EVOLVE: Experiment-based Validation of Control Channels for Cognitive Radio Systems

WINGS ICT solutions

Overall description: EVOLVE was implemented in the w.iLab-t testbed, where mobile robots where exploited to act as mobile nodes (MN), while fixed nodes acted as access points (APs) and as relay nodes. Each node was enhanced with Java-based agents that add functionalities according to the role of each and also implemented the control channel through which the control messages are exchanged. The Device-to-Device (D2D) connectivity was realized through the use of the IEEE 802.11s standard that creates wireless mesh networks. In the experiment, a MN was served by a specific AP and thus, it could have access to various applications e.g., ping, video streaming and file transfer. Due to the fact that other APs were also transmitting, thus causing interference to the received signal of the MN, the MN was experiencing low Quality of Service (QoS) or even was going out of the coverage of the AP. Therefore, the proposed solution was to maintain the connectivity (or to improve the QoS) of the MN by exploiting the opportunities available because of the presence of neighboring relay nodes. Specifically, a path was identified that led to the AP through the exchange of control messages among the nodes that contained profile, context and policies. In the MN, the received signal quality from the AP was monitored and if it dropped below a certain threshold or if the MN lost its connectivity, the procedure of the identification of a path to the AP through the neighboring nodes was initiated in order to create the D2D network. When the D2D network was established, the applications mentioned above were executed in the MN in order to measure their performance in relation with the number of hops and the distance from the node that executed the traffic generation (i.e. the AP).

Results: Regarding the obtained benefits, the user can achieve sufficient throughput and delay even when 5 hops are needed to communicate with the AP, due to the proximity of the devices. In addition, the operator can reduce its operating expenditure due to the fact that the devices can exploit their neighbours in order to maintain their QoS and there is no need for deployment of more infrastructure nodes. Finally, it should be noted that the developed solution takes into account the overhead of the signalling load. Therefore, in our experiment with 20 terminals the signalling load was around 2 Mbps.

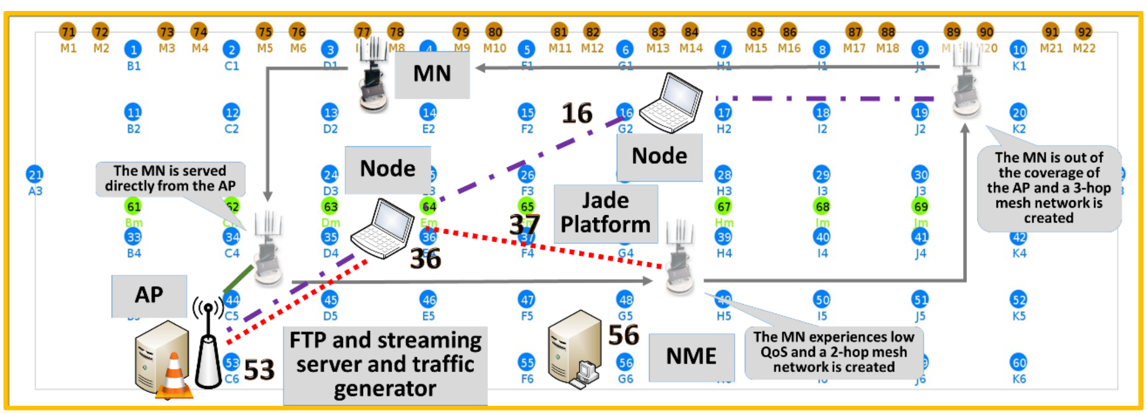

Figure 1: Experimentation layout which uses the w.iLab-t testbed in Ghent, Belgium

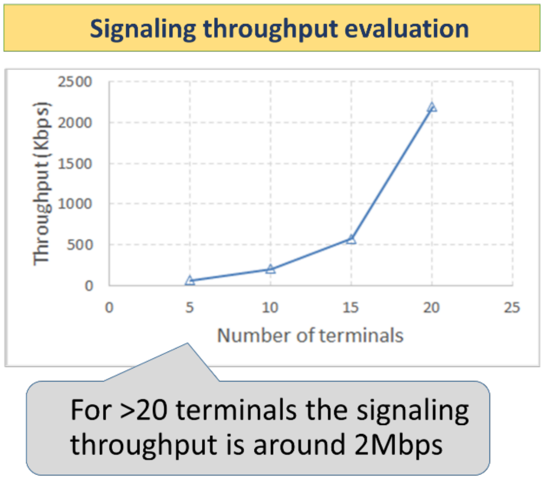

Figure 2: Signaling throughput evaluation which takes into account the exchanged contextual messages

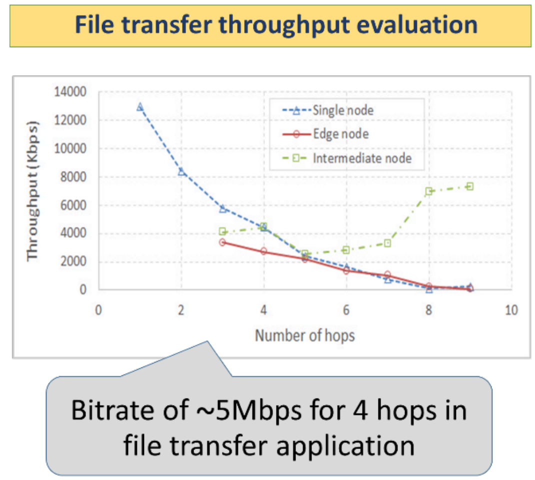

Figure 3: Throughput evaluation of a file transfer application

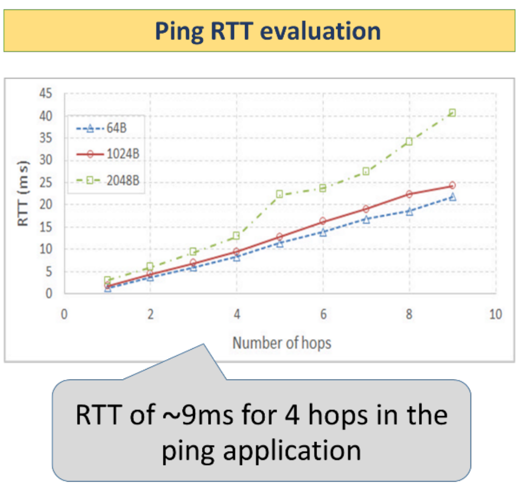

Figure 4: Evaluation of Round Trip Time for a ping application by utilizing nodes of the w.iLab-t testbed

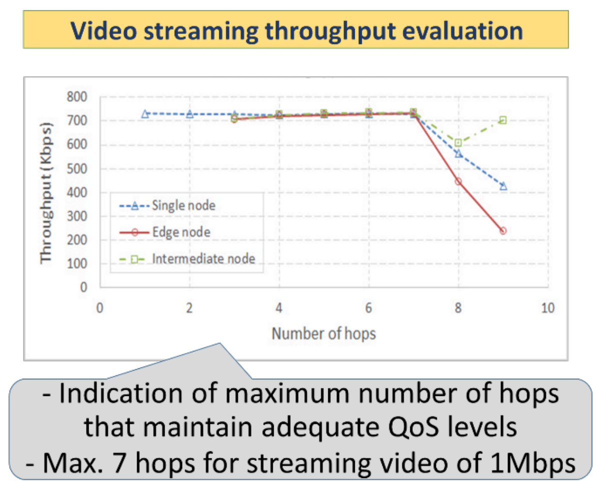

Figure 5: Throughput evaluation for a video streaming application transmitting among nodes of the w.iLab-t testbed