Demo: *SDN@Play* as a strategy to enhance the multicast delivery rate in WLANs

Estefanía Coronado*, Roberto Riggio‡, José Villalón* and Antonio Garrido*
*High-Performance Networks and Architectures (RAAP). University of Castilla–La Mancha, Albacete, Spain
Email: {Estefania.Coronado, JoseMiguel.Villalon, Antonio.Garrido}@uclm.es
‡CREATE-NET, Trento, Italy
Email: Roberto.Riggio@create-net.org

***Abstract*—In view of the exponential growth in the live multimedia content applications, multicast communications would imply a considerable traffic reduction compared to the unicast ones. However, given the absence of feedback information, packets are sent at the lowest rate, hence occupying the medium for long periods. Software Defined Networking (SDN) has changed the traditional network operations, therefore simplifying the network management and resource allocation. On this basis, in this demo we present an SDN-based algorithm for the dynamic multicast rate adaptation in Wi–Fi networks that outperforms the channel usage of the IEEE 802.11 standard, while maintaining the quality of the transmission. The performance of our solution has been preliminarily tested on a real–world testbed, therefore proving how it can be run on any WLAN infrastructure.**

***Keywords*—SDN, WLANs, 802.11, multicast, rate adaptation.**

I. Introduction

The past years have shown how the demand for multiuser and multimedia contents has surged with the popularity of video on-demand applications, such as Youtube. At the same time, the change in business models towards co-working and collaborative environments have highlighted the need to deliver the same information to several receptors due to the traffic overhead that multiple transmissions would generate.

802.11 WLANs are one of the most popular wireless technologies in both the industry and daily life domains. Although the IEEE 802.11 [1] standard supports a wide range of modulation and coding schemes (MCS), multicast frames are sent at the lowest rate due to the lack of ACKs and retransmissions. As a result, they saturate the channel and damage the performance of other applications. The IEEE 802.11aa [2] amendment introduces a set of multicast retransmission policies to enhance the communications reliability. Nevertheless, no mechanism for the delivery rate adaptation is specified. Despite many approaches have aimed to address this problem, most of the logic is set on the Access Points (APs) or are not compatible with the market devices [3].

Software Defining Networking (SDN) has changed the traditional network management by decoupling the network logic into the control–plane and the data–plane. Particularly, the introduction of high level programming abstractions allows the shift of the network intelligence to a logically centralized controller. However, the most popular protocols in SDN (such as OpenFlow [4]) are targeted at wired networks and only a few of them have emerged in the wireless domain [5].

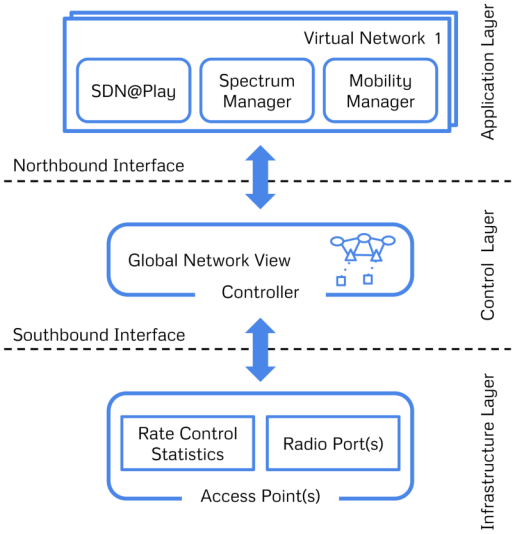

Fig. 1: *SDN@Play* System Architecture.

This demo will show a new programming abstraction for multicast transmissions in 802.11 WLANs. Moreover, *SDN@Play* is illustrated as an SDN-based application for the dynamic MCS selection in multicast communications. Due to the use of higher rates in comparison with the IEEE 802.11 standard, our approach outperforms the bandwidth consumption and reduces the wireless channel occupancy. Therefore, the performance of other applications is also enhanced.

II. EmPOWER SDK

The deployment of *SDN@Play* takes as a reference point the programming abstractions and the architecture defined in the EmPOWER platform [5]. Fig. 1 depicts the system architecture where the logic is divided into the infrastructure, control and application layers. The infrastructure layer is composed of the APs, which can be found in the data–plane, refereed as Wireless Termination Points (WTPs). The control layer corresponds to the EmPOWER Runtime controller, which forwards the network operations to the control plane through the southbound interface. Likewise, the application layer presents a Python-based SDK that allows the development of Networks Apps for the network management.

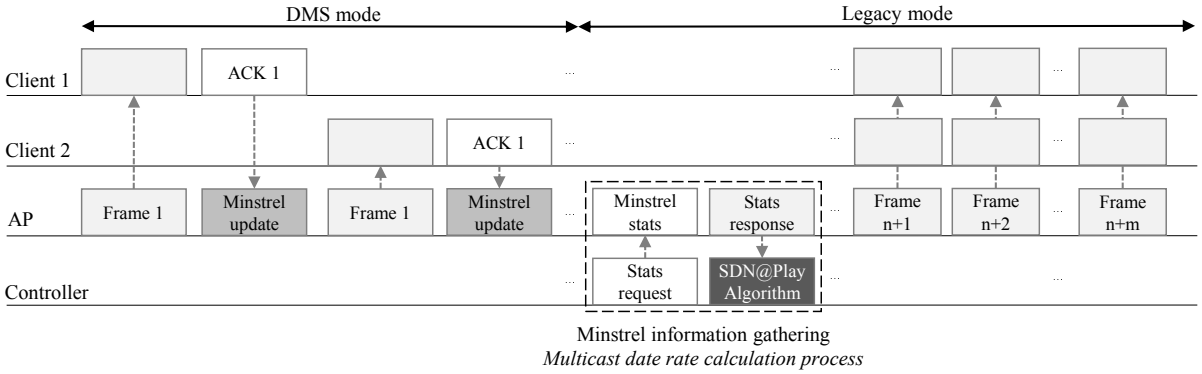

Fig. 2: *SDN@Play*'s scheme. In the *first phase DMS* is used as multicast policy allowing the link delivery statistics gathering. In the *second phase* the policy is switch to *Legacy* and the collected statistics are used to compute the optimal multicast MCS.

III. The *SDN@Play* tool

SDN@Play is an algorithm for the multicast rate adaptation, which is based on the link delivery statistics and the combination of different retransmission policies. The working mode of *SDN@Play* is divided into two phases, as shown in Fig. 2. In the *first phase* (the shortest one), the controller sets Direct Multicast Service (DMS) as multicast policy for a given address *M*. Notice that DMS transmits as many unicast frames as the number of receivers in the network. Thus, the AP gathers the statistics of every receptor, which is precisely the input of the algorithm that is run at the beginning of the *second phase*. Based on this information, it estimates the MCS with the highest delivery probability for all the stations in the group. In the *second phase*, the Legacy mode is set as the retransmission policy and the calculated MCS is used for the address *M* during that period. This process is repeated periodically until the transmission finishes.

IV. Demonstration

In this demo we will show the capacity of the *SDN@Play* to adapt the multicast transmission rate. Fig. 3 shows the demo scenario, where the EmPOWER controller and a WTP can be found. Furthermore, a group of multicast receptors (MRs) are distributed along a room, where at least one of them is situated relatively further from the AP than the others.

The performance of the algorithm will be shown through the delivery of some video sequences to the MRs. Firstly, these sequences will be transmitted at a high rate (e.g. 54Mbps) using the Legacy multicast mode. Given that in this mode the delivery rate cannot be adapted, the quality of the stream for the worst receptor will be highly damaged. After that, the *SDN@Play* tool will be enabled, proving that it is able to calculate the most appropriate rate considering the channel conditions of all the MRs. Therefore, the video stream can be watched in a good quality in all the stations in the network.

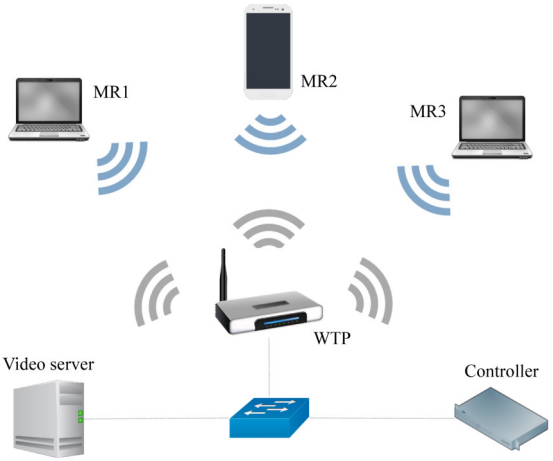

Fig. 3: *SDN@Play* System Demonstration Deployment.

Acknowledgment

This work has been supported by the Spanish Ministry of Economy under project TIN2015-66972-C5-2-R and by the European Union's MINECO/FEDER funds under Grant Agreement BES-2013-065457 and H2020 Research and Innovation Action under Grant Agreement H2020-ICT-671639 (COHERENT).

References

[1] *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications*, ANSI/IEEE Std 802.11, LAN/MAN Standards Committee of the IEEE Computer Society Std., 2012.

[2] *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. Amendment 3: MAC Enchancements for Robust Audio Video Streaming*, ANSI/IEEE Std 802.11aa, LAN/MAN Standards Committee of the IEEE Computer Society Std., 2011.

[3] S. Paris, N. Facchi, F. Gringoli, and A. Capone, "An Innovative Rate Adaptation Algorithm for Multicast Transmissions in Wireless LANs," in *Proc. of IEEE VTC–Spring*, Dresden, 2013.

[4] N. McKeown, T. Anderson, H. Balakrishnan, G. Parulkar, L. Peterson, J. Rexford, S. Shenker, and J. Turner, "OpenFlow: Enabling Innovation in Campus Networks," *SIGCOMM Comput. Commun. Rev.*, vol. 38, no. 2, pp. 69–74, 2008.

[5] R. Riggio, M. K. Marina, J. Schulz-Zander, S. Kuklinski, and T. Rasheed, "Programming abstractions for software-defined wireless networks," *IEEE Transactions on Network and Service Management*, vol. 12, no. 2, pp. 146–162, 2015.