VoD Service in a Private Cloud Environment: Performance Monitoring and Modeling through Stochastic Petri Nets

Jamilson Ramalho Dantas

jrd@cin.ufpe.br

Orientador: Prof. Paulo Maciel

Introduction and Motivation

- **Cloud computing** platforms provides **storage capacity**, **processing power** and other **computational resources** in a flexible way.

- Current **video streaming** services offer a large variety of multimedia content in **many formats**

Introduction and Motivation

- A Fact
  - Netflix was pointed out as the single largest source of Internet traffic in the United States, consuming 29.7% of peak downstream traffic [1].

- In this context video file format and the streaming is a factor which might affect the quality of service (QoS), due to large network traffic and overloaded servers.

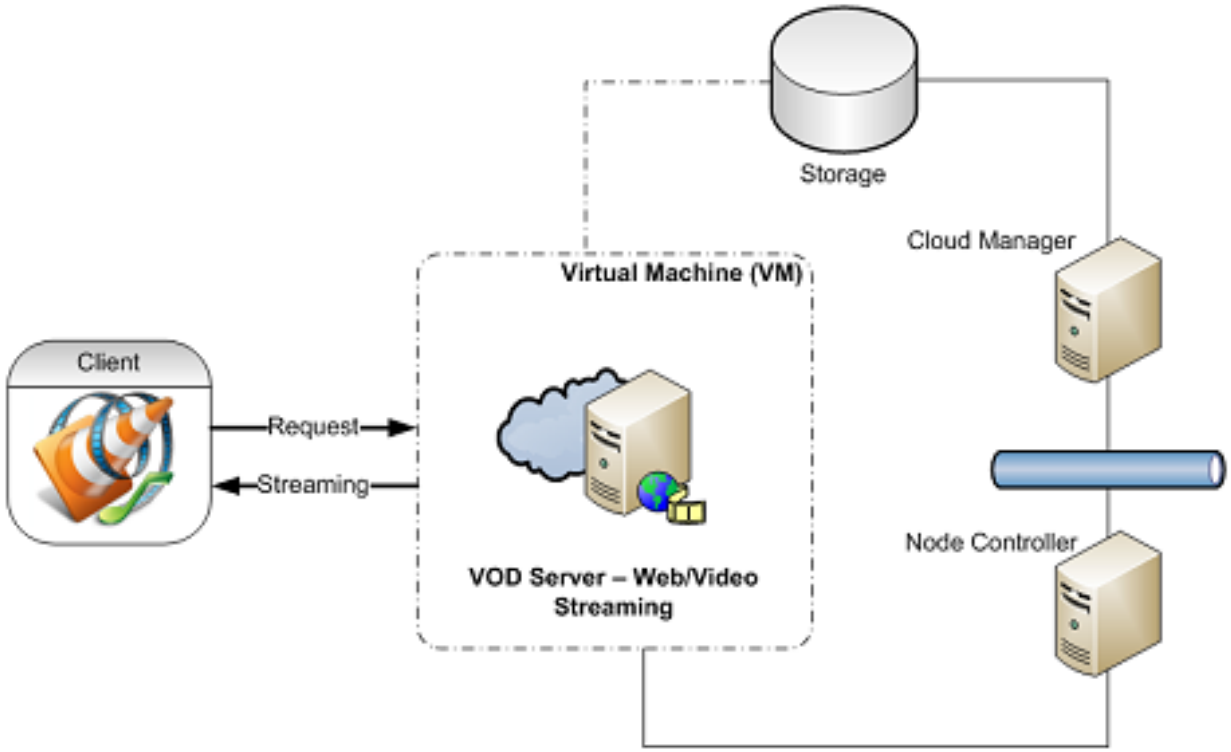
[1] Adhikari, V.K., Guo, Y., Hao, F., Varvello, M., Hilt, V., Steiner, M., Zhang, Z.L.: Unreeling netflix: Understanding and improving multi-cdn movie delivery. In: INFOCOM, 2012 Proceedings IEEE, pp. 1620–1628. IEEE (2012)

Objective

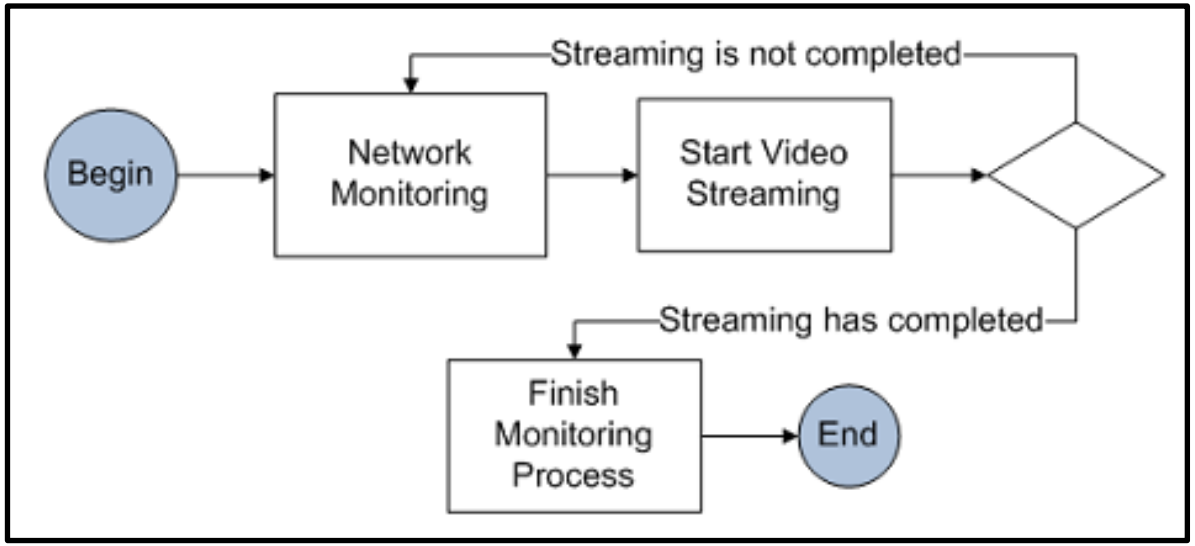
- Investigate the Quality of Service (QoS) perceived by end users that might be affected by network congestion.
  - videos in MPG, MP4, AVI and FLV formats.

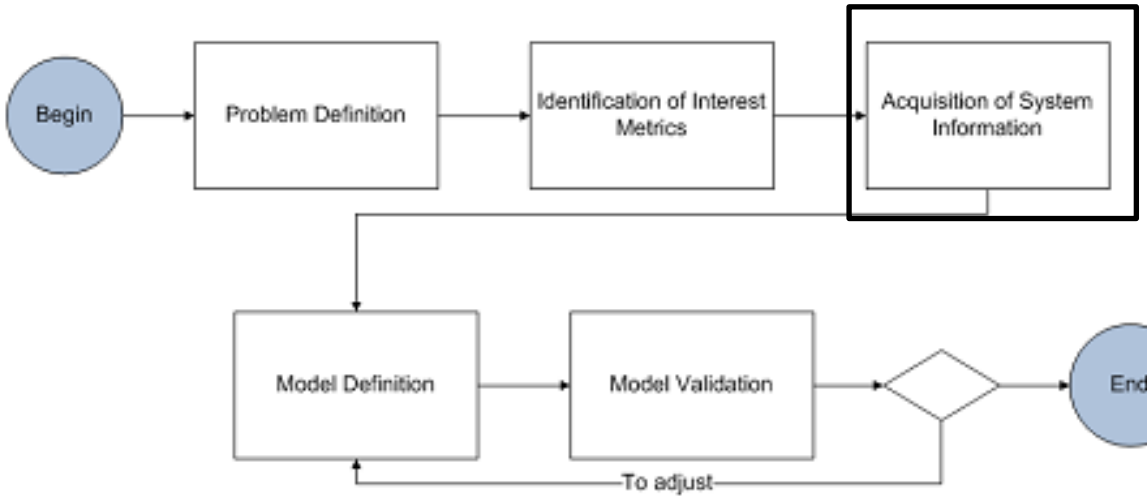
- To Provide
  - a SPN model for quantify the packet loss ratio, packets received by end users and throughput for each kind of video in a cloud-based VOD environment.

System Description and evaluation methodology



System Description and Evaluation Methodology



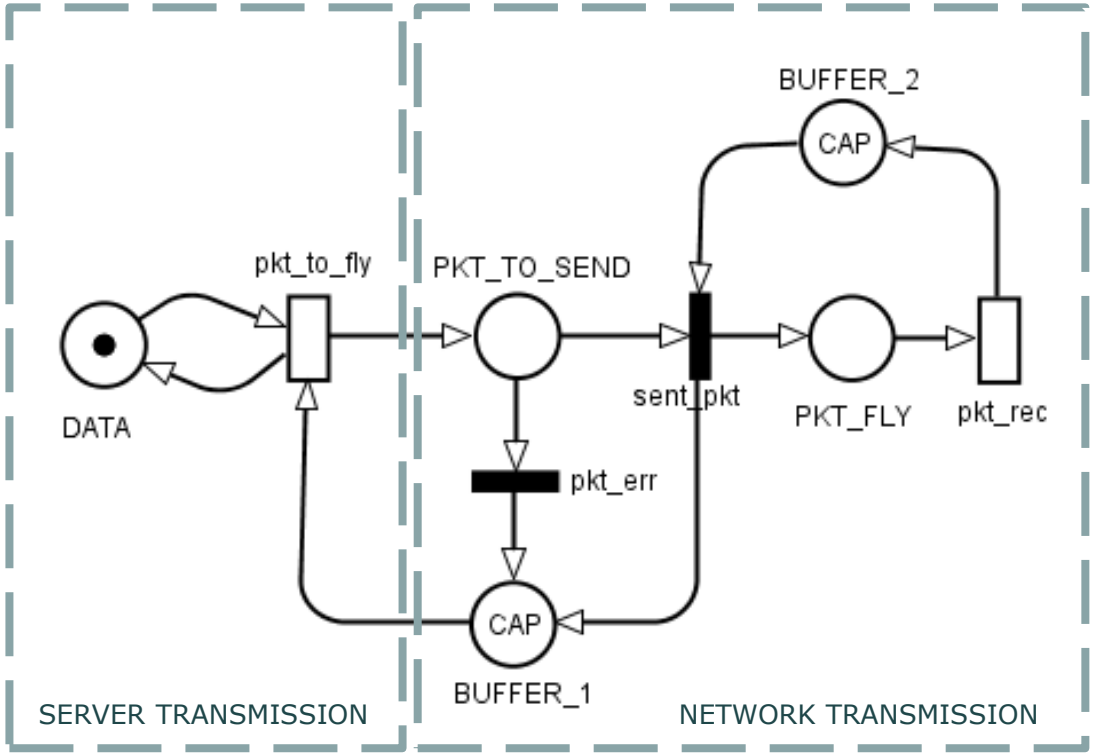


Acquisition of System Information

- Four video types were employed: MP4, MPG, AVI and FLV formats. Each video has a duration of five minutes, and the experiment was executed thirty times for each video.

- Metrics
  - Packets received by client
  - Packets sent by the server
  - Packets lost
  - Throughput

Performance Model



Performance Model

- Information assigned to Immediate Transitions

Transition	Weight		Priority	guard Function
pkt_err	MP4	0.0029	1	—
	MPG	0.0021		—
	AVI	0.0027	1	—
	FLV	0.0007	1	—
sent_pkt	MP4	0.9971	1	—
	MPG	0.9979	1	—
	AVI	0.9973	1	—
	FLV	0.9993	1	—

- Definition Delays for Timed Transitions

Transition	Delay (ms)	
pkt_to_fly	MP4	5.691
	MPG	6.802
	AVI	5.860
	FLV	5.727
pkt_rec	MP4	5.565
	MPG	6.752
	AVI	5.751
	FLV	5.619

Performance Model

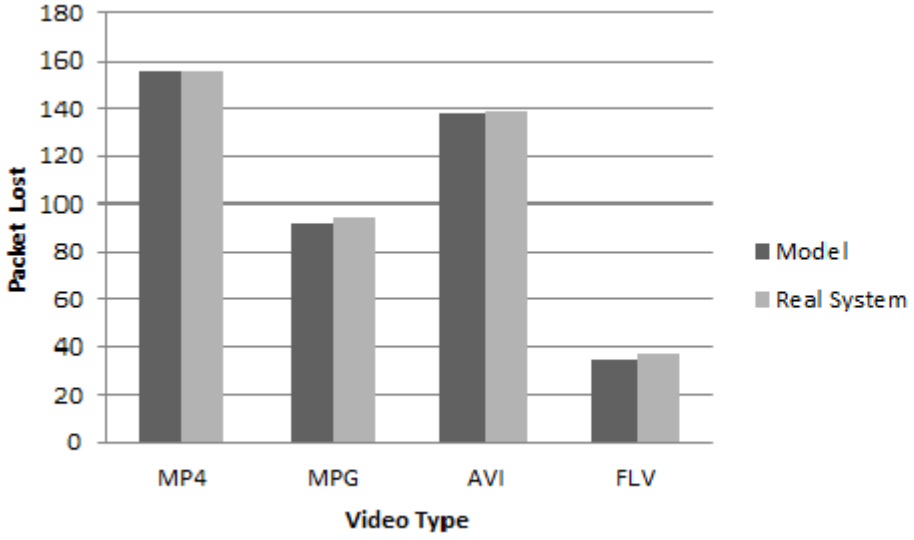
Metrics	Equation
Packets sent (PS)	$TPS * (T_{ns} - T_{is})$
Packets received (PR)	$TPC * (T_{nc} - T_{ic})$
Packets lost (PL)	$PS - PR$
Throughput (TPC)	$E\{\#PKT\_FLY\} * (1/pkt\_rec)$
Throughput (TPS)	$E\{\#DATA\} * (1/pkt\_to\_fly)$

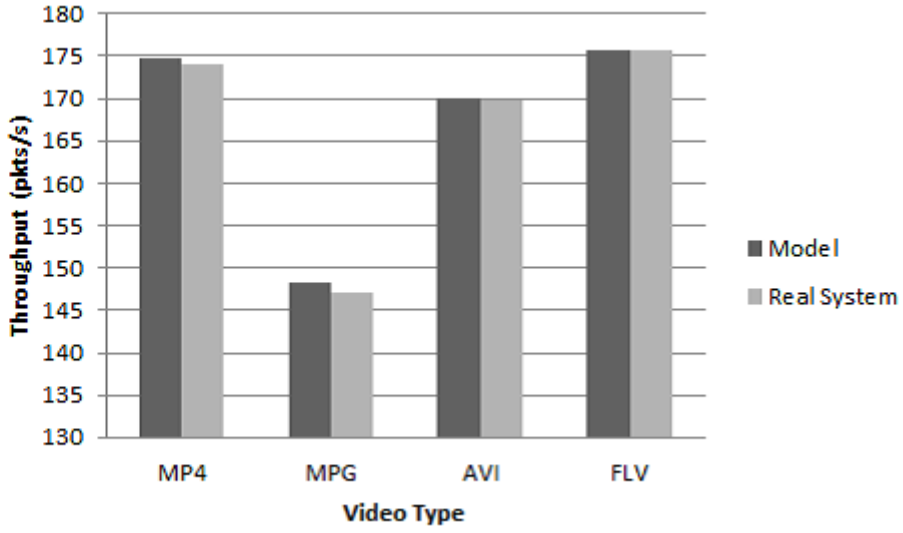
Results

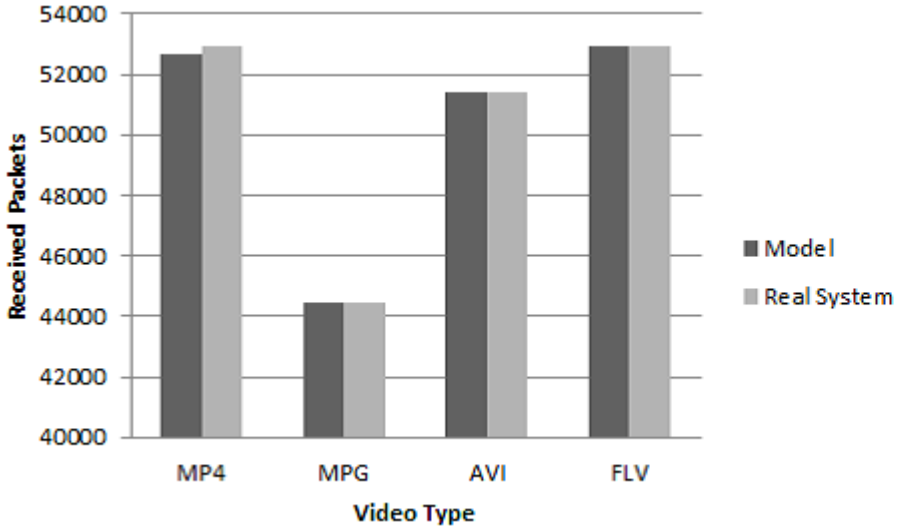
- Performance Model Validation

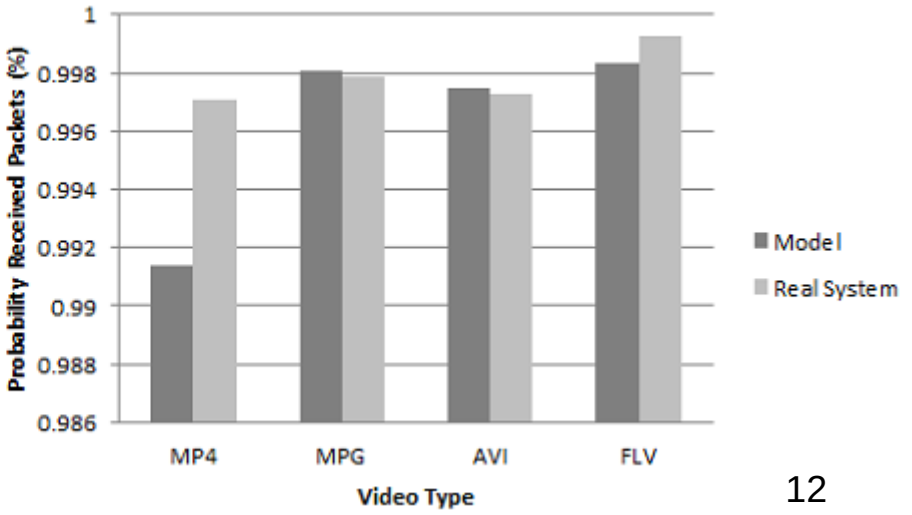
	Video Type	Model (α)	Real System	Interval (bootstrap)
Packet Loss	MP4	155.66	156.27	92.93 $<\alpha<$229.80
	MPG	92.49	94.60	63.63 $<\alpha<$124.27
	AVI	138.20	139.27	105.13 $<\alpha<$174.10
	FLV	35.32	37.70	17.67 $<\alpha<$63.40
Packets Received	MP4	52635.76	52938.73	52613.67 $<\alpha<$53000.83
	MPG	44461.10	44452.40	44420.33 $<\alpha<$44481.67
	AVI	51437.29	51427.73	51392.70 $<\alpha<$51461.60
	FLV	52894.98	52946.30	52818.53 $<\alpha<$52966.07
Throughput	MP4	174.78	174.04	173.94 $<\alpha<$174.90
	MPG	148.23	147.81	147.44 $<\alpha<$148.30
	AVI	169.93	169.86	169.85 $<\alpha<$170.09
	FLV	175.99	175.70	175.68 $<\alpha<$176.31

Results

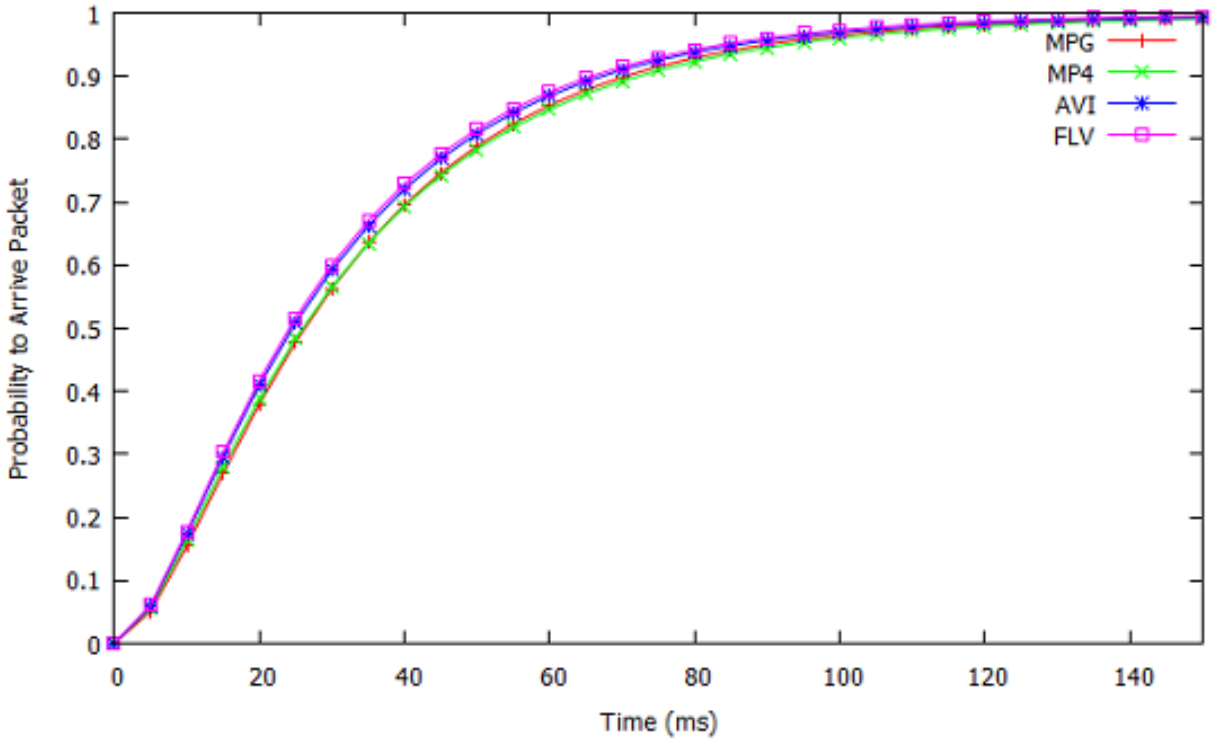

180
160
140
120
100
80
60
40
20
0
Packet Lost
MP4
MPG
AVI
FLV
Video Type
Model
Real System


180
175
170
165
160
155
150
145
140
135
130
Throughput (pkts/s)
MP4
MPG
AVI
FLV
Video Type
Model
Real System


54000
52000
50000
48000
46000
44000
42000
40000
Received Packets
MP4
MPG
AVI
FLV
Video Type
Model
Real System


1
0.998
0.996
0.994
0.992
0.99
0.988
0.986
Probability Received Packets (%)
MP4
MPG
AVI
FLV
Video Type
Model
Real System

Results


Probability to Arrive Packet
Time (ms)
MPG
MP4
AVI
FLV
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
20
40
60
80
100
120
140

Conclusion and Future Works

- Performance model validation to evaluate some metrics of a video streaming service over UDP protocol in a cloud computing environment.

- As a future work, we intend to analyze other scenarios.

Thanks!

Jamilson Dantas

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