed (27%) say they have issues with slower-than-expected rollouts due to the difficulties of putting together business cases. Almost one-third (30%) are experiencing high Capex due to inefficient allocation, and 15% cite poor customer experience related to delivery and performance."*



Introduction

CSPs typically purchase systems, hardware, and software from 50 to 100 vendors. These systems include billing, accounts, contract management, order management, production network infrastructure, and more.

Most of these tasks have migrated to digital solutions during the past decade in what many call the "digital era." However, it's not enough. CSPs continue to struggle with digital sufficiency. Deeper awareness of each other's resources, skills, inner workings, etc., is required for the digital systems implemented.

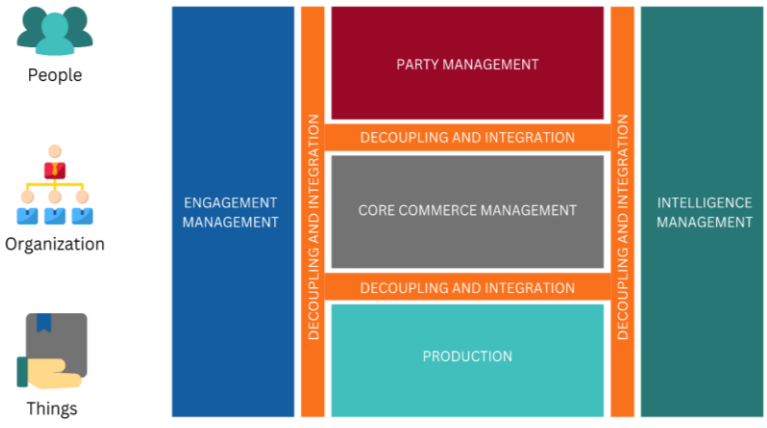


Fig: TMF Open Digital Architecture - Functional

A crucial question that needs to be answered is how to enable seamless communication and integration between the systems, portals, and interfaces developed by CSP vendors intended for different functions within the company. The TMF Consortium and its Open APIs can be a valuable resource in this situation. The consortium comprises small to large-scale CSPs, software and hardware firms, and companies offering OSS and BSS services. TMF Open APIs also provide a blueprint for designing and developing APIs for products that operate in different management or functional domains, ultimately enabling the delivery of NaaS.

TMF has provided open APIs that cater to a host of systems belonging to every management domain of the Open Digital Architecture. However, Anuta Networks has attempted to limit our focus to open APIs for services most important to the ATOM platform and the production domain in which it operates. Some of the TMF specs supported in varying degrees of coverage are the following:

TMF 628	Performance Management
TMF 633	Service Catalog Management
TMF 638	Service Inventory Management
TMF 639	Resource Inventory Management
TMF 640	Service Activation Management
TMF 641	Service Ordering Management
TMF 642	Alarm Management
TMF 652	Resource Ordering Management
TMF 645	Service Qualification Management
TMF 653	Service Test Management
TMF 656	Service Problem Management

Anuta's platform offers a well-maintained REST API with its own set of endpoints for internal resources. We had to expose new endpoints per open API guidelines. We created a TMF Open API gateway to help translate ingested data via new endpoints within existing resource structures.

Impact

The digital systems running inside various management domains must not be siloed.

When preparing a service offer that involves configuring transmission and IP network components, individuals from business management functions typically need to collaborate with multiple departments to understand requisite resources, availability, challenges, and configuration components.

This process is repeated frequently for service offerings and during other service lifecycle phases. In addition to lengthening the time to market for every offer, this significantly slows down the rate of innovation among CSPs. Conversely, significant increases in efficiency can be realized if systems belonging to different departments (Operational Domains) interact.

The sheer number of members that TMF has is further evidence that the industry is embracing this change. It is anticipated that newer products released by these member organizations will automatically support open API standards. As part of standard requirements for the products onboarded, some CSPs have already started requesting TMF Open API compliance in new proposal requests. This can potentially reduce order-to-delivery timeframes for all CSP services, dramatically improving their bottom lines and profit margins.

In most cases, delays resulting from human intervention and mistakes in each step of the service delivery process will be resolved. Organizations will also realize the benefits of more NaaS offerings after implementing TMF Open APIs. This promotes innovation and provides CSPs more options for best-in-class suppliers and products. It also reduces internal bureaucracy, facilitates plug-and-play models, and provides a consistent experience across multiple domains.

An added benefit is that standardized processes, tasks, topologies, services, and hierarchies will facilitate the generation of easily consumable operational data from network infrastructure and organizational functions, ultimately unlocking greater business insights.

To deliver NaaS at scale, CSPs have to embrace ODA. ODA is not just a low-level architectural change, but rather it can drive the transformation of organizational structure, policies, and function in such a way that it accelerates NaaS implementation.

Production for a CSP consists of complete network infrastructure elements, which further can have infra controlled or maintained by different teams like Transmission, IP Networks, Radio, etc. These various types of network infra are categorized as operational domains.

According to TMF, to enable NaaS, the production component must be fully matured to the point where a single tool, known as the End to End Service Manager, provides a Northbound Open API interface to the entire network infrastructure stack. This tool interacts with other ODA Blocks/Components and can interact with all network infrastructure elements and controllers in the southbound direction. It should also comprehend the underlying network infrastructure and associated controllers to provide a holistic view. This is where ATOM shines in its ability to function as the End-to-End Service Manager.

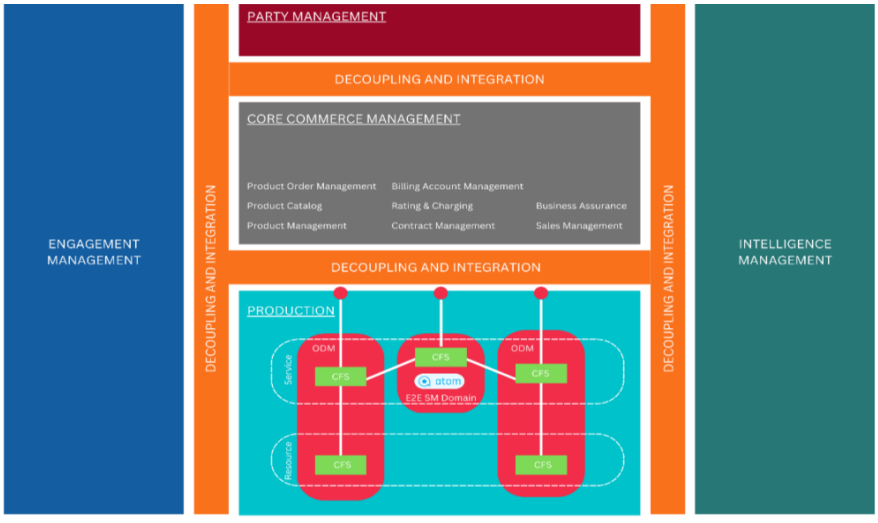


Fig: TMF Open Digital architecture focusing on PRODUCTION and CORE COMMERCE MANAGEMENT domains

ATOM- TMF Features

- **Service Orchestration**

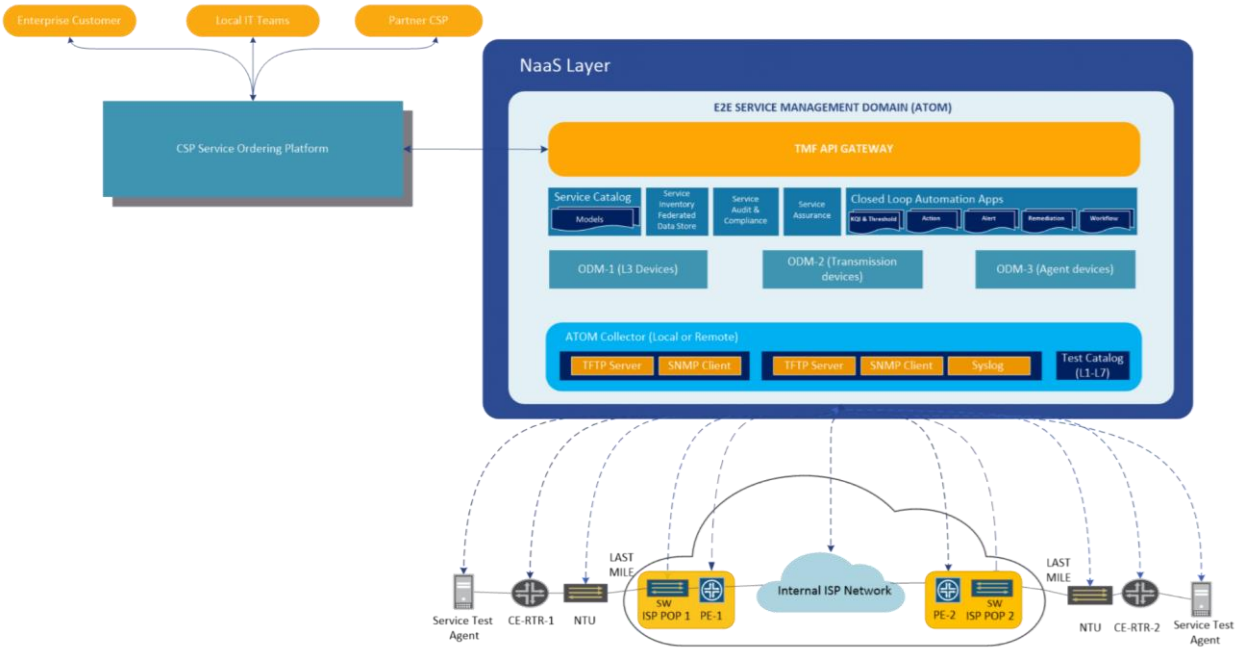


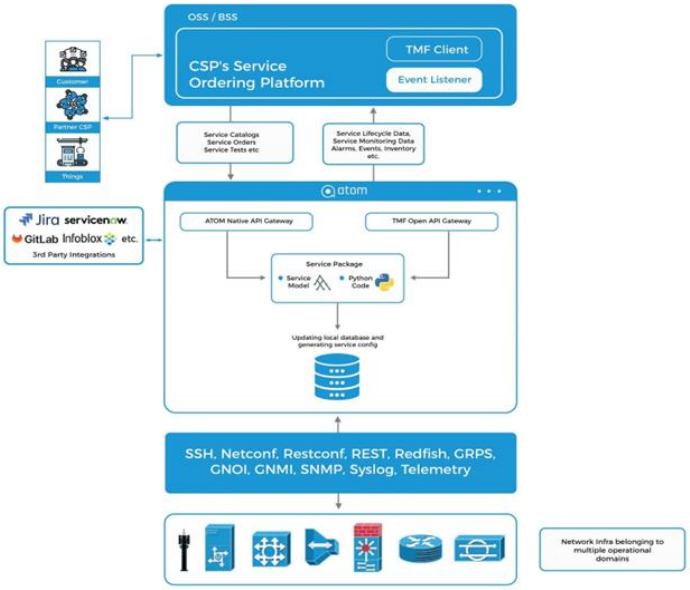
Fig: A Service Deployment use case Flow Diagram

Service Orchestration involves configuring and setting up equipment belonging to one or multiple operational domains within a CSP, allowing customers to access their resources in a logical manner, even when elements are in geographically distant locations.

The underlying network infrastructure often contains virtual infrastructure, domain-specific controllers with exposed custom APIs on the northbound route, physical/ virtual network infrastructure on the southbound way, and actual devices at separate sites. The E2E domain controller may also communicate with IPAMs, OSS/ BSS functions, ticketing systems, and other high-level systems from the Core Commerce Management, Intelligence Management, Party Management, and Engagement Management domains in addition to core network infrastructure.

To convert the specific service information provided by the customer or other stakeholders into a "serviceOrder.json" file for service orchestration, ATOM relies on the TMF client capability, which is often included in the CSP's service ordering platform. This file was produced following TMF Open API (TMF 640/641) guidelines and considering the service features chosen for the catalog. The Northbound REST API endpoints are also aligned to TMF Open APIs (TMF 640/641), where service details are received.

.These endpoints are linked to the corresponding southbound systems, functions, and resources in the ATOM database. The configuration is developed and deployed on the southbound network elements, such as RAN, optical, transmission, IP Backbone, Test Agents, data center components, cloud, and more, to provision, alter, or delete the totality or a portion of the service



Using the Event Listener capability, the customer portal and various OSS/BSS functionalities can be aware of these events. Every activity creates the appropriate alerts, which then passes on to the Event Listener functionality. These event alerts adhere to TMF Open API (TMF 642) standards.

Fig: TMF Open Digital architecture focusing on PRODUCTION and CORE COMMERCE MANAGEMENT domains

- **Service Monitoring**

Service Validation and Troubleshooting

The first step in controlling the service is creating and implementing a proper configuration. ATOM examines each endpoint interface status on the access side. It validates the control plane and data plane across all service sites.

ATOM users can also use the Active Service Assurance feature to send synthetic traffic over the established service path to ensure not just the end-to-end functioning of the service but also the defined SLAs.

Using the TMF 645 (Service Qualification) and TMF 653 (Service Test Management) APIs, the ATOM TMF API gateway also enables services that are to be validated and rectified.

OAM and SLA Monitoring

Users of ATOM can configure CFM flows between service endpoints to employ Y.1731 frames for end-to-end service monitoring. Users can also create SLA iterators and assign them to a service to periodically measure the data, or they can collect performance data on demand.

Fault and Performance Management

ATOM triggers early warnings about network problems and allows service providers to meet SLAs.
ATOM can also share the fault and performance management data with the northbound OSS/BSS using the TMF 642 (Alarm Management) API.

Traffic Flows on UNIs

ATOM provides interface traffic for all endpoints in the VPN service.
TMF Event listener (part of CSPs customer service portal) can use ATOM to collect traffic flow information using TMF 656 (Service Problem Management) API.

Additional features of ATOM's Service Monitoring

Configuration Audit

ATOM validates at the configuration level to determine whether the intended configurations are on all targeted devices. ATOM TMF gateway can also perform the service qualification using TMF 640 (Service Activation) and TMF 645 (Service Qualification) APIs.

Auto-Ticketing

ATOM can facilitate improved control to remediate issues. With an open & API-driven platform, ATOM integrates with ITSM and OSS/BSS tools to trigger incident tickets or send notifications automatically.ATOM can also integrate with OSS/BSS using TMF 641 (Service Order Management) and send the alert details using TMF 642 (Alarm Management) API to open the trouble tickets.

Brownfield Service Discovery

ATOM possesses a service discovery feature to discover brownfield services with resources and manage them accordingly.

LSP Monitoring

ATOM provides information on transport LSP for each service and monitors traffic.
TMF Event Listener can collect LSP stats from ATOM using the TMF 656 (Service Problem Management) API.

The following architecture diagram shows the positioning of the TMF API Gateway, which communicates with the TMF Client (a component of the CSPs Service Ordering Platform) and the internal ATOM components.

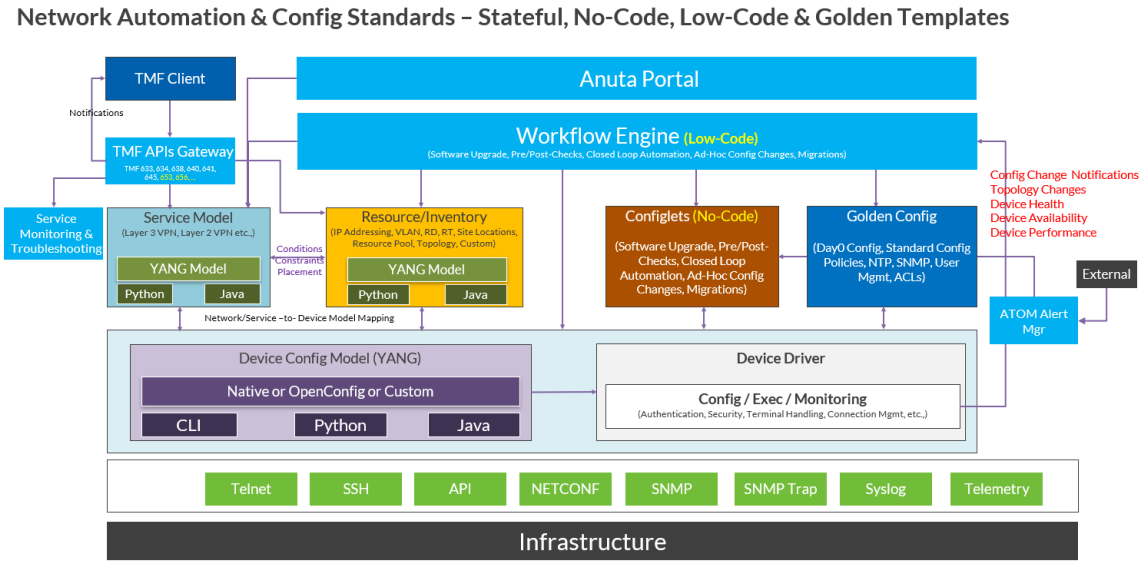


Fig: ATOM Network Automation Based on Open Standards

Conclusion

With Anuta Networks ATOM, the company aspires to become the E2E Service Management domain, where it will have the power to directly or indirectly affect, control, and modify configurations, resources on controllers, and devices belonging to practically every Operational Domain. Business functions only need to engage with one system for all types of network requirements, which facilitates a more efficient CSP underlying network and cloud infrastructure.