Performance Evaluation of Decentralized task scheduling algorithms

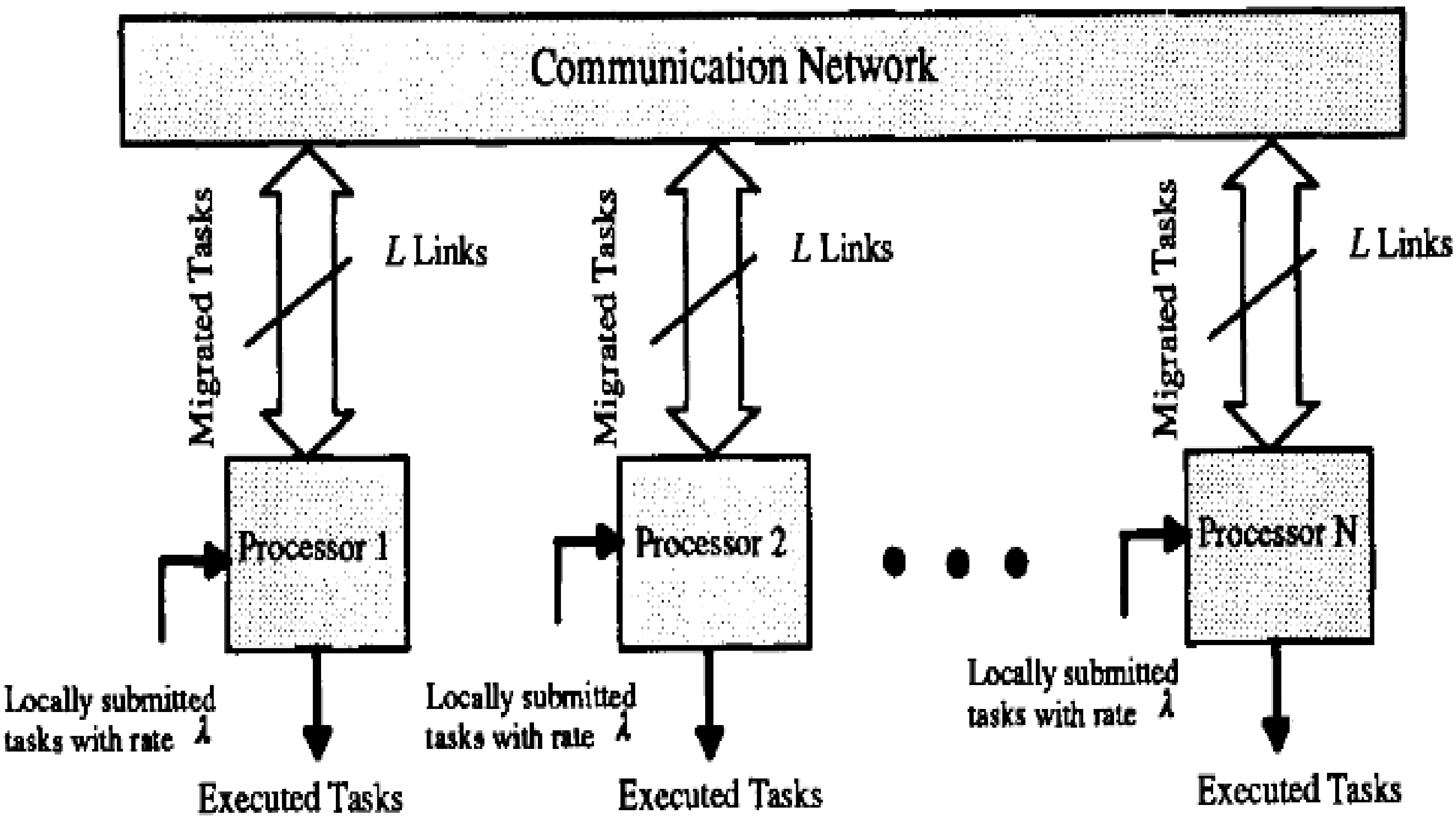
Pulkit Goyal(07305009)

Sagar Bijwe(07305023)

Introduction

- Scheduling Algorithms
  - Centralized v/s Decentralized
  - Static v/s Dynamic
- Dynamic Scheduling
  - Suitable if tasks are created at random.
  - Aim - To balance computational load by migrating workload from heavily loaded nodes to lightly loaded nodes dynamically.

Logical View



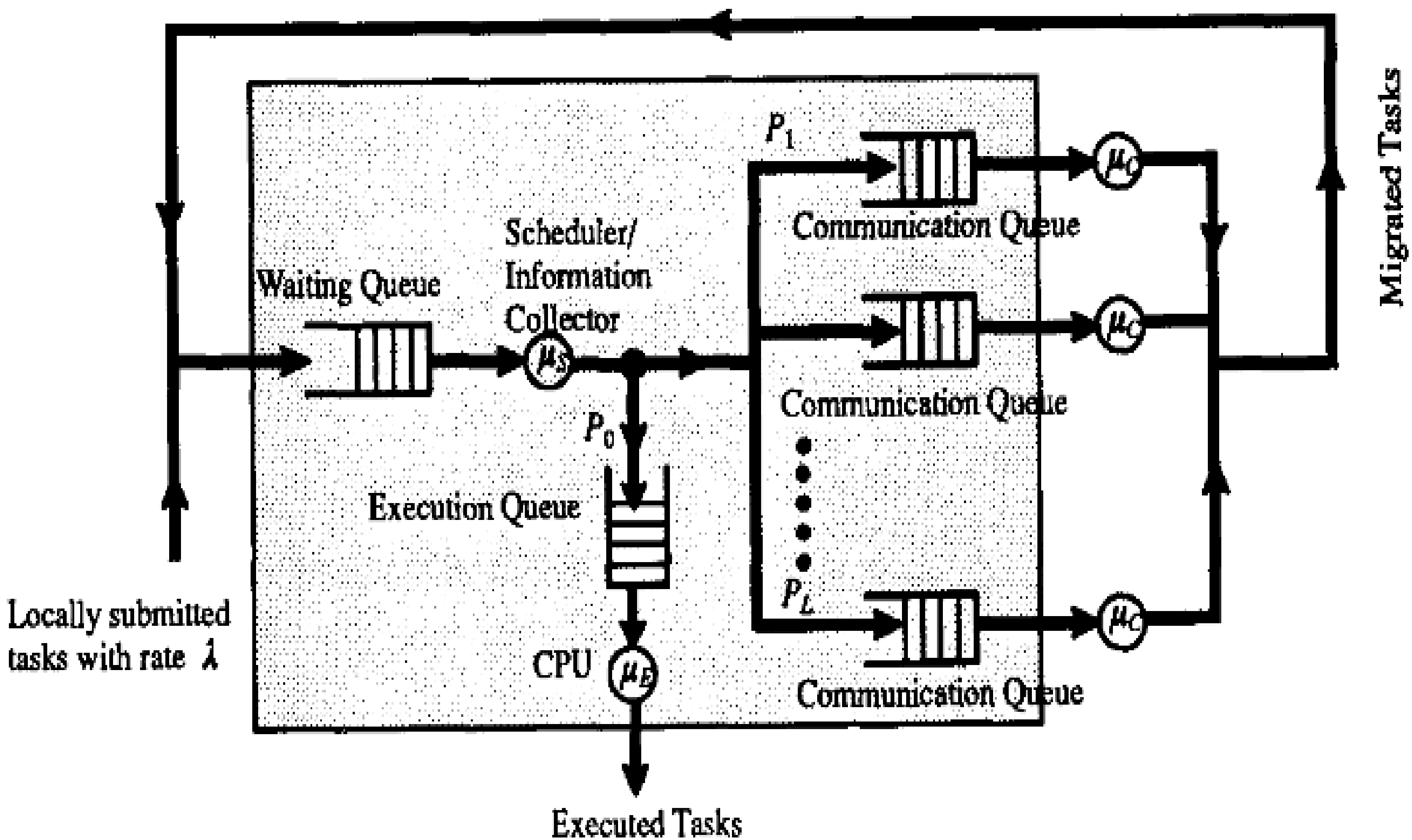
Dynamic Scheduling Algorithms

- Random
  - If avg load of neighbor < own load then

    migrate the task to the neighbor randomly.
- Bid-Average
  - If avg load of neighbor < own load then

    migrate the task to the lightest loaded neighbor among all the neighbor whose load is less than their avg neighbors' load.

System Model



Questions asked about System

- Stability of the system.
- Effect of scheduling time and communication time.
- Effect of densely/sparsely connected network.
- Whether the load on each node is balanced or not?
- Which of the two above scheme will work better?

Assumtions

- Arrivals are Poisson.
- Scheduling time, execution time, communication time are exponentially distributed.
- Task transferred from other node and task joined locally are of equal priority for scheduling.
- All queues is assumed to be have infinite buffer.
- Local CPU servers on FCFS basis with no preemption.

System Parameters

- Load per node.
- Scheduling and communication rate.
- Network Topology.

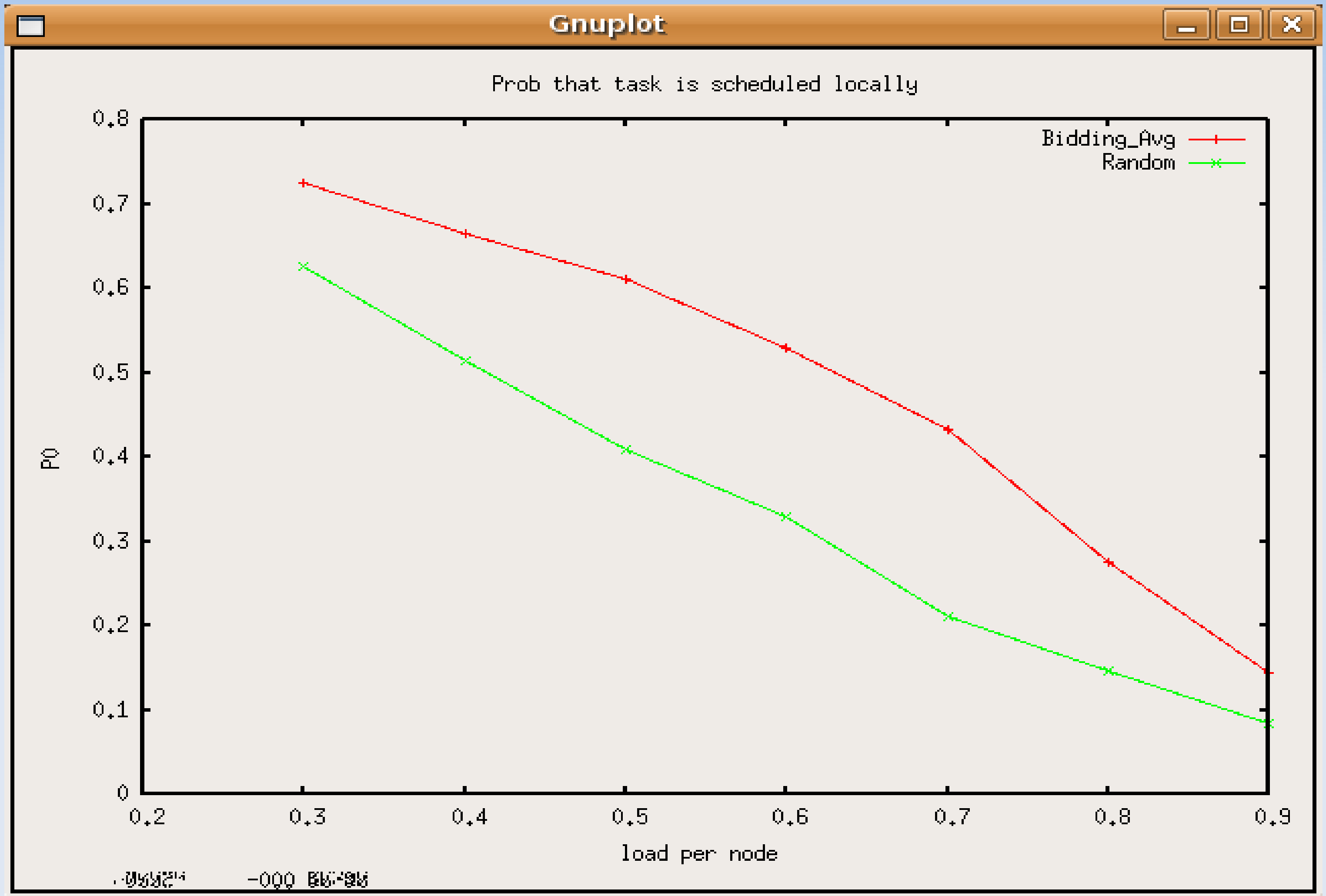
Performance Evaluation Metrics

- Probability that task is scheduled locally.
- Response time of task is divided into two phases:
  - Task settling time.
  - Waiting time in execution queue.
- Execution queue length.

Experiment Setup

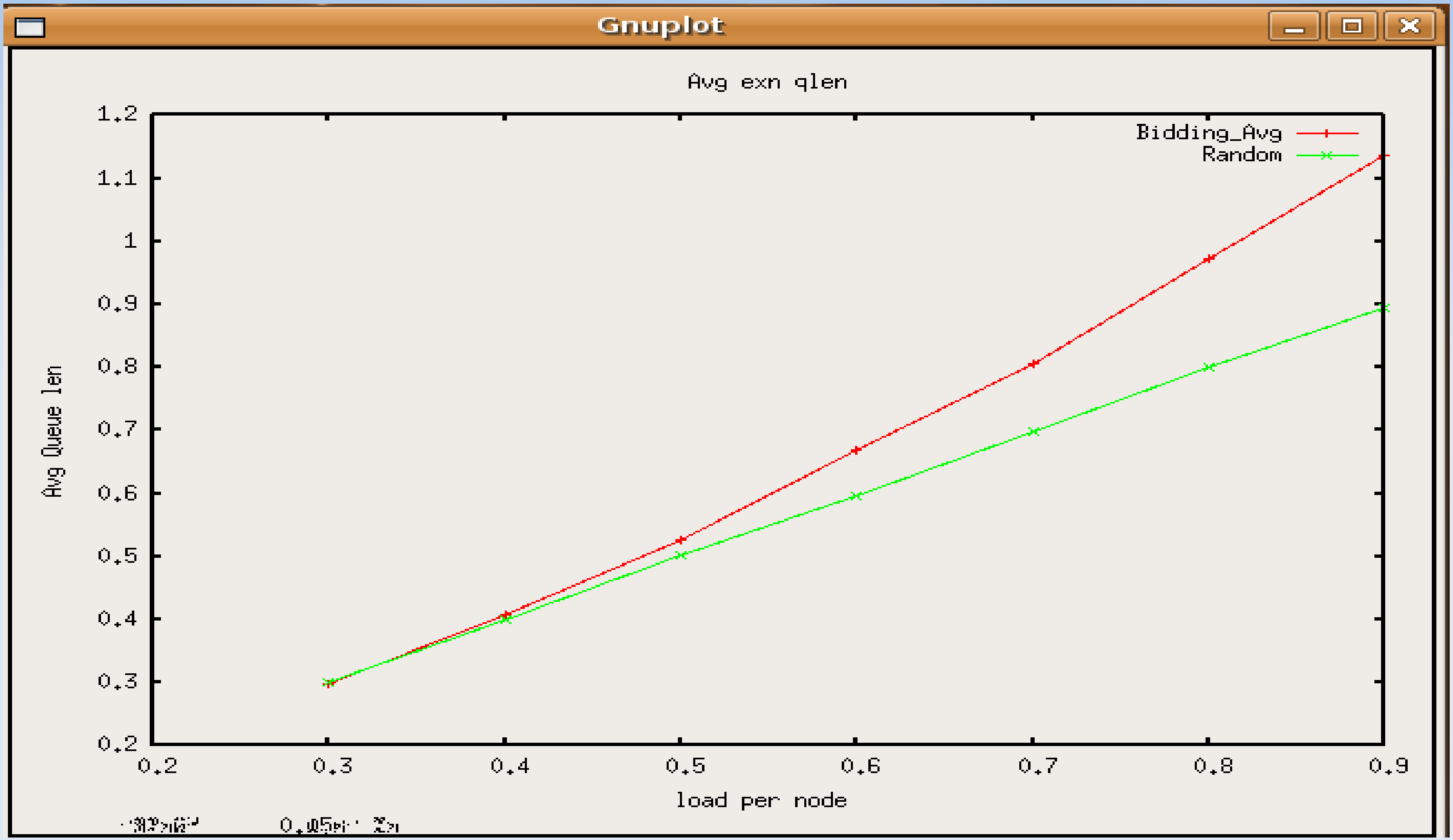
- Phase 1 – Comparison b/w two schemes.
  - Sim-time=1000 units of time.
  - Arrival Rate varies from .3 to .9 tasks per unit time.
  - Execution Rate=1 task per unit time.
  - Scheduling and Communication Rate= 20 tasks per unit time.
  - No. of iteration=10.
  - Welch Procedure on total avg. response time.

Experiment Results



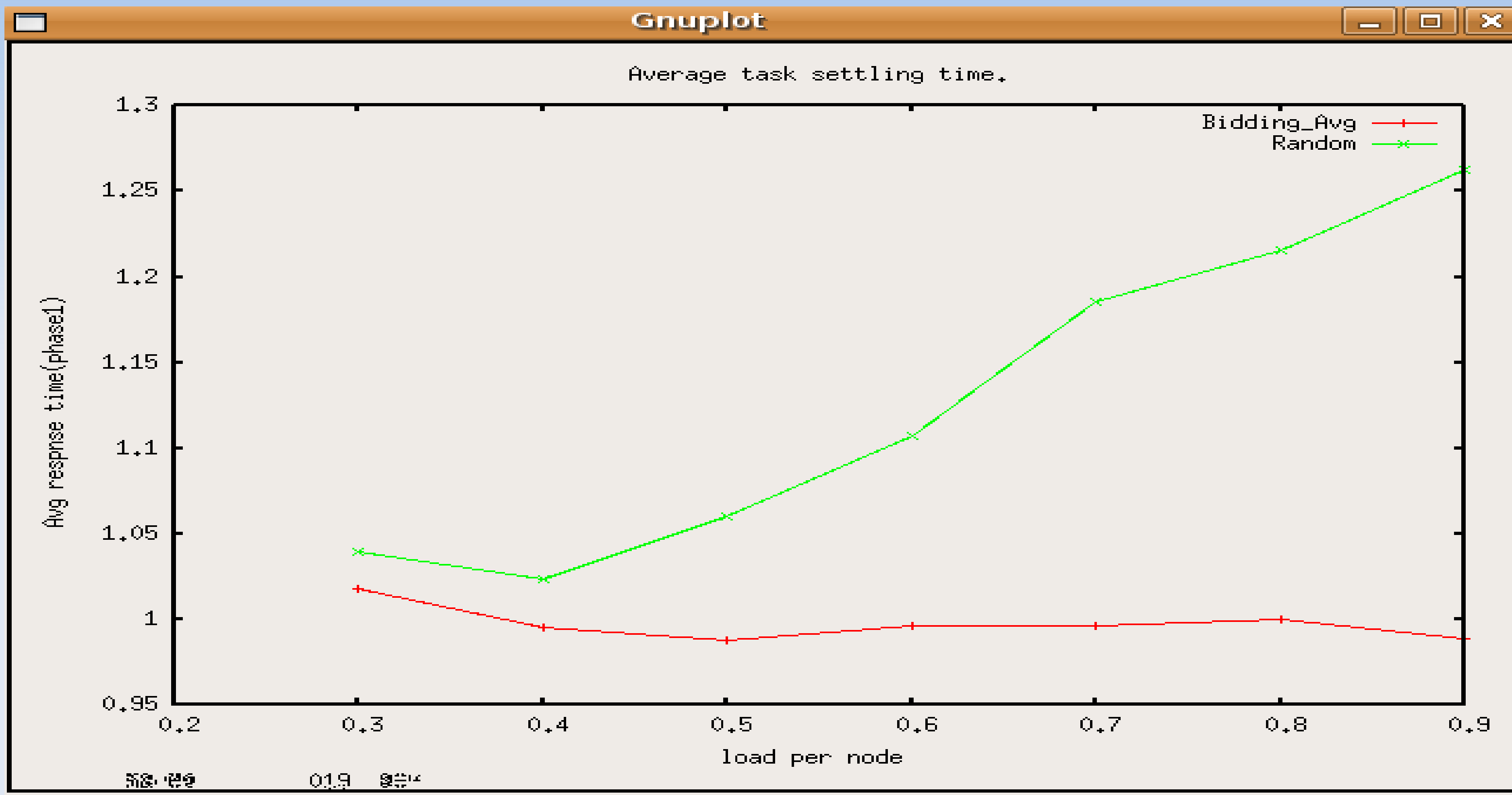
Probability of task being scheduled locally is high in bidding avg but low enough to cause migration for load balancing.

Experiment Result (Cont..)



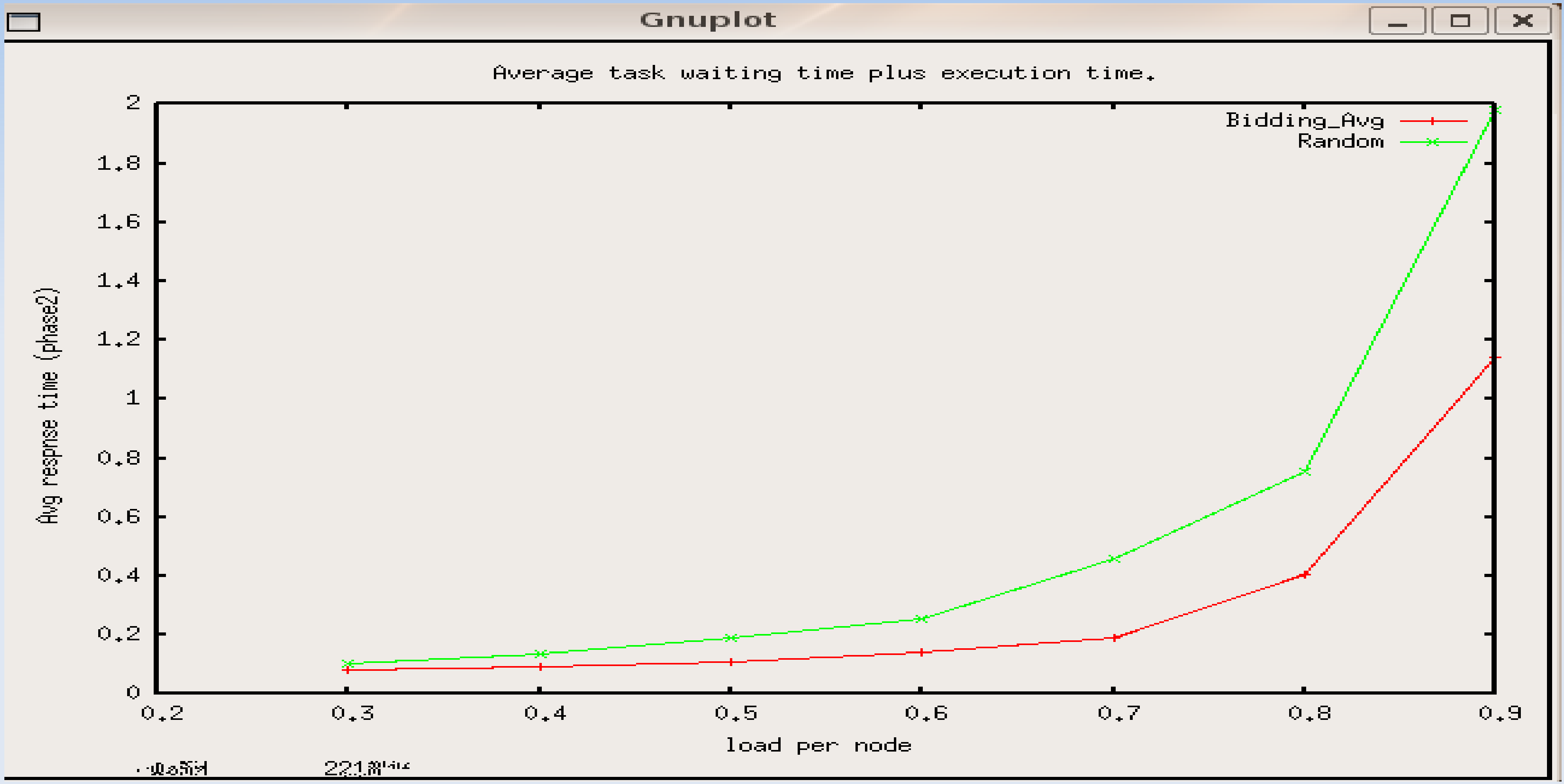
Avg execution queue length is high for bidding avg because more jobs spent time in migrating from one node to another in case of random.

Experiment Result (Cont...)



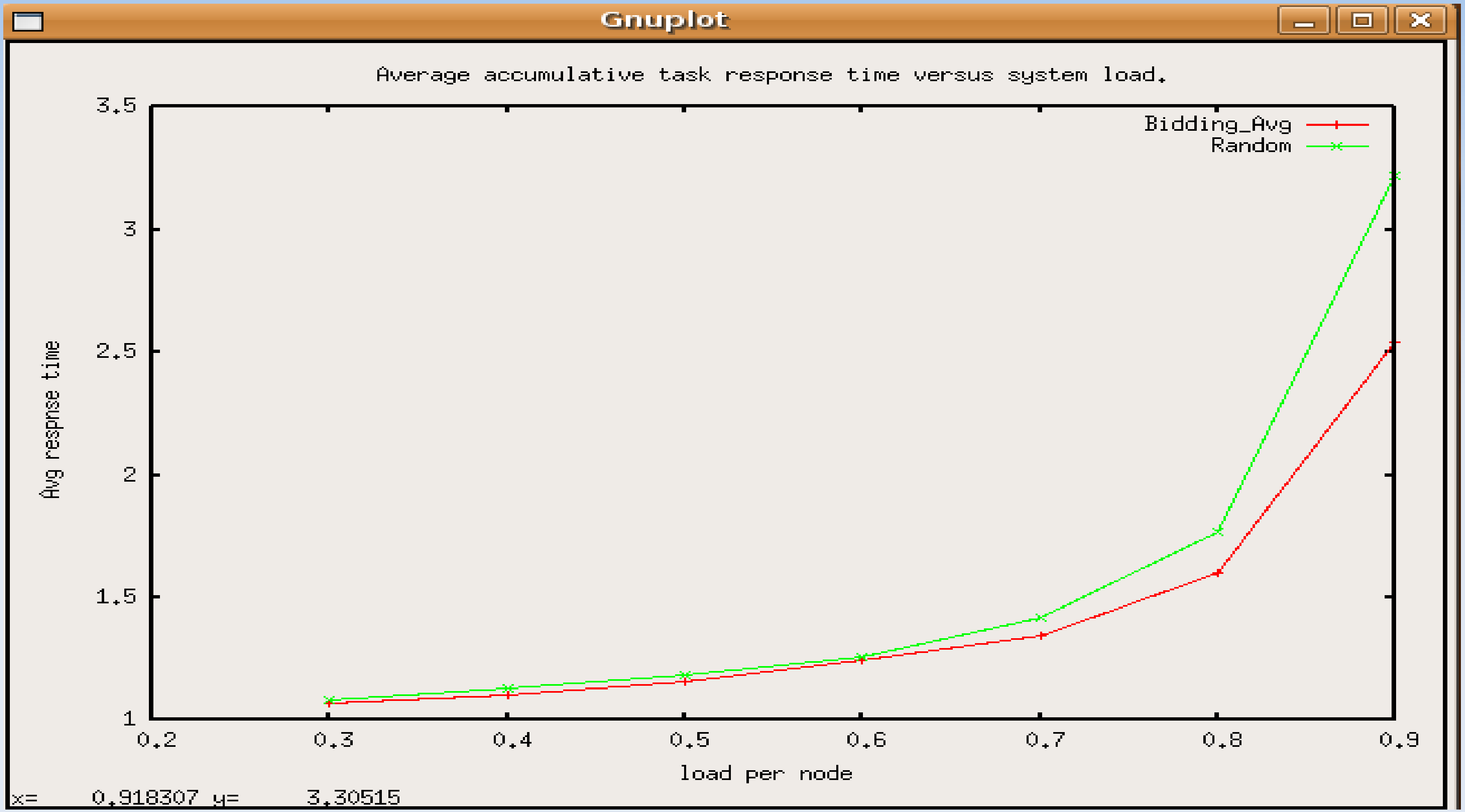
As the load increases more nodes are heavily loaded so it shifts its load to other nodes leading to high settling time but in case of bid avg very few neighbor bids for the load accpetance.

Experiment Result(Cont...)



For bid avg, task is scheduled to more lightly loaded system so its phase 2 response time is less.

Experiment Result (Cont...)

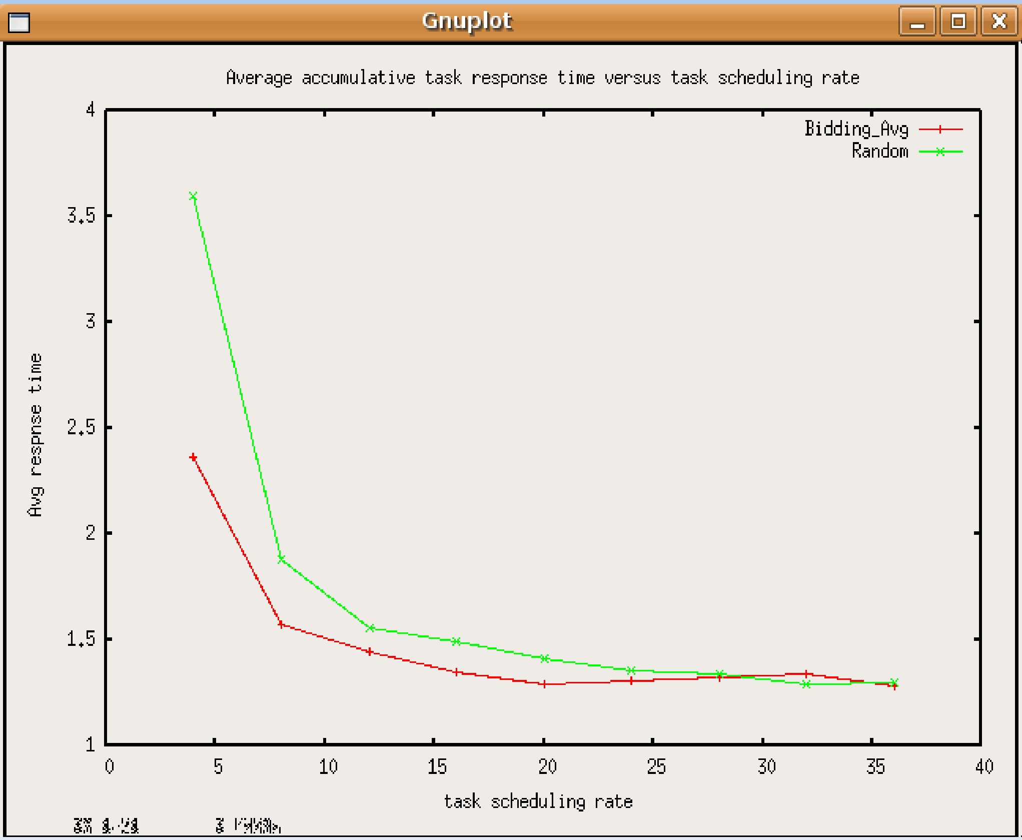


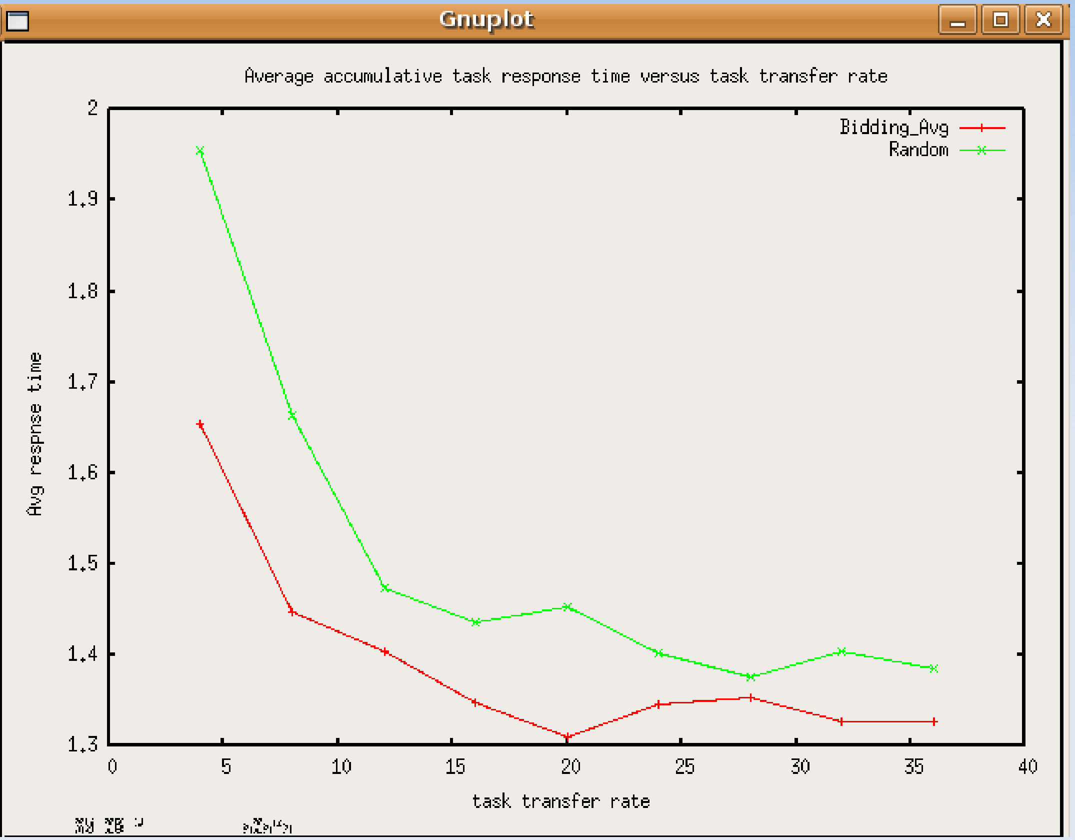
This graph is drawn by applying welch procedure.

Experiment Setup

- Phase 2 – Effect of scheduling rate and communication rate
  - Sim-time=1000 units of time.
  - Arrival Rate = .8 task per unit time.
  - Execution Rate=1 task per unit time.
  - Scheduling and Communication Rate varies from 4 to 36.
  - No. of iteration=1.

Experiment Result (Cont...)



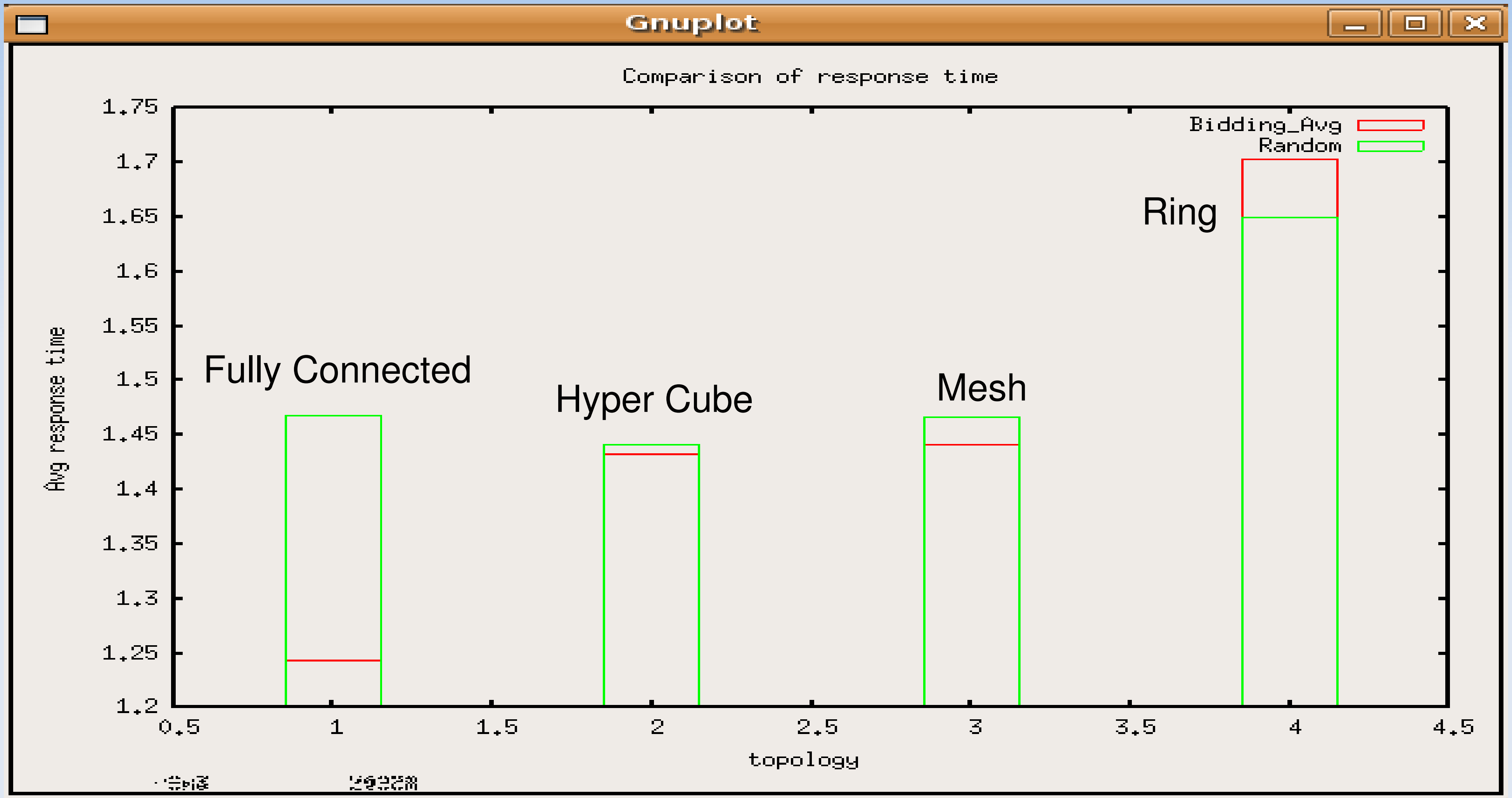


The impact of scheduling rate is more on avg response time. It indicates that avg response time with slow scheduling rate and high communication rate is greater than response time with fast scheduling rate and slow communication rate.

Experiment Setup

- Phase 3 – Effect of Densely/Sparsely Topology
  - Sim-time=1000 units of time.
  - Arrival Rate = .7 task per unit time.
  - Execution Rate=1 task per unit time.
  - Scheduling and Communication Rate = 20 tasks per unit time.
  - No. of iteration=1.
  - Different topology = Fully connected graph, Hypercube, Mesh, Ring

Experiment Result (Cont...)

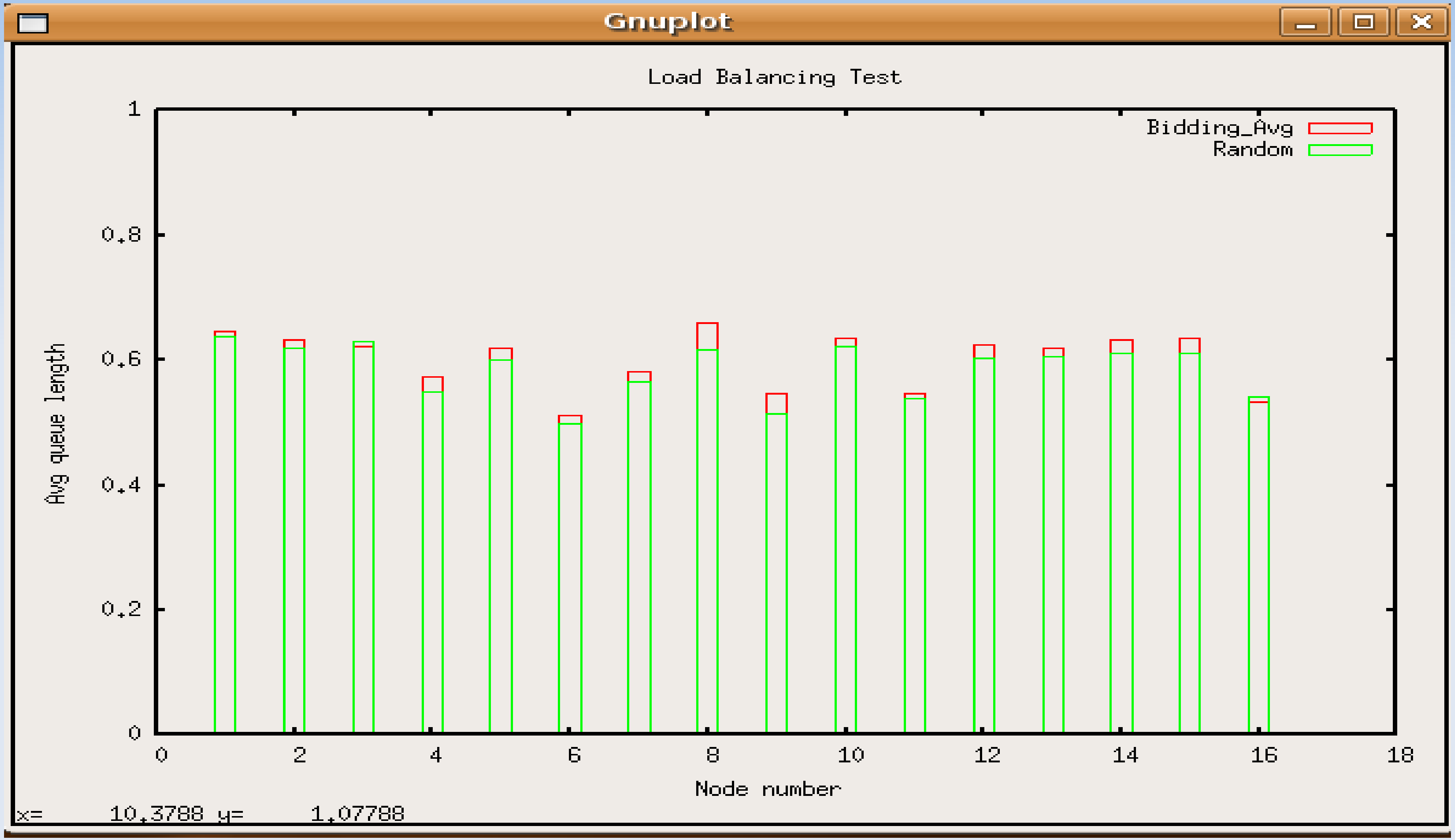


Bidding Avg works well in densely connected network while for sparsely connected network, random work little better than bidding avg.

Experiment Setup

- Phase 4 – Load Balancing Test
  - Sim-time=1000 units of time.
  - Arrival Rate = different at different nodes.
  - Execution Rate=1 task per unit time.
  - Scheduling and Communication Rate = 20 tasks per unit time.
  - No. of iteration=10.

Experiment Result (Cont...)



From the figure, we can say that load is well distributed among all the nodes.

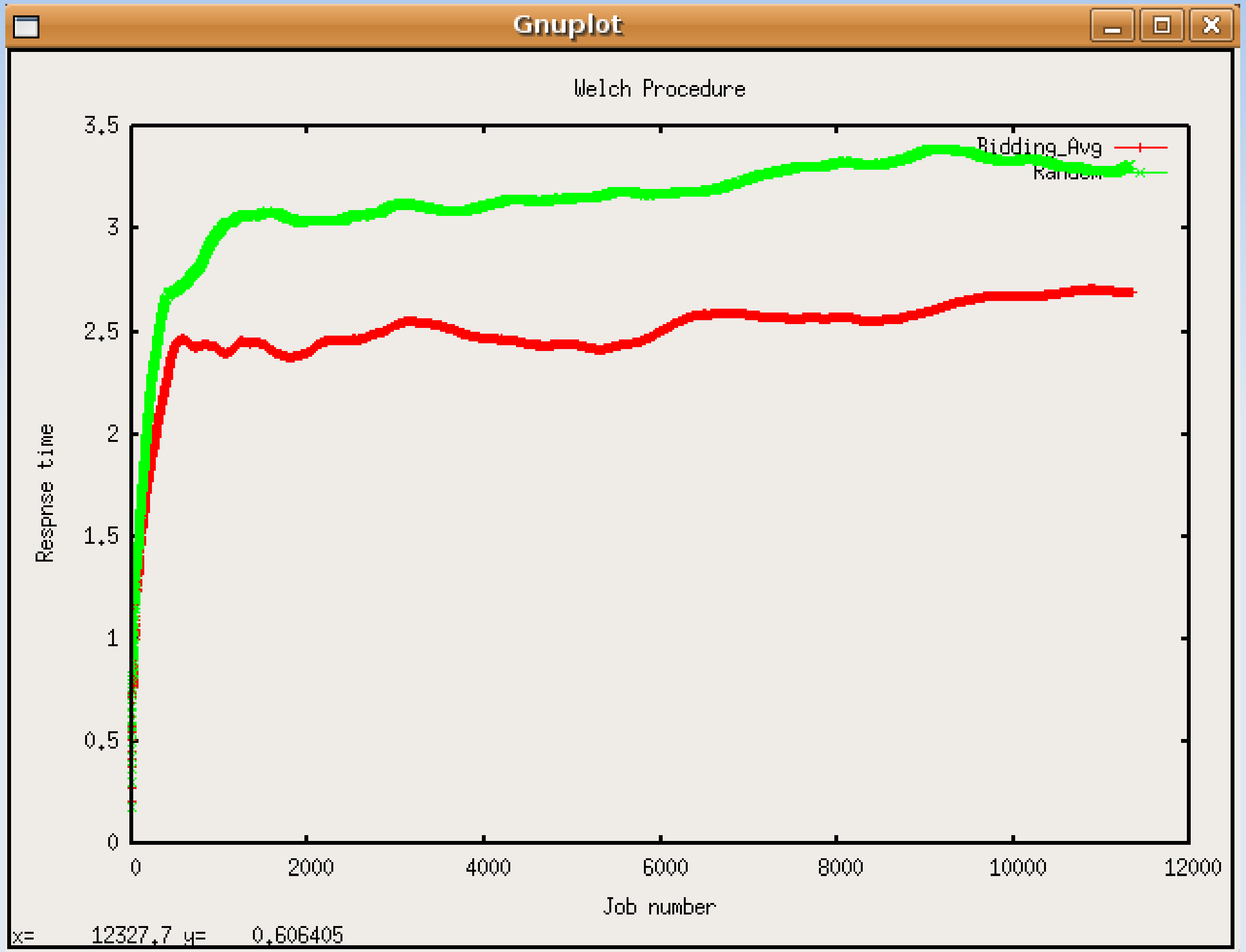
Conclusion

- Bidding avg is more stable in terms of trashing.
- High scheduling rate is more important than communication rate.
- Both algorithms provide load balancing for homogeneous as well as hetrogenous networks.

References :

- Ishfaq Ahmad, Arif Ghafoor, and Kishan Mehrotra, ”A *Decentralized Task Scheduling Algorithm and its Performance Modeling for Computer Networks*”, *In proc. of Parallel and Distributed Processing*, 1991.

Welch Slide(Back Up)



Confidence Interval

Total Response Time

Load	mean	Confidence interval
.3	0.896535	[0.848525,0.944545]
.4	0.881661	[0.804694,0.958628]
.5	0.964270	[0.876789,1.05175]
.6	1.114944	[1.01797,1.21192]
.7	1.316026	[1.16475,1.46731]
.8	1.508578	[1.19693,1.82022]
.9	2.059628	[1.30441,2.81484]

Bidding Avg

Load	mean	Confidence interval
.3	0.917457	[0.866801,0.968113]
.4	0.933595	[0.869452,0.997738]
.5	0.990521	[0.886241,1.0948]
.6	1.136332	[1.04252,1.23014]
.7	1.442958	[1.25585,1.63007]
.8	1.694040	[1.23541,2.15267]
.9	2.036382	[1.6943,2.37846]

Random