Dynamic Routing Protocols Analysis based on Dissimilar Number of Packets

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***Abstract*—**Efficient routing is one of the key challenges in the design and performance of a large scale intra-domain network. This paper describes the analysis of dynamic routing protocols IS-IS,IGRP,RIP for the scenario which has fifty number of workstations working on three dissimilar applications(Ftp, Remote Login and Videoconferencing) based on increasing number of packets per sec sent. High speed network is the demand of the user in order to perform multiple tasks with reliability so that its performance is efficient that is why we opted for dissimilar number of packets varying from hundred to thousand and analyzed their effects in the performance of LAN. Simulation is carried out with the help of Optimized Networking Engineering Tool (OPNET) which gives the better edge over the other network simulation tools available. The assessment is based on two parameters namely Ftp Download Response Time and Ftp Upload Response Time. The results concluded that that overall best performance can be achieved with the help of IS-IS protocol other than RIP and IGRP for increasing number of packets in the given scenario and hence it is observed that by sending maximum number of packets there is speed enhancement in the given network with high efficiency.

***Keywords*—**FTP Download Response Time; FTP Upload Response Time; IGRP; IS-IS; LAN; OPNET; RIP.

***Abbreviations*—**Interior Gateway Routing Protocol (IGRP); Intermediate System To Intermediate System (IS-IS); Local Area Network (LAN); Optimized Network Engineering Tool (OPNET); Routing Information Protocol (RIP).

I. INTRODUCTION

THE constant improvement in communication technologies and the related dramatic increase in user demand to be connected anytime and anywhere to both the wealth of information accessible through the internet and other users and communities have boosted the pervasive deployment of wireless and wired networked systems. Routing research has fully accompanied the evolution of networking to constantly adapt the routing protocols to the different novel communication technologies and to the changes in user demand. The router has prior knowledge about the adjacent networks, which can assist in selecting the routes between two nodes. For interconnecting various computer networks Internet Protocol (IP) is the most widely used network layer protocol. Intradomain routing protocols are basically dynamic routing protocols that are classified into two categories: Distance Vector Routing Protocol and Link State Routing Protocol [Jasleen Kaur, 2009]. Most of the popular routing algorithms are used are RIP (Routing Information Protocol), IGRP (Interior Gateway Routing Protocol), IS-IS (Intermediate System to Intermediate System). RIP and IGRP are the Distance Vector Routing Protocol [Hao Huang et al., 1999] that incorporates Bellman Ford Algorithm [Umut Acar, 2013] to determine the best path whereas IS-IS is the Link State Routing Protocol based on Dijkstra's Algorithm [Siddhartha Sankar Biswas et al., 2013]. RIP, IGRP and IS-IS are the dynamic routing protocols [Jeff Doyle, 2001] used in practical networks to disseminate network topology to the adjacent routers.

In this paper three routing protocols, RIP (Distance vector protocol), IS-IS (Link state Protocol) and IGRP (Distance vector protocol) are analyzed on the basis of Ftp Download Response time and Ftp Upload Response time for the scenario which have fifty fixed workstations on the basis of different number of packets sent per second of same size and observed the behaviour of each protocol. Assessment is done from minimum number to maximum number of packets i.e. for 100, 200, 500, 800 and 1000 number of packets and showed best Ftp response on the basis of number of packets and respective protocol that performs well for the network.

II. LITERATURE SURVEY

Many researchers in the past have compared the performance of the dynamic routing protocols i.e. RIP, IGRP and IS-IS based on different parameters. Ahmad Karim & Minhaj Ahmad Khan (2011) showed the behaviour of routing protocols for medium to large scale networks. He evaluated these protocols on the basis of quantitative metrics such as CPU processing power, point to point throughput, point to point queuing delay. Results show that IS-IS protocol uses only 0.0004% of the CPU processing capability, whereas RIP produces greater point to point throughput and also has the highest point to point queuing delay. Jagdeep Singh & Rajiv Mahajan (2013) showed the comparative study of RIP, OSPF, EIGRP and found that RIP performs well for Email download and upload response time and DB query response time. Ikram Ud Din et al., (2010) presented the analysis of routing protocols in real time transmissions. It has been shown that IGRP performs well in packets dropping, traffic received and end to end delay while in case of jitter RIP performs a bit well than IGRP. Pethe & Burnase (2011) hypothesized network. They done comparisons of OSPF, IGRP and RIP with EIGRP, also there are problems with redistributing routes between RIP, OSPF or IGRP than in case of EIGRP. It includes the various trouble resolving techniques and traffic handling techniques during communication in simple as well as in bulky networks. Shravan K. Narisetty & Santosh K. Balsu (2011) have chosen three different application i.e., video conferencing, e-mail and ftp. They use OPNET to design and simulate the network and compare the performance of the EIGRP, IS-IS/RIP routing protocols in terms of convergence time, throughput and end-to-end delay and propose which routing is suitable for IP networks. After a several simulations in OPNET, the combination of IS-IS/RIP protocol shows better performance compared to EIGRP protocol in terms of throughput and end-to-end delay. Whereas, the network convergence of EIGRP protocol is better than IS-IS/RIP protocol.

III. ROUTING INFORMATION PROTOCOL (RIP)

RIP is a distance vector routing protocol that employs the hop count as a routing metric. It is assigned the reserved port number 520. It has lower power consumption and memory. RIP incorporates the Bellman Ford Distance Vector algorithm to determine the best path. Brief detail of this algorithm is given below [Umut Acar, 2013]:

- Bellman Ford algorithm is an algorithm that computes the shortest paths from a single source vertex to all of the other vertices in a weighted digraph.
- It is more versatile as it is capable of handling graphs in which some of the edge weights are negative numbers.
- If graph contains a negative cycle(i.e. a cycle whose edges sum to a negative value) that is reachable from the source, then there is no cheapest path. In such case Bellman Ford algorithm can detect negative cycle and report their existence.

IV. INTERIOR GATEWAY ROUTING PROTOCOL (IGRP)

IGRP is a distance vector routing protocol developed by cisco systems for routing multiple protocols across small and medium sized cisco networks. IGRP provides a robust protocol for routing within an autonomous system [Aaron Balchunas, 2012]. It uses a composite metric that is calculated by factoring weighted mathematical values for internetwork delay, bandwidth, reliability and load. It also prefers Bellman Ford algorithm to determine the best achievable path.

V. INTERMEDIATE SYSTEM TO INTERMEDIATE SYSTEM (IS-IS)

The IS-IS protocol was developed in the late 1980s by Digital Equipment Corporation (DEC) and was standardized by the International Standards Organization (ISO) in ISO/IEC 10589.IS-IS is a link state routing protocol used with large enterprise. IS-IS and OSPF shares almost similar properties. They both use areas to form a two level hierarchical topology. They both follow the Dijkstra's algorithm [Carlos Moreno, 2012] for calculating the shortest path. It is an IGP (Interior Gateway Protocol) scalable only for dynamic routing within a domain.

VI. OPNET MODELER

Optimized Network Engineering Tool (OPNET) [Prokkola, 2008; Vohra et al., 2010; Kennelly, 2012; Rajan Vohra et al., 2012, 2012A] is a commercial network simulation environment for network modeling. It is a powerful network simulator. It simulates the network graphically and its graphical editors mirror the structure of actual networks and network components. It provides a variety of toolboxes to design, simulate and analyze a network parameters. Network with several hundreds of nodes can be managed. OPNET modeler version 14.5 is used for simulations.

VII. SIMULATION MODEL

The model consists of 500 Km × 400 Km enterprise network with three interconnected subnets: subnet_0, subnet_1, subnet_2. Each subnet consists of two switches, different number of routers (as stated in table 1), fifty workstations or LANs working on three different applications i.e. Ftp, Remote Login and Videoconferencing. Initially each subnet considered has fifty workstations and the network was duplicated three times to have three scenarios. Then RIP considered in the first scenario, IS-IS in the second scenario

and IGRP in the third scenario. The scenario is shown in figure 1 and the internal topology of the subnet for 50 workstations is shown in figures 2. The main characteristics of the scenario are depicted in table 2.

Table 1: Number of Routers in Subnets

Subnet	Number of Routers
Subnet_0	4
Subnet_1	3
Subnet_2	5

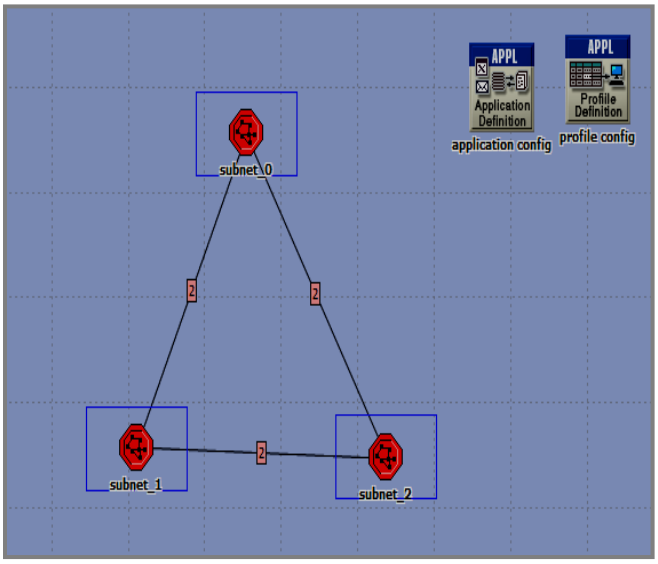

Figure 1: Network Scenario

Table 2: Main Characteristics of Scenario

Parameters	Values
Simulator	OPNET Modeler version 14.5
Protocols Studied	RIP,IGRP,IS-IS
Scenario Size	500 Km × 400 Km
Number of Subnets	3
Number of Workstations	50
Links	100BaseT, PPP_DS3
Applications	Ftp, Remote Login, Videoconferencing
Simulation Duration	5 min
Simulation Kernel	Optimized

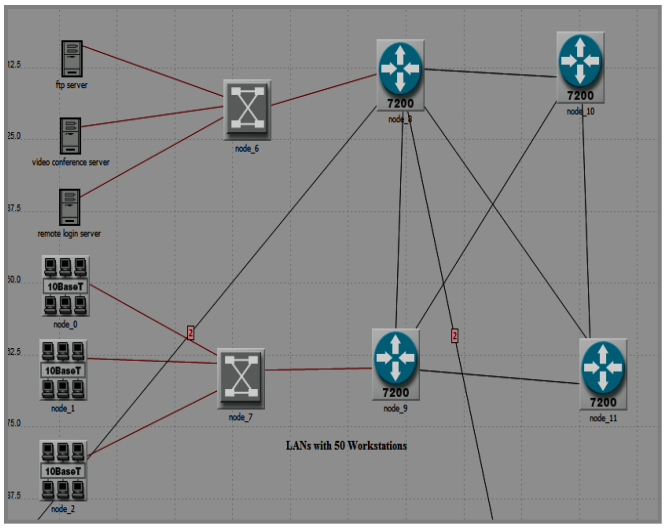

Figure 2: LANs with 50 workstations for subnet_0 Topology

VIII. Simulation Results and Analysis

The results of simulation are studied and analyzed to get the performance of three routing protocols i.e. RIP, IGRP, IS-IS for three different scenarios. The comparative analysis is based on two parameters: Ftp Download Response Time and Ftp Upload Response Time. All the metric statistics are collected for different scenarios.

Table 3: Ftp Download Response Time for Different Number of Packets

Ftp Download Response Time (sec)			
Number of Packets per sec	Protocols		
	IS-IS	IGRP	RIP
100	6.46	7.82	8.44
200	2.037	7.11	18.613
500	6.4631	12.080	13
800	0.8198	16.616	18.846
1000	0.8198	17.891	12.537

IX. FTP Download Response Time

Ftp application is heavily used by the users in the scenario, the Ftp access is done from the Ftp server in the network. Figures 3, 4, 5, 6 and 7 shows Ftp download response time in seconds for different packets varying from 100,200,500,800 and 1000 per second. Table 3 predicts the results obtained by Ftp download response time. Observations show that for IS-IS 50 workstations for 800 and 1000 packets, Ftp download response time is fastest of 0.8198 sec over other protocols. The slowest Ftp download response time of 18.846 sec is delivered by RIP protocol for 800 packets. It has been found that Ftp download response time for IGRP prodigally increases for large number of packets up to 17.891sec of response time for 1000 packets. RIP protocol possesses increase in the Ftp download response time for different packets than for 1000 packets sent which implies a sustained reduction in the response time i.e. 12.537 sec. It is well noticed that Ftp download response time decreases for increasing number of packets implied on IS-IS protocol which has observed fast response than other protocols and hence it is advantageous in terms of high performance, less consumption of time, and speed enhancement for this particular network.

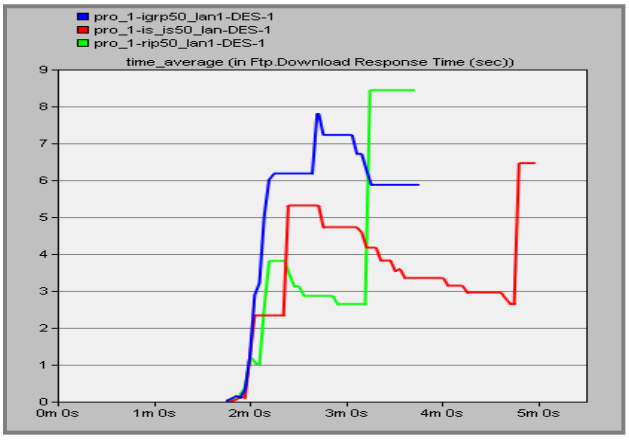

Figure 3: Ftp Download Response Time for 100 Packets

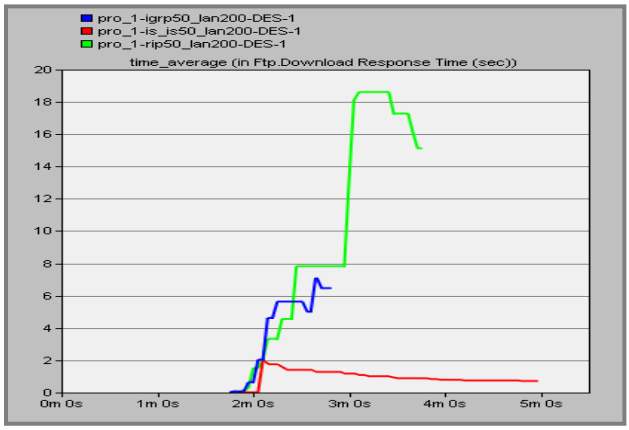

Figure 4: Ftp Download Response Time for 200 Packets

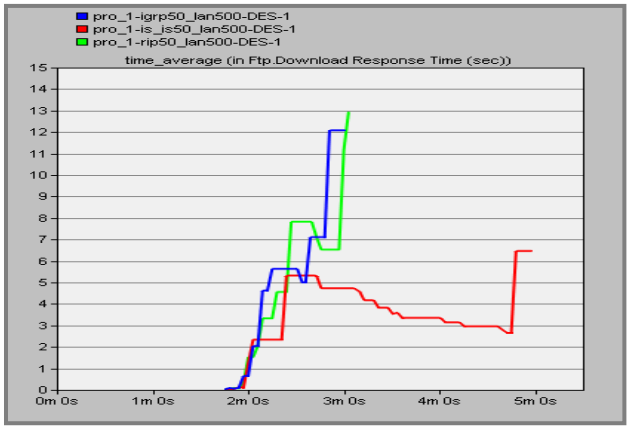

Figure 5: Ftp Download Response Time for 500 Packets

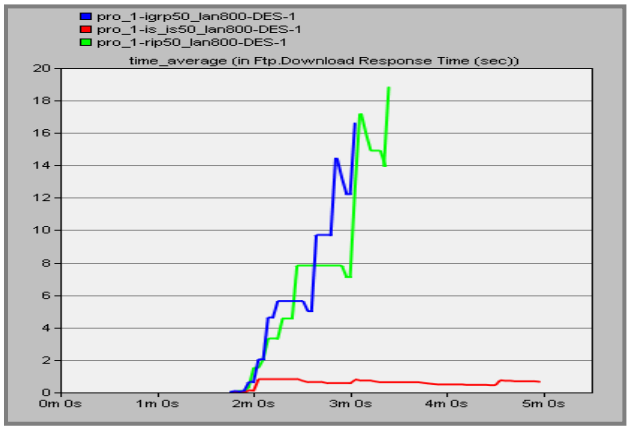

Figure 6: Ftp Download Response Time for 800 Packets

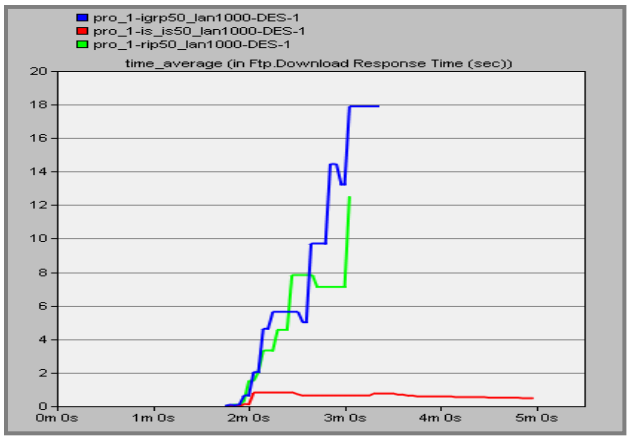

Figure 7: Ftp Download Response Time for 1000 Packets

Table 4: Ftp Upload Response Time for Different Packets

Ftp Upload Response Time (sec)			
Number of Packets per sec	Protocols		
	IS-IS	IGRP	RIP
100	5.30	26	14.650
200	8.655	15.325	17.69
500	5.307	22.592	14.593
800	2.074	17.485	18.18
1000	2.074	17.800	20.466

X. FTP UPLOAD RESPONSE TIME

Heavy Ftp Upload Response Time is used by the users in the network and the application service is supported by the server. Figure 8 to 12 shows Ftp upload response time in seconds for different packets. Table 4 describes the Ftp upload response time after simulating for five minutes. It was conferred that fastest Ftp upload response time is 2.074 sec for 800 and 1000 packets affirmed by IS-IS protocol whereas RIP leads to increase in the Ftp upload response time for increasing number of packets. IGRP showed increase in the Ftp upload response of 26 seconds for 100 packets whereas IS-IS showed response of 5.30 seconds which is differing largely than IGRP. Again for rest of the packets IS-IS gives fast response time as compared to IGRP and RIP. IS-IS and IGRP represents almost same ftp upload response time for 800 and 1000 packets whereas RIP has slightly varying values i.e. increases for 1000 packets. Also IS-IS and RIP performs certainly equal for 100 and 500 packets than IGRP whose response time is decreasing form 26 sec to 22.592 sec which is better to enhance the speed of a network. The slowest Ftp upload response time is given by IGRP of 22.592 sec for 500 packets.

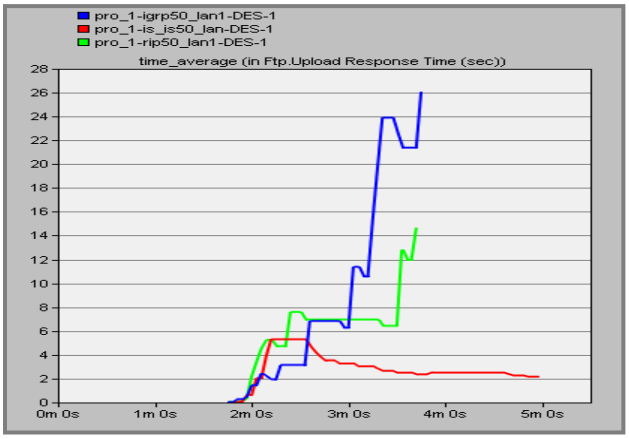

Figure 8: Ftp Upload Response Time for 100 Packets

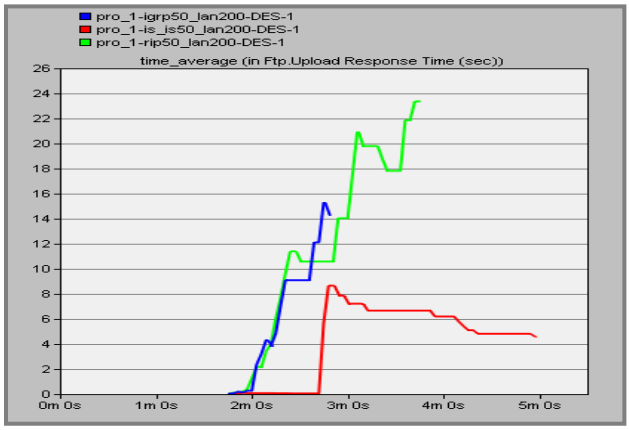

Figure 9: Ftp Upload Response Time for 200 Packets

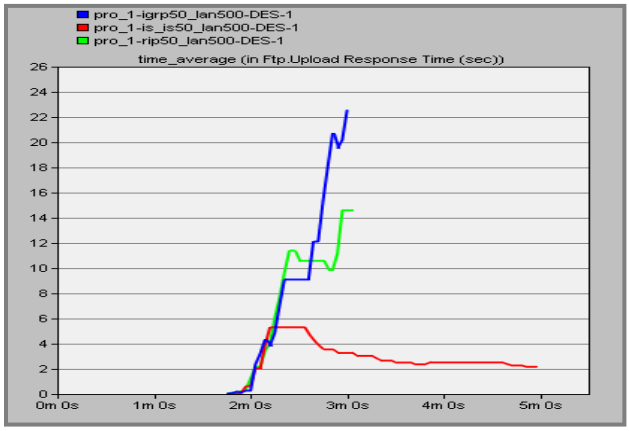

Figure 10: Ftp Upload Response Time for 500 Packets

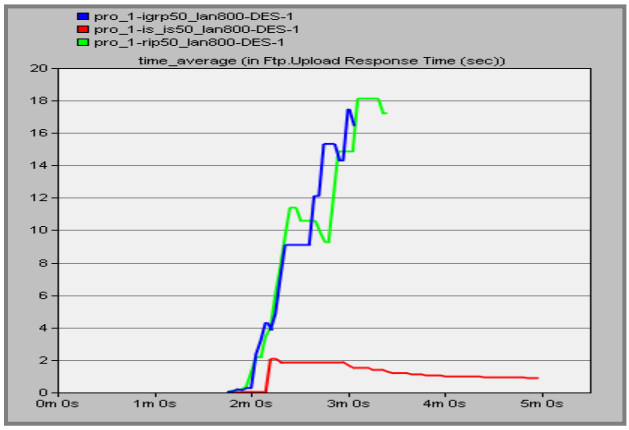

Figure 11: Ftp Upload Response Time for 800 Packets

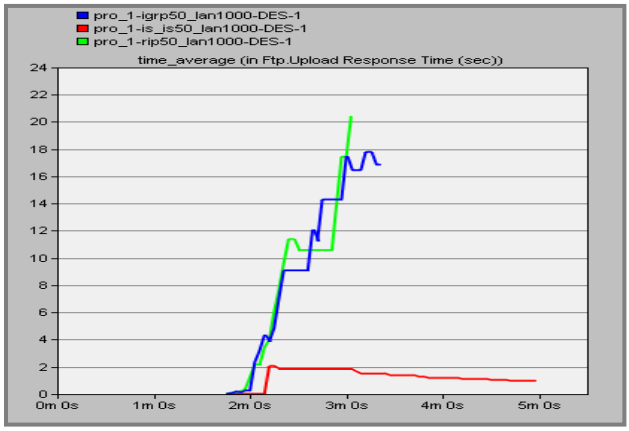

Figure 12: Ftp Upload Response Time for 1000 packets

XI. Conclusion and Future Work

Concluding the performance of the routing protocols it was observed that to have fastest Ftp download response time IS-IS should be preferred for 800 and 1000 packets whereas slowest response is obtained by RIP protocol. IS-IS also converges faster which means IS-IS is fast in response in comparison to IGRP and RIP. Ftp download response time for IGRP occupies a place in between for increasing number of packets.RIP for increasing number of packets affirms slower Ftp download response time. Ftp Upload Response Time for IS-IS protocol is fastest than IGRP and RIP protocols and slowest Ftp upload response time is given by IGRP. It is concluded that IS-IS is considered for larger number of packets while RIP suits best for smaller number of packets. IS-IS protocol study reveals that for increasing number of packets Ftp download response time and upload response time becomes faster and hence it is quiet advantageous in terms of high speed network performance which makes it reliable and less consumption of bandwidth. It is desirable to extend these studies further to evaluate the performance of the routing protocols for other applications and different parameters. There will be more evaluation of results by using the different attributes of nodes that are used to design the network scenario. The project prefers the same size of traffic sent for different number of packets, so further implementation can be done by using different size of packets. There could be extend to the design of network scenario by using higher number of network nodes, adding more workstations, traffic load and different application with varying description.

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