Performance Analysis of Orb

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Overview

- **What is Orb?**
- Why to study Orb?
- Experiments
- Future Steps

What is Orb?

- Orb is a free software which enables users to access media files from their Home PC to any Internet connected device.
- Launched in 2005. Over 7 million registered users .
- Features:
  - Allows to Share photos, video, audio
  - watch TV , Internet Radio.
  - Webcam Monitoring
  - Can be used along with a gaming console.

Installation and Use

- Host End
  - Download Orb from http://www.orb.com/en/download_orb
  - Install in host PC
- Client End
  - Open web browser and go to link https://mycast.orb.com/orb/html/login.html
  - Login and access media files from anywhere in the world

How does Orb Stream?

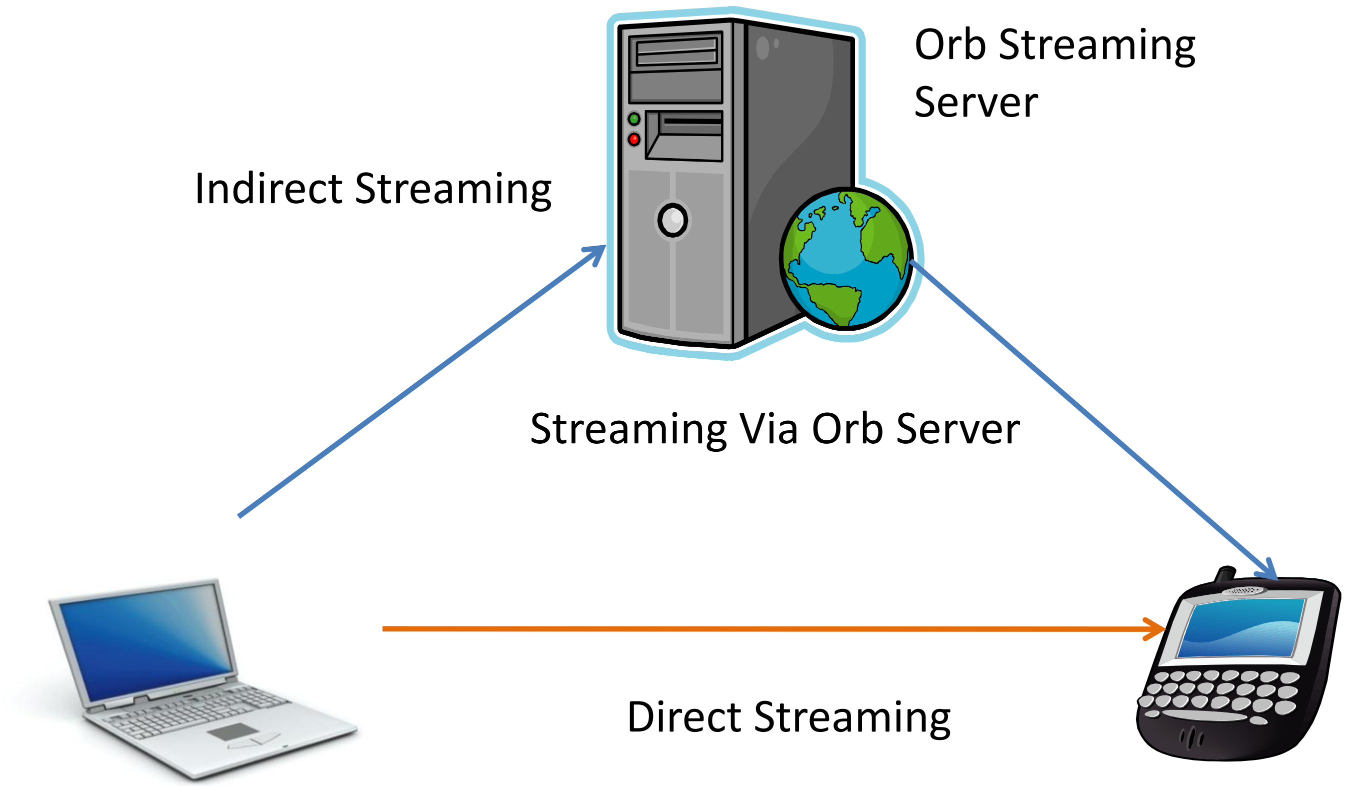
- Two methods of streaming
  - Direct Streaming
  - Streaming via Orb server
- **Direct Streaming**

  Streaming of the video content from the Host PC to the client directly.
- **Streaming via Orb server**

  Data sent from Host PC to the Orbstreaming server

  Orb server redirects data to the client.

Direct Streaming and Streaming via Orb server



Orb Streaming Server

Indirect Streaming

Streaming Via Orb Server

Direct Streaming

Host PC

Client

Direct Streaming

Scenarios of Direct Streaming:

- Host PC and Client are connected to the same LAN and share the same public IP address
- Orb host PC connected to the Internet through a router with UPnP(Universal Plug and Play functionality) enabled.
- Host Orb PC is not a part of a LAN and is directly connected to the broadband modem.

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Why Study Orb?

- Orb different from typical Internet streaming

- Typical video streaming:
  - Video performance affected by downlink bandwidth to client
  - High-end servers, reliable

- Orb – video from Home PC has differences:
  - Uplink bandwidth is important
  - Home network configuration matters (i.e. wireless)
  - Servers are off-the-shelf PCs

- Difference may impact performance, use may impact Internet traffic

Overview

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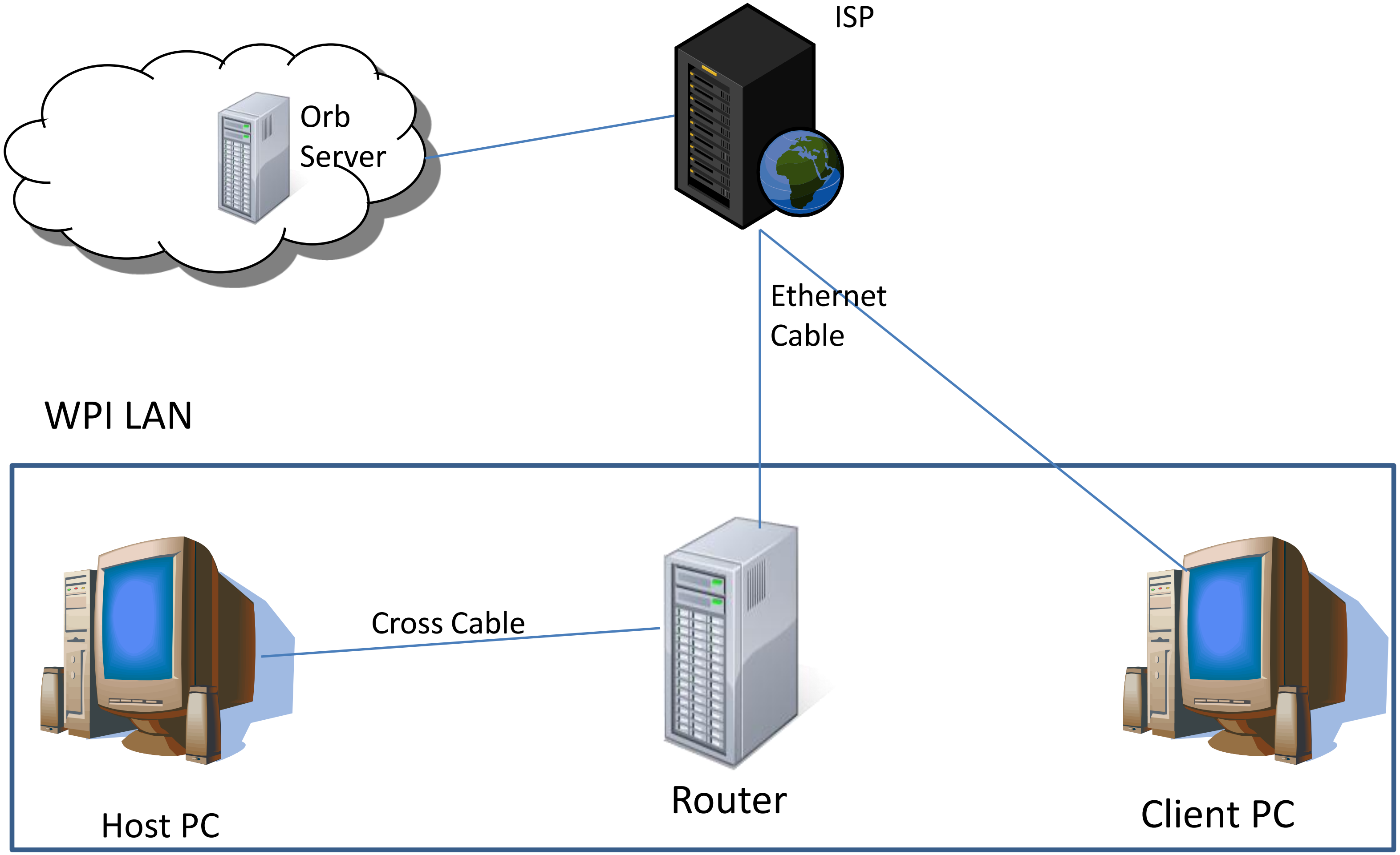
- Why to study Orb?

- **Experiments**

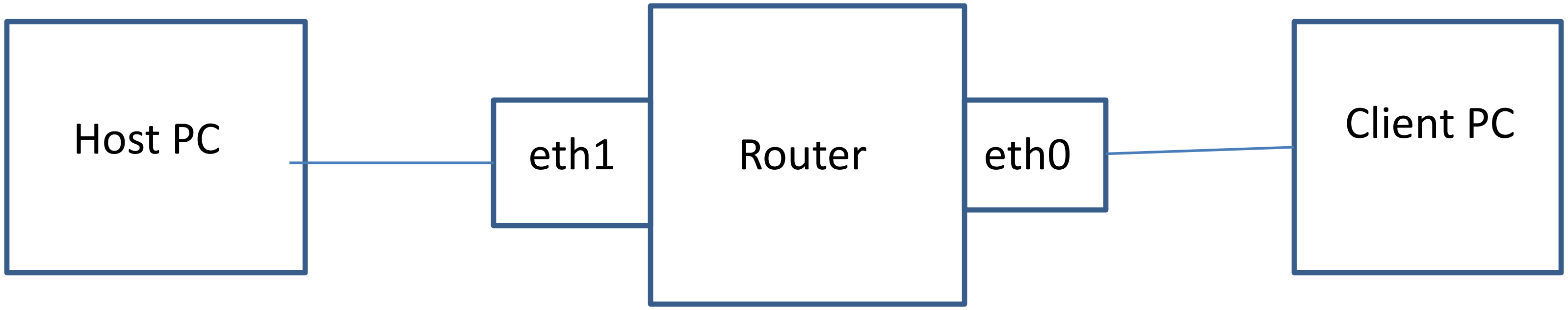
- Future Steps

Experimental Setup



We focus only on Direct Streaming

Router Setup



- Router has the Netem module
- Netem used for network emulation

Experimental Setup

Host PC and Client PC Spec:

  - RAM – 1 GB
  - CPU speed – 2.80 GHz
  - OS - Windows XP

- **Software on the host:**
  - Orb version - 2.51.0032
  - Process Explorer
- **Software on Client:**
  - Media Tracker
- **Applications on both Client and Host PC:**
  - Wireshark
  - Iperf

Router :

  - SuSE-Linux 10.3 (2.6 kernel version)
  - Two PCI cards
  - Netem module

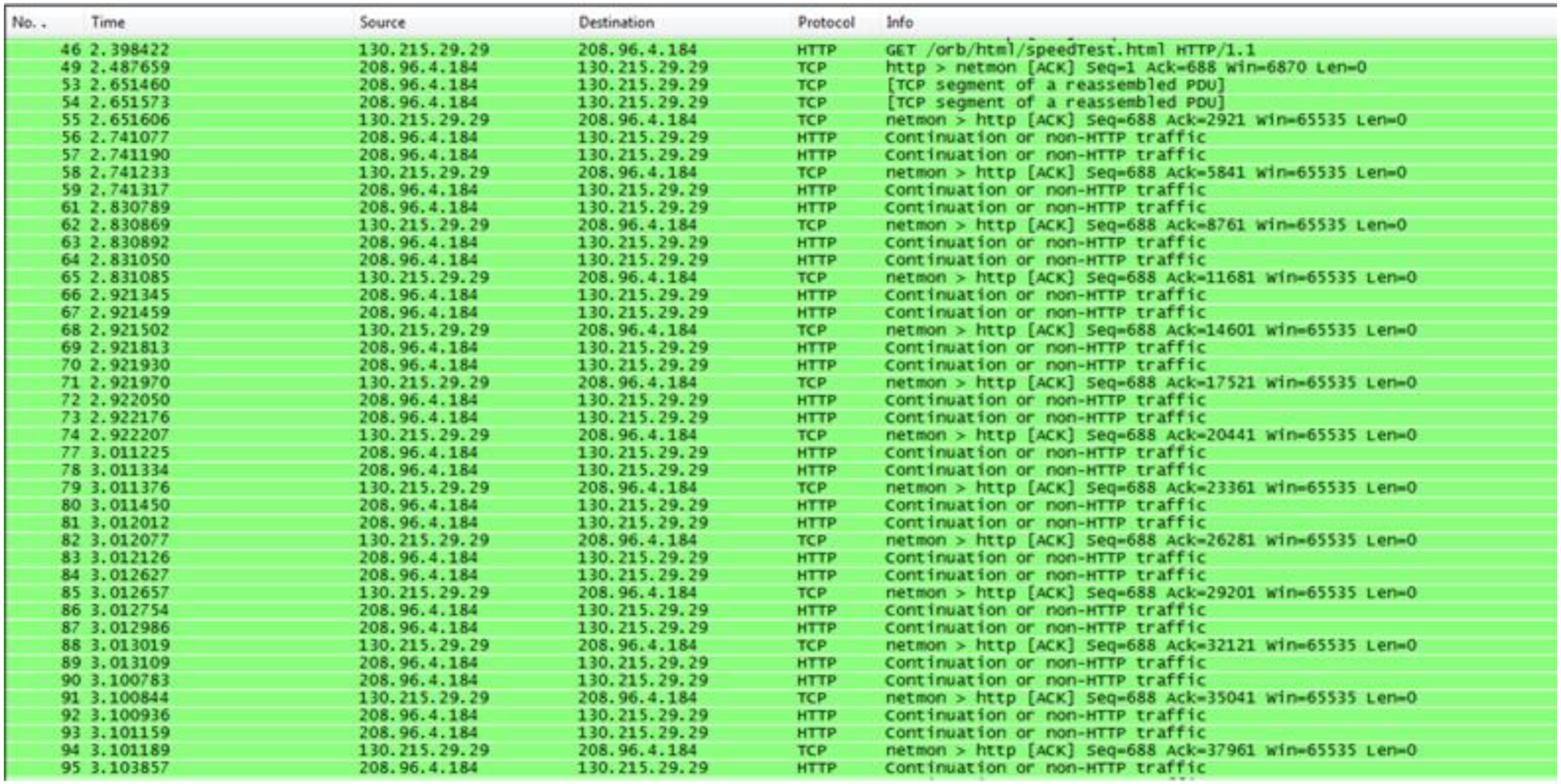
Set of Experiments Conducted

- Analyze bandwidth calculation by Orb
- Video quality measurements with MediaTracker
- CPU and memory usage on the server

Bandwidth Estimation By Orb

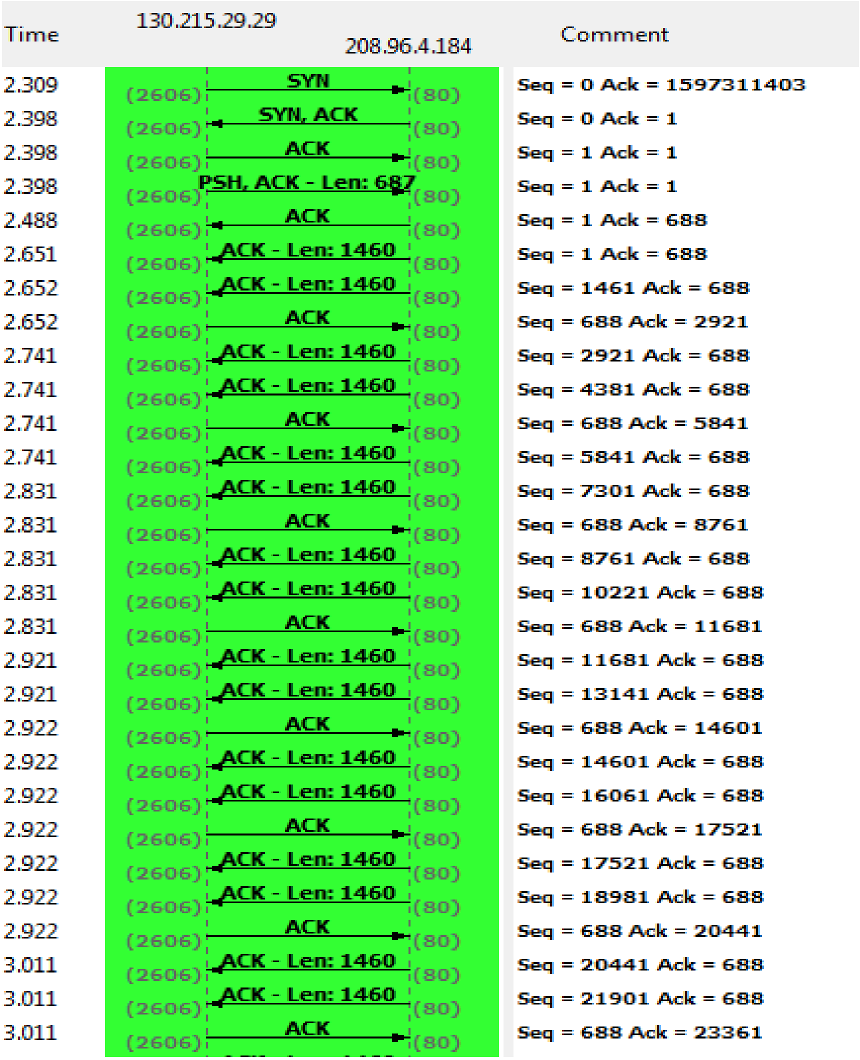
- Steps Followed
  - Start Wireshark at the client
  - Click on the ‘Control Panel’. Go to ‘Streaming speed’ and calculate the web speed and the upstream speed by clicking the ‘Recalculate button.
  - Capture Wireshark trace on Client during web speed calculation.
  - Wireshark run on the Host side to analyse how the host upstream is calculated.
  - Analyze trace.

Client Web Speed Calculation Trace



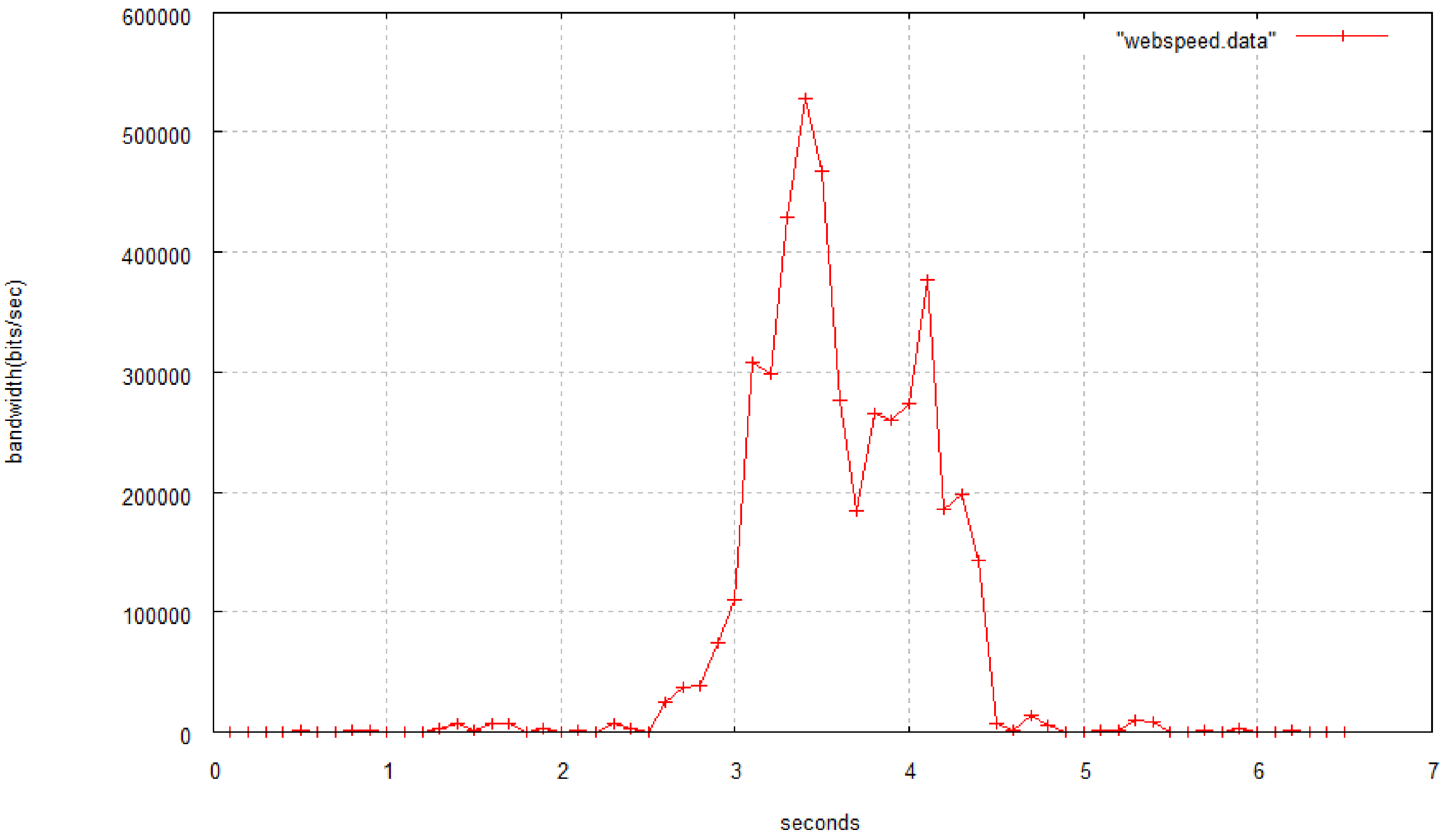
No.	Time	Source	Destination	Protocol	Info
46	2.398422	130.215.29.29	208.96.4.184	HTTP	GET /orb/html/speedTest.html HTTP/1.1
49	2.487659	208.96.4.184	130.215.29.29	TCP	http > netmon [ACK] Seq=1 Ack=688 Win=6870 Len=0
53	2.651460	208.96.4.184	130.215.29.29	TCP	[TCP segment of a reassembled PDU]
54	2.651573	208.96.4.184	130.215.29.29	TCP	[TCP segment of a reassembled PDU]
55	2.651606	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=2921 Win=65535 Len=0
56	2.741077	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
57	2.741190	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
58	2.741233	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=5841 Win=65535 Len=0
59	2.741317	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
61	2.830789	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
62	2.830869	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=8761 Win=65535 Len=0
63	2.830892	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
64	2.831050	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
65	2.831085	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=11681 Win=65535 Len=0
66	2.921345	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
67	2.921459	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
68	2.921502	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=14601 Win=65535 Len=0
69	2.921813	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
70	2.921930	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
71	2.921970	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=17521 Win=65535 Len=0
72	2.922050	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
73	2.922176	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
74	2.922207	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=20441 Win=65535 Len=0
77	3.011225	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
78	3.011334	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
79	3.011376	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=23361 Win=65535 Len=0
80	3.011450	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
81	3.012012	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
82	3.012077	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=26281 Win=65535 Len=0
83	3.012126	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
84	3.012627	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
85	3.012657	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=29201 Win=65535 Len=0
86	3.012754	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
87	3.012986	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
88	3.013019	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=32121 Win=65535 Len=0
89	3.013109	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
90	3.100783	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
91	3.100844	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=35041 Win=65535 Len=0
92	3.100936	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
93	3.101159	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic
94	3.101189	130.215.29.29	208.96.4.184	TCP	netmon > http [ACK] Seq=688 Ack=37961 Win=65535 Len=0
95	3.103857	208.96.4.184	130.215.29.29	HTTP	Continuation or non-HTTP traffic

TCP Flow Graph- Client Web Speed



Time	130.215.29.29		208.96.4.184	Comment
2.309	(2606)	SYN →	(80)	Seq = 0 Ack = 1597311403
2.398	(2606)	← SYN, ACK	(80)	Seq = 0 Ack = 1
2.398	(2606)	ACK →	(80)	Seq = 1 Ack = 1
2.398	(2606)	PSH, ACK - Len: 687 →	(80)	Seq = 1 Ack = 1
2.488	(2606)	← ACK	(80)	Seq = 1 Ack = 688
2.651	(2606)	← ACK - Len: 1460	(80)	Seq = 1 Ack = 688
2.652	(2606)	← ACK - Len: 1460	(80)	Seq = 1461 Ack = 688
2.652	(2606)	ACK →	(80)	Seq = 688 Ack = 2921
2.741	(2606)	← ACK - Len: 1460	(80)	Seq = 2921 Ack = 688
2.741	(2606)	← ACK - Len: 1460	(80)	Seq = 4381 Ack = 688
2.741	(2606)	ACK →	(80)	Seq = 688 Ack = 5841
2.741	(2606)	← ACK - Len: 1460	(80)	Seq = 5841 Ack = 688
2.831	(2606)	← ACK - Len: 1460	(80)	Seq = 7301 Ack = 688
2.831	(2606)	ACK →	(80)	Seq = 688 Ack = 8761
2.831	(2606)	← ACK - Len: 1460	(80)	Seq = 8761 Ack = 688
2.831	(2606)	← ACK - Len: 1460	(80)	Seq = 10221 Ack = 688
2.831	(2606)	ACK →	(80)	Seq = 688 Ack = 11681
2.921	(2606)	← ACK - Len: 1460	(80)	Seq = 11681 Ack = 688
2.921	(2606)	← ACK - Len: 1460	(80)	Seq = 13141 Ack = 688
2.922	(2606)	ACK →	(80)	Seq = 688 Ack = 14601
2.922	(2606)	← ACK - Len: 1460	(80)	Seq = 14601 Ack = 688
2.922	(2606)	← ACK - Len: 1460	(80)	Seq = 16061 Ack = 688
2.922	(2606)	ACK →	(80)	Seq = 688 Ack = 17521
2.922	(2606)	← ACK - Len: 1460	(80)	Seq = 17521 Ack = 688
2.922	(2606)	← ACK - Len: 1460	(80)	Seq = 18981 Ack = 688
2.922	(2606)	ACK →	(80)	Seq = 688 Ack = 20441
3.011	(2606)	← ACK - Len: 1460	(80)	Seq = 20441 Ack = 688
3.011	(2606)	← ACK - Len: 1460	(80)	Seq = 21901 Ack = 688
3.011	(2606)	ACK →	(80)	Seq = 688 Ack = 23361

Client Web Speed Calculation

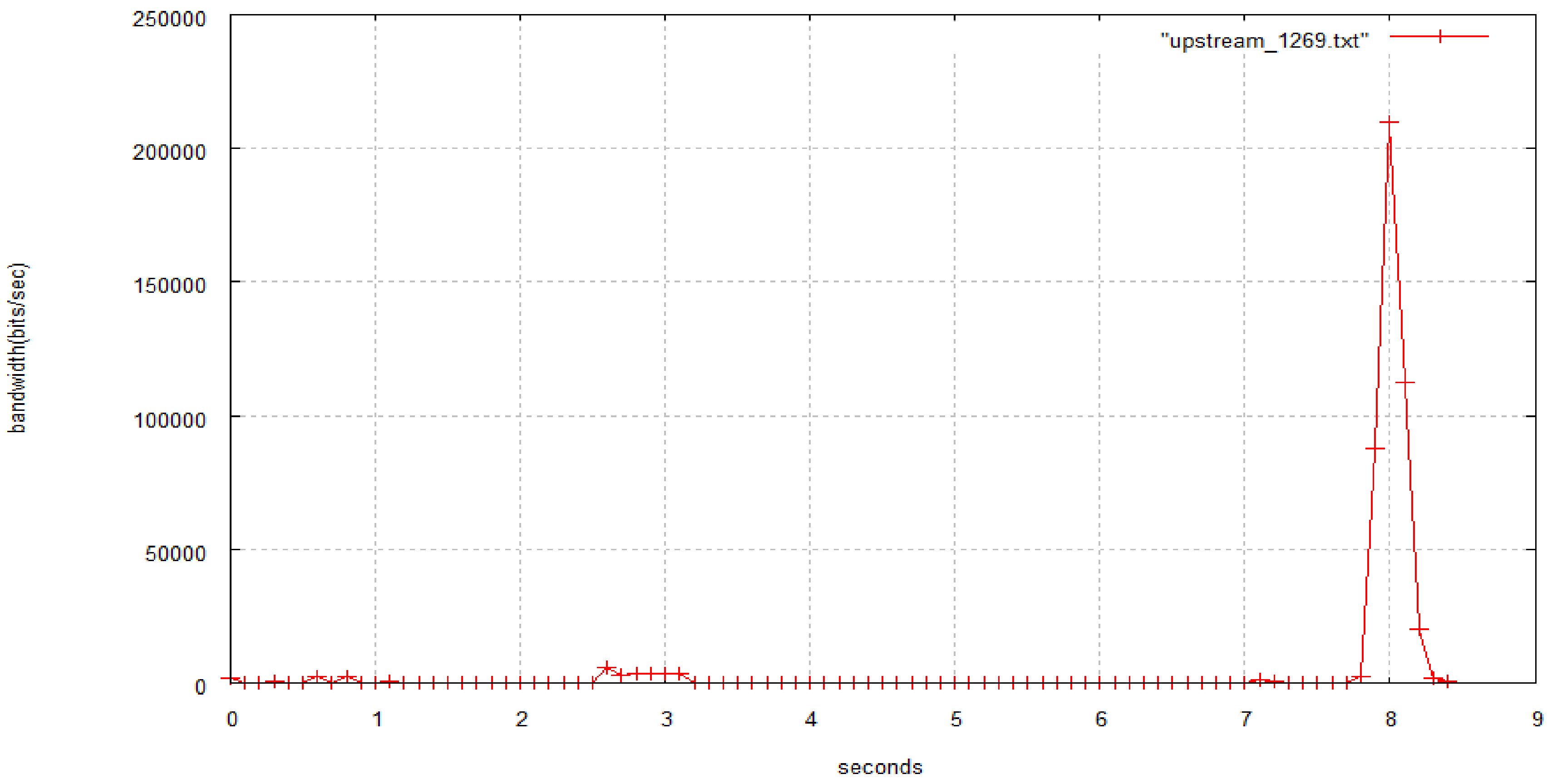


Client downloads 4Mb of data

Bandwidth = Data downloaded/ download time

Reported Web Speed = 2306 Kbps

Upstream Speed Calculation



Host PC uploads 400Kb data to Orb Server

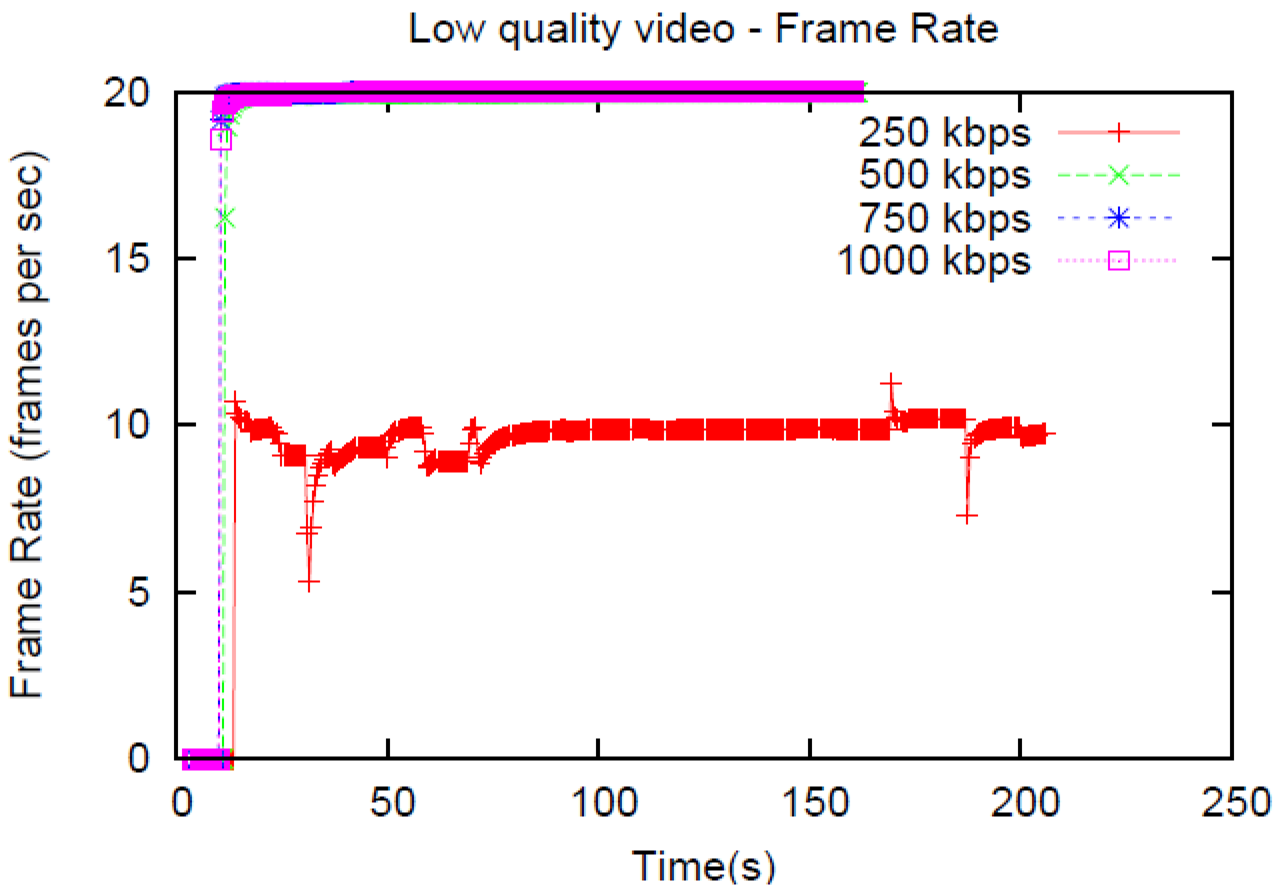
Upstream Speed calculated based on the upload time(~ 0.5 sec here)

Reported Upstream Speed = 1269 kbps

Video Quality Measurements

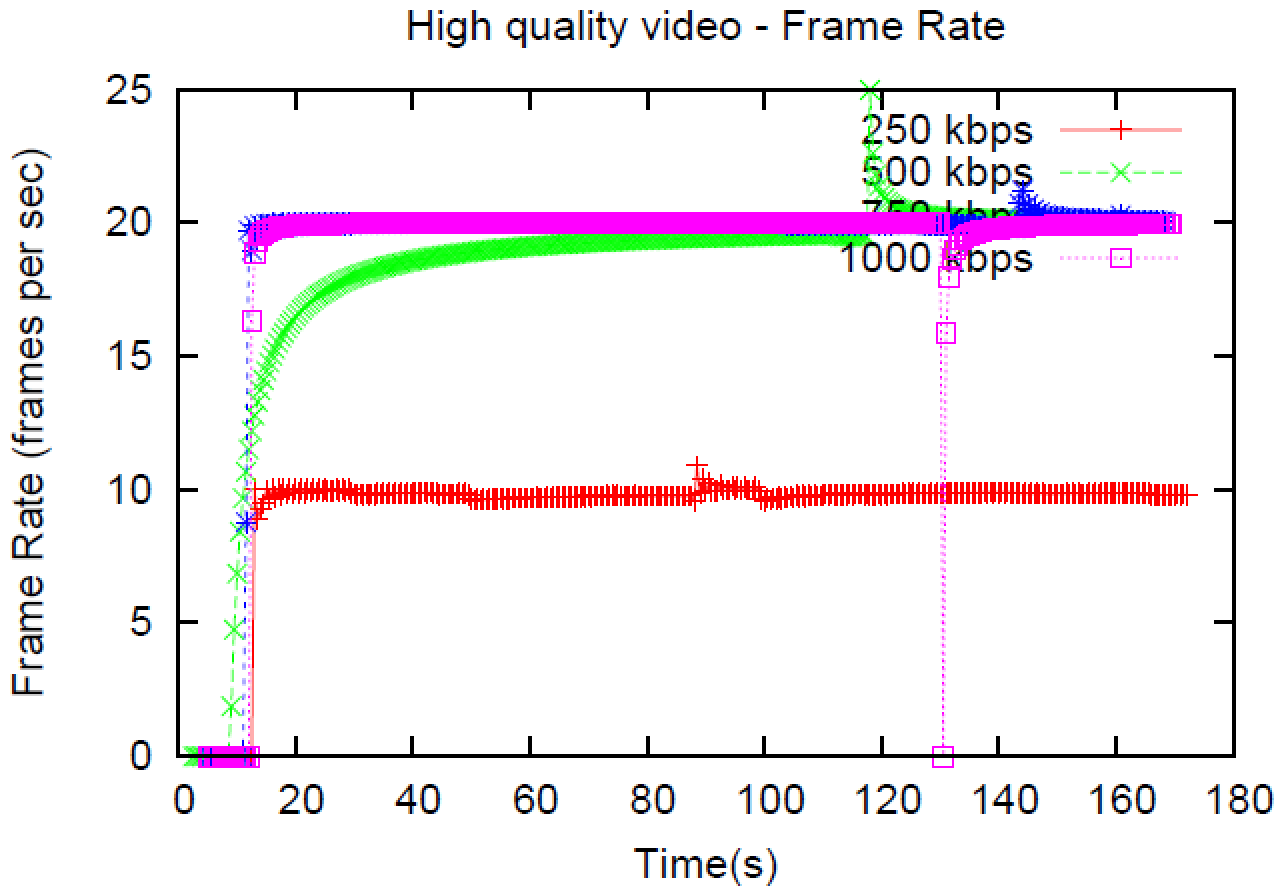
- Videos used:
  - WMV format
  - Low quality video
    - Resolution – 320*240, File size – 14.4 MB, Duration – 150 sec, bitrate - 768 Kbps
  - High quality video
    - Resolution - 1280*720, File size – 29MB, Duration – 150 sec, bitrate - 1546 Kbps
- Metrics for measurement
  - buffer Progress, bit rate, frame rate
- Vary bandwidth to 1000 kbps, 750 kbps, 500 kbps and 250 kbps, measure performance

Frame rate – Low quality video



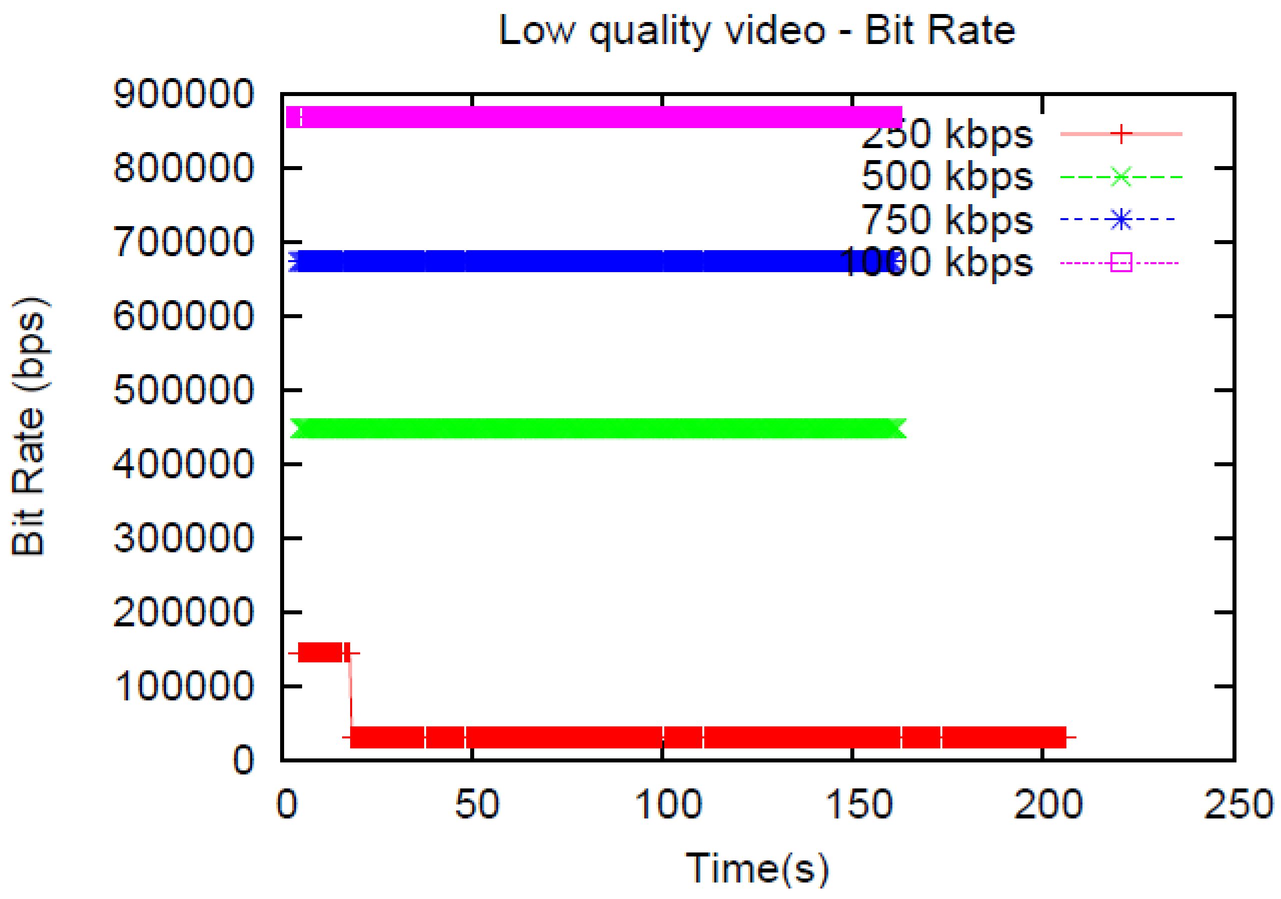
Orb does Temporal Scaling

Frame rate – High quality video



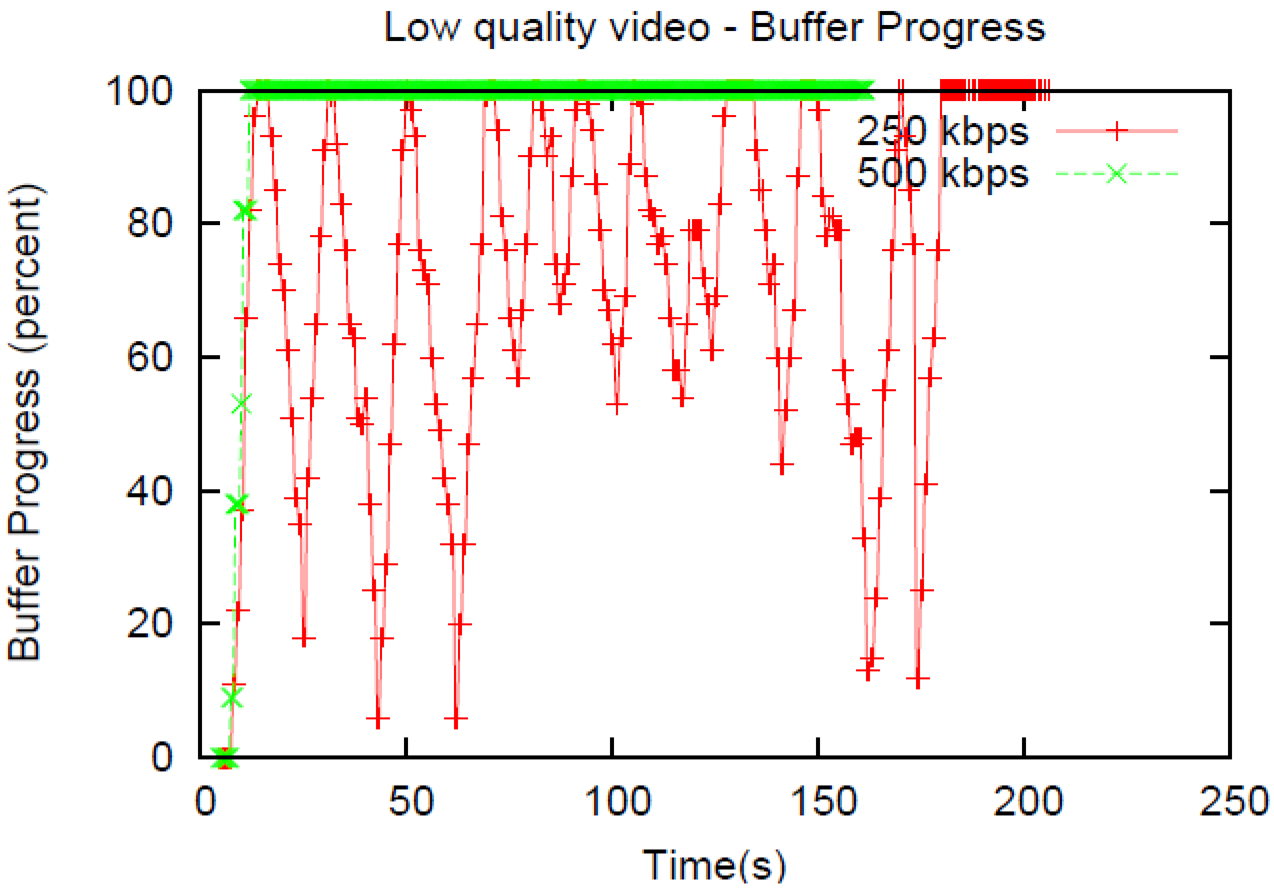
Orb does Temporal Scaling

Bit rate – Low quality video

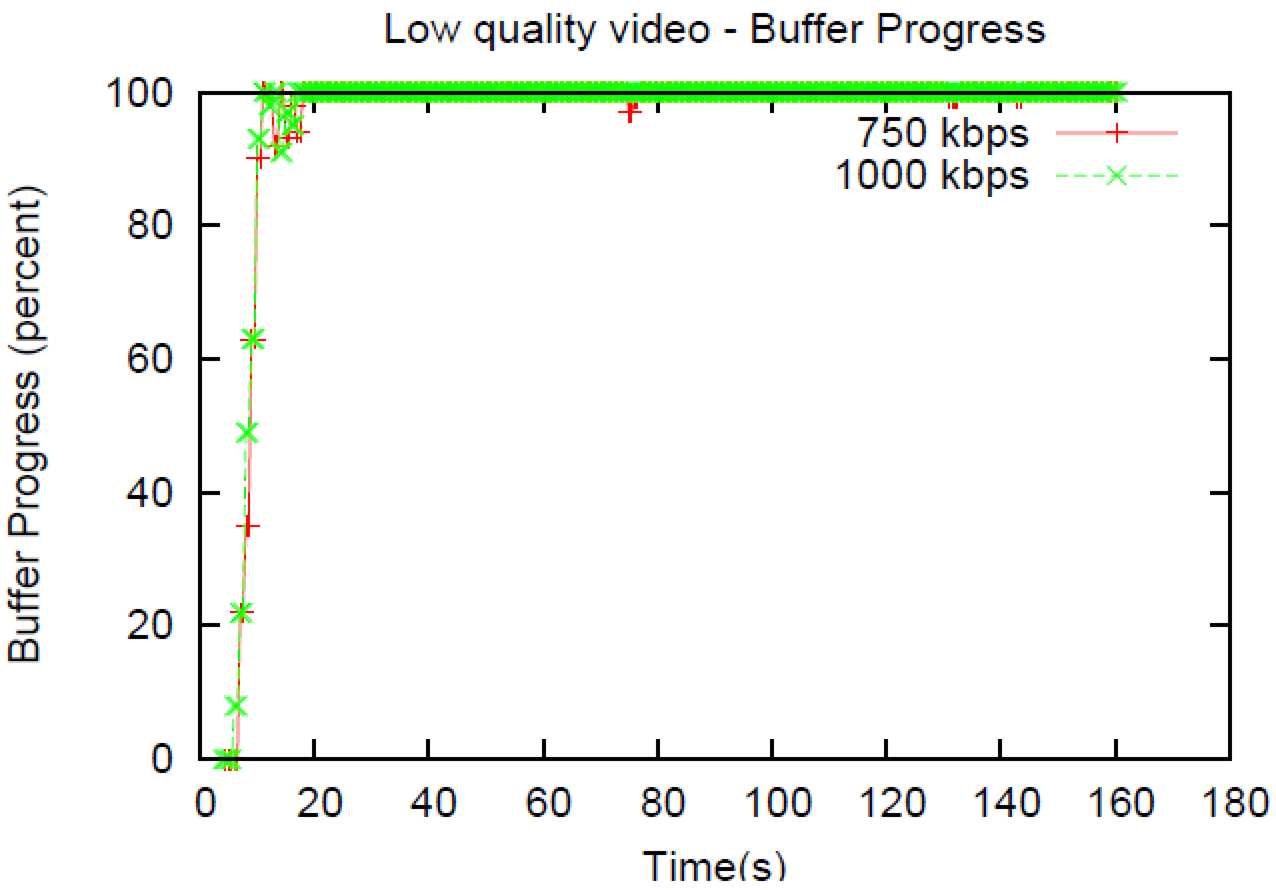


Orb does Spatial Scaling also

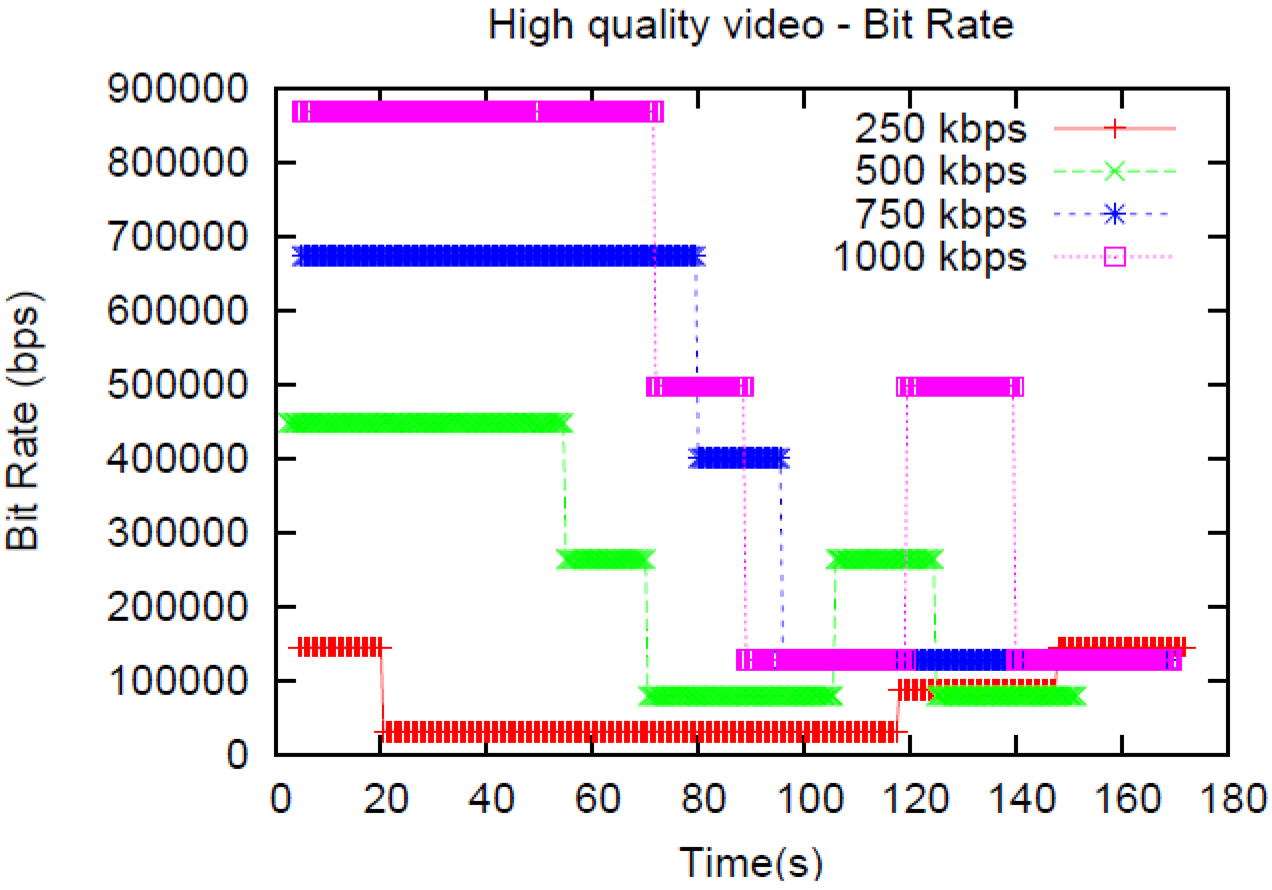
Buffer Progress – Low quality video



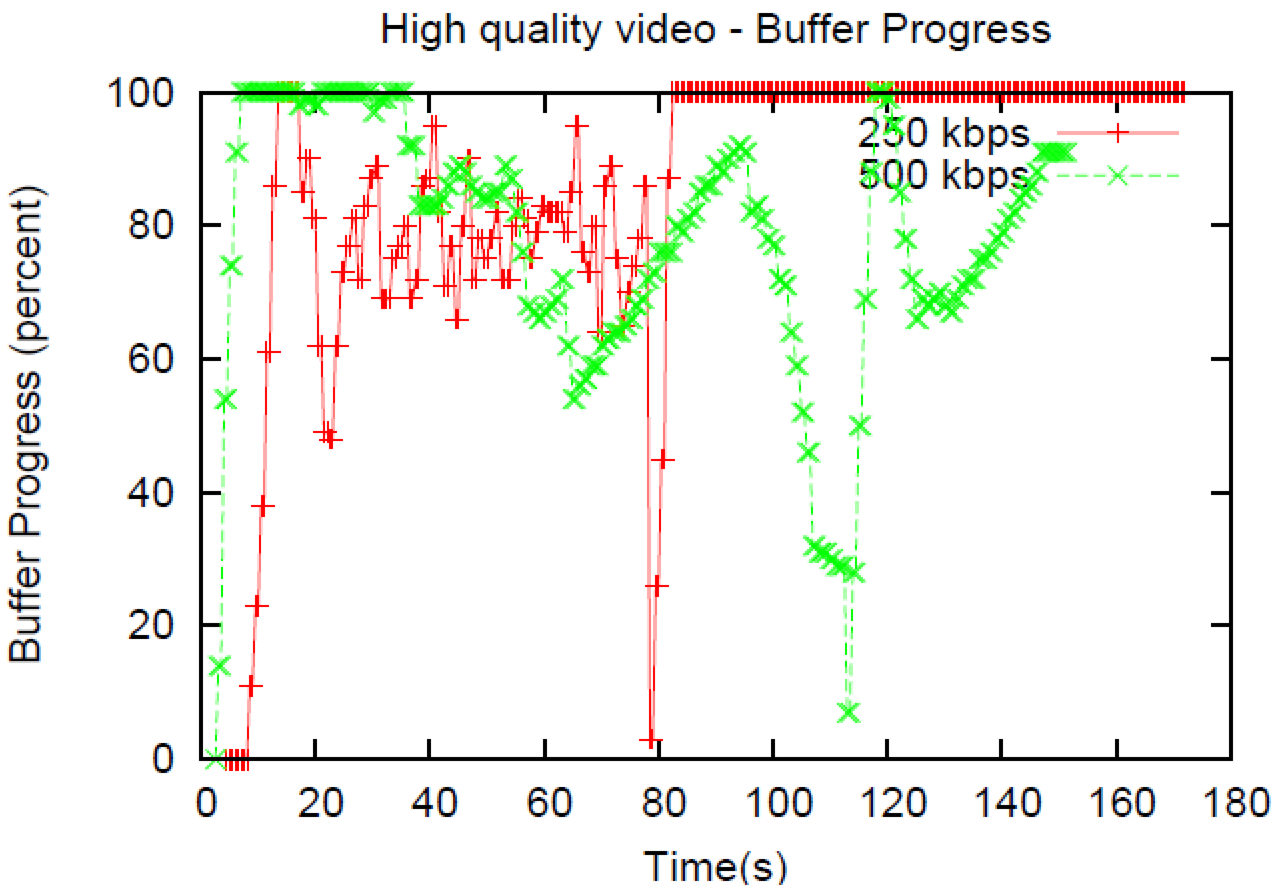
Buffer Progress – Low quality video



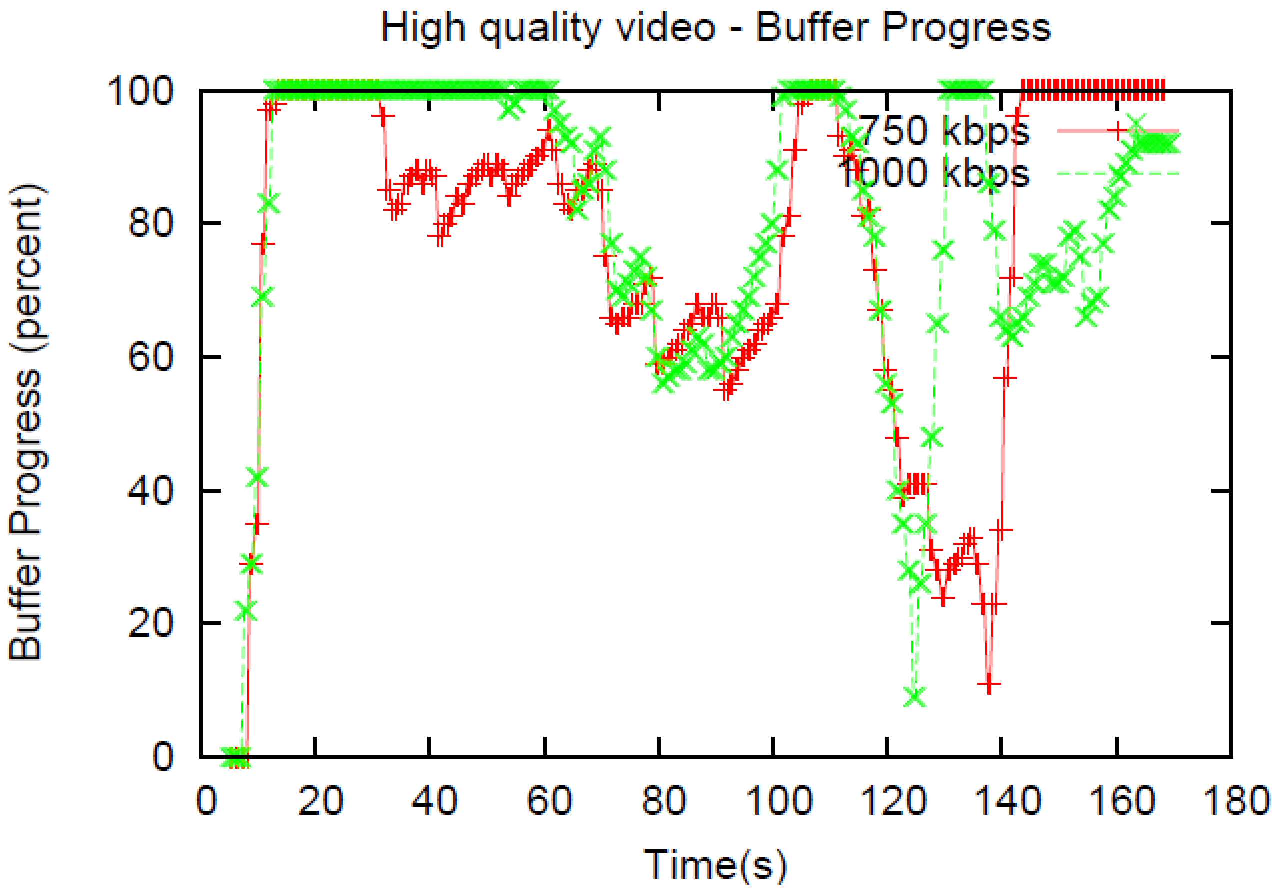
Bit rate – High quality video



Buffer Progress – High quality video



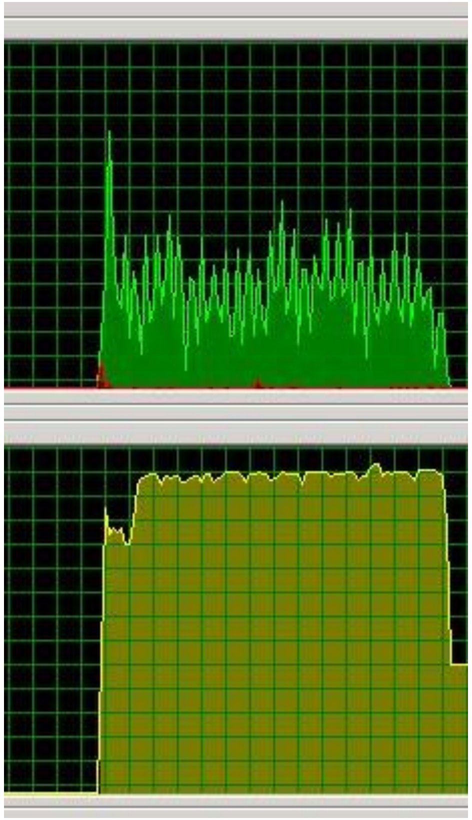
Buffer Progress – High quality video



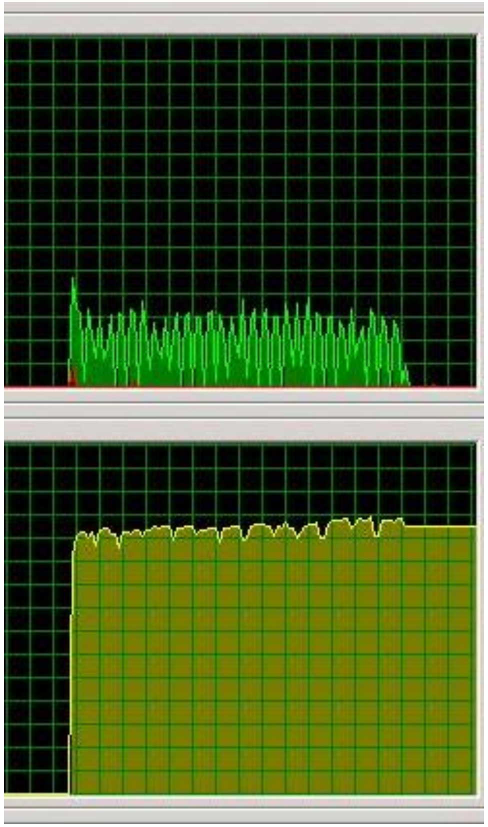
CPU Usage at the Host PC

- Orb uses *ffmpeg* library for real-time transcoding to suit the network conditions.
- We measured the CPU usage at the Host PC for multiple source and destination formats.

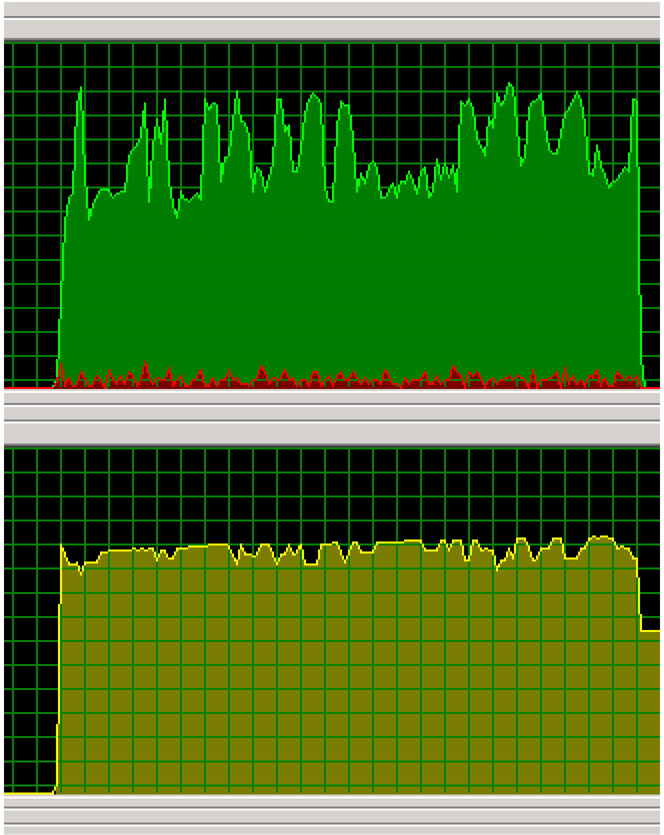
CPU Usage at the Host PC



Src: FLV
320x214
Dest: WMV
320x208

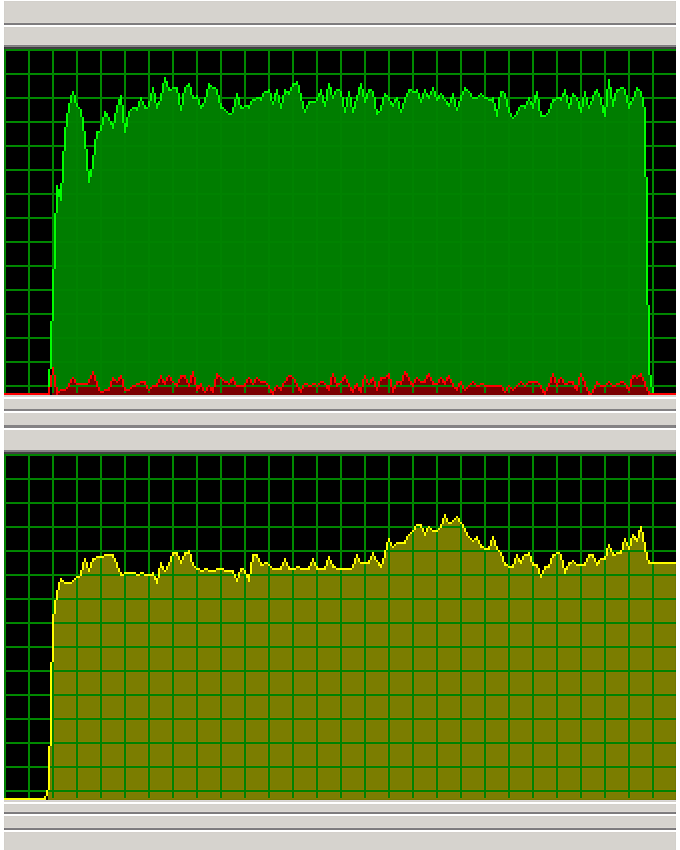


Src: FLV
320x214
Dest: FLV
312x208

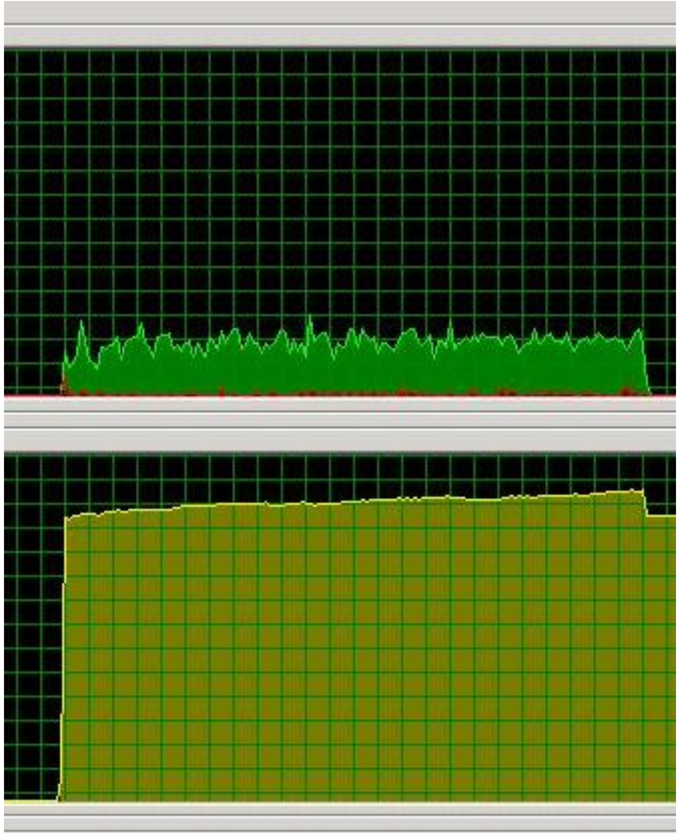


Src: WMV (HQ)
1280x720
Dest: FLV
296x168

CPU Usage at the Host PC



Src: WMV (HQ)
1280x720
Dest: WMV
296x168



Src: WMV
320x240
Dest: FLV
312x208

Conclusion

- Host upstream capacity crucial for video performance.
- Orb adapts to change in bandwidth
  - Bandwidth less than encoded bit rate
    - Reduces Frame rate (Temporal scaling)
  - Bandwidth more than encoded bit rate
    - Sends at a higher rate
- Host PC does transcoding
  - Significant drain on CPU and memory

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Future Work

- Study video quality for different source and destination formats like flash, mov.
- Measure the impact of loss and delay for different bandwidth settings.
- Compare with Slingbox , Location free devices.

Thank You

Questions?