Computer System Modeling and Semantic Web

Final Assignment Report

Professor: Mauro Iacono

Prepared by: Kian Mesgouchi

Matricola: B34000116

Assignment Description:

A newsletter dispatching system receives two kinds of streams:

- a quick news information stream (on the average, D_{News} news per hour).
- a detailed article stream (on the average, $D_{Article}$ articles per hours).

Each stream is processed by a text and image processing system, where quick news requires an average of D_{News}, while articles need an average of $D_{Article}$. Feeds are then sent to three social media, namely Facebook, Twitter, and Instagram, each one using a sending queue that works in FCFS. Each feed might be sent to one or more of the considered media. Each social network receives the following percentage of feeds, and requires a different average time for being processed:

Social media	news %	news time	article %	article time
Facebook	50%	8 s.	80%	10 s.
Twitter	80%	6 s.	10%	12 s.
Instagram	75%	8 s.	60%	9 s.

All service time distributions can be considered exponential, and arrivals are Poisson processes. Note that social media can be modeled by infinite server stations, since those services are generally spread over an extremely large number of servers (which is unknown to the users). The administrator would like to study the average time required to publish an article over all its media. Parameters given:

λ_{News}	$\lambda_{Article}$	D'_{News}	$D'_{Article}$
1 job/S	0,1 job/S	500 mS	2 S

REPORT

To start with two types of classes have been defined for the simulation as in the description provided, the model is a multi-Class type with the two following classes defining their lambda for their exponential inter arrival time distribution:

Color	Name	Type	Priority	Population	Interarrival Time Distribution		Soft Deadline	Reference Station	
	News	Open	0		exp(1)	Edit	0.0000	Source News	
	Article	Open	0		exp(0.1)	Edit	0.0000	Source Article	

Furthermore, two Sources are provided in the schema for each of the classes which are assumed to be the model's input node.

Given that each stream is processed by a text and image processing system a Queue node has been inserted as a system to process the mentioned services given their average service time distribution with a FCFS (First Come First Serve) Queueing Policy:

Class	Strategy	Service Time Distribution	
News	Load Independent	exp(2)	Edit
Article	Load Independent	exp(0.5)	Edit

Moreover, since each of the defined Social Medias should get all the processed data, a Fork node is placed to divide all the processed data into three routers with Branch Probabilities as the Fork Strategy. Then all the probabilities are assumed to be 1 as all the Social Medias get a percentage of the processed data. Jobs entering the Fork node are getting queued with a FCFS policy.

Advanced Fork Strategies

Class	Fork Strategy
News	Branch Probabilities
Article	Branch Probabilities

Branch Probabilities

Destination	Probability
Router Facebook	1.0
Router Twitter	1.0
Router Instagram	1.0

The whole processed data queued in the Queue node is sent to each router apart from other routers because of the cumulative percentages being higher than 100%.

After, each router will pass the provided percentage of data in the given table to the servers of all three Social Medias. The remaining share of data of each router will bypass the following Social Media server toward the Join node which is placed after the delay stations because the remaining jobs cannot be lost, for the Fork node a Join node is considered which all the jobs are joining together. (The jobs entering from Fork must be equal to the ones entering to the Join node). The model is implemented this way to prevent it from facing inconsistencies, errors or misleading simulation results.

Facebook Router:

Routing Options

Destination	Probability
Facebook Media	0.5
Joining the Outputs	0.5

Routing Options

Destination	Probability
Facebook Media	0.8
Joining the Outputs	0.2

Twitter Router:

Routing Options

Destination	Probability
Twitter Media	0.1
Joining the Outputs	0.9

Routing Options

Destination	Probability
Twitter Media	0.8
Joining the Outputs	0.2

Instagram Router:

Routing Options

Destination	Probability
Instagram Media	0.75
Joining the Outputs	0.25

Routing Options

Destination	Probability
Instagram Media	0.6
Joining the Outputs	0.4

* Routing Strategy for all the routers in Probabilistic. *

To complete the simulating model three delay stations are added representing the Facebook, Instagram and Twitter Social Medias servers. As it is mentioned in the model description these delay stations have infinite servers preventing jobs from waiting in queues. Subsequently mean service times are defined for each delay station which has an exponential service time distribution.

Facebook Delay Station:

Class	Strategy	Service Time Distribution	
News	Load Independent	exp(0.125)	Edit
Article	Load Independent	exp(0.1)	Edit

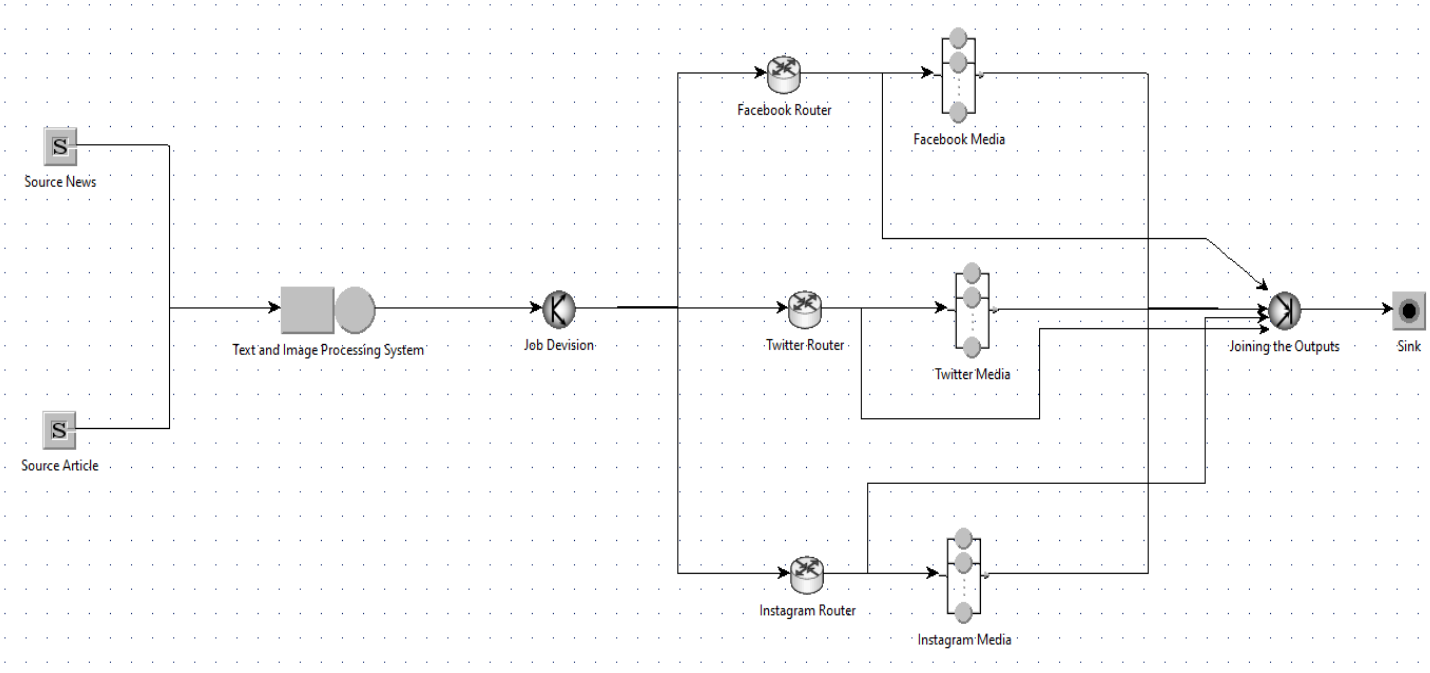
Twitter Delay Station:

Class	Strategy	Service Time Distribution	
News	Load Independent	exp(0.167)	Edit
Article	Load Independent	exp(0.083)	Edit

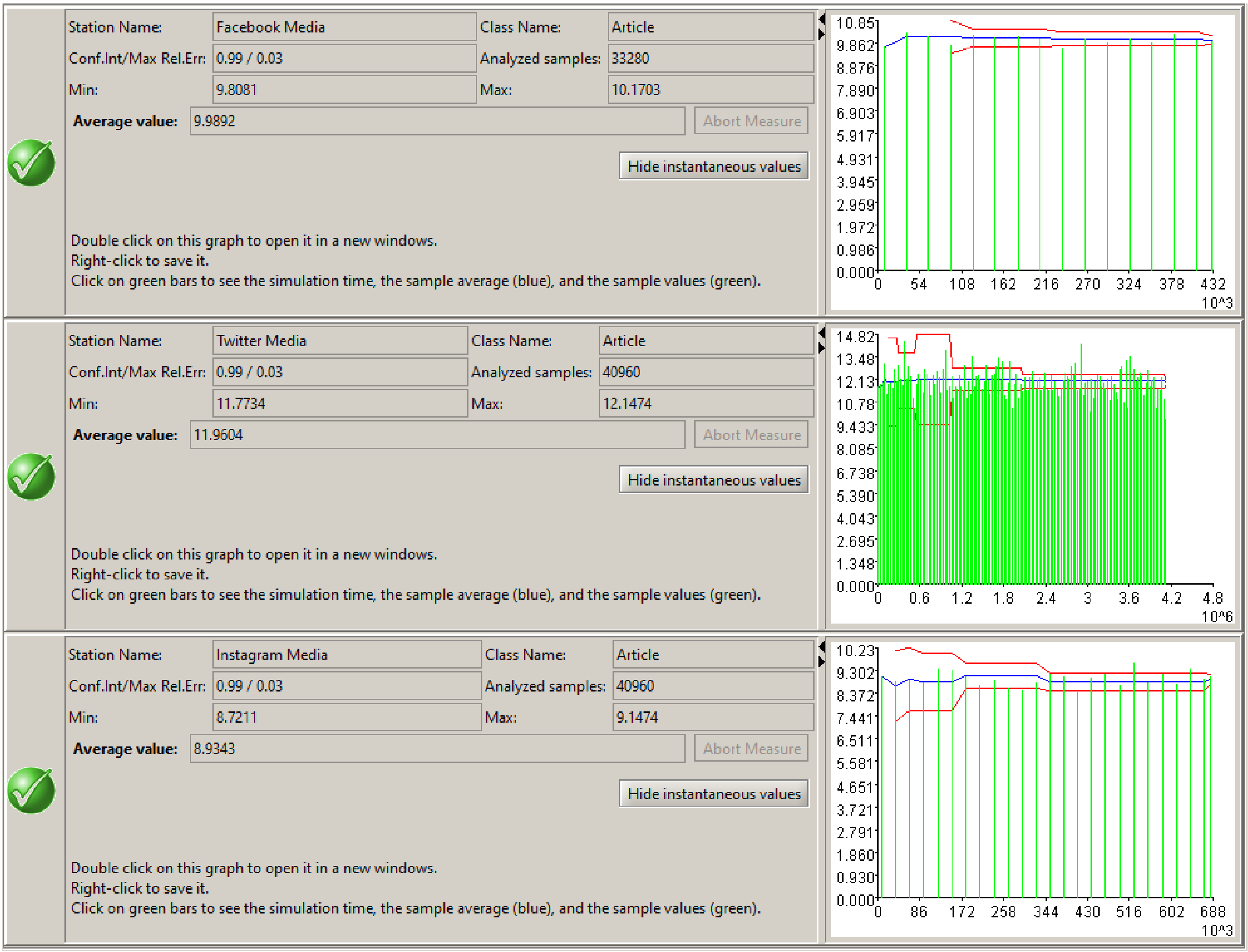
Instagram Delay Station:

Class	Strategy	Service Time Distribution	
News	Load Independent	exp(0.125)	Edit
Article	Load Independent	exp(0.111)	Edit

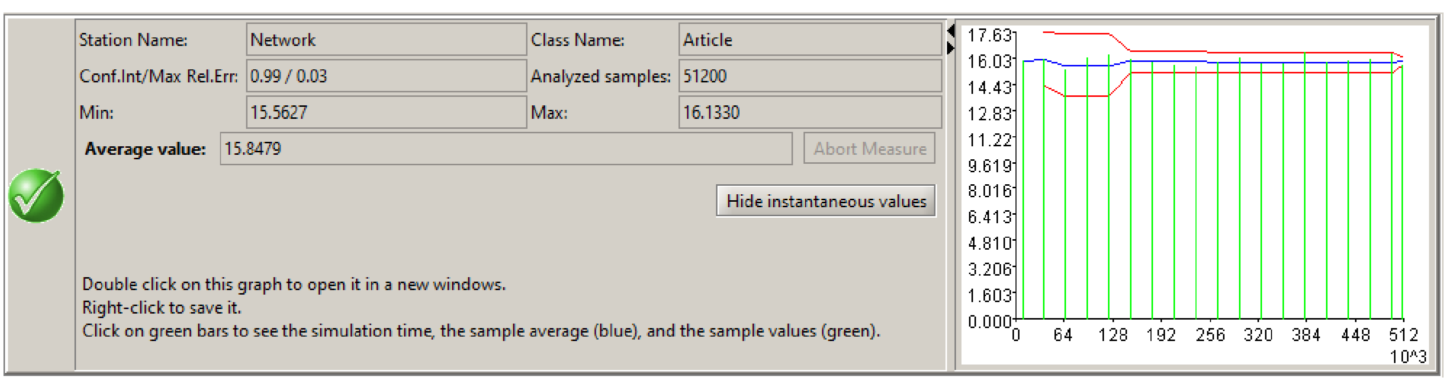
Finally, a Sink node has been considered after the Join node as a destination for the jobs in the system in which jobs exit the system. The schema of the implementation would be:



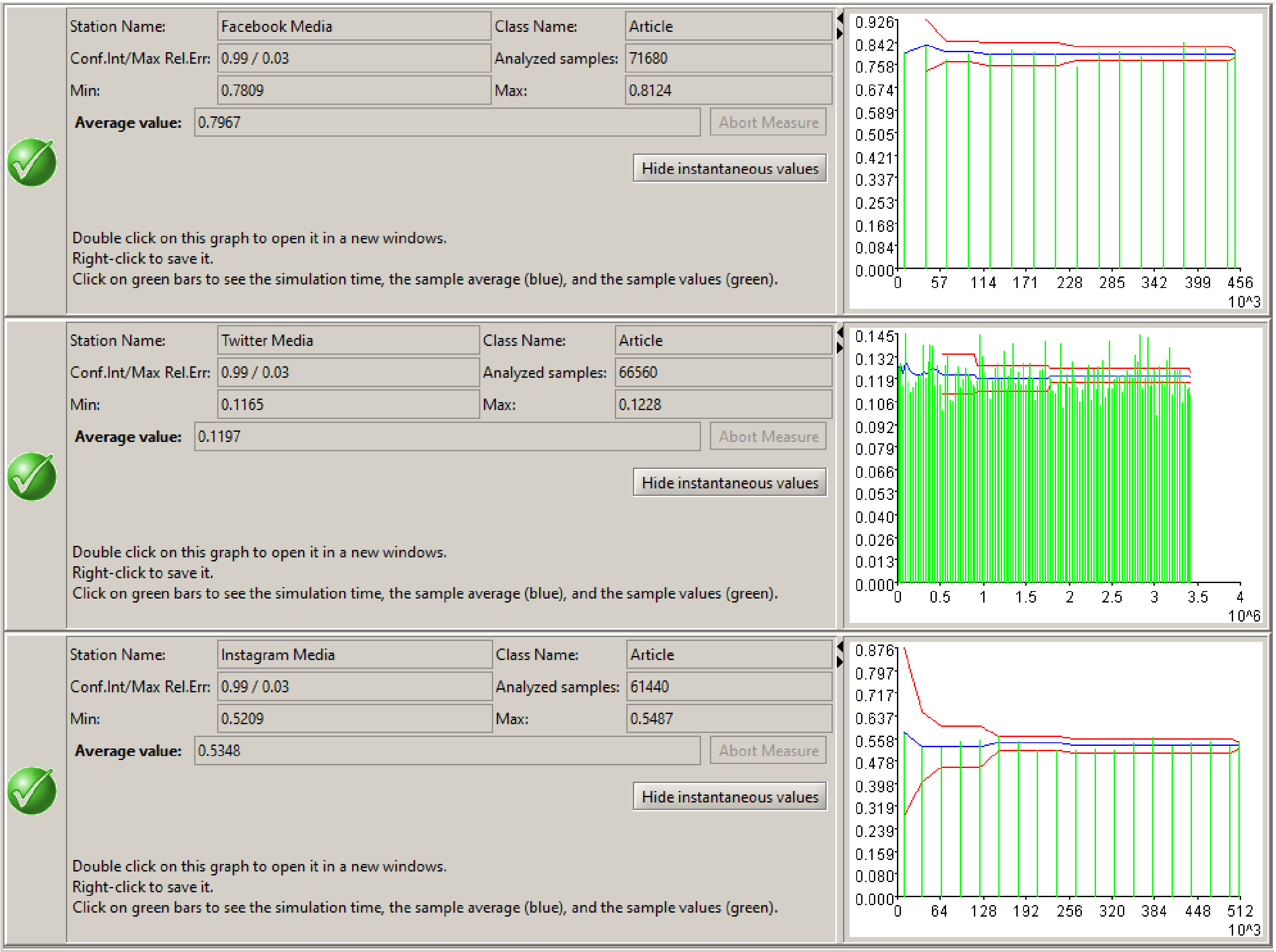
Running the system with the defined parameters in this simulation model the response time of every delay station for the Article class would be:



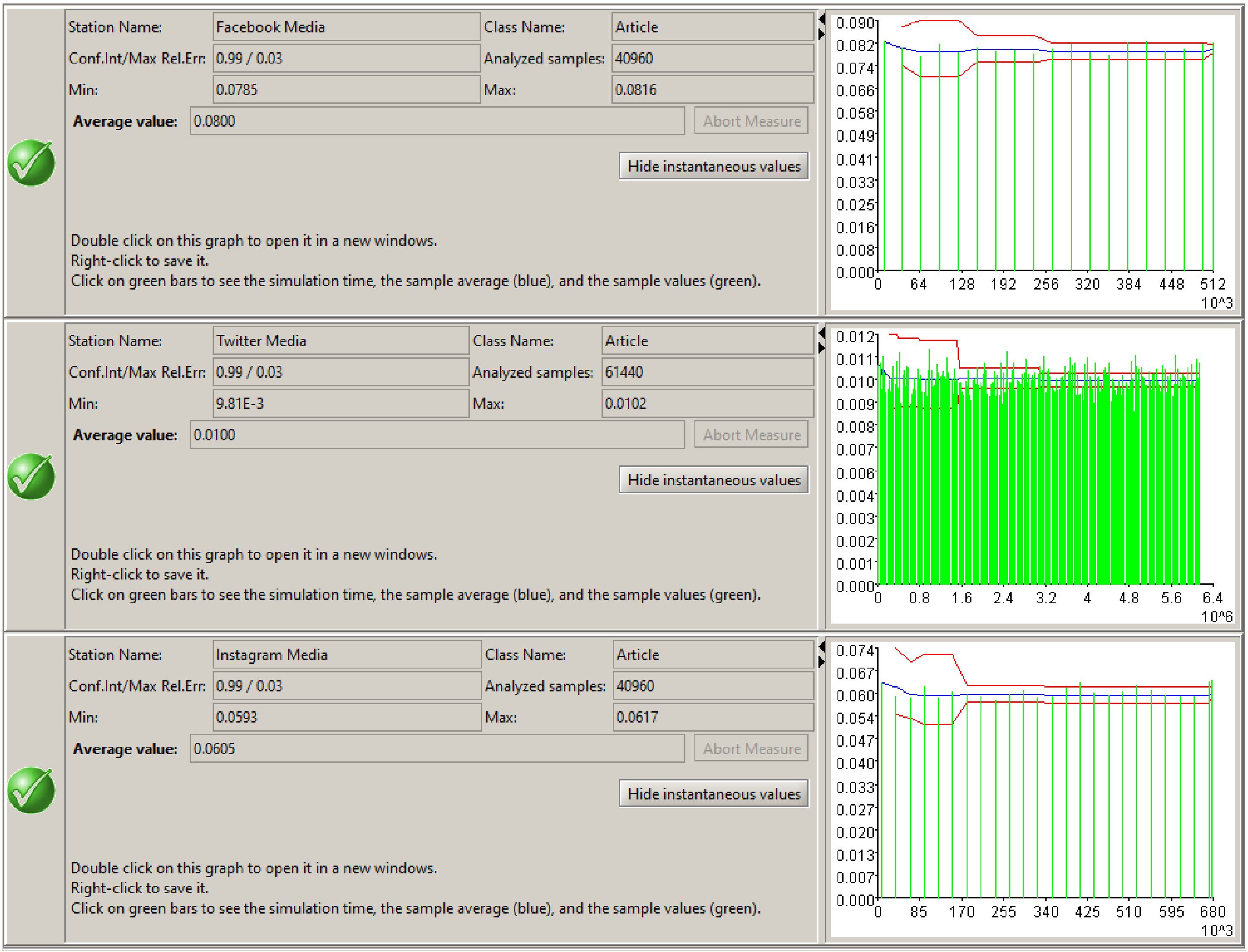
And the response time for Article class in the system would be:



With the same parameters the Utilization of every delay station for Article class would be:



And the Throughput for every delay station would be:



Given the Utilization Law we have:

$$U_{<Article><Facebook>} = X_{<Article><Facebook>} * S_{<Article><Facebook>}$$

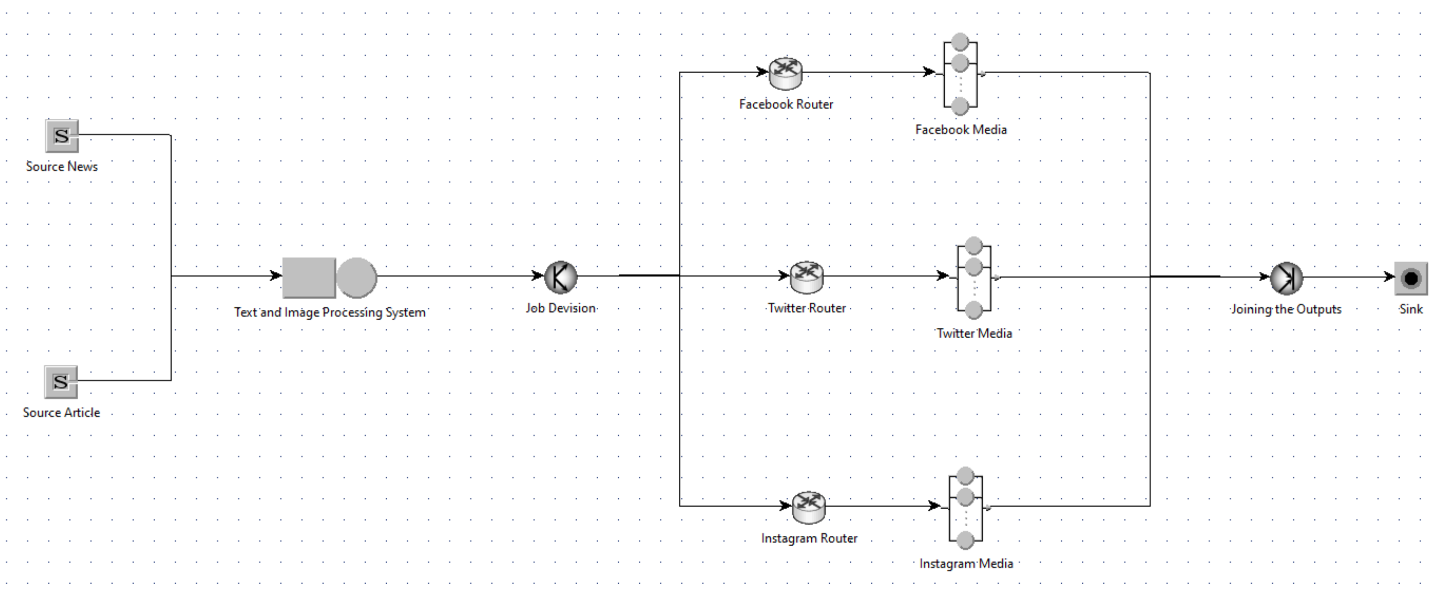
$$S_{<Article><Facebook>} = \frac{U_{<Article><Facebook>}}{X_{<Article><Facebook>}}$$

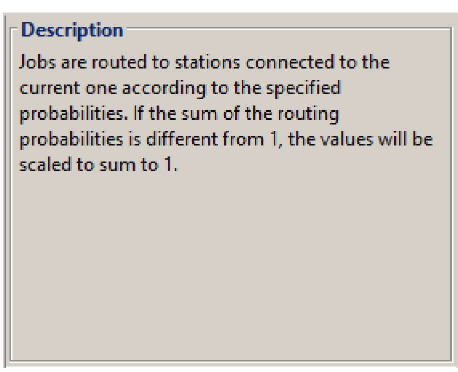
Given the Average Response Time for Facebook delay station:

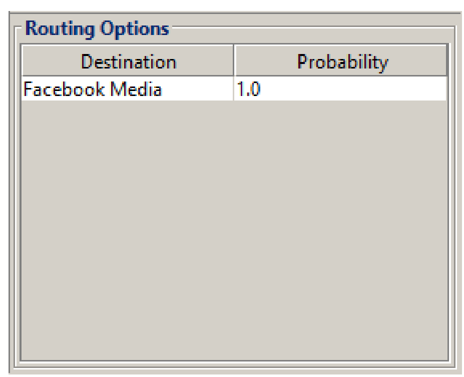
$$R_{<Article><Facebook>} = 9.9892\ sec$$

$$S_{<Article><Facebook>} = \frac{0.7967}{0.08} = 9.95875 \approx 9.9892\ sec$$

Implementing the Model like the following schema causes an issue. Since the cumulative percentages of data which are sent to the other nodes should be equal to one, (or 100 percent) using Probabilistic routing strategy for the social media's routers it is not possible to just send a percentage of the data from routers to the delay stations. (It is even mentioned on the editing window of the Router node)

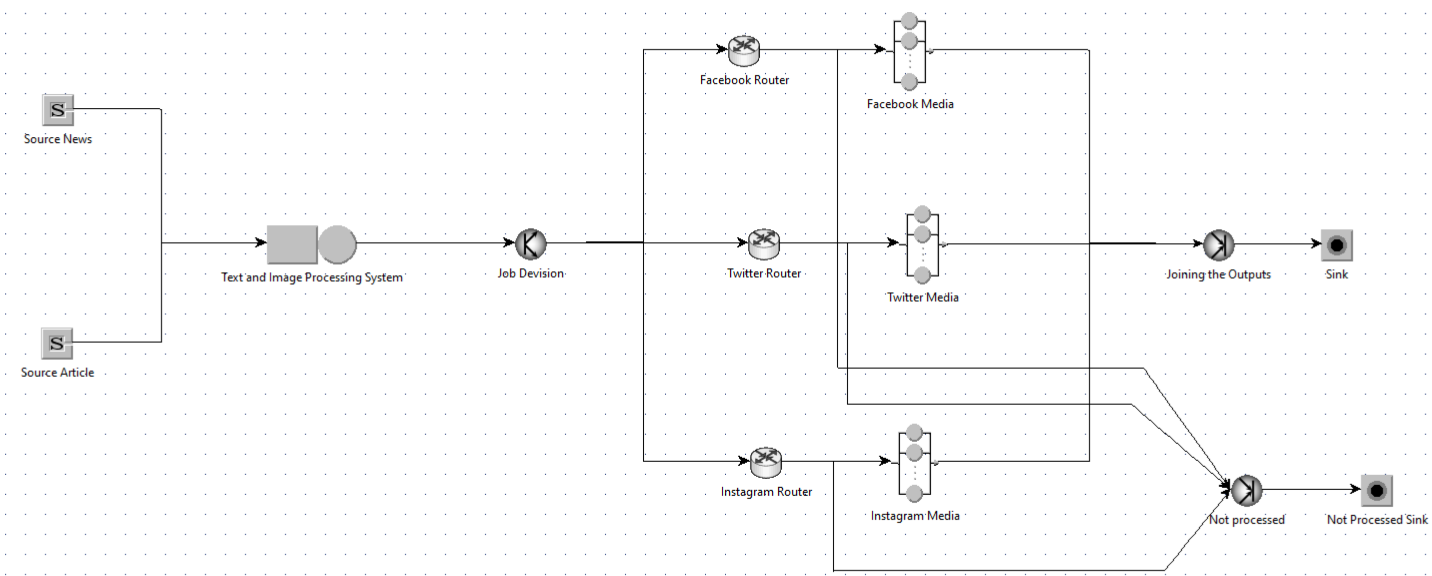






As it is mentioned on the Description of the Router nodes edit window no matter the defined percentages if the total sum is not equal to one (or 100 percent) JMT will consider the probability equal to 1.0.

Given the fact that the cumulative probabilities must be equal to one, a possible schema for the defined system could be the following in which the data which are not sent to the delay stations of the social medias to get processed, are pushed into another Join node followed by a separated Sink node. However, the Fork and Join nodes are pairs, using two Join nodes for a Fork node causes the model not to simulate successfully. This implementation causes inconsistency, and the results of this simulation are not reliable.



Running this system causes JMT to stick in a simulation loop which causes an overload and force stop for the modeling tool.