Algorithmic Implementation of Load Balancing –in Wireless LAN

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Abstract: Intra domain traffic engineering (TE) has become an indispensable tool for Internet service providers (ISPs) to Optimize network performance and utilize network resources efficiently . Various explicitrouting TE methods were recently proposed and have been able to achieve high network performance. However, explicit routing has high complexity and requires large ternary content addressable memories (TCAMs) in the routers. Moreover, it is costly to deploy explicit routing in IP networks. In this paper, we present an approach, called generalized destination-based multipath routing (GDMR), to achieve the same high performance as explicit routing. The main contribution of this paper is that we prove that an arbitrary explicit routing can be converted to a loop-free destination-based routing without any performance penalty for a given traffic matrix. We present a systematic approach including a heuristic algorithm to realize GDMR. Extensive evaluation demonstrates the effectiveness and robustness of GDMR.

Keyword *: Destination-based routing, load balancing,multipath.*

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INTRODUCTION

INTRADOMAIN in today’s Internet service provider (ISP) network traffic engineering (TE) has been widely TE con figures the parameters of the routing system to control traffic distribution across the network to optimize network performance and resource utilization. Given the highly competitive nature of the ISP market and the high cost of network resources [1], TE has become an indispensable tool for ISPs. Quite a few explicit routing TE methods were proposed in the last few years [2]–[7]. Explicit routing allows traffic flows of each source–destination pair to be distributed along predetermined paths (a flow can be flexibly de fined, e.g., 5-tuple header fields). Due to the fine-grained traffic distribution control that explicit routing offers, explicit routing TE methods can be used to achieve high network performance. Explicit routing is supported by several routing mechanisms, such as multiprotocol label switching (MPLS) [2] and software-de fined networking (SDN).1 However, with explicit routing, each router has to maintain a complex forwarding table. For instance, to distinguish source and destination addresses of packets, an explicit routing forwarding table has to store, at worst, entries for a network with hosts. Due to the high cost-to-densityratio (US $350 for a 1-Mb chip) and high power consumption (about 15 W/1 Mb) of ternary content addressable memory (TCAM) [10], routers have limited TCAM resources (e.g., the HP 5406 zl switch supports about 1500 288-bit TCAM entries [11]). Explicit routing relies on TCAM to maintain line rate lookup and thus suffers from scalability issues.2 Explicit routing can also be deployed in IP networks by attaching to each packet the IP address of each node along the explicit path and forwarding packets hop by hop. However, this approach makes the overhead in the packet prohibitively expensive [5]. Another category of TE is based on destination-based routing, where routers make forwarding decisions solely based on the destination addresses specified in packet headers. Thus, each router forwards packets targeted for the same destination in the same way regardless of the source addresses. Due to this hop-by-hop forwarding property, this type of routing has low forwarding complexity. Each router is only required to maintain a simple forwarding table with, at worst, entries for a network with hosts. Moreover, destination-based routing can save 100% TCAM consumption by storing destination-based forwarding entries in random-access memory (RAM). Most destination-based routing TE methods aim to optimize Interior Gateway Protocol (IGP) link costs to achieve good network performance [12]–[15]. For instance, with IGPs such as Open Shortest Path First (OSPF) [16] and Intermediate System to Intermediate System (IS-IS) [17], routers exchange link state information to learn about a topology map of a network. According to link costs contained in link state information messages, shortest paths to each destination are calculated, and corresponding forwarding tables are installed in each router. If there exist multiple next-hops for a destination, the router splits traffic evenly among them, according to the Equal-Cost Multipath (ECMP) [18] split rule (it is common practice to forward packets belonging to the same flow (e.g., defined byavailable next-hops. Therefore, it can further adjust traffic distribution to improve load balancing. However, the performance of this scheme is still affected by the link cost setting. If the shortest paths are not well defined, there would not be significant improvement. The smart OSPF scheme presented in [21] and [22] extends the capabilities of OSPF by allowing source edge nodes to distribute traffic to the neighbor nodes with predetermined split ratios. The neighbor nodes then deliver the traffic to destinations along OSPF paths. Compared to traditional OSPF, S-OSPF provides more routing flexibility. However, the improvement is limited by link costs and topologies. To avoid forwarding loops, each source edge node cannot forward any traffic to its OSPF ancestors. Thus, source edge nodes may have very limited available neighbor nodes to adjust traffic distribution. We present weighted ECMP in [23]. The scheme extends ECMP to allow weighted traffic splitting at each node. Weighted splitting achieves significant performance improvement over ECMP. However, the improvement also depends on the selected shortest paths. In this paper, we present an approach, called generalized destination-based multipath routing (GDMR), to achieve the same high performance as explicit routing. The key insight of our approach is that we show an arbitrary explicit routing can be converted to a loop-free destination-based routing without any performance penalty for a given traffic matrix. The contributions of this paper are summarized as follows. 1) We design an efficient routing conversion method and theoretically prove the correctness of the conversion from explicit routing to loop-free destination-based routing. 2) The routing conversion method offers a new way to solve a destination-based routing problem, i.e., we can first formulate and solve the routing optimization problem using a simple explicit routing model, and then convert the explicit routing solution

1. EXISTING SYSTEM

There is a large body of literature on traffic engineering [4]–[7], [12]–[15], [23], [36]–[40]. The schemes in [4] and [6] are based on MPLS protocol. It formulates the routing problem as an optimization problem and solves the problem to obtain the explicit routes for each source–destination pair to distribute traffic. The schemes in [12]–[14] are based on OSPF and ECMP protocols. The idea is to carefully fine-tune the link costs to adjust path selection in ECMP so as to optimize load balancing. These schemes bring performance improvement to ECMP compared to arbitrarily configured link costs. However, These schemes are hard to converge to near-optimal solutions in most cases. Even splitting traffic among next-hops further limits the performance of these types of schemes. As a result, such schemes are not guaranteed to achieve near-optimal load balancing. The scheme in [15] is also based on ECMP. It is unique in that instead of distributing traffic among all available next-hops, it carefully selects a subset of allowable next-hops for each destination IP prefix. Therefore, it can further adjust traffic distribution to improve load balancing. However, the performance of this scheme is still affected by the link cost setting. If the shortest paths are not well-defined, improvement is not significant. We present weighted ECMP in [23]. The scheme extends ECMP to allow weighted traffic splitting at each node. Weighted splitting achieves significant performance improvement over ECMP. However, the improvement still depends on the selected shortest paths. If the shortest paths are not well defined, the effect of weighted traffic splitting becomes limited.Another category of traffic engineering is based on two-phase routing [7], [34]. In such schemes, traffic is sent from each source to a set of intermediate nodes with predetermined split ratios. The intermediate nodes then deliver the traffic to the final destinations. Performance optimization is achieved by carefully picking a set of intermediate nodes and tuning thesplit ratios. The advantage of the two-phase approach is that it handles highly dynamic and fluctuating traffic very well. However, the two-phase routing protocol proposed by [7] is rather complex since it delivers traffic through IP tunnels, optical-layer circuits, or label switched paths in each phase. LB-SPR [34] decreases the complexity of two-phase routing by using the standard shortest path routing protocol for each phase. However, additional modules are still required to support LB-SPR, such as replacing the destination IP addresses with the IP addresses of the intermediate routers to redirect packets and forwarding packets to intermediate routers with predetermined ratios.

2. PROPOSED WORK

Let denote the network congestion ratio, which refers to the maximum link utilization (i.e.,) in the network. The generalized destination-based multipath routing problem can be described as follows. Given a network with a traffic demand matrix , our objective is to obtain the best loop-free weighted destination-based routing configuration so that the network congestion ratio is minimized. (In this paper, we aim to minimize the network congestion ratio to achieve good load balancing. However, our approach can also be applied to the routing optimization problems with different objective functions such as minimizing end-to-end delay.) Based on the theories presented in Section III, a loop-free destination-based routing solution can be converted from an explicit routing solution. Thus, the GDMR problem can be solved in a new way, i.e., instead of obtaining the destination-based routing configuration directly, we can first solve a corresponding explicit routing optimization problem and then convert the obtained explicit routing solution to the desired loop-free destination-based routing solution. The corresponding explicit routing optimization problem is described as follows. Given a network with a traffic demand matrix , our objective is to obtain the best explicit routing ratios , so that the network congestion ratio is minimized. This section focuses on the modeling, and Section V presents the heuristic algorithm.The objective function (11a) minimizes the network congestion ratio . Functions (11b) and (11c) de fine the link load and congestion ratio, respectively. Function (11d) is the flow conservation constraint. By solving the above linear programming (LP) problem using LP solvers (such as CPLEX [27]), we can obtain the optimal explicit routing solution . Based on the traffic matrix and Algorithm 1 presented in Section III, a loop-free destination-based routing solution can be derived from . Since the conversion from explicit routing to loop-free destination-based routing does not cause a performance penalty, the derived destination-based routing solution achieves the optimality of the original explicit routing problem. Theorem 3: If (11a) is set to the corresponding optimal explicit routing solution of LP problem (11) can be directly converted to a loop-free destination-based routing solution using (1), i.e., the loop elimination procedure of Algorithm 1 is not required for the routing conversion (is the sum of all link load and is sufficiently small to ensure that the minimization of takes higher priority). Proof: Proof by contradiction. Assume there is an optimal explicit routing with minimum , and a destination-based routing derived from using (1) contains loops. There must exist a loop-free destination-based routing with smaller derived from using Algorithm 1 because is de finitely decreased after executing the loop elimination procedure for . Since destination-based routing is a special case of explicit routing in terms of forwarding strategy, there must exist an explicit routing with the smaller . This contradicts the given assumption that is an optimal explicit routing with minimum . Thus, the destination-based routing derived from using (1) must be loop-free. Discussion: The optimal destination-based routing solution of the proposed GDMR problem can also be obtained by solving an LP problem in the destination-based routing formulation (13) (shown in the Appendix) using LP solvers. The optimal solution of dest(13) achieves the exact same as that of explicit routing formulation (11), based on the analysis discussed in Section III. However, it is difficult to design a heuristic algorithm based on destination-based routing due to the constraints of destination-based routing, which include distributing packets along shortest paths and splitting packets to the same destination with identical ratios. Let us take Fig. 2 as an example. If we increase the cost of link to let traffic of pair be distributed along a single shortest path , the paths of pair would also be affected. There would also be only one shortest path for pair . We are unable to specify the paths for each node pair since destination-based routing distributes traffic along shortest paths. Moreover, if we adjust the traffic distribution of pair on node 3 (e.g., and), the traffic distribution of pair on node 3 would also be changed. This is because that destination-based routing distributes packets to the same destination with identical ratios. In contrast, explicit routing supports flexible routing for each individual flow (i.e., specifying arbitrary paths and tuning traffic split ratios for each individual flow). This greatly facilitates heuristic algorithm design. Thus, we design a heuristic algorithm to obtain the near-optimal explicit routing solution and then apply the routing conversion to get the destination-based routing solution.

Advantages:

- In our proposed Energy Efficient , a hop-by-hop power control mechanism is used to adjust the total power consumption of the network.
- This information is used by the Graphical User Interface component of the IDE to generate the attack reports.
- It have observed the different approaches used to bring secure energy efficiency in routing.

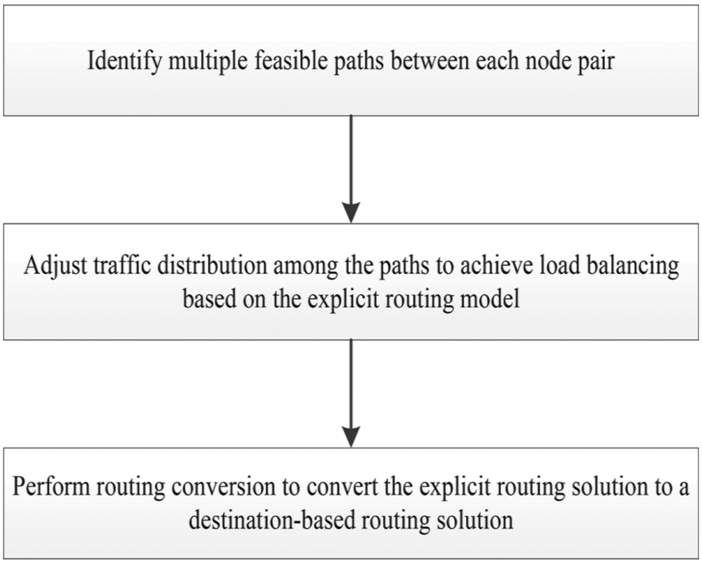

Fig 2.1. Framework of the heuristic algorithm.

Based on the analysis and discussion presented in previous sections, we develop a heuristic algorithm to obtain near-optimal solutions for large-scale networks. The proposed heuristic Algorithm optimizes destination-based routing in three steps.We first identify multiple loop-free paths for each source–destination pair. We then adjust traffic distribution among the paths to achieve load balancing based on the explicit routing model.Finally, we perform routing conversion to convert the explicit routing solution to a loop-free destination-based routing solution.The framework of the proposed heuristic algorithm is illustrated in Fig 2.1.

3. FRAMEWORK AND DESIGN OFEXPERIMENTATION

3.1 SYSTEM ARCHITECTURE

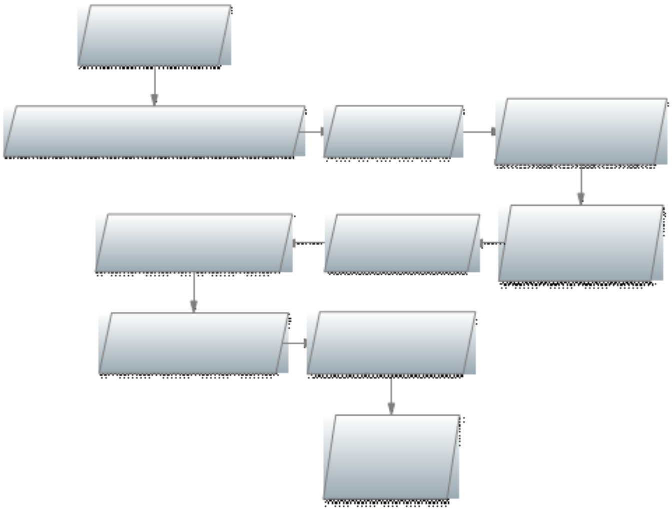

Fig 3.1 .Architecture of Load Balancing of IP-Network

using Generalized Destination-Based Multipath Routing

4. DESIGN OF EXPERIMENTAL SET-UP & INSTRUMENTATION

4.1 Greedy Algorithm:

In many problems, a greedy strategy does not in general produce an optimal solution, but nonetheless a greedy heuristic may yield locally optimal solutions that approximate a global optimal solution in a reasonable time. When choosing the optimal cache locations on any SPT with the greedy method, the core nodes with higher fan-out and more traffic will be appropriate candidates.

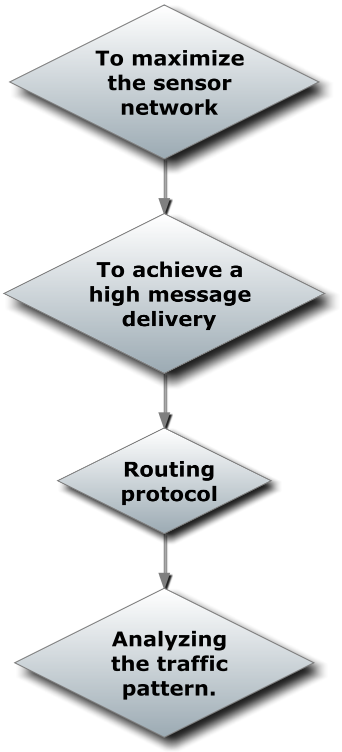

Fig 4.1 Greedy Algorithm

5. FORMULATION OF MODELS

GDMR
Sensor Node
Routing
Design Goals

5.1. MODULE DESCRIPTION

GDMR:

- In this paper, for the first time, we propose a secure and efficient Cost-Aware Secure Routing protocol .
- That can address energy balance and routing security concurrently in WSNs. In CASER protocol, each sensor node needs to maintain the energy levels of its immediate adjacent neighboring grids in addition to their relative locations.
- Using this information, each sensor node can create varying filters based on the expected design tradeoff between security and efficiency.

Sensor Node:

- Each sensor node can update the energy levels based on the detected energy
- usage. The actual energy is updated periodically.

- It also assume that data generation in each sensor node is a random variable.
- Each sensor node can create varying filters based on the expected design tradeoff between security and efficiency.
- In protocol, each sensor node needs to maintain the energy levels of its immediate adjacent neighboring grids in addition to their relative locations.

Routing:

- It is developed a two-phase routing algorithm to provide both content confidentiality and source location privacy.
- In phantom routing protocol each message is routed from the actual source to a phantom source along a designed directed walk through either sector-based approach or hopbased approach.
- To solve this problem, several schemes have been proposed to provide source-location privacy through secure routing protocol design.

Design Goals:

- To maximize the sensor network lifetime, we ensure that the energy consumption of all sensor grids are balanced.
- To achieve a high message delivery ratio, our routing protocol should try to avoid message dropping when an alternative routing path exists.
- The adversaries should not be able to get the source location information by analyzing the traffic pattern.

CONCLUSION

We propose a generalized destination-based multipath routing scheme to achieve the same high performance as explicit routing. The key insight of our approach is that we show an arbitrary explicit routing can be converted to a loop-free destination-based routing without any performance penalty for a given traffic matrix. This has great value for practice in that the property of destination-based routing allows forwarding entries to be stored in RAM instead of TCAM, which greatly reduces hardware cost. We design an efficient routing conversion method and prove its correctness. We show that the desired loop-free destination-based routing solution can be obtained by solving an explicit routing problem and then doing the routing conversion. We also present a heuristic algorithm to realize GDMR. The performance of the proposed heuristic algorithm is verified in several practical networks using simulation. The results show that the proposed heuristic algorithm for GDMR provides extremely good load balancing that is comparable to the performance of optimal explicit routing. GDMR has very low complexity and completes all experiments in a very short time. We also show that GDMR is robust regarding fluctuations in traffic.

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REFERENCES

[1]. D. Awduche,A.Chiu,A. Elwalid, I. Widjaja, and X. Xiao, “Overview and principles of internet traffic engineering,” IETF RFC 3272, May 2002.

[2]. E. Rosen, A. Viswanathan, and R. Callon, “Multiprotocol label switching architecture,” IETF RFC 3031, Jan. 2001.

[3]. D. Awduche, J. Malcolm, J. Agogbua, M. O’Dell, and J. McManus, “Requirements for traffic engineering over MPLS,” IETF RFC 2702,Sept. 1999.

[4]. Y. Wang and Z. Wang, “Explicit routing algorithms for internet traffic engineering,” in *Proc. 8th Int. Conf. Comput.Commun.Netw.*, 1999,pp. 582–588.

[5]. A. Elwalid, C. Jin, S. Low, and I. Widjaja, “MATE: MPLS adaptive traffic engineering,” in *Proc. 20th Annu. IEEE INFOCOM*, 2001, vol.3, pp. 1300–1309.

[6]. E. Osborne and A. Simha, *Traffic Engineering With MPLS*. Upper Saddle River, NJ, USA: Pearson Education, 2002.

[7]. M. Kodialam, T. V. Lakshman, J. B. Orlin, and S. Sengupta, “Oblivious routing of highly variable traffic in service overlays and IP backbones,” *IEEE/ACM Trans. Netw.*, vol. 17, no. 2, pp. 459–472, Apr. 2009.

[8]. Cisco, San Jose, CA, USA, “Cisco Open Network Environment:Adaptable framework for the Internet of everything,” [Online]. Available: http://www.cisco.com

[9]. N. McKeown*et al.*, “OpenFlow: Enabling innovation in campunetworks,”*Comput,Commun. Rev.*, vol. 38, pp. 69–74, Mar. 2008.

[10]. K. Kannan and S. Banerjee, “Compact TCAM: Flow entry compaction in TCAM for power aware SDN,” in *Distributed Computing and Networking*. New York, NY, USA: Springer, 2013, pp. 439–444.

[11]. A. R. Curtis *et al.*, “DevoFlow: Scaling flow management for highperformance networks,” *Comput. Commun. Rev.* , vol. 41, pp. 254–265,Aug.2011.

[12]. B. Fortz and M. Thorup, “Optimizing OSPF/IS-IS weights in a changing world,” *IEEE J. Sel. Areas Commun.*, vol. 20, no. 4, pp. 756–767, May2002.

[13]. K. Holmberg and D. Yuan, “Optimization of internet protocol network design and routing,” *Networks*, vol. 43, no. 1, pp. 39–53, 2004.

[14]. C. Jian and L. Chin-Tau, “Optimal link weights for IP-based networks supporting hose-model VPNs,” *IEEE/ACM Trans. Netw.*, vol. 17, no.3, pp. 778–788, Jun. 2009.

[15]. A. Sridharan, R. Guerin, and C. Diot, “Achieving near-optimal traffic engineering solutions for current OSPF/IS-IS networks,” *IEEE/ACMTrans. Netw.*, vol. 13, no. 2, pp. 234–247, Apr. 2005.

[16]. J. Moy, “OSPF version 2,” IETF RFC 2328, Apr. 1998.

[17]. D. Oran, “OSI IS-IS intra-domain routing protocol,” IETF RFC 1142,Feb.1990

[18]. D. Thaler and C. Hopps, “Multipath issues in unicast and multicast next-hop selection,” IETF RFC 2991, Nov. 2000.

[19]. C. Hopps, “Analysis of an equal-cost multi-path algorithm,” IETF RFC 2992,Nov.2000.

[20]. Z. Cao, Z. Wang, and E. Zegura, “Performance of hashing-based schemes for internet load balancing,” in *Proc. 19th Annu. IEEEINFOCOM*, 2000,vol.1,pp.332–341.

[21]. A. Mishra and A. Sahoo, “S-OSPF: A traffic engineering solution for OSPF based best effort networks,” in *Proc. IEEE GLOBECOM*, Nov. 2007, pp.1845–1849.

[22]. E. Oki and A. Iwaki, “Load-balanced IP routing scheme based on shortest paths in hose model,” *IEEE Trans. Commun.*, vol. 58, no. 7, pp. 2088–2096, Jul. 2010.