ENSC 894: COMMUNICATION NETWORKS
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FINAL PROJECT PRESENTATION
Performance evaluation of IPTV over WiMAX
http://pbatta.webs.com/

Prerna Batta
301225595
pbatta@sfu.ca
Team No. 3

Roadmap

- Motivation and Goal
- Introduction
- Simulation Design
- OPNET model
- Simulation Results
- Conclusions
- References

Motivation

- Deployment Video on Demand (VoD) over the next generation (WiMAX)
- Efficiency of video streaming over next generation 4G

Goal

- Performance evaluation of IPTV (VoD) over WiMAX
- Measure the quality of video traffic using the Mean Opinion Score (MOS) metric

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WiMAX Introduction

- Worldwide Interoperability for Microwave Access
- Wireless Broadband Standard
- Based on IEEE 802.16 standard
- Started in 1999 : as an alternative to DSL
- 2005: Landmark Year
  - Standard 802.16e released
  - Mobility was introduced
- Evolved into 4G technology

WiMAX Features

- Operates in 10−66 GHz
- provides high throughput broadband connections over long distance
- Use of adaptive modulation
- Strong QOS Mechanism
- Data rates between 1.5 to 75 Mbps are achievable

IPTV Introduction

- Internet Protocol Television
- Set of multimedia services distributed over IP network
- Manages to provide the required level of QoS
- IPTV services can be categorized into:

i. Live television
ii. Time shifted television
iii. Video on demand (VoD)

- IPTV is sensitive to packet loss and delays if the streamed data is unreliable

Video Traffic and Streaming

- Video traces with different video codes from past research [1] are used
- These traffics were obtained from Arizona State University [2], with 532×288 resolution
- OPNET modeler doesn't have built in features to support video streaming
- Encoding rate is 30 frames per second
- Video streaming for real time video codec coded by H.264/AVC and SVC was considered and is delivered by an IP-Unicast

Video Traffic Characteristics

- Quality of Experience (QoE)
- Quality of Service (QoS)
  I. Packet End-to-End delay
  II. Packet loss
  III. Jitter
  IV. Throughput

Video Codec tracer Characteristics

Parameters	H.264/AVC	SVC
Frame Compression Ratio	21.7	18.01
Min Frame Size (Bytes)	17	22
Max Frame Size (Bytes)	62289	58150
Mean Frame Size (Bytes)	7004.52	8440.74
Peak Frame Rate (Bytes)	14.92	13.9
Mean Frame Rate (Bytes)	1.68	2.02
Mean Frame PSNR (dB)	46.49	47.89

Table 1. Video Codec traces characteristics [2]

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Simulation Design

- Circular placement of nodes in a hexagon with:

i. One WiMAX Base station (BS)

ii. Five Subscriber stations (SS)

- Distance between SS and BS:1km
- Fixed nodes
- BS connected to IP backbone via DS3 WAN link
- Video server connected to server backbone via ppp_sonet_oct1 link

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NETWORK TOPOLOGY

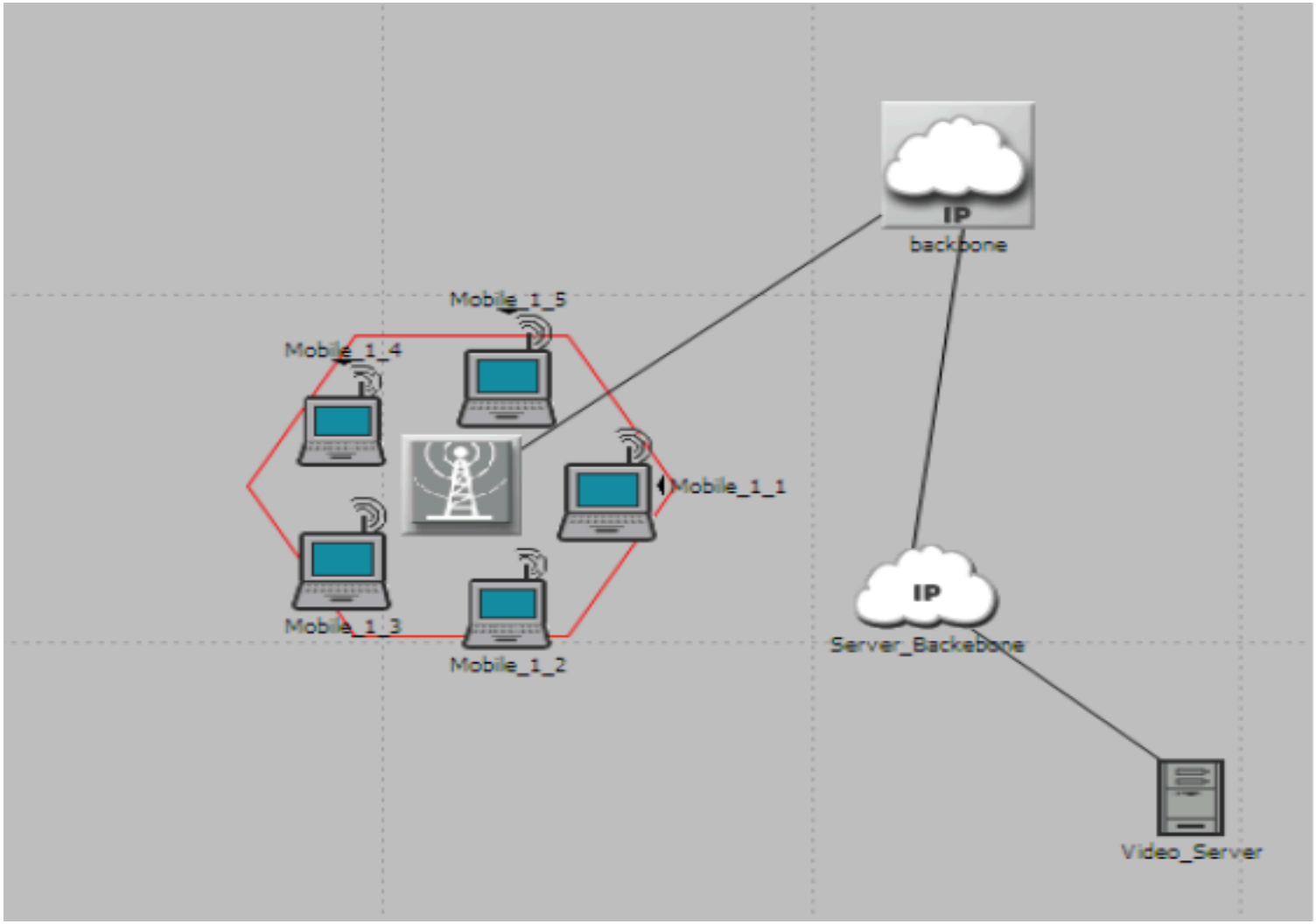

Figure 1. OPNET model of WiMAX network

WiMAX configuration

Uplink/Downlink	16-QAM/64-QAM
Maximum sustained traffic rate	5Mbps
Maximum reserved traffic rate	1Mbps
Maximum latency	30.0 milliseconds
Base station transmit power	3.8 W
Client station transmit power	2 W
Base station gain antenna	15 dBi
Client station gain antenna	14 dBi

Table 2. WiMAX configuration parameters

Configuration

Attribute	Value
Incoming Stream Inter-arrival Rate (seconds)	Constant (0.033)
Outgoing Stream Inter-arrival Rate (seconds)	None
Incoming Stream Frame Size (bytes)	Scripted (SVC)
Outgoing Stream Frame Size (bytes)	Scripted (SVC)

Table 3. Application configuration of video traffic

- The operation mode for the profile in OPNET modeler was configured to be simultaneous, with a starting time of 70 seconds
- Simulation time:74 minutes

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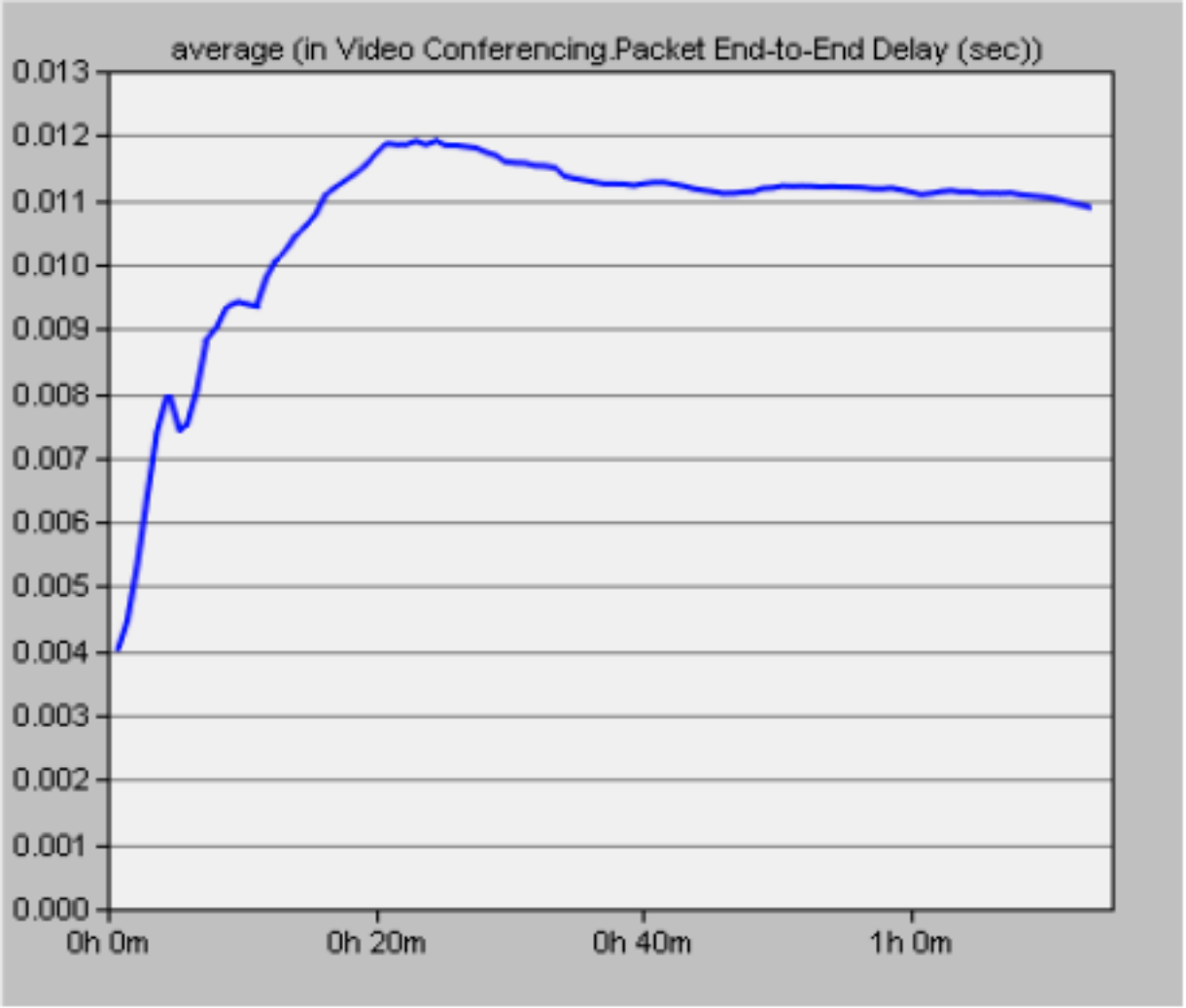

Figure 2. Average End-to-End packet delay

- Average:200ms
- Achieved:11ms

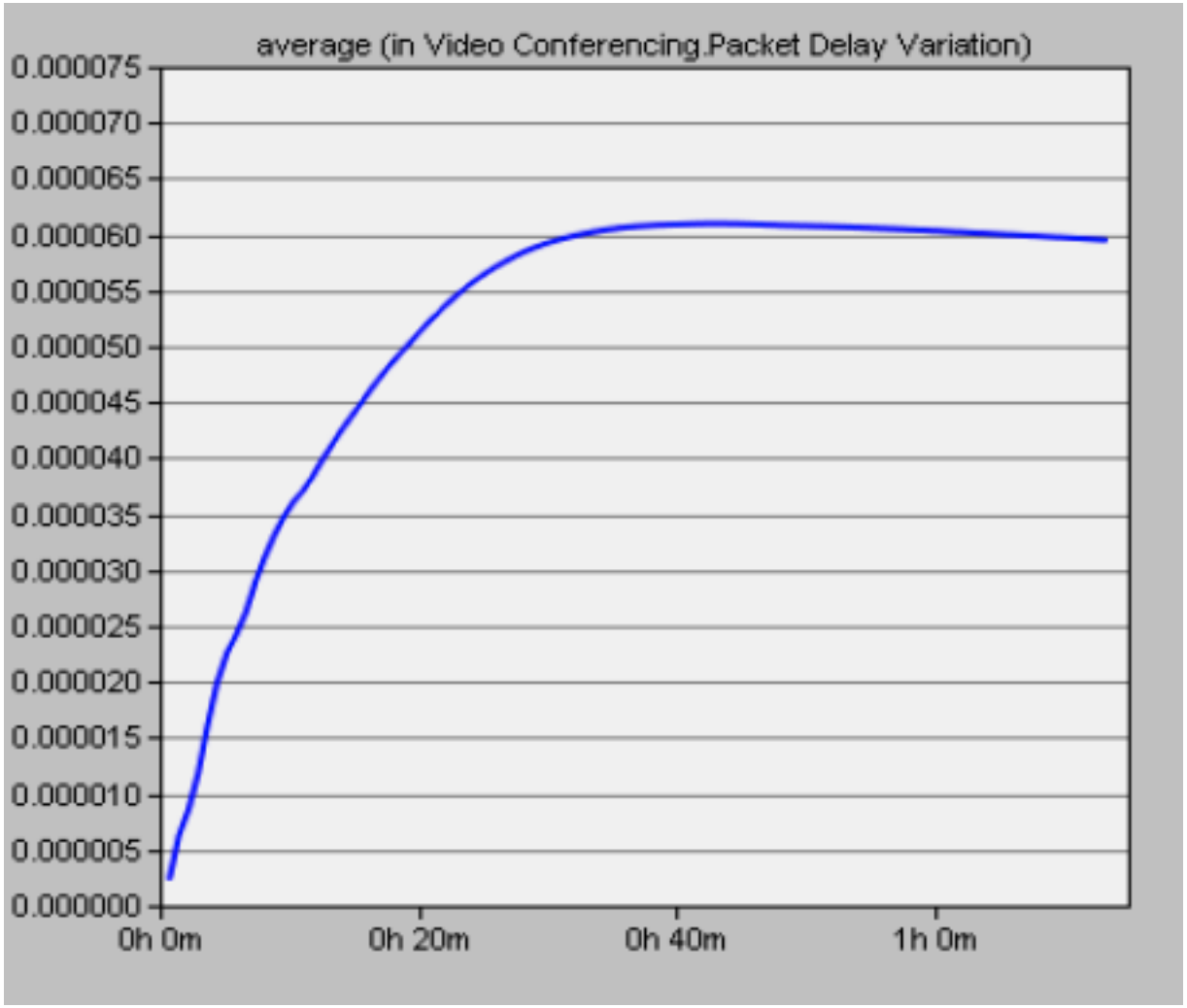

Figure 3. Jitter delay

- Ideal jitter value:10ms
- Achieved jitter value:60 microseconds

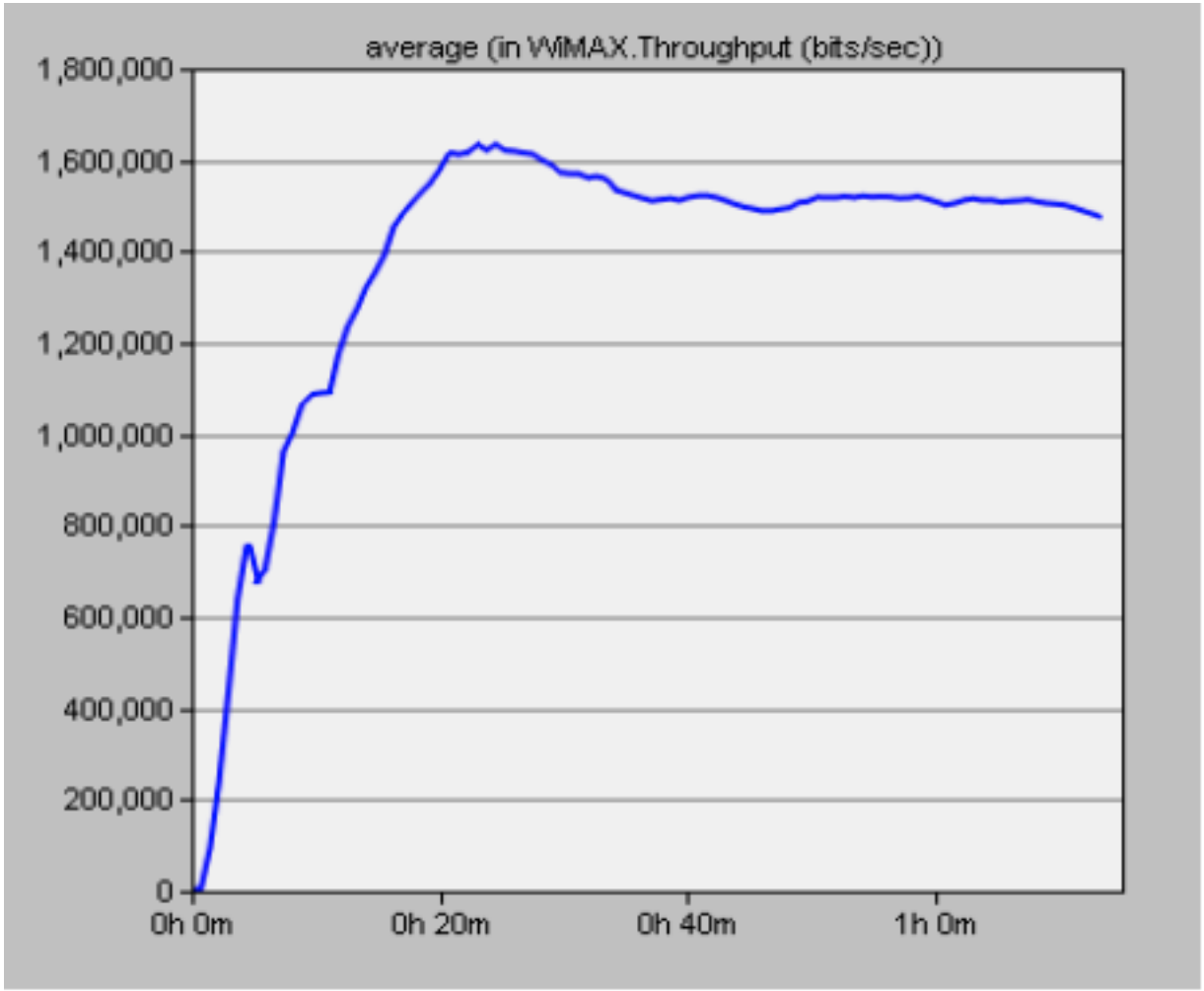

Figure 4. Average throughput

- Throughput range required:10 kbps−5 Mbps
- Throughput achieved:1.5 Mbps (as expected)

Modulation	Coding	Information Bits/symbol/Hz	Required SNR (dB)
QPSK	½	1	9.4
	¾	1.5	11.2
16-QAM	½	2	16.4
	¾	3	18.2
64-QAM	⅔	4	22.7
	¾	4.5	24.4

Table 4. Modulation/Coding rates [1]

- The SS exhibits a downlink SNR that is below the necessary minimum level of 64-QAM with ¾ coding
- Low SNR for the SS is a major contributor to the high packet loss rate

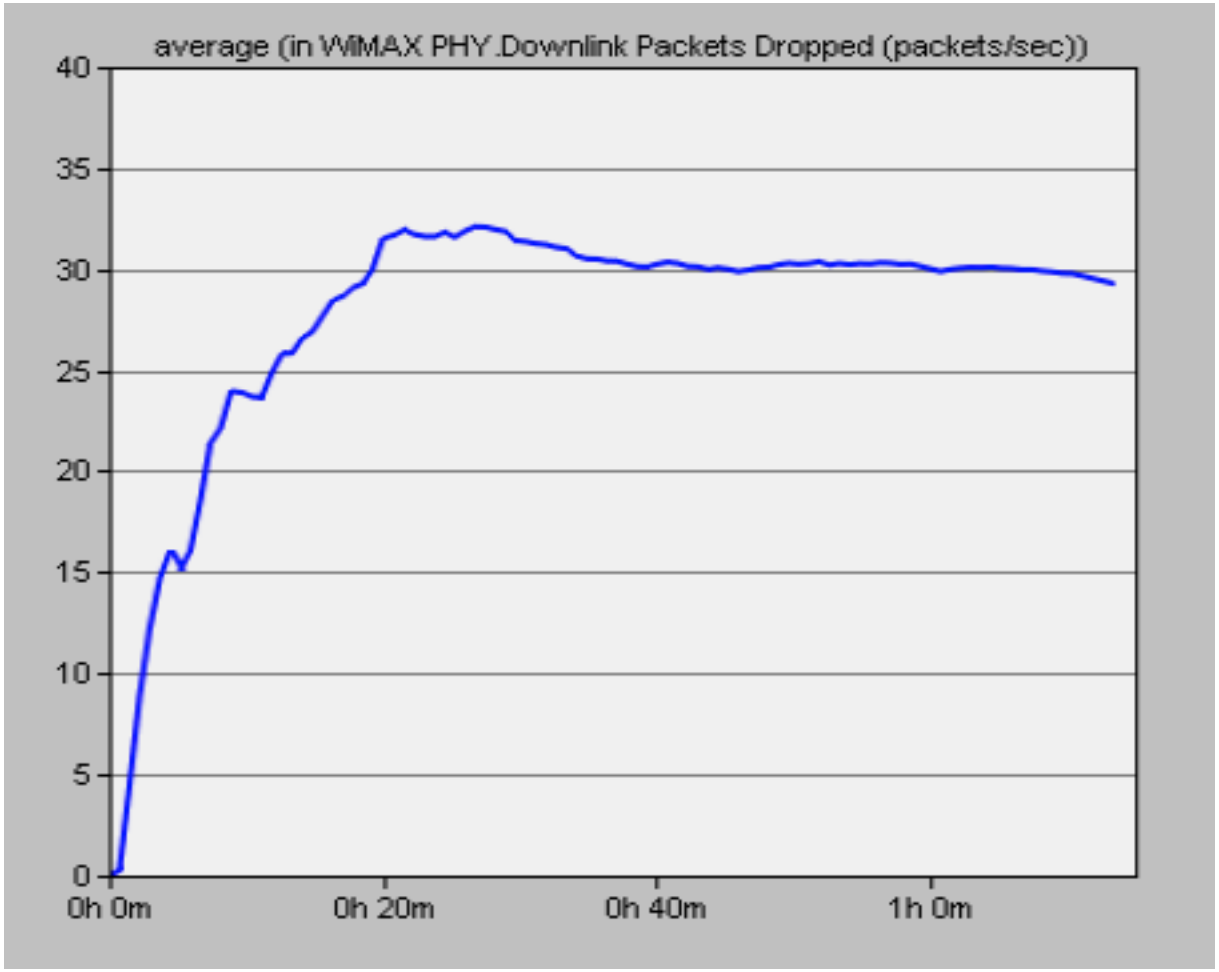

Figure 5. Dropped packet rates by PHY layer for WiMAX SS

- Higher loss rate achieved

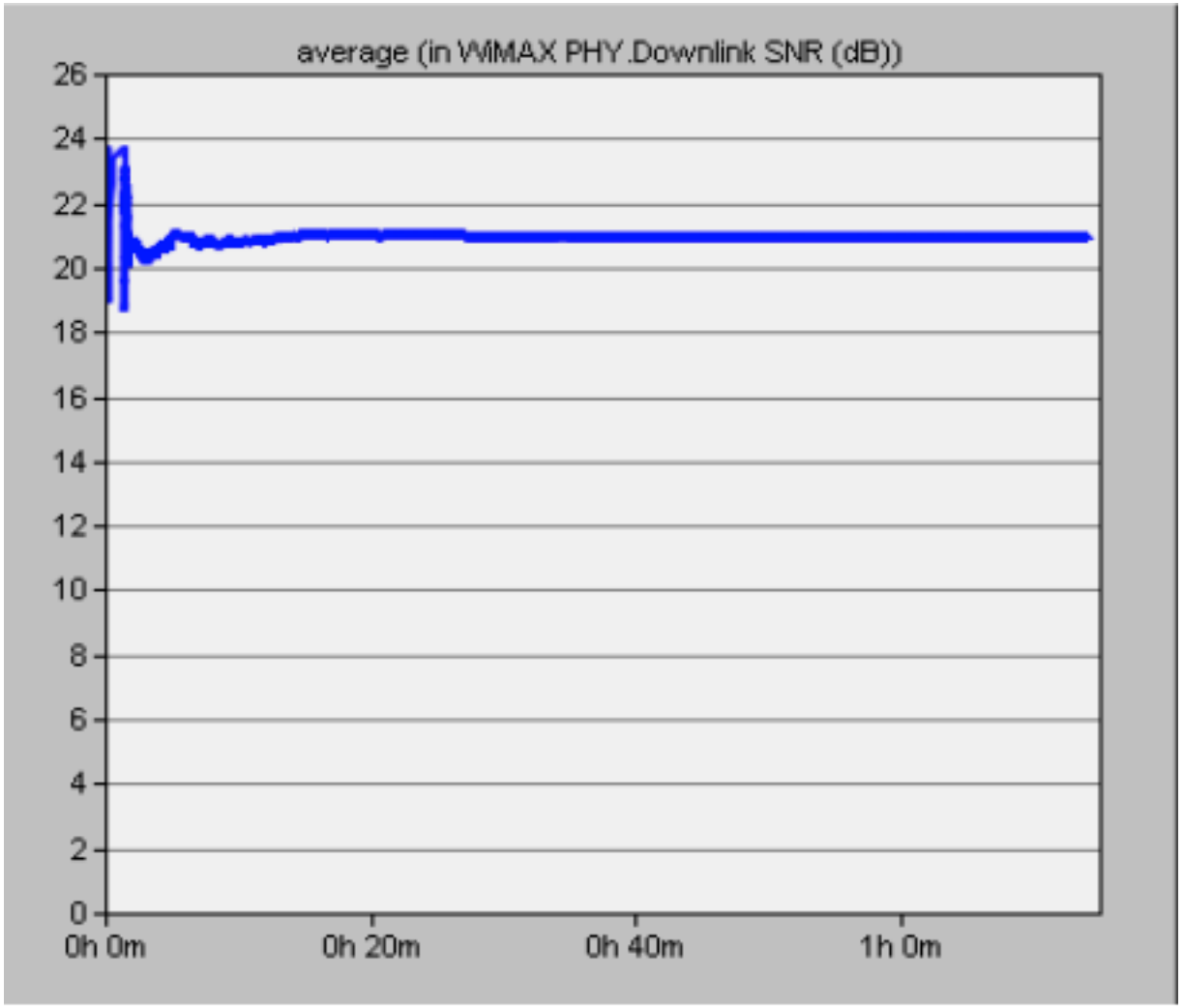

Figure 6. Downlink Signal Noise Ratio (SNR) for SS

- Mean Opinion Score (MOS) is dependent on calculating Peak Signal Noise Ratio(PSNR).
- PSNR for SVC code is about 47.89, which means it has an excellent MOS

Parameters	**SVC**
Throughput	1.25 Mbps
End-to-End delay	2.7 milliseconds
Jitter delay	5.6 microseconds
PSNR	47.89 dB

Table 4. Performance metrics SVC video codec

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Conclusion

- SVC provides the best quality of video in terms of MOS value, throughput, end-to-end delays and jitters
- SVC is most appropriate video codec scheme for delivering IPTV services over WiMAX network
- SVC video codec offers improved visual quality

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