INTERCONNECTING ROUTING PROTOCOLS

[1]D.Gurupandi ,[2] K.kumarra tamizh parithi,[2]R.parthiban,[2] M. gajendiran

Tmzhparithi5@gmail.com, parthi747@gmail.com,gajendiranmurugesh@gmail.com

[1]Assistant professor,[2] U.G scholar ECE panimalar institute of technology

***Abstract*—Many operators run more than one routing instance—more than one routing protocol, or more than one instance of a given routing protocol—in their networks. Route election and route redistribution are mechanisms introduced by router vendors to interconnect routing instances. We show that these mechanisms do not heed basic performance goals. Especially, we show that, in general, they do not allow network configurations that are simultaneously free from routing anomalies and resilient to failures. We then propose a new form of interconnection that overcomes the limitations of route election and route redistribution, permitting the configuration of a resilient and efficient routing system. We conduct a thorough study of this new form of interconnection, presenting conditions for its correctness and optimality. The precepts of the study are applied to routing instances substantiated by the current Internal Gateway Protocols of the Internet: RIP, OSPF and EIGRP.**

***Key words*—Algebraic theory of routing, interconnection of networks, routing, routing protocols.**

I. INTRODUCTION

THE ROUTING system of many enterprise and university networks consists of distinct Interior Gateway Protocols (IGPs) or distinct instances of any given IGP running concurrently in separate or overlapping parts of the network . IGPs come in different forms, and they select paths for data packet transport according to diverse criteria. RIP and EIGRP belong to the class of vector protocols. RIP guides data packets along shortest paths, OSPF belong to the class of link-state protocols, guiding data packets along shortest paths. The set of processes running a common instance of an IGP in part of a network is called a routing instance. There are several reasons for the presence of multiple routing instances in a network . Networks evolve dynamically. Oftentimes, networks running their own IGPs have to be combined to form a larger network. instance of an IGP is advantageous in that it improves the scalability, manageability, and security of the network. Routing instances can be interconnected with BGP , similarly to the way the autonomous systems of the Internet are interconnected. However, contrary to the autonomous systems of the Internet, the routing instances of an enterprise or university network are under a common administration. The overall performance of the network is a major concern, and it calls for a routing system that is both resilient and efficient. These requisites are not attainable with an interconnection supported on BGP. In addition, some network operators shy away from a perceived complexity in running BGP. A widely used alternative to interconnect routing instances relies on the twin mechanisms of route election and route redistribution developed by router vendors for precisely this purpose. Each routing instance is assigned an administrative distance (AD) at each border node. For every destination, the border node elects a route computed from within the routinginstance having the smallest AD. Only elected routes give rise to entries in the forwarding table of the border node. ADs may be configured per destination. By default, a border node does not announce elected routes across routing instances. To do so requires configuration of route redistribution. A border node announces in routing instance B an elected route computed from within routing instance A only if it has been configured to redistribute from A to B. As with ADs, so can route redistribution be configured per destination. Through a number of case studies, and exposed the sensitivity of route election and route redistribution to incorrect routing behaviors, such as route oscillations, forwarding deflections, and forwarding loops. As a first contribution, we conduct a systematic assessment of the interconnection solutions made possible with route election and route redistribution. In particular, we show that correctness is incompatible with effective resiliency to network failures. The necessity of correctness severely constrains the configuration of route redistribution. As a consequence, many of the paths physically existing in the network are, nonetheless, never discovered by the routing system, with the implication that they cannot be counted on to carry data packets. Even aside this strong limitation, current route election and route redistribution are not amenable to an efficient routing system: In electing routes, ADs override the performance-related attributes computed from within individual routing instances; in redistributing routes, these performance- related attributes are overwritten by default values of the target routing instance.

VIEW OF DYNAMIC ROUTING PROTOCOLS

A. *Routing Information Protocol (RIP)*

The Routing Information Protocol (RIP) is a veteran distance-vector routing protocol that uses UDP

1.
A request message is used to ask neighboring routers to send an update.

2.
A response message carries the update.

When RIP is configured on a router, it sends Broadcast packets containing the request message out the Entire RIP enabled interfaces and then listens for response messages. Routers receiving the request message respond to it by sending their routing tables in the response message. This process continues until the network is converged. A RIP router sends out its full routing table in its update once in 30 seconds. If any new entry is found in an update, the RIP router enters it into the routing table along with the sending router's address. It uses the hop count as a metric for determining best paths. The maximum hop count is15; thereby preventing routing loops in the network. This also limits the size of the network supported by it. If the hop count of an incoming route is 16, it is considered to be inaccessible or undesirable and is at an infinite distance. RIP prevents inappropriate information from propagating throughout the network, by the use of its features like split horizon, route poisoning and hold down timers, thus providing stability to the network. RIP can perform load balancing for up to six equal-cost links.

B. *Open Shortest Path First (OSPF)*

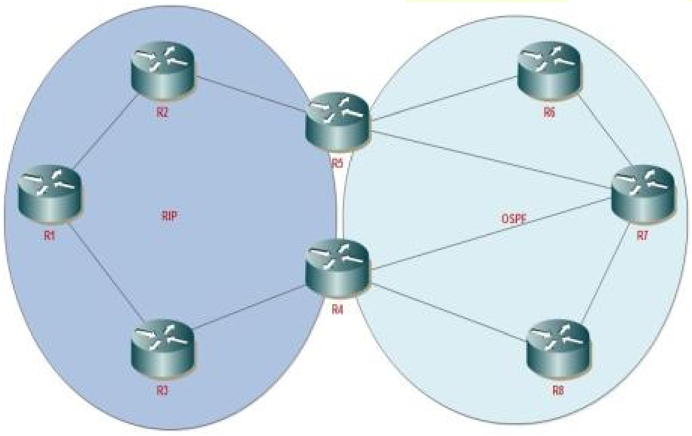
*[*Link-state routing protocol is also known as shortest path routing protocol, as it compute the finest path in the network which is the shortest path available from the source network to the destination network. Each router joined the routing domain, will held link state databases which consist of a router list in the network. Every router has the same database. The database then is used to describe to network topology.

Each router in the same domain will run the algorithm using their link-state database. Firstly, they will build a tree with each router as the root. Then, the tree consists of shortest path available to each router in that network. Other router which is joined the network will be known as leave. Link-state advertisement (LSA) is responsible for the routing information exchange between routers. Neighbor router information can be known each time LSA is received.LSA is sent by each routing using flooding method. Each router floods its LSA to the network, and then each router will receive the LSA and processed it. Every time a network topology altered, router will send LSA to the networks. Thus the other routers will know about the network topology changes soon. Dijkstra algorithm is used to computes the shortest path from each router to other router in the same routing domain. Dijkstra algorithm used cost for each link available in the router for the computation. OSPF is a routing protocol developed by Interior Gateway Protocol (IGP) working group of the Internet Engineering Task Force (IETF) for Internet Protocol (IP) network. OSPF is a connect state routing protocol that is used to distribute routing information within a single Autonomous System (AS).

$$256 * (R1 * Rw + R2 * Rw/256 - load + R3 * delay) * R5/R4 + reliability$$

For weights, the default values are:

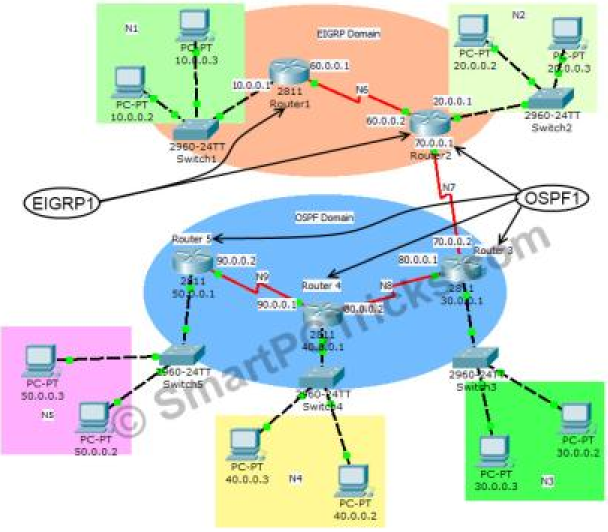
$R1=1,\quad R2=0,\quad R3=1,\quad R4=0,\quad R5=0.$



1 .RIP and OSPF interconnection

C. *Enhanced Interior Gateway Routing Protocol (EIGRP)*

Distance vector routing protocol present routes as function of distance and direction vectors where the distance is represented as hop count and direction is represented interface. In the distance vector routing protocol, Bellman-Ford algorithm is used for the path calculation where router take the position of the vertices and the links. For each destination, a specific distance vector is maintained for all the router joined the network. The distance vector consists of destination ID, shortest distance and after that hop. Now every node passes a distance vector to its neighbor and informs about the shortest paths. Each router depends on its neighboring routers for collecting the routing information. The routers are responsible for exchanging the distance vector. When a router in the network receives the advertisement of the lowest cost from its neighbors, it followed by add this admission to the routing table.
In distance vector routing protocol, the router do not know the information of the entire path. The router knows only the information about the direction and the interface where the packet will be forwarded. One of distance vector routing protocol is Enhanced Interior Gateway Routing Protocol (EIGRP). EIGRP is a CISCO proprietary protocol, which is an improved version of the interior gateway routing protocol (IGRP). Route computation in EIGRP is done through Diffusion Update Algorithm (DUAL).



2 .shortest path OSPF 1

III. Routing Static Dynamics RIP OSPF IGRP EIGRP

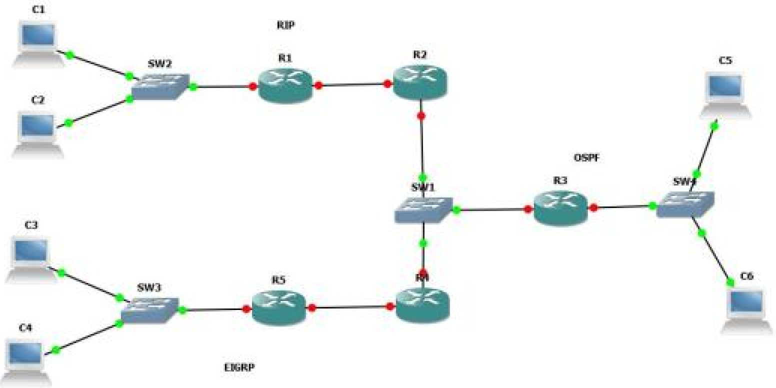
Routing is the process of determining where to send data packets that are destined for addresses outside the local network. Routers gather and maintain routing information to enable the transmission and receipt of these data packets.

Routing information takes the form of entries in a routing table, with one entry for each identified route. The router can use a routing protocol to create and maintain the routing table dynamically so that network changes can be accommodated whenever they occur.

It is important to understand dynamic routing and how the various types of routing protocols, such as distance vector and link-state, determine IP routes. It is equally important to understand scalability and convergence constraints with routing protocols.

In this section we would cover following CCNA objectives

- Describe the purpose and types of dynamic routing protocols
- Describe the operation and implementation of distance vector routing protocols
- Describe the operation and implementation of link-state routing protocols



3. routing dynamics 1

IV. EXISTING SCHEME

A path physically existing in a network wiil only be able to carry data packets if al nodes are prepared to propagate a route upstream along the path,in the direction opposite that of data-packet flow. Since a routing instance running a link-state protocol is modelled as a complete diagraph, virtual link exists in the network. Resiliency presupposes the ability to render usable to render all paths physically existing in the network. Virtual link stands for existence of path from to inthe original network.

V. PROPOSED SCHEME

We proposed a third option to inter connect routing instances at overcomes the deficiencies of current approaches. The proposed mode of interconnecting routing instances with generality and address questions of correctness, and resiliency, we first need the models that describe the operation of both vector and link-state protocols .we propose a new frame work to interconnect routing instances with built-in correctness and support for resiliency, efficiency, and optimality when the latter is at all possible. A new set of primitives for interconnecting routing instances. Then propose a new form of interconnection that overcomes the limitations of route election and route distribution,permitting the configuration of a resilient and efficient routing system.

VI. INCOMPATIBILITY BETWEEN CORRECTNESSAND RESILIENCY

The primal requirement on any routing system is *correctness*. Here, correctness means that, barring alterations in the network, the exchange of routing information eventually terminates in a stable state devoid of forwarding deflections and forwarding loops. Since link failures cannot be predicted, the postulates of correctness apply to a network and any of its subnetworks resulting from arbitrary sets of link failures.

A path physically existing in a network will only be able to carry data packets if all its nodes are prepared to propagate a route upstream along the path, in the direction opposite that of data-packet flow. A path satisfying this premise is called *usable*; one not satisfying it is called *unusable* . In general, all paths within a routing instance are usable. However, contemplating scalability and security, a network operator may require the nodes of a routing instance to be shielded from routes pertaining to a destination belonging to a different routing instance . In order to realize this requirement, the network operator does not configure redistribution into the former routing instance at any of its border nodes for routes pertaining to the destination. Paths from a node in the routing instance to the destination become unusable. With the exception of paths covered by shielding requirements, a network operator will want all other paths to be usable, so that routing instances can backup each other against link failures inside one of them . We say that a routing system is *resilient* if all paths other than those covered by shielding requirements are usable. A resilient routing system makes the best use of the network infrastructure in delivering data packets in spite of link failures. The main thesis asserted in the next few sections is that route election via ADs does not allow for the configuration of a resilient routing system, in general.

VII. PERFORMANCE-ORIENTED INTERCONNECTIONOF ROUTING INSTANCES

Beside correctness and resiliency, *efficiency* is a design objective of network operators . By efficiency, we mean that routing can be configured to run along paths with good end-to-end properties, respecting, in particular, the attributes ofsubpaths within routing instances. Ultimate efficiency leads to*optimality*, whereby data packets are delivered along paths that are the best possible according to some quality criteria.

Current route election and route distribution do not substantiate an efficient routing system. Route election is primarily based on ADs, parameters that bear no association with the performance-related attributes computed from within routing instances; these attributes are even lost when a route is announced across routing instances.

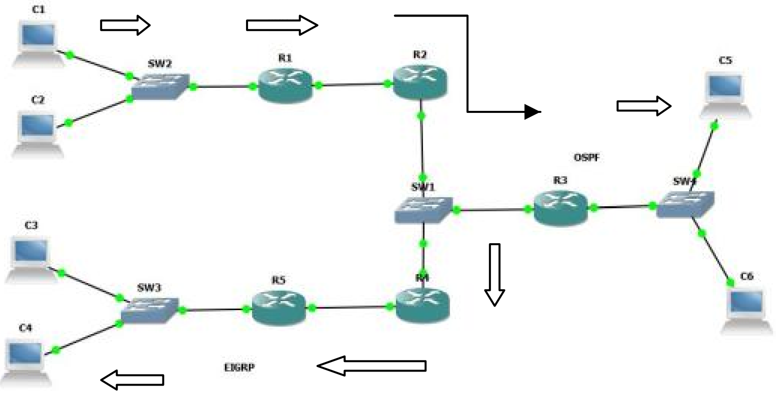
We propose a new framework to interconnect routing instances with built-in correctness and support for resiliency, Efficiency, and optimality when the latter is at all possible. In the new framework, attributes belonging to distinct routing instances are entwined into a common ranking in a flexible way that can be tuned by the network operator. Border nodes respect this common ranking in electing routes from those available through the routing instances in which they participate. Moreover, they are not restrained in announcing routes across routing instances, thus paving the way for resiliency.

When an elected route is injected into a routing instance, the attribute of the elected route is converted into an attribute of the target routing instance, in a manner that assures correctness and mirrors the quality of the elected route.

The proposed framework operates at the level of election and conversion of attributes. It does not presuppose alterations to the operation of either vector or link-state routing protocols, neither does it expect any special configuration from them.

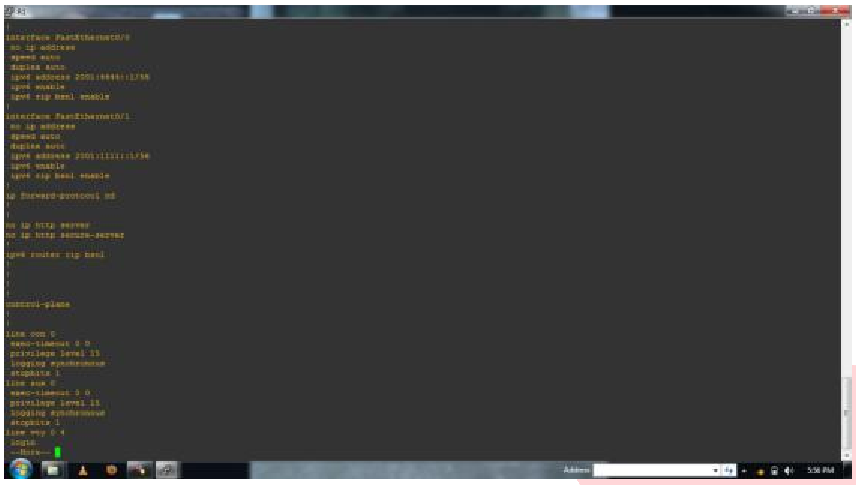
In order to expound the proposed mode of interconnecting routing instances with generality, and address questions of correctness, resiliency, and optimality with rigor, we first need models that describe the operation of both vector and link-state protocols.

VIII. RESULT ANALYSIS

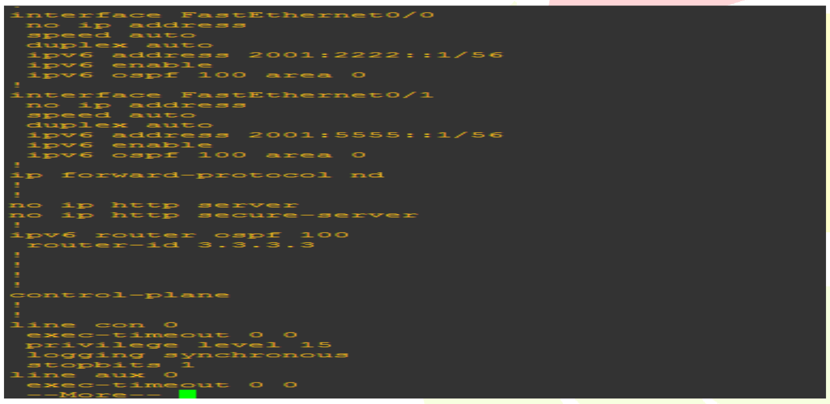


This shows the flow of packets from RIP to EIGRP via OSPF

4. routers interconnected 1

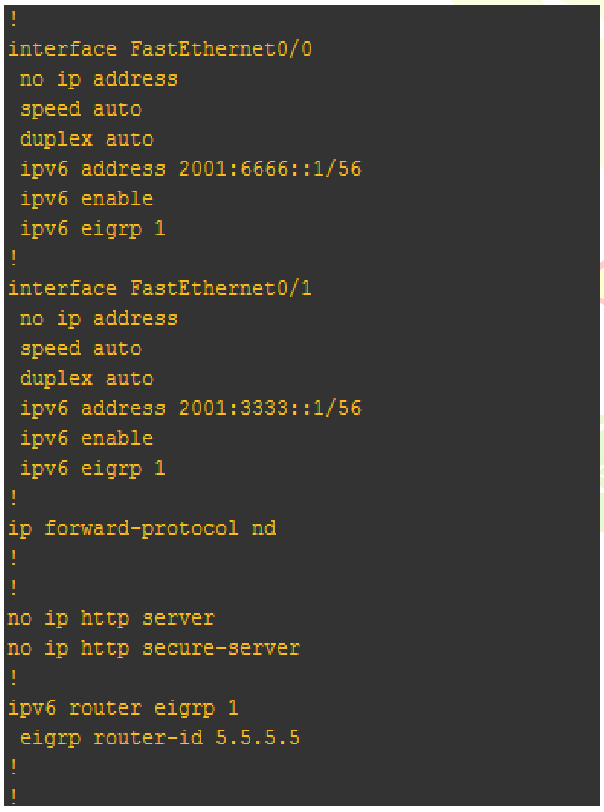


5. show run of router1 rip



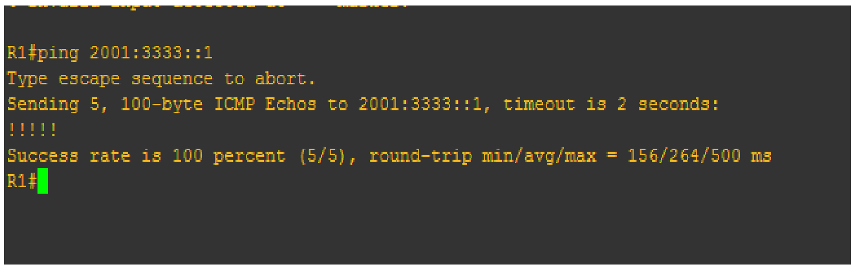
```
interface FastEthernet0/0
 no ip address
 speed auto
 duplex auto
 ipv6 address 2001:2222::1/56
 ipv6 enable
 ipv6 ospf 100 area 0
!
interface FastEthernet0/1
 no ip address
 speed auto
 duplex auto
 ipv6 address 2001:5555::1/56
 ipv6 enable
 ipv6 ospf 100 area 0
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
ipv6 router ospf 100
 router-id 3.3.3.3
!
!
!
!
control-plane
!
!
line con 0
 exec-timeout 0 0
 privilege level 15
 logging synchronous
 stopbits 1
line aux 0
 exec-timeout 0 0
 --More--
```

6. show run of router3 ospf



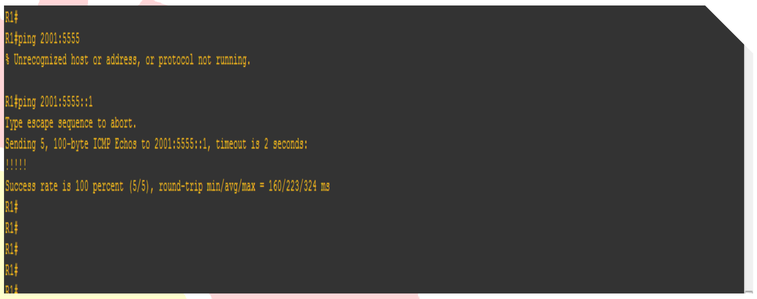
```
!
interface FastEthernet0/0
 no ip address
 speed auto
 duplex auto
 ipv6 address 2001:6666::1/56
 ipv6 enable
 ipv6 eigrp 1
!
interface FastEthernet0/1
 no ip address
 speed auto
 duplex auto
 ipv6 address 2001:3333::1/56
 ipv6 enable
 ipv6 eigrp 1
!
ip forward-protocol nd
!
!
no ip http server
no ip http secure-server
!
ipv6 router eigrp 1
 eigrp router-id 5.5.5.5
!
!
```

7. show run of router6 eigrp



```
R1#ping 2001:3333::1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:3333::1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 156/264/500 ms
R1#
```

5. pinging from r1 to r3 1



```
R1#
R1#ping 2001:5555
% Unrecognized host or address, or protocol not running.

R1#ping 2001:5555::1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:5555::1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 160/223/324 ms
R1#
R1#
R1#
R1#
R1#
```

6 .pinging from r1 to r5 1

As all the routers are inter connected through RIP, OSPF and EIGRP the results are verified by pinging from router 1 to router 5, that is pinging from RIP to EIGRP.

IX. CONCLUSION

We have presented, to the best of our knowledge, the theory for reasoning about the routing across multiple routing instances. The theory is general because it models the interconnectionsbetween any combination of link-state, distance-vector and path-vector routing protocolinstances. Specifically,if each routing instance internally finds optimal paths, as is the case with RIP and OSPF then the paths found by therouting system can be made network-wide optimal as well.Concrete global orderings and conversions were presentedfor the attributes most commonly used within routing instances:lengths as in RIP and OSPF and pairs length-capacity asin EIGRP.

ACKNOWLEDGEMENT

we would like to thank the anonymous reviewers for comments that led to a better formulation of our work.

REFERENCES

[1] D. A. Maltz, G. G. Xie, J. Zhan, H. Zhang, G. Hjálmtýsson, and A. Greenberg, “Routing design in operational networks: A look from the inside,” in *Proc. SIGCOMM*, 2004, pp. 27–40.

[2] F. Le, G. G. Xie, D. Pei, J.Wang, and H. Zhang, “Shedding light on the glue logic of Internet routing architecture,” in *Proc. SIGCOMM*, Aug. 2008, pp. 39–50.

[3] T. Benson, A. Akella, and D. Maltz, “Unraveling the complexity of network management,” in *Proc. 6th USENIX Symp. Netw. Syst. Design Implement.*, 2009, pp. 335–348.

[4] G. Malkin, “RIP version 2,” RFC 2453, Nov. 1998.

[5] I. Pepelnjak, *EIGRP Network Design Solutions: The Definitive Resource for EIGRP Design, Deployment, and Operation.*. San Jose, CA, USA: Cisco Syst., 2000.

[6] J. T. Moy, “OSPF version 2,” RFC 2328, Apr. 1998.

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

[8] Y. Rekhter, T. Li, and S. Hares, “A border gateway protocol 4 (BGP-4) ,” RFC 4271, Jan. 2006.

[9] R.White, D.McPherson, and S. Sangli, *Practical BGP*. Boston, MA, USA: Addison-Wesley, 2005.

[10] R. Mahajan, D. Wetherall, and T. Anderson, “Mutually controlled routing with independent ISPs,” in *Proc. 4th USENIX Symp. Netw. Syst. Design Implement.*, 2007, pp. 355–368.

[11] J. Boney, *Cisco IOS in a Nutshell*, 2nd ed. Oxford, U.K.: O’Reilly, 2005.

[12] Cisco Systems, San Jose, CA, USA, “OSPF redistribution among different OSPF processes,” Doc. ID: 4170, Jan. 2006.

[13] Cisco Systems, San Jose, CA, USA, “Redistributing routing protocols,” Doc. ID: 8606, Mar. 2012.

[14] Cisco Systems, San Jose, CA, USA, “Route selection in Cisco routers,”Doc. ID: 8651, Jan. 2008.

[15] Cisco Systems, San Jose, CA, USA, “What is administrative distance,” Doc. ID: 15986, Mar. 2007.

[16] T. Thomas, D. Pavlichek, L. Dwyer, R. Chowbay, W. Downing, And J. Sonderegger, *Juniper Networks Reference Guide: JUNOS Routing, Configuration, and Architecture*. Reading, MA, USA: Addison-Wesley, 2002.

[17] *Junos OS Policy Framework Configuration Guide*, 11th ed. Sunnyvale, CA, USA: Juniper Netw., Feb. 2011.

[18] F. Le, G. G. Xie, and H. Zhang, “Understanding route redistribution,” in*Proc. ICNP*, Oct. 2007, pp. 81–92.

[19] F. Le, G. Xie, and H. Zhang, “Instability free routing: Beyond one protocol instance,” in *Proc. CoNEXT*, Dec. 2008, p. 9.

[20] F. Le and G. G. Xie, “On guidelines for safe route redistributions,” in *Proc. SIGCOMM Workshop Internet Netw.Manage.*, Aug. 2007, pp. 274–279.

[21] F. Le,G.Xie, and H. Zhang, “Theory and newprimitives for safely connecting routing protocol instances,” in *Proc. SIGCOMM*, Aug. 2010, pp. 219–230.

[22] J. L. Sobrinho, “Algebra and algorithms for QoS path computation and hop-by-hop routing in the Internet,” *IEEE/ACM Trans. Netw.*, vol. 10, no. 4, pp. 541–550, Aug. 2002.

[23] J. L. Sobrinho, “An algebraic theory of dynamic network routing,” *IEEE/ACM Trans. Netw.*, vol. 13, no. 5, pp. 1160–1173, Oct. 2005.

[24] A. Alim and T. Griffin, “On the interaction of multiple routing algorithms,” in*Proc. CoNEXT*, Dec. 2011, p. 7.

[25] J. L. Sobrinho and T. Quelhas, “A theory for the connectivity discovered by routing protocols,” *IEEE/ACM Trans. Netw.*, vol. 20, no. 3, pp. 677–689, Jun. 2012.

[26] T. G. Griffin, A. Jaggard, and V. Ramachandran, “Design principles of policy languages for path vector protocols,” in *Proc. SIGCOMM*, Karlsruhe, Germany, Aug. 2003, pp. 61–72.

[27] J. Bang-Jensen and G. Gutin, *Digraphs: Theory, Algorithms and Applications*, 2nd ed. London, U.K.: Springer-Verlag, 2008, 1848009976.

[28] M. G. Gouda and M. Schneider, “Maximizable routing metrics,” *IEEE/ACM Trans. Netw.*, vol. 11, no. 4, pp. 663–675, Aug. 2003.

[29] L. Lamport, “An assertional correctness proof of a distributed algorithm,” *Sci. Comput. Program.*, vol. 2, no. 3, pp. 175–206, Dec. 1982.