Chapter 7

The Contribution of MDA in Software-Defined Network: A Survey

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ABSTRACT

Software-defined networking is changing the way we design and manage networks. This prominent paradigm based on the separation of control and management plane is highly heterogeneous with different devices from various technologies and leads to an incredible growing of materials. As SDN expands in size of devices and complexity, it faces greater administrative and management challenges. The paradigm of MDA was introduced using NETCONF/YANG as a way to model in order to deal with these management challenges and soften the development of SDN applications. The researchers joined the MDA and its related concepts as model-driven engineering to SDN to implement a platform called model-driven networking increasing the level of abstraction on development. This chapter presents a comprehensive survey of the research relating to MDN paradigm. It starts by introducing the basic concepts of SDN. Next, it presents the concepts related to MDA, and the YANG which is a modeling language. Last, it highlights the studies introducing the MDN paradigm and its benefits in SDN applications.

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INTRODUCTION

According to latest research from strategy analytics (« Number of connected devices reached 22 billion, where is the revenue? », 2018), which reflects an enormous augmentation in terms of using networks, as a result, the management of networks may become more challenging and complex. Software defined networking (SDN) is changing the way we design and manage networks. It enables the network programmability, via an external controller. The application development in this context is still complex due to the difficulties of integration and compatibility, as the new programmed network had to be incorporated in the existing environment. To cope with these challenges, researchers introduced an approach based on the model driven architecture (MDA) paradigm to raise the level of abstraction in development and ease the integration of SDN networks in the existing networks. This chapter book surveys latest developments in this active research area of SDN. The researchers first present basic concepts of SDN with the aforementioned two characteristic features, potential benefits, main components and faced challenges of SDN. Secondly they dwell on SDN implementation (Openflow) and a related work about a comparison of the existent SDN controllers, which leads to their presentation of Mininet as the most powerful testing platform. Subsequently the model driven architecture (MDA) is introduced as a paradigm allowing the ease of development in SDN environment. Finally, they highlight some related work using MDA in SDN networks, and conclude this chapter book with some suggested open research challenges.

BACKGROUND

The key idea of SDN is to decouple the control plane from the data plane and allow flexible and efficient management and operation of the network via software programs. Nevertheless, the application development in this context is still complex for such recent technology. Moreover, there is a strong need for methodologies and tools exploring the abstraction levels potentials supported by SDN. In the move to this architecture, model-driven templating plays a pivotal role in helping develop and deliver new services more quickly (Abel Tong, 2016). In this context, many researches have been proposed using the Model-Driven Architecture and its concepts to ease the application development within the new paradigm. A novel Software-Defined Networking (SDN) Controller architecture that is founded on Model-Driven Software Engineering (MDSE) concepts was presented (Jan Medved et al., 2014). It supports both the “classic” OpenFlow-based approach to SDN and emerging model-driven network management/programmability technologies, such as NETCONF/YANG. (Felipe A. Lopes et al., 2015) introduced a new approach based on the Model-Driven Engineering (MDE) paradigm, called Model Driven Networking (MDN). MDN relies on a Domain-Specific Modelling Language (DSML) to create SDN applications. This proposal increases the level of abstraction on development, therefore reduces the complexity to implement SDN applications. These applications should be built in a more customized fashion, and seamless integrated with existing SDN infrastructure and control. (JoãoEurípedes Pereira Júnior et al., 2019) proposed a Model-Driven Development (MDD) approach to SDN application development and integration so as to ensure high-quality network services. The suggested method is based on the use of ontology-driven conceptual modeling to understand the behavior of existing and to improve the network architecture’s elements in order to optimally interface and integrate into models. These models are transformed into source code that respects the requirements of existing components and enforce the requirements of SDN applications been developed leading to higher continuity and lower time to market and maintenance
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