POLITECNICO DI TORINO

Dipartimento di Automatica e Informatica

PhD in Computer and Control Engineering

XXXII cycle

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Formal assurance of security policies in automated network orchestration (SDN/NFV)

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1. Introduction

With the rise of Software-Defined Networking (SDN) and Network Function Virtualization (NFV), networks are becoming increasingly dynamic and automated. Consequently, a high level of automation is also demanded in the management of such networks. Specifically, for security management, automated orchestration of network security functions is a need. At the same time, automation can be exploited to provide formally correct and optimal solutions, which is difficult to achieve manually

2. Objectives

The PhD activity goals are to improve automation of network modeling, security configuration, and orchestration, at the same time providing optimization, and formal assurance that security policies are satisfied.

3. Method

To cover the semantic gap between the artifacts produced by software developers and those accepted by automation tools, we designed a framework for automatically extracting formal models from a Java based representation of a network function [1].

The generated models were used to obtain optimal and formally correct placement plans [2] and to generate optimal and formally verified security configurations [3]. This has been achieved by formulating the problem as (weighted) Maximum Satisfiability Modulo Theory (MaxSMT), in contrast to the combinatorial encoding adopted in literature.

4. Results

A tool, named VerefOO [1], has been developed to implement the method. It has been applied successfully to several use cases.
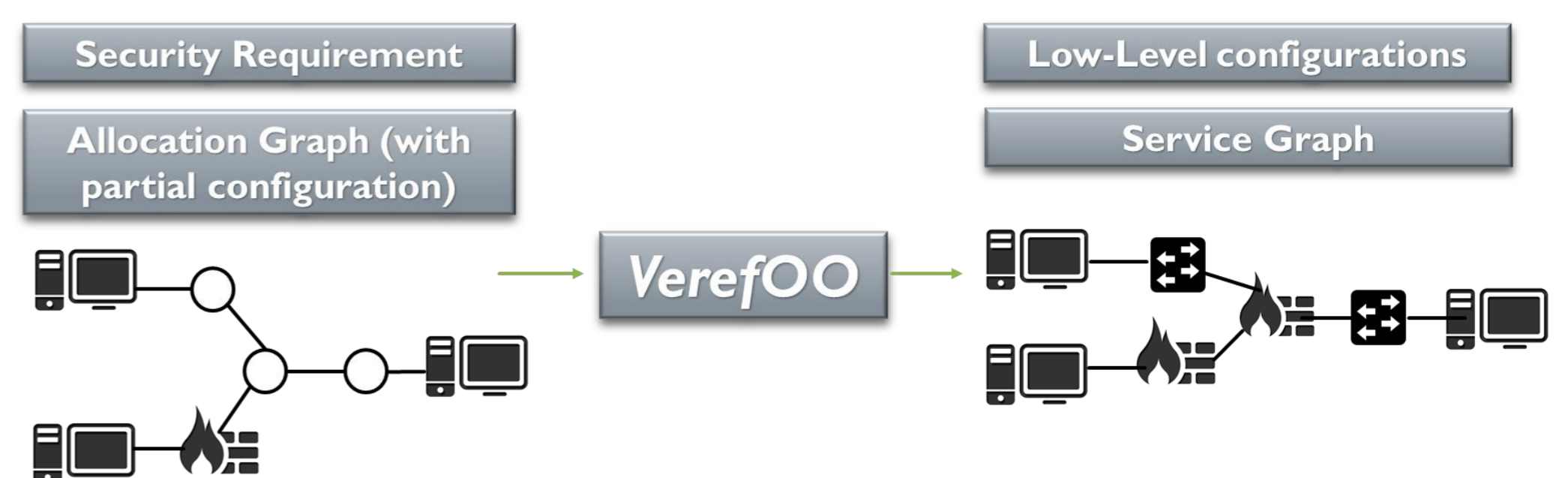
Experimental results show that usually the computation time required by VerefOO does not increase exponentially. This result is particularly positive, given the intrinsic worst-case computational cost of a MaxSMT problem, which belongs to the NP-complete class. Here we show computation time versus number of allocation places and security requirements, for the automatic allocation and configuration of firewalls.
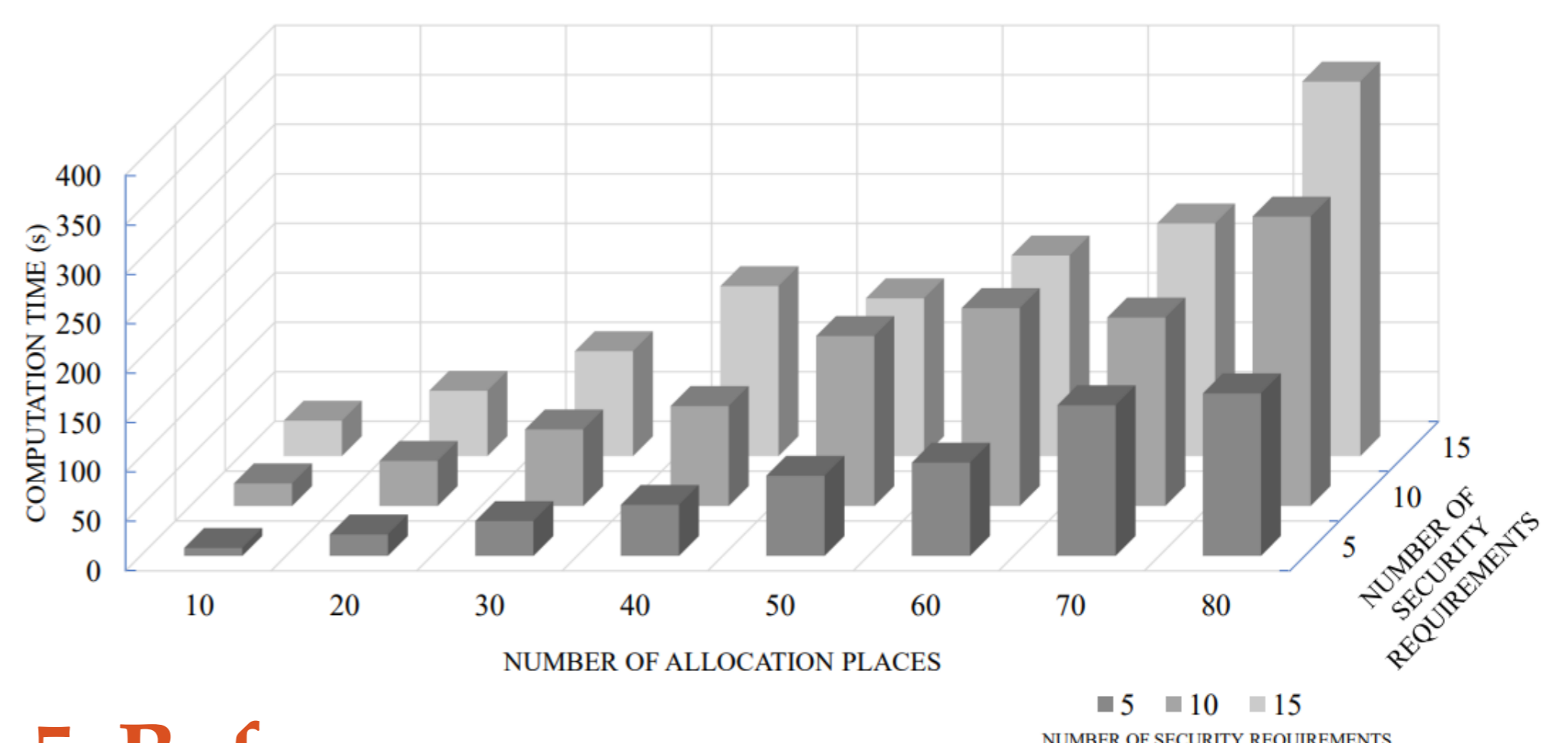
5. References

1. A Framework for Verification-Oriented User-Friendly Network Function Modeling. G. Marchetto, R. Sisto, F. Valenza, J. Yusupov IEEE Access, 2019

2. Formally verified latency-aware VNF placement in industrial Internet of things. G. Marchetto, R. Sisto, J. Yusupov, A. Ksentini, 14th International Workshop on Factory Communication Systems (WFCS), 2018

3. Automated Security Management for Virtual Services, M. Repetto, A. Carrega, J. Yusupov, F. Valenza, F. Risso, G. Lamanna, Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN), In Press.

[1]https://github.com/netgroup-polito/verifoo