A Fog-based Architecture for the Efficient Support of Innovative Teaching Scenarios in Primary and Secondary Education

Vasiliki Giannou
University of West Attica
Athens, Greece
vgiannou@uniwa.gr

Basilis Mamalis
University of West Attica
Athens, Greece
vmamalis@uniwa.gr

ABSTRACT

Fog computing is a new kind of computation type in modern years, which allocates part of the compulsion of cloud computing storage, estimation and processing, closer to the network edge [1]. The impact of cloud and fog computing on collaboration in an educational context, is now more than ever of high importance [2]. In the present study, a special focus is given on the innovative designed services of fog computing in the educational field.

1 Introduction

For many years the main trend in internet/cloud applications was that end-users communicate directly with the cloud servers and interact with each other through web services. However, several problems may appear on closer inspection, including issues with latency, bandwidth, security, scalability, availability and durability control. To overcome the above limitations, fog computing places processes and resources closer to the network edge, while data remains mostly stored in the cloud. This leads to faster processing times and fewer resources consumed [1]. In educational territory, fog computing techniques push educational operations and offer the chance for implementing innovative teaching scenarios. Fog computing is a new technology that is going to have progress in the future, as well as will considerably improve day-to-day methods for many sectors, including education [2-5]. Eventually, design and assessment issues of innovative services in educational system are considered.

2 The proposed fog-based architecture

In the above context, our research deals with the construction and implementation of a fog-based platform that provides an integrated solution for real-time educational collaboration between students either in the same school building or between different school building. The proposed system investigates the way that Fog Computing helps to efficiently aggregate the data from the end-user (students) devices, so that the processing that takes place is distributed manner at the fog/edge devices of the network [3]. In this way, the system obviously reduces the network traffic across the network core layers. The architecture and implementation of the system are presented in relation to the existing use of the case of an educational scenario which can take place in an educational environment [4]. In our case a fog architecture of multiple layers will be used; the first layer (classroom fog nodes) will manage the collaboration within the same classroom, the second one will manage the collaboration within the same school building (different classrooms), and the third one the collaboration in the peripheral layer (among different school buildings). The performance of our prototype architecture is going to be evaluated through extended simulations as well as over a real-world pilot environment.

3 Modern fog-enabled teaching scenarios

Furthermore, special focus will also be given on the design and implementation of innovative teaching scenarios, emphasizing big data-stream management techniques, distribution of the computational congestion and data in intermediate nodes, and flexible servers distribution in classroom layer, in school layer, between schools layer, in peripheral layer, etc. The proposed scenarios will include both student-student interaction and teacher-student interaction with real time requirements in transmitting image/video content [2,4]. For example, online assignments that require synchronous and asynchronous video collaboration (with or without the need of real time teacher feedback) among students in the same or in different classrooms located either in the same or in different schools, educational games (with or without virtual reality features) demanding the concurrent real-time participation of one or more students teams or individual students either in the same or in different schools, etc. The heavy image/video loads that have to be exchanged in real time will be efficiently distributed over the appropriately selected fog nodes in each case. The end-user devices may be any kind of smart/portable device (i.e. phones, tablets, laptops etc.).

Concluding, it is proposed to create virtual educational environments connecting different classrooms and schools, in which online collaborative video exercises / teaching scenarios will be efficiently performed. Modern technologies (container-based virtualization and microservices) will be used to support the implementation. The assessment of the proposed architecture is going to present the advantages and disadvantages of the existing educational resources and the changes which need to be done in order to do educational things better and more effective.

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