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Network Route Minimization Using Time Based Interface Control

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***Abstract*—**The demand for networking is increasing day by day with the progressive need of communication. As a result the communication channel and state database are increased with correspondingly. A rise in the amount of state database maintenance is one of the important cost effective issues for communication devices. The most challenging think is router state database reducing. As of now, many different types of state table accomplishments method are proposed for router state database reducing.

In this purpose, we apply and modify the SPF algorithm by time based interface control. Dijkstra's SPF algorithms searching the shortest specific link among from the all link then build a router state database table. If the state table size is little amount, then router OS using little amount of clock cycle. Some of Network interface are down for a fixed amount of time in a router. Therefore, we proposed a time based interface control method on SPF algorithm for re-build a new state database table. The modified SPF time based interfaces control algorithm suggests a new approach on dynamic routing protocol for reducing routing table size and saving router state-database size, resulting in a better convergence time.

Keywords-*Link State, Time Based Interface Control, Route Minimization, Dijkstra's SPF Algorithm, LSDB, SPF, OSPF*

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I. INTRODUCTION

Computer Industry faces the greatest challenge for networking factors like time, cost and database size utilization are always the challenging criteria for this industry. Many methods are available for dealing with this problem. OSPF, EIGRP, BGP, RIP, IS-IS [14] and many others protocol are used in industry for constructing a Network at present.

The aim is to calculate a path with the least cost (best path) so as to send traffic (packet) via that path. Computer is a collection of computing devices that are connected in various ways in order to communicate and share resources.

Protocol is a set of rules that has given data communication; data authentication. Protocols can fall into two groups: static routing and dynamic routing. Static routing is simply the process of manually. However, dynamic routing allows routers to select the best path. Most routing protocols can be classified into two classes: distance vector and link state. Distance vector routing protocol is based on Bellman – Ford algorithm. A distance vector routing protocol uses a distance calculation. Link state routing protocols build a complete topology of the entire network are and then calculating the best path from this topology of all the interconnected networks. [14], [16]. We have planned to reduce state database by modifying SPF algorithm and time based link control. Such as when route information comes from other router then router search all link in state database. Then select the proper link and through the packet in selected link. A certain amount time later router updates their state database. If any new link connects then add the new link in the state table. This is one of the most important issues for router and its OS to collect specific link from the desired Networks. Also its depends on the performance, capacity, memory, processing power and other similar criteria. Now-a-days, there is more than 0.55 million public route present in worldwide Networks [Cisco]. The Internet Router processes this 0.55 million route for sending a packet through the Internet. And also the Router generates the all of route itself. This huge route generation process increases the convergence time of Networks.

OSPF (Open Shortest Path Fast) is popular dynamic routing protocol. Now days it is run on most routers, since it is based on an open standard. It uses the SPF algorithm, developed by Dijkstra, to provide a loop-free topology. It provides fast convergence with triggered, incremental updates via Link State Advertisements (LSAs).It allows for a hierarchical design with VLSM and route summarization. [13]

The Scope of thesis Link State Advertisements (LSAs) reducing give the better performance of OSPF routing protocol and other dynamic routing precool which are inter related to SPF methodology.

II. LITERATURE REVIEW

The interfaces on a router provide network connectivity to the router. The console and auxiliary ports are used for managing the router. Routers also have ports for LAN and WAN connectivity.

The LAN interfaces usually include Ethernet, Fast Ethernet, Fiber Distributed Data Interface (FDDI), or Token Ring. The

AUI port is used to provide LAN connectivity. You can use a converter to attach your LAN to the router. Some higher-end routers have separate interfaces for ATM (Asynchronous Transfer Mode) as well. Synchronous and Asynchronous serial interfaces are used for WAN connectivity. ISDN (Integrated Services Digital Network) interfaces are used to provide the ISDN connectivity. Using ISDN, you can transmit both voice and data.

Ethernet is one of the earliest LAN technologies. An Ethernet LAN typically uses special grades of twisted pair cabling. Ethernet networks can also use coaxial cable, but this cable medium is becoming less common. The most commonly installed Ethernet systems are called 10BaseT. The router provides the interfaces for twisted pair cables. A converter can be attached to the AUI port of a router to connect to a 10base2, 10baseT, or 10base5 LAN interface. Ethernet and Token Ring use MAC addressing (physical addressing). [17]

The Ethernet interfaces on the router are E0, E1, E2, and so on. E stands for Ethernet, and the number that follows represents the port number. These interfaces provide connectivity to an Ethernet LAN. In a non-modular Cisco router, the Ethernet ports are named as above, but in modular routers they are named as E0/1, where E stands for Ethernet, 0 stands for slot number, and 1 stands for port number in that slot.

Ethernet - Ethernet is typically Ethernet IEEE 802.3 standard based physical interface, which operates at 10 Mbps speed. The media standard used is 10BaseT.

Fast Ethernet - Fast Ethernet is typically Ethernet IEEE 802.3u standard based physical interface which operates at 100 Mbps speed. The media standard used is 100BaseT.

Gigabit Ethernet - Gigabit Ethernet is typically Ethernet IEEE 802.3ab standard based physical interface which operates at 1000 Mbps speed. The media standard used is1000BASE-T.

Serial: Serial interfaces are typically used for WAN connections from ISP (Internet Service Providers) for connectivity types like Frame Relay, T1, T3, etc.FDDI Fiber Distributed Data Interface. - FDDI networks operates at 100 Mbps speed and uses a token-passing mechanism to prevent collisions.

Token Ring - Token Ring interfaces can operate at either 4 Mbps or 16 Mbps. In Token Ring networks a token is passed around the network (configured in ring topology), allowing the owner of the token to transmit a frame, to avoid collision. Token Ring networks vanished from networking industry long way back. [17]

A. Dijkstra's SPF Algorithm

Dijkstra's Algorithm is a graph search algorithm that solves the single –source shortest path problem for a graph with non-negative edge path costs, producing a shortest path tree. This algorithm is often used in routing and other network related protocols. For a given source vertex (node) in the graph, the algorithm finds the path with lowest cost (i.e. the shortest path) between that vertex and every other vertex. It can also be used for finding costs of shortest paths from a single vertex to a single destination vertex by stopping the algorithm once the shortest path to the destination vertex has been determined. [7]
This thesis has included the time based interface control procedure, which was reduce link state database. Dijkstra's SPF algorithm make the link state database on OSPF routing protocol. Thus, time based interface control consider these modify SPF algorithm for link state database optimized the link state. By reducing the number of link count between the path followed from source to destination the total amount of network resources are also reduced. Thus this optimizes Dijkstra's SPF Algorithm on OSPF routing protocol purpose.
Imagine a simple Network as shown in the figure below:

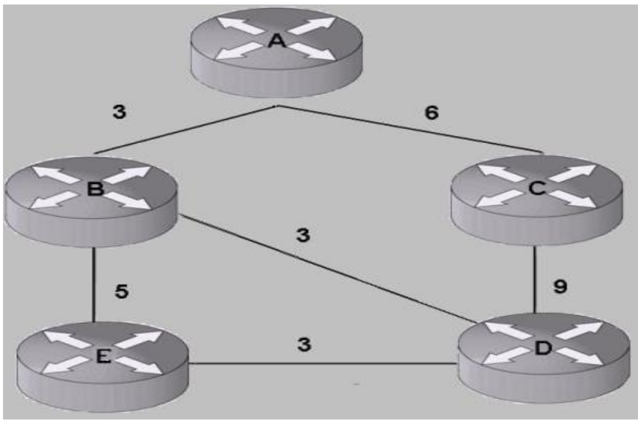

Figure 1: A Simple Network [7]

Once each router has flooded its link state information in the network, all routers know about all the other routers and the links connecting them. The link state database on each router looks like the following:

[A, B, 3], [A, C, 6], [B, A, 3], [B, D, 3], [B, E, 5], [C, A, 6], [C, D, 9], [D, C, 9], [D, B, 3], [D, E, 3], [E, B, 5] [E, D,3].

Each triple should be read as {originating router, router its connected to, the cost of the link connecting the two routers}

So what does Router A do with this information and how is this used in SPF?

While running SPF, each router maintains two lists – the first is a list of nodes for which the shortest path has been determined and we are sure that no path shorter than the one we have computed can exist. This list is called the PATH (or PATHS) list.

The second is the list of paths through the routers that may or may not be the shortest to a destination. This list is called the Tentative list, or simply the TENT list From now on, TENT would refer to the TENT list and PATH, to the PATH list.[2]

Each router runs the following algorithm to compute the shortest path to each node: [7]

Step I: Put "self" on the PATH with a distance of 0 and a next hop of self. The router running the SPF refers to itself as either "self" or the root node, because this node is the root of the shortest-path tree.

Step II: Take the node (call it the PATH node) just placed on the PATH list and examine its list of neighbors. Add each neighbor to the TENT with a next hop of the PATH node,unless that neighbor is already in the TENT or PATH list with a lower cost.

Step III: Find the lowest cost neighbor in the TENT and move that neighbor to the PATH, and repeat Step 2. Stop only when TENT becomes empty.

B. Iteratipon of SPF

Let's follow the sequence that Router A goes through for building its SPF tree:

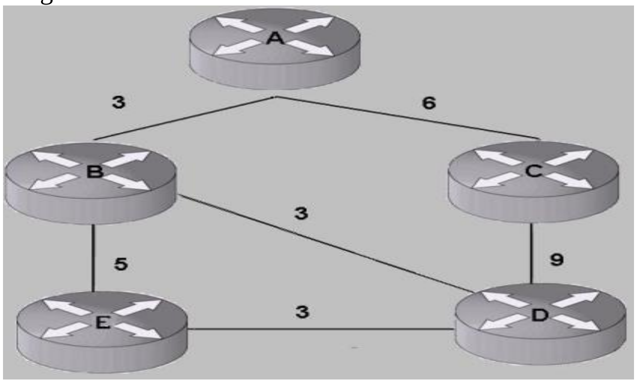

Figure 2: A Simple Network for Calculating Iteration of SPF [7]

1st Iteration step of the SPF running: [2]

Step I: Put "self" on the PATH with a distance of 0 and a next hop of self. After thisstep the PATH and TENT look as follows:

PATH – {A, 0, A}
TENT – { }

Step II: Take the node (call it the PATH node) just placed onthe PATH list and examine its list of neighbors.

PATH – {A, 0, A}
TENT – {B, 3, A}, {C, 6, A}

Similarly……

2nd Iteration step of the SPF running:

1. PATH – {A, 0, A} {B, 3, A}
   TENT – {C, 6, A}
2. PATH – {A, 0, A} {B, 3, A}
   TENT – {C, 6, A} {D, 3, B}, {E, 5, B}
3. PATH – {A, 0, A} {B, 3, A}
   TENT – {C, 6, A} {D, 6, B}, {E, 8, B}
4. PATH – {A, 0, A} {B, 3, A} {C, 6, A}
   TENT – {D, 6, B}, {E, 8, B}

3rd Iteration step of the SPF running:

1. PATH – {A, 0, A} {B, 3, A} {C, 6, A}
   TENT – {D, 6, B}, {E, 8, B} {D, 9, C}
2. PATH – {A, 0, A} {B, 3, A} {C, 6, A}
   TENT – {D, 6, B}, {E, 8, B} {D, 15, C}
3. PATH – {A, 0, A} {B, 3, A} {C, 6, A}
   TENT – {D, 6, B}, {E, 8, B

4th Iteration step of the SPF running:

1. PATH – {A, 0, A} {B, 3, A} {C, 6, A} {D, 6, B}
   TENT – {E, 8, B}
2. PATH – {A, 0, A} {B, 3, A} {C, 6, A} {D, 6, B}
   TENT – {E, 8, B} {E, 3, D}
3. PATH – {A, 0, A} {B, 3, A} {C, 6, A} {D, 6, B}
   TENT – {E, 8, B} // {E, 3, D} isremoved,
   Because D is already in PATH
4. PATH – {A, 0, A} {B, 3, A} {C, 6, A} {D, 6, B} {E,8, B}
   TENT – { }

And finally the PATH is……
{A, 0, A} {B, 3, A} {C, 6, A} {D, 6, B} {E, 8, B}

B. State Table by SPF Algorithm

The routing table consists of at least three information fields:

1. The network id: i.e. the destination subnet the network id
2. Cost/metric: i.e. the cost or metric of the path through which the packet is to be sent
3. Next hop: The next hop, or gateway, is the address of the next station to which the packet is to be sent on the way to its final destination next hop [7]

Depending on the application and implementation, it can also contain additional values that refine path selection:

1. Quality of service associated with the route. For example, the U flag indicates that an IP route is up.
2. Links to filtering access lists associated with the route
3. Interface: such as eth0 for the first Ethernet card, eth1 for the second Ethernet card, etc. [12]

Routing tables are also a key aspect of certain security operations, such as unicast reverse path (uRPF). In this technique, which has several variants, the router also looks up, in the routing table, the source address of the packet. If there exists no route back to the source address, the packet is assumed to be malformed or involved in a network attack, and is dropped. Select a path with the minimum cost in terms of expected end-to-end delay in a network. Routers first exchange hellos and become neighbors. Then they decide to form adjacencies. An adjacency is a state where two routers agree to exchange LSAs (link state advertisements). The LSA exchange between any two routers wills populates their link state databases. At this point both routers will have the same copy of the link state database for the particular area. Then the routers will individually run SPF (Dijkstra Shortest Path First algorithm) against the recently populated link state database to determine the shortest path between the calculating router and all other routers in the network. It can think of the link state database as your input to the Dijkstra SPF algorithm (program). Because all routers run the same calculation on the same data (same link state database), every router has the same picture of the network, and packets are routed consistently at every hop. In summary, database is you input to SFP. LSAs for to a missing neighbor will be removed and SFP will run again against your new database without the old LSAs (possibly with some new replacement LSAs) [15]

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C. Generate Routing Table

Once OSPF is enabled on a router interface, a Link StateDatabase **(**LSD**)** is established and all interfaces running OSPF are added to this table to be used in Link State Advertisements **(**LSAs**)**, OSPF then the begins neighbor discovery and forming adjacency process. [5] The following steps to takes a Router Generate its Routing Table:

1. Hello message sending to Neighbor Router
2. Build up Neighbor Table
3. LSDB update
4. Build-up Topology Table and
5. Build-up Routing Table

Hello Message Sending to Neighbor Router

In OSPF Protocol which enables network routers to share information with each other, a HELLO packet is a special message that is sent out periodically from a router to establish and confirm network adjacency relationships. On networks capable of broadcast or multicast transmission, a HELLO packet can be sent from a router simultaneously to other routers to discover neighboring routers.

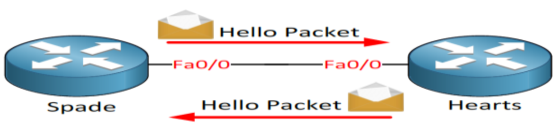

Figure 3: Hello Message Sending to Neighbor Router [12]

Neighbor Table

As a link state routing protocol, OSPF establishes and maintains neighbor relationships to exchange routing updates with other routers. The neighbor relationship table is called an adjacency database in OSPF. If OSPF is configured correctly, it forms neighbor relationships only with directly connected routers. These routers must be in the same area as the interface to form a neighbor relationship. An interface can only belong to a single area. [12]
This table lets you access, create and update OSPF Neighbor parameters.

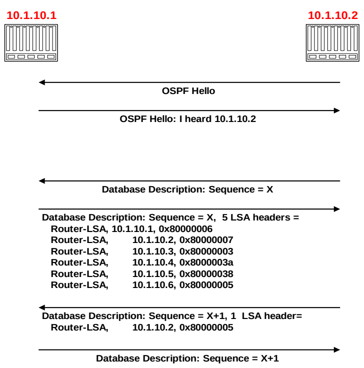

Figure 4: Neighbor Table Generation [12]
LSA Exchanges Request and Response

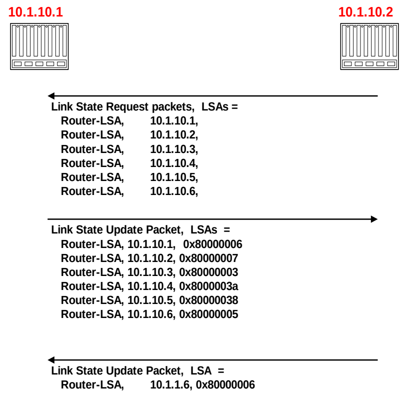

Figure 5: LSA Exchanges Request and Response Procedure

Routing Table

A router typically has multiple interfaces configured. The routing table stores information about both directly connected and remote routes. As with directly connected networks, the route source identifies how the route was learned. For instance, common codes for remote networks include:

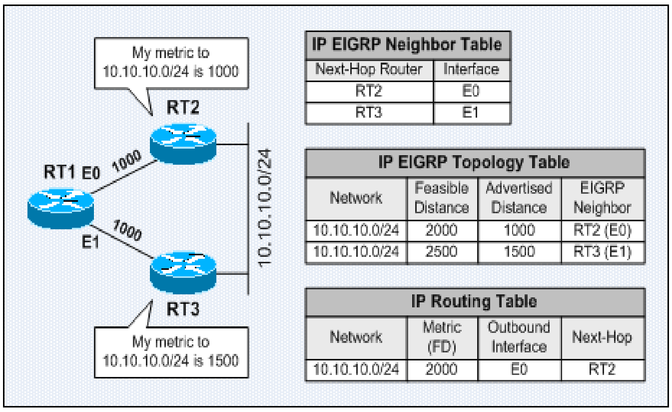

Figure 6: Routing Table [16]

Dijkstra's SPF Algorithm Pseudocode [7]

```
function Dijkstra(Graph, source):
    create vertex set Q
    for each vertex v in Graph:
      dist[v] ← INFINITY
       prev[v] ← UNDEFINED
       add v to Q
    dist[source] ← 0
    whileQ is not empty:
       u ← vertex in Q with min dist[u]
        remove u from Q
        for each neighbor v of u:
            alt ← dist[u] + length(u, v)
            ifalt<dist[v]:
               dist[v] ← alt
               prev[v] ← u
   returndist[], prev[]
```

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III. PROPOSED METHOD

Physical structured networks construct in any Organization, Industry, Bank, Campus or similar area. The networks build up with many routers, switch, and other networks devices. Some of Router interfaces are down for a fixed amount of time. Therefore, we proposed a time based interface control method on SPF algorithm for re-build a new state database table. It helps to route minimization on Router by making a smaller link state database table. The modified SPF time based interfaces control algorithm suggests a new approach on dynamic routing protocol for reducing routing table size and saving router state-database size, resulting in a better convergence time.

Proposed Method Pseudocode
Modified Dijkstra's SPF Algorithm Pseudocode

```
switch (SPF)
Case: (Initial SPF)
functionDijkstra(Graph, source,   interface):
   create vertex set Q
for each vertex v in Graph:
            dist[v] ← INFINITY
            prev[v] ← UNDEFINED
         add v to Q
            dist[source] ← 0
   whileQ is not empty:
            u ← vertex in Q with min dist[u]
         remove u from Q
            for each neighbor v of u:
            alt ← dist[u] + length(u, v)
            ifalt<dist[v]:
            dist[v] ← alt
            prev[v] ← u
         interface[port,time], interface[]
            returndist[], prev[]

Case: (TBIC SPF)
functionDijkstra(Graph, source, interface):
   create vertex set Q
   for each vertex v in Graph:
            dist[v] ← INFINITY
            prev[v] ← UNDEFINED
         add v to Q
            dist[source] ← 0
            whileQ is not empty:
            u ← vertex in Q with min dist[u]
         remove u from Q
            for each neighbor v of u:
            alt ← dist[u] + length(u, v)
         If
         (interface[port,time]==interface[port,time)
         else
            ifalt<dist[v]:

            dist[v] ← alt
            prev[v] ← u
         interface[port,time]
            returndist[], prev[],interface[]
```

IV. EXPERIMENTAL SETUP

Description of Network A
Network A consists of 5 routers and 6 LAN (see Figure 9). Where every LAN have specific time schedule. Suppose, LAN 1 is work on 24 hours in 7 days. LAN 2 work on certain period of time like (Sunday to Tuesday).LAN 3 works same as LAN 1.LAN 4 works same as LAN 2.LAN 5 works fixed schedule of time like (8am-5pm) and LAN 6 works fixed schedule of time like (8am-8pm).For this time combination we consider three schedule of time 6am, 12pm and 9pm. And construct network corresponding of this time schedule. Then we get LSDB (Link State Database) from this network. Take Comparison between LSDB & Modified LSDB Using Time Based Interface Control. At last build up a comparison Chart.

A. Simulated Network: Network A

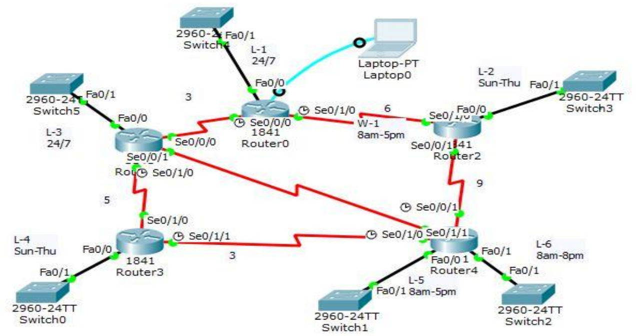
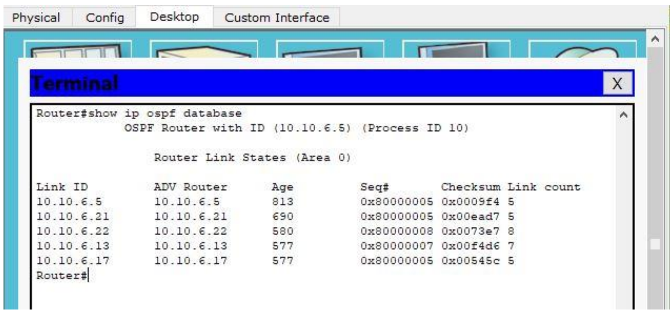


Figure 9: Simulated Network: A

LSDB of Simulated Network: Network A


Physical Config Desktop Custom Interface
Terminal

```
Router#show ip ospf database
            OSPF Router with ID (10.10.6.5) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.10.6.5       10.10.6.5       813         0x80000005 0x0009f4 5
10.10.6.21      10.10.6.21      690         0x80000005 0x00ead7 5
10.10.6.22      10.10.6.22      580         0x80000008 0x0073e7 8
10.10.6.13      10.10.6.13      577         0x80000007 0x00f4d6 7
10.10.6.17      10.10.6.17      577         0x80000005 0x00545c 5
Router#
```

Figure 10: LSDB of Simulated Network: A

LSDB & Modified LSDB Comparison Using Time Based Interface Control in Variant Time

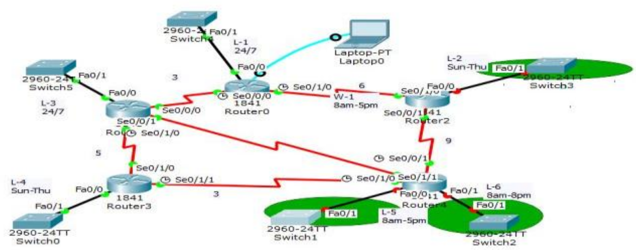


Figure 11: Simulated Network: A at 6:00am

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LSDB of Simulated Network: Network A at 6:00 am

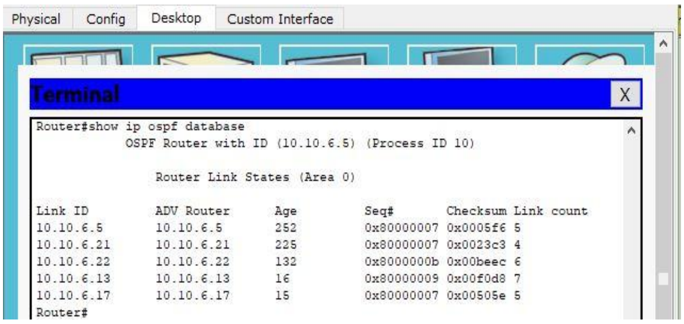

Figure 12: LSDB of Simulated Network: A at 6:00 am.

Simulated Network: Network A at 12:00 pm

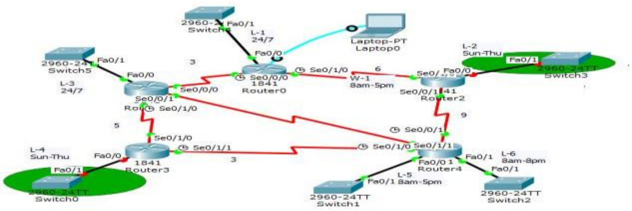

Figure 13: Simulated Network: A at 12:00pm.

LSDB of Simulated Network : Network A at 12:00 pm

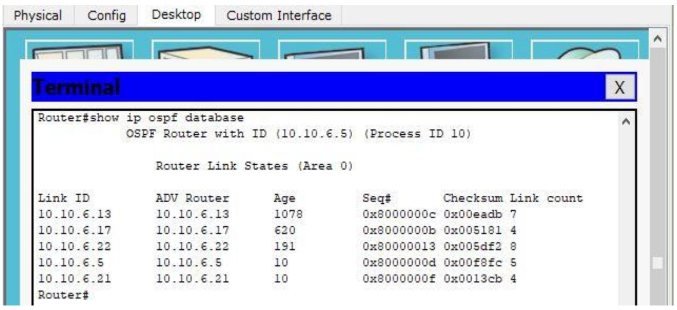

Figure 14: LSDB of Simulated Network: A at 12:00 pm.

Simulated Network: Network A at 9:00 pm

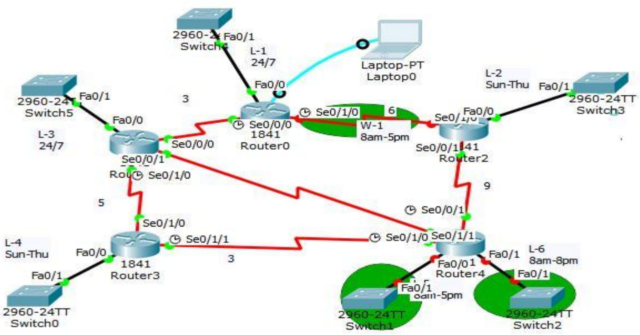

Figure 15: Simulated Network: A at 9:00pm.

LSDB of Simulated Network: Network A at 9:00 pm

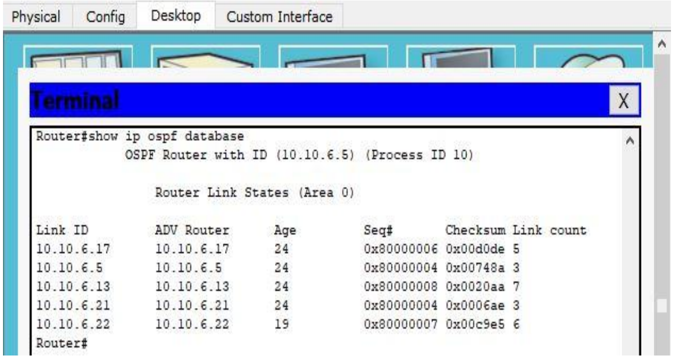

Figure 16: LSDB of Simulated Network: A at 9:00 pm.

LSDB & Modified LSDB Comparison Table: Network A

In this table we show link state database link count for proposed network A and take link state database link count for different different network then make Comparison table among them.

Link Count	Link Count (06:00 am)	Link Count (12:00 pm)	Link Count (09:00 am)
5	5	7	5
5	4	4	3
8	6	8	7
7	7	5	3
5	5	4	6
Total= 30	Total= 27	Total= 28	Total= 24

Table 1: LSDB & Modified LSDB Comparison Table: Network A

LSDB & Modified LSDB Comparison Chart: Network A

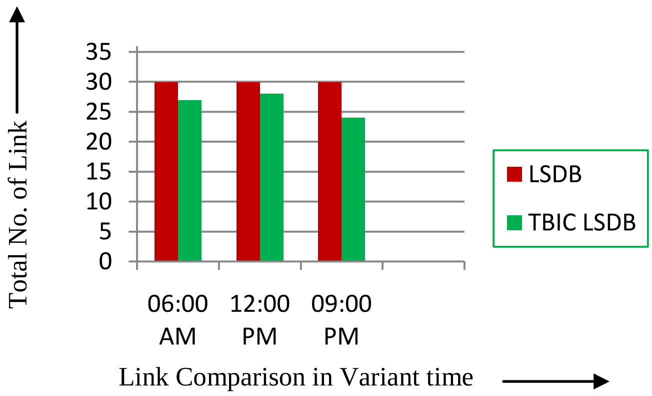

Figure 17: Link Comparison of Current System and Proposed System in Variant Time

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B. Description of Network B

Network B consists of 10 routers and 12 LAN. Where every LAN have specific time schedule. Suppose LAN 1 is work on 24 hours in 7 days. LAN 2 work on certain period of time like (Sunday to Tuesday).LAN 3 works same as LAN 1.LAN 4 works same as LAN 2.LAN 5 works fixed schedule of time like (8am-5pm) and LAN 6 works fixed schedule of time like (8am-8pm) and so on. For this time combination we consider three schedule of time 6am, 12pm and 9pm. And construct network corresponding of this time schedule. Then we get LSDB (Link State Database) from this network. Take Comparison between LSDB & Modified LSDB Using Time Based Interface Control. At last build up a comparison Chart.

4.2.1 Simulated Network: Network B

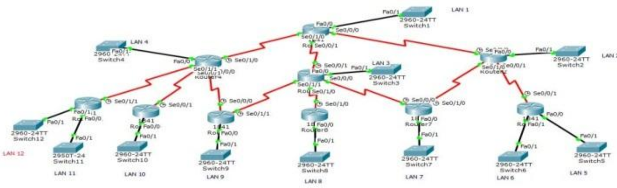
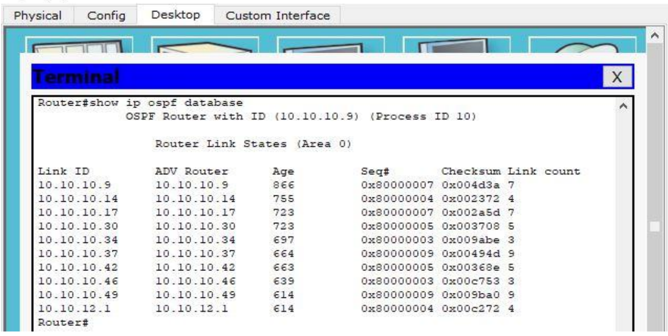


Figure 18: Simulated Network: B

4.2.2 LSDB of Simulated Network: Network B




```
Router#show ip ospf database
            OSPF Router with ID (10.10.10.9) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.10.10.9      10.10.10.9      866         0x80000007 0x004d3a 7
10.10.10.14     10.10.10.14     755         0x80000004 0x002372 4
10.10.10.17     10.10.10.17     723         0x80000007 0x002a5d 7
10.10.10.30     10.10.10.30     723         0x80000005 0x003708 5
10.10.10.34     10.10.10.34     697         0x80000003 0x009abe 3
10.10.10.37     10.10.10.37     664         0x80000009 0x00494d 9
10.10.10.42     10.10.10.42     663         0x80000005 0x00368e 5
10.10.10.46     10.10.10.46     639         0x80000003 0x00c753 3
10.10.10.49     10.10.10.49     614         0x80000009 0x009ba0 9
10.10.12.1      10.10.12.1      614         0x80000004 0x00c272 4
Router#
```

Figure 19: LSDB of Simulated Network: B

Simulated Network: Network B at 6:00 am

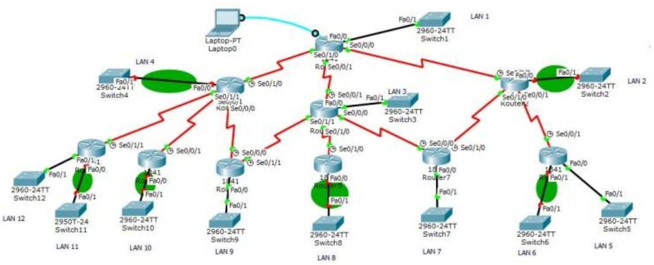
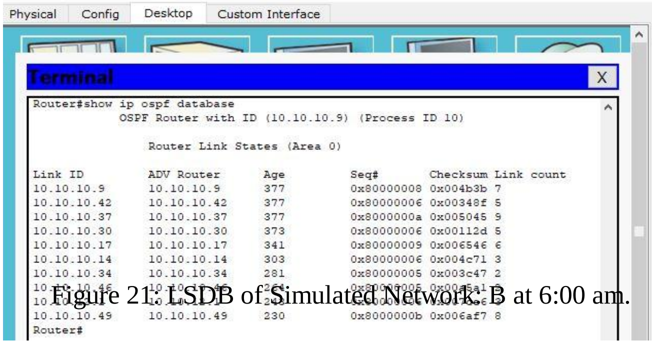


Figure 20: Simulated Network: B at 6:00am.

LSDB of Simulated Network: Network B at 6:00 am




```
Router#show ip ospf database
            OSPF Router with ID (10.10.10.9) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.10.10.9      10.10.10.9      377         0x80000008 0x004b3b 7
10.10.10.42     10.10.10.42     377         0x80000006 0x00348f 5
10.10.10.37     10.10.10.37     377         0x8000000a 0x005045 9
10.10.10.30     10.10.10.30     373         0x80000006 0x00112d 5
10.10.10.17     10.10.10.17     341         0x80000009 0x006546 6
10.10.10.14     10.10.10.14     303         0x80000006 0x004c71 3
10.10.10.34     10.10.10.34     281         0x80000005 0x003c47 2
[illegible]
[illegible]
10.10.10.49     10.10.10.49     230         0x8000000b 0x006af7 8
Router#
```

Figure 21: LSDB of Simulated Network: B at 6:00 am.

Simulated Network: Network B at 12:00 pm

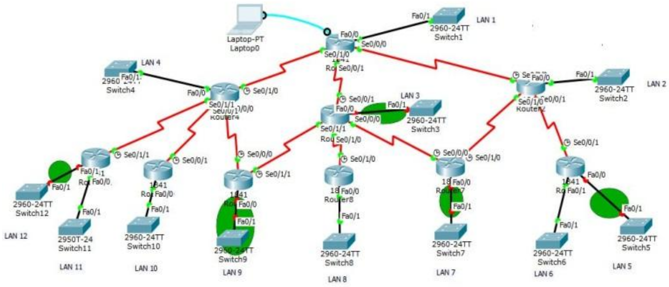
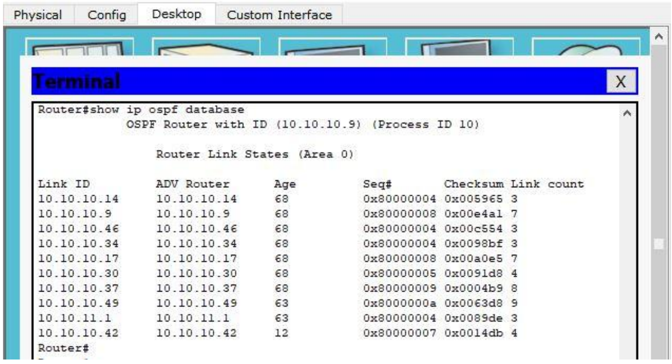


Figure 22: Simulated Network: B at 12:00pm.

LSDB of Simulated Network: Network B at 12:00 pm

According to the figure 22 we make LSDB from router A. At first we enter the router A interface .then we give command in privileged mode: Router# show ipospf database. LSDB means link state database.in this purpose we construct LSDB for network A. Here we get total 51 link count, where network was not schedule. LSDB indicate which path allows selecting proper link and readying to throughout the selected link.




```
Router#show ip ospf database
            OSPF Router with ID (10.10.10.9) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.10.10.14     10.10.10.14     68          0x80000004 0x005965 3
10.10.10.9      10.10.10.9      68          0x80000008 0x00e4a1 7
10.10.10.46     10.10.10.46     68          0x80000004 0x00c554 3
10.10.10.34     10.10.10.34     68          0x80000004 0x0098bf 3
10.10.10.17     10.10.10.17     68          0x80000008 0x00a0e5 7
10.10.10.30     10.10.10.30     68          0x80000005 0x0091d8 4
10.10.10.37     10.10.10.37     68          0x80000009 0x0004b9 8
10.10.10.49     10.10.10.49     63          0x8000000a 0x0063d8 9
10.10.11.1      10.10.11.1      63          0x80000004 0x0089de 3
10.10.10.42     10.10.10.42     12          0x80000007 0x0014db 4
Router#
```

Figure 23: LSDB of Simulated Network: B at 12:00 pm.

Simulated Network: Network B at 9:00 pm

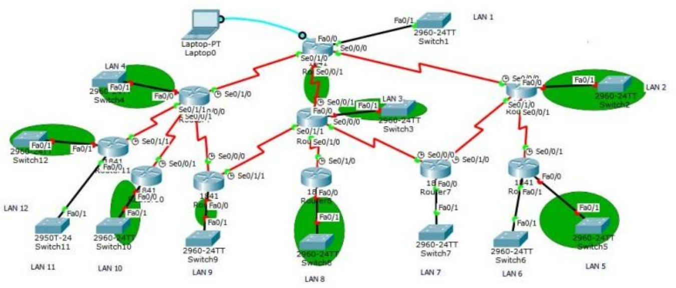
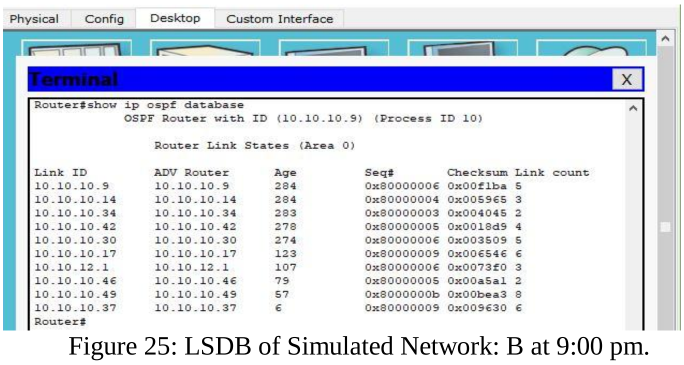


Figure 24: Simulated Network: B at 9:00pm

LSDB of Simulated Network: Network B at 9:00 pm



```
Physical   Config   Desktop   Custom Interface
Terminal
Router#show ip ospf database
            OSPF Router with ID (10.10.10.9) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.10.10.9      10.10.10.9      284         0x80000006 0x00f1ba 5
10.10.10.14     10.10.10.14     284         0x80000004 0x005965 3
10.10.10.34     10.10.10.34     283         0x80000003 0x004045 2
10.10.10.42     10.10.10.42     278         0x80000005 0x0018d9 4
10.10.10.30     10.10.10.30     274         0x80000006 0x003509 5
10.10.10.17     10.10.10.17     123         0x80000009 0x006546 6
10.10.12.1      10.10.12.1      107         0x80000006 0x0073f0 3
10.10.10.46     10.10.10.46     79          0x80000005 0x00a5a1 2
10.10.10.49     10.10.10.49     57          0x8000000b 0x00bea3 8
10.10.10.37     10.10.10.37     6           0x80000009 0x009630 6
Router#
```

Figure 25: LSDB of Simulated Network: B at 9:00 pm.

LSDB & Modified LSDB Comparison Table: Network B

Link Count	Link Count (06:00 am)	Link Count (12:00 pm)	Link Count (09:00 am)
7	7	3	5
4	5	7	3
7	9	3	2
5	5	3	4
3	6	7	5
9	3	4	6
5	2	8	3
3	2	9	2
9	3	3	8
4	8	4	6
Total= 56	Total= 50	Total= 51	Total= 44

Table 2: LSDB & Modified LSDB Comparison Table: Network B

We see in this table 2 proposed network B total link count 56.and schedule network for different time like Link Count for (06:00 am) is 50, Link Count for (12:00 pm) is 51 , Link Count for (09:00 am) is 44.They are compare to lower than proposed network B.

LSDB & Modified LSDB Comparison Chart: Network B

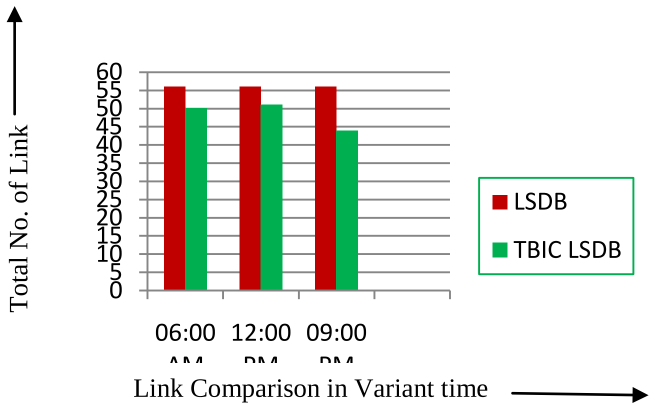


Figure 26: Link Comparison of Current System and Proposed System in Variant Time

C. Description of Network C

Network C consists of 15 routers and 18 LAN. Where every LAN have specific time schedule. Suppose LAN 1 is work on 24 hours in 7 days. LAN 2 work on certain period of time like (Sunday to Tuesday).LAN 3 works same as LAN 1.LAN 4 works same as LAN 2.LAN 5 works fixed schedule of time like (8am-5pm) and LAN 6 works fixed schedule of time like (8am-8pm) and so on. For this time combination we consider three schedule of time 6am, 12pm and 9pm. And construct network corresponding of this time schedule. Then we get LSDB (Link State Database) from this network. Take Comparison between LSDB & Modified LSDB Using Time Based Interface Control. At last build up a comparison Chart.

Simulated Network: Network C

.

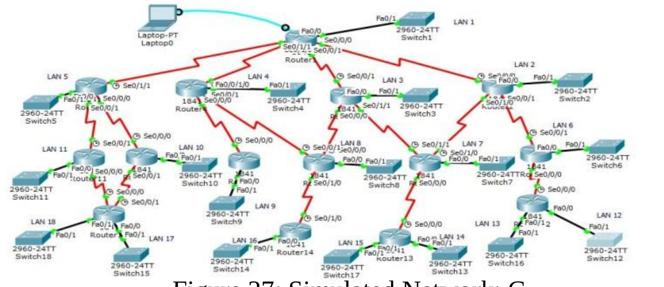
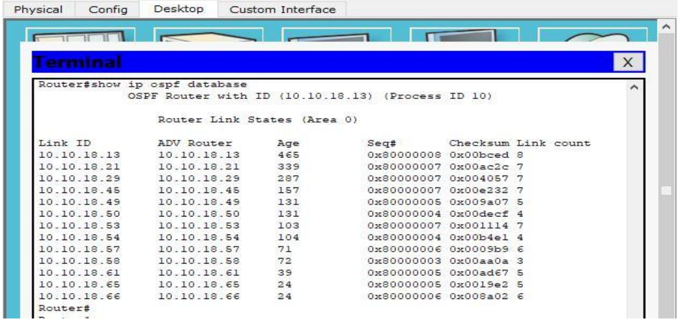


Figure 27: Simulated Network: C

LSDB of Simulated Network: Network C



```
Physical   Config   Desktop   Custom Interface
Terminal
Router#show ip ospf database
            OSPF Router with ID (10.10.18.13) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.10.18.13     10.10.18.13     465         0x80000008 0x00bced 8
10.10.18.21     10.10.18.21     339         0x80000007 0x00ac2c 7
10.10.18.29     10.10.18.29     287         0x80000007 0x004057 7
10.10.18.45     10.10.18.45     157         0x80000007 0x00e232 7
10.10.18.49     10.10.18.49     131         0x80000005 0x009a07 5
10.10.18.50     10.10.18.50     131         0x80000004 0x00decf 4
10.10.18.53     10.10.18.53     103         0x80000007 0x001114 7
10.10.18.54     10.10.18.54     104         0x80000004 0x00b4e1 4
10.10.18.57     10.10.18.57     71          0x80000006 0x0009b9 6
10.10.18.58     10.10.18.58     72          0x80000003 0x00aa0a 3
10.10.18.61     10.10.18.61     39          0x80000005 0x00ad67 5
10.10.18.65     10.10.18.65     24          0x80000005 0x0019e2 5
10.10.18.66     10.10.18.66     24          0x80000006 0x008a02 6
Router#
```

Figure 28: LSDB of Simulated Network: C

Simulated Network: Network C at 6:00 am

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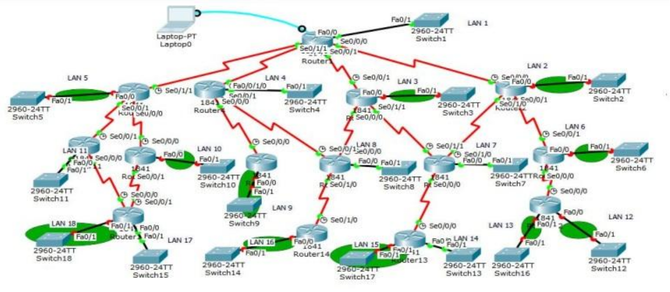
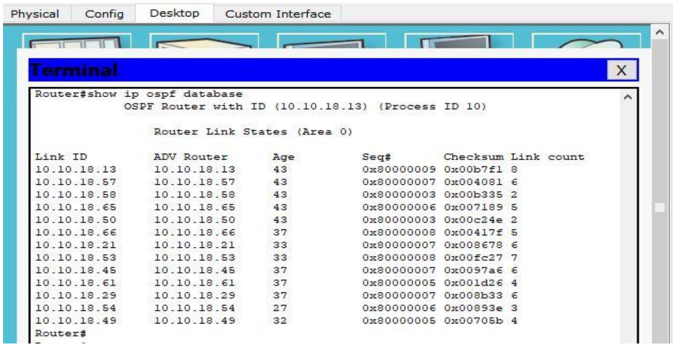


Figure 29: Simulated Network: C at 6:00am.

LSDB of Simulated Network: Network C at 6:00 am



```
Router#show ip ospf database
            OSPF Router with ID (10.10.18.13) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.10.18.13     10.10.18.13     43          0x80000009 0x00b7f1 8
10.10.18.57     10.10.18.57     43          0x80000007 0x004081 6
10.10.18.58     10.10.18.58     43          0x80000003 0x00b335 2
10.10.18.65     10.10.18.65     43          0x80000006 0x007189 5
10.10.18.50     10.10.18.50     43          0x80000003 0x00c24e 2
10.10.18.66     10.10.18.66     37          0x80000008 0x00417f 5
10.10.18.21     10.10.18.21     33          0x80000007 0x008678 6
10.10.18.53     10.10.18.53     33          0x80000008 0x00fc27 7
10.10.18.45     10.10.18.45     37          0x80000007 0x0097a6 6
10.10.18.61     10.10.18.61     37          0x80000005 0x001d26 4
10.10.18.29     10.10.18.29     37          0x80000007 0x008b33 6
10.10.18.54     10.10.18.54     27          0x80000006 0x00893e 3
10.10.18.49     10.10.18.49     32          0x80000005 0x00705b 4
Router#
```

Figure 30: LSDB of Simulated Network: C at 6:00am.

Simulated Network: Network C at 12:00 pm

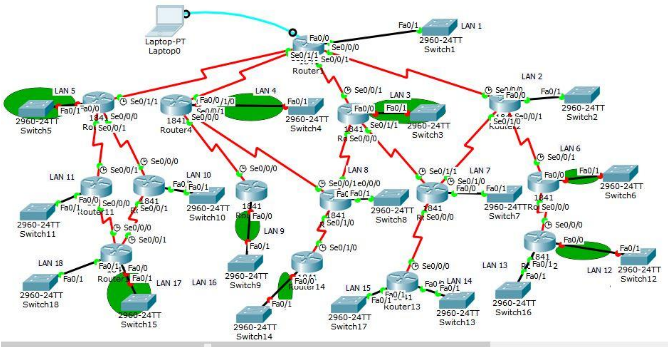
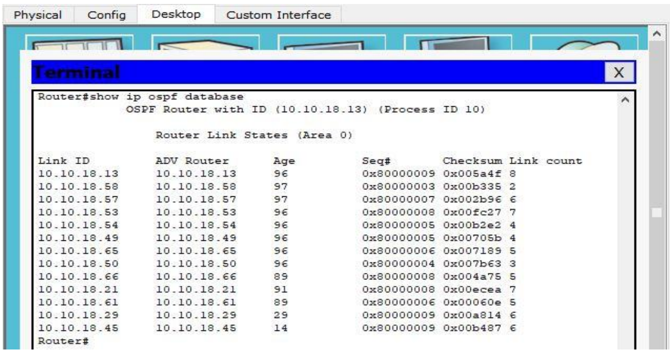


Figure 31: Simulated Network: C at 12:00pm.

LSDB of Simulated Network: Network C at 12:00 pm



```
Router#show ip ospf database
            OSPF Router with ID (10.10.18.13) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.10.18.13     10.10.18.13     96          0x80000009 0x005a4f 8
10.10.18.58     10.10.18.58     97          0x80000003 0x00b335 2
10.10.18.57     10.10.18.57     97          0x80000007 0x002b96 6
10.10.18.53     10.10.18.53     96          0x80000008 0x00fc27 7
10.10.18.54     10.10.18.54     96          0x80000005 0x00b2e2 4
10.10.18.49     10.10.18.49     96          0x80000005 0x00705b 4
10.10.18.65     10.10.18.65     96          0x80000006 0x007189 5
10.10.18.50     10.10.18.50     96          0x80000004 0x007b63 3
10.10.18.66     10.10.18.66     89          0x80000008 0x004a75 5
10.10.18.21     10.10.18.21     91          0x80000008 0x00ecea 7
10.10.18.61     10.10.18.61     89          0x80000006 0x00060e 5
10.10.18.29     10.10.18.29     29          0x80000009 0x00a814 6
10.10.18.45     10.10.18.45     14          0x80000009 0x00b487 6
Router#
```

Figure 32: LSDB of Simulated Network: C at 12:00 pm.

Simulated Network: Network C at 09:00 pm

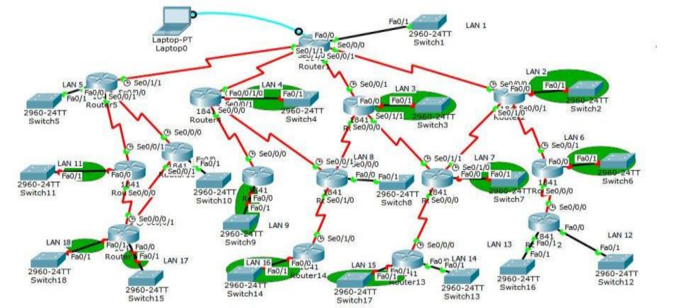
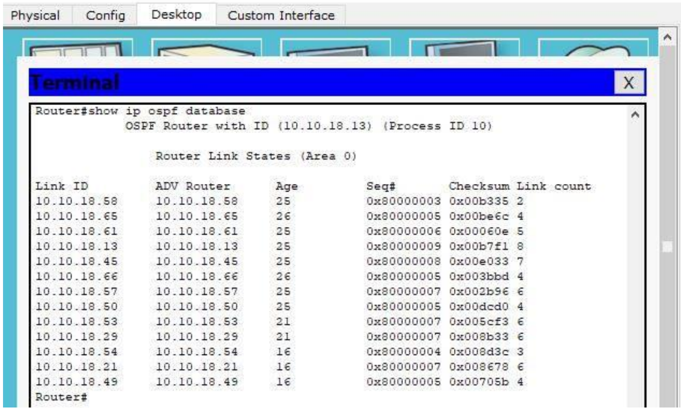


Figure 33: Simulated Network: C at 9:00pm.

LSDB of Simulated Network: Network C at 09:00 pm



```
Router#show ip ospf database
            OSPF Router with ID (10.10.18.13) (Process ID 10)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
10.10.18.58     10.10.18.58     25          0x80000003 0x00b335 2
10.10.18.65     10.10.18.65     26          0x80000005 0x00be6c 4
10.10.18.61     10.10.18.61     25          0x80000006 0x00060e 5
10.10.18.13     10.10.18.13     25          0x80000009 0x00b7f1 8
10.10.18.45     10.10.18.45     25          0x80000008 0x00e033 7
10.10.18.66     10.10.18.66     26          0x80000005 0x003bbd 4
10.10.18.57     10.10.18.57     25          0x80000007 0x002b96 6
10.10.18.50     10.10.18.50     25          0x80000005 0x00dcd0 4
10.10.18.53     10.10.18.53     21          0x80000007 0x005cf3 6
10.10.18.29     10.10.18.29     21          0x80000007 0x008b33 6
10.10.18.54     10.10.18.54     16          0x80000004 0x008d3c 3
10.10.18.21     10.10.18.21     16          0x80000007 0x008678 6
10.10.18.49     10.10.18.49     16          0x80000005 0x00705b 4
Router#
```

Figure 34: LSDB of Simulated Network: C at 9:00 pm.

LSDB & Modified LSDB Comparison Table: Network C

In this table we show link state database link count for proposed network C and take link state database link count for different different network then make Comparison table among them.

Link Count	Link Count (06:00 am)	Link Count (12:00 pm)	Link Count (09:00 am)
8	8	8	2
7	6	2	4
7	2	6	5
7	5	7	8
5	2	4	7
4	5	4	4
7	6	5	6
4	7	3	4
6	6	5	6
3	4	7	6
5	6	5	3
5	3	6	6
6	4	6	4
Total= 74	Total= 64	Total= 68	Total= 65

Table 3: LSDB & Modified LSDB Comparison Table: Network C

We see in this table 3 proposed network C total link count 74.and schedule network for different time like Link Count for (06:00 am) is 64, Link Count for (12:00 pm) is 68 , Link

Count for (09:00 am) is 65.They are compare to lower than proposed network C.

LSDB & Modified LSDB Comparison Chart: Network C

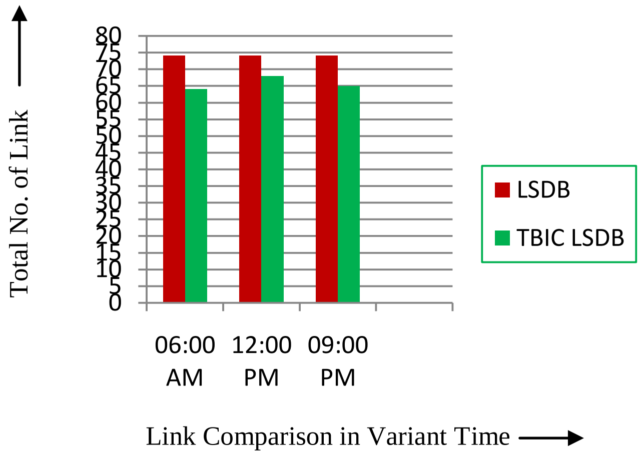


Figure 35: Link Comparison of Current System and Proposed System in Variant Time

V. RESULTS AND DISCUSSIONS

Result Comparison between Current Method and Proposed Method

In this table we show link state database link count for proposed network A, B, C and take link state database link count for different different network then make Average of proposed method LSDB and we find % of Link State Reduce. At last calculate average of current network A, B, C. And calculate average of proposed network then calculate average of % of Link State Reduce.

Network	Current Method LSDB	Proposed Method LSDB	Proposed Method LSDB (Average)	% of Link State Reduce
A	30	6am 27 12pm 28 9pm 24	26.33	12.23%
B	56	6am 50 12pm 51 9pm 44	48.33	13.69%
C	74	6am 64 12pm 68 9pm 65	65.66	11.27%
Total(A,B,C)	**53.33**	**46.77**		**12.40%**

Table 4: Result Comparison between Current Method and Proposed Method.

We see in this table 4 proposed network C total link count 74.and schedule network for different time like Link Count for (06:00 am) is 64, Link Count for (12:00 pm) is 68 , Link Count for (09:00 am) is 65.They are compare to lower than proposed network C.

Comparison Chart between Current Method and Proposed Method

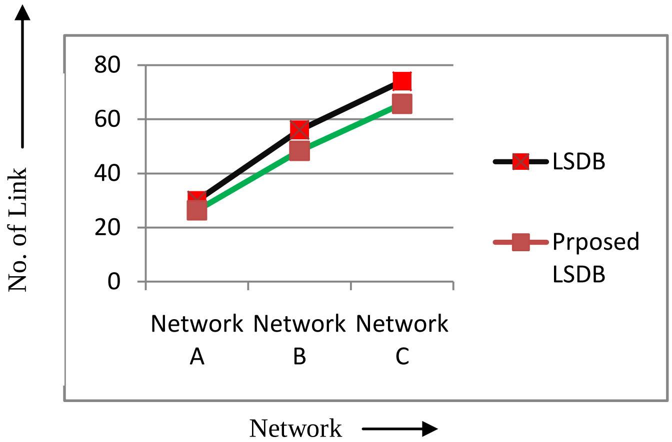


Figure 36: Comparison Chart between Current Method and Proposed Method

VI. CONCLUSION AND FUTURE WORKS

We have showed a network route minimization using time based interface control. In this approach it is flexible with dynamic nature of networks as database updates their sequence according to a number of available routes. It provides better convergence time which construct network more efficient.

Our simulations results have shown that time base interface control reduce the link count in database .Hence it build up a network more effective and provide better convergence time

In our future work, we want to implement the modified SPF algorithm in router operating system to make link state database in new procedure.

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