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CYNET OAV Architecture Analysis

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Abstract

This document undertakes an analysis of CYNET's network architecture components. It does so by comparing the current status to the TMForum's Open Digital Architecture (ODA), which is the reference architecture selected by the GN4-3 project's Orchestration, Automation and Virtualisation (OAV) focus group within the Network Technologies and Services Development Work Package. The analysis can help to further develop the potential for CYNET to be compatible with future OAV multi-domain processes and workflows throughout Europe.

Table of Contents

Table of Figures

Executive Summary

This document analyses CYNET's network architecture components by comparing its current status to the TMForum's Open Digital Architecture (ODA), which is the reference architecture selected by the GN4-3 project's Orchestration, Automation and Virtualisation (OAV) focus group within the *Network Technologies and Services Development* Work Package.

The analysis aims to help to further develop CYNET's potential to be compatible with future OAV multi-domain processes and workflows throughout Europe, and concludes that the CYNET architecture, although independently developed, and at an early stage of its automation journey, can be aligned with the ODA core principles and design concepts. Overall, the ODA information governance (with the use of Open APIs and TM Forum Frameworx standards) can help CYNET to move towards a digital transition at its own pace, while remaining compatible with others who also work aligned to the ODA reference architecture.

1 Introduction

CYNET is Cyprus' National Research and Education Network. It provides a network infrastructure for the Cypriot Research and Education Community and connects educational and research institutions. CYNET-II, the national backbone of CYNET, is connected to the European backbone GÉANT which is part of the world-wide community of research and education networks. Because Cyprus is a small island, CYNET is a National Research and Education Network (NREN) that serves only a few universities (around 17) which has so far allowed its workflows to be mainly non-automated processes. However, although CYNET is currently only at the beginning of its journey into Orchestration, Automation and Virtualisation (OAV), going forward the organisation would like to do more to benefit from adopting OAV principles, and to make sure it is compatible with future OAV multi-domain processes and workflows throughout Europe. Therefore, in May 2019, CYNET participated in a GÉANT survey about orchestration, automation and virtualisation [OAVS] conducted by the GN4-3 project. CYNET is also an active participant in the Network Services Evolution and Development Task (Task 2) of the GÉANT4-3 project's Network Technology and Services Development Work Package (WP6), particularly in the OAV focus groups related to OAV terminology, reference architecture and training

2 Workflow Analysis

The current Operation Support System (OSS) in CYNET comprises several components that are a mixture of commercial and open source modules. For example, CYNET utilises XEN virtualisation techniques in conjunction with Azure cloud services. CYNET also uses the Request Tracker for Incident Response (RTIR) solution for workflow monitoring and ticketing. The Office 365 Excel workbook is widely used for inventory and customer support.

The current workflows in CYNET can best be described by the following use case:

A customer is interested in CYNET's EumedConnect2 service. The customer downloads the Excel sheet for the service from the CYNET services page, fills in the form, and then emails it to the CYNET info email address. When the customer's request for the EumedConnect2 service arrives, it is manually saved to the file server as an Excel worksheet, and a ticket is manually opened for the technicians to handle the request at the RTIR (with the Excel sheet attached to the ticket). Next, the manager assigns the ticket/request from RTIR to a CYNET technician. If the service needs changes/additions to the customer's roles/permissions in terms of accessing the GÉANT service, the technician who has access to Active Directory and/or LDAP adjusts the permissions of the customer accordingly (this is necessary, because GÉANT services are set up locally in CYNET's internal servers; therefore, the managing of the access is executed by CYNET technicians). Once the technician resolves the ticket/request and adds the service to be monitored in Nagios, the manager updates and closes the ticket/request in RTIR, and informs the customer and the manager via email that the Excel sheet needs to be updated and saved on the file server.

3 Goals and Requirements

Although its workflows are currently not supported by automation or orchestration, CYNET is planning to use orchestration with automated components in the future. Being able to set up a central configuration management database for automating network provisioning is seen as a benefit of establishing automation and orchestration. This ensures the integrity of the configuration and accurate monitoring by having a single point of truth for configuration data, rather than using multiple version control repositories of configuration files on network devices. An advantage of using a multi-domain management orchestrator is the option to grant self-service operations to customers (e.g. Cyprus universities) for requesting network additions or changes.

CYNET is also planning to provide services like Campus Network management as a Service (CNaaS) [CNaaS] with a self-service integration through an orchestrator in the future. Therefore, a multi-domain management orchestrator is a necessity for letting customers manage their own networks which are provided by CYNET via CNaaS (as shown in the CNaaS project) with self-service management (as shown in the NMaaS project) [NMaaS].

For the above reasons, CYNET will in the future hand over control to the customer via a self-service portal. CYNET sees this self-service approach as a benefit of OAV implementation in addition to the enhanced management of the complete service lifecycle (i.e. strategy decision, design, build, operate, improve), which targets the operations of provisioning, change-add-remove, termination, and the capability to offer composable services [ITIL], [FRAM]. The main requirements for the realisation of orchestration and automation, as seen by the CYNET development team, include:

- One place to hold all the network configurations (central repository).
- Automation through orchestration. This central repository of all network configurations can be used by any automating component to automatically set up a series of network elements.
- Flexible and dynamic design of the network in a security-conscious manner. Therefore, it will have the ability to detect and restrict unauthorised access. However, if any unauthorised change occurs on a network element, provisioning will enable the automation component to roll back the changes at a specific time, based on the central repository of all network configurations.
- Use of standardised interfaces based on REST Application Programming Interfaces (APIs).
- Definition of workflows that will be part of predefined processes for service provisioning, using standardised steps that are essential to deploy each specific service type.
- The final aim is to move towards working with different technology domains. The management of all devices (for networking and for services) that belong to a technical domain will be done in a uniform manner, enabling the creation of standardised workflows on the orchestration layer.

4 Mapping to the OAV Reference Architecture

To ensure that CYNET's OAV platforms will be compatible with other NRENs, and to allow CYNET to go forward with OAV at its own pace, CYNET would like to follow a flexible reference architecture in its digital transformation process. As reported in Deliverable D6.6 Transforming Services with Orchestration and Automation [D6.6], the GN4-3 WP6 OAV architecture team selected TMForum's Open Digital Architecture (ODA) [ODA] as an open reference "blueprint" against which GÉANT community organisations can map their own architectures. The ODA architecture uses functional building blocks and open APIs, which offers the potential needed for the type of decoupling and integration that CYNET envisions to be achieved, and future multi-domain provisioning that is based on a common multi-domain reference framework. This section explores the mapping of CYNET's platforms to ODA.

An analysis was performed at CYNET to identify all CYNET architectural components, and to investigate how they could be matched to TMForum's ODA reference architecture and its functional blocks. When put into this context, the CYNET architecture can be mapped as in Figure 4.1, which shows its functional representation. The grey boxes in the diagram correspond to CYNET architecture components, and their placement within the ODA functional blocks is defined based on their main functionalities.

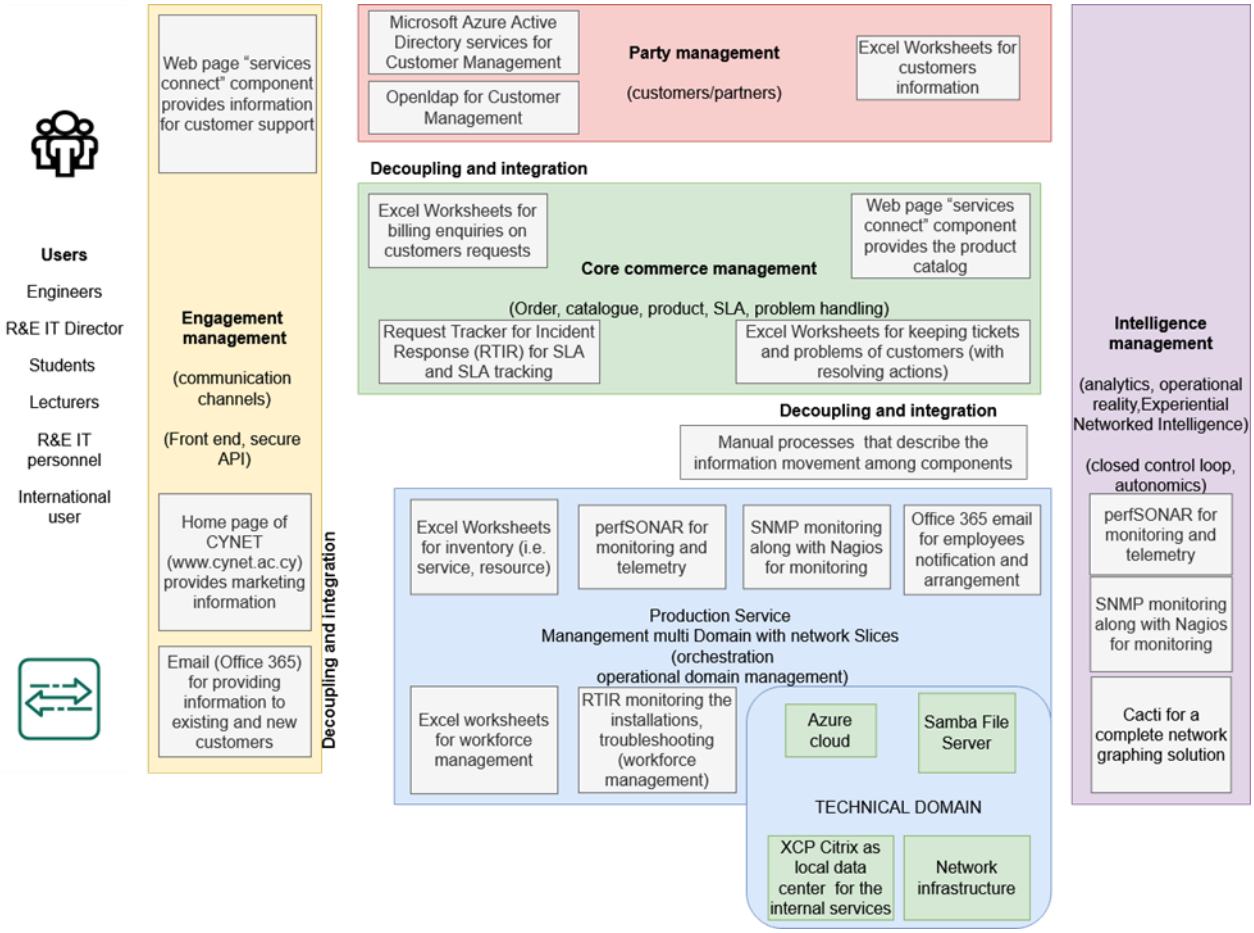

Figure 4.1: CYNET OAV architecture mapped to TMForum's ODA

When compared to the ODA core concepts and design principles, it is evident that the CYNET architecture has considered and adopted some similar ideas and approaches, e.g. using an RTIR-based service management process that is not only responsible for the implementation and lifecycle of the service, but is also used to put monitoring of the service and SLA tracking into place. The RTIR ticket system is part of core commerce management compared to ODA core concepts.

The following sections describe all functional blocks of the ODA architecture, and how CYNET's current architecture can be mapped to this reference model. This will later make it possible to identify common interfaces for OAV processing in the multi-domain environment not only for GÉANT NRENs but also for CYNET's other partners and customers.

4.1 Engagement Management

The Engagement Management functions of ODA in CYNET can be associated with:

- The Home page of CYNET [Cynet], which provides information about services, CYNET policies, CYNET processes, marketing, the network, etc.
- An e-mail communication channel using Office 365 for the main user engagement of CYNET, providing information to existing and new customers, as well as promoting new or existing services to new and other potential customers.
- Customer support by informing new or existing customers. More specifically, CYNET defines customer management procedures where each customer must find the appropriate Excel sheets, and submit the relevant form(s) via email [Procedures].

4.2 Party Management

In CYNET, the Party Management functional domain components deal with:

- Storing information of existing and new customers using Excel worksheets.
- Management of the accounts (delete/update/insert) of customers (existing/new), carried out through the management component of the Microsoft Cloud/Openldap Active Directory services (LDAP), which includes roles and permissions management.

4.3 Core Commerce Management

The Core Commerce Management functions of ODA at CYNET consist of:

- Storing records of customer requests (ordering forms to capture order information) using Microsoft Excel template worksheets, which are subsequently used for billing enquiries.
- Managing tickets and problems reported by customers together with the first response actions, using Excel worksheets. Based on the filled out template in Excel, tickets are then manually created and added to the Request Tracker for Incident Response (RTIR) (including SLA and SLA tracking), so that RTIR, using the Puppet-RT module, can keep history and tracking information for all incidents and requests. Once the service is completed, the Excel sheets are saved on a file server.
- The product catalogue, which is provided by the “services connect” component that is hosted on the CYNET website [Connect].
- GÉANT services, which are offered by CYNET alongside other services by the “services connect” component [Connect], which serves as an extension to CYNET’s product catalogue. Examples of these GÉANT services are certificates, eduroam, perfSONAR, NMaaS, WiFiMon, PMP services, Connections, and eduVPN. Examples of non-GEANT services that CYNET provides are the services that the EUMEDGRID project offers, i.e. EUmedGridsupport and EumedConnect2.

4.4 Production

For the Production Management functional domain, the ODA components/modules that can be associated are best understood if the service provisioning process is examined first.

The process of service provisioning starts with a request made by new or existing customers, using a template Excel file that is downloaded from the CYNET website, and submitted to CYNET via email. Next, the administrative person responsible for handling the customer SLA and implementation of services creates a ticket in the RTIR as a new request and creates a new workflow to be handled by CYNET technicians.

The monitoring of the installations, troubleshooting and support of the workforce people, and, hence, the workforce people management, is handled using Excel worksheets for ticketing, incident flow, and workflows through the CYNET departments using the RTIR workflows.

Throughout the whole process workflow, the manager assigns and monitors the ticket/request from RTIR to a CYNET technician. Once the technician resolves the ticket/request, the technician updates and closes the ticket/request at RTIR, and informs the customer via email. The technician also requests the manager via email to update the Excel sheet to and save it to the file server. If the technician installs software/hardware on the client's side in order to resolve a ticket, the workflow also includes updates of the client's hardware and software inventories (i.e. service, resource), which is stored in the form of Excel worksheets.

perfSONAR and SNMP monitoring tools along with Nagios are used to monitor the current runtime metrics, and the current operation of the network and server infrastructure. These monitoring tools can give a runtime indication of the status of the network and servers that are located in the CYNET network in terms of network resources and hardware resources utilisation (e.g. utilisation of bandwidth, CPU, memory, and storage).

The current technical domains in CYNET include a Citrix XCP XENSERVER, which is used to provide internal service resources, and Azure along with Microsoft Office 365, which are used to provide cloud resources, network infrastructure resources (e.g. Juniper routers, Juniper switches), and Samba file service resources.

The CYNET email service is hosted in the cloud technical domain, which is based on Microsoft Azure and Office365, and is used for employee notification and request submission and handling. The rest of the software components and internal CYNET services, such as the RTIR software and Samba file services, are hosted in CYNET's local data centre. This technical domain is used for hosting Virtual Machines (VMs) that reside in CYNET. XCP Citrix is used for the local data centre, where management is performed using "Xen Orchestra XCP-ng / XenServer".

4.5 Decoupling & Integration

The implementation of ODA's Decoupling & Integration can be associated with the manual processes and procedures that are put in place and describe how to move information from one component to another. Based on the CYNET NREN needs, these processes can be automated in the future.

4.6 Intelligence Management

The implemented Intelligence Management functions can mostly be associated with data gathering and data management processes. In CYNET, perfSONAR is used for monitoring and telemetry along with SNMP monitoring using Nagios and Cacti for a complete network-graphing solution. The data gathered by the tools are analysed by CYNET technicians for the purpose of capacity planning and troubleshooting. The implementation of a feedback loop or closed control loop is done manually at the moment, based on the information gathered from the monitoring tools. Note that perfSONAR and SNMP monitoring using Nagios are also associated with the production service ODA component, due to the runtime features that are provided in order to monitor the production infrastructure.

5 Conclusions

Overall, it can be concluded that the CYNET architecture, although independently developed, and at an early stage of its automation journey, can be aligned with the ODA core principles and design concepts. The reference architecture of ODA is iterative and versatile, to a great extent modular, and the process of implementing an orchestrator will be easier with ODA alignment, and its decoupling and integration approach in the context of multi-domain orchestration.

The ODA information governance is well designed because the API-based functional building blocks provide the ability to incorporate many components of the internal systems, but also to integrate them with other external systems (if needed) in a multi-domain manner. Overall, the ODA information governance (with the use of Open APIs and TM Forum Frameworx standards) can help CYNET to move towards a digital transition at its own pace, while remaining compatible with others who also work aligned to the ODA reference architecture.

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Glossary

API	Application Programming Interface
CNaaS	Campus Network management as a Service
LDAP	Lightweight Directory Access Protocol
NMaaS	Network Management as a Service
NREN	National Research and Education Network
OAV	Orchestration, Automation and Virtualisation
ODA	Open Digital Architecture
OSS	Operation Support System
REST	REpresentational State Transfer
RTIR	Request Tracker for Incident Response
SNMP	Simple Network Management Protocol
VM	Virtual Machine
VPN	Virtual Private Network
WP	Work Package