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Performance Issues and Evaluation considerations of web traffic for RIP & OSPF Dynamic Routing Protocols for Hybrid Networks Using OPNET™

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Abstract— In this paper, performance analysis of the Wireless and Wired computer networks for combination of conventional model of RIP and OSPF is evaluated through simulation which has been attempted using OPNET as simulating tool. For networks, the performance parameters like wireless LAN media access delay and throughput have been investigated with varying conventional and intergraded proposed protocol. The investigations have been analyzed through parameters like analysis of HTTP traffic sent and received, Client HTTP page and Object response time and Server HTTP task processing time. From the obtained results, it is gathered that there is significant improvement in Server HTTP task proceeding time with the same server HTTP load. For the tested simulation scenarios the performance is observed to be better for combined RIP and OSPF dynamic routings protocol with significant change in client HTTP page and object response time, which has been reduced by the order of 2sec.

Keywords - RIP, OSPF, Hybrid Networks and OPNET.

I. INTRODUCTION

Forwarding of The Internet Protocol (IP) packets is the primary purpose of Internet routers [1]. A routing protocol is a set of process, algorithm, and messages that are used to learn about remote networks and to quickly adapt whenever there is a change in the network topology. Routing protocols can be classified into different groups according to their characteristics: Interior Gateway Protocol (IGP) or Exterior Gateway Protocol (EGP); Distance Vector or Link State; Classful or Classless. Some of the most commonly used routing protocols are as the follows:

- RIP: A classful distance vector IGP
- RIPv2: RIP version 2. A classless distance vector IGP
- EIGRP: The advanced distance vector IGP developed by Cisco
- OSPF: A link state IGP

There are several ways to differentiate routing protocols. An important characteristic of a routing protocol is how quickly it converges when there is a change in the topology. The network has converged when all routers have complete and accurate information about the network. Other characteristics include scalability, resources usage, end-to-end delay, and management overhead. The primary goal of this paper is to analyze these characteristics under a variety of network settings by using professional simulation software called OPNET.

However, in the real world, nodes are added to networks, links fail, and topologies change. As networks get larger, administration and management headaches increase. Therefore, automated route management rapidly becomes a necessity. This paper takes a look at two of the more significant routing mechanisms that are used in the Internet, the Routing Information Protocol (RIP), and the Open Shortest Path First (OSPF). RIP, implemented in the widely available BSD UNIX daemon routed, has been around for some time and is an example of a vector-distance routing scheme. OSPF is a newer development, and is based on a link-state algorithm. The Open Systems Interconnect (OSI) Intermediate System (IS) to IS protocol is similar in concept to OSPF as it is based on a link-state algorithm and includes many of the same features that can be found in OSPF.

The Internet architecture is based on the concept of the interconnection of many "Autonomous Systems." An Autonomous System is characterized by a single management authority along with the use of a consistent routing architecture. Each of these systems is responsible for the maintenance of its own routing, and connects to the network through different routing protocols. The routing algorithms used within the Autonomous System are referred to as Interior Gateway Protocols (IGP), that can be RIP, OSPF, or whatever else is chosen by the network architects. The routing algorithm used to connect the Autonomous System to the Internet is referred to as Exterior Gateway protocols.

Several exterior gateway protocols are in use today, with the most popular being the Exterior Gateway Protocol (EGP) and the Border Gateway Protocol (BGP). The term "gateway" is somewhat historical, and is the term applied in early Internet architecture efforts. The term "router" is more consistent with the concepts as defined within the OSI standards.

Feature	RIP	OSPF
Algorithm	vector-distance	link-state
Maximum Hops	15. 16 hops is considered to be infinity, implying that the destination is unreachable	Limited only by size of routing tables within routers
Subsystem Segmentation	Treats the autonomous system as a single subsystem	Breaks the autonomous system into one or more areas with two levels of routing algorithms, intra-area, and inter-area.
Metric	destination/hop	destination/cost/link identifier
Integrity	no authentication in RIP-1, Authentication has been added to RIP-2	Supports Authentication. Several authentication algorithms are available ranging from simple password operations to more complex cryptographic algorithms.
Complexity	Relatively Simple - Each router	More Complex. Several more PDUs and exchanges are defined in the protocol. Routing tables are large and include not only destinations, but also a tree representation of local network.
Acceptance	Widely Available, BSD routed supports RIP	newer, published in RFCs
Route Options	Identifies a single route to a destination	Supports multiple routes to a single destination. Facilitates load-balancing traffic distribution
Types of Routes	host, network. RIP-2 adds the ability to transfer subnetwork route entries	Host, network, and subnetwork routes

TABLE 1 - MAJOR FEATURES OF RIP, OSPF

As can be seen by this discussion on routing, RIP provides the major services required to perform automated route management within an autonomous system, provided that the system complexity is kept small (no greater than 15 logical hops between any two nodes), can afford to risk faulty routing broadcasts, and does not require any form of load balancing. Systems requiring these services should consider either RIP-2 that adds features for logical subnetting and authentication, or consider using the more complex OSPF protocols. OSPF, as a link-state protocol, scales to larger topologies and avoids the slow convergence problems through routers maintaining a more complete map of the network topology. Both RIP and OSPF are widely deployed but at the same time RIP is not applicable in large networks due to slow convergence and limited network size that can be handled where as at the same time OSPF is suitable for large networks due to fast convergence and hierarchical routing. OSPF (Open Shortest Path First) is an interior gateway protocol. OSPF [2] is a classless link state protocol. OSPF is standardized and widely deployed in public and private networks. OSPF is link-state protocol. Link- state refers to the idea of that OSPF advertise information about each route instead of sending periodic routing table updates like a distance vector protocol. OSPF is also known as hierarchical routing protocol because of its ability to divide the large areas into small multiple areas. This includes the concept of area routers and edge routers. Area routers routes within the area while edge routers provide the facility for routing between the multiple areas. Each area is associated with an area number (also known as autonomous number system). The backbone area is always having area number 0. The areas are also divided into the backbone area, stub area,
totally stub area and not-so-stubby area based upon the organization requirements. Extending OSPF to work will allow new heterogeneous networks to exist, encompassing both wired parts and multi-hop wireless parts in the same routing domain [3]. OSPF uses the SPF (Shortest Path First) algorithm to calculate the cost. SPF works in tree structure to calculate the cost from root. Root is the router from which cost is calculated to other routers. This algorithm is known as the DijKstra's algorithm [3]. The paper [4] studies the effect of routing tables update-time on networks' performability, i.e. the ability of network to deliver services at predefined level. The paper [5] presents Performance Analysis of Wired and Wireless LAN Using Soft Computing Techniques.

This paper presents the modeling and simulation of hybrid network based on OPNET^{TM} to investigate the performance of integration of RIP with OSPF. We have been focused on the estimation of effects on behavior of HTTP traffic, throughput, delay using varying routing protocols , varying physical characteristics have investigated Client HTTP Page Response Time (sec) and Object Response Time (sec), HTTP Server task processing time(sec), Wireless LAN

Load(bits/sec), Wireless LAN Throughput(bits/sec), Wireless LAN Media Access Delay (sec), the for two routed hybrid network consisting of four independent WLANs connected through a wire line distribution system.

The proceeding sections involve the implementation of wired and wireless local area network models and the performance analysis of both conventional and integrated routing protocol on hybrid networks using OPNET (Optimized Network Engineering Tool).

II. MODELLING AND SIMULATION

A model is a logical, physical, mathematical representation of an entity, process, a system or phenomenon. These models are analyzed by the network designers to predict how these networks would perform in real-time. This adoption of low cost simulation techniques helps to overcome expenses and design an accurate network model. Models can be static or dynamic. While static models are not effective for changing environments, the dynamic models are much effective over there. This dynamic modeling is called simulation. Simulation can be used to model the ideas, evaluate the pros and cons of the network designs, make alternatives and finally choose a better configuration just by sitting at one place .i.e. the designers can predict and estimate the performance of the system. It is the replica of a dynamic process within a model to achieve knowledge, which one can carry over to reality. Network simulations allow alternatives to be compared under a wider variety of workloads and environments.

Among the various simulators available, Optimized Network Engineering Tools (OPNET) IT Guru Academic Edition is a simulator which is comprehensive and technology neutral in its capabilities [6]. IT Guru enables the network designers to create a virtual network consisting of relevant hardware, protocols, and application software. This virtual network is a pure software entity that can run on an individual workstation. This network can be scaled from a small LAN to wide area network. Once a virtual network has been created it can be manipulated according to the need of the application. The OPNET IT Guru provides a GUI to create the virtual network conveniently. OPNET simulator is built on top of discrete event system (DES) and it simulates the system behaviour by modeling each event in the system and processing it through user defined processes. OPNET is very powerful software to simulate heterogeneous network with various protocols. It has several distinct methods of creating topologies. Modeler supports almost all network types and technologies [7].

A. Design and Analysis in OPNET

When implementing a real model of the system in the OPNET, some steps are to be followed to design on simulator. Figure 1 shows the workflow for OPNET.

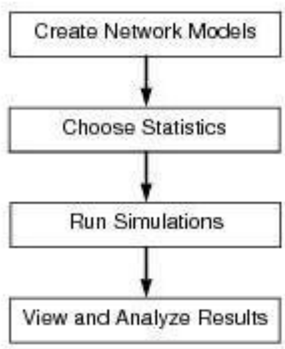

Figure 1: Design Steps

B. Simulation Environment

The scenario consists of 4 independent wireless LANs (WLANs). These WLANs are connected through a wireline distribution system. There are two servers in the entire campus, located in the office building 1 and 2 subnets. The workstations in the other two office buildings will communicate with one of these servers using wireline distribution systems. Note that all the workstations in the campus will select random server destination.

Scenario I: Hybrid Network with RIP routing protocol
Scenario II: Hybrid Network with RIP and OSPF routing protocol

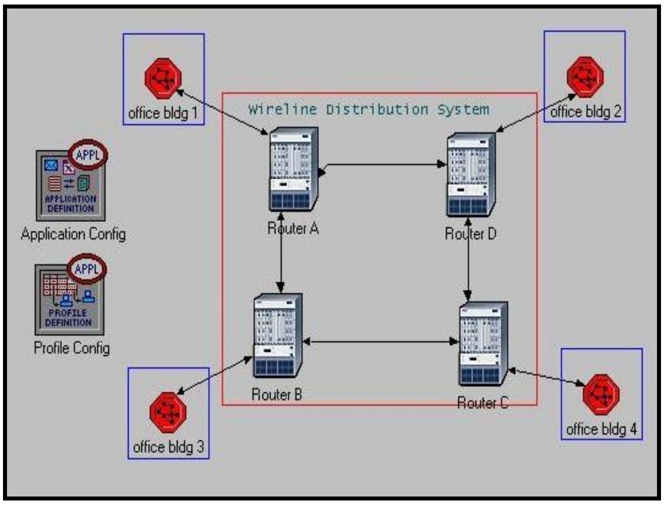

Figure 2: Network Diagram

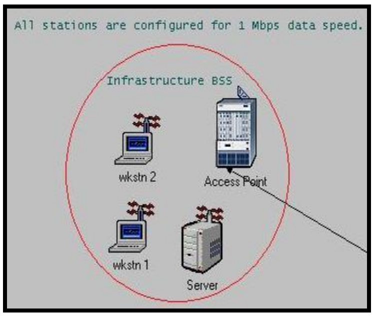

Figure 3: Office 1

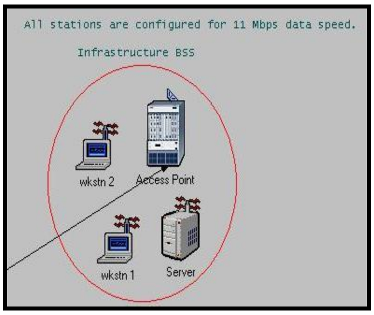

Figure 4: Office 2

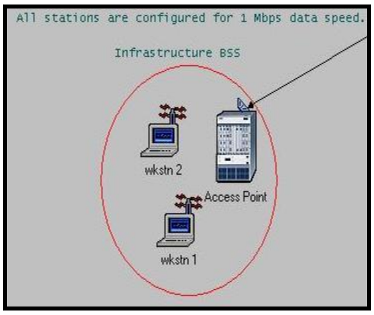

Figure 5: Office 3

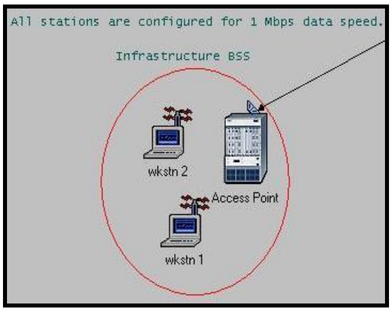

Figure 6: Office 4

Moreover, analysis and optimization is difficult in real but simulation is one of the alternative options for the same.

III. PERFORMANCE ANALYSIS

This section describes the performance analysis of wireless and wired computer networks using simulation. In this paper simulations has been performed for both the conventional RIP and proposed integration of RIP and OSPF protocol are presented in figure 6 to 15. The simulation shows the affect of high speed wireless LAN network with media access delay and HTTP object / Page response time statistics for both the protocols.

Figure 6 and 7 illustrates the wireless LAN media access delay and wireless LAN throughput with both the scenarios. We can see that media access delay is lower in case of modified protocol, it has been reduced from 36msec to 32msec where as the throughput has been increased from 113 bits/sec to 123 bits/sec.

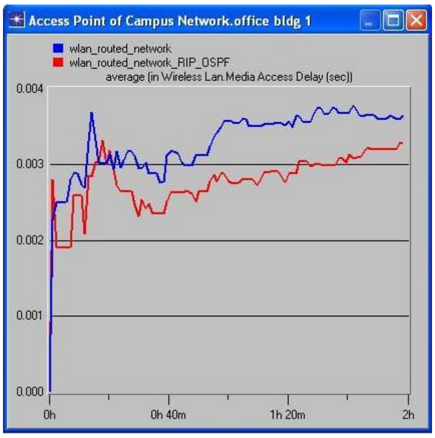

Figure 6: Wireless LAN Media Access delay (Sec)

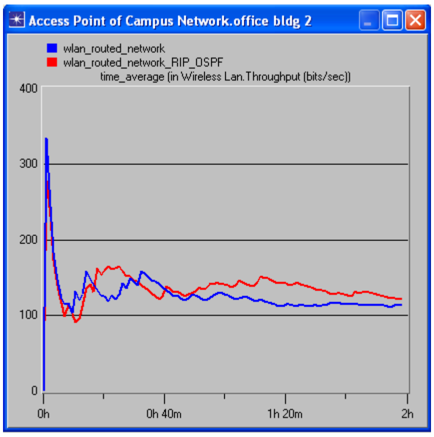

Figure 7: Wireless LAN Throughput (bits/sec)

Figure 8 to 15 shows simulations run-time corresponding to the client and server HTTP response time while transferring the files between networks under both the conventional and proposed scenarios. Simulation results shows that the client HTTP page response time has been reduced from 85msec to 65msec with the new modified protocol where as the client HTTP object response time (sec)n has been reduced from 41.1msec to 32.2msec with the proposed scenario.

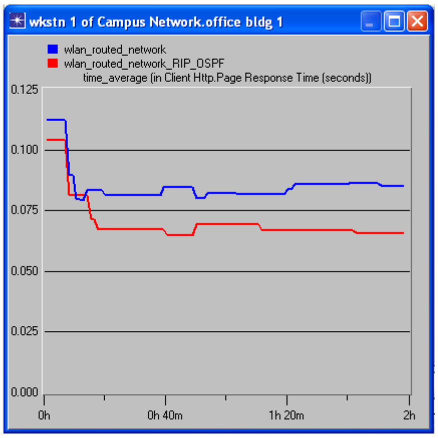

Figure 8: Client HTTP Page Response Time (Sec)

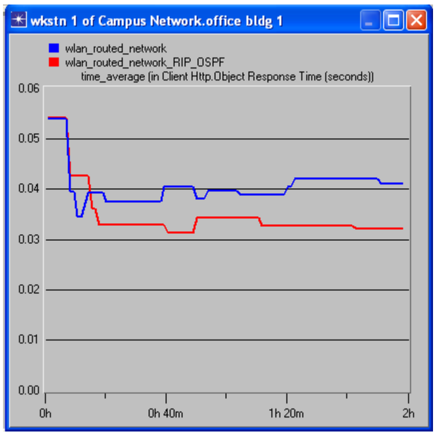

Figure 9: Client HTTP Object Response Time (Sec)

Figure 10 and 11 illustrates the client HTTP Traffic Sent and received, which has shown significant improvement for traffic sent it has been increased from 3.57bytes/sec to 5.56bytes/sec and traffic received has been increased from 2.63 to 4.17 bytes/sec.

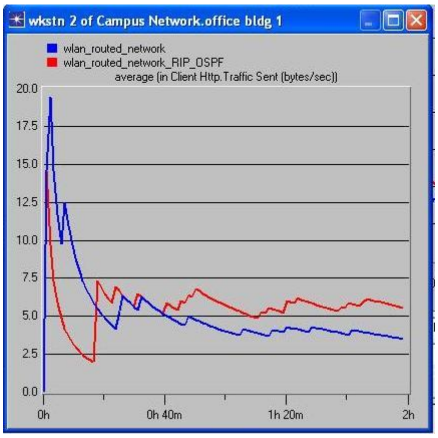

Figure 10: Client HTTP Traffic Sent (bytes/sec)

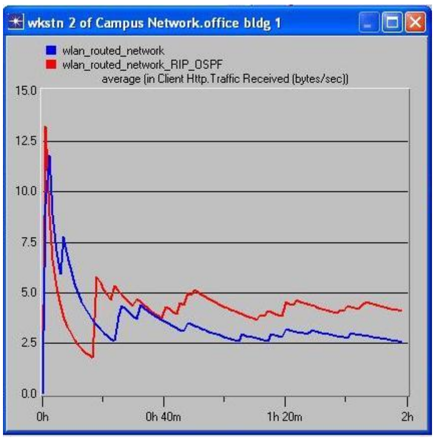

Figure 11: Client HTTP Traffic Received (bytes/sec)

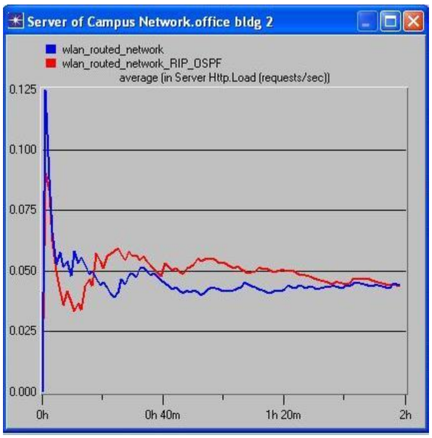

Figure 12: Server HTTP Load (requests/sec)

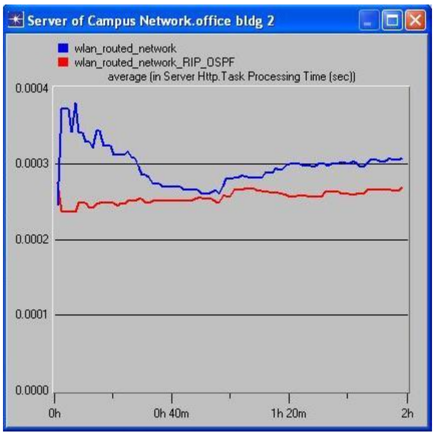

Figure 13: Server HTTP Task Processing Time (sec)

Figure 14 -15 shows the server HTTP downloaded objects and client HTTP downloaded pages which remain same as the simulation progress which is 6.7 objects and 1.11 pages respectively with both the scenarios.

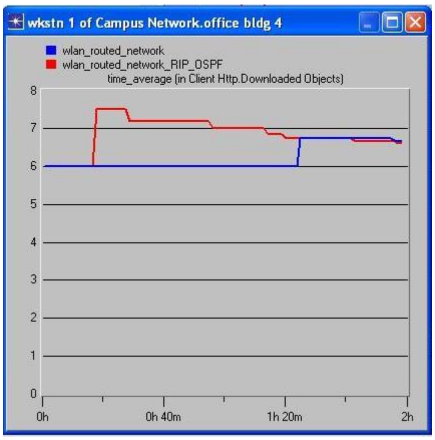

Figure 14: Client HTTP Downloaded Objects (Objects)

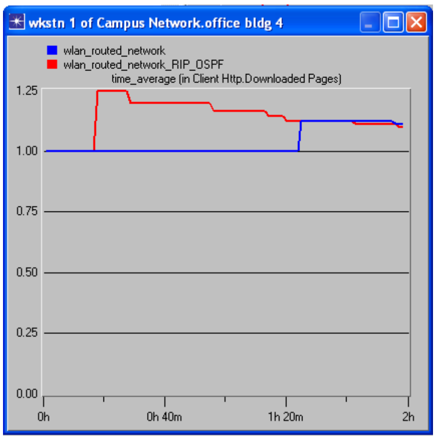

Figure 15: Client HTTP downloaded Pages

IV. CONCLUSIONS

This paper present the network for web HTTP traffic for different routing protocols using OPNET™. The paper presents the implementation decisions to be made when the choice is between protocols that involve distance vector or link state or the combination of both. Here a comparison is made between different parameters and a detailed simulation study is performed on the network with both the conventional RIP and RIP with OSPF routing protocols and it has been shown that RIP with OSPF provides a better network performance as compared to RIP. RIP is the dynamic routing protocols being used in the practical networks to propagate network topology information to the neighboring routers.

The simulations were evaluated with respect to Client HTTP page and object response time and client HTTP traffic sent and received when the HTTP traffic is exchanged between the nodes in network. From the obtained results, it is gathered that there is significant improvement in Server HTTP task proceeding time with the same server HTTP load. For the tested simulation scenarios the performance is observed to be better for combined RIP and OSPF dynamic routings protocol with significant change in client HTTP page and object response time, which has been reduced by the order of 2sec.

There have been a large number of static and dynamic routing protocols available but choice of the right protocol for routing is dependent on many parameters critical being network convergence time, scalability, memory and CPU requirements, security and bandwidth requirement etc.

The future work may include the performance analyses on EGP protocols.

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