MANAGING A COST REDUCTION OF THE COMPUTER NETWORK FOR RETAIL'S BUSINESS BY USING THE OSPF PROTOCAL

Varin Vongmanee[1] and Vatin Vongmanee[2]
[1]Electrical and Energy Technology Research Laboratory
Electrical Engineering Department, School of Engineering
University of the Thai Chamber of Commerce
126/1 Vibhavadee-Rungsit Rd. Dindaeng, Bangkok, Thailand,10400.
Tel: (66)0-2697-6705, Fax: (66)0-2275-4892
E-mail: varin_von@utcc.ac.th
[2]RIS Company Limited
139 Ratchadaphisek Rd., Dindaeng, Bangkok, Thailand, 10400
Tel: (66)0-2610-5890, Fax: (66)0-2642-2188
E-mail: vovatin@central.co.th

ABSTRACT
This paper presents the information technology system improvement for the computer network of retail business by using the open shortest path first (OSPF) protocol application. Case study of the CRC Company Limited is considered because the computer network is complicated that result to high administration and maintenance cost. The project implementation invests 1,384,000 baths that consist of 626,000 baths of installation cost and 758,000 baths of equipments cost. The results of implementation are shown that the management cost is decreased 1,703,412 baths/year or 11%. The network system is standard and easy to management and maintenance.

KEY WORDS
Open Shortest Path First, OSPF Protocol, Retail Business

1. Introduction

Economic of speed is important for the modern business in globalization. The professional management from centralize have more efficiency than branch management because it have more specialist and data. But the truth is impossible because cost of specialist is high. Therefore the information technology will be considered owing to the trade information is usually updated that is important to decision. The retail business has many branches and many business units (BU) so the telecommunication is used for data exchange, especially the internet system. For this reason, the data communication of business will have not constraint of time and place. It is the route of data transportation for support the centralize administration for example the procurement, human resource, transportation, warehousing management and distribution. So, this efficiency management results to the cost of logistics is decreased. The IT planning and physical designs are vital problem that result to high administration cost especially data communication cost between branch. It composes of four categories. First, the lead line charge that connected between host/host and branch/host. The increasing cost depends on amount of link, for example the communication system between Bangkok and Phuket that have eight branches are necessary connected lead line cover all branches. For that reason, the cost is increased that vary as distance, starting point, ending point, speed of communication and physical connection. Second, the connection equipment cost per unit which is imported is expensive for example switch, router and special equipment. Third, the maintenance cost is high because the specialist is need. Finally, the administration cost for lead line connection is expensive that vary as amount of connection. Therefore the link management and OSPF protocol application are solution.

This paper presents the IT improvement by using OSPF protocol application for reduce lead line usage, maintenance and administration cost that the business competitive advantage is increased. This paper consists of 5 sections: 1. Introduction, 2. OSPF protocol, 3. Problem analysis, 4. Project implementation and 5. Conclusion.

2. OSPF Protocol (Open Shortest Path First)

2.1 OSPF Definition

OSPF protocol is used for routing consideration and link-state status improvement. The main property has not over-hard that mean the small resource of equipment is used. The OSPF protocol is favorably used for internal network connection of ISP Company and others network that link mutuality and supported the extensive network very well. The identification of subset network is efficiently supported by using OSPF protocol so the network operator can separate the network to variety subset network. OSPF protocol, an Interior Gateway Protocol, is used to distribute the data, link-state and routing information within a single autonomous system that means the main router connect the slave router. However the autonomous system mechanism can communicate between the main router protocol and the other router protocol for example RIP or EGP protocol [1,2,3,4].

OSPF protocol is importance routing protocol that applied to many organization networks. It is developed for internet protocol (IP) networking by the Shortest Path First algorithm that designed to solve the problem of the distance vector routing protocol. The advantage is fast response and good mechanic for status monitoring of router communication between the owner router and neighborhood router with "Hello mechanism".

2.2 OSPF Characteristics

OSPF is a link-state routing protocol that calls for the sending of link-state advertisements (LSAs) to all other routers within the same hierarchical area. Information on attached interfaces, metrics used, and other variables are included in OSPF LSAs. As OSPF routers accumulate link-state information, they use the SPF algorithm to calculate the shortest path to each node. The OSPF characteristics are summarized that:

- It's routing protocol, which depend on network interface update for neighbor router, then the neighbor router build and compute the shortest path to all known destinations. The routing table is not sent to the neighbor router that different from the distance vector.
- Bandwidth is considered for the shortest routing selection.
- The variable length subnet mask: VLSM is supported and subnet mask is sent to neighbor router.
- Network topology changing is restricted by the network area zoning, "OSPF Area".
- The route summarization is supported.
- The data packet is distributed on the routing that is equal bandwidth.
- OSPF allows for routing authentication by using different methods of password authentication.
- Fast response to network topology change.

The OSPF package is shown in Figure 1.

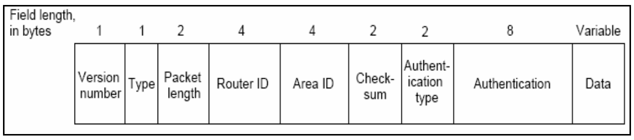

Figure 1: OSPF Package

Cost of an interface in OSPF is an indication of the overhead required to send packets across a certain interface. If the network is large, it should be divided to small networks or areas and set router at the central area for exchange routing with external area. Cost of an interface is inversely proportional to the bandwidth of that interface. A higher bandwidth indicates a lower cost. There is more overhead (higher cost) and time delays involved in crossing a 56k serial line than crossing a 10M ethernet line [1,2,3,4]. The Figure 2 shown an example of routing selection by cost consideration and Table 1 is shown the connection cost that calculated from equation 1.

$$\mathrm{cos}t = \frac{108}{bandwidth} \qquad (1)$$

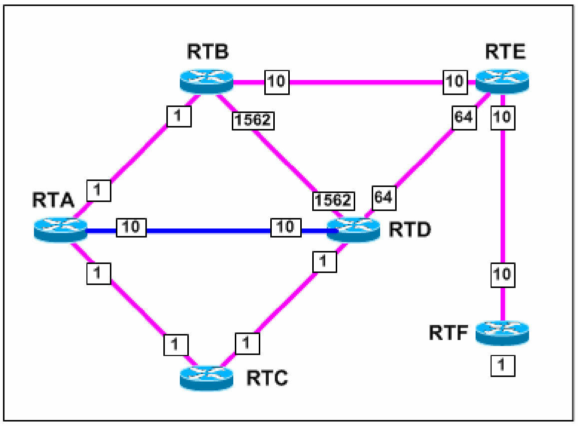

Figure 2: Example of Routing Selection by Cost Consideration

Table 1: Connection Cost

Media	Default Cost
56 Kbps Serial Link	1785
64 Kbps Serial Link	1562
T1 (1.544 Mbps Serial Link)	65
E1 (2.048 Mbps Serial Link)	48
4 Mbps Token Ring	25
Ethernet 10 Mbps	10
16 Mbps Token Ring	6

Figure 2 is shown the example of the shortest path routing selection by OSPF cost consideration which the router and the subnet address are connected. The router A (RTA) is connected the router F (RTF) with subnet 172.16.5.0 that has many paths:

- RTA--> RTB --> RTE --> RTF = Cost (1+10+10+1) = 22
- RTA--> RTB --> RTD --> RTE --> RTF = Cost (1+1562+64 +10+1) = 1638
- RTA--> RTD --> RTE --> RTF = Cost (10+64+10+1) = 85
- RTA--> RTD --> RTB --> RTE --> RTF = Cost (10+1562+10 +10+1) = 1593
- RTA--> RTC --> RTD --> RTE --> RTF = Cost (1+1+64+10 +1) = 77
- RTA--> RTC --> RTD --> RTB --> RTE --> RTF = Cost (1+1 +1562+10+10+1) = 1585

The minimum cost is path RTA--> RTB -->RTE --> RTF that cost is 22

2.3 Link-State Algorithm

OSPF is a link-state routing protocol that calls for the sending of link-state advertisements (LSAs) to all other routers within the same hierarchical area. Information on attached interfaces, metrics used, and other variables are included in OSPF LSAs. As OSPF routers accumulate link-state information, they use the SPF algorithm to calculate the shortest path to each node. As a link-state routing protocol, OSPF contrasts with RIP and IGRP, which are distance-vector routing protocols. Routers running the distance-vector algorithm send all or a portion of their routing tables in routing-update messages to their neighbors [3].

2.4 Multi-Area OSPF

OSPF routing protocol is applied to the large network which is separated to many sub-network. It is call area and many areas are autonomous system that is network's border of the same organization. In the same organization, all routers within an area have the exact link-state database. Routers that belong to multiple areas, and connect these areas to the backbone area are called area border routers (ABR). The same area will setup the same AREA ID. The multi-area network of OSPF is shown in figure 3.

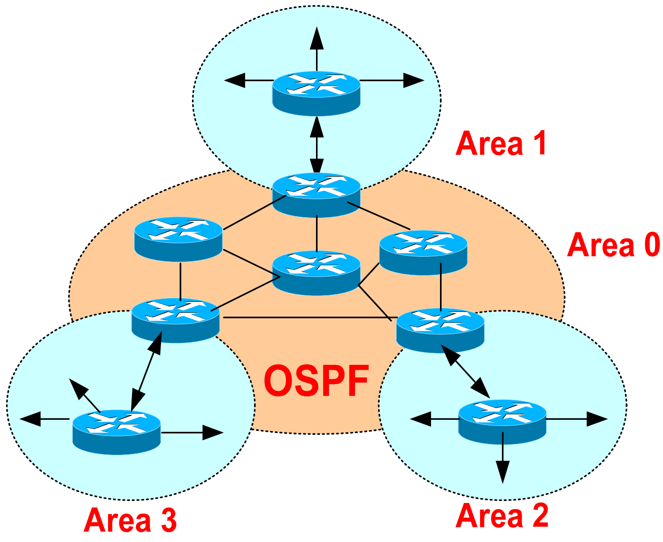

Figure 3: The Multi-Area OSPF Network

In the figure 3, the router, that have 2 interfaces, is divided to 2 areas. The link state update is only communicated to the router in the same area. It is not communicated to the router in the other areas. The network status changing in the area will not affect to the other areas for example WAN link's router of the area 1 shutdown and new startup and then the router find, the Link State Advertisement, LSA is sent to the other router in same area. Then, the router that updates new LSA will run SPF algorithm. So the area divider is limit blood of LSA update and decreases the calculation's SPF algorithm of the router in the other area. The advantages of area divider are summary:

- The network traffic is limited because LSA update will not be sent to other area.
- SPF algorithm calculation is reduced because it only run when receive LSA update from router in the same area.
- Memory space for store routing table is decreased because it can be compressed by route summarization at the ABR (Area Border Router).

The function of ABR is subnet data sending in area to other ABR in other area via backbone router resulting to their ABR is updated subnet address on internal router in own area. After the ABR receive subnet address from the other ABR, it will set the Next HOP Router field in routing entry of subnet address to identify the ABR that informs subnet address data.

3. Problem Analysis

The Case study analyses data from CRC Company which include 5 main businesses: Retail, Real estate, Hotel, Food & Beverage and Wholesale. In this paper only focus in the retail business. It consists of 8 business units (BU) 379 branches: 34 branches of Department store from 2 BUs, 70 branches of Super Sport, 80 branches of Power Buy for electrical equipment consumer, 80 branches of B2S for education, 10 branches of Home Work, 5 branches of Office Depots and 100 branches of Super market. Now, the data communication between head office and branches consist of 4 nodes.

- Node A is support's host of department and head office.
- Node B is main host that supports all hosts.
- Node C is support's host for 5 BUs.
- Node D is support's host for 5 BUs.

3.1 Data communication characteristic

The data communication between 4 nodes that support subsystem in every BUs is about sale and market for example: report system, promotion system and monitoring system. All BUs has the same main function that is directly sent to Ratchada head-office for check stock, pricing, purchasing, financing, accounting and customer relationship. The host link of subsystem is shown in figure 4 that include 87 links of 5 providers.

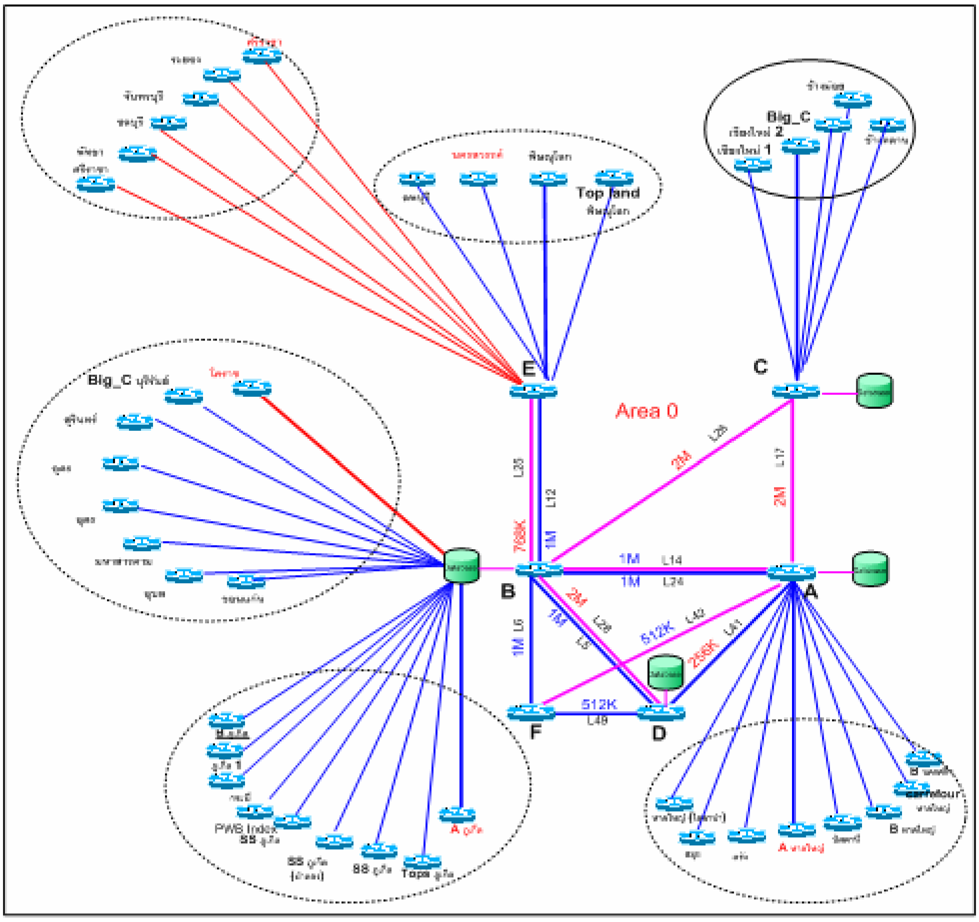

Figure 4: The Infrastructure of Host to Host Communication

3.2 System problem

The problem in system includes 2 sections: Host to Host link and Host to Branch link.

- Host to Host link problem
  - High cost that result from redundant link
  - Low efficiency of link management.
  - The same data is repeatedly communicated on cable. It sent to FTP server of BU and then to host at the head office.
  - Line unbalancing between speed of communication and real using quantity.
- Host to Branch link problem (the communication between head office and branch)
  - No backup link that results to the manual communication is used when link has problem.
  - Redundant link in the same way.
  - All link connected to centralize system.
  - Long distance result to expensive cost.
  - Low efficiency of link management.
  - No efficiency of monitor system.
  - Many types of technology that result to more time to configuration.
  - The equipment setup is no standard.
  - Router is work hard because of no area dividing.
  - High cost of hardware maintenance because it has more than one hardware in branch.

Generally, branch consists of six BUs: PWB, B2S, SSP, HW, TOPs and OD. Amount of BUs in each branch depend on size and sale quantity. All BUs is connected on same backbone besides TOPs that has own network. Figure 5 show branch network characteristic that have 2 links and 2 routers. Router 1 connects to all BUs and router 2 belongs to TOPs network, so router link repeat that result to high operation cost.

4. Project Implementation

The project implementation consists of 2 sections. First is head office network and second is branch network. Node for communication between head office include of 4 main nodes that shown in figure 6. It is not standard of network design principle so we have to improve it by make backup link, decrease overlap link, optimize speed communication and setup router for load balancing that result to the data transfer on optimum routing.

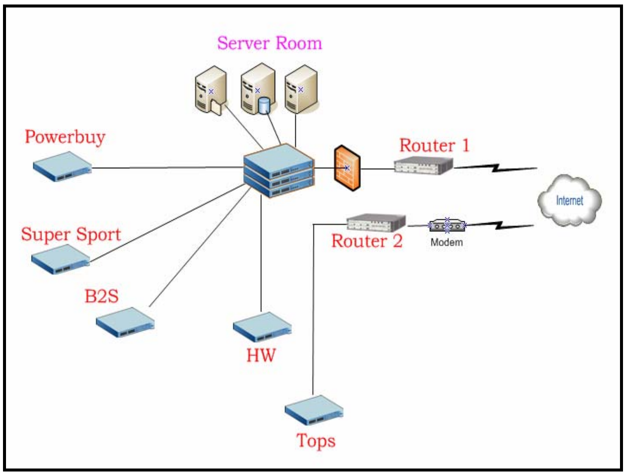

Figure 5: The Characteristic of Branch Connection

Main nodes are same as router backbone so we have to make network stability first and identify to Area 0. Area 0 is managed by decrease link from 12 links to 9 links that is shown in figure 7. The connection characteristic is backup link vice versa between nodes. When link has problem, the data will be changed to other route that lower cost than main link. OSPF technique is used for route changing that result to more stable of system. The service provider and cost of operation before improvement is shown in table 2.

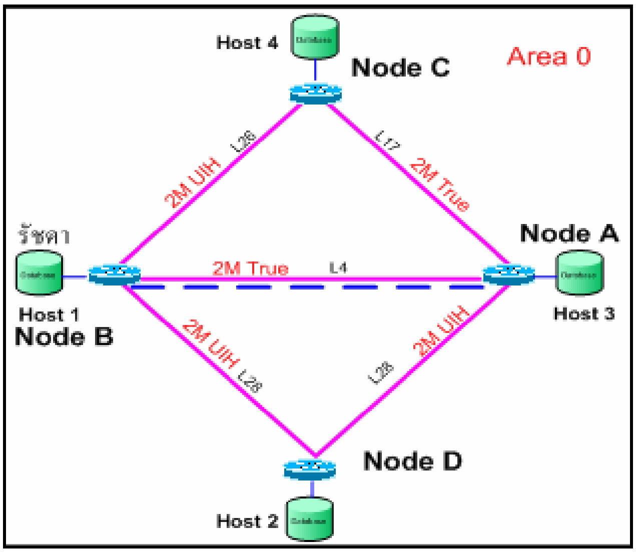

Figure 6: Main Node Connection

Host to Host system before improvement is shown in figure 7 that operation costs (Lead line, connection and management cost) are 3,670,800 baths/year and after improvement is shown in figure 8 that operation costs are 3,585,600 baths/year decreasing to 112,200 baths/year. So, the system efficiency is increased because it had good backup link. The example of cost calculation in each route is shown that:

1. BR-->RIS=100 = Cost is 100
2. BR-->JCT --> RIS = 110+54 = Cost is 164
3. BR--> JCT--> CL --> RIS = Cost (110+60+65) is 235

The data will run on route 1 first because of low cost. If it has problem the data will run on route 2 and 3 in order. This is basic principle of OSPF protocol.

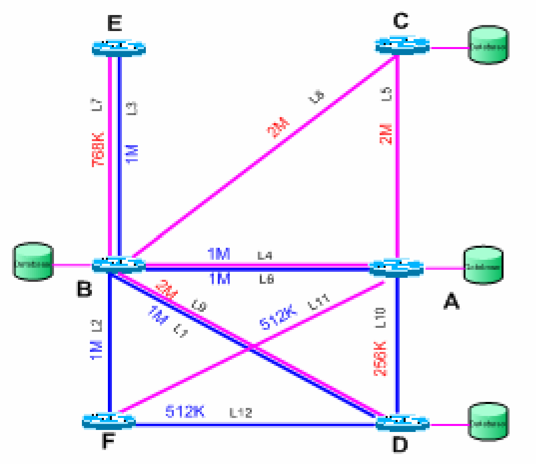

Figure 7: Host to Host Connections before Improvement

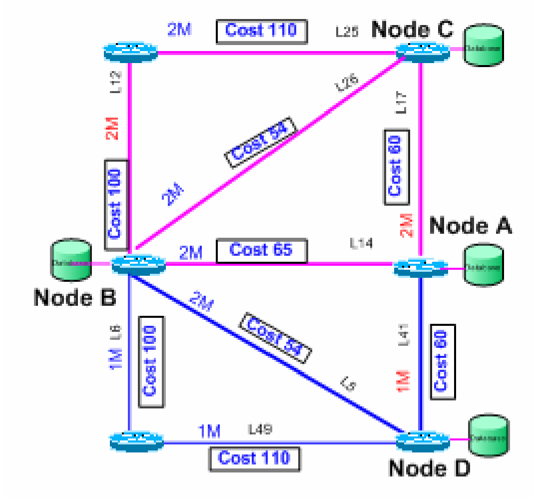

Figure 8: Host to Host Connections after Improvement

The lead line connecting cost between branches and head office is expensive because of the connection link repeat that cost directly depend on distance and speed in communication. Case study is CRC network that have over 80 links. So, the network system is divided to 5 areas and separate improvement to 5 phases.

- Phase 1: Main link is identified to area 0 that consists of 4 nodes: RIS, CL, JCL and CFR.
- Phase 2: Eastern section is identified to area 1 that consists of 6 branches and node located at Cholburi.
- Phase 3: North-Eastern section is identified to area 2 that consists of 8 branches and node located at Nacornrachasima.
- Phase 4: Northern section is identified to area 3 that consists of 10 branches and node located at Chiangmai and Nacornsawan.
- Phase 5: Southern section is identified to area 4 that consists of 17 branches and node located at Phuket and Hardyai.

The network system of branches after improvement is shown in figure 9. The example cost of connection of Host to Host or Main link (before and after improvement) is shown in table 3 and table 4. Cost before improvement is 3,670,800 baths/year and after improvement is 3,585,600 baths/year decreasing to 112,200 baths/year. The detail of connection cost between branches is not shown in this paper because of very much of data the page not enough to show.

Table 2: Service Provider and Cost of Operation before Improvement

Item	Provider	Link	Type	%
1	UIH	55	LL , F/R	55.55%
2	TA	23	LL , F/R	23.23%
3	Datanaet	11	HDLC	11.11%
4	TOT	9	LL,ISDN	9.10%
5	TT&T	1	LL	1.01%
		99		100.00%

Item	Provider	Cost/Year	%
1	UIH	9,242,652	57.34
2	TA	4,334,040	26.89
3	Datanaet	2,128,800	13.21
4	TOT	173,400	1.08
5	TT&T	240,000	1.49
		16,118,892	100

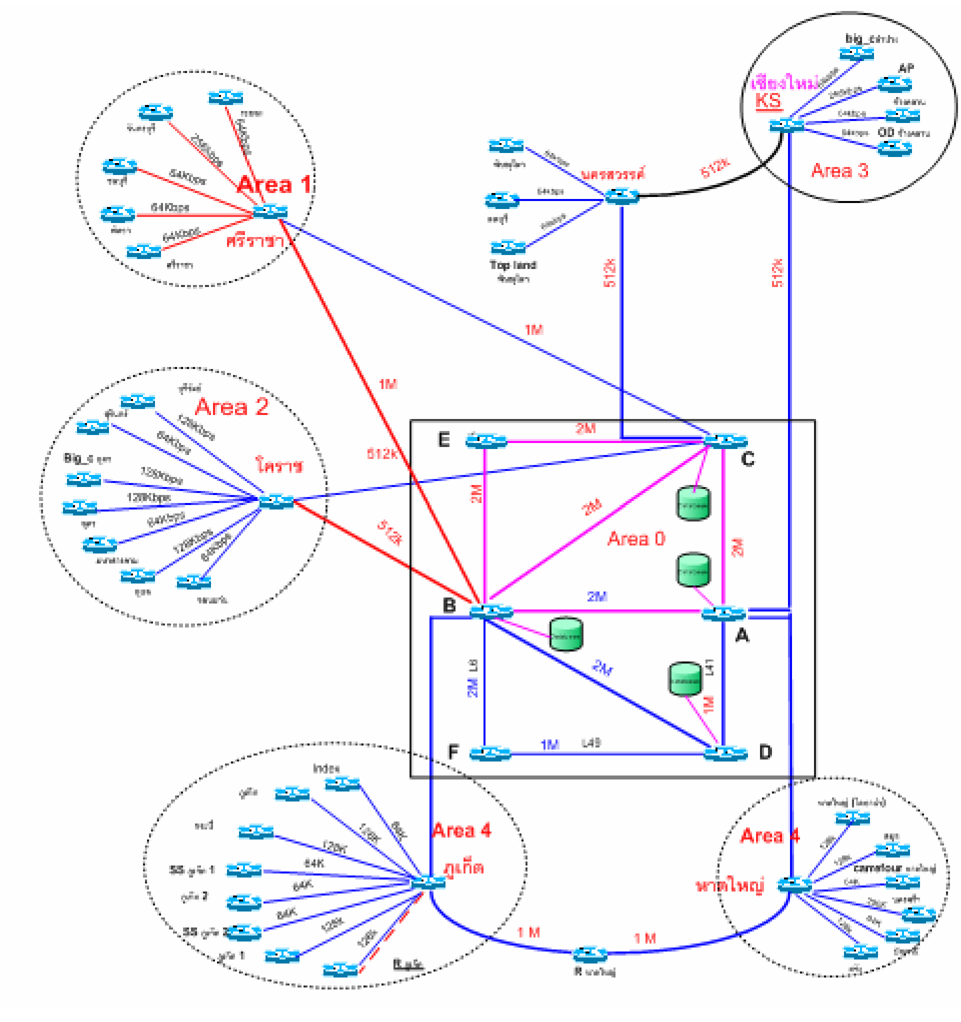

Figure 9: Multi Area Network

Table 3: Cost of Connection of Host to Host (Main Link) before Improvement

Cost of connection of Host to Host befor improvement						
NO.	Type	Origin	Destination	Speed	Monthly	Supplier
1	DDN	B รัชดา	ลาดพร้าว	1M	27,000	TRUE
2	DDN	B รัชดา	F สีลม	1M	27,000	TRUE
3	DDN	B รัชดา	B บางรัก	1M	27,000	TRUE
4	DDN	B รัชดา	A ชิดลม	1M	27,000	TRUE
5	DDN	C	A ชิดลม	2M	36,300	TRUE
6	LL	B รัชดา	A ชิดลม	1M	23,000	UIH
7	LL	B รัชดา	B บางรัก	768K	23,000	UIH
8	LL	C	B รัชดา	2M	36,300	UIH
9	LL	B รัชดา	A ลาดพร้าว	2M	36,300	UIH
10	HDLC	A ชิดลม	A Lad Prao	256K	11,000	Datanet
11	HDLC	A ชิดลม	A Silom	512K	16,000	Datanet
12	HDLC	D	A Silom	512K	16,000	Datanet
				Total	305,900	Bath/mount
				Total	3,670,800	Bath/year

Table 4: Cost of Connection of Host to Host (Main Link) after Improvement

	Cost of connection of Host to Host after improvement									
ITEM			Origin	Destination	speed	Monthly	Supplier	Type	Area
1			node B	node D	2M	36,300	TRUE	LL	0
2			node B	A Silom	1M	27,000	TRUE	DDN	0
3			node B	node E	2M	36,300	TRUE	DDN	0
4			node B	node A	2M	36,300	TRUE	LL	0
5			node C	node A	2M	36,300	TRUE	DDN	0
6			node B	node A	-	-	-	-	-
7			node C	node E	2M	36,300	UIH	LL	0
8			node C	node B	2M	36,300	UIH	LL	0
9			node B	node D	-	-	-	-	-
10			node A	node D	1M	27,000	Datanet	HDLC	0
11			node A	A Silom	-	-	-	-	-
12			node D	A Silom	1M	27,000	Datanet	HDLC	0
					Total	298,800	Bath/month		
					Total	3,585,600	Bath/year		

After system improvement by new link management and new area grouping, cost of operation is 14,415,480 bath/year (from 16,118,892 bath/year before improvement) that decreases 1,703,412 bath/year. The project implementation invests 1,384,000 baths that consist of 626,000 baths of installation cost and 758,000 baths of equipments cost.

5. Conclusion

In this project solves the problem of data communication between host to host and host to branches of CRC company case study by using OSPF protocol application which easy to implementation and small equipment. The implement results are shown that the cost of link connection and hardware are decreased result to maintenance cost is decreased too. Besides cost reduce, the new configuration has good stability both main and backup route, short distance of data transfer, low risk of communication, decrease redundant link, increase speed of data transfer and good efficiency of backup link that is generated by default resulting to immensely reduce cost for build the backup system. The payback period of project is about 1 year.

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