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Feature-Based Suitability Study of EIGRP and OSPF Routing Protocols for Healthcare, Banking and ISPs Enterprises Networks' Optimization

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Abstract

Due to the broadening of services from industrial enterprises to customers, the industrial network has gained more significance than what is really thought. As a part of this revolution, this paper tried to introduce the best suitable routing option for the healthcare, banking and internet services industries to optimize the routing department of their enterprises. RIP is not associated with this study, being out of favor in the industries due to hop count limitation.

The idea behind doing such a thing is to avoid improper implantation of routing inside the enterprises which causes lack of optimization in routing department. The method which is selected for this paper is qualitative case study of banking, healthcare and internet services industries with unstructured interviews of IT experts of the respected industries in an open-ended questions fashion.

The results were illustrated based on the stories and the discussion of the stories is the main contributor to the result of the study. The evaluation results of the stories have illustrated, that EIGRP is a suitable routing option for health care and banking, while OSPF can be suitable for the internet services industry.

The implication of the study can be optimized network of industries such as healthcare, banking and internet services and it introduces the best suitable routing option for the demanded industries with the case study method and narrative analysis of the stories, which start from load balancing type and ends to demanded routing protocol, while reaching to demanded routing protocol, it introduces the best suitable routing option of that industry.

Keywords: Routing Protocol, Throughput, Fault Tolerance, Convergence.

1. Introduction

Routing is the process of exchanging routes between different routers bi-directionally as it is always known as the key factor for industries [1]. Being optimized in the routing department is the key feature demanded by every enterprise to exchange network between different IP network [2]. This paper is focusing on the importance of industries' optimization by proper implementation of suitable routing protocol in the purposed enterprises. There is an ambiguous point in networks to implement which routing protocol into which enterprise industry type, a massive gap in the literature and shortage of implementation in genuine network infrastructures is the point of contention that will be focused by the paper [3]. This paper is supervising the question of the best suitable routing protocol for enterprises that operate in industries of banking, healthcare and internet services, although both contemplating routing protocol are reliable by taking alternate route or routes in routing table [4].

This paper is not only fulfilling its initial task which is the introduction of suitable routing protocol for the banking, healthcare and internet services enterprises' networks but also paying well attention onto the optimization of the aforementioned enterprises which differ in operating mode one from other in terms of their daily affairs.

The routing protocol has optimized through many years since 1980. Thus, optimization is much more substantial subject that, in a glimpse attracts most of attention onward it [5]. As briefly, it can be stated that the significance of the paper is obvious that why it is tried to acquire such thing? As time goes ahead since the existence of an organization, there are more services are added in networks and all that can create pressure and strain onto network infrastructure, which tend to the shortage of optimization in enterprises. This study analyzes the relationship between healthcare, banking and internet services enterprises' optimization with insight of routing worthiness in the enterprise

environments. These variables are thoroughly related to each other and the industries are hosting the magnificent impact of routing protocol in the core (routing) department.

The ultimate purpose of this paper is to introduce EIGRP or OSPF in accordance with healthcare, banking and internet services industries' optimization. As routing has gain significant role in industries, the result of this paper will be crucial to the healthcare, banking and internet services industrial networks' optimization with the determination of EIGRP and OSPF for the specific industry.

This research paper utilizes qualitative method with narrative analysis in order to determine the what and how of the story [6,7]. In order to gather reliable data case study of FMIC hospital in healthcare, ANS among ISPs, Miwand Bank in banking enterprises are taken with unstructured interviews to accomplish the research [8,9].

2. Related Work

There are wide range of papers that discusses the significance of routing protocols performance and enterprise networks. Dynamic protocols enable routers to find routes and alternate routes in case of link failure in the running network. Administrative-overhead is a lot less in dynamic-routing protocols as parallel to static-routing however, the dynamic-routing protocols are more expensive in terms of processing operations and bandwidth utilization. Different routing protocols are perfect in different scenarios even the use of static routing cannot be ousted from the marathon [10].

Routing protocols are divided into two parts. IGP (Interior Gateway Routing Protocols) and EGP (Exterior Gateway Routing Protocol). IGPs are those protocols that can be implemented in a single AS for route exchange such as OSPF, RIP, and EIGRP, whilst EGPs are those that can be implemented for connecting different autonomous systems. BGP is an instance of such protocol. These protocols are playing substantial role in today 's networks. They facilitate the process of route exchange between different routers. Although, this paper is only studying two predominant routing protocols for internal networks EIGPR and OSPF, the main purpose of current the research paper is to optimize the performance and efficiency of core routing in enterprises such as healthcare, banking and ISPs [11].

2.1 EIGRP

EIGRP (Enhanced Interior Gateway Routing Protocol) is an interior gateway protocol (IGP) distance vector routing protocol. The official classification of EIGRP indicates, that the protocol is distance vector but it also has the feature of link state routing protocols such as OSPF and IS-IS. For an instance EIGRP obeys the incremental update role which is the regulation of link state routing protocol. Incremental update means one-time update and after that, the update is sent just when a route is lost or a new route is added to the topology. Besides, this feature that EIGRP possesses, it is known as distance vector routing protocol. EIGRP was released by Cisco for the first time as an improvement of IGRP. The protocol is called enhanced interior gateway routing protocol because of supporting variable length subnet mask (VLSM), Classless interdomain routing (CIDR) and summarization [12].

2.2. OSPF

Open shortest path first was introduced as an improvement to RIP, offered faster convergence. A links state routing protocols use link state information to receive about the reachability of the other routers that are in the same routing domain and use it for the creation of topology map and elect the best route to destination. Link state routing protocols like OSPF, send full update only once. To keep the routing table balance, when there is any change to topology, it sends incremental update. OSPF utilized Dijkstra algorithm for the best path selection, it uses an accumulated value known as cost. In order to determine the distance from source to destination, each router determines its own cost and advertise to the rest of the routers. The value which is assinged to route are based on the usefulness of the route. The measurable extent for the usefulness of the route is Cost. For the process of choosing the best route, the cost is calculated from source to destination and the lower is preferred over the higher cost value [13].

2.3 Earlier studies about routing protocol performance

Here is a series of earlier research with thier accomplishments. Golap in his research Performance Analysis of RIPV2, EIGRP and OSPF, performed simulation on eight routers and a switch on GNS3 simulator. He found that EIGRP is better in terms of performance as compared to RIPv2 and OSPF. RIP is better in small networks and OSPF is better in large networks [2]. Another research on routing protocols between EIGRP, RIP and OSPF using OPNET simulation software has been conducted to compare the convergence time, the findings indicate that EIGRP has the fastest convergence time [14]. Anibrika Bright in his research, Performance Analysis Between EIGRP And OSPF For Real-Time Applications Using OPNET Simulation, expressed that EIGRP is better in performance for real-time applications using OPNET simulation expressed that EIGRP is better in performance for real-time application, Alabady, S. A and co-authors paper for Performance Analysis of Dynamic Routing Protocols for Sustainability and Reliability, the evaluation conducted between EIGRP, OSPF and RIP [15]. The network topology has been simulated in Packet Tracer with 25 routers aimed to find out the performance of routing protocols in a large network under the anomaly situation, the result illustrates that, OSPF has faster convergence as compared to RIP and EIGRP [16].

In the paper called Performance Analysis and Route Optimization: Redistribution Between EIGRP, OSPF and BGP, routing and redistribution have been configured in GNS3 simulator. Metrics (of study is Convergence, Throughput, and Packet Delay) have been compared using Wireshark Packet analyzer and it illustrated that, EIGRP is much quicker in convergence and took the least time to converge its topology change than OSPF and BGP. Besides that, EIGRP is the quickest in terms of throughput and received the replies in the least interval of time than other protocols [3].

This paper addresses the gap in literature which is the insufficient amount of guidance toward the correct implementation of routing protocol in industries such healthcare, banking and internet services to achieve adequate level of optimization in the routing department.

3. Significance of Routing on Industry

A single perpetual desire of all industries is to be connected to the modern world via online services and the majority of the tasks that are in, related to optimized infrastructure in their organizations. Routing is the core of network infrastructure in enterprises, which is adoptable reason for illustrating how routing gain significant role in enterprises networks, as it formed the core of routing, being optimized in core is pivotal point for the network infrastructure.

A set of well-known policies and tasks that an organization is operating on, is defining the industry role, which an enterprise is operating in and the commerce type of the enterprises is crucial for the enterprises to stay connected with high pace changing world, is possible through optimized network and routing serve as the crucial part of the optimized network. Thus, this paper focuses on routing optimization for the three proposed industries.

4. Methodology

The study of routing protocol suitability with the purpose of industry is the main question that the paper is going to answer in order to accomplish that, the paper has taken qualitative study approach with case study of Miwand banking (Bank), French Medical Hospital for Mother and Children (Hospital) and Ariana Network Services (ISP). The purpose of this paper is to determine which routing protocol is going to act better for the desired industry, as a part of its achievement this paper covers three industries of healthcare, banking and internet services industries.

This research has been designed in qualitative manner with the case study of a bank, a hospital, and an internet service provider, for every industry type a sample of the industry has been chosen for the analysis. It has tried its best, to select the best possible sample amongst all possible samples and the result, which comes from this particular research is based on sample. The sample of banking industry is Miwand bank, the sample of healthcare is FMIC and ANS is the sample of internet services industry that all of their data have gathered with unstructured interview. In order to prove the what and the how of the case, qualitative case study of the enterprises was the best possible option with the accessibilities in hand.

The participants of the study are the group of IT experts who have been in this field for so many years and this study focused to select those who are well experienced in IT. The analysis method of the paper is narrative study and it also utilizes the frequency of repetition (FRI) as statistical approach for the determination of the best suitable routing protocol in enterprise networks. The study was faced with some ethical issues such as the confidentiality of enterprise policies and the identities of the participants, are respected utmost.

As this paper is following narrative data analysis, the data has been departed in several stories and based on storyteller and story analyst. Following are the list of stories to be discussed in order to find Demanded RP (routing protocol) in enterprises.

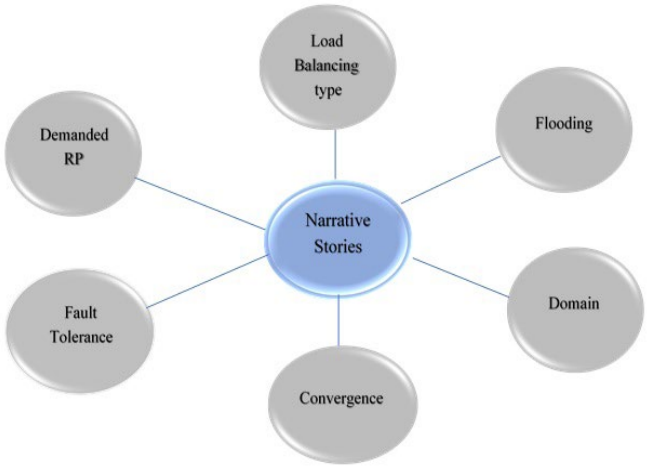

Figure 1: Narrative Stories

As part of data gathering, the data have been gathered from storytellers are IT experts and the story analyst section of narrative analysis has been considered by the interpretational analysis of data on stories' basis which was designed for the study. In this study the cycle of predesigned stories is the key for determination of best suitable routing protocol for the industr ies. The study is going to be analyzing load balancing type s, equal cost (OSPF Load balance) and unequal cost (EIGRP Load balance), then the positivity and negation o f flooding in OSPF is undertaken to stud y, domain of EIGRP and OSPF is undertaken to study from point of build, security and easiness to work, other predesigned story is convergence in this context neighborship and timers are the main focus of this story and finally fault tolerance of EIGRP an d OSPF is the last story . T he circumstances, that happen for the stor ies are indicating why a routing protocol is superior in a specific industry.

we have coded all the stories. As SC1 code for load balancing, SC2 is coded for flooding, SC3 as the routing domain, SC4 convergence, SC5 as the fault tolerance, and RSC6 as the demanded routing protocol. SC is shortened for story code and SRC story result c ode.

The interpretational study model of research story is as follo wing in healthcare industry

SC1

WHAT	WHY
Unequal Cost LB	Faster Optimization
	Better traffic forwarding
	Make higher availability

SC2

WHAT	WHY
Negative	Negative effect
	Utilizes CPU cycle

SC3

WHAT	WHY
EIGRP	Easy
	Secure

SC4

WHAT	WHY
EIGRP	Faster Convergence
	Less hello interval
	Less dead interval

SC5

WHAT	WHY
EIGRP	Goes only active for the specific routes
	No all-topology changes
	Less effort converges

SRC is equal to EIGRP

The overall of analysis illustrates the initial result, that EIGRP is the preferable routing protocol for the healthcare industry according to the data analysis that was collected from FMIC hospital in Kabul.

In this stage of analysis let's explore the analysis of the research stories on Miwand Bank. Miwand Bank is acting as the instance of the banking enterprises in this research.

SC1

WHAT	WHY
Unequal Cost LB	Critical application up
	Better traffic forwarding
	Increase availability to 24/7

SC2

WHAT	WHY
Negative	It slows down the performance of network
	Use more CPU resource
	Scramble time creation

SC3

WHAT	WHY
EIGRP	Easy to work
	Secure than OSPF

SC4

WHAT	WHY
EIGRP	Faster Convergence
	Less hello interval
	Quick uptime

SC5

WHAT	WHY
EIGRP	Backup route in the topology
	Quick fall over than OSPF
	No SPF re-run

SRC is equal to EIGRP

Due to the stories, that are analyzed in Miwand bank as an instance of banking enterprises, it is obviously clear that the feature that is fulfilling their necessities is EIGPR and known as much more reliable for the banking enterprises to implement EIGRP.

In the last section of analysis, the paper is going to analyze routing protocols for internet services enterprises, and Ariana Network Services (ANS) is the sample of study for the research. The analysis of research story codes in interpretational study model as below.

SC1

WHAT	WHY
Unequal Cost LB	Maximize network live time
	Better utilization of link bandwidth
	Avoiding from bandwidth spoiling

SC2

WHAT	WHY
Positive	Automatic topology change discovery
	Route Refreshment Provide path recovery

SC3

WHAT	WHY
OSPF	Easy to work
	Secure

SC4

WHAT	WHY
OSPF	Reliable Convergence
	Covering slow convergence by fast failure detection protocols

SC5

WHAT	WHY
OSPF	Breach of the policy to declare

SRC is equal to OSPF.

SRC is equal to OSPF.

The overall, of the analysis illustrates the initial result, that OSPF is the preferable routing protocol for the internet services industry, according to the data analysis that was conducted on Ariana Network Services an internet service provider.

To simply illustrate the desire of the banking, healthcare and internet services industries, the industry desire table is an easy way to understand the desire of the banking, healthcare and internet service industries.

Industry	Load-balancing	Flooding	Domain	Convergence	Fault tolerance
Banking	Unequal Cost	Negative	EIGRP	EIGRP	EIGRP
Healthcare	Unequal Cost	Negative	EIGRP	EIGRP	EIGRP
Internet Services	Unequal Cost	Positive	OSPF	OSPF	OSPF

table I: Industry Desire

In terms of convergence, even though most of the industries are willing to have fast convergence, but the internet services industry was convinced with a little low convergence of OSPF. The paper titled Performance Analysis of Enhanced Interior Gateway Routing Protocol (EIGRP) Over Open Shortest Path First (OSPF) Protocol with Opnet is clearly indicates that EIGRP has fast convergence than other protocols. For instance, when 20 bits were sent to the destination the packet delay measured, it was 26 milliseconds for EIGRP and it is 49 milliseconds for OSPF [15].

Fault tolerance is the ability to tolerate the fault, convergence time is the time in which how fast the protocol is converged its routes, is vital for the industry, Thus the importance of the convergence, fault tolerance, and reliability of the industries is summarized in the below table according to the paper findings.

Industry	Convergence	Fault Tolerance	Reliability	Convergence	Fault tolerance
Banking	Highly Fast	Highly important	Highly important	EIGRP	EIGRP
Healthcare	Highly Fast	Highly important	Highly important	EIGRP	EIGRP
Internet Services	Moderate fast	Moderately important	Highly important	OSPF	OSPF

Table II: Industry Con-Fault-T-Rel

In term of domain, this research paper has studied three domain sub codes for healthcare, banking and internet service industries. Although between these sub codes there are some resemblances and some distinctions, the overall of the concept is that domain is extremely important for the all-industries type.

While the data was gathered during the interviews, the trio industry had their own desire for the prospect of domain building and they were emphasized security in a specific level, and the ease of operation is the common desire among all industries. Below is a table that indicates the significance of domain from point of prefer to build, security and easiness to work according to data which has been gathered through interview with open ended question and analysis of the data in qualitative form.

Industry	Convergence	Fault Tolerance	Reliability	Convergence	Fault tolerance
Banking	Highly Fast	Highly important	Highly important	EIGRP	EIGRP
Healthcare	Highly Fast	Highly important	Highly important	EIGRP	EIGRP
Internet Services	Moderate fast	Moderately important	Highly important	OSPF	OSPF

Table III: Domain-value

The analysis method which has utilized for this paper was narrative analysis, it focuses on the narration of interviewee ‘s idea and prospects of their view about the phenomenon, in this case it is routing protocol role in optimization of enterprises. The stories were traveling from load balancing type to demanded routing protocol which ends the analysis. The result that can be drawn from the analysis will be further discussed in result section but the initial results of the analysis depict the fact that EIGRP is widely usable in enterprise networks due to a deduction in convergence time.

5. Result & Discussion

In this section, this paper has studied the importance of routing protocol in industry with the case study of real infrastructures and then it has analyzed the data through narrative analysis in the form of the story. The result that can be drawn from this study is that EIGRP is the most suitable current routing protocol for healthcare and banking industries, whilst OSPF is the perfect solution for the internet services industry based on interpretational study model. The other findings of this paper are that convergence time, domain, fault tolerance and reliability of EIGRP is outweighing on OSPF in healthcare and banking industries while the opposite scenario is dominant in internet services industry, OSPF is outweighing. The interpretational study model contributes to the field for the identification of suitable routing protocol for industry which was the main aim

of this paper and running the correct routing protocol can bring adequate level of optimization in routing department of every enterprise, thus, this paper has tried that.

Frequency of repetition (FRI) is worldwide standard and acceptable method for analysis of qualitative data. The method illustrates the fact that demanded routing feature in every industry is different from other industries. The FRI in healthcare industry demonstrates the fact that demand features are exist in EIGRP. One of the reasons is that, the industry was preferring EIGRP convergence time. Fast convergence is extremely important for the healthcare enterprises, which EIGRP can fulfill this need, it has been proved that EIGRP has less delay and higher throughput than OSPF, it is an indication for fast convergence of EIGRP [15].

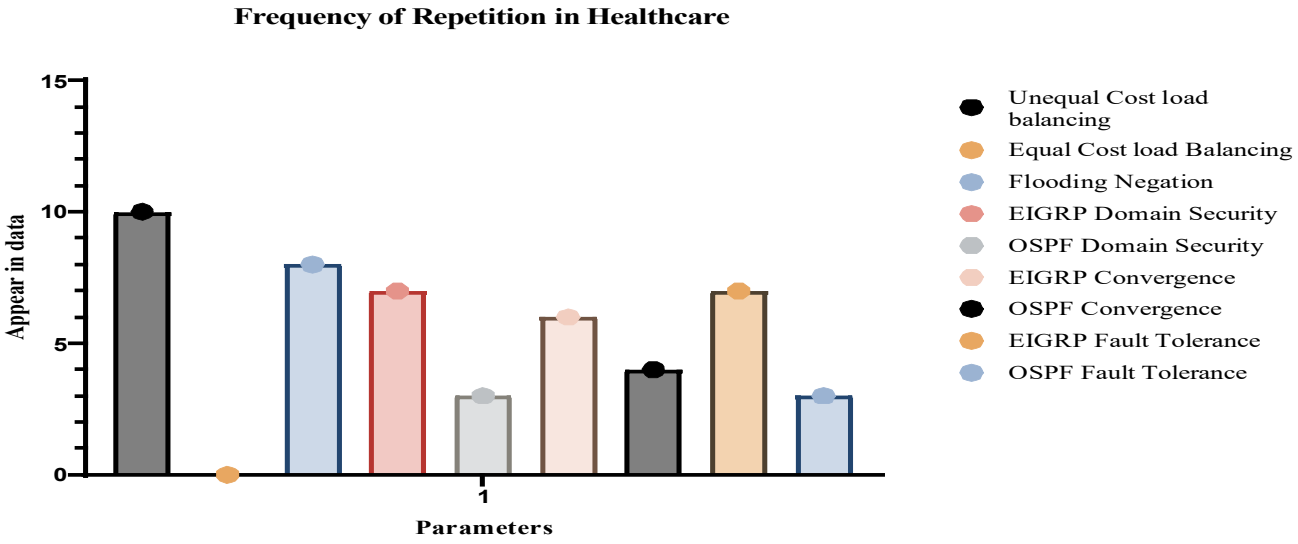

Figure 2: FRI in Health Care

Furthermore, FRI has also studied for banking in order to illustrates on-demand features of routing protocol from the point of IT experts in this industry and the result of FRI indicates the fact that EIGRP has the most of on demand features, as it depicts that EIGRP is best suitable option for this industry. This is because of fault tolerance and fast convergence is highly important in banking industry according to IT experts for exchanging credential data and data related to accounts.

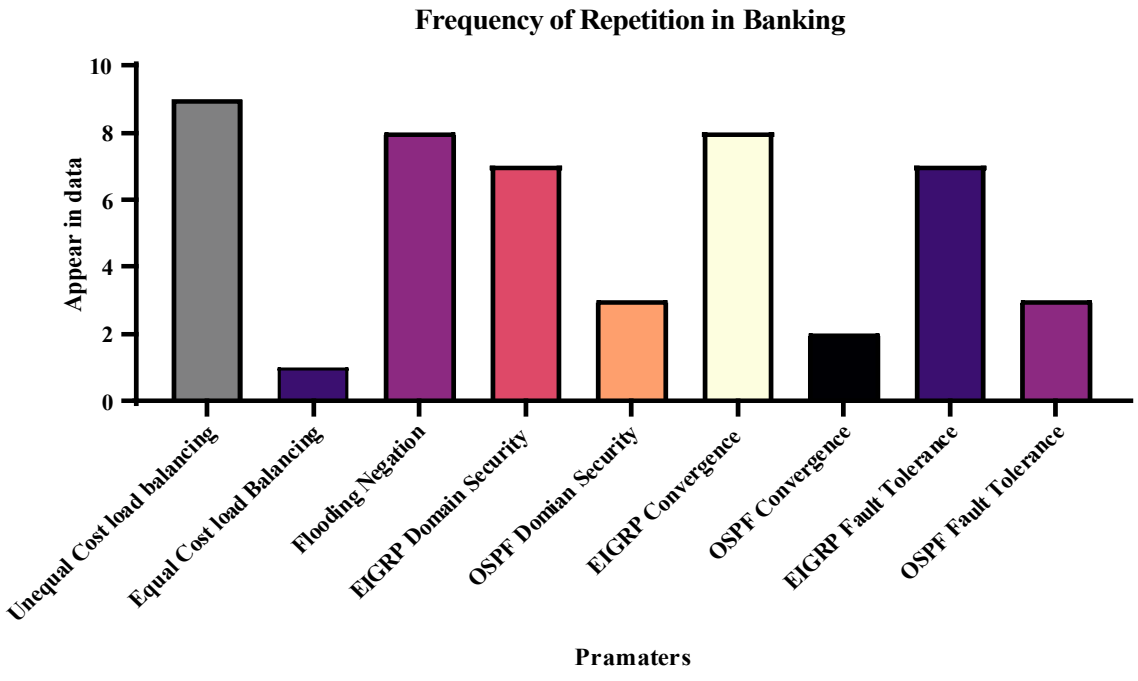

Figure 3: FRI in healthcare

Eventually, FRI has been studied for the internet services industry, in order to illustrate on-demand features of routing protocol from the point of IT experts in this industry and the result of FRI indicates, the fact that EIGRP has the most on-demand features that are required in ISPs. It illustrates that OSPF is the best suitable option for this industry, that is because the internet services industry organs are demand fast failure recovery and the flooding characteristic of OSPF is a positive sign in this era while in others are not, due to of route refresh for every half an hour, and thus. this can be efficient in the internet services industry due to the automatic route refreshment of the topology table.

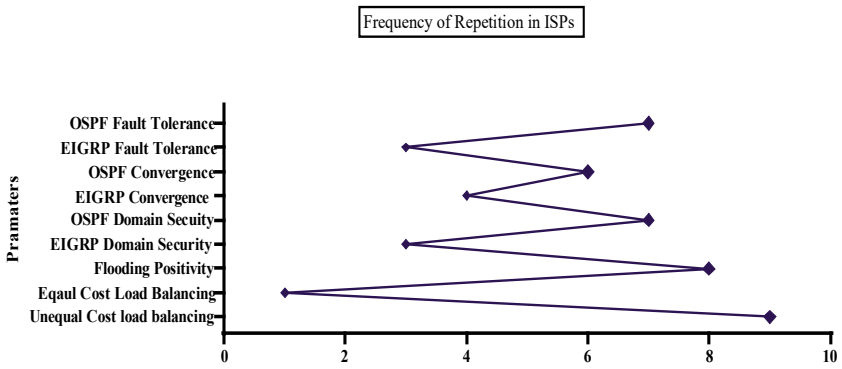

Figure 4: FRI in ISP

In general, this paper suggests EIGRP for banking and healthcare enterprises and OSPF for internet services industry based on interpretational model and based on FRI.

6. Conclusion and Future Work

Routing is the heart of the network and being optimized in this era is crucial to the network infrastructure of every industry, this study has contemplated routing protocols (EIGRP and OSPF) for healthcare, banking and internet services industries by introducing the best possible routing protocol for enterprise, which this paper introduces EIGRP as the suitable routing protocol for healthcare and banking industry while OSPF is introduced for the internet services industry which it was the main question of this paper. Furthermore, by proper implement of routing implantation, is possible to minimize the lack of optimization in the routing department of an industry, this has tried to be achieved well in this paper.

The implication of this paper is, that wants to introduces the best suitable routing option for industrial enterprises, amongst EIGRP and OSPF that operate in industry and down the line optimize their routing department. In order to accomplish that, the research was struggling with a few limitations such as narrow scope that only three type of industry was under the focus of this paper and some ethical restriction due to policies of the enterprises. The closing statement of the paper is that EIGRP can be a suitable option for the healthcare and banking industries and OSPF can be best suitable option for the internet services industry.

It is clear, that a single study is never perfect thus, it is recommended for the future researchers, that future researcher should explore more industries with evaluating of EIGRP, and OSPF and even adding more routing protocols like BGP and ISIS or they even can include more factors in their research for evaluating of routing protocol. Furthermore, a new study which can be in this sphere can be a variation in the methodology of the research, for example, researchers are able to consider a mix of qualitative and quantitative approaches, in order to achieve more accurate results.

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