



# Rate Adaptation for Adaptive HTTP Streaming

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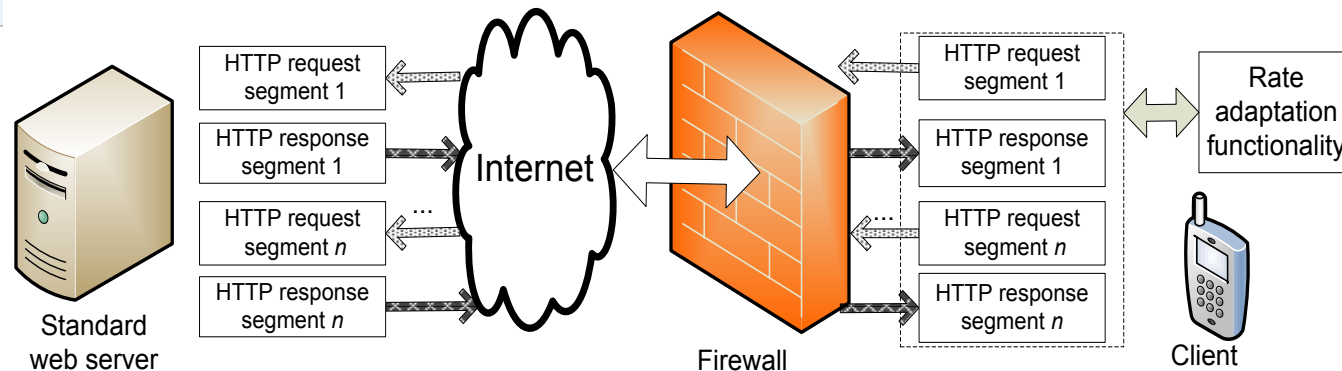


# Outline

- ❖ Adaptive HTTP streaming system
- ❖ Terms and definition of Adaptive HTTP Streaming of in 3GPP PSS
- ❖ Proposed rate adaption for adaptive HTTP streaming
- ❖ Simulation results



# Adaptive HTTP streaming system



**Fig.1. Adaptive HTTP streaming system**

- **Server**

- Can be a standard web server
- Media segment can be prepared in-line or off-line

- **Client**

- Send series of HTTP GET segment request and receives the segment
- Perform the rate adaptation before sending a GET segment request



# Terms and definition of Adaptive HTTP Streaming of in 3GPP PSS

- Media Presentation Description (MPD)
  - The MPD can provide metadata
    - For requesting (GET request) media segments
    - For example, the MPD may provide unique uniform resource locators (URLs) or uniform resource identifiers (URIs) that may be used to locate and download each segment for presentation [1].
  - The MPD provides metadata
    - Rate adaptation purpose
    - Regarding the number of representations as well as the characteristics of each representation [1].
- Segment
  - A segment may include media data or metadata to decode and present the included media content [1].



# Rate adaptation metric

-Proposed rate adaption for adaptive HTTP streaming(1)

- Proposed metric used for the rate adaptation of adaptive HTTP streaming

$$\mu = \text{MSD} / \text{SFT}$$

(1)

$\mu$  : rate adaption metric

MSD: media segment duration

SFT: segment fetch time starting from sending GET  
segment request to receiving last byte of the



# Switch up

## Proposed rate adaption for adaptive HTTP streaming(2)

Switch up: if inequality (2) meets and the buffered media time is larger than it's minimum.

$$\mu > 1 + \varepsilon \quad (2)$$

$$\varepsilon = \max\{(br(i+1) - br(i)) / br(i)\} \quad (3)$$

$\mu$  : rate adaptation metric

- The ratio of media segment duration to segment fetch time

$b_{r(i)}$ : bitrates of representation level  $i$

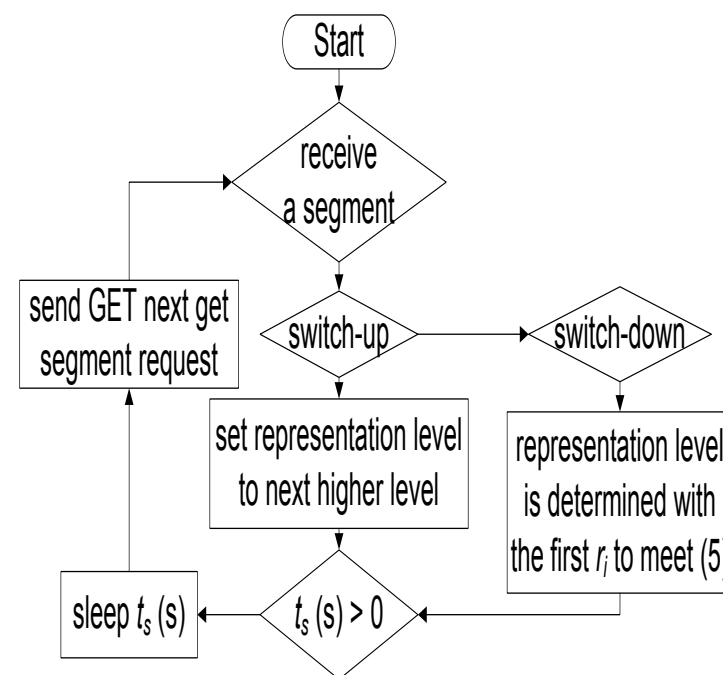


Figure 2. Flowchart of the proposed rate adaptation algorithm of the adaptive HTTP streaming

# Switch down

Proposed rate adaption for adaptive HTTP streaming (3)

- Switch down: if inequality (4) is true.

$$\mu < \gamma_d \quad (4)$$

$\mu$  : rate adaptation metric

- The ratio of media segment duration to segment fetch time which

$\gamma_d$  : denotes switch down threshold.



# Switch down

## Proposed rate adaption for adaptive HTTP streaming (4)

- Switch down,
  - an aggressive switch down to prevent plaback interruption
  - The selected representation level is determined to be the first representation (in descending order) with level to meet

$$b_{r(i)} < \mu b_c \quad (5)$$

$b_{r(i)}$  : encoded media bitrate of the representation level  $i$

$\mu$  : ratio of media segment duration to segment fetch time

$b_c$  : bitrate of current representation





# Idle time

## Proposed rate adaption for adaptive HTTP streaming (5)

- The idle time

- to limit maximum buffered media time, save bandwidth
- deployed before sending the next GET request

$$t_s = t_m - t_{\min} - b_c \text{MSD} / b_{\min} \quad (6)$$

$T_s$ : idle time in seconds

$t_m$ : buffered media time

$t_{\min}$ : minimum buffered media time

$b_c$ : current representation bitrate

$b_{\min}$ : minimum representation bitrate

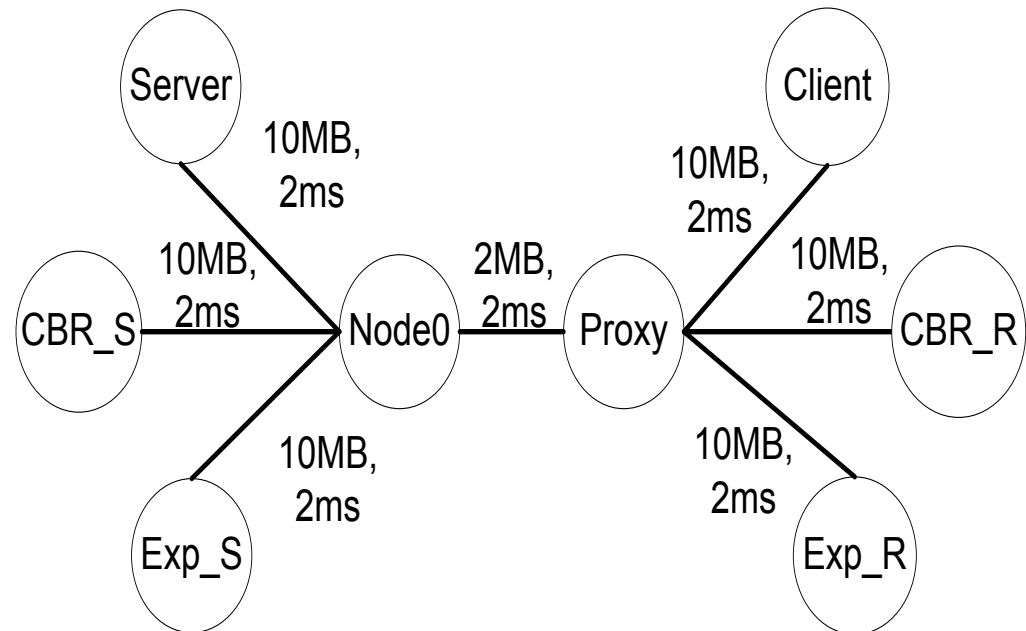
MSD: media segment duration



# Network topology

## -Simulation results (1)

- Media bitrate:
  - (100Kbits-1000Kbits)
  - Step of 100 Kbits/s
- Bitrates of CBR traffic
  - 400 Kbits/s to 1400 Kbits/s
  - Steps of 200 Kbits/s
- Bitrate of exponential traffic
  - 500Kbit/s on average
- Parameters setting
  - MSD,  $t_{\min}$ ,  $\gamma_d$  are set as 10s, 9s and 0.67



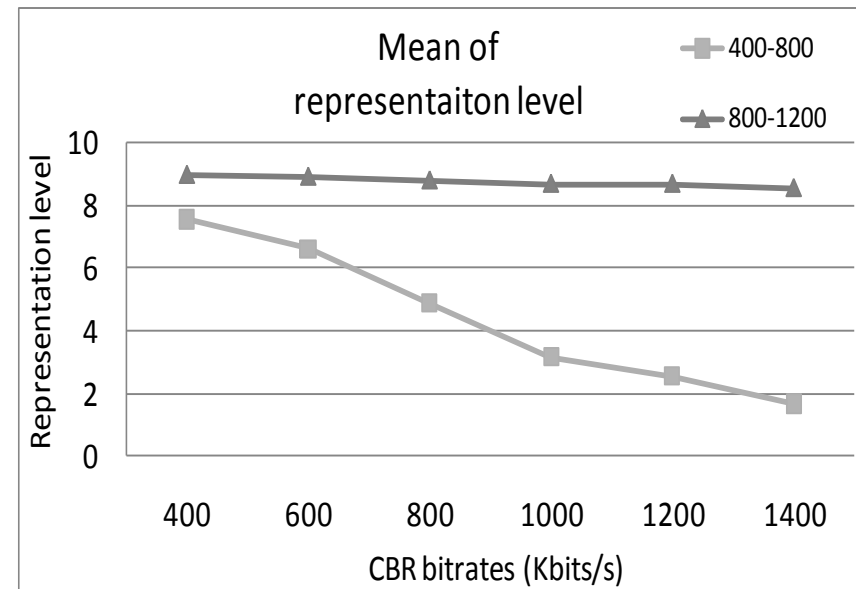
**Figure. 3. Network topology**



# Mean of representation levels

## -Simulation results (2)

- 400s-800s(with CBR)
  - Representation level
    - Decrease with increase in the CBR bitrates
    - Bottleneck bandwidth: 2Mbits/s
    - Exp: 0.5 Mbits/s
    - CBR: 0.4-1.4Mbits/s
      - Remaining: 1.1-0.1Mbits/s
- 800s-1200 (without CBR)
  - Representation level
    - Larger then 8 (bitrate 0.9Mbits/s)
    - Demonstrate the high speed of rate enhancement after removing the CBR traffic



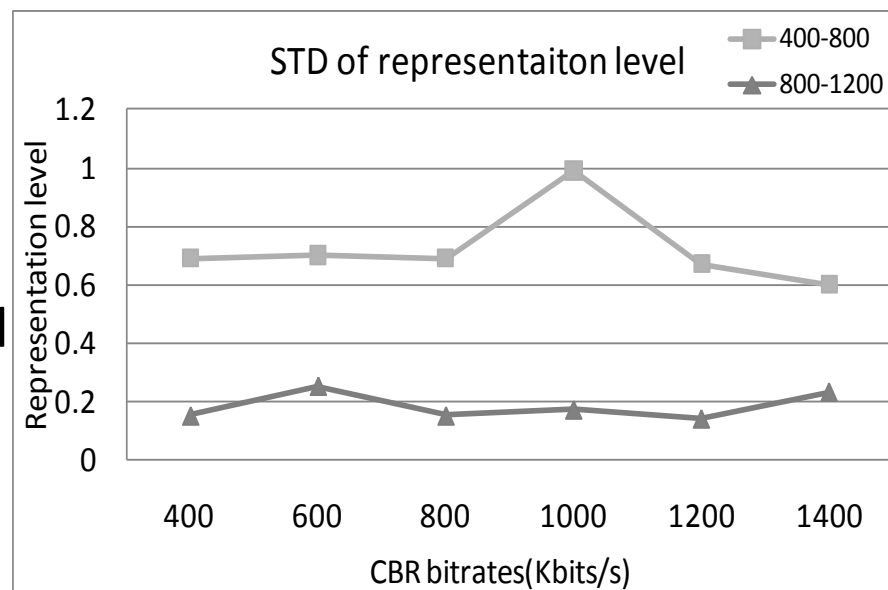
**Figure. 4. Mean of representation levels with CBR bitrates in different time periods**



# STD of representation level

-Simulation results (3)

- 400s-800s (with CBR)
  - Stability in the representation level
    - STD are lower than 1 for all CBR
- 800s-1200 (without CBR)
  - Stability in the representation level
    - STD are lower than 0.3 for all CBR



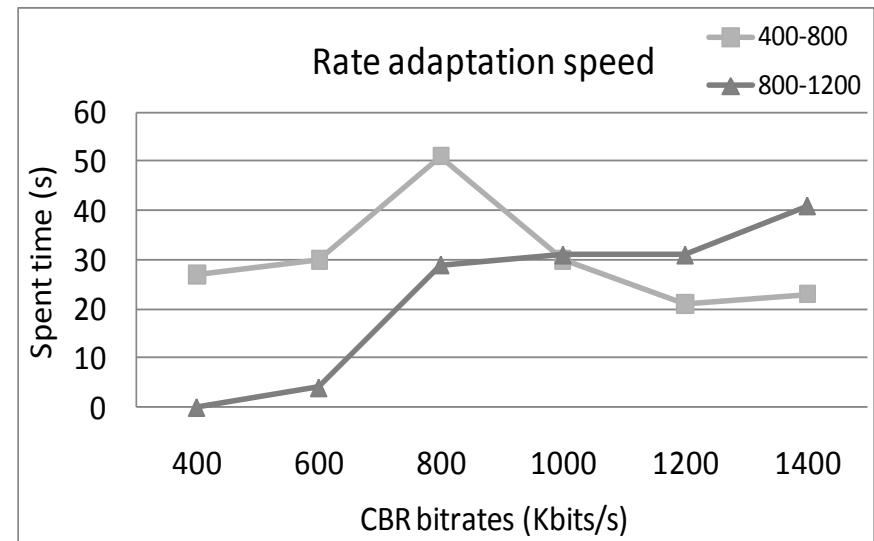
**Figure. 5. Standard deviation (STD) of representation level with different CBR bitrates in different time periods**



# Rate adaptation speed

-Simulation results (4)

- Rate adaptation speed
  - represent the time spent to reach the stable representation level starting from the instant of changing the bottleneck bandwidth.
  - Take around 30 seconds to reach the stable representation level



**Figure. 6. Rate adaptation speed with different CBR bitrates in different time periods**



# References

- [1] 3GPP TS 26.234: “Transparent end-to-end Packet-switched Streaming Service (PSS); Protocols and codecs,” (Release 9.5.0), Dec. 2010.





# Thanks & Question ?

