Project D – Performance Evaluation and Applications

Performance of the LAN in a cloud datacenter

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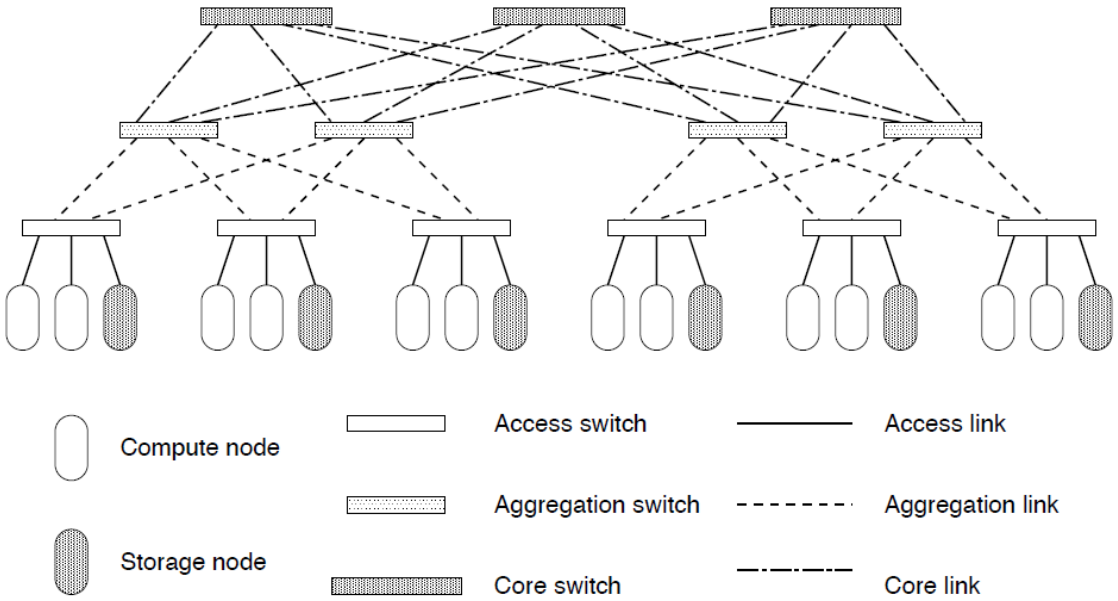
Specifications

Layers

A three layer cloud architecture is composed by three layers of switches:

- Access – *112 MB/s*
- Aggregation – *280 MB/s*
- Core – *1.12 GB/s*

Services can be considered exponentially distributed. Data can be routed among different parallel redundant paths.



Routing policy

Consider two nodes per layer, and four type of traffic:

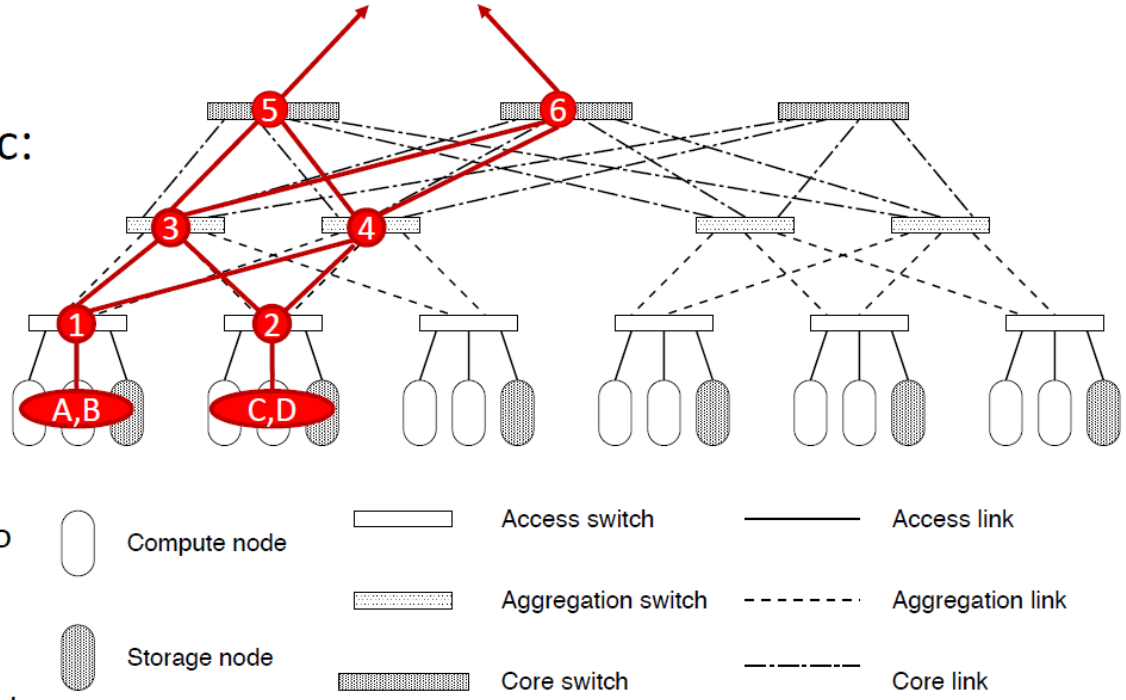
A: 1 -> 3 -> 5

B: 1 -> 4 -> 5

C: 2 -> 4 -> 6

D: 2 -> 3 -> 6

Data traces in files `TraceD-D.txt` to `TraceD-D.txt` shows *the time instant* when a 1MB block of data is received for each of the traffic types, expressed in milliseconds from the start of the logging.



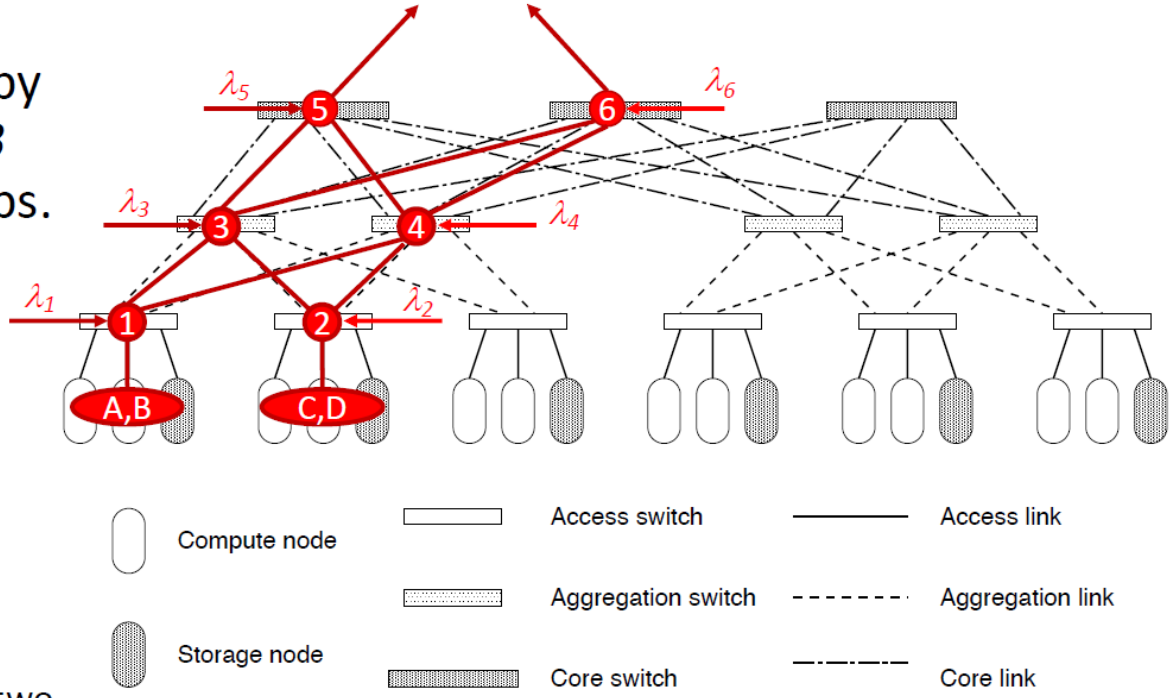
Background Traffic

Nodes are characterized by a finite capacity of ***16 MB*** (at all the levels) and drops.

Nodes are also characterized by background traffic, λ_1 to λ_6:

- $\lambda_1 = \lambda_2 =$ *40 MB/s*
- $\lambda_1 = \lambda_2 =$ *180 MB/s*
- $\lambda_1 = \lambda_2 =$ *600 MB/s*

Background traffic is routed to the two upstream nodes with equal probability. It can be considered a Poisson process.



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Problem

Problem

The system is experiencing **too many losses**: the manager would like to add an **extra link**, with the same characteristics as the existing nodes.

- Which type of link (access, aggregation or core) should be added? How traffic of the four classes should be re-routed to take advantage of the new node?

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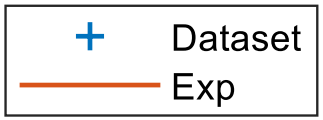
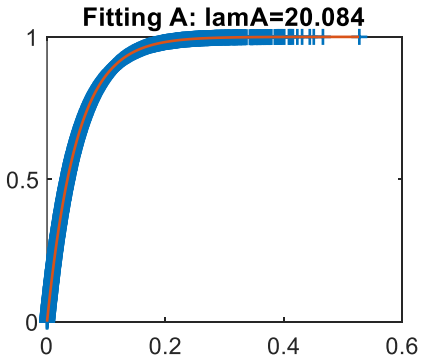
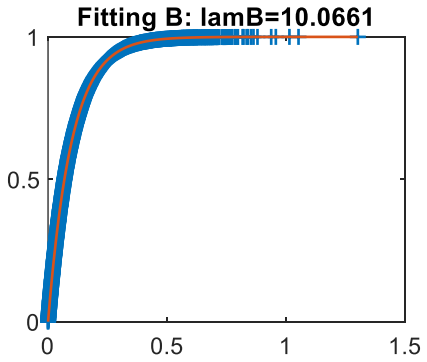
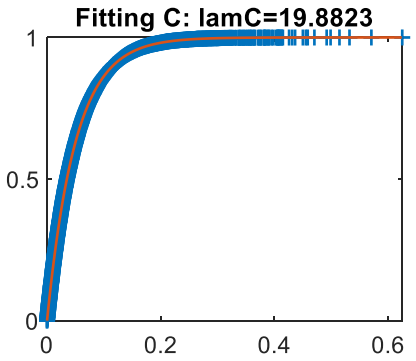
Performances evaluation to identify the cause of the problem

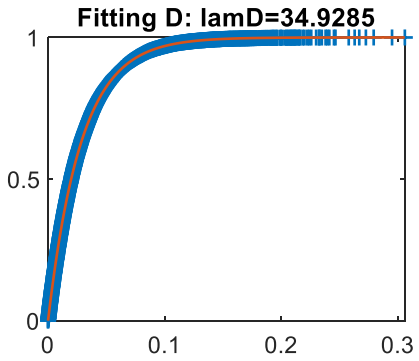
Matlab results of the fitting







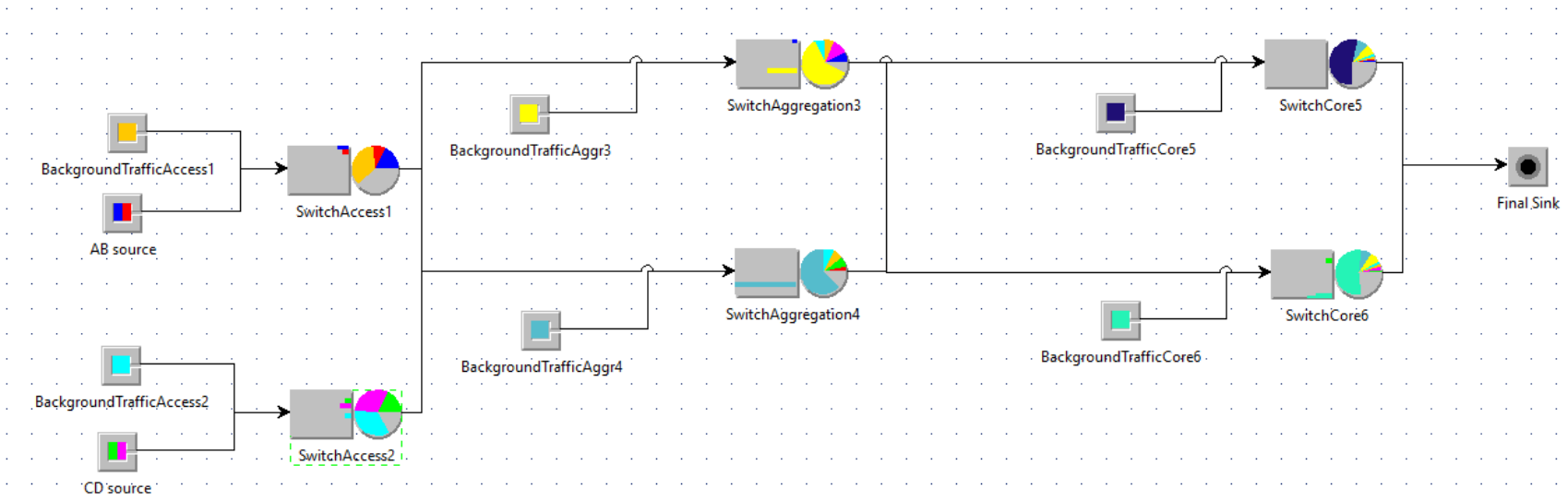




Model in JSIM: Classes

	packetA	Open	0		exp(20.084)	Edit	AB source
	packetB	Open	0		exp(10.066)	Edit	AB source
	packetC	Open	0		exp(19.882)	Edit	CD source
	packetD	Open	0		exp(34.929)	Edit	CD source
	packetBgndTraffAccess1	Open	0		exp(40)	Edit	BackgroundTrafficAccess1
	packetBgndTraffAccess2	Open	0		exp(40)	Edit	BackgroundTrafficAccess2
	packetBgndTraffAggreg3	Open	0		exp(180)	Edit	BackgroundTrafficAggr3
	packetBgndTraffAggreg4	Open	0		exp(180)	Edit	BackgroundTrafficAggr4
	packetBgndTraffCore5	Open	0		exp(600)	Edit	BackgroundTrafficCore5
	packetBgndTraffCore6	Open	0		exp(600)	Edit	BackgroundTrafficCore6

Model in JSIM: Model



JSIM Simulation Results

DROP RATE

Station name	Average Value (pkt/sec)
SwitchAccess1	-
SwitchAccess2	1.0830
SwitchAggregation3	13.5803
SwitchAggregation4	4.9248
SwitchCore5	2.1572
SwitchCore6	3.0894
System	24.7657

Conf.Int/Max Rel.Err: 0.99 / 0.03

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Hypotesis

What's the problem?

The station with the biggest drop rate is the 3rd (SwitchAggregation3), mostly caused by the packet D.

The best way to solve the problem could be to **re-route all the packets** (A-B-C-D) on the aggregation layer **using a new switch**.

In this way SwitchAggregation3 and SwitchAggregation4 will take only the background Traffic and the drop rate will decrease significantly.

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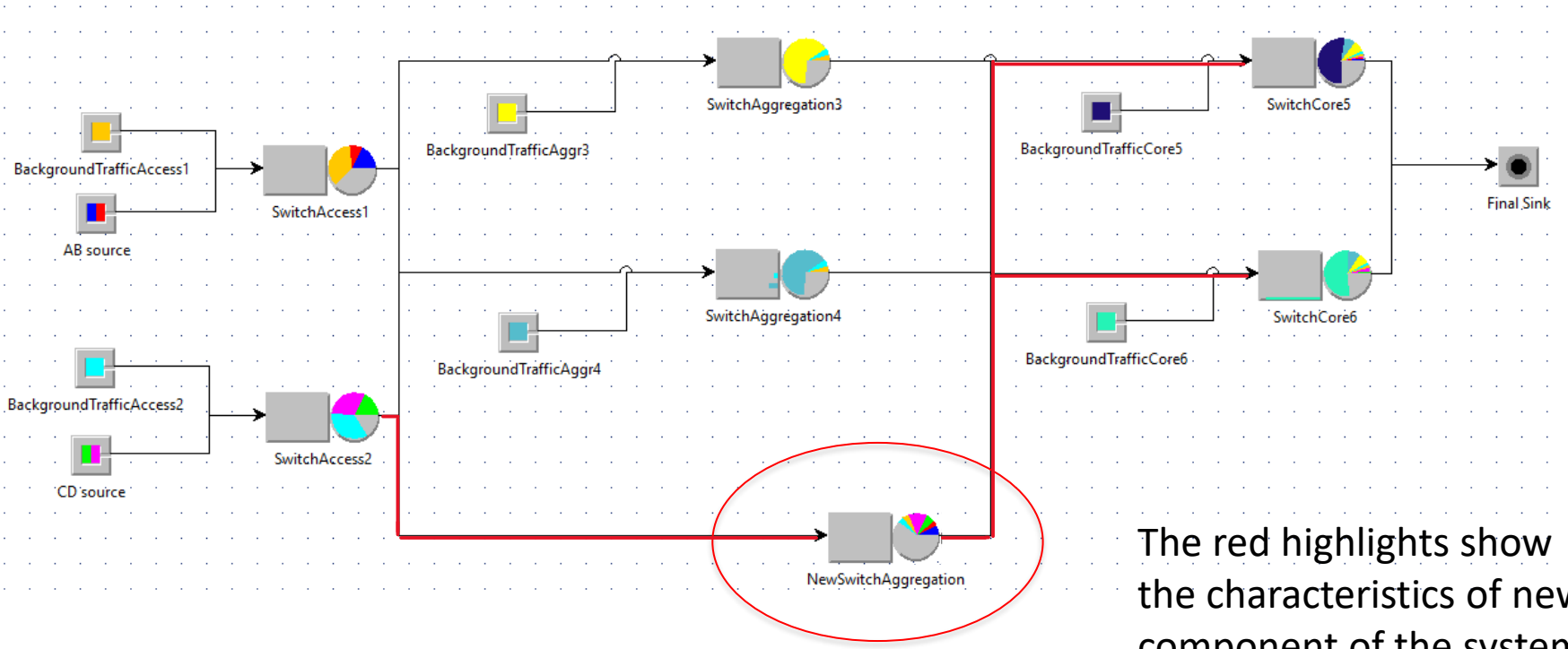
Performance evaluation after the transformation process

New model in JSIM



The red highlights show the characteristics of new component of the system

New results

DROP RATE

Station name	Average Value (pkt/sec)
SwitchAccess1	-
SwitchAccess2	1.0656
SwitchAggregation3	-
SwitchAggregation4	-
SwitchCore5	2.7815
SwitchCore6	3.2428
NewSwitchAggregation	-
System	7.92

Conf.Int/Max Rel.Err: 0.99 / 0.03

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Did I reach the goal?

Comparing the results

DROP RATE

Station name	Average Value OLD (pkt/sec)	Average Value NEW (pkt/sec)	
SwitchAccess1	-	-	Same
SwitchAccess2	1.0830	1.0656	- 0.016 %
SwitchAggregation3	13.5803	-	-100%
SwitchAggregation4	4.9248	-	-100%
SwitchCore5	2.1572	2.7815	+28.9%
SwitchCore6	3.0894	3.2428	+ 5.20%
NewSwitchAggregation	Not exists	-	
System	24.7657	7.92	-68%

Good result!

Conf.Int/Max Rel.Err: 0.99 / 0.03

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Conclusion and comments

Conclusion

New station utilization is low (**40%**) and it can manage an higher traffic of packets than before.

The effect of decreasing the drop rate on the aggregation layer is that the drop rate in the core layer increased as shown in result comparing slide.

There is another way to reach a good result: routing only packet D to the new node. The drop rate obtained with this method is 12, instead of 7.92. I want to propose this other way beacuse of less hardware and software addings overall the layers involved and there is a less impact related to core layer.