3.1 Optimized Network Engineering Tools:-

Optimized Network Engineering Tools (OPNET) Modeler is the industry's leading simulator specialized for network research and development. It allows users to design and study communication networks, devices, protocols, and applications with great flexibility.

OPNET is a simulator built on top of a discrete event system (DES). It simulates the system behavior by modeling each event happening in the system and processes it by user- defined processes [21].

3.1.1Design 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 4.1 shows a flow chart of the steps

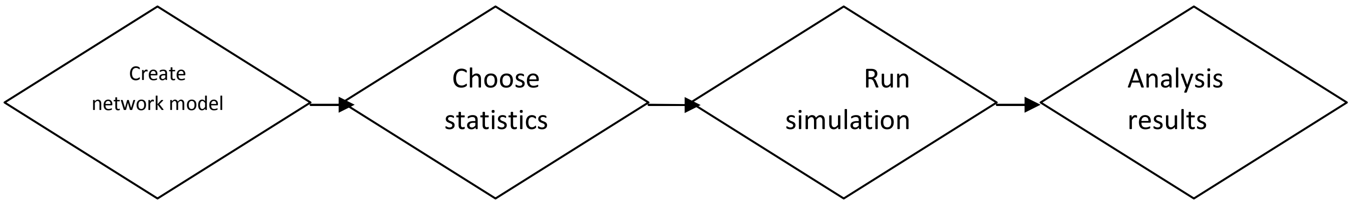

Figure (3.1) flow chart of the steps

In this section, would discuss the breakdown of the project implementation from initiating the topologies to setting various protocol and simulation parameters. In the following sections, would present the obtained simulation results and compared the performance of the three routing protocols.

In order to compare RIP, OSPF and EIGRP, would used OPNET 14.5 to implement two networks. These implementations were realized using Cisco routers connected by PPP_DS1. The small ring and mesh topologies that would implement, though unrealistic, are simple examples that are easy to analyze and focus on routing protocol behavior and performance. In other words, the purpose of the two simple topologies is for validation of the routing protocols. Would is obtained routing tables from the small ring topology in order to better understand the routing system of each protocol [22].

3.2 Network Topologies:-

TO used two networks topology for evolution three routing protocols: RIP, OSPF and EIRGP.

3.2.1 Small Ring Topology:

First would implement the simple ring topology shown in Figure (3.2) with 5 routers, each connected to 2 neighbor routers. The Rapid Configuration option on OPNET would used to achieve this network. Would chose this topology because of its simplicity, and also because would wanted to analyze its behavior when a link failure is added between Router 1 and Router 2. When this failure occurs, routes would be changes and routing tables would be updated. For example, all packets from Router 1would now have to flow through Router 5. Would analyze the routing tables from this topology after the link failure so as to ensure that this expected

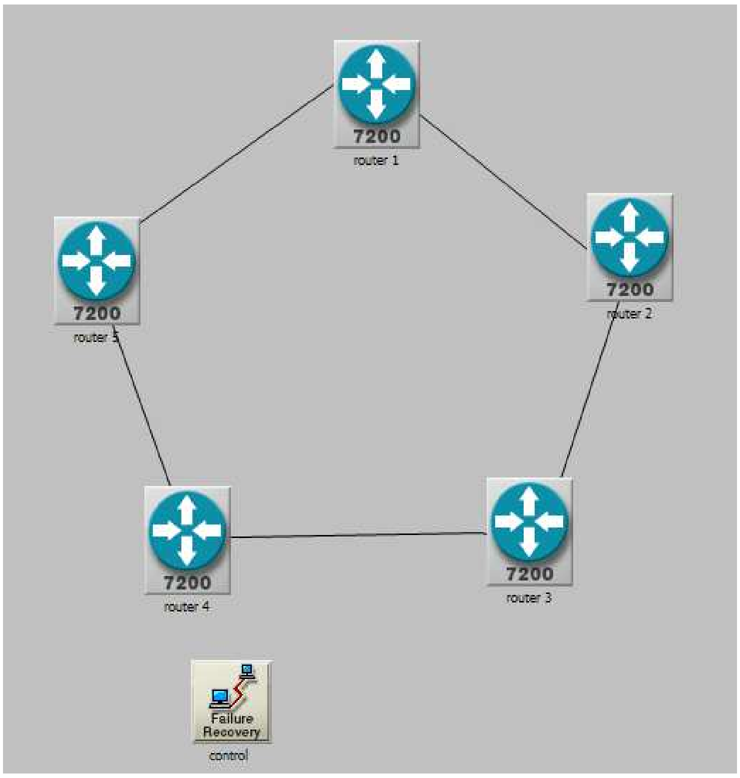

Figure (3.2) simple ring topology

3.2.2Small Mesh Topology:

Next topology, also attained by Rapid Configuration, is shown in Figure (3.3) .This small mesh also consists of 5 routers; however, now each router is connected to the 4 other routers in the network. As in the ring topology, would implemented a link failure between Router 1 and Router 2. Unlike in the ring topology, now each destination in the network is only one hop away. Therefore, when a link fails, routers have more than one backup path. Also, would expect more routing traffic sent than in the ring topology because each router has more neighbors to communicate with. Though this topology is not Realistic for most networks, it is simple and easy to understand.

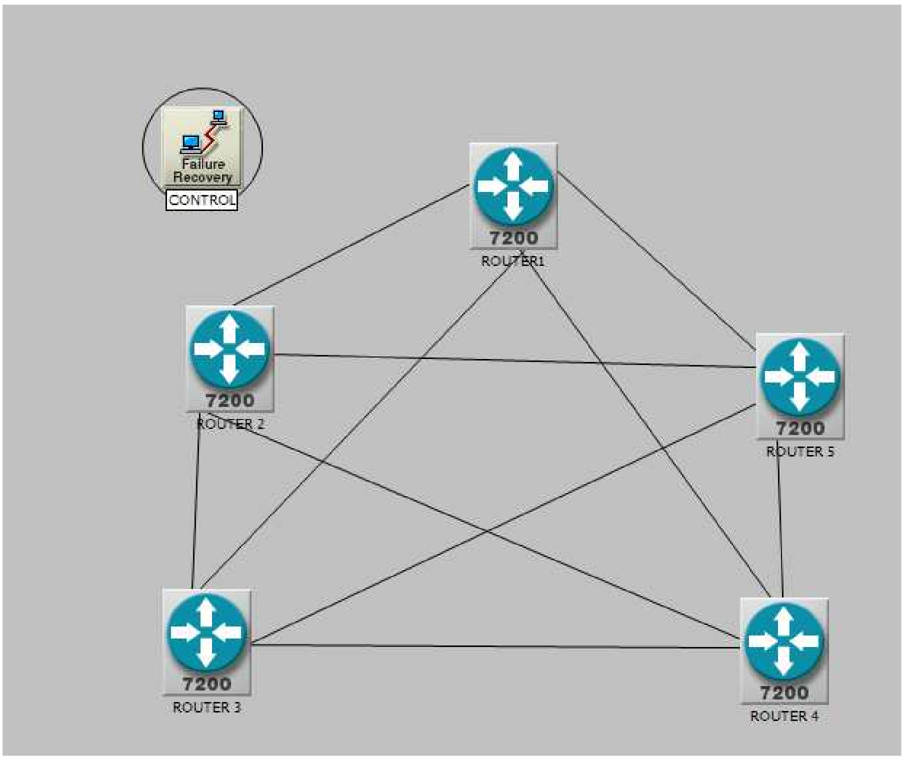

Figure (3.3) small Mesh topology

3.3 Simulation setup:-

Would presented simulation setup for failure/recovery and Global Attribute in networks.

3.3.1 Simulation setup for failure/recovery:

Would choose collect three sets of statistics. First, for the small ring topology would exported the routing tables of each protocol after the link failure. These tables serve to give us a better understanding of each protocol. Next, for all scenarios would collect Convergence Activity, Convergence Duration (sec) and Traffic Sent (bits/sec). It should be noted implemented user applications.

Here would mention the simulation parameters that are common to all network topologies and all protocols implementations. First, would simulate each scenario for 15 minutes, with a random seed of 128. Also, the link failure occurs at 300 seconds, and recover occurs at 480 seconds. Each protocol starts with a constant distribution and a mean outcome of 5. In OPNET's Discrete Event Simulation (DES) preferences window, would disabled RIP, OSPF, and EIGRP simulation efficiency to ensure that these protocols continue throughout the entire simulation [19].

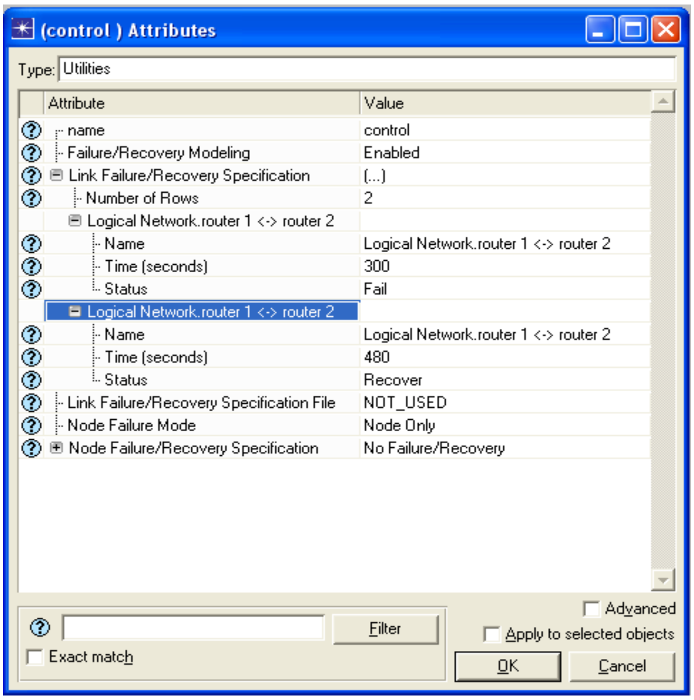

Figure (3.4) Simulation Setup for Individual DES statics

Since three protocols would examine, the individual statics would be set differently. It concludes the features would be compared in the project which is Convergence Activity, Convergence Duration and Traffic Sent (bits/sec).

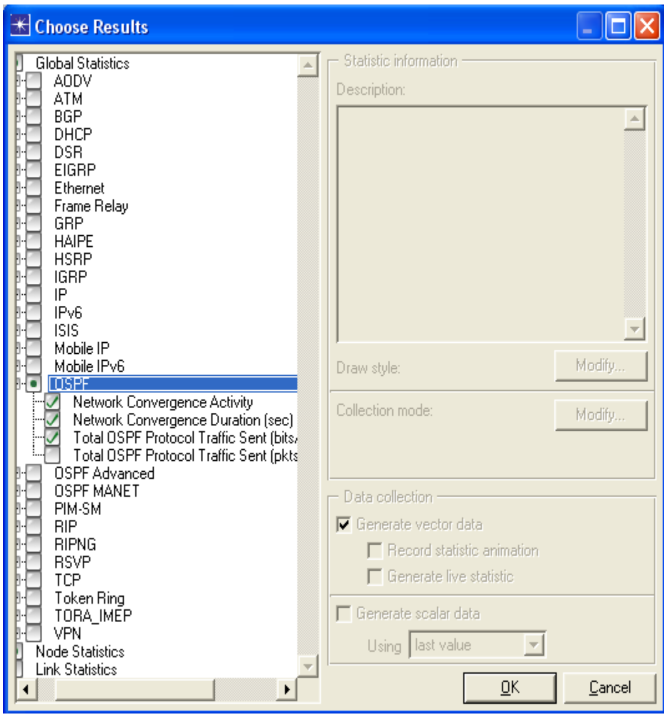

Figure (3.5) OSPF DES statics

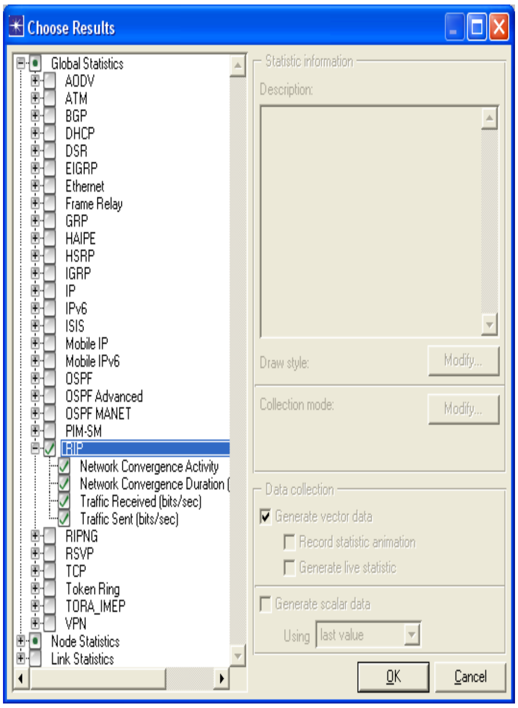

Figure (3.6) RIP DES statics

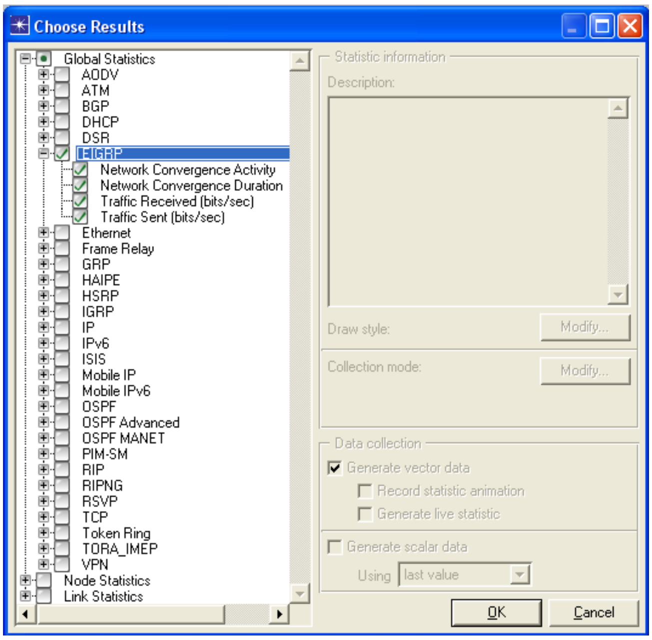

Figure (3.7) EIGRP DSE static

3.3.2 Simulation Setup for Simulation Global Attributes:

IP dynamic Routing Protocol is set to be RIP, OSPF and EIGRP respectively. And it exports routing table once the simulation is completed. Simulation efficiency for three protocols are disabled and stop time has been set to longer than the simulation time, it guarantees the protocols continue throughput until the end of the simulation [23] .

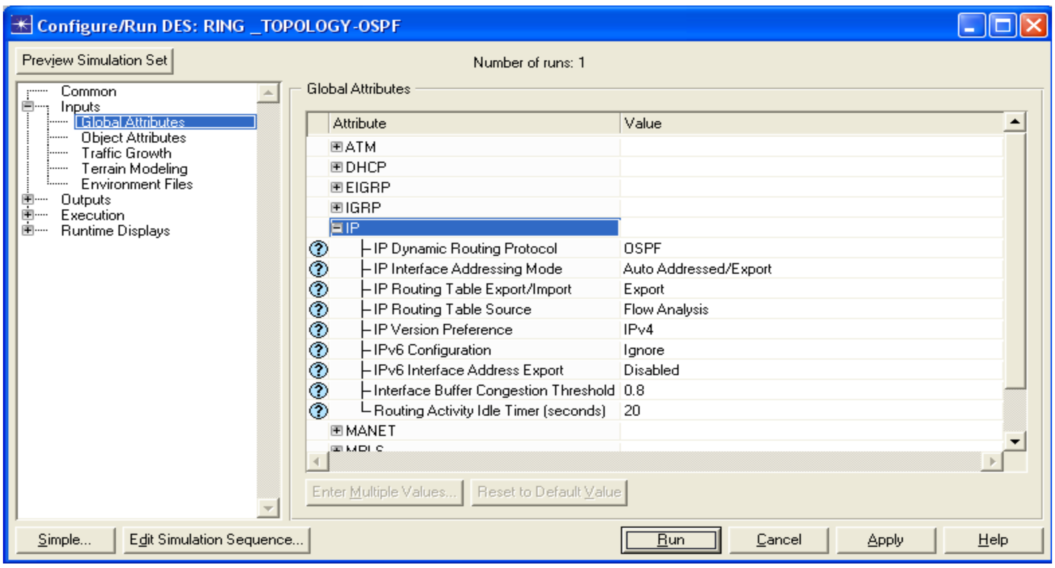

Figure (3.8) Simulation Global Attributes

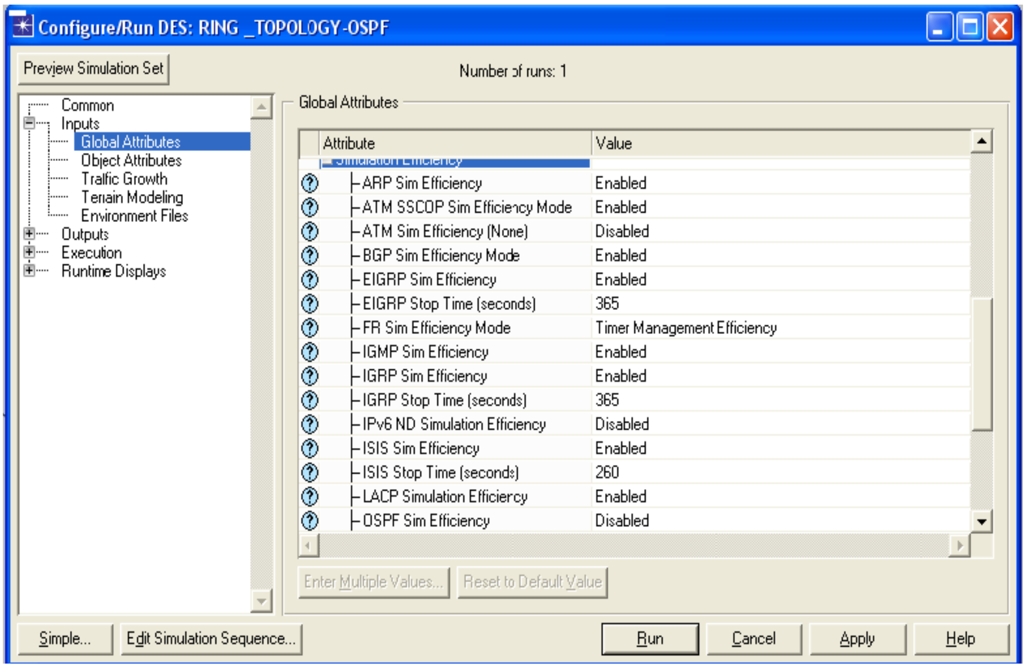

Figure (3.9) Simulation Efficiency setup

3.4 Routing Protocol Parameters:-

Routing protocol parameters for RIP, OSPF and EIGRP

3.4.1 RIP Parameters:

- The RIP routing tables are initialized with the local gateways IP addresses. The cost for these routes is set to 0.
- Silent RIP processes are modeled with a parameter that can be controlled by the user. Silent RIP processes do not send out routing update messages, and are normally used for hosts that do not act as network gateways.
- The start time at which the first regular routing updates are generated is a parameter that can be controlled by the user.
- Split Horizon with Poisoned Reverse is implemented to avoid including routes in updates sent to the gateway from which they were learned. Such routes are included in updates, but their metrics are set to infinity.
- Regular and Triggered Updates
- Garbage Collection (Flush) and Timeout (Route Invalid) timers [20].

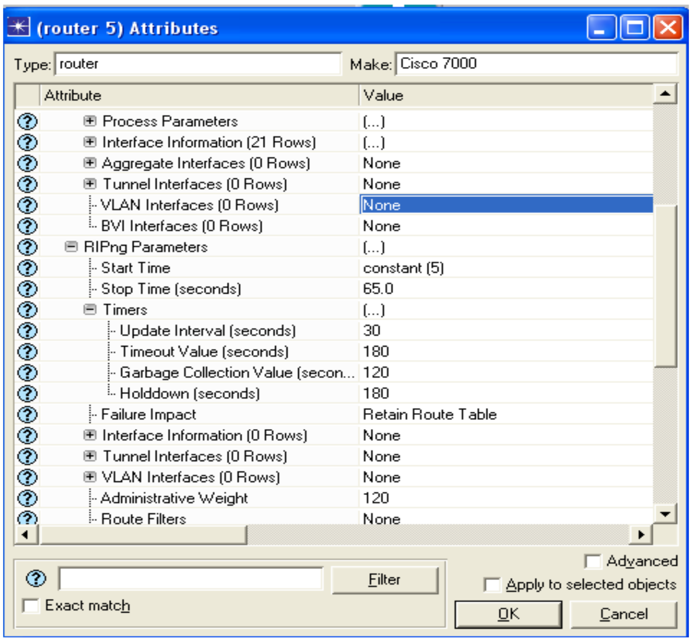

Figure (3.10) RIP Parameters

3.4.2 OSPF parameters:

- Hello interval: Time between Hello packets sent by the router on this interface. This value should be same for all interfaces connected to common network. The default value is 10 seconds.
- Router Dead Interval: Time after which, if a neighboring router's Hello messages are not seen, it is considered inactive. It should typically be set to some multiple of the Hello Interval, and should be the same for all interfaces attached to a common network. The default value is 40 seconds.
- Interface Transmission Delay: The estimated time it takes to transmit a link state advertisement (LSA) packet over this interface. This value is used to age an LSA prior to transmission on an interface. The default value is 1 second.
- Retransmission Interval: Time (in seconds) between LSA retransmissions for adjacencies belonging to this interface. The default value is 5 seconds [21].

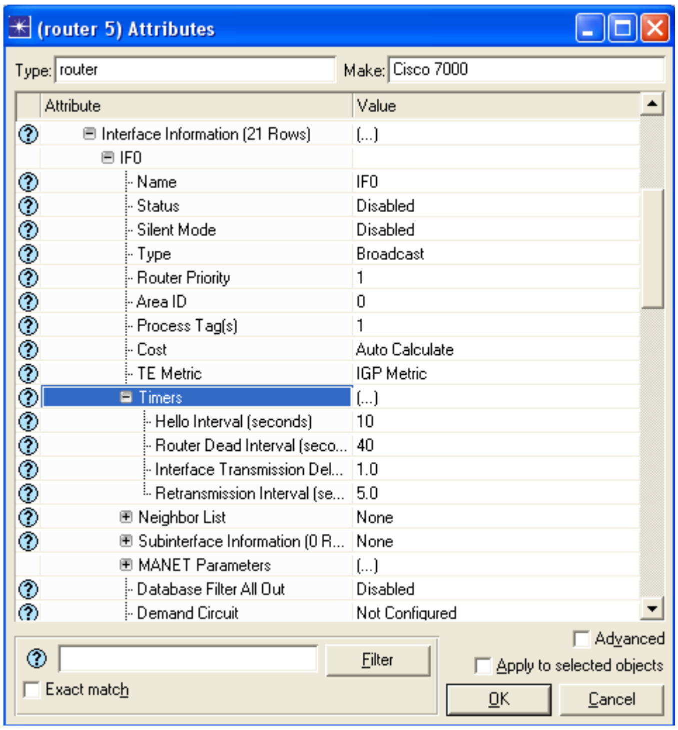

Figure (3.11) OSPF Parameters

3.4.3 EIRGP parameters:

- Hello Interval. Determines the times hello interval between hello messages. A high value lowers the EIGRP traffic in steady state, and a low value enables node failures to be detected more quickly.
- Hold Time. Specifies the value of hold time, which is advertise in the hello message sent over the corresponding interface. The hold time value defines the amount of time a neighbor should wait for another hello message from this process model before marking its node as down. A high hold time value delays the detection of node failures, and a low value may cause misjudging the status of a neighbor as down because of a few delayed or dropped hello packets.
- Split Horizon. Enables or disables split horizon on the interface. The default configuration enables this feature on all interfaces.
- Route Filters. Specifies the prefix/distribute lists used to filter routes received on or sent from this interface. Prefix/distribute lists are defined in the IP > IP Routing Parameters > Prefix Filter Configuration attribute [23].

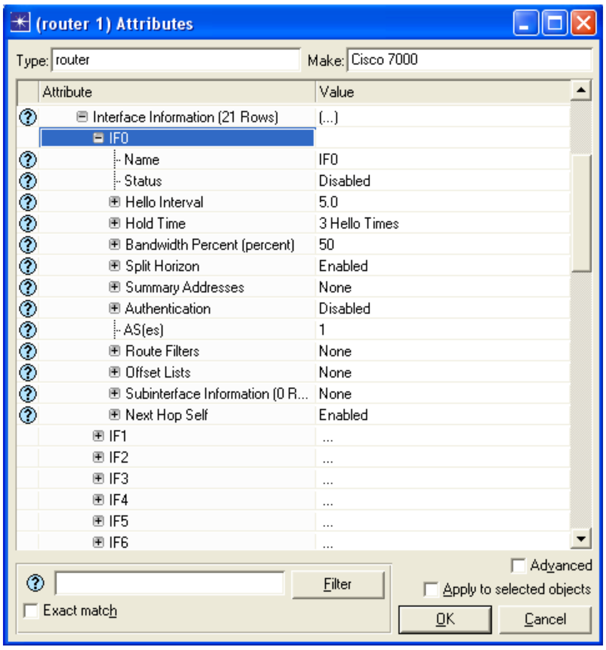

Figure (3.12) EIRGP Parameters