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Use Cases for Video Transport
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Abstract

IP video traffic represents a large fraction of Internet traffic. How to transmit video traffic efficiently poses traffic management challenges to both network operators and Internet applications.

The traffic characteristics of encoded video have a significant impact on the network transport. This document provides use cases where network operator and Internet application can be cooperative to improve video transmission efficiency, based on the fundamental traffic characteristics (e.g. frame priority, adaptive bit rate, etc.).

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

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1. Introduction

Video consumption has grown so fast that the bottleneck link is congested during peak hours. Globally, IP video traffic will be 82 percent of all IP traffic (both business and consumer) by 2020, up

from 70 percent in 2015. 4K Ultra HD technology is by itself a very new trend in the overall electronics landscape, and the impact of it is growing month by month. 4K content increases the demand for network capacity greatly. How to transmit video traffic efficiently poses traffic management challenges to both network operators and

Internet applications. However, the existing video transport schemes mainly treat the traffic data in a content agnostic fashion. Such scheduling approaches cannot effectively exploit the limited network resources to maximize the perceived quality as video streaming is characterized by complex content parameters (e.g., frame priority, decoding dependency, etc.).

This document provides use cases where network operator and Internet application can be cooperative to improve video transmission efficiency, based on the fundamental traffic characteristics, such as frame types (e.g., I, P, or B), adaptive bit rate, etc. The problem of optimizing the delivery of video content to clients while meeting the constraints imposed by the available network resources is considered.

2. Terminology

This section contains definitions for terms used frequently throughout this document.

2.1. Abbreviations and acronyms

BRAS: Broadband Remote Access Server

DRR: Deficit Round Robin

HD: High-Definition

MOS: Mean Opinion Score

OLT: Optical Line Terminal

QoE: Quality of Experience

TCP: Transmission Control Protocol

2.2. Definitions

4K: known as Ultra HD or UHD, is used to describe a new high resolution video format with a minimum resolution of 3840 x 2160 pixels in a 16 x 9 aspect ratio for any display.

3. Use Cases

3.1. Video Service Experience Evaluation

3.1.1. Problem Statement

4K Ultra HD technology is by itself a very new trend in the overall electronics landscape, and the impact of it is growing month by month. As the increasing of the implementations of Ultra HD and to keep the increasingly sophisticated customers content while remaining profitable at the same time, it is important to design and manage the video service based on the user quality of experience (QoE) to provide attractive 4K video. Assessing the QoE of 4K video service is therefore essential.

ITU-T Recommendations (see [ITU-T P.1201] and [ITU-T P.1202], for instance) define the models to estimate video Mean Opinion Scores (MOS). The video MOS model is applicable to progressive download and adaptive streaming where the quality experienced by the end user is affected by audio- and video-coding degradations, and delivery degradations due to initial buffering, re-buffering (which are both perceivable as stalling of the media), and media adaptations. A media adaptation is where the player switches video playback between a known set of media quality levels while adapting to network conditions. Each of the quality levels typically differs in a significant video or audio or audio/visual quality change. These quality changes are most readily observed by changes in bitrate, resolution, frame rate, and similar attributes.

For the models of estimating video MOS for UHD content, another crucial scenario - fault localization for QoE degradation is also

considered. For example, an IPTV provider can implement video MOS models in their key network devices, such as core router, BRAS (Broadband Remote Access Server), and OLT (Optical Line Terminal), to locate where a QoE degradation fault happens in an IP video network, as shown in figure 1.


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Figure 1: Video MOS Deployment Example

In this use case, the video MOS probes may be deployed on some key network points for monitoring of transmission quality for operations

and maintenance purposes. The network monitoring points are required to provide video MOS to the video MOS control center. By estimating the video MOS at different network monitoring points, it is possible to perceive several diagnostic signals and reflect the location of the impairments on the IP network being measured.

3.1.2. Information Exposed

The video MOS model will receive media information and prior knowledge about the media stream or streams. In various modes of operation, different inputs may be extracted or estimated in different ways. For example, the video MOS model may need the following input signals of operation:

Table 1: Video MOS Model Inputs Example

Description	Values	Frequency
Segment duration	Duration in seconds	Per media segment
Video encoding resolution	Number of pixels (WxH) in transmitted video	Per media segment
Video codec and profile	One of: H264-baseline, H264-high, H264-main	Per media segment
Type of each picture	"I" or "Non-I"	Per video frame

3.2. Intelligent Packet Dropping

3.2.1. Problem Statement

Backbone routers in the Internet are typically configured with buffers that are several times larger than the product of the link bandwidth and the typical round-trip delay on long network paths. Such buffers can delay packets for as much as half a second during congestion periods. When such large queues carry heavy TCP traffic loads, and are serviced using the Tail-Drop policy, the large queues remain close to full most of the time. Thus, even if each TCP flow is able to obtain its share of the link bandwidth, the end-to-end delay remains very high. This is exacerbated for flows with multiple hops, since packets may experience high queuing delays at each hop.

In order to improve the performance, it is desirable for systems to react to current channel conditions using rate adaptive transmission

technology. [I-D.you-tsvwg-latency-loss-tradeoff] enables an application to request treatment for either low-loss or low-latency at a congested network link. The objective is to retain the best-effort service while providing low delay to real-time applications at the expense of increased loss or providing low loss to non real-time applications at the expense of increased delay. [DSL-IPD] makes use of the fact that some packets containing video information (e.g., I-picture or P-picture) are more important than others (e.g.,

B-picture), and this importance level can be indicated in the packet header. When congestion in the DSLAM occurs, the low priority packets are preferentially dropped. [IPD] proposes to detect the congestion by measuring the length of the queue. When the buffer occupancy increases, the data packets are dropped depending on priority assigned to the data packets. [IPD-TCP] presented DTDRR (Dynamic Threshold DRR) and DSDRR (Discard State DRR) as alternatives to QSDRR (Queue State DRR) that provide comparable performance, while allowing packets to be discarded on arrival, saving memory bandwidth.

We consider the rate-delay tradeoffs under the assumption that a small fraction of packets can be dropped. It shows that intelligently dropping packets can dramatically improve the performance in average delay if a non-zero packet drop rate can be tolerated.

3.2.2. Information Exposed

When congestion is detected, intelligent packet dropping technique is implemented to control congestion due to buffer overflow. The main objective is to drop the packets based on priority, so that the performance of the network is improved.

A consequence of these requirements is that packets with lower priority are more likely to be dropped during bouts of congestion than packets with high priority. For example, B-frames in video transmissions are more likely to be dropped than I-frames when congestion.

3.3. Network Congestion State Feedback

3.3.1. Problem Statement

Network congestion typically occurs in the form of router buffer overflows, when network nodes are subjected to more traffic than they are designed to handle. With the increasing range of speeds of links and the wider use of networks for distributed computing, effective control of the network load is becoming more important. The lack of control may result in congestion loss and, with retransmissions, may ultimately lead to congestion collapse.

Network components can be involved in congestion control either

implicitly or explicitly. In the former, their operation is optimized by properly adjusting the values of a number of free-selected parameters, to support the end-to-end congestion control. In the latter, feedback signal are issued by explicit signal mechanisms, which are typically realized in the network routers. The network device exploits new bits in the packet header to convey information regarding the path congestion status back to the transmitting source, helping the congestion controller to make the necessary decisions towards congestion avoidance.

[I-D.flinck-mobile-throughput-guidance] proposes that the cellular network provides information on throughput guidance to the TCP server; this information will indicate the throughput estimated to be available at the radio downlink interface. The throughput guidance information is added into the Options field of the TCP header of packets from the TCP client to the TCP server. In our use case, for example, if video is encoded in multiple bitrates, the application server can select the appropriate encoding based on the network conditions. Similar use case is also discussed in [I-D.kuehlewind-spud-use-cases].

3.3.2. Information Exposed

The interesting feature of explicit signaling scheme is the use of a minimal amount of feedback from the network to users to enable them to control the amount of traffic allowed into the network. The routers in the network detect congestion and insert this information into packets flowing in the forward direction. This information is communicated back to the users by the destination that receives the packets. This feedback information is examined by the user to control the amount of traffic that is placed on the network, for example by setting the control-related TCP properties. This information enables switching of video quality to an appropriate bit-rate based on the network congestion state, and preserving the important visual information to be transmitted.

4. Security Considerations

Trust relationship between network and user is needed as the provided information leads to the accuracy of the video MOS (section 4.1) or differentiated operations by both sides (section 4.2 and 4.3).

5. IANA Considerations

This document has no actions for IANA.

6. References

6.1. Normative References

[ITU-T_P.1201]
"Recommendation ITU-T P.1201 (2012), Parametric non-intrusive assessment of audiovisual media streaming quality".

[ITU-T_P.1202]
"Recommendation ITU-T P.1202 (2012), Parametric non-intrusive bitstream assessment of video media streaming quality".

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

6.2. Informative References

[DSL-IPD] Van Caenegem, T., Struyve, K., Laevens, K., Vleeschauwer, D., and R. Sharpe, "Maintaining video quality and optimizing video delivery over the bandwidth constrained DSL last mile through intelligent packet drop", Bell Labs Technical Journal 13(1): 53-68, 2008.

[I-D.flinck-mobile-throughput-guidance]
Jain, A., Terzis, A., Flinck, H., Sprecher, N., Swaminathan, S., and K. Smith, "Mobile Throughput Guidance Inband Signaling Protocol", draft-flinck-mobile-throughput-guidance-03 (work in progress), September 2015.

[I-D.kuehlewind-spud-use-cases]
Kuehlewind, M. and B. Trammell, "Use Cases for a Substrate Protocol for User Datagrams (SPUD)", draft-kuehlewind-spud-use-cases-01 (work in progress), March 2016.

[I-D.you-tsvwg-latency-loss-tradeoff]
You, J., Welzl, M., Trammell, B., Kuehlewind, M., and K. Smith, "Latency Loss Tradeoff PHB Group", draft-you-tsvwg-latency-loss-tradeoff-00 (work in progress), March 2016.

[IPD] Chakravarthi, R. and C. Gomathy, "IPD: Intelligent Packet Dropping Algorithm for Congestion Control in Wireless Sensor Network", Trendz in Information Sciences and

Computing (TISC2010) 2010, pp: 222-225, 2010.

[IPD-TCP] Kantawala, A. and J. Turner, "Intelligent Packet Discard Policies for Improved TCP Queue Management", Technical Report WUCSE-2003-41 , May 2003.

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