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Publication date	2015-06-13
Original Citation	Quinlan, J. J., Raca, D., Zahran, A. H., Khalid, A., Ramakrishnan, K. K. and Sreenan, C. J. 'D-LiTE: A platform for evaluating DASH performance over a simulated LTE network'. 2016 IEEE International Symposium on Local and Metropolitan Area Networks (LANMAN), Rome, Italy, 13-15 June 2016, 1-2. doi: 10.1109/LANMAN.2016.7548874
Type of publication	Conference item
Link to publisher's version	10.1109/LANMAN.2016.7548874
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Download date	2024-04-25 16:30:58
Item downloaded from	https://hdl.handle.net/10468/4756

D-LiTE: A platform for evaluating DASH performance over a simulated LTE network

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***Abstract*—In this demonstration we present a platform that encompasses all of the components required to realistically evaluate the performance of Dynamic Adaptive Streaming over HTTP (*DASH*) over a real-time NS-3 simulated network. Our platform consists of a network-attached storage server with DASH video clips and a simulated LTE network which utilises the NS-3 LTE module provided by the LENA project. We stream to clients running an open-source player with a choice of adaptation algorithms. By providing a user interface that offers user parametrisation to modify both client and LTE settings, we can view the evaluated results of real-time interactions between the network and the clients. Of special interest is that our platform streams actual video clips to real video clients in real-time over a simulated LTE network, allowing reproducible experiments and easy modification of LTE and client parameters.**

The demonstration showcases how changes in LTE network settings (fading model, scheduler, client distance from eNB, etc.), as well as video-related decisions at the clients (streaming algorithm, quality selection, clip selection, etc.), can impact on the delivery and achievable quality.

***Index Terms*—Dynamic Adaptive Streaming over HTTP, DASH, NS-3, LTE**

I. Introduction

Recent years have seen a monumental increase in video streaming over cellular networks, reaching over 55% of mobile data in 2015 and expected to rise to over 75% by 2020 [1]. Difficulties arise in conducting empirical research on video delivery over LTE, since the need for controlled experiments and reproducible results makes the use of operational networks impractical, while a laboratory LTE network is hard to instrument and expensive to purchase and maintain. Hence the need for software-based experimentation platforms such as the LTE module provided by the LENA project for NS-3. The authors of [2] illustrate the steps required to create an NS-3/LTE network, which we replicate in our platform to create the LTE component. We extend the authors evaluation of a single client by providing a dynamic means of increasing the number of clients. Our contribution is an experimental platform that builds on the NS-3/LTE simulated network to create a realistic setting for experimenting with Dynamic Adaptive Streaming over HTTP [3] (*DASH*). The quality of experience for customers when streaming video content over cellular networks can vary greatly due to frequent changes in wireless link quality. To mitigate these changes, progressive download or Adaptive HTTP streaming techniques such as DASH have been proposed. These techniques strive to improve the customer satisfaction by changing the requested video quality to match the current network conditions. DASH fragments the video stream into *segments* which allow fine-grained quality adaptation decisions by the client each time it requests the next segment.

Table I
UI Parameters utilised to modify LTE, client and clip settings

LTE	
Users	Number of User Equipment (Clients)
Distance	The distance from the base station to each client
Fading Model	NS-3-LTE Options include: noFading, Static, Pedestrian Mobility (3Km/h) and Vehicular Mobility (30Km/h)
Scheduler	NS-3-LTE Options include: Proportional Fair, Freq. Domain - Blind Equal Throughput , Freq. Domain - Maximum Throughput and Priority Set Scheduler
Client	
Algorithm	Options include: default GPAC, and implementations of Festive, BBA2, Conventional, and Elastic
Video Driver	Options include: X11 - display GPAC player and RAW - do not display GPAC player
Clip	
Segment Duration	Options include: 2-, 4-, 6-, 8- and 10-second
# of Segments	Defined by a number of segments or the duration of the selected clip
Clip Selection	Options include: two encoders (H.264 and H.265) and three clips (open-source content: big buck bunny, sita sings the blues and elephant dreams)

This demonstration is of a hybrid physical and simulated infrastructure in which actual DASH video clips are streaming from a server to clients over an LTE air-interface in real-time. A parameterised User Interface (*UI*) provides a means of modify both client and LTE settings, shown in Table I, and illustrates evaluated results of real-time interactions between the network and the clients.

II. Platform Overview

In this demonstration, as shown in the upper image of Figure 1, content is requested from a local network-attached storage (*NAS*) server. We use a laptop as the NS-3/LTE link, with two additional Raspberry Pi's as our clients. "Ubuntu MATE version 16.04" is installed on the 32GB microSD-HC cards of the Raspberry Pi's and "Ubuntu 14.04" is installed on the laptop. On the clients we use a well-known multimedia

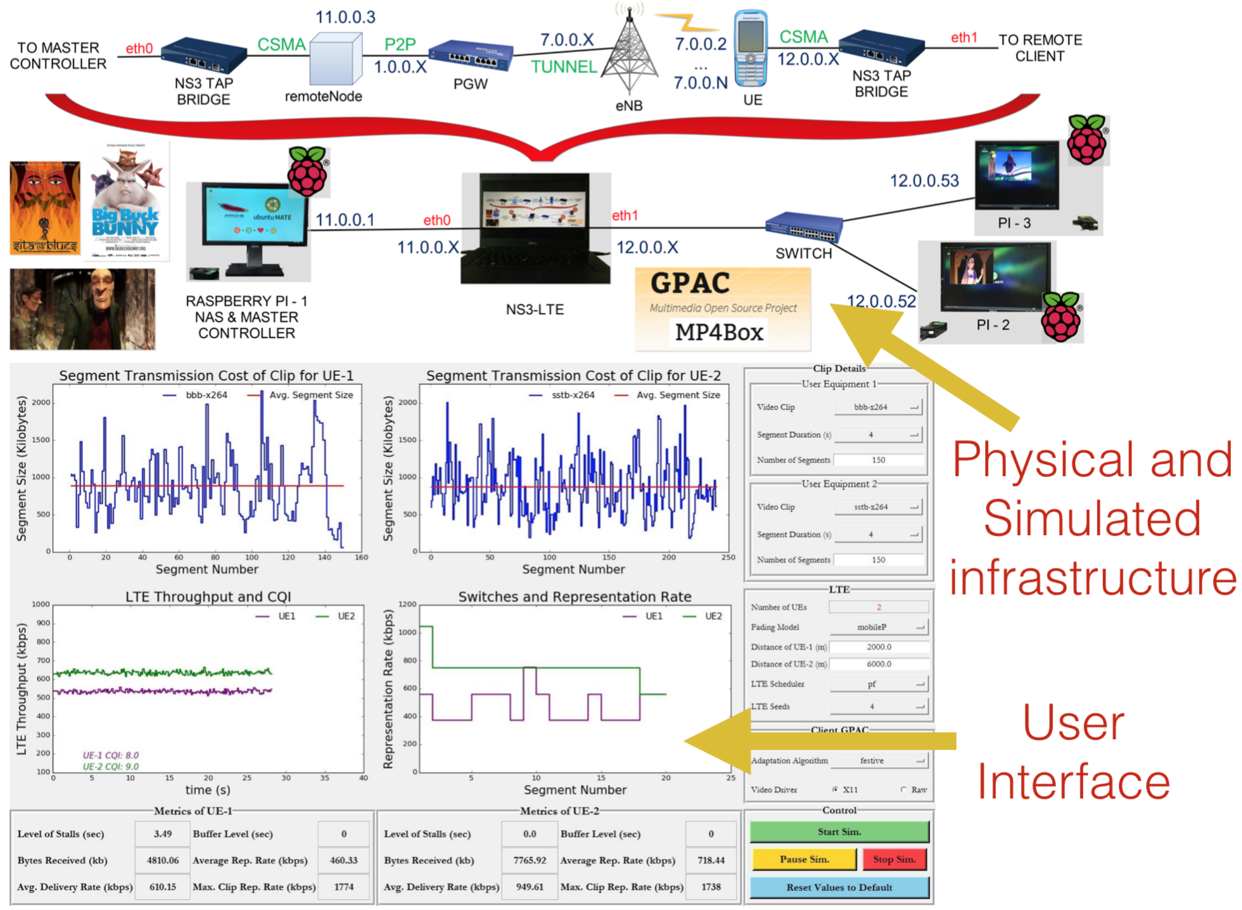

Figure 1. Upper Image: Physical and Simulated infrastructure defined in the platform. Lower Image: User Interface utilised to modify LTE, client and clip settings, as well as view real-time interaction between the network and the the clients.

player from GPAC [1], an open-source multimedia framework used for research and academic purpose. This permits H.264 and H.265 decoding at the clients. Information on the implementation steps used for the NS-3/LTE aspect of the demo can be found in [4]. The DASH dataset [5] utilised for this demo is available at [2]. On the NAS, we define a master controller by which we build the LTE network, call GPAC on the clients, and gather the interactions between the network and the clients.

III. Platform Demonstration

This demonstration offers a means of modifying LTE, client and clip settings, and viewing the effects of these changes on the delivery and achievable quality of the video at the clients. Through the use of the UI, as shown in the lower image of Figure 1, the user can modify these settings. These settings illustrate the pertinent metrics but are only a sample of possible interaction point to the clients and LTE. The UI also offers a means of viewing the interactions between the network and the clients mandated by the input settings. Information provided to the user include: the natural oscillation that occurs in the byte transmission cost of the clip segments, the variation in LTE throughput and CQI values plotted over time, changes in the achievable quality at the clients, as well as client values for: buffer level, bytes received, avg. delivery rate, avg. quality rate and stall duration. Further information and build instructions for the components utilised in this demo are available at [3]

Acknowledgement - This publication has emanated from research conducted with the financial support of Science Foundation Ireland (SFI) under Grant Number 13/IA/1892.

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[3]www.cs.ucc.ie/misl/research/current/ivid_demo/lanman2016