### **VTBO** (Video Traffic Bandwidth Optimization)

#### James Won-Ki Hong, PhD

Senior Executive Vice President Chief Technology Officer Advanced Institute of Technology | 2013. 09



### Contents

- 1 Introduction
- **2** Issues in Video Streaming Delivery
- **3** Proposal for Video Traffic Bandwidth Optimization
- 4 Summary

1	Introduction
2	Issues in Video Streaming Delivery
3	Proposal for Video Traffic Bandwidth Optimization
4	Summary

### 01 Background

 Growth of video traffic leads to data explosion and wireless network resource depletion

#### Smart Devices Generate Explosive Video Traffic

- 70% of Mobile Data Traffic to be Video (2016; Cisco)
- KT's mobile traffic increased 300X during the last 3 years

#### **Limitations of Network Investment**

- Insignificant revenue growth compared to CAPEX growth
- Scarce spectrum resources





<sup>1</sup>Quality of Experience

1	Introduction
2	Issues in Video Streaming Delivery
3	Proposal for Video Traffic Bandwidth Optimization
4	Summary

### **02 Stakeholders in Video Streaming Face Serious Issues**

#### The Current Situation



- Rapid diffusion of smart devices and customers' acceptance for video streaming service resulted in data explosion
- Customers experience inconvenience such as delays, motion stops, blurred and broken images in video streaming services

	Concerns	Interim Solution	
Content	<ul><li>Low user satisfaction</li><li>Fierce Competition</li></ul>	Adaptive Streaming/CDN	Issues
Providers (CPs)		<ul> <li>Higher Quality Video Files for Competition</li> </ul>	• QoE vs. Cost
Network	<ul> <li>Significant traffic burden on network</li> </ul>	<ul> <li>Cache</li> <li>Capacity Investment</li> </ul>	<ul> <li>Impact of large file size on network congestion</li> <li>Provision of a single video</li> </ul>
Users	<ul> <li>Delays in loading</li> <li>Low level of QoE</li> <li>Wasted Data</li> </ul>	<ul> <li>Better Smart Devices</li> <li>Switch to another CP</li> </ul>	file for a variety of screen sizes and resolutions



- Need for Video Traffic Optimization Solution
  - Differentiate encoding bit rate for different types of device and content
  - Control video delivery when network is congested

### 04 Evolution of Video Streaming Technology



- The evolving streaming technologies still have limitations:
  - Video quality not optimized to human perception
  - Not possible to assure video quality when network is congested

→ Video streaming with network's help should be considered

- **1** Introduction
- 2 Issues in Video Streaming Delivery
- 3 Proposal for Video Traffic Bandwidth Optimization
  - 4 Summary

### **05 Video Traffic Bandwidth Optimization (VTBO)**

Proposal to overcome limitations of streaming technologies

Optimization of video quality and Priority-based traffic control



### 06 Optimal Encoding Bit Rate Guideline (1/2)

Issue: No consideration of device/content types in video encoding



- Non-linear relationship between QoE and bandwidth usage
- Optimal encoding bit rate prevents excessive traffic generation

## Suggest optimal encoding bit rate for different types of device/content

Reduce network bandwidth usage

### 07 Optimal Encoding Bit Rate Guideline (2/2)

- Study in progress by KT and Yonsei University
  - Devices: iPhone 5, Galaxy S4, iPad Retina Display
  - Content types: Documentary, Sports, Drama, etc.

#### Test Example (Source: Full HD (1080p) 8Mbps Video)

Source	Content Type			Device Type	Encoding (	Guideline
Source	Genre	Spatial Frequency	Activity	Device	Video Resolution	<b>Bit Rate</b> (Mbps)
1	Documentary	Medium	Medium	iPhone	540p	4.0
				Galaxy S4	720p	5.0
				iPad	1080p	6.0
2	Sports	Medium	High	iPhone	540p	4.0
				Galaxy S4	1080p	4.0
				iPad	1080p	6.0
3	Drama	High	Medium	iPhone	540p	2.5
				Galaxy S4	540p	2.5
				iPad	720p	3.0

- Derived optimal encoding bit rate and video resolution required to have QoE similar to that of the source based on subjective QoE measurements
- Experiment (based on ITU-T 910 standard) conducted for 30 content sources

### 08 Video Traffic Packetizing and Labeling

Issue: Difficult to sustain QoE when network is congested

- CPs decide on VTBO priority (High, Medium, Low) of video packets and mark them accordingly
  - Non-VTBO stream: best effort delivery



Priority-based traffic control is expected to minimize QoE degradation when network is congested

### 09 Video Traffic Control (1/2)

- Issue: Need for video traffic control during network congestion
- Control with minimal changes in existing network
  - All video packets are delivered when network is not congested
  - VTBO Scheduler controls video packets with priorities during network congestion



### 10 Video Traffic Control (2/2)

Provide dedicated bearer with higher QoS for VTBO Streaming



VTBO is expected to introduce network's control over video delivery

### 11 Video Quality Comparison: Conventional vs. VTBO



#### **Random Discard**

#### Priority-based Discard

#### Test conditions

- Original video with bit rate 4Mbps and resolution 480p (640 x 480), 30fps
- Approximately 50% of frames dropped for both cases
- Priority-based discard: only low-priority frames (b-frames) were dropped
- Random discard: frames were dropped randomly

1	Introduction
2	Issues in Video Streaming Delivery
3	Proposal for Video Traffic Bandwidth Optimization
4	Summary

### **12 Video Traffic Optimization Landscape**



Enhance QoE and the efficiency of video streaming

### **13 Expected Benefits**





We are trying to make VTBO an international standard

# Thank you