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Enhancement Load Balance (ELB) Model for Port Ether-Channel Technology

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ABSTRACT

The main aim of this paper is to propose a comprehensive load-balancing model that can be applied for all types of networks. The proposed model is based on dividing the load regularly among the links and the communication between devices will be controlled. Consequently, EtherChannel reduces part of the binary pattern, so the addresses in the frame create a numerical value which selects one of the links. This selection aims to distribute frames across the particular link in a channel by modifying the Cisco−proprietary hashing algorithm. The results show that the proposed solution avoid overload on the link that is leading to loss packet at the same time there is a free space in another link, minimize packet delay, reduce congestion and enhance the work of network efficiency and reliability.

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1. Introduction

The problem in multiples port Ether-channel If load balancing will overload in a single link while other links have very little traffic. Load balancing is a methodology in order to get the best use of the link with spread the traffic across multiple links. Load balancing helps the network to minimize packet delay and packet loss, reduce congestion, increase network efficiency and reliability. The use of more than one Link to interconnect LAN switches, routers and servers is to allow load sharing of traffic among the links.

Our model is aimed to avoid overload on the link that is leading to the packet loss at the same time there is a free space in another link by reducing the difference in load between the links with effective bandwidth management, and as total to enhance the work of network efficiency. While there are no noted works related to port channel technologies, so this will be the base of our paper works. Scientific contributions focus on how to reduce the Congestion in the switch which leads to delay and loss data, so the switch distribute the load among links based on the value range in proposed model.

2. Related Works.

Many papers have been published to discuss the load balancing issue in different cases. Some of the proposed, presented decentralize method of LB, which focuses on minimization of communication costs and minimization of communication delays, Avoidance of non-productive trannsmission, and avoidance of oscillations, [6]. In othr paper, authors proposed a distributed Biased Random Sampling technique, which is the network structured dynamically to distribute the load efficiently [7].

3. Trunk Technology.

The trunk as a definition is a link between two communication systems work to handle multi transmission in the same time and used to interconnect network

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sites or between the main units specially switches in data centers. The trunk design to carry signals in its different forms analog form or digital form, also it used with all type of data, voice (VOIP), text (ASCII), multimedia (Photo and Video). [1]

For cisco devices, Trunking is one form that any interface can work with. That interface can be used to carry one or more VLAN (Virtual Local Area Network) between two switches. The different between any trunk interface and the Access interface, that access interface can be used to handle traffic only for one VLAN, and it's not allowed for other VLANs to use it. Those multi VLANs that used through trunk need an identity to distinguish them, for that reason a tag used for each VLAN to give it a special identity between the different switches that it go through, access interface not need to use this tag, because it have to carry just one VLAN and this VLAN have to be assigned by the switch itself. [2].

For some technologies Trunking name replaced with VLAN trunking.

4. Ether-Channel (Port- channel).

Cisco switches used a port link aggregation technology called Ether-Channel or (Port-Channel).This technology allows multi Ethernet interfaces to be like one logical Ethernet interface as shown in Figure 1, it used for providing high speed links between switches, servers and routers.[1]. Also it provides a fault tolerance for those devices. The ether-channel also used between switch and server and it can be from two active interfaces to eight active interfaces, those interfaces could be fast, gigabit or 10-Gigabit Ethernet ports, it's also used in the backbone network, and sometimes it used to connect end user clients.[1].

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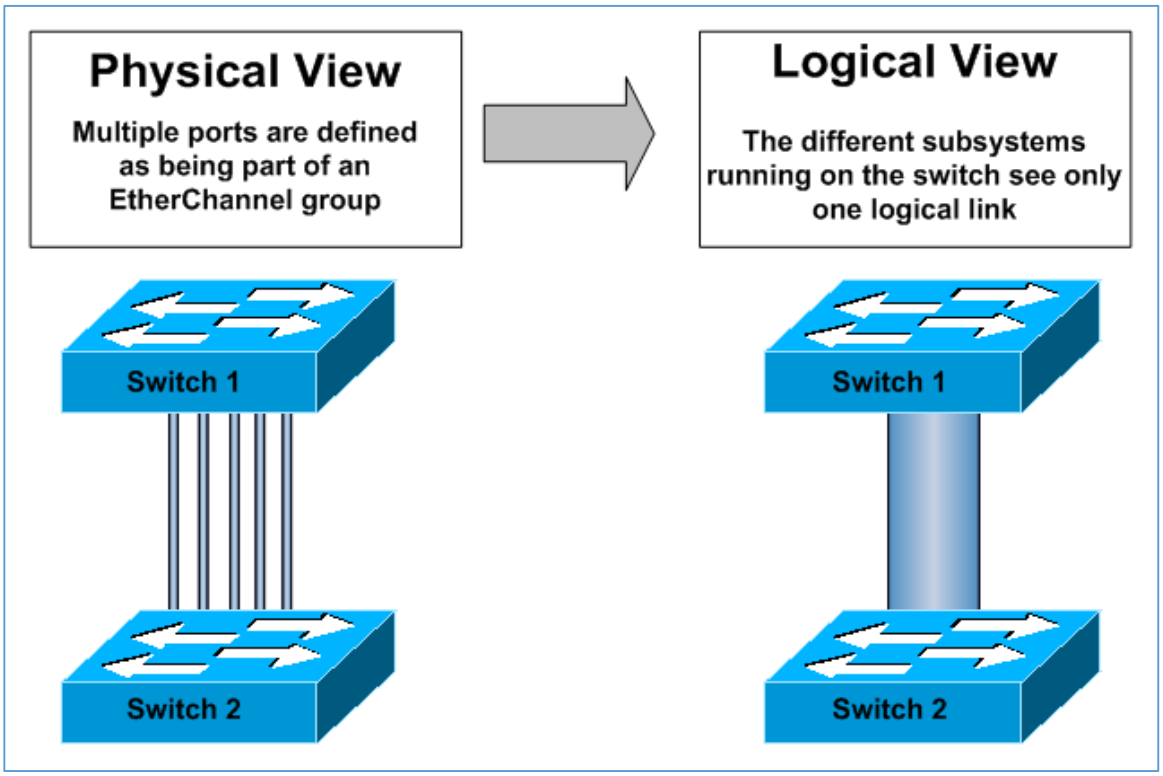

Figure 1 The Physical View Vs The Logical View for the Port Channel Technology.

The following functions performed by the Port-Channel

1. It used to increase the aggregate bandwidth on link by distributing the band between the worked links in that channel.
2. Applying balance in load across the multiple links and maintains the bandwidth to reach optimum usage.
3. Provide high fail tolerance , if one link go down traffic will moved directly to other links in the same channel group, and the table of MAC address will not affected by this failure.[2]

Ether-channel can be used at all network levels to make links with high bandwidth, used in some type of connection that used high traffic, and because it used an existing wiring it makes it very scalable.

Ether-Channel technology used by all of cisco switches, configuring ether-channel in any network made this channel part of it and transparent to other device in the network, those devices will see one link with one MAC address,

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and they will not get any information about the real MAC address for links used to create this channel. [4]

5. Load Balancing in Ether-Channel.

Ether-channel create one logical channel from combined multi physical links , this allows load sharing of bandwidth and traffic between links and add a redundancy in the event that any link or more may get fail. Ether-Channel used to interconnect LAN devices via fiber cables (single-mode and multi-mode), and UTP (unshielded twisted pair). [3].

Ether-Channel distribute the traffic among the active links in the channel, each link is selected using proprietary made by cisco called hash algorithm, this algorithm with decide where to send each traffic according to its source or destination MAC address, IP address or its port number. The algorithm gives a number from zero to seven. Table 1 will show how the 8 numbers are distributed among the 2 to 8 physical ports. [2].

In the hypothesis of real random hash algorithm, 2, 4 or 8 ports configurations lead to fair load balancing, whereas other configurations lead to unfair load balancing. Table 1 show the distribution of load in Port channel technology [1].

Table 1. The distribution of load in Port Channel Technology.

Number of Ports in the Ether-Channel	Load Balancing ratio between Ports
8	1:1:1:1:1:1:1:1
7	2:1:1:1:1:1:1
6	2:2:1:1:1:1
5	2:2:2:1:1
4	2:2:2:2
3	3:3:2
2	4:4

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The switch is using per flow balancing because this is the way how hardware works. When the switch receive the packet, it would make a hash result from fields located in the header line source/destination MAC address, source/destination IP address or source/destination port number. From which fields the device would make a hash depends on certain ASIC. Not all switches were made equal. Software is using those hashes to make a decision on which port (Physical port number) sends the packet out to another device in the path. [3].

The Cisco−proprietary hash algorithm computes a value in the range 0 to 7. With this value as a basis, a particular port in the Ether-Channel is chosen. The port setup includes a mask which indicates which values the port accepts for transmission. With the maximum number of ports in a single Ether-Channel, which is eight ports, each port accepts only one value. If you have four ports in the EtherChannel, each port accepts two values, and so forth. Table 2 lists the ratios of the values that each port accepts, which depends on the number of ports in the Ether-Channel.

6. The Based Model of load balancing.

(Value range 0 to 7):

Table 2. Load balancing Table Original Model.

No. of port	Load Balancing								Value
1	8								8
2	4	4							8
3	3	3	2						8
4	2	2	2	2					8
5	2	2	2	1	1				8
6	2	2	1	1	1	1			8
7	2	1	1	1	1	1	1		8
8	1	1	1	1	1	1	1	1	8

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We conclude from Table 3 that, the percentage of each link from the total value of load, and the ratio that shows varying loads between links in each case (1, 2, 3 …7 ports), we will see the difference of load between the highest and lowest load.

Table 3. the difference between the maximum and minimum transmission ports Original Model.

No. of port	Percentage of Load Balancing								Perc. of Deff
1	100%								0%
2	50%	50%							0%
3	37.50%	37.50%	25.00%						12.50%
4	25%	25%	25%	25%					0%
5	25.00%	25.00%	25.00%	12.50%	12.50%				12.50%
6	25.00%	25.00%	12.50%	12.50%	12.50%	12.50%			12.50%
7	25.00%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%		12.50%
8	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	0%

7. The Proposed Method

This paper includes two cases:

7.1: Case-1 for Value Range 0 to 15 (First Proposed Model).

Assuming to increase the value from the range 0-7 to 0-15 in order to optimize the distribution load according to Table 4. The load is evenly divided among the links and that the varying loads between links be minimized.

Table 4. Load balancing table Range 16.

No. of port	Load Balancing								Value
1	16								16
2	8	8							16
3	6	5	5						16
4	4	4	4	4					16
5	4	3	3	3	3				16
6	3	3	3	3	2	2			16
7	3	3	2	2	2	2	2		16
8	2	2	2	2	2	2	2	2	16

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From Table 5 the Proposed model conclude the percentage of each link from the total value of load, and the ratio that shows varyingloads between links in each case (1, 2, 3 …16 ports), we will see the difference of load between the highest and lowest load.

Table 5. the difference between the maximum and minimum transmission ports Range 16.

No. of port	Percentage of Load Balancing								Perc. of Deff
1	100%								0%
2	50%	50%							0%
3	37.50%	31.25%	31.25%						6.25%
4	25%	25%	25%	25%					0%
5	25.00%	18.75%	18.75%	18.75%	18.75%				6.25%
6	18.75%	18.75%	18.75%	18.75%	12.50%	12.50%			6.25%
7	18.75%	18.75%	12.50%	12.50%	12.50%	12.50%	12.50%		6.25%
8	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	0%

7.2: Case-2 for Value Range 0 to 31(Second Proposed Model)

Supposing to increase the range value to 0-31 in order to confirm the improved distribution load as shown in Table 6. The load balancing divided the traffic between the links and that the varying of loads between links be minimized less than Case-1(First Proposed Model).

Table 6. Load balancing table chart Range 32.

No. of port	Load Balancing								Value
1	32								32
2	16	16							32
3	11	11	10						32
4	8	8	8	8					32
5	7	7	6	6	6				32
6	6	6	5	5	5	5			32
7	5	5	5	5	4	4	4		32
8	4	4	4	4	4	4	4	4	32

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From the table 6 of Second Proposed Model conclude the percentage of each link from the total value of load, and the ratio that shows varying loads between links in each case (1, 2, 3 …32 ports), we will see the difference of load between the highest and lowest load in Table 7.

Table 7. the difference between the maximum and minimum transmission ports Range 32.

No. of port	Percentage of Load Balancing								Value
1	100%								**0%**
2	50%	50%							**0%**
3	**34.38%**	**34.38%**	**31.25%**						**3.13%**
4	25%	25%	25%	25%					**0%**
5	**21.88%**	**21.88%**	**18.75%**	**18.75%**	**18.75%**				**3.13%**
6	**18.75%**	**18.75%**	**15.63%**	**15.63%**	**15.63%**	**15.63%**			**3.13%**
7	**15.63%**	**15.63%**	**15.63%**	**15.63%**	**12.50%**	**12.50%**	**12.50%**		**3.13%**
8	13%	13%	13%	13%	13%	13%	13%	13%	**0%**

8. Results and Conclusions

Several cases in the proposed optimization process have been excluded from the optimization, these cases are if one, two, four or eight Links, because of the load is equivalent in these links.

Load balancing helps the network to minimize packet delay and packet loss, reduce congestion, increase network efficiency and reliability. The use of more than one Link to interconnect LAN switches, routers and servers is to allow load sharing of traffic among the links.

Our model is aimed to avoid overload on the link that is leading to the packet loss at the same time there is a free space in another link by reducing the difference in load between the links with effective bandwidth management, and as total to enhance the work of network efficiency.

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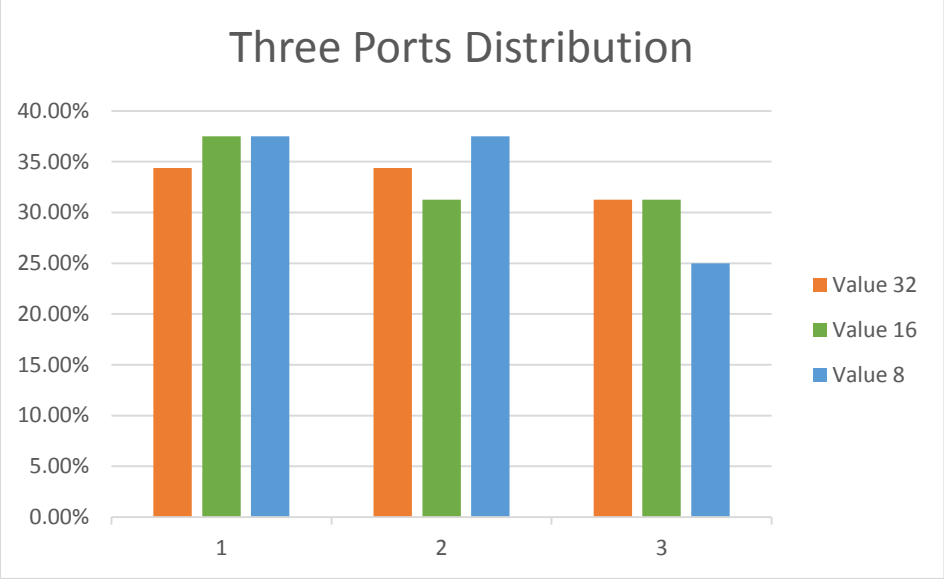

Figure 2. Three Port Distribution.

Three port's distribution it means three links which sharing load with this links as shown in Figure 2. In case value 16 the first link does not change but the second link will decrease 6.25% and third link will increase 6.25% from the original model. In case value 32 the first link will decrease 4.12% and second link also will decrease 4.12% and third link will increase 6.25% from the original model.

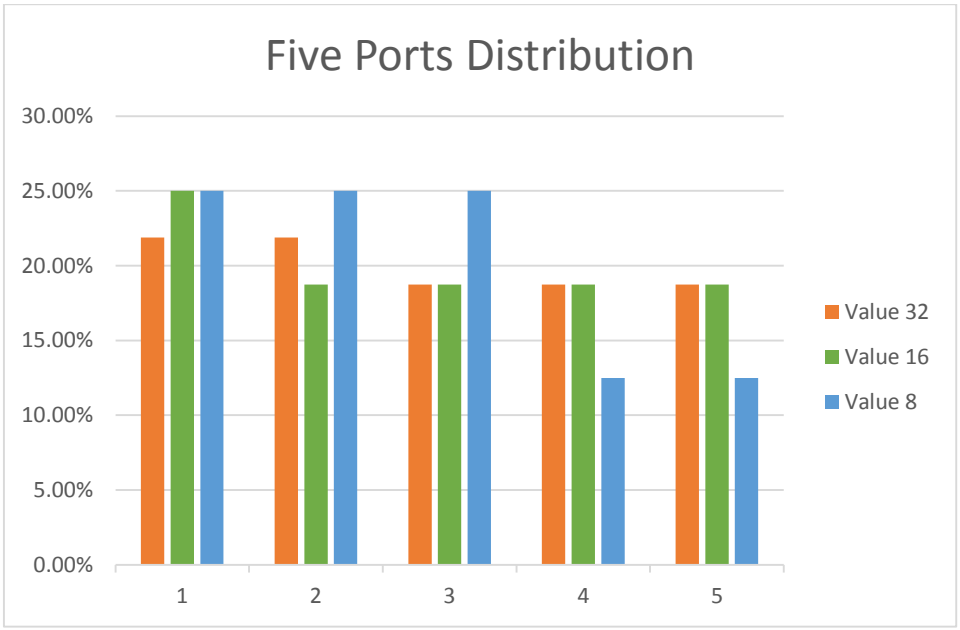

Figure 3. Five Port Distribution.

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Five ports distribution it means five links which sharing load with this links as shown in Figure 3. In case value 16 the first link does not change but the second and third link will decreases 6.25%. The fourth and fifth links will increase 6.25% from the original model. In case value 32 the first and second links will decrease 3.12%. The third link also will decrease 6.25%. The fourth and fifth links will increase 6.25% from the original model.

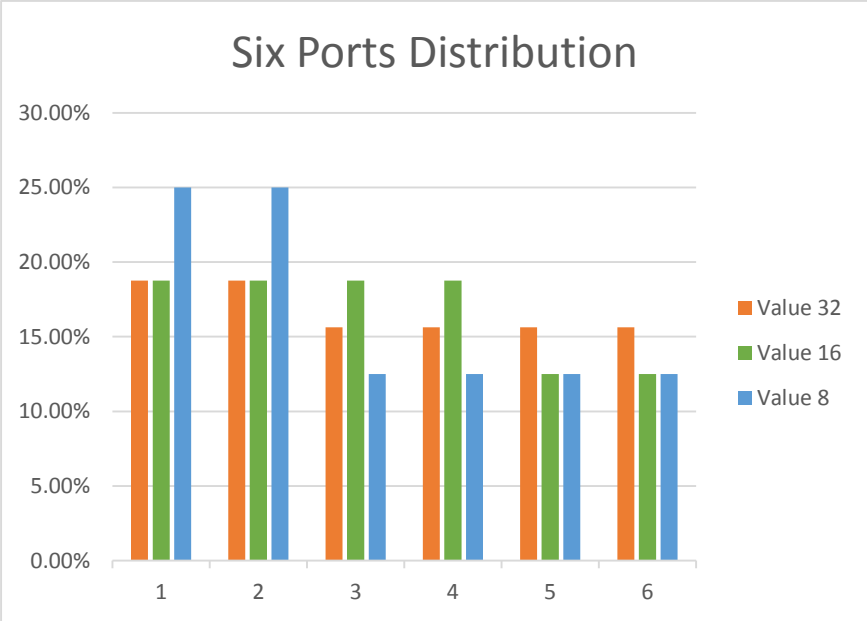

Figure 4. Six Port Distribution.

Six ports distribution it means six links which sharing load with this links as shown in Figure 4. In case value 16 the first and second links will decreases 6.25%.The third and fourth links will increase 6.25%. The fifth and sixth links does not change from the original model. In case value 32 the first and second links will decrease 6.25%. The third, fourth, fifth and sixth link also will increase 3.13% from the original model.

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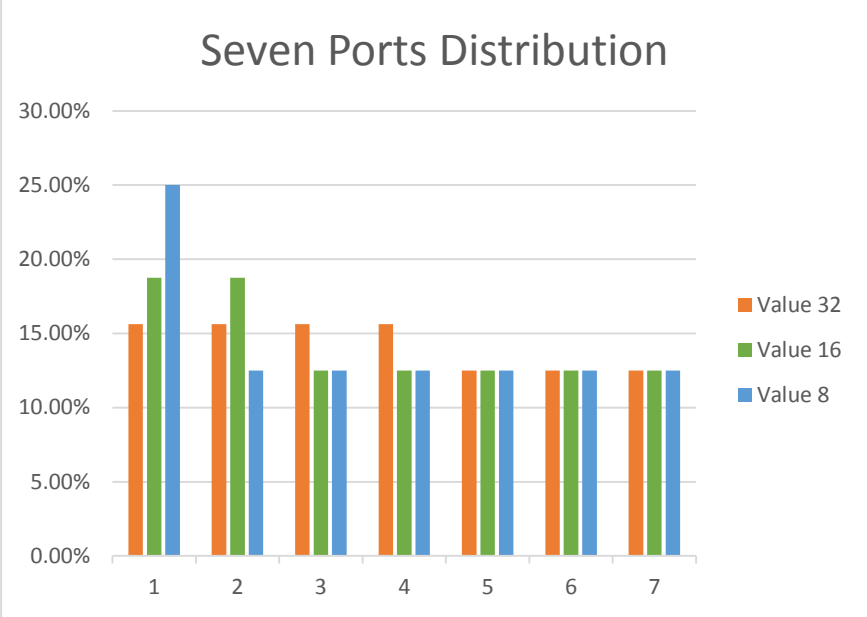

Figure 5. Seven Port Distribution.

Seven ports distribution it means seven links which sharing load with this links as shown in Figure 5. In case value 16 the first link will decreases 6.25%.The second link will increase 6.25%. The third, fourth, fifth, sixth and seventh links does not change from the original model. In case value 32 the first link will decrease 9.37%. The second, third and fourth links will increases 3.13%. The fifth, sixth and seventh links does not change from the original model.

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پوختە

ئامانجی سە رە کی ئە و توژینە وە یە نیشاندانی شیوازیکی کاملە(comprehensive) بوهاوسە نگ کردنی بار l oad bal anci ng کە دە توانری بو هە مو جورە شە بە کە یە ک(network) بە کار بهیندری. بناغە ی ئە و شیوازە لە سە ر دابە ش کردنی بە یە ک رادە ی l oad لە نیوان لینکە کان و پە یوە ندی لە نیوان ئامیرە کونترول کراوە کان دارشتراوە. لە دە رانجامدا، EtherChannel بە شە کانی شیوازی بایتری کە م دە کاتە وە و ئادرە سە کان لە فریم فورم(framd form) بو ارقام کە لینکیک هە لدە بژیری بە مە بە ستی دابە شکردنی فریمە کان (frames) لە مابە ینی لینکە کانی یە ک کانال بە دە ستیوە ردانی سیسکوی تایبە ت (Cisco-proprietary) بە الگوریتمی هاش (hashing algorithm).هاوسە نگ کردنی بار l oad bal anci ngە یارمە تی دە دا تا تاخیر و لە دە سچونی پاکە ت لە نیو شە بە کە بە کە مترین ئاست خوی بگا و ازدحام کە م دە کاتە وە و کاریگە ری و باوە رپیکردنی شە بە کە زیاد دە کا.

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الخلاصة

الهدف الرئيسي من هذا البحث هو اقتراح نموذج موازنة التحميل الشامل الذي يمكن تطبيقه لجميع أنواع الشبكات. النموذج المقترح يستند على تقسيم الحمل بشكل منتظم بين الروابط ويتم التحكم بالاتصال بين الأجهزة. ونتيجة الى ذلك (Ether Channel) يقلل جزءا من النمط الثنائي, لذلك العناوين في الاطار تشكل بقيمة رقمية والتي تختار واحد من الروابط من اجل توزيع الاطارات عبر هذا الرابط في القناة عن طريق تعديل خوارزمية التجزئة المملوكة ل سيسكو. موازنة الحمل تساعد الشبكة لتقليل تأخير حزمة وتقليل فقدان الحزمة والحد من الازدحام وزيادة كفاءة الشبكة وموثوقيتها.