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Energy optimized design in cross layer approach for minimizing routing disruption for IP over WDM networks

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Abstract: Energy consumption of network equipment and environment protection are gaining increasing concern in recent years, to develop energy efficient network architecture and operational costs as to reduce the energy consumption of the internet. In cross layer approach back up paths are selected and widely used in IP networks to protect IP links from failures. Hence cross layer approach for minimizing routing disruption caused by IP link failures and optimizing the energy during this operation is going to be addressed. In the present research, we concentrate on minimizing the energy consumption of an IP over WDM networks and minimizing routing disruption caused by IP link failures during cross layer approach, with the CPF model we develop efficient algorithm to select multiple reliable backup paths to protect each IP link, when an IP link fails, its traffic is split onto multiple backup paths and the rerouted traffic load on back up paths and the rerouted traffic load on each IP link does not exceed the usable bandwidth, we solve our approach using real ISP network with both optical and IP layer topologies specifically in IP over WDM network energy is consumed by network elements at both IP and WDM layers. And current network infrastructure have no energy saving scheme, here we develop efficient approach called mixed integer linear programming(MILP).this approach is based on traditional virtual topology and traffic grooming designs, experimental results show that two backup paths are adequate for protecting a logical link, and back up path selected by our approach are at least 18% more reliable and the routing disruption is reduced by at least 22 percent, and the proposed approach prevents the rerouted traffic from interfering with normal traffic, finally it is also useful and interesting to find an energy efficient network design is also a cost efficient design because of the fact that IP routers play an important role in both energy consumption and network cost in the IP over WDM networks.

Keywords—IP over WDM networks, routing, failures crosslayer, IP networks recovery, CPF model.

1. INTRODUCTION

IP link failures are commonly observed in the internet for various reasons and the internet expansion capacity increases the energy consumption of the network equipment today the cost of transmission is considered as one of the major barrier to the growth of the internet in the high speed IP networks like the internet backbone disconnection of link for several se-protect their domains. Here backup paths are pre computed, configured and stored in routers, when a link failure is detected, traffic originally traversing the link is immediately switched to the backup path of the link, by this the routing disruption duration is reduced to the failure detection [5].when a link failure is detected alternative backup path have to be selected at that time in IP over WDM networks, energy is consumed by network elements at both IP and WDM layers. there are two key implication of this, first increased energy consumption of the internet will increases operational costs in the network and increases the green house effect of the network, secondly increased energy consumption will exacerbate the thermal issues associated with large data centers and switching nodes[6].current IP backbone networks are built on the wavelength division multiplexing(WDM) infrastructure [7].In this layered structure, IP layer topology is embedded on the optical layer topology(physical topology) and each IP link(logical link) is mapped to a physical topology.

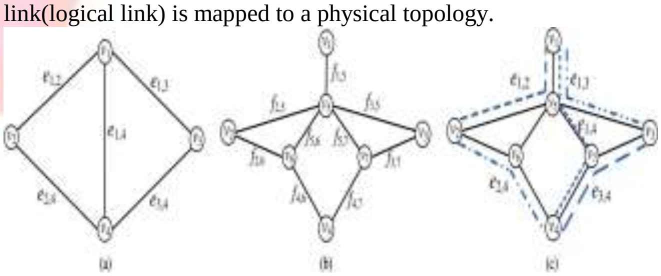

Fig. 1. Example of the mapping between the logical and physical topologies in IP-over-WDM networks. (a) Logical topology. (b) Physical topology. (c) Mapping between the logical and fiber links

Fig.1 shows an example of the topology mapping in IP-over-WDM networks. In the present research, we concentrate on minimizing energy (or power) consumption of the backbone IP over WDM networks during the selection of alternative backup paths the problem of designing an energy efficient IP over WDM network is important because electricity power consumption is one of the major operational costs for a network service provider and today energy is becoming more and more scarce resource, the energy oriented IP over WDM network and minimized energy MILP optimization model are novel, in which the physical layer issue such as power consumption of each component is specifically considered[8,9].

Finally, it is significant to find that energy efficient IP over WDM network is also a cost effective network as observed [10] most link overload in an IP backbone is caused by the traffic rerouted due to IP link failures. Therefore, back-up paths should be carefully selected to prevent causing link overload we can determine reliable backup paths with the CPF model, we develop a correlated probabilistically failure (CPF) model based on the topology mapping and the failure probability of fiber links and logical links. The CPF model calculates the failure probability of fiber links, logical links, and backup paths under the condition that an IP link fails With the CPF model an algorithm is proposed to select at most N reliable backup paths for each IP link our approach is different in three aspects.

First cross-layer design, which considers the correlation between logical and physical topologies, the proposed CPF model can reflect the probabilistic correlation between logical link failures, second each logical link with multiple backup paths to effectively reroute traffic and avoid link overload, Third, considers the traffic load and bandwidth constraint. It guarantees that the rerouted traffic load does not exceed the usable bandwidth, even when multiple logical links fail simultaneously, in this present work the backup paths selected by our approach are at least 18 percent more reliable and the routing disruption is reduced by at least 22 percent. Moreover, the proposed approach prevents logical link overload caused by the rerouted traffic.

Finally energy optimization during cross layer approach is over come by method called MILP, it minimizes total network energy consumption of an IP over WDM networks and it also minimizes the number of network components, including IP router ports, EDFAs, and transponders, weighted by a set of factors of energy consumption, potential traffic disruption.

2. RELATED WORK

In general, Existing work can be divided into three categories related to our approach.

2.1. IP Link Protection Based On Backup Path.

Consider backup path selection as a connectivity problem and mainly focus on finding backup paths to bypass the failed IP links [4], [11], [12], [13], [14], and [15]. Consequently, the rerouted traffic may causes severe link overload on an backbone IP networks as they ignore the fact that a backup path may not having enough bandwidth as observed by [10]. In recent work, we develop CPF model to highlight the probabilistic correlation between logical link failures, and split the rerouted traffic onto multiple backup paths to avoid link overload and minimizes routing disruption.

2.2. Correlation between the Logical and Physical Topologies

IP-over-WDM networks consider the correlation between the physical and logical topologies. Minimizing the impact based on fiber and logical links failures [7], showed that topology mapping is strongly affected by the reliability of IP layer. Moreover, our approach is based on a cross-layer design. They aim at finding reliable backup paths; while our objective is to minimize routing disruption. Our paper also considers the topology mapping, but it is different in two aspects.

First, the CPF model considers both independent and correlated logical link failures.

Second, Multiple backup paths protects each logical link in this paper, But protected by single backup path in [15]

2.3. Allocation of Bandwidth and Multi-path Routing

Quality-of-Service (QoS) routing protocols [5], use multiple paths between a source-destination to achieve traffic engineering goals, e.g., minimizing the maximal link utilization. However, they do not consider the correlation between physical and logical link failures. There are some recovery approaches that are built on multiple recovery paths. The approach in [9] aims at minimizing the bandwidth reserved for backup paths. It assumes that the network has a single logical link failure and only uses IP layer information for backup path selection. IN [4] reroutes traffic with multiple paths and the method in [8] combine addresses failure recovery and traffic engineering in multipath routing. Moreover, they ignore the correlation between logical link failures and consider backup paths should have same reliability and they focus on traffic engineering goals rather than minimizing routing disruption.

3. CPF MODEL

CPF model is built on three kinds of information, i.e., the topology mapping, failure probability of fiber links, and failure probability of logical links, all of which are already gathered by ISPs, The failure probability of fiber links and logical links are obtained with internet measurement approaches deployed at the optical and IP layers. We propose an algorithm to select multiple backup paths with the CPF model to protect each IP link. From routing updates we can extract information of logical link failures. ISPs maintain failure information, because they monitor the optical layer and IP layer of their networks with this model we develop two algorithms for selecting back up paths the first algorithm focus on reliability and aims at choosing the backup paths with minimum failure probability.

The second algorithm considers the band width constraints and aims at minimizing the traffic disruption caused by failures; our approach considers both reliability and bandwidth constraints. It helps to protect each logical link with multiple backup paths and splits the rerouted traffic on to them, because there are no individual backup paths that have enough bandwidth for the rerouted traffic.

4. BACKUP PATH SELECTION

This section is divided into three categories based on our approach.

4.1. IP link protection based on backup path selection

This approach is widely used in the intra-domain routing. In this, Router selects a backup path for each of its logical links. If in case any of the logical link failure is detected, only the routers connected by the link can detect the failure. Router immediately switches the traffic sent on this logical link onto alternative backup path upon detecting the failure. Since most IP link failures are temporary and last for few seconds, rapidly triggering the convergence may cause route flapping and make networks more unstable [12].Therefore, routers has to wait for few seconds before detecting the failure information. To reroute the traffic backup path is used .Routers compute backup paths based on new network topology. In fig.1 (a)., suppose that node v1 adopts v1->v2->v4 as backup path for e(1,4).If v1 detects that e(1,4)fails, it forwards the packets towards v4 along v1->v2->v4.After the routing protocol converts to new shortest path towards v4,and thus the process stop using the backup path selection. Backup paths can be implemented with multiprotocol label switching [13], widely used and supported in current internet. Rerouted traffic load on a back up path can be controlled by the routers and each back up paths are configured as a label switched path (LSP)

4.2. IP over WDM networks model

The IP-over-WDM network under study has a logical topology and physical topologies, which are commonly, modeled as two undirected graphs [2]. In the physical topology $GP = (VP; FP)$, VP is a set of nodes and FP is a set of fiber links. The fiber link from node $vi \in VP$ to node $vj \in VP$ is denoted by $fi;j$. In the logical topology $GL = (VL; EL)$, $VL \subseteq VP$ and EL is a set of logical links. The logical link from node $vm \in VL$ to node $vn \in VL$ is denoted by $em;n$. The entire logical link is mapped on the physical topology as a light path, i.e., a path over the fiber links, embedding of a logical link on fiber links which carries logical links. As logical link stated the topology mapping is quite stable and does not change frequently.

Table 1. Table of notations

Symbols	Meaning
$G_P = (V_P ; F_P)$	physical topology
$G_L = (V_L;E_L)$	logical topology
$f_{i;j}$	fiber link from node v_i 2 V_P to node v_j 2 V_P
$e_{m;n}$	logical link from node v_m 2 V_L to node v_n 2 V_L

4.3. Correlated probability failure model (CPF)

With the CPF model, we develop two algorithms to choose backup paths. The first algorithm aims at choosing the backup paths with minimum failure probability and focuses on reliability. The second algorithm aims at choosing backup paths to minimize the traffic disruption caused by failures and focuses on bandwidth constraint moreover; to prevent causing logical link overload it controls the rerouted traffic.

5. MILP OPTIMIZATION MODELS

MILP models have been developed to minimize either average packet delay or total network costs for the IP over WDM network [8] We extended these models for our energy-minimized design. However, it should be clarified that the model developed here differs from the traditional ones in the following aspects: First, our energy-optimization model concentrates on minimizing total energy consumption by various components of network including WDM transponders, IP routers and EDFAs. The traditional virtual-topology design and traffic grooming models generally maximize network throughput or minimization in packet delay. Second, rather than pure network capacity as in the traditional virtual topology design and traffic grooming models, our energy optimization model also concerns the physical layer issues such as the layout of EDFAs, the number of required EDFAs related to link wavelength capacity, energy consumption of WDM transponders and EDFAs, etc. Third, in our energy optimization model, in addition to the IP router ports used for establishing virtual light path links, the ports used for aggregating data traffic from the low-end routers are considered. In the traditional models, only IP router ports (or optical transceivers) used for establishing virtual light path links between optical cross-connect node pairs are considered.

6. OBJECTIVE

Energy optimization faces several challenges in various level of research development. There is a need to develop a method which is an energy efficient and dynamic routing and so on. Bandwidth is also major constraint.

The following are the certain objective which has been considered in this work.

1. Cross layer approach avoids interference
2. Cross layer approach focus on choosing reliable backup path to reduce routing disruption
3. Band width constraint is carefully selected to prevent causing link overload
4. Lifetime energy optimization can be obtained at cross layer approach to conserve energy at IP layer.

7. CONCLUSION

This paper looks into the energy saving of the IP over WDM networks during cross layer approach. Cross layer design is being proposed for minimizing routing disruption caused by IP link failures. For the impact of IP link failure on the reliability of backup paths we develop a CPF model. An algorithm is proposed for minimizing the routing disruption by choosing multiple reliable backup paths to protect each IP link with this CPF model. Simulation results show that multiple backup paths are developed for protecting a logical link. Compared with prior works, the backup paths selected by our approach are at least 18% more reliable and the routing disruption is reduced by at least 22%.moreover, the proposed approach achieves higher recovery rate without causing logical link overload. To reduce energy consumption, we developed MILP optimization model. This MILP model for the IP over WDM network follows an approximately linear relationship with network traffic demand in the cross layer design.

8. REFERENCES

[1] Q. Zheng, G. Cao, T.L. Porta, and A. Swami, ''Optimal Recovery from Large-Scale Failures in IP Networks,'' in Proc. IEEE ICDCS, 2012, pp. 295-304.

[2] A. Bremler-Barr, Y. Afek, H. Kaplan, E. Cohen, and M. Merritt, ''Restoration by Path Concatenation: Fast Recovery of MPLs Paths,'' in Proc. ACM PODC, 2001, pp. 43-52.

[3] V. Sharma and F. Hellstrand, Framework for MPLS-Base Recovery, RFC 3469, 2003.

[4] M. Shand and S. Bryant, IP Fast Reroute Framework, RFC5714, Jan. 2010.

[5] P. Francois, C. Filsfils, J. Evans, and O. Bonaventure, ''Achieving Sub-Second IGP Convergence in Large IP Networks,'' ACMSIGCOMM Comput. Commun. Rev., vol. 35, no. 3, pp. 35-44, July 2005.

[6] F. Giroire, A. Nucci, N. Taft, and C. Diot, ''Increasing the Robustness of IP Backbones in the Absence of Optical Level Protection,'' in Proc. IEEE INFOCOM, 2003, pp. 1-11.

[7] A. Kvalbein, A.F. Hansen, T. Cicic, S. Gjessing, and O. Lysne, ‘‘Fast IP Network Recovery Using Multiple Routing Configurations,’’ in Proc. IEEE INFOCOM, 2006, pp. 1-11

[8] S. Kini, S. Ramasubramanian, A. Kvalbein, and A.F. Hansen, ‘‘Fast Recovery from Dual Link Failures in IP Networks,’’ in Proc. IEEE INFOCOM, 2009, pp. 1368-1376.

[9] M. Hou, D. Wang, M. Xu, and J. Yang, ‘‘Selective Protection: A Cost-Efficient Backup Scheme for Link State Routing,’’ in Proc. IEEE ICDCS, 2009, pp. 68-75.

[10] M. Johnston, H.-W. Lee, and E. Modiano, ‘‘A Robust Optimization Approach to Backup Network Design with Random Failures,’’ in Proc. IEEE INFOCOM, 2011, pp. 1512-1520.

[11] E. Oki, N. Matsuura, K. Shiomoto, and N. Yamanaka, ‘‘A Disjoint Path Selection Scheme with Shared Risk Link Groups in GMPLS Networks,’’ IEEE Commun. Lett., vol. 6, no. 9, pp. 406-408, Sept. 2002.

[12] L. Shen, X. Yang, and B. Ramamurthy, ‘‘Shared Risk Link Group (SRLG)-Diverse Path Provisioning Under Hybrid Service Level Agreements in Wavelength-Routed Optical Mesh Networks,’’ Proc. IEEE/ACM Trans. Netw., vol. 13, no. 4, pp. 918-931, Aug. 2005.

[13] H.-W. Lee and E. Modiano, ‘‘Diverse Routing in Networks with Probabilistic Failures,’’ in Proc. IEEE INFOCOM, 2009, pp. 1035-1043.

[14] A. Markopoulou, G. Iannaccone, S. Bhattacharyya, C.-N. Chuah, Y. Ganjali, and C. Diot, ‘‘Characterization of Failures in an Operational IP Backbone Network,’’ IEEE/ACM Trans. Netw., vol. 16, no. 4, pp. 749-762, Aug. 2008.

[15] D. Turner, K. Levchenko, A.C. Snoeren, and S. Savage, ‘‘California Fault Lines: Understanding the Causes and Impact of Network Failures,’’ in Proc. ACMSIGCOMM, 2010, pp. 315-326.