Modeled of Traffic Generated by the Live Videostreaming Service on Mobile Networks LTE with QoE

MSc. Ing. HÉCTOR FABIO BERMUDEZ OROZCO
Tutor: PhD. Ing. JOSÉ LUIS ARCINIEGAS
Co-tutor: PhD. Ing. WILMAR Y. CAMPO

Department of Telematics
Faculty of Electrical Engineering and Telecommunications
UNIVERSITY OF CAUCA
2016
Agenda

- Introduction.
- Relevant Concepts.
- Statement of the problem.
  - Related works.
  - Gaps.
  - Research question.
  - Hypothesis.
- Objectives.
- Progress.
- References.
Total global monthly data and voice traffic from Q2 2010 to Q4 2015

65% growth in data traffic between Q4 2014 and Q4 2015

2X
Q4 2010: traffic generated for mobile data is twice that for voice

[Ericsson, 2016]
## Mobile subscription essentials

<table>
<thead>
<tr>
<th>Service</th>
<th>2015</th>
<th>2021 forecast</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worldwide mobile subscriptions</td>
<td>7,300</td>
<td>9,100</td>
<td>million</td>
</tr>
<tr>
<td>Smartphone subscriptions</td>
<td>3,400</td>
<td>6,400</td>
<td>million</td>
</tr>
<tr>
<td>5G subscriptions</td>
<td>0</td>
<td>150</td>
<td>million</td>
</tr>
<tr>
<td>Mobile PC, tablet and mobile router</td>
<td>250</td>
<td>350</td>
<td>million</td>
</tr>
<tr>
<td>Mobile broadband subscriptions</td>
<td>3,600</td>
<td>7,700</td>
<td>million</td>
</tr>
<tr>
<td>Mobile subscriptions, GSM/EDGE-only</td>
<td>3,600</td>
<td>1,300</td>
<td>million</td>
</tr>
<tr>
<td>Mobile subscriptions, WCDMA/HSPA</td>
<td>2,200</td>
<td>3,200</td>
<td>million</td>
</tr>
<tr>
<td>Mobile subscriptions, LTE</td>
<td>1,000</td>
<td>4,100</td>
<td>million</td>
</tr>
</tbody>
</table>

## Accumulated mobile data traffic

<table>
<thead>
<tr>
<th>Service</th>
<th>2010–2015</th>
<th>2016–2021 forecast</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>120</td>
<td>1,600</td>
<td>ExaByte</td>
</tr>
<tr>
<td>Video</td>
<td>50</td>
<td>1,000</td>
<td>ExaByte</td>
</tr>
<tr>
<td>Social networking</td>
<td>15</td>
<td>180</td>
<td>ExaByte</td>
</tr>
</tbody>
</table>

[Ericsson, 2016]
Introduction

Mobile data traffic by application type (monthly ExaBytes)

In 2014, video accounted for around 45% of mobile data traffic

15% of mobile data traffic in 2014 came from social networking

13x growth

60% of all mobile data traffic will be from video by 2020. It will grow by 55% annually during this period

[Ericsson, 2015]
World population coverage by technology

- **GSM/EDGE**
  - 2014: ~90%
  - 2020: ~95%

- **WCDMA/HSPA**
  - 2014: ~65%
  - 2020: ~90%

- **LTE**
  - 2014: ~40%
  - 2020: >70%

By 2020, around 90 percent of the world’s population will be covered by mobile broadband networks.

WCDMA will be driven by increased internet access demand and the growing affordability of smartphones.

LTE uptake is driven by demand for an improved user experience and faster networks.

[Ericsson, 2016]
Traffic modeling approaches [Yin et al. (2011)]
Relevant Concepts.

VoD

It is a service that allows users to access multimedia content at the exact moment you want [Held et al (2007)].

Videostreaming

RTSP/RTP Descarga Progresiva

LVS

Service that allows users to view and deliver videos over the Internet with real-time transmission on a cell phone, camera or computer. [Díaz (2014)]

Management tasks:

VQA
QoS, QoE
Relevant Concepts.

General classification of IQA algorithms [Manap(2015)]
Statement of the problem.

- Traffic growth
  - Video
    - VoD
    - LVS
  - VQA
  - RAN
    - Resize
    - Testbeds-Simulation
## Statement of the problem.

### Video LVS Problems:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Alternative</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth efficiency</td>
<td>Dynamic Adaptive streaming</td>
<td>DASH [3GPP(2012)]</td>
</tr>
<tr>
<td>Traffic efficiency</td>
<td>Adaptation to the properties of CDN</td>
<td>LTE-A [3GPP(2012)]</td>
</tr>
<tr>
<td>The stress of streaming delays</td>
<td>QoE</td>
<td>Temporary interruptions, due to mobility, reconnection and connections to particular networks</td>
</tr>
</tbody>
</table>
Statement of the problem.

- **RAN Problems:**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Alternative</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation of new services</td>
<td>Testbeds</td>
<td>Deployment scenarios and setting up</td>
</tr>
<tr>
<td>Developing Technology</td>
<td>Opportunities for new developments</td>
<td></td>
</tr>
</tbody>
</table>
**Statement of the problem.**

**VQA Problems:**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Alternative</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undefined metrics</td>
<td>LTE Video Adopting metrics other scenario (IPTV)</td>
<td>[3GPP(2012)]</td>
</tr>
<tr>
<td>QoE measure</td>
<td>Relationship between QoS and QoE</td>
<td>Hypothesis IQX Goran [(2014)] Partial differential equations Fiedler[(2011)]</td>
</tr>
</tbody>
</table>
### Statement of the problem.

- **Related works: VQA**

<table>
<thead>
<tr>
<th>Work</th>
<th>Contributions/weaknesses</th>
</tr>
</thead>
</table>
Statement of the problem.

Related works: VQA

<table>
<thead>
<tr>
<th>Work</th>
<th>Contributions/weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Experience-Related Differential Equations and Provisioning-Delivery Hysteresis. Fiedler, et al. (2010)</td>
<td>Math ratioship between QoS y QoE. It is adjust to LVS.</td>
</tr>
<tr>
<td>Towards a QoE-Driven Resource Control in LTE and LTE-A Networks. Gómez, et al (2013)</td>
<td>Architecture for resource control, present the KPIs. It does not focus on services</td>
</tr>
</tbody>
</table>
## Statement of the problem.

### Related works: LVS

<table>
<thead>
<tr>
<th>Work</th>
<th>Contributions/weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic adaptive streaming over HTTP: standards and design principles. Stockhammer (2011)</td>
<td>General concepts of DASH</td>
</tr>
<tr>
<td>Performance analysis of dynamic adaptive video streaming over mobile content delivery networks. Munaretto (2014)</td>
<td>Introduces the concept of the LTE architecture CDN and use of DASH</td>
</tr>
<tr>
<td>Modelo de Tráfico para Servicios Interactivos de una Comunidad Académica Virtual, con contenidos de Audio y Video de Alta Calidad. Campo (2014)</td>
<td>How to make a traffic model. Other networks and other services.</td>
</tr>
<tr>
<td>Evaluation and prospects from a measurement campaign on real multimedia traffic in LTE vs. UMTS. Fowler, et al (2014)</td>
<td>Methodology for characterizing traffic, LTE weaknesses. It focuses on VoIP</td>
</tr>
</tbody>
</table>
## Statement of the problem.

- **Related works: RAN- Emulation**

<table>
<thead>
<tr>
<th>Work</th>
<th>Contributions/weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>LENA : <strong>LTE-EPC Network simula</strong>tor. LENA(2016)</td>
<td>LENA is an open source product-oriented LTE/EPC Network Simulator that allows LTE small/macro cell vendors to design and test Self Organized Network (SON) algorithms and solutions</td>
</tr>
</tbody>
</table>
Statement of the problem.

- **Gaps.**
  - No service LVS based on DASH applied to wireless networks found.
  - No clear metrics in measuring QoE for service LVS.
  - QoE measuring from QoS parameters is not obvious.
  - No evidence of emulation environments for service LVS.
  - No traffic modeling studies for LVS service are evident in wireless network.
Statement of the problem.

Research question.

What is the traffic model that characterizes the behavior of Live Videostreaming service, applied to the LTE technology as radio access network under QoE parameters?
Statement of the problem.

- Hypothesis.

Traffic modeling Live Videostreaming service supported by the wireless mobile network with technology LTE, will allow network designers and planners have an emulation tool for predicting the behavior of the service LVS.
Objectives

- **General Objective**
Obtain the traffic modeling of Live Videostreaming service that permit evaluation their performance in a wireless mobile communications networks with LTE technology under QoE parameters.

- **Specific Objectives**
  1. Build a testbed to emulate a LTE network.
  2. Determine the different parameters that define a LVS-DASH service supported by LTE networks with QoE parameters.
  3. Characterize traffic for Live Videostreaming service supported by LTE networks with QoE parameters.
  4. Develop and validate a basic model from real traffic traces for live videotreaming service over a LTE network.
  5. Build test scenarios to assess the performance of the LTE network with LVS service under QoE parameters.
Estado del Arte de los Métodos de Evaluación de QoE y Entornos de Emulación para el Servicio de Video en Redes LTE

QoE Assessment and Emulation Environments for Video Service Networks LTE: Review

H. F. Bermúdez, J. L. Arciniegas, E. Astúa

Abstract—This article presents a review of the methods currently used to measure Quality of Experience - QoE and Quality of Service - QoS for video service using techniques of streaming video through an Internet service provider. The main differences are enumerated between objective and subjective metrics, use scenarios and disadvantages presented in a wireless environment. In addition, the radio access technology – RAN - Long Term Evolution – LTE as the radio access technology and wireless technology most likely to use in the future come to service deployment in the broadband mercado and consumo electrónico tenga una nueva dinámica [1]. La gran variedad de dispositivos móviles tales como: notebooks, tablets, smartphones iPhone, iPad, etc. soportan múltiples servicios multimedia, y aplicaciones de streaming de video en tiempo real (Live Video Streaming – LVS) o bajo demanda - VoD, Televisión Digital Terrestre – TDT y servicios de audio y video en tiempo real a través de internet [2]. Lo anterior ha generado el flujo de datos en el extremo móvil ha presentado un incremento asombroso; según estadísticas presentadas por [3] y [4] a principios del 2015 el número total de suscriptores móviles supera la población mundial, producto de un crecimiento anual del 7% anual, con 108 millones de adiciones registradas neta en tan solo el primer trimestre de 2015. El porcentaje de tráfico de video con respecto al tráfico total de datos móviles fue del 53% en el 2013 y se espera supere el 69% para el año 2018, exigiendo un mayor uso del limítrofe ancho de banda de los canales inalámbricos [3]. Ante la situación anterior surge la pregunta: ¿Qué tecnología de red de acceso de radio (RAN) en entornos móviles soportará los mencionados volúmenes de tráfico? Dos décadas atrás, las redes GSM (Global System for Mobile Communication) fueron desarrolladas anualmente para proveer servicios de telefonía móvil, mediante algunas mejoras tales como GPRS (General Packet Radio System) y EDGE
Progress.

- Automation of the process generated by a lexical analyzer (AWK programming language) for traffic analysis.
Progress.
References.

References.


References.


References.


References.

- D. Munaretto, F. Giust, M. Zorzi, “Performance analysis of dynamic adaptive video streaming over mobile content delivery networks”, 2014 IEEE International Conference on Communications (ICC), Sydney, NSW, pp. 1053-1058. 2014. DOI: 10.1109/ICC.2014.6883460

- W. Y. Campo, “Modelo de Tráfico para Servicios Interactivos de una Comunidad Académica Virtual, con contenidos de Audio y Video de Alta Calidad”, Tesis Doctoral, Universidad del Cauca, Popayán - Colombia, 2014.


Any Questions... Just Ask!