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S6: a Smart, Social and SDN-based Surveillance System for Smart-cities

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Abstract

In the last few years, Software Defined Networks (SDN) and Network Functions Virtualization (NFV) have been introduced in the Internet as a new way to design, deploy and manage networking services. Working together, they are able to consolidate and deliver the networking components using standard IT virtualization technologies not only on high-volume servers, but also in end user premises, Telco operator edge and access nodes thus allowing the emergence of new services.
In this context, this paper presents a smart video surveillance platform designed to exploit the facilities offered by full SDN-NFV networks. This platform is based on free and open source software running on Provider Equipment (PE), so allowing function deployment simplification and management cost reduction.

Peer-review under responsibility of the Conference Program Chairs.

Keywords: Software Defined Networking; Network Functions Virtualization; Fog/Edge Computing; Live Video Broadcasting.

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1. Introduction

The new paradigms of Software Defined Networks (SDN)[1] and Network Functions Virtualization (NFV)[2,3] have recently redefined the vision of the Internet: the power of SDN is based on its characteristic of decoupling control and data planes, moving the network intelligence to a centralized controller. On the other hand, the emerging technology of NFV introduces an important change in the network service provisioning approach, leveraging on standard IT virtualization technology to consolidate many network equipment facilities and application services onto standard servers that could be located in data centers, network nodes and even in the end user premises[4].

Therefore, a joint application of SDN/NFV framework allows a Telco Operator to run network and application functions within virtual machines, by using NFV, and to dynamically steer traffic flows through the requested virtual network functions (VNFs) thanks to the underlying SDN network. By so doing, Telco Operators are migrating their networks from a completely hardware platform made up of hardware middle boxes[5] or software routers[6,7], towards a more flexible softwarized network where VNFs can be instantiated and migrated according to specific policies aimed at optimizing energy efficiency, costs and performance[8,9], and taking into account congestion of parts of the network, or even faults, at run-time.

Moving from this technical background, this paper proposes an SDN/NFV-based video surveillance platform allowing to easily deploy a huge number of IP cameras in the territory of a smart city, and associate the related video streams to interested users that may be local police, security forces, administrative entities and even simple citizens.

Against the classical approach used by the legacy video surveillance systems[10,11], here, thanks to the presence of the SDN/NFV interconnection network, the video stream generated by each IP camera is automatically rerouted directly to the "interested receivers" in a point-to-multipoint fashion. Thanks to this peculiarity, installation of new cameras is trivial because cameras do not need to be configured since where sending the video stream is automatically decided by the network. Moreover, thanks to the contribution of SDN, video stream generated from a camera is not replicated for each destination, while thanks to the contribution of NFV, new plugins can be easily added in the form of service chains of Virtual Functions (VFs) between the source and the destination of a data stream. For example, additional virtual machines can be run in the network to provide network- and application-layer services, like for example video rate control[12,13,14], flow encryption[15,16], or TCP flow control[17]. Let us stress that point-to-multipoint communication is not realized with approaches that can be now considered obsolete, as for example peer-to-peer (P2P) multipoint communication, which may present some instability problems[18,19,20]. On the contrary, point-to-multipoint communication in the system proposed in this paper is realized within the network, so minimizing traffic and maximizing performance thanks to the possibility of orchestrating network-level and application-level resources at the same time.

2. Platform description

The target of the proposed platform is to develop a video surveillance platform that presents the following main peculiarities: smart, plug-and-play, flexible, scalable in terms of number of transmitting and receiving devices.

More specifically, the access to the platform is achieved by positioning SDN/NFV-compliant Smart Access Node (SAN) devices realized by using general-purpose hardware providing WiFi or 4G connectivity, each being in charge of covering a small/medium area (e.g. car park, square, school and so on), and allowing the connection of both video transmitters and receivers. Each user connected to the platform, through a web application or a mobile app, has a map of the territory covered by the platform (i.e. the smart city), with all the active cameras represented with a green circle. Association of one or more cameras to a registered user is done very easily by clicking on the map viewed on the screen, or through a QR-code that is present in proximity of the camera. The user can then customize the received video and the events associated to each camera, for example requiring the system to be alerted in case of a motion detection from a specific camera. Other tools are available like for example a mosaic view conveying the flow stream of multiple cameras. Of course, more than one user can be "interested" to the same camera installed in a given area covered by the service. Thanks to the presence of the SDN/NFV underlay network, the video stream generated by each IP Camera is automatically rerouted directly to the "interested receivers" in a point-to-multipoint fashion. Thanks to this peculiarity, installation of a new camera is trivial because no additional configuration is needed: the destination of a video stream is automatically decided by the Platform Orchestrator. Moreover, thanks to