SCALABLE HTTP MEDIA STREAMING USING DYNAMIC CONNECTIONS

By

Samar Ibrahim Ali Farag

A Thesis Submitted to the
Faculty of Engineeringat Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
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Under the Supervision of

Prof. Dr. Neamat Sayed AbdelKader
Professor of Engineering
Electronics and Communications Engineering Department
Faculty of Engineering, Cairo University

Dr. Mohmoud Hamed Ismail
Associate Professor
Electronics and Communication Engineering Department
Faculty of Engineering, Cairo University

Dr. Ahmed Hamdy Zahran
Assistant Professor
Electronics and Communication Engineering Department
Faculty of Engineering, Cairo University

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Approved by the Examining Committee:

Prof. Dr. Neamat Sayed AbdelKader, Thesis Main Advisor

Associate Prof. Yasmine Aly Fahmy, Internal Examiner

Prof. Dr. Abdelhalim Abdelnaby Zekry, External Examiner
(Ain Shams University)

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2016

Engineer's Name:	Samar Ibrahim Ali Farag
Date of Birth:	10/04/1989
Nationality:	Egyptian
E-mail:	samarali.cairouniv@gmail.com
Phone:	01140917029
Address:	Assuity st., Imbaba, Giza, Egypt
Registration Date:	01/10/2012
Awarding Date:	–/–/2016
Degree:	Master of Science
Department:	Electronics and Communications Engineering

Supervisors:

Prof. Dr. Neamat Sayed AbdelKader
Dr. Mohmoud Hamed Ismail
Dr. Ahmed Hamdy Zahran

Examiners:

Prof. Dr. Abdelhalim Abdelnaby Zekry (Ain Shams University)	(External Examiner)
Associate Prof. Yasmine Aly Fahmy	(Internal Examiner)
Prof. Dr. Neamat Sayed AbdelKader	(Thesis Main Advisor)

Title of Thesis:

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Key Words:

Media Streaming; Video Encoding; Multiple Connections; Enhancement Layer Selection Policy; Video quality

Summary:

This thesis identifies the main components of the adaptive HTTP client and proposes a streaming heuristic over dynamic multiple connections. The key parameters of the streaming client are: the properties of the requested data, the connection management, and the enhancement policy used to improve the video quality. Our results show that the algorithm successfully achieves interruption free streaming under all the tested bandwidth and link configurations. Additionally, the usage of multiple connections results in noticeable improvements in the achieved streaming quality for large link delays.

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Samar Ali

Dedication

This dissertation is dedicated to
my parents,
my sisters,
and all my family.

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List Of Symbols And Abbreviations

HTTP	Hypertext Transfer Protocol
DASH	Dynamic Adaptive Streaming Over HTTP
SVC	scalable video coding
PSNR	Peak Signal to Noise Ratio
IPTv	Internet Protocol TV
NAT	Network Address Translation
RTP	Real time protocol
UDP	User Datagram Protocol
TCP	transmission control protocol
AVC	advanced video coding
MPEG	Moving Picture Experts Group
SVC-DASH-M	Scalable Video Coding Dynamic Adaptive Streaming Over HTTP using Multiple Connections
JPEG	Joint Photographic Experts Group
I-frame	intra-coded frame
P-frame	predictive-frame
B-frame	bi-directionally predictive-coded frame
GoP	Group of Pictures
Did	spatial scalability layer (Multiple resolutions)
Tid	temporal scalability layer(Multiple frames per second)
Qid	quality scalability layer
MDC	Multiple description coding
MPD	Media Presentation Description
SAP	Stream Access Point
URL	Uniform Resource Locator
QoS	quality of service
QoE	quality of Experience
MOS	Mean Opinion Score
T_{init}	initial buffering time

T_{rebuf}	mean rebuffering duration
f_{rebuf}	rebuffering frequency
OSMF	Open Source Media Framework
RTSP	Real Time Streaming Protocol
HetNets	Heterogeneous Networks
RAN	Radio Access Network
WiMAX	Worldwide Interoperability for Microwave Access
WiFi	wireless fidelity
E-UTRAN	Evolved Universal Mobile Telecommunications System Terrestrial Radio Access Network
LTE	Long Term Evolution
LTE-A	Long Term Evolution-Advanced
HAS	HTTP Adaptive Streaming
CDN	Content Distribution Network
SFTM	Segment fetch time metric
MSD	media segment duration
SFT	segment fetch time
RSFT	remaining segment fetch time, and real time buffering status of DASH
TBMT	target buffered media time
ts_{ns}	playback time-stamp of the first frame of the next segment
ts_0	current playback time-stamp at the time instant of requesting the next segment
$\tilde{B}$	estimated bitrate of the next segments
SFT_{av}	available time to fetch the next segment without suffering from any playout interruption
n_p	number of parallel receiving segments
b_{s_k}	received bits of segments s_k
ft_{s_k}	fetch time from requesting s_k to the current time
d_{ns}	denotes the next segment duration
PFTM	portion fetch time metric
NS2	Network Simulator-version 2
AHS	Adaptive HTTP Streaming
ISAVS	Intelligent Bit-rate Switching based Adaptive Video Streaming
λ	represents an appreciation weight for the quality variations
T_c	segment inter-arrival time
T_R	segment duration
$[f_{T_c}(t)]_i$	probability density function of inter-fragment time for the *i*th quality level
yuv	yuv model defines a color space in terms of one luma (Y)

	and two chrominance (UV) components
JSVM	Joint Scalable Video Model
Seg_file	segment file
NALU	Network Abstraction Layer Unit
AWK	interpreted programming language
B_{min}	low threshold for the data to be maintained in the buffer
	to accommodate network condition variations
B_{target}	represents a target buffer level that the application should be operating around
SD	duration of the received segment
SFT	duration over which segment is fetched
μ	Network indication ratio
Kb/s	Kilo bit per second
ϵ	application demand ratio
r_{next}	rate of the next two segments to be requested
r_{prev}	rate of the received segment
MIN	minimum buffer level
TARGET	Target buffer level
CIF	Common Intermediate Format
QCIF	Quarter CIF
FIFO	first-in first-out scheduler
RR	Round-Robin algorithm
TBF	Token Bucket Filter
HZ	Hertz
mpu	Minimum Packet Unit
MTU	Maximum transfer Unit
Bw	Bandwidth
I/O	Input/output
TSO	Tcp-Segmentation-Offload
NIC	network interface controller
GSO	generic-segmentation- offload
GRO	generic-receive-offload
API	Application Program Interface
OS	Operating System
MSE	mean squared error
fps	number of frames per second
SNR	Signal to Noise Ratio
t_d	download time

KPI	Key Performance Index
ms	milliseconds
Mbps	Mega bit per second
CBR	Constant Bit rate
ICT	International Conference on Telecommunications
n_i	The number of interrupts
n_c	The number of opened connections
n_{cc}	The number of closed connections due to low bandwidth
d_v	The application downloaded data
t_d	The time at which the application stops downloading more layer-segments
γ	The application goodput
q	The average quality