



Robert Botez



● EXPERIENȚA PROFESIONALĂ

08/2019 – ÎN CURS

CERCETĂTOR – UNIFIED COMMUNICATIONS IN CLOUD LABORATORIES - UCLABS

- Dezvoltarea și implementarea algoritmilor de rutare
- Administrarea infrastructurilor de tip cloud privat orchestrate de OpenStack
- Implementari in infrastructuri de tip cloud

Cluj-Napoca, România

07/2018 – 10/2018

INGINER DE APLICAȚII SOFTWARE – BOSCH ENGINEERING CENTER CLUJ

- Dezvoltarea de algoritmi pentru sistemele de direcție electrică

Cluj-Napoca, România

07/2017 – 09/2017

ASISTENT DE CERCETARE – "DIGITALLY ENHANCED RF AND ANALOG IC" GROUP – DERFAIC RESEARCH GROUP

- Procesarea semnalului și proiectarea circuitelor analogice

Cluj-Napoca, România

● EDUCAȚIE ȘI FORMARE PROFESIONALĂ

10/2021 – ÎN CURS – Cluj-Napoca, România

DOCTOR – Universitatea Tehnică din Cluj-Napoca

10/2019 – 07/2021 – Cluj-Napoca, România

INGINER DIPLOMAT ÎN DOMENIUL TELECOMUNICAȚIILOR – Universitatea Tehnică din Cluj-Napoca

- Unified Communications in Cloud, Wireless Systems, Quality of Service in Next Generation Networks, Cybersecurity, Basis of High Throughput Data Transmissions, 3G/4G/5G Mobile Communications, Spread Transmission Systems with Spectral and Power Efficiency

My tasks included:

- An in-depth literature study about SDN, NFV and Network Slicing and their impact in 5G networks.
- Migrating the 4G and 5G packet core to containers and orchestrate them with Kubernetes.
- Managing the scalability and deploying of the 4G/5G packet core as CNF in virtual environments such as OpenStack and OpenShift.

Results:

- A novel solution to achieve network slice scalability based on the least-load CNF for the User Plane Function (UPF) with the use of Kubernetes and SDN. The results were published in Sensors journal by MDPI: <https://doi.org/10.3390/s21113773>.
- The results led to a unique deployment of the CumuCore 5G-SA in the OpenShift platform: https://catalog.redhat.com/software/cnf/detail/5g_core_with_network_slice_manager_and_5glan_tsn_support_functions

Domeniul (domeniile) de studiu

- Tehnologiile ale informației și comunicațiilor (TIC)

Lucrarea de diplomă: SDN and NFV for Network Slicing Scalability: A Kubernetes Approach

5 (highest) | Nivelul 7 CEC | ECTS | 31

2015 – 2019 – Cluj-Napoca, România

INGINER ÎN DOMENIUL TELECOMUNICAȚIILOR – Technical University of Cluj-Napoca

- Internet Protocols, Routing and Switching, Cloud Computing, Data transmission, Modulation Techniques, Mobile Communications

2011 – 2015 – Oradea, România

DIPLOMĂ BACALAUREAT – Colegiul Național „Mihai Eminescu”, Oradea

- Mathematics-Informatics profile

● **COMPETENȚE LINGVISTICE**

Limbă(i) maternă(e): **ROMÂNĂ**

Altă limbă (Alte limbi):

	COMPREHENSIVNE		VORBIT		SCRIS
	Comprehensiune orală	Citit	Exprimare scrisă	Conversație	
ENGLEZĂ	C1	C1	C1	C1	C1
FRANCEZĂ	A2	A2	A1	A1	A2

Niveluri: A1 și A2 Utilizator de bază B1 și B2 Utilizator independent C1 și C2 Utilizator experimentat

● **COMPETENȚE DIGITALE**

Microsoft Office | Microsoft Word | Microsoft Excel | Microsoft Powerpoint | Google Drive | Google Docs | Zoom

● PUBLICAȚII

An SD-WAN Approach for EUt+Network

Iustin-Alexandru Ivanciu, Robert Botez, Calin-Marian Iurian, Virgil Dobrota

<https://doi.org/10.1109/RoEduNet54112.2021.9638308> – 2021

The European University of Technology (EUt+) is an alliance of eight universities which aims to offer students the possibility of studying at different partners all over the continent and obtaining a recognized diploma. Our goal is to propose a framework for the European University of Technology network, which needs to support both the physical and virtual mobility of students between the partners. We rely on Software-Defined Wide Area Network (SD-WAN) and Management and Orchestration (MANO) for deploying the network. Next, several traffic engineering mechanisms are added to find the best path for different types of traffic and thus achieve the highest Quality of Experience for the users. Finally, we employ homomorphic encryption to secure not only student and staff personal information but also to maintain the autonomy of each partner when it comes to handling private data.

Use Case of a Management and Orchestration for Network Functions Virtualization in a VoIP Testbed

Benjamin Koné, Ahmed Dooguy Kora, Robert Botez, Iustin-Alexandru Ivanciu, Virgil Dobrota

<https://doi.org/10.1109/BlackSeaCom52164.2021.9527877> – 2021

This paper examines a practical approach for Network Functions Virtualization (NFV) management and orchestration (MANO) based on the Open Source MANO (OSM). The proposed testbed uses the OSM Open Source orchestration platform, in order to handle and orchestrate the NFV Voice over Internet Protocol (VoIP) in OpenStack used as Virtual Infrastructure Manager (VIM). On top of this, we implemented Software-Defined Networking (SDN) by means of the Open Network Operating System (ONOS) controller and Open vSwitch. Our experiments show that the solution is feasible, with the latency, jitter, packet-loss and Mean Opinion Score (MOS) all within the range.

SDN-Based Network Slicing Mechanism for a Scalable 4G/5G Core Network: A Kubernetes Approach

Robert Botez, Jose Costa-Requena, Iustin-Alexandru Ivanciu, Vlad Strautiu, Virgil Dobrota

<https://doi.org/10.3390/s21113773> – 2021

Managing the large volumes of IoT and M2M traffic requires the evaluation of the scalability and reliability for all the components in the end-to-end system. This includes connectivity, mobile network functions, and application or services receiving and processing the data from end devices. Firstly, this paper discusses the design of a containerized IoT and M2M application and the mechanisms for delivering automated scalability and high availability when deploying it in: (1) the edge using balenaCloud; (2) the Amazon Web Services cloud with EC2 instances; and (3) the dedicated Amazon Web Services IoT service. The experiments showed that there are no significant differences between edge and cloud deployments regarding resource consumption. Secondly, the solutions for scaling the 4G/5G network functions and mobile backhaul that provide the connectivity between devices and IoT/M2M applications are analyzed. In this case, the scalability and high availability of the 4G/5G components are provided by Kubernetes. The experiments showed that our proposed scaling algorithm for network slicing managed with SDN guarantees the necessary radio and network resources for end-to-end high availability.

Quantum Implementation of the Modified Dijkstra's Routing Algorithm

Robert Botez, Iustin-Alexandru Ivanciu, Calin-Marian Iurian, Virgil Dobrota

<https://acad.ro/sectii2002/proceedings/doc2021-1/11-Dobrota.pdf> – 2021

Quantum computing can be used to solve certain problems faster than classical computers. One such problem is related to optimal routing in Internet of Things and sensor networks where the number of nodes is very high and multiple constraints (energy efficiency, latency, throughput) must be met. We propose a quantum implementation of the Modified Dijkstra's algorithm for finding the optimal route between a source node and a destination node in a connected graph. This is a particular case of the Travelling Salesman Problem, which is NP hard. Our contribution is two-fold: first of all, we encode both the Available Transfer Rate and the One-Way Delay in the controlled unitary matrices in order to be able to use Quantum Phase Estimation for computing the composite metric of a path. Second, we use an optimized version of the Grover quantum search algorithm to find the path with the minimum composite metric with zero failure rate.

Implementation of a Continuous Integration and Deployment Pipeline for Containerized Applications in Amazon Web Services Using Jenkins, Ansible and Kubernetes

Artur Cepuc, Robert Botez, Ovidiu Craciun, Iustin-Alexandru Ivanciu, Virgil Dobrota

<https://ieeexplore.ieee.org/document/9324857> – 2020

Nowadays, cloud computing has become the go to solution for most enterprises. This has led to the introduction of DevOps techniques in which developers work closely with network engineers in order to ensure fast and reliable deployment of their applications. This paper presents an entire automated pipeline, starting with detecting changes in the Java-based web application source code, creating new resources in the Kubernetes cluster to host this new version and finally deploying the containerized application in AWS. The solution follows DevOps best practices and relies on Jenkins for the Continuous Integration stage. The novelty herein is that we used Ansible for Continuous Deployment thus increasing the scalability and overall ease of use. The solution ensures zero downtime and proves fast, even though it combines six different technologies and requires very few computational resources.

Management and Orchestration for Network Function Virtualization: An Open Source MANO Approach

Manuela-Ioana Csoma, Benjamin Koné, Robert Botez, Iustin-Alexandru Ivanciu, Virgil Dobrota

<https://ieeexplore.ieee.org/document/9324847> – 2020

This paper presents a functional solution for the management and orchestration (MANO) of the Network Function Virtualization (NFV), based on Open Source MANO (OSM). Two different Virtual Infrastructure Managers (VIMs) were tested: OpenVIM and OpenStack. Following the European Telecommunications Standards Institute (ETSI) requirements two experimental scenarios were devised: (1) with OpenVIM in test mode: two Ubuntu 16.04.6 virtual machines (VMs), hosted by different physical computers, acted as two virtual infrastructure managers (VIMs); one of them was collocated with Open Source MANO (OSM); (2) with OpenStack as a VIM and OSM running on an Ubuntu 18.04 virtual machine. The experimental results helped us defined some best practices for integrating OSM with both VIMs. In the future, we plan on extending the infrastructure orchestrated by OSM to include an SDN controller and several clouds acting as VIMs.

Containerized Application for IoT Devices: Comparison between balenaCloud and Amazon Web Services Approaches

Robert Botez, Vlad Strautiu, Iustin-Alexandru Ivanciu, Virgil Dobrota

<https://ieeexplore.ieee.org/document/9301070> – 2020

Depending on the requirements, the deployment of containerized applications for monitoring Internet of Things devices can be done in Cloud or on the Edge. This paper discusses the design of a containerized application monitoring temperature and humidity for IoT devices in three implementations: (1) balenaCloud for edge deployment; (2) Amazon Web Services cloud with EC2 instances; and (3) dedicated Amazon Web Services IoT service. The experiments showed that there are no significant performance differences between Edge and Cloud deployments regarding the resource consumption. However, for fast and almost effortless action, Amazon Web Services IoT is the go-to option when it comes to serverless applications based on Message Queuing Telemetry Transport. For all-in-one automated fleet management balenaCloud seems to be a good tool for IoT developers.

Deploying a Dockerized Application With Kubernetes on Google Cloud Platform

Robert Botez, Calin-Marian Iurian, Iustin-Alexandru Ivanciu, Virgil Dobrota

<https://ieeexplore.ieee.org/document/9142014> – 2020

The fast development of IoT networks and the integration of these scenarios in everyday life has also led to great diversity of SD-WAN solutions. With the advent of 5G, more and more devices will be connected, which requires careful monitoring especially in crucial situations such as transport scenarios. This paper presents the implementation of a web application based on microservices, each of them running in a dedicated Docker container, which gathers information in real-time from two vehicles. These standalone executable packages of software are orchestrated by Kubernetes and hosted on Google Cloud Platform. The data used during the execution of the project is stored into a Cloud SQL instance. All the necessary resources in order to build the project can be monitored with Stackdriver.

● PROIECTE

10/2020 – 04/2022

● CLOUDUT - UTCN Research Cloud

<http://cloudut.utcluj.ro/>

Obiective principale:

- Creșterea *capacității de cercetare* în scopul ridicării nivelului de competitivitate științifică pe plan internațional al Universității Tehnice din Cluj-Napoca, prin crearea unei infrastructuri de calcul de înaltă performanță, numită CLOUDUT, integrabilă în structuri naționale și internaționale de tip cloud și infrastructuri de date masive;
- Dezvoltarea *colectivelor de cercetare științifică interdisciplinară* și a capacității de colaborare în proiecte naționale și internaționale de cercetare în domeniile big data, inteligență artificială, date spațiale și IoT, precum și utilizarea acestor tehnologii într-o gamă largă de aplicații inginerești, economice și administrative, solicitate de mediul economic regional și național.

● PERMIS DE CONDUCERE

Permis de conducere: AM

Permis de conducere: B1

Permis de conducere: B

● COMPETENȚE ORGANIZATORICE

Competențe organizatorice

- Abilități bune de conducere a unei echipe dobândite ca antrenor de arte marțiale

● COMPETENȚE DE COMUNICARE ȘI INTERPERSONALE

Competențe de comunicare și interpersonale

- Abilități bune de comunicare dobândite prin interacțiunile cu echipa mea de lucru sau colegii de facultate
- Spirit de echipa

● **JOB-RELATED SKILLS**

Job-related skills

- Cloud Computing
- TCP/IP
- Tehnologii 2G, 3G, 4G, 5G
- Tehnici de codare și modulare
- Quantum computing
- Aplicații software
- Aplicații software embedded
- Limbaje de programare: C/C++/C#, Python, Java, MySQL, Matlab, Assembly, Javascript, PHP
- Tehnologii de virtualizare și containerizare: VirtualBox, VMware, Docker, Kubernetes, KVM, QEMU
- Sisteme de operare: Windows, macOS, Linux
- Experiență cu infrastructuri de tip cloud public și privat: OpenStack, VMware, AWS, GCP

● **OTHER SKILLS**

Other skills

- Arte marțiale: fost campion mondial la *kumite*
- Șah
- Literatură