Assignment 7

Stochastic PetriNets

Harshit Kumar Gupta
Entry No. 2013EET2369

Computer Technology
Department of electrical Engineering
Indian Institute of Technology Delhi
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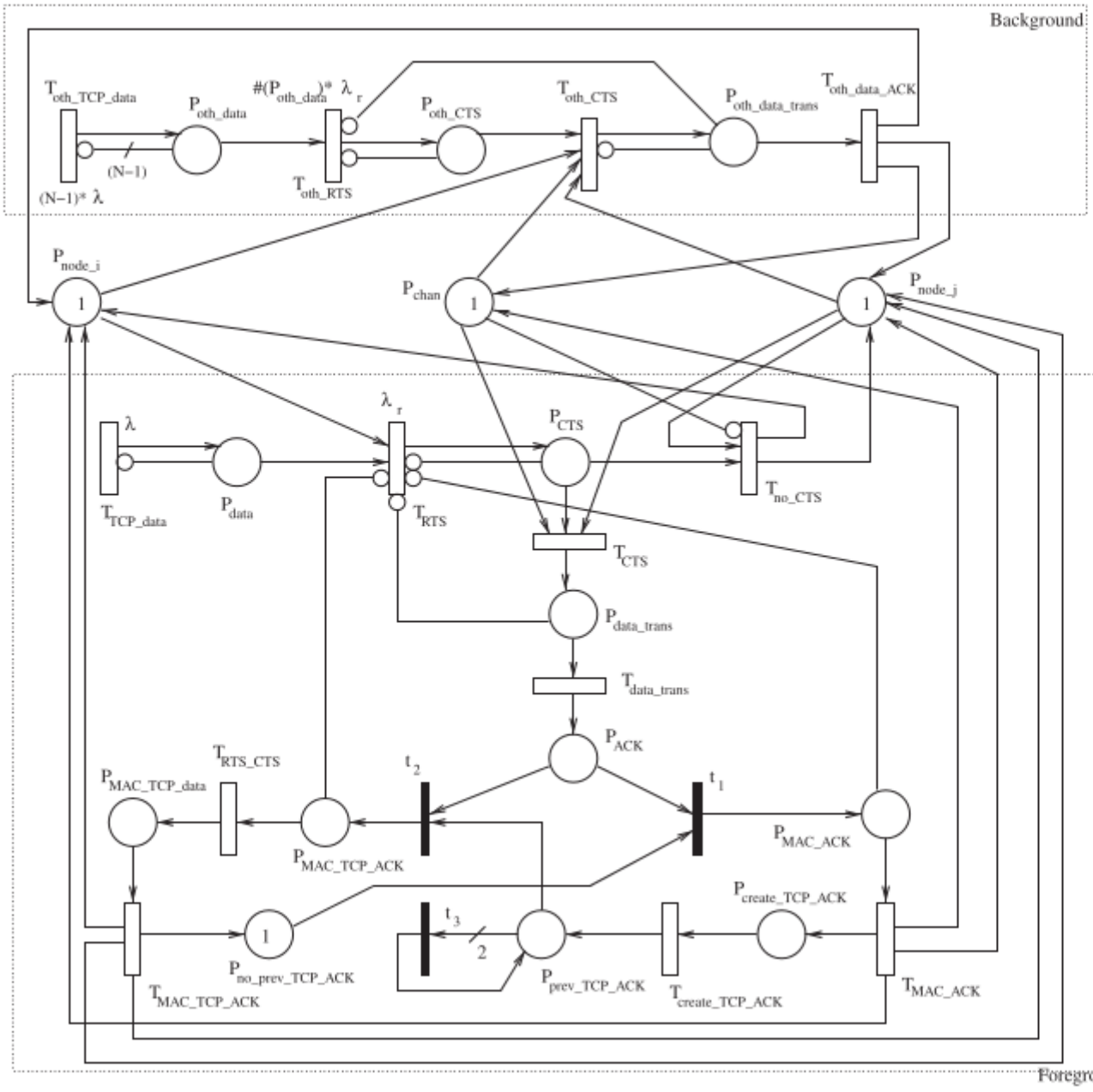
Contents

1 Problem Statement :

Simulate the given Model in the paper(PFA) in Sharpe and obtain the results and also plot the graph b/w

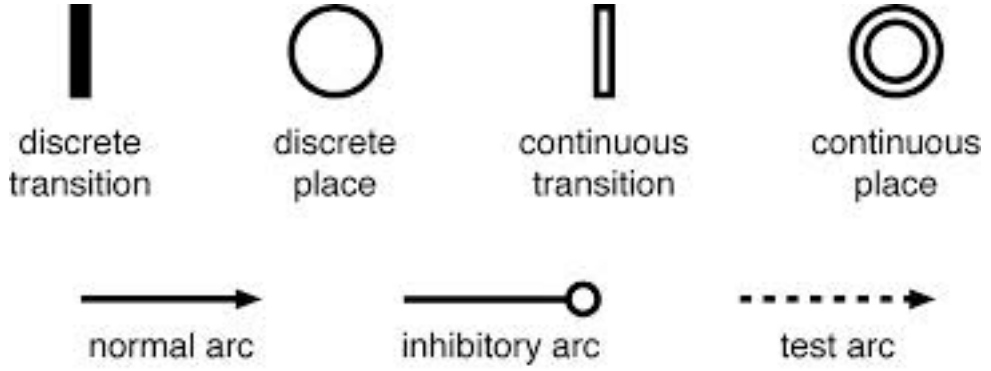
- arrival rate v/s throwput
- virtual load v/s throwput


Background
T oth_TCP_data
P oth_data
#(P oth_data)* λ r
P oth_CTS
T oth_CTS
P oth_data_trans
T oth_data_ACK
(N−1)
(N−1)* λ
T oth_RTS
P node_i
P chan
P node_j
1
λ
λ r
P CTS
T TCP_data
P data
T RTS
T no_CTS
T CTS
P data_trans
T data_trans
P ACK
T RTS_CTS
t 2
t 1
P MAC_TCP_data
P MAC_TCP_ACK
P MAC_ACK
P create_TCP_ACK
t 3
2
P no_prev_TCP_ACK
P prev_TCP_ACK
T MAC_TCP_ACK
T create_TCP_ACK
T MAC_ACK
Foregro

2 Theory :

2.1 Sharpe GUI :

The SHARPE GUI implements eight interchangeable modeling description techniques for reliability engineering: fault trees, Markov chains, reliability block diagrams, reliability graphs, generalized stochastic Petri nets, product queuing networks, multi-chain product form queuing networks and task graphs. future, all the modeling description techniques contained in SHARPE will be available in the GUI (phase mission, multi-components fault trees, semi-Markov chains).



2.2 Stochastic PetriNets :

Petri Nets (PN) are a graphical tool for the formal description of the flow of activities in complex systems. With respect to other more popular techniques of graphical system rep- resentation (like block diagrams or logical trees), PN are particularly suited to represent in a natural way logical interactions among parts or activities in a system. Typical situations that can be modelled by PN are synchronization, sequentiality, concurrency and conflict.

A petrinet is represented as a quintuple (P, T, I, O, M), where:

- P = p1 , p2 , . . . , pnp is the set of np places (drawn as circles in the graphical repre- sentation)
- T = t1 , t2 , . . . , tnt is the set of nt transitions (drawn as bars)
- I is the transition input relation and is represented by means of arcs directed from places to transitions
- O is the transition output relation and is represented by means of arcs directed from transitions to places

- M = m1 , m2 , . . . , mnp is the marking. The generic entry mi is the number of tokens (drawn as black dots) in place pi in marking M

3 Approach :

- There are two main parts of this model.
- The upper part of the model (the small dashed rectangle) represents the background traffic activity
  generated by N ambient nodes in the ad hoc network, i.e. it captures the cumulative behavior of all
  the other stations.
- The lower part of the model (the large dashed rectangle) represents the foreground traffic activity between two
  representative nodes i and j in the network, i.e. it captures the behavior of the reference station in
  detail. The three circles in the gap between the two rectangles represent the TCP sender i (on the left), the TCP receiver j (on the right), and the shared wireless channel (in the middle). The places, timed transitions, and immediate transitions.
- the SRN model assumes exponentially distributed firing times for all the timed transitions, although
  some events in the SRN model might be deterministic rather than random.
- This is represented by the firing of the timed transition TRTS .
- The firing time of TRTS is exponentially distributed with parameter r
  .

4 Specification and Assumpation :

Specification and assumption are :

4.1 Specification :

- we develop the SRN model for the original IEEE 802.11 MAC protocol with RTS/CTS mechanism.
- This model assumes a single shared channel for operation.
- This implementation is based on SHARP TOOLS implementation and Stochastic PetriNets knowledge.
- Deals with the simulation of IEEE 802.11 mac protocol with RTS/CTS mechanism.

4.2 Assumption :

- The SRN model assumes exponentially distributed firing times for all the timed transitions,
  although some events in the SRN model might be deterministic
- The firing time of TTCP data is exponentially distributed with parameter .
- It is sufficient to model the DCF operations of the HoL packets at all stations.
- Arrival rate propotional to tha packet size.
- Virtual load will be propotional to the square of the arrival rate.

5 Working :

The upper part of the model (the small dashed rectangle) represents the background traffic activity generated by N ambient nodes in the ad hoc network, i.e. it captures the cumulative behavior of all the other stations. The lower part of the model (the large dashed rectangle) represents the foreground traffic activity (i.e. the movement of TCP data packets and TCP acknowledgements) between two representative nodes i and j in the network, i.e. it captures the behavior of the reference station in detail. The three circles in the gap between the two rectangles represent the TCP sender i (on the left), the TCP receiver j (on the right), and the shared wireless channel (in the middle).

6 Performance Measures :

Performance measures Average system throughput The average system through-

$$E(D^2) = 2\left(\frac{\sharp(P_{\mathrm{CTS}})}{\eta_{T_{\mathrm{RTS}}}}\right)^2$$

put is given by : Mean Delay The delay of a packet is defined as the time spent by a packet in the system until it is successfully transmitted (i.e. the packet is received correctly by the destination station, and the corresponding ACK is received correctly by the source station). The delay can be calculated as follows

$$\bar{D}_{\mathrm{HoL}} = \frac{\sharp(P_{\mathrm{data}})}{\eta_{T_{\mathrm{TCP\_data}}}} + \frac{\sharp(P_{\mathrm{CTS}})}{\eta_{T_{\mathrm{RTS}}}} + \frac{1}{\mu} \qquad \bar{D} = \bar{D}_{\mathrm{HoL}}\left[1 + \frac{\rho}{2(1-\rho)}(1+C_D^2)\right]$$

$$C_D^2 = \frac{E(D^2)}{\bar{D}_{\mathrm{HoL}}^2} \qquad E(D^2) = 2\left(\frac{\sharp(P_{\mathrm{CTS}})}{\eta_{T_{\mathrm{RTS}}}}\right)^2$$

The mean delay obtained above is the mean delay suffered by any packet in the system because all the stations are independent and behave identically.

7 Result :

Here the graph is gentared for each scenario so the observation is shown blow
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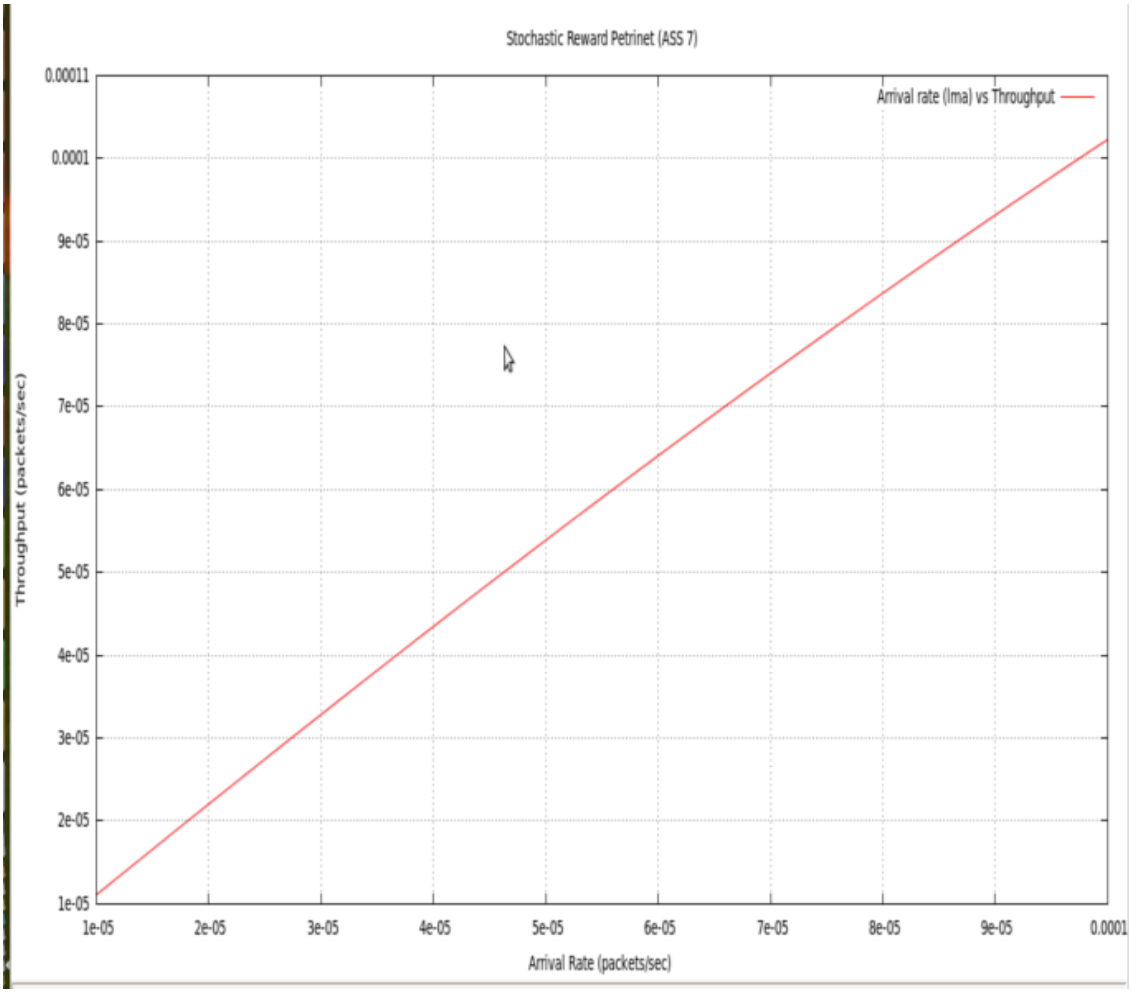
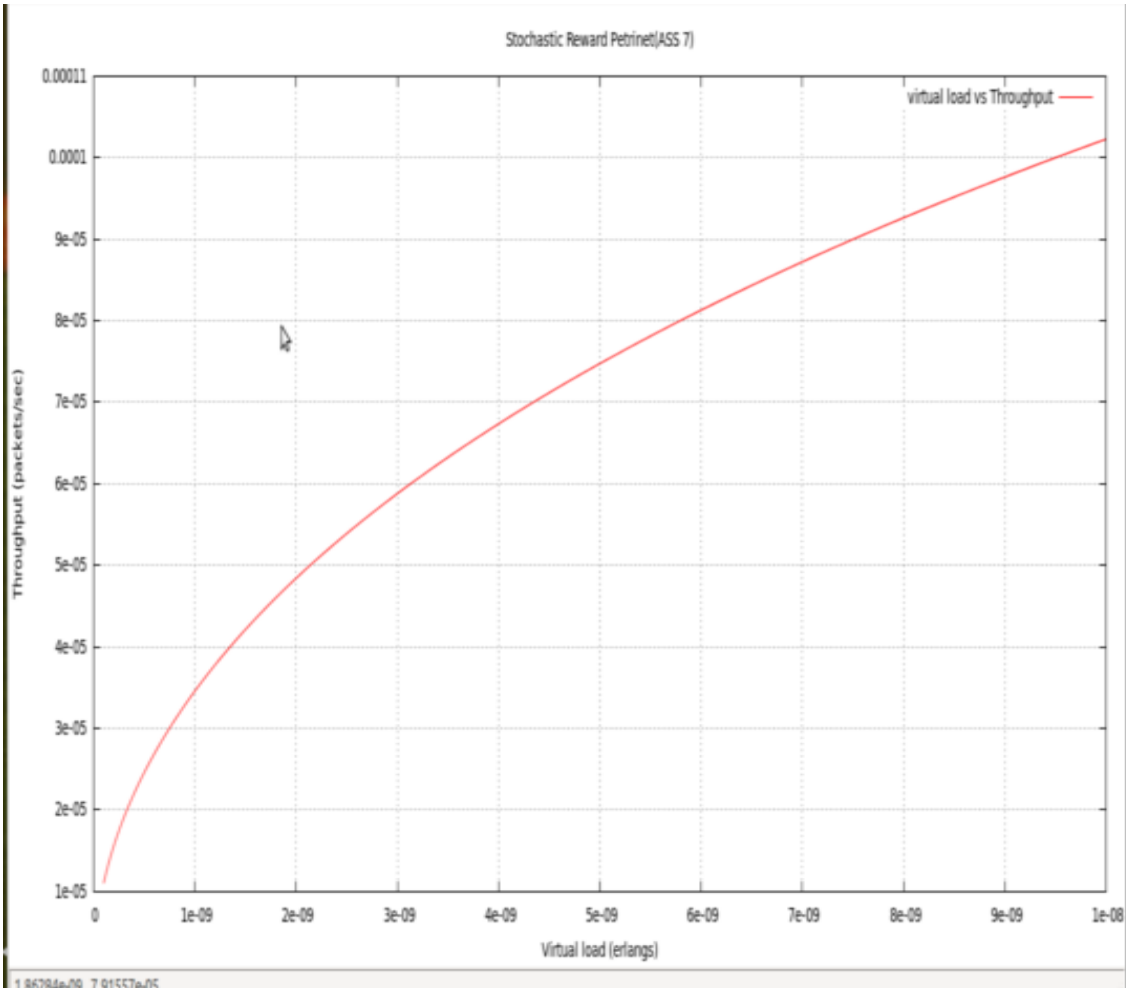
The observed Graph are :

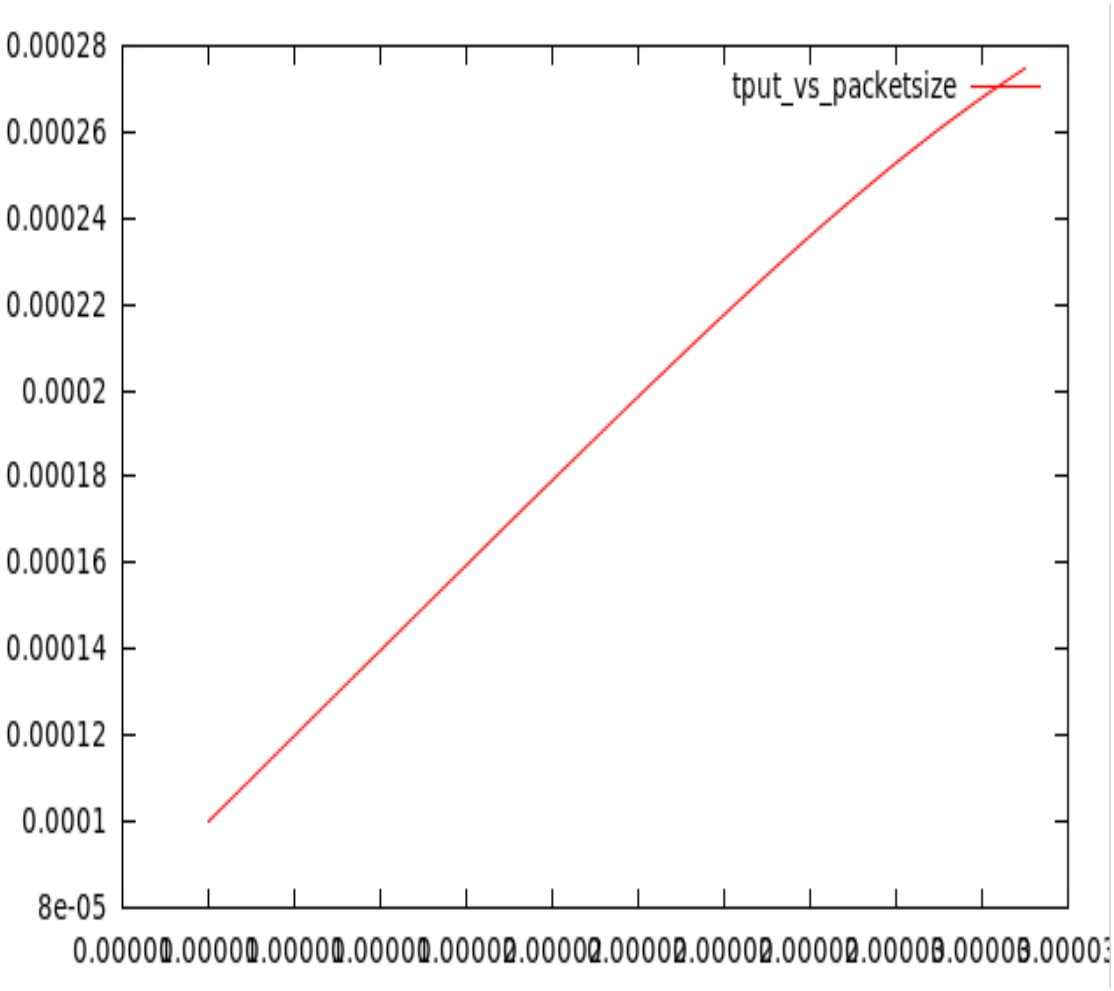
7.1 lma v/s throwput :



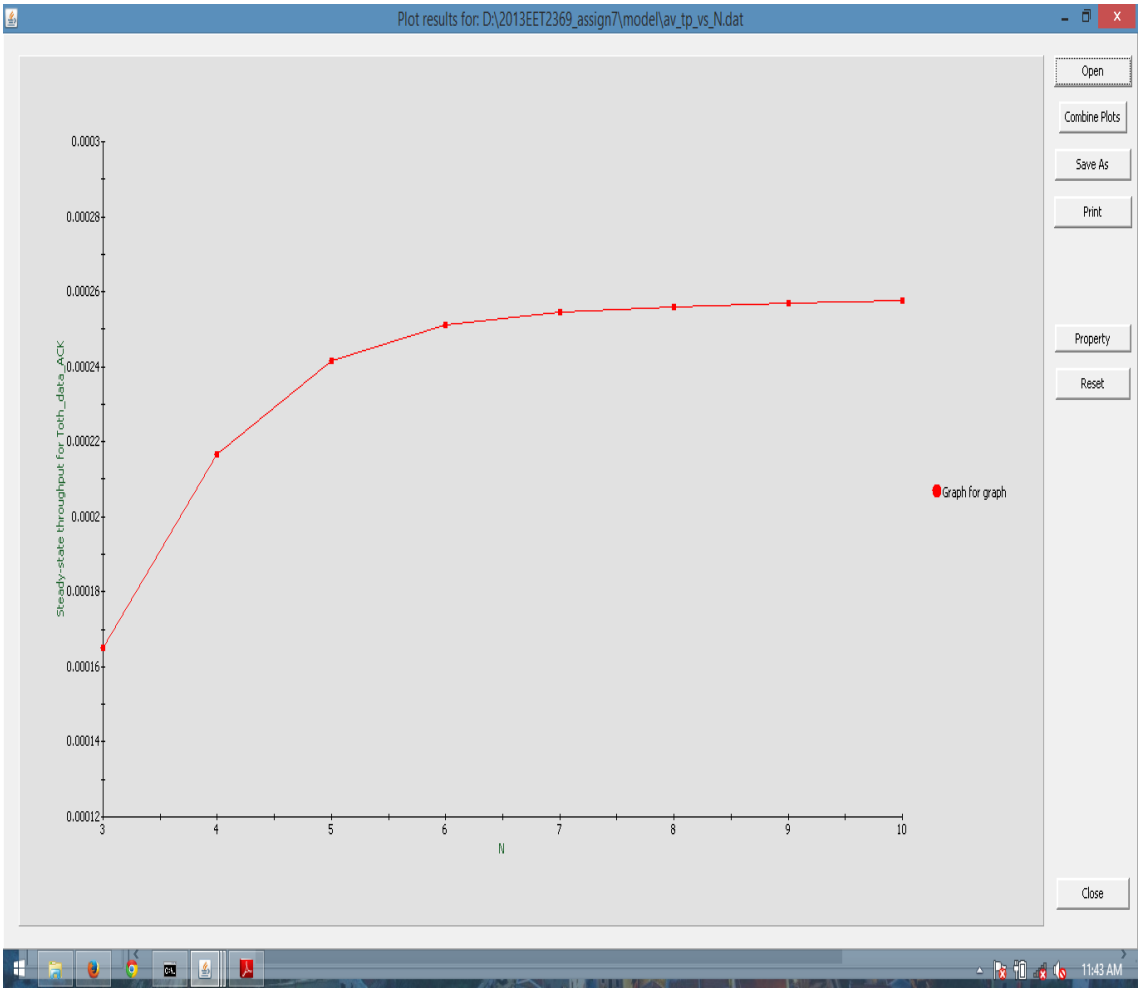
7.2 virtual load v/s throwput :



7.3 Avg Throughput v/s Packet Size :

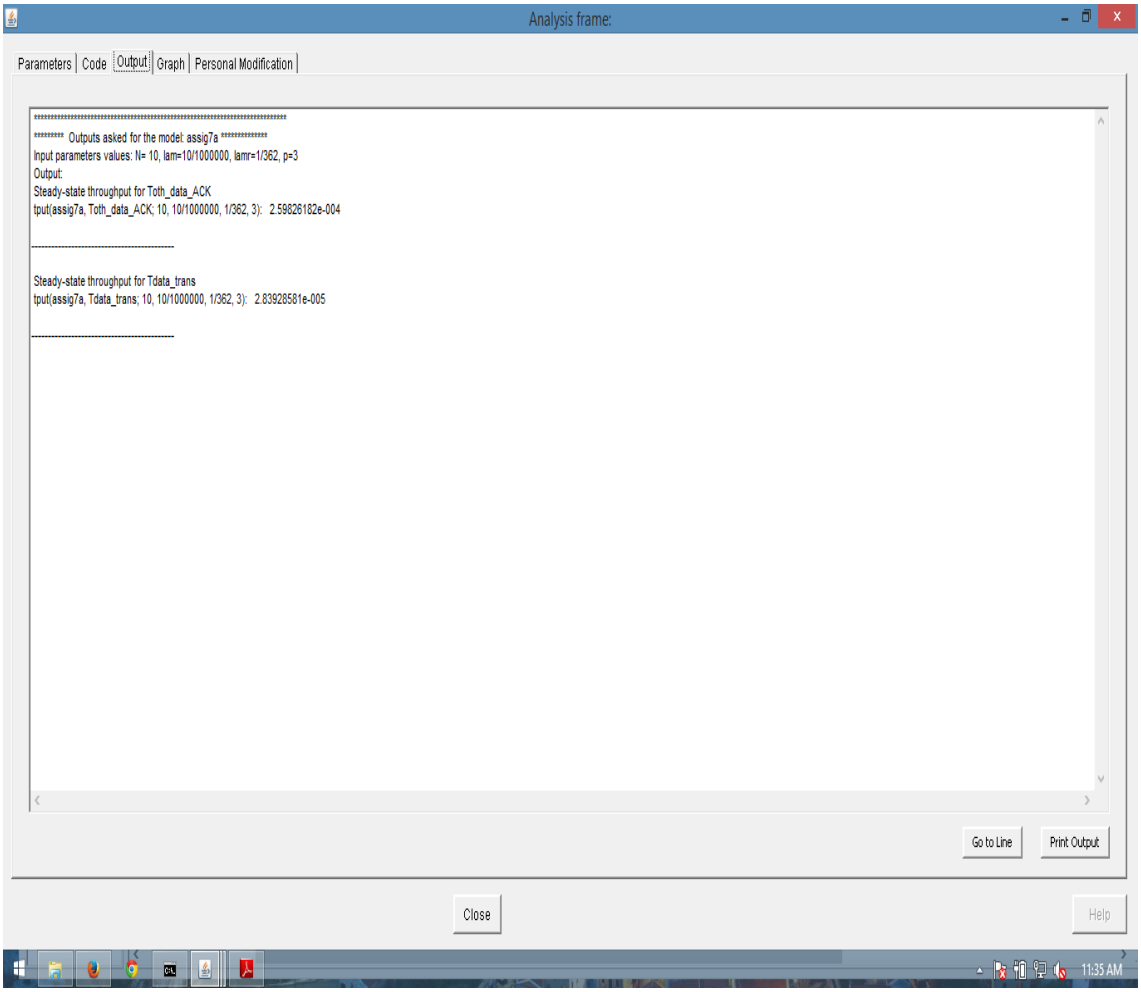


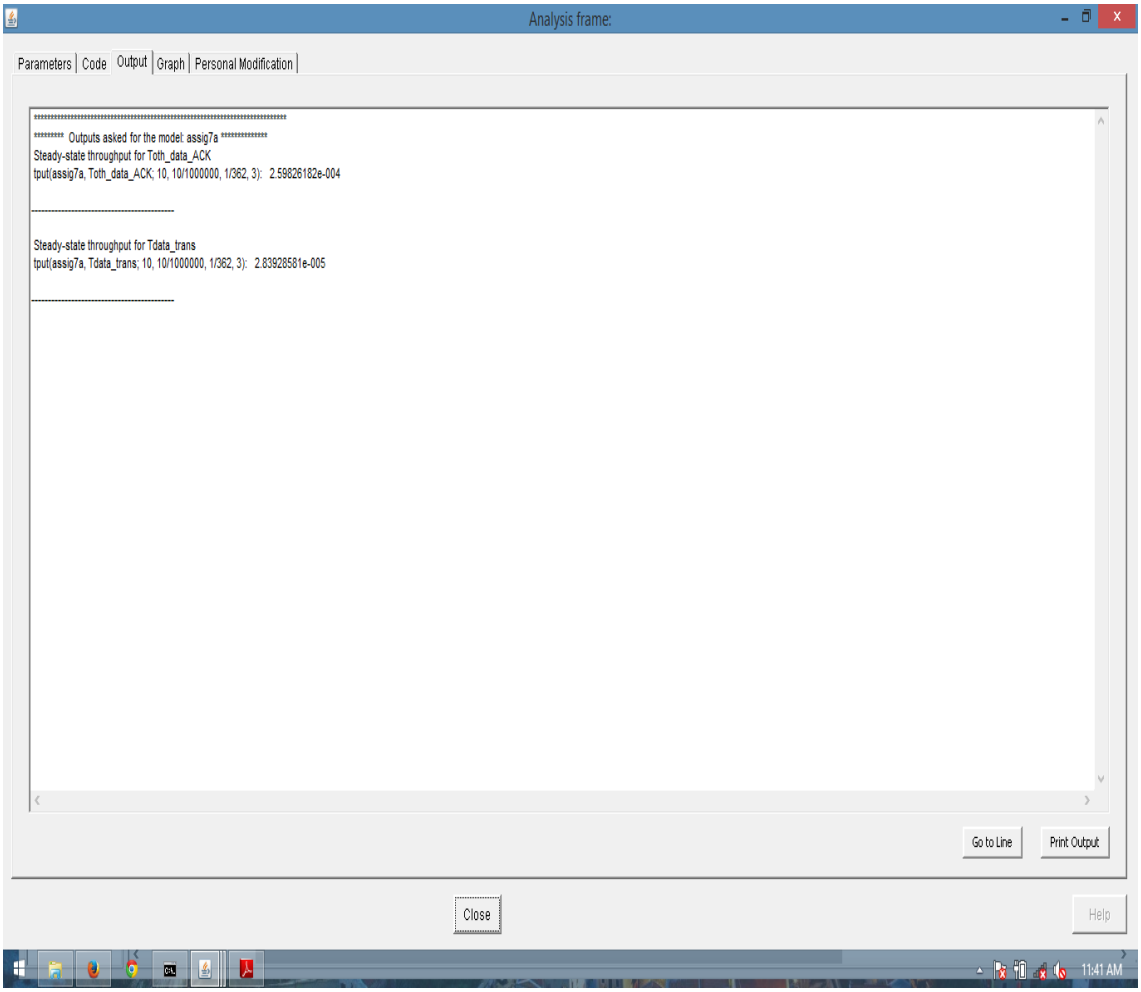
7.4 Avg Throughput v/s No Of NOdes :



8 Conclusion And Output :

- The given model has been modelled using SRN.
- The Graph is plotted b/w arrivalrate and throwput, and the second graph is plotted b/w virtual load and throwput.
- The difference b/w two graph is shown in graph .




Analysis frame:
Parameters
Code
Output
Graph
Personal Modification
********** Outputs asked for the model: assig7a **********
Steady-state throughput for Toth_data_ACK
tput(assig7a, Toth_data_ACK; 10, 10/1000000, 1/362, 3): 2.5982618 2e-004
Steady-state throughput for Tdata_trans
tput(assig7a, Tdata_trans; 10, 10/1000000, 1/362, 3): 2.83928581e-005
Go to Line
Print Output
Close
Help
11:41 AM